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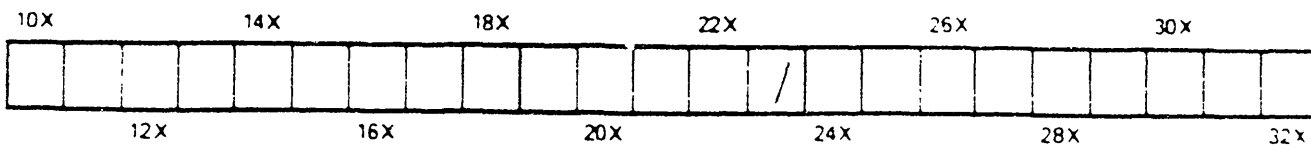

THE CANADIAN JOURNAL.

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THE PRESIDENT'S ADDRESS.

BY THE REV. JOHN M°CAUL, LL.D.,
PRESIDENT OF UNIVERSITY COLLEGE, TORONTO.

Read before the Canadian Institute, January 10th, 1863.

GENTLEMEN OF THE CANADIAN INSTITUTE,—

In opening the proceedings of a new year of the Society's existence with the customary address, my first duty is to return thanks for the honour which you have conferred upon me, by your unanimous election of me as President of the Institute. Whilst I highly appreciate this mark of your estimation, I must confess that when I received the official notification of our Secretary, I had some hesitation as to the propriety of my accepting the office, for I was conscious that it would be impossible for me to discharge the duties with that regularity which you might expect, and which I myself would desire. In other Societies, in which I have held a similar position, I have endeavoured, if prevented by my avocations from lending active co-operation, at all events to give assistance by punctuality of attendance at their meetings. In the case of the Canadian Institute, however, as its season extends over precisely that period of the year, when my duties are most heavy, and my engagements most pressing, I could not hope to

be able to give even that proof of the interest, which I feel in its welfare. Whilst I was still doubting on this point, I had the opportunity of ascertaining the views of some of our members, who have taken a most active part in promoting the welfare of the Institute, and they assured me that such uniformity of attendance, as I believed to be necessary for the satisfactory discharge of the duties, was not indispensable. Influenced by these assurances, and confiding in the aid of my able colleagues, the Vice-Presidents, I accepted the office with which you have honored me, with the determination to discharge the duties to the best of my ability, and with the persuasion, that any necessary shortcomings would receive considerate indulgence at your hands.

The commencement of a new year suggests to Societies, as well as to individuals, the expediency of taking a retrospect of that which has just passed away, and of considering what they, and what others, in a like position, or engaged in similar pursuits, have done during the past twelve months. Following out this suggestion, I purpose submitting a brief review of the progress which has been made, during the year 1862, in those departments of human knowledge, which it is the object of this Institute to cultivate. In attempting this summary, it is scarcely necessary for me to premise that it must necessarily be very imperfect. The brief fortnight which has elapsed since I was unexpectedly called upon to prepare an Inaugural Address—the shortness of time, suitable for observations, on such an occasion as the present, which imposes cramping restraint in treating so extensive a subject—the vast number of particulars which solicit attention—and my own inability to handle all the branches, of which I must necessarily treat, with the skill, or ease, or confidence, that almost nothing but special attention to each can bestow,—all these compel me to give but the merest outline, and to select from the mass of materials, only those which, as it were, crop out on the surface.

The construction of star charts, those invaluable aids to the practical astronomer, is still in progress by Argelander of the Bonn Observatory and Chacornac of the Paris Observatory. In the volumes, which have been recently published by the former distinguished astronomer, the approximate places are given of 216,000 stars between the parallels of 2° South Declination, and 41° North Declination. This magnificent work is intended to be an Atlas of the stars of the Northern Heavens within 92° of polar distance. An impor-

tant result of the publication of these charts has been that they have greatly facilitated the discovery of the small planets or asteroids between the orbits of Mars and Jupiter. Since 1859 no fewer than twenty of these remarkable bodies have been discovered, so that their number at the close of last year was seventy-six.

The investigations of the motion of Sirius by Bessel and Peters had revealed some irregularities in right ascension, and Bessel had surmised that they were due to the influence of some unknown body in the vicinity of the star. This companion, whose existence had not been ascertained by sight, was discovered on Jan. 31, by Mr. Clark of the U. S., with his new achromatic glass, and was subsequently observed by Prof. Bond at the Observatory of Harvard College. We have thus another most interesting example of the wondrous power of mathematical research to reveal that latent cause of perturbation, which the keenest vision, aided by the most powerful instruments, had previously failed to detect. It is proper, however, that I should add that Dr. Peters does not accept the identity of this stranger with that which he had computed.

In accordance with the suggestion of Sir John Herschel, made about eight years ago, relative to the advantages of taking daily photographs of the sun, a new and valuable instrument was invented, the Photoheliograph, or rather, as the name has been emended, the Heliautograph. At the last meeting of the British Association for the advancement of Science, Prof. Selwyn exhibited a series of those wonderful portraits taken by the sun of himself. They represent the progress of the spots with their *penumbræ* as the sun revolves on his axis, and the *faculæ* or bright streaks which accompany those spots. On the same subject Mr. Nasmyth stated his observations relative to the three luminous strata—which envelope the sun—the mist envelope—the penumbral stratum—and the external, in which the lenticular, or, as they are called, the willow leaf structures are found. Photography has also been successfully applied to the moon, and Mr. De la Rue's skilful manipulation has produced most accurate representations.

At the same meeting, Prof. Challis communicated a paper on the terrestrial atmosphere, which he regarded as definitely limited, and balloon ascents were noticed as a probable mode of furnishing approximations for its actual height. Previously to this the most remarkable ascent on record had been made by Messrs. Glaisher and Coxewall, in which the astonishing altitude of 35,000 or 36,000 feet

was gained, not, however, without the most imminent risk to the aeronauts. In reading the very interesting account of this ascent, we cannot contemplate without admiration the coolness with which one of the adventurers continued his scientific observations until at length at some five or six miles above the surface of the earth, he lost all power of eyes and limbs, and fell back in the car as in sleep, and the presence of mind with which his companion, when his hands had failed him, "seized the line between his teeth and pulled the valve open until the balloon took a turn downward," and the numbed observers were thawed into consciousness.

During the past year two comets have been visible—one by computation only nine millions of miles from the earth. The other, and the more remarkable of the two, continued within the circle of perpetual apparition for five weeks, but when nearest to the earth was distant thirty-three millions of miles.

In connexion with this subject, I have pleasure in calling attention to a magnificent volume, giving a full account of the great comet of 1858, by Mr. Bond, Director of the Observatory of Harvard College. This is, so far as I am aware, the most complete work on the subject that has ever been published.

The government of Ecuador have offered to the French government the site for an observatory on the plateau of Durito. This locality presents almost unequalled advantages for observation from its position on the globe, and from the remarkable clearness of the atmosphere. The parallax observations, which have been made during the past year, taken in connexion with Foucault's experiments on the velocity of light, and Struve's measurement of an arc of parallel, promise the most important results relative to the question of the sun's distance.

But little calling for special notice, on such an occasion as the present, has been done during the year in pure mathematics, but a most remarkable example, illustrating their beauty and their power as applied to constructive mechanics, has been presented by the explanation given by the Astronomer Royal, of the directions and magnitudes of the strains on the sides of tubular bridges. It must be most gratifying to Prof. Airy to find that his theory was accepted not only by mathematicians, who admired the skill with which he produced the equations and the ingenuity with which he rendered them manageable, but also by practical men, such as Mr. Fairbairn and

Mr. Russell, who recognized the precise agreement of the theory with experiment. It is important to add, that the lines of strain as pointed out by him were regarded as bearing some relation to the lines of polarization and depolarization produced by strained glass.

As I have adverted to Mechanical Science, I cannot pass from the subject without noticing an admirable application of siphons by Mr. Appold, which seems to surpass steam-pumping both in efficiency and in economy. The air is exhausted from the siphons by a small engine, which works air pumps, and the quantity of water discharged by six siphons was no less than 50,000 gallons a minute.

Nor should I omit noticing Mr. Peter's most wonderful machine for microscopic writing, the working of which seems almost incredible. "Within a circle of the three-hundredth of an inch, about the size of a transverse section of a human hair, the Lord's Prayer can be written so as to be legible; and a calculation has been made that with this machine the entire Bible might be written twenty-two times in the space of a square inch."

In an examination, which I lately saw somewhere, of the sums expended by the British Association for the advancement of Science, I observed a complaint that so small an amount, less than a tenth I believe, was spent for the encouragement and promotion of the important department of Chemistry. The want of this pecuniary aid, however, does not seem to have produced any injurious consequences, for there can hardly be a more satisfactory practical proof of the success with which this branch has been cultivated during the past year than the fact that three out of the four medals of the Royal Society were awarded for chemical researches. A notice of these investigations will, probably, be the most satisfactory review which I can present of the progress of chemical science during the past year. The Copley Medal was awarded to Mr. Graham, Master of the Mint, for his discoveries in the employment of the diffusion of liquids in chemical analysis, or, as he terms the process of separation, *dialysis*. Compound substances are by him distinguished into *colloids* and *crystalloids*, and thees forms are regarded, the former as the dynamic, the latter as the statical form of matter. The importance of the results attainable by this new method justifies our ranking Graham with Dalton and Davy in the advancement of Chemical Science.

The Rumford Medal was awarded to Professor Kirchoff of Heidelberg, as a just recognition of his remarkable researches in Spectral

analysis. What a wonderful example is presented, in this most beautiful and valuable discovery, of the progress of human knowledge! About two hundred years ago Sir Isaac Newton astonished the scientific world by the discovery of the composition of solar light, and for many years it was a favorite optical experiment to produce the spectrum by a prism, and prove the variety of the tints that are combined in what had been regarded as simply white light. Just sixty years have elapsed since Wollaston added to our knowledge of the spectrum by the discovery of the seven dark lines. The subject thus commenced in England was taken up by Fraunhofer who observed no less than 590 of these lines, and since his time the number has been increased by the researches of Brewster and Gladstone to about 2000. In Kirchoff's experiments five prisms were used, and he has succeeded in producing an exact map giving the distances, the breadth, and the degree of darkness in the lines. But this is not all. With a similar instrument he and Professor Bunsen examined the spectra of the chemical elements, and the application of this new mode of analysis has already resulted in the addition of three new metals. But the most astonishing of Kirchoff's discoveries is the detection of sodium, nickel, barium and copper in the solar atmosphere. The process has also been applied to the fixed stars and Donati has compared the refractive powers of stellar and solar light.

When we consider the magnitude of these sublime discoveries and the variety of their probable results, we cannot but look with admiration and with gratitude on the wondrous powers of the human intellect—that mighty instrument with which our Almighty creator has equipped us. With it we have bound the hostile elements, fire and water, in amity together and have yoked them in iron harness to execute our will; with it we have descended into this globe of ours; classed its stratifications; analyzed its natural history; investigated its age; and even ventured to pourtray, in ideal sketches, the principal features of the primæval landscape: with it we have explored the depths of ocean and laid down the elevations and depressions of its bed in charts of submarine geography: with it we have ascended into heaven and mapped down the courses of the bright luminaries that stud its vault: with it we have brought under our cognizance the composition of the physical source of light, and are able to pronounce, with the certainty of Science, on the constituent elements of a body 95,000,000 of miles removed from us, through the aid of an analysis so subtle that on

this earth it detects the 100,000,000th portion of a grain. Well may we exclaim in those words which are each year receiving further confirmation and development:—"What is man that thou art mindful of him? and the Son of man that thou visitest him? For thou hast made him a little lower than the angels and hast crowned him with glory and honour. Thou madest him to have dominion over the works of thy hands; thou hast put all things under his feet."

Of the remaining two medals of the Royal Society one was awarded to Professor Williamson for his researches in compound ethers, and his establishment of the correctness of the theory of types, as foreshadowed by Mr. Sterry Hunt of the Canadian Survey, and now almost universally adopted by chemists.

The benefits of the inter-communication afforded by the electric telegraph are being rapidly extended all over the earth, and so many links of the chain destined yet to gird the world have been completed, that messages on ordinary business are now transmitted over 4000 or 5000 miles. Hopes are entertained, and not without reason, that the old and the new worlds will soon be connected by a line more durable and more secure than that which a few years ago raised expectations that were so soon disappointed. Nor should I omit mentioning, whilst adverting to the subject, that amongst the astonishing notices of discoveries of the past year is one, apparently trustworthy, that electric signals are now transmitted without any artificial conductors.

Before I pass on from this most interesting and important field of scientific research, let me briefly notice the remarkable manufacture of artificial stone by Mr. Ransome. The material consists of "any kind of mineral fragments, sand, limestone or clay, mixed into paste by a mould with fluid silicate of soda, and afterwards dipped into a solution of chloride of calcium."

At the progress of knowledge in the Natural Sciences—Mineralogy and Geology, Zoology and Botany,—I can take but a passing gl[illegible].

The Surveys which have been carried on both in Europe and on this continent, have greatly extended our acquaintance with the crust of the earth, and no inconsiderable advancement of our knowledge may be expected from the new science of Seismology.

A notable addition to Palæontology has been made by the discovery of a bird in the oolitic slate of Solenhofen, the most ancient ornithic specimen of which we possess any certain evide[illegible]ce. Professor Owen has given a description of it, characterised by his usual acumen. He

had proposed *Griphornis* as a name for the creature, but he has abandoned it in favor of *Archæopteryx* of Von Meyer.

For nine years a committee of the British Association have been engaged in experiments on the preservation of vegetative power in seeds. They have established the fact that "the greatest age at which the seeds experimented upon were found to vegetate was about forty years." Much progress has been made in acclimitization; the introduction of the eland into England has succeeded—that of camels into this continent is regarded as promising, and already the warbling of the feathered songsters of Europe has been heard in the Australian woods.

The gorilla controversy so far as it relates to the credibility of M. Du Chaillu may be regarded as set at rest. Mr. Reade, after five active months in the country the habitat of the creature, asserts "that he is in a position to state that M. Du Chaillu shot neither leopards, buffaloes, nor gorillas; that the gorilla does not beat his breast like a drum; that the *Kulukambu* does not utter the cry of *Kooloo* or anything like it; that the young gorilla in captivity is not savage; and that while M. Du Chaillu affects to have been "a poor fever-stricken wretch" at Camma, he was really residing in robust health at the Gaboon." Mr. Reade, however, adds that he "must do M. Du Chaillu the justice to confess, that from the same sources that afforded me proof of his impostures, I learn that he is a good marksman; possessed of no common courage and endurance; that he has suffered many privations and misfortunes of which he has said nothing; that his character as a trader has been unjustly blemished; that his labours as a naturalist have been very remarkable; and that during his residence in Africa he won the affection of the natives and the esteem of those who most merit to be esteemed—the missionaries." Mr. Reade's communication ends with the just and generous expression of his regret "as a fellow-laborer though an humble one, that, actuated by a foolish vanity or by ill advice, he should have attempted to add artificial flowers to a wreath of laurels which he had fairly and hardly earned."

Another and a more important controversy relative to the gorilla has arisen between Prof. Owen and Prof. Huxley, extending to the general consideration of the differences in the structure of the brain between man and anthropoid apes. The question discussed by these eminent anatomists has been ably treated by Dr. Wagner, with refer-

ence to their views and those of Gratiolet, in an article which appeared in the *Archives of Natural History* in 1861.

In Geographical researches, much has been done during the last year. Within the first twelve months after the concession of the right of travelling with a passport through China, no fewer than twelve of the eighteen provinces have been visited by British subjects,—the great Yangtze has been traced through 1800 miles of its course,—and seven other journeys have been made by English explorers through portions of the Celestial Empire, hitherto unknown to Europeans. In Africa Speke, Petherick, Livingstone, Le Jean, and Von der Decken, have extended the limits of our knowledge. The continent of Australia has lately been traversed for the third time, happily without any such disastrous result to the adventurous explorers, as attended the expedition under the command of the gallant O'Hara Burke. In the Arctic regions Mr. Hall of Cincinnati, has discovered that Frobisher's Strait is really a bay; he has also minutely examined a tract in N. Lat. 62° 52′, W. Long. 65° 05′, which seems not to have been visited or seen by any white man for almost 300 years.

Of all the expeditions which have been undertaken during the last year, probably the most remarkable, is that which proceeded in the spring under the Duke of Saxe-Coburg, with the object of exploring Central Africa. The party included the Duchess and another lady, two Princes, a physician, a litterateur, a painter, a linguist and a numerous retinue. This is doubtless the first Ducal progress with such a suite that has ever been attempted in a field so unpromising for comfort or security. In the Ethnological investigations, which have been prosecuted during the year, although but few positive results have been arrived at, much valuable material has been collected by the careful examination of *crania*, and by a more scientific analysis of language in accordance with the principles applied by Müller. The questions raised by the discovery of implements in the drift, and of human bones with those of extinct animals, have not yet been brought to a satisfactory issue. The remarkable fact seems worthy of notice, that so far no human remains have been found with the implements in the drift. To the works illustrative of this science, an important addition has recently been made by the publication of two volumes by one of our own members. The value of Dr. Wilson's "Prehistoric Man, or Researches into the Origin of Civilization in the Old and New

World," has been recognized by other labourers in the same sphere of enquiry.

The most important discovery during the year, in its bearings on History, is that of the Assyrian canon by Sir Henry Rawlinson. In searching through the collection of antiquities in the British Museum, he found some fragmentary tablets containing lists of eponymes or high priests, who gave their name to the year. Of this canon four versions have been found, and the application of the information thus derived, relative to the period between the 7th and 8th centuries, before Christ, cannot fail to be most interesting and valuable, especially as it may be used in illustration of Biblical History and Chronology. I regret to observe, that from the English periodicals it appears that an alienation of feeling has arisen from this discovery, between Rawlinson and that acute and profound scholar, Hincks. Let us earnestly hope that this estrangement will soon pass away, and that they will be found again working together in investigations so honourable to themselves and so beneficial to their fellow-men.

In Archæology, judicious excavations have revealed some most important memorials of the past. Under the careful superintendence of Fiorelli, many houses have been opened in Pompeii, and numerous most interesting remains have been discovered. It is much to be desired, that the work which has been entered upon under such good auspices, may be continued until the whole town is exhumed.

At Rome, excavations in different parts of the city have been made, and the results have been in some cases so satisfactory, that it may be hoped that some *quæstiones vexatæ* that have troubled Topographical Antiquarians will at last be settled. Some sculptures, especially a statue of remarkable excellence, have been found in the explorations in the Palatine, conducted at the expense of the Emperor of the French. But the most important discovery has been that of the original Church of St. Clement on the Esquiline, for which archæologists are indebted mainly to the Prior of the Irish Dominican College in the adjoining Convent, who, from his limited means, supplied the funds by which a considerable portion of this ancient structure has been exposed to view. The ancient tradition is, that this church was founded by Constantine on the site of the house of St. Clement, the fellow-labourer of St. Paul. That there was one there in the fifth century there can be no doubt, but it was more than once destroyed and rebuilt, and the new church now stands above the level

of the columns of the original edifice. A remarkable confirmation of the tradition as to the time of the erection of the subterranean building has been found in an inscription, on a slab discovered in one of the aisles, which gives the names of the consuls of the year 339. Before I close this reference to the progress of Archæological researches in "the Eternal City," I must mention that the first volume of the great work by De Rossi on the Christian Inscriptions found at Rome has been published. The whole collection numbers about 11,000, of which 4,000, drawn from the catacombs, are anterior to the time of Constantine, and about 1,250 bear dates.

The labours of the Prussian Commission in Athens have been rewarded by discoveries of singular interest. Prof. Strack had the honor of pointing out the spot where the remains of the Theatre of Dionysius were found, and early in the year the thirteen lowest rows of seats, with two marble thrones in front, were exposed to view. Other important results are expected from the excavations carried on under the superintendence of two other members of this Commission, Profs. Böttiger and Curtius. The enquiries of the former were directed to the Erectheion and Parthenon, of the latter to the Pnyx.

In France, the researches promoted by the Emperor have been rewarded by the discovery and identification of some localities mentioned by Cæsar in his account of his Gallic wars. The question relative to the points from which Julius Cæsar started, and at which he landed, in his invasion of Britain, has been reconsidered. The first of these has been fixed at Wissant, coorrectly, as seems to me; but others believe either Boulogne or Calais, especially the former, to have stronger claims to identification with the *Portus Itius*. The other point, *scil*, that of his landing, has been placed at Deal, or between Walmer Castle and Sandwich; but on this we may expect more definite information when the report of an English committee appointed to investigate the subject shall have been published.

The excavations, which are proceeding in England, near Wroxeter, the ancient Viroconium, may be expected to yield a considerable number of Roman relics—already some valuable remains have been discovered. The ambitious name, however, which has been given to the place, "the British Pompeii," is likely to raise hopes which will certainly not be realized. Very lately in the north of England, in the line of the Roman Wall, at Benwell, the ancient *Condercum*, two altars have been discovered, the inscriptions on which add another

name to the list of the deities worshipped by the northern nations in the Roman period.

The Runic inscriptions which were discovered about two years ago at Maeshowe in the Orkneys have been deciphered and translated by Profs. Stevens, Munch and Rafn with but partial success. I perceive by a recent announcement that much light has been thrown on them, and a more satisfactory explanation offered by Dr. Barclay, Principal of the University of Glasgow.

In Africa some very important discoveries have been made. Many interesting relics, including a large number of inscriptions, amongst them one in Libyan characters, have been lately exhumed in Algiers; and other explorations at Carthage have yielded some most valuable remains, especially specimens of Phœnician Epigraphy.

In Industry and Art the great event of the year has been the International Exhibition; and nobly has this glorious project for national improvement by national competition been a second time carried out. The building, however open to objection as a specimen of architectural taste and skill, seems to have admirably answered the purposes for which it was intended, and the Exhibition itself must be regarded as completely successful. An examination of the awards of the judges presents results well worthy of consideration; my limits, however, permit me only to take a passing glance at them. In machines of all classes, tools, philosophical instruments, naval architecture, cars and carriages, glass and lace, Great Britain stands foremost—in ceramic works and those in metal, in dyes and chemicals, in sculpture, and, strange to say, in food substances, France bears the palm, whilst she disputes precedence in woollen fabrics with Austria and England, in furniture with Italy and Spain, and bears favourable comparison in painting with the Belgians, the Dutch, the Zollverein, and the Scandinavians. Our continent has not been as well represented at this exhibition as at that of 1851. Our friends in the United States have been so engrossed with the deplorable war, which has taxed all their energies to supply materials for its prosecution, that their contributions have been wholly disproportionate to their vast means, whilst we ourselves have done little more than manifest the unrivalled resources of Canada in woods and in minerals. In this display we have again had the advantage of Sir W. Logan's assistance, and the Province can point with pride to the Catalogue of her Economic Minerals by one of her most gifted sons as the model of what such a work should be. Nor should I omit noticing

the valuable aid rendered by Dr. Hurlburt in the department of forest products.

Magnificent as was the scene presented at the *concursus* of nations in this temple of Industry and Art, there was that which dimmed its brightness from the full enjoyment there was a drawback, in the absence of him,

> "The silent father of our kings to be,
> Mourn'd in that golden hour of jubilee,"

to whom was due the honor of having first conceived and carried out the glorious idea of collecting in one spot the natural and artificial productions of the nations of the earth, as the means of mutual improvement, as an index of the progress of human civilization, and as a standard of the advancement of Industry and Art. In the inscrutable wisdom of the Almighty, the Prince Consort was removed before he saw the second triumph of the noble project which he had originated, but though absent, he was present in the memory of the hundreds of thousands of visitors, who deplored the loss of one who had right royally discharged his duty towards his adopted country, and whose name will long be held in fond remembrance throughout every part of the British dominions, as "Albert the Good." And now having taken a hasty and imperfect glance at the principal points of interest in the progress of Science, Industry, and Art, during the past year, permit me briefly to enquire what we have been doing ourselves—what has been the work of the Institute during 1862. On reference to our *Journal*—for in estimating the work of our members, I consider only the communications which have been published—I find that in the six numbers for the past year, there are nineteen original papers, exclusive of Reviews and Scientific and Literary notes. Although such a result of a year's work may be regarded by some as much less than what ought to be expected, when the large number of members of the Institute is taken into account, I cannot but think that reflection will prove that this view of it should not be entertained. In the first place, the character of the articles suitable for publication in a *Journal*, which has already attained distinction amongst Scientific and Literary periodicals, is such that there must necessarily be but few capable of writing them. The chief object of our *Journal* is the advancement of human knowledge by the publication of original matter, comprehending new facts, or hypotheses, or deductions, corrections of errors, and such communications as define or extend the limits of what is known. Now in communities much older and more numerous, and more favourably circumstanced than ours, there

are comparatively but few who have the necessary qualifications for handling such subjects. What then may be expected of a young Province—not yet a century old—in which the great majority are occupied in acquiring or securing the means of subsistence or comfort—in which there are necessarily but few that are so highly educated as to have reached the point of knowing what has been accomplished in each department and what remains to be done—and in which, of those few that have the requisite qualifications, the greater number, in consequence of the requirements of their official or social position, can find but little time for the prosecution of those subjects of study to which they would desire to devote their leisure? Let me add to this the want of libraries, museums, and instruments, such as would be necessary to place investigators here in an equal position with labourers in the same fields of research in an European capital. Such considerations as these must induce us rather to feel satisfied than discontented with what we have done during the past year. And yet I doubt not that more might have been done—I doubt not that more will be done; for I am persuaded that some of our members, well qualified to give effective aid, are deterred from even making the attempt by apprehensions which I cannot but regard as ill founded. Some of those, with whom I have spoken on the subject, seemed to think that discoveries were hopeless under the circumstances in which we are placed, except, indeed, in those investigations which have for their object the peculiarities of the region which we inhabit. The broad Atlantic, say they, interposes between them and the objects of their study—all that can be done by them is to form probable conjectures, which sight might materially modify. And yet the history of some of the greatest discoveries in our time shews the fallacy of this reasoning. LeVerrier and Adams, by the force of mathematical reasoning, had discovered the existence and calculated the position of Neptune before mortal eye had ever looked upon its orb; the investigations of Bessel and Peters had found out the companion of Sirius before it was visible through any telescope; Sir Roger Murchison announced the existence of auriferous strata in Australia before the labour of the miner was rewarded by a single grain of gold; Bunsen predicted the presence of a new alkaline metal before a particle of *Cæsium* or *Rubidium* had ever been exposed to view; Grotefend made the first step towards the reading of the cuneiform language, with the aid merely of engraved representations of some inscriptions, before he had ever seen a tablet or a cylinder. Why, then, may not similar results be attained here

by those who adopt similar means? I see around me those who have cultivated the subjects of their special study up to that point at which valuable results of original researches may naturally be expected; whilst there are very few indeed of our members who are not qualified by their reading to add to the pleasure of our weekly meetings by the communication of papers of general interest, not suitable, it may be, for the pages of our *Journal*, but yet imparting information in a new or attractive form, welcome for their intrinsic merit, welcome also as the earnest of better things to come. Let us, then, gentlemen, proceed in the course which we have so far successfully pursued, thankful for the past, hopeful for the future, with the determination to contribute, so far as in us lies, towards the advancement of knowledge and the attainment of truth, and with the desire to extend the usefulness of an Institute, destined, I doubt not, to do good service in promoting "Industry, Science, and Art," in fostering intellectual and literary pursuits amongst our population, and in elevating the reputation of our country.

A POPULAR EXPOSITION OF THE MINERALS AND GEOLOGY OF CANADA.

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PART V.

CANADIAN ROCK-FORMATIONS: THEIR SUBDIVISIONS, FOSSILS, ECONOMIC MATERIALS, AND TOPOGRAPHICAL DISTRIBUTION.

Introductory Notice.—The lowest rocks of the geological series, hitherto recognised, consist of a vast thickness of crystalline and semi-crystalline strata, or beds in a more or less altered or metamorphic condition, entirely destitute of organic remains, and hence classed together under the common term of *Azoic Rocks*. They are regarded as sedimentary deposits, collected in the earlier seas which extended over the greater portion of the earth during that period of its history which preceded the creation of organic types In Canada, as will be seen below, these Azoic rocks are enormously developed.

Above the deposits of the Azoic Age, various sandstones, limestones, slates and other strata, in which organic remains first appear, are recognized as forming the second geological series, and are known collectively as *Palæozoic Rocks*. The term "Palæozoic," signifying "ancient life," is bestowed on these strata in allusion to the marked difference which prevails between their organic types, viewed as a whole, and those belonging to existing Nature. Among the more remarkable extinct forms of the Palæozoic Age, Graptolites, Cystideans, numerous Brachiopods, Orthoceratites, Trilobites, and some peculiar fishes, hold a prominent place. Reptilian types are rare, and of comparatively low organization; and Mammalia appear to have been entirely absent. In Canada, the lower members of the Palæozoic strata are largely developed, but the higher divisions of the series are of only partial occurrence, or are altogether wanting.

The strata of a succeeding series, still ascending in the geological scale, are known as *Mesozoic* or *Secondary Fossiliferous Rocks*. Their organic remains are quite distinct from those which occur in the underlying formations. Ammonites and Belemnites, with highly organized reptilian types, including the Ichthyosaurus, Plesiosaurus, Pterodactyl, Iguanodon, &c., are among their more characteristic and extinct forms. Fishes with equally-lobed tail-fins, and others with scale-coverings similar to those of the great majority of fishes which inhabit our present waters, first appear in the deposits of this Secondary Fossiliferous Age. Mammalian types are all but unknown, and those hitherto discovered, are of low organization. In Canada, the Mesozoic rocks are without representatives.

The *Cainozoic* or *Tertiary Fossiliferous Strata* succeed the Mesozoic. In these, the organic remains closely approximate to the forms of the present epoch. Amongst the mollusca, brachiopods become scarce, and cephalopods with chambered shells have greatly diminished. Those with foliated septa (as ammonites, baculites, &c.) have entirely disappeared, together with the huge and abnormal reptiles of the Mesozoic Age. Mammalian types, on the other hand, are fully represented—examples of all existing orders, with the exception of that in which Man is alone included, being met with in these deposits. In Canada, however, the Cainozoic formations do not occur.

Finally, a still higher series of deposits, partly merging into the Cainozoic, where these occur, and in part consisting of the products of existing causes, may be classed together under the term of Post-

Tertiary deposits. These, which include the great Drift formation, and sundry accumulations of more recent origin, are largely developed in Canada.

SKETCH-SECTION OF CANADIAN ROCK-FORMATIONS.

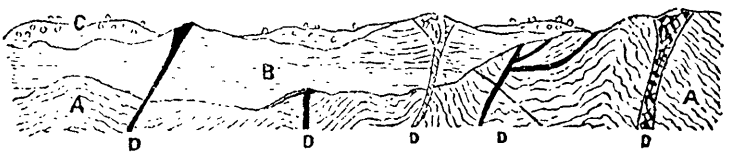

Fig. 151.

A=Azoic Strata (Laurentian and Huronian.)
B=Palæozoic Strata (Chiefly Silurian and Devonian.)
C=Post-Tertiary deposits (Drift and Modern accumulations.)
D=Eruptive rocks (Traps, Trachytes, Syenite, Granite.)

Our rock-formations, therefore, as shown in the accompanying diagram, comprise representatives of the Azoic, Palæozoic, and Post-Tertiary series, a wide break occurring between the two latter,—together with trap dykes and other masses of eruptive origin. The subdivisions and leading characters of these will now be considered. We commence with the older formations, and proceed upwards to those of modern date.*

AZOIC ROCKS OF CANADA.

Huronian.
Laurentian.

The Canadian rock-formations of Azoic age, are referred to two series: the *Laurentian*, below; and the *Huronian* above. This subdivision, not yet fully recognized by American geologists, was first proposed by Sir William Logan; and the terms "Laurentian" and "Huronian" are of his bestowal. The former is now adopted in Europe for gneissoid strata of the same ancient date. The Lauren-

* In the present place, these rock-formations will be considered separately, and in a more or less detailed manner as regards structural characters, economics, characteristic fossils (when exhibited), localities of instructive exposures, and other allied points of inquiry; and afterwards, in a connected sketch, their mutual relations will be shewn, together with the special geological areas which occur within the Province. The general reader will scarcely gain a clear idea of the Geology of Canada, until after the perusal of this latter section. The present details are necessary, however, as an introduction to this.

tian series, which forms the lower and more largely developed portion of the Azoic group, is chiefly characterised by its highly crystalline condition, and (as regards Canada) by the great beds of iron ore which it contains. The Huronian series includes many conglomerates and partially-metamorphosed slates amongst its strata, and is traversed by numerous quartz veins holding copper pyrites and other copper ores. Iron ore is also associated with this series, but not abundantly in Canada. The semi-crystalline condition of its rocks (as compared with the highly crystalline gneissoid strata of the Laurentian series) and the marked prevalence of slaty conglomerates, constitute its more distinctive characters.

Laurentian Series.—These strata, the oldest series of deposits recognised on the American continent, are regarded as sedimentary accumulations, originally collected together by the action of water, and converted subsequently into a crystalline condition by the agency of metamorphic forces. (See under the head of "Metamorphic Rocks" in *Part III*). Their absolute thickness cannot be ascertained, but it must be very great, embracing many thousands of feet; and their exposed area in Canada, as estimated by Sir William Logan, covers a surface of about 200,000 square miles. It will be convenient to consider these Laurentian rocks under the following heads:—(1) Mineral characters; (2) Structure; (3) Associated intrusive rocks; (4) Economic materials; and (5) Topographical distribution.

Mineral characters of the Laurentian strata:—The stratified rocks of Laurentian age consist essentially of vast beds of micaceous and hornblendic gneiss; interstratified with subordinate beds of quartz-rock' mica-slate, hornblende-rock, crystalline limestone and dolomite, and oxidized iron ores; and associated with thick beds of feldspar rock or anorthosite. In addition to these, a few quartzose conglomerates (shewing the metamorphic character of these deposits), thin layers of serpentine, beds and layers of a talcose character (Renselaerite or pyrallolite: s. Part II.), and others composed in large part of Wollastonite, are interstratified with the limestones, or with the gneissoid beds, of particular localities. These different kinds of metamorphic rocks have been described already in Part III.; but a few additional remarks on some of their more special characters are necessary here. Viewing our Canadian formations, of this age, in their broader features, we may subdivide them conveniently, and to some extent naturally,

into three groups, viz :—(*a*) Gneissoid strata ; (*b*) Limestones, Quartzites, and Iron bands ; and (*c*), Anorthosites or feldspar rocks.

(*a*) *Gneissoid Strata :*—These make up the larger mass of our Laurentian rocks. Ordinary gneiss, as explained in PART III., consists of quartz, potash-feldspar, and mica ; whilst in syenitic gneiss, the mica is replaced by hornblende. These varieties occur both alone and mixed with one another, throughout our Laurentian districts The feldspar is generally red or white, the quartz colourless and vitreous, and the mica and hornblende of some dark tint—black, brown, or green. The two latter minerals occasionally die out, when a binary mixture of quartz and feldspar results. In certain beds of coarse structure, the stratification lines become obscure ; but usually, and even in hand specimens, gneiss exhibits a striped or banded aspect, by which it is distinguished from ordinary granite. The potash-feldspar or orthoclase (see PART II.) is sometimes replaced or accompanied by soda-feldspar or albite, but the instances of this are not common. The predominating colour of these gneissoid strata, is reddish or dark grey, the latter resulting from stripes of dark mica combined with narrow zones of white quartz and white or pale red feldspar. When much hornblende is present, the rock may assume a black or dark greenish colour, or present a flecked surface of red and black : exhibiting in the former case, a transition into hornblende-rock. A red gneiss with green layers of epidote, forming a stone well adapted for ornamental purposes, occurs at Carlton Place near Kingston, and at some other localities. The black or dark green hornblende-rock associated with the gneissoid and limestone strata, frequently contains crystals of red garnet (Barrie township, &c.) ; and the latter mineral sometimes occurs in the gneiss or quartzites in considerable abundance (Grenville, River Rouge, &c.) It is usually found, however, in the vicinity of the limestone bands, occasionally forming true garnet-rock.

(*b*) *Limestones, Quartzites, and Iron Ores :*—The limestone beds associated with the gneissoid and other Laurentian rocks are often of a fine granular or saccharoidal texture ; at other times coarse granular, and occasionally almost compact. The colour is usually white or grey, but for short distances the rock is sometimes of a pale reddish, or greenish tint. It is frequently zoned with specks and scales of mica, serpentine, or graphite, and contains also various accidental minerals, of which the more abundant or interesting comprise : Iron pyrites ; apatite or phosphate of lime ; sulphate of baryta ; tremolite, diopside,

and other varieties of hornblende and augite; garnet; tourmaline; condrodite; spinel; corundum, molybdenite, &c. Descriptions of these minerals are given in PART II. of this series of Papers. A talcose mineral (Renselaerite or Pyrallolite), probably an altered augite, (see PART II.) occurs also in interstratified beds with the limestones of some localities (Ramsay, Grenville, Rawdon); and in Grenville and Burgess, yellowish and greenish-grey serpentine occurs under similar conditions. Phosphate of lime likewise, occasionally forms irregular bands amongst the strata: as, more especially, in North Elmsley, South Burgess, and Ross; and at Calumet Falls.

Some of the limestone beds are of great thickness. According to Sir William Logan, who has devoted much time to an elaborate examination of the crystalline limestones of the Ottawa region in particular, certain beds exhibit a thickness of 1500 feet. In the district alluded to, four beds, presenting an aggregate thickness of over 3500 feet, have been traced out and mapped. For full information respecting the structural and other characters of these, the reader is referred to the Revised Report on the Geology of Canada, by Sir William Logan and the other officers of our Geological Survey.* The more important localities in which workable beds of crystalline limestone occur, will be found under the head of "Economic Materials," below. The crystalline dolomites, composed of carbonate of lime and carbonate of magnesia, closely resemble the crystalline limestones, and occur under the same conditions, the two being frequently interstratified. A fine saccharoidal variety is found on Lake Mazinaw in the County of Frontenac, and a more compact kind occurs in the townships of Madoc, McNab, Loughborough, Sheffield, Grenville, &c. Many of these dolomites, it is remarked by Sir William Logan, become of a yellowish brown colour by weathering.

The quartzites and quartzose conglomerates, mentioned above, may be referred to in connection with the limestones, as they are generally found in their immediate vicinity or otherwise interstratified with them. Some beds of quartzite present a thickness of several hundred feet. This rock, composed of quartz more or less pure, exhibits a vitreous or sub-vitreous aspect, and is either colourless or of a pale reddish, brownish, or greenish tint. The quartzose conglomerates are com-

* To this valuable and truly national work, it may be mentioned here, the present Essay is mainly intended to serve as an introduction: illustrating and explaining the various technicalities and details, a knowledge of which, on the part of the reader, is necessarily presupposed in the Report in question.

paratively rare, but some occur in the townships of Rawdon and Bastard, associated with crystalline limestone. They are usually somewhat micaceous, and the imbedded pebbles consist of quartz, feldspar, (often decomposed), sandstone, and sometimes of limestone. The quartzites of Bay St. Paul, and those of Rawdon, contain garnets in great abundance, and pass into garnet rock.

The beds of iron ore, also placed in this subdivision from their general association with the crystalline limestones and dolomites, belong partly and chiefly to Magnetic iron oxide, and partly to Specular iron ore—minerals of which full descriptions are given in PART II. of this Essay. These ores occur in vast beds interstratified with the limestones and other Laurentian strata. In thickness they vary from a yard or two, to upwards of two hundred feet. Their more important localities are mentioned below.

(*c*) *Anorthosites*:—The term anorthosite was first employed by Prof. Sterry Hunt of the Geological survey, to designate the more purely feldspathic rocks of the Laurentian series. These rocks consist of a mixture of lime and soda feldspars—minerals forming several species (Labradorite, Albite, Anorthite, &c., see PART II), all of which belong to the Triclinic or Anorthic system of crystallization (PART I.) The anorthosites make up in themselves a vast thickness of the Laurentian rocks, and cover surface areas of large extent. They appear, according to Prof. Hunt, to occupy a higher position than the orthoclase gneiss-rocks, although occasionally interstratified with subordinate beds of these, and also, though more rarely, with strata of quartz-rock. Their structure is coarsely crystalline, or otherwise more or less compact; and their marks of stratification are frequently obscure. They often contain laminar masses of hypersthene of a brown (or green) submetallic tint; and when this mineral becomes somewhat abundant, the variety termed "hypersthene rock" originates (see PART III.) Ilmenite or titaniferous iron ore (described in PART II) is also sometimes present. An immense bed, 300 feet long and about 90 feet wide, occurs in a feldspathic rock of this series, near Bay St. Paul, below Quebec. These rocks are chiefly of a greyish blue colour, but some are white, and others exhibit a yellowish, greenish, or reddish tint. All become opaque white by weathering. Many contain cleavable masses of lime feldspar or Labradorite (PART II.), or appear to be almost wholly made up of that mineral. In these, a fine green and blue opalescence or play of colour is sometimes observable: as in

the anorthosite of the township of Abercrombie in the county of Terrebonne, in those of Morin and Mille-Isles, and in some of the boulders met with in the Ottawa district.

2. *Structure of Laurentian rocks*:—These rocks, as a general rule, occur in inclined beds- the dip varying from eight or ten to over seventy degrees. The direction of the dip is extremely variable, as the strata are not only inclined, but are folded more or less into a series of anticlinals and synclinals. In some beds, both of gneiss and limestone, the subordinate layers are much contorted, as shown in the annexed figure, sketched on Crow Lake, north of Marmora; and the same peculiarity is seen in many other localities. Between the Laurentian strata and the Silurian beds which rest upon them in Eastern and the greater part of Western Canada (the Huronian being absent), there is always a want of conformability. Along the line of junction of the two formations, between the eastern extremity of Lake Ontario and the east coast of Georgian Bay, the Laurentian strata appear to dip very generally towards the north, that is, between N.W. and N.E, or away from the Silurian beds —as shown in the accompanying section, taken on Lake St. John in the township of Rama, C. W. The dotted line in this section shows

Fig. 152.

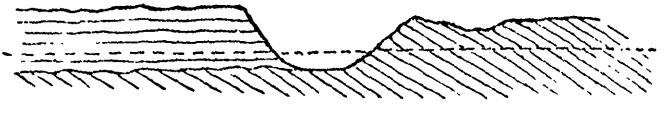

Fig 153.

the ordinary level of the lake. The Laurentian strata have a general northerly dip also, near the junction line of the two formations in the township of Elzevir, and at other points visited by the writer; but this does not apply everywhere, as on Loughborough and Crow Lakes the dip is SE. or nearly so; neither does it continue apparently for any great distance to the north, the dip rapidly changing with the foldings of the strata. The Sketch-section on a previous page (fig. 151), in which an attempt is made to convey an idea of the foldings of the Laurentian strata generally, will render this sufficiently clear.

3. *Intrusive Rocks*:—Considering the immense extent of country occupied by the Laurentian rocks, intrusive masses of contempora-

neous geological age, appear to be exceedingly rare. Many of the granitoid and quartzose veins seen amongst the gneissoid strata, are considered, by those who have had the best opportunities to study them, as veins of segregation rather than true eruptive matters. The most important example of undoubted eruptive origin, is the great mass of syenite described by Sir William Logan as occupying an area of about thirty-six square miles in the townships of Grenville, Chatham, and Wentworth, near the left bank of the Ottawa. This consists of red or white potash-feldspar, with black hornblende, and a small amount of quartz; but here and there it contains a certain amount of mica also, forming the variety generally known as syenitic granite. This eruptive mass ... a series of greenstone dykes belonging to a still earlier eruption; and is in itself traversed by another series of porphyritic dykes of a necessarily more recent origin. The greenstone dykes, according to Sir William Logan, exhibit a well-marked columnar structure, and vary in width from a few feet to a hundred yards. These three eruptive formations are also intersected by a fourth series of dykes, supposed to be of Palæozoic age. (See Report for 1853. Also the Revised Report on the Geology of Canada). As the more northern and uncleared districts within the vast area of our Laurentian region become opened up or more thoroughly explored, other eruptive masses of an analogous character will, in all probability, be brought to light.

4. *Economic Materials:*—In addition to good building stones of gneiss, &c., obtainable generally throughout the region occupied by our Laurentian rocks, the following are the more important economic materials discovered in these strata up to the present time:* (*a*) *Iron Ores;* (*b*) *Lead Ore;* (*c*) *Sulphide of Molybdenum;* (*d*) *Graphite;* (*e*) *Mica;* (*f*) *Ornamental Feldspars;* (*g*) *Marbles*, (*h*) *Sulphate of Baryta:* (*i*) *Millstones.*

(*a*) *Iron Ores.*—These comprise Magnetic Oxide of Iron; Specular Iron ore (or Red oxide of Iron); and Titaniferous Iron Ore. The magnetic ore occurs principally at the following localities:—(1) Belmont Township (the Marmora mine): several beds, lying between crystalline limestone and gneiss, and mixed with layers of serpentine, talcose slate, &c. Total thickness of the ore beds, over 400 feet.—2, Madoc Township: Bed of ore of excellent quality, 25 feet thick, in

* These various substances will be found described in full, as regards mineral characters, composition, &c, in PART II. of this Essay.

gneiss.—3, South Crosby Township, Newborough mine: Bed in gneiss, on Mud Lake, 200 feet in thickness.—4, South Sherbrooke Township: Bed of 12 feet in gneiss.—5, Hull Township on the Ottawa: Dome-shaped bed in gneiss; thickness, about 90 feet.—6, Grenville Township, C. E.: Bed of 10 or 12 feet in thickness.—7, Grandison Township, C. E., 20 feet bed. The average amount of iron in these beds, varies from 60 to 70 per cent. Specular iron ore (averaging about 55 per cent. of metal) occurs in a 30 feet bed, in the township of McNabb, near the Lac des Chats. Also in "Iron Island" on Lake Nipissing. Titaniferous Iron (Ilmenite), as already mentioned, forms a bed of 90 feet in thickness, in Feldspar-rock (anorthosite) at Bay St. Paul on the Lower St. Lawrence.

(*b*). *Lead Ore*:—This consists of galena or sulphide of lead. Mixed with a gangue of calc spar and heavy spar it forms a series of narrow veins in the townships of Lansdowne, Ramsay, and Bedford, C. W. These veins, which vary in thickness from six inches to a foot, belong, probably, to a somewhat more recent period of formation than the Laurentian epoch; but as they occur among the Laurentian rocks, they are properly mentioned in connexion with these strata. The lead ore is very slightly argentiferous, and apparently in no great quantity in the veins. It occurs also, under similar conditions, in the township of Dummer, Peterborough Co., C. W.

(*c*). *Sulphide of Molybdenum*:—This mineral (see PART II.) is not at present of much value. It forms the source of various molybdenum compounds, some of which are employed in chemical investigations, and occasionally in porcelain painting. It occurs, in small quantities, in the Laurentian rocks of several localities, as mentioned under the description of the mineral in a preceding part of this Essay; but in workable quantities it has only been found, as yet, at the mouth of the Quetachoo River on the north shore of the Gulf of St. Lawrence. ("Descriptive Catalogue of the Economic Minerals of Canada in the Exhibition of 1862"—issued by the Geological Survey.)

(*d*). *Graphite*:—Found in workable quantities in the Augmentation of Grenville, on the Ottawa, (see PART II.) Also in the townships of Burgess and Lochaber. The quality is scarcely sufficient to render the substance available as a material for pencils, but the graphite of these localities is well adapted for refractory crucibles, and also as a burnishing material for stoves and grates.

(*e*). *Mica*:—This mineral occurs in pieces sufficiently large for

stove-doors, &c., in the townships of North and South Burgess, C. W. Also in Grenville and the "Augmentation" of that township in C. E.

(*f*). *Ornamental Feldspars*:—These comprise, the Labradorite of Abercrombie township, C. E.; the Peristerite (an iridescent variety of Albite) found in the townships of Bathurst and Burleigh, C. W.; and the Perthite (an iridescent Orthoclase,) of the township of Burgess. See PART II. The two latter varieties were first made known (as occurring in these localities) by Dr. James Wilson of Perth.

(*g*). *Marbles*:—The principal marbles of Laurentian age occur at the following localities: Arnprior, MacNabb township (grey, striped); Grenville township (white with yellowish specks of serpentine, or yellowish-white); Augmentation of Grenville (white with pale green spots of serpentine); Elzevir township, C. W., (white but of somewhat coarse grain); Barrie township, at Lake Mazinaw, &c., (a crystalline dolomite, pure white, and of saccharoidal texture).

(*h*). *Sulphate of Baryta*:—This substance, used as a paint material or substitute for white lead (see PART II.), is found in considerable quantities, in connexion with Laurentian rocks, in the townships of Lansdowne, Burgess, Bathurst, and Dummer, in Canada West, where it occurs in the form of veins which often contain galena. It is found still more abundantly on Lake Superior, but in rocks of another age.

(*i*). *Millstones*:—The intrusive mass of syenite in the township of Grenville, C. E., (described under the head of "Eruptive Rocks" above) is associated with some remarkable veins of *chert* (a variety of quartz) from which good millstones have been manufactured. These veins are regarded by Sir William Logan as veins of segregation; and it is considered probable that the siliceous matter of which they consist may have been derived from the decomposition of the feldspar in the adjoining mass of syenite. The feldspar is said to be converted into kaolin for a considerable distance on each side of the chert.

5. *Area of the Laurentian Rocks*:—As shewn by the shaded surface in the accompanying map, (figure 154), the Laurentian strata may be regarded as constituting from the coast of Labrador, the whole of the north shore of the Saint Lawrence to within a short distance of Quebec (Cape Tourmente)—a few isolated and narrow strips of Lower Silurian strata (made known by the Geological Survey) alone intervening between these rocks and the waters of the Gulf or river. These outlying patches occur on the north shore of the Straits of

Belle Isle, at the mouth of the Mingan River, near the Seven Islands, and at the Murray Bay River, and the Gouffre. From Cape Tourmente, the Laurentian strata run inland, at a distance of from ten to thirty miles from the river but roughly parallel with its course, and cross the Ottawa near the Lac des Chats. From this point, the strata extend both southwards and to the northwest. The southern portion crosses the Saint Lawrence about the Thousand Isles, and occupies a large area in the State of New York between Lake Ontario and Lake Champlain, including the wild district of the Adirondack Mountains. The narrow belt of crystalline rock connecting this southern Laurentian area with the main or northern region of these strata, probably exerted at the close of the Drift period, as discussed on a succeeding page, a remarkable influence on the physical condition of the country to the west. The other portion of the Laurentian outcrop, west of the Lac des Chats, traverses the back townships of the counties of Frontenac, Addington, Hastings, Peterborough, Victoria, and Simcoe, and strikes Georgian Bay near the mouth of the River Severn. From thence, the Laurentian rocks form the eastern and north-eastern shores of the Bay up to a point nearly opposite the east end of the Manitoulin Islands, or some five or six miles west of the most western mouth of French River, where they are overlaid by Huronian deposits. They reappear upon the east and north shore of Lake Superior, and extend far into the great North-West—reaching in all probability to the shores of the Arctic Ocean. The vast area thus occupied by the Laurentian rocks, includes many thousands of square miles; and that part of it which lies within the limits of Canada properly so-called, greatly exceeds in extent the other portions of the Province.

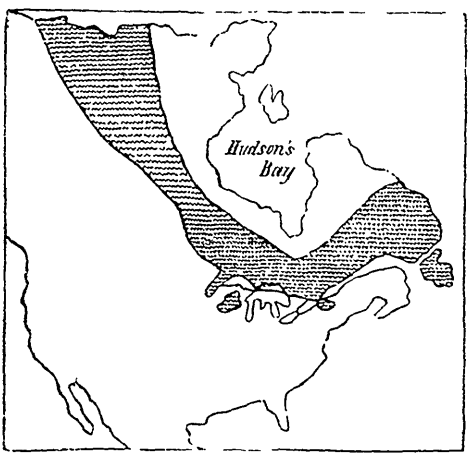

Fig. 154.

6. *Agriculturvl Capabilities*:—As a general rule, liable only to par-

tial or local exceptions, the Laurentian area is not favorably circumstanced for agricultural occupation. Soils of depth and fertility can only be expected to occur under the following conditions:—first, where feldspar rocks or anorthosites prevail, most of these yielding calcareous soils by decomposition; secondly, where the belts of crystalline limestone crop out and form the surface of the country; and thirdly, where the rocks are covered to a sufficient depth by Drift clays and sands. These latter deposits, however, are usually filled in these districts with large and numerous boulders, and rarely extend over areas of any considerable size. Patches of a certain extent occur here and there, but they are too generally separated by huge and bare masses of gneissoid rock, familiarly known to the settlers as "elephants backs." Such, at least, is the general condition of the country in the back townships of the western counties mentioned above. Northwards, and in Eastern Canada, the severe climatic relations which there prevail, must be added to these disadvantages. In those parts of the province, however, which are occupied by other rock-formations, numerous uncleared tracts of unrivalled fertility are still left to repay the settler's toil.

Huronian Series:—The rocks of this group, the next in ascending order above the Laurentian series of strata, may be described under the following heads:—1, Mineral characters; 2, Associated intrusive rocks; 3, Economic materials; and 4, Topographical distribution.*

1. *Mineral Characters of the Huronian Strata*:—These rocks consist principally of thick beds of quartzite, passing into quartzose and jasper conglomerates; green slate rocks passing into slate conglomerates; bands of compact or sub-crystalline limestone; and interstratified masses or beds of greenstone. The entire thickness of the series, where fully displayed, is probably not far short of 20,000 feet. The quartzites are chiefly white or greenish in colour, but exhibit in some places grey, brownish, and also red tints. Some are vitreous in texture; others, more or less arenaceous. In the conglomerates, the included pebbles, which are sometimes quite small, consist of different varieties of quartz—colourless, opaque-white, brown, black, dark-red,

* It is but just to state, that most of the facts given under these heads, are drawn from the publications of the Geological Survey of Canada. The writer, however, has visited the north shore of Lake Huron where the rocks of this series are chiefly displayed; and he has thus examined many of the strata and greenstone masses *in situ*, and has procured, personally, a considerable collection of specimens from that locality. He is consequently better able than a mere compiler would be, to classify and separate from subordinate details the more salient points belonging to the study of this geological group. These observations will apply also to other cases in which he is more especially indebted to the labours of the Survey

&c.,—the latter constituting the variety known as jasper. The slates and slate conglomerates appear to owe their general green colour to the presence of chlorite and epidote, or perhaps more commonly to the former alone. In some, different shades of green (or of green, black, and red) run in parallel lines, imparting to the rock a beautiful ribanded aspect. Well-marked slaty cleavage, however, is apparently very rare: if ever present. In the conglomerates, the enclosed pebbles, or rounded fragments, for some are eight or ten inches across, consist of pieces of gneiss, syenite, quartz, &c., evidently derived in many instances from the adjacent Laurentian rocks. Some of these slates and slate conglomerates form vast stratified masses of between two and three thousand feet in thickness. The limestone beds of the Huronian series are of comparatively subordinate importance. They are chiefly of a light or dark grey colour, though in places they offer a white, greenish or brownish tint. In structure, they are more or less compact, or but slightly crystalline; the latter condition is, however, rare. Some exhibit a brecciated appearance, and all seem to contain a good deal of siliceous matter. Thin beds of chert (a flinty variety of quartz) occur indeed interstratified with them, in some places. In addition to their want of crystalline texture, these limestones differ from those of the Laurentian series in not containing any crystallized minerals—apatite, garnets, tourmaline, hornblende, &c.,—a fact pointed out by Professor Sterry Hunt. The masses of greenstone interstratified with the slates and other beds of this series, are of somewhat doubtful origin. They may consist, as suggested by Prof. Hunt, of altered sedimentary deposits; or they may be stratified beds made up of materials derived from neighbouring dykes and eruptive greenstone masses; or, otherwise, they may consist of overflows of igneous rock during the building up of the associated strata; or of lateral dykes, so to say, forced at some after period between the lines of bedding. As regards structure, &c., they exhibit several varieties. Some are large-grained, consisting of feldspar (usually of a greenish-white color) and dark green or black hornblende. Other varieties are fine-grained, and of a uniform green colour except when they become amygdaloidal or contain cavities filled with calc spar, magnesite, quartz, &c. Certain fine-grained varieties also become schistose and quite sectile, from the presence of a large quantity of chlorite. These finer greenstones are likewise porphyritic in places, or hold imperfect crystals of feldspar; and those of coarser grain, by the addition of a little quartz, pass

occasionally into syenitic gneiss or syenite—according as to whether the rock be regarded as of sedimentary or eruptive origin.

2. *Associated Intrusive Rocks, Mineral Veins, &c* :—The intrusive rocks which break through the Huronian series, and belong apparently to the same geological period, consist of numerous dykes of dark greenstone, varying in breadth from less than a foot to two hundred feet or more; and of some large masses and veins of red granite, frequently of an epidotic character. An exposure of the latter occurs in force on the north shore of Lake Huron, associated with Laurentian strata, but is regarded by Sir William Logan as most probably of Huronian age from its agreement in mineral characters with similar veins which traverse the deposits of that period at neighbouring localities. Some of the greenstone dykes are older, and others newer, than the granite masses. The vein-fissures filled with copper pyrites, &c., which are so abundant amongst these Huronian strata, are of still later formation, since they cut many of the greenstones and granites, and often break the continuity of these and the surrounding beds, causing upthrows or downthrows of greater or less extent. An enormous fault caused by a dislocation of this character, has been traced out by Mr. Murray in the valley of the Thessalon and adjoining district. In one place, a downthrow of nine thousand feet is attributed to this fault. (See the Report for 1858. Also *Canadian Journal*. vol. V, p. 463.) Finally, it may be observed that several large anticlinals extend across the Huronian strata of this region generally. The axis or summit of one of these, crosses the workings of the Bruce Mines.

3. *Economic Materials* :—The more important substances of this class obtained from the Huronian rocks, comprise: copper ores; quartzose sandstones suitable for glass making purposes; hones of good quality; and (as ornamental stones) the jasper conglomerates mentioned above. The copper ores belong chiefly to copper pyrites, purple copper pyrites or erubescite (the "horse flesh ore" of the miners), and copper glance: minerals which have been fully described in PART II. These occur on the north shore of Lake Huron in veins or lodes, varying in thickness from about two to ten feet. The gangue or veinstone consists essentially of quartz, and the average yield of metal is said to be from six to eight per cent: amounting, however, in the dressed ore to about eighteen or twenty per cent. The principal workings are at the Bruce Mines (Cuthbertson location), Wellington Mines (Keating location), and at the Copper Bay Mines; but ore has

been found also at the Wallace Mine near the mouth of White Fish River, at Echo Lake, Root River, Garden River, Mississagui River, Spanish River, and other localities of that region. The ore (according to Mr. Murray's observations) appears to be far more abundant in the greenstones than in the quartzites. Lodes of some richness in the greenstone, when passing into the latter frequently become quite poor. Ottertail Lake, an expansion of the Thessalon River, is named by the Geological Survey as a locality from which good hones may be obtained. They are cut from the green or greyish siliceous slates, found towards the base of the series. From some of the soft chloritic slates, also, the Indians have long obtained sufficiently compact and sectile masses to be worked into pipe-bowls and other objects.

4. *Topographical Distribution* :—The Huronian rocks are unknown throughout the greater portion of Western Canada, and in the East they appear to be entirely wanting. The Laurentian rocks of these districts, either form the surface of the ground, with or without a covering of Drift, or are otherwise overlaid unconformably by Silurian strata—the Huronian being absent. The principal Huronian area extends along the north coast of Lake Huron from a few miles west of French River, where this enters the lake, up to the the neighbourhood of Root River opposite the northern part of Sugar Island, or to within a short distance of the Sault Ste. Marie. A narrow strip of the shore-line, however, from about ten miles north of the entrance to Lake George to a point west of Little Lake George, consists apparently of newer strata. The extension northward of this Huronian belt has not yet been definitely made out, but it does not appear to exceed ten or fifteen miles, and in places is less than this. Huronian rocks are exposed also at several points on Lake Superior: as in Batchchwahnung Bay; at the mouth of the Doré, and around the lower part of Michipicoten River; in strips along the coast farther west; and more extensively around the lower part of the Kaministiquia River, and elsewhere, on the coast of Thunder Bay. In many parts of this region, the Huronian rocks are followed unconformably by a somewhat similar series of altered strata, associated with dykes and interstratified masses of trap, and containing also, copper ores, native copper, and other metallic matters. Until recently, these strata were considered to be of Huronian age; but they are now looked upon as altered Silurian deposits, belonging in part to the Potsdam group,

and partly to the Calciferous or Quebec Series. They will be described, consequently, under those divisions.

[The present series of papers on the Minerals and Geology of Canada will be concluded in two other articles. These will comprise a review of our Silurian and higher strata, with many figures of characteristic fossils, sections, &c., and a brief recapitulatory sketch of the geology of the Province generally.]

ILLUSTRATIONS OF THE SIGNIFICANCE OF CERTAIN ANCIENT BRITISH SKULL FORMS.

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During a recent visit to Washington, I availed myself of the facilities afforded me by Professor Henry, the learned Secretary of the Smithsonian Institution, to examine with minute care the ethnological collections preserved there, including those formed by the United States Exploring Expedition; and especially a highly interesting collection of human crania. The latter includes those of Esquimaux and Tchuktchi, a number of compressed and greatly distorted Chinook and other Flathead skulls, as well as examples of those of other Indian tribes, both of North and South America; and of Fiji, Kanaka, and other Pacific islanders. On my return I spent a short time in Philadelphia chiefly for the purpose of renewed study of the valuable materials of the Mortonian collection; and while there enjoyed the opportunity of examining, in company with Dr. J. Aitken Meigs, a series of 125 Esquimaux crania obtained by Dr. Hayes during his Arctic Journey of 1854.

The materials for craniological investigation which such collections supply can scarcely be surpassed in some of their departments; and invite to very diverse researches by the illustrations they are calculated to afford. It chanced, however, that my attention had been recently recalled to an old subject of speculation, relative to the possible modification of the forms of ancient British crania by some of the very causes which so materially alter those of many American tribes; and this accordingly influenced me in part, in the notes I made of the collections both at Washington and Philadelphia; and will now give direction to some remarks bearing on the same inquiry.

Among the most prized crania in the collection of the Academy of Natural Sciences at Philadelphia is the celebrated Scioto Mound skull. But though on a former visit, I made the ancient mound crania an object of special study, this most remarkable example of the series was not then included among them; and I now examined the original for the first time. The result of this examination was to satisfy me that the remarkable form and proportions of that skull are much more due to artificial influences than I had been led to suppose from the views published in the *Smithsonian Contributions to Knowledge*.* The vertical view, especially, is very inaccurate. In the original it presents the peculiar characteristics of what I have before designated as the truncated form: passing abruptly from a broad flattened occiput to its extreme parietal breadth, and then tapering with slight lateral swell, until it reaches its least breadth immediately behind the external angular processes of the frontal bone. The occiput has been subjected to the flattening process to a much greater extent than is apparent from the drawings; but at the same time it is accompanied by no corresponding affection of the frontal bone, such as inevitably results from the procedure of the Chinooks and other Flathead tribes; among whom the desired cranial deformation is effected by bandages crossing the forehead and consequently modifying the frontal as much as the parietal and occipital bones. On this account, great as is the amount of flattening in this remarkable skull, it is probably due solely to the undesigned pressure of the cradle-board acting on a head of markedly brachycephalic proportions and great natural posterior breadth. The forehead is fully arched, the glabella prominent, and the whole character of the frontal bone is essentially different from the Indian type. The sutures are very much ossified; and even to some extent obliterated. So early as 1857, when discussing Dr. Morton's theory of one uniform cranial type pervading the whole ancient and modern tribes of North and South America, with the single exception of the Esquimaux, I remarked: I think it extremely probable that further investigation will tend to the conclusion that the vertical or flattened occiput, instead of being a typical characteristic, pertains entirely to the class of artificial modifications of the natural cranium familiar to the American ethnologist alike in the disclosures of ancient graves, and in the customs of widely separated living tribes.†

* *Ancient Monuments of the Mississippi Valley: pl.* xlvii. and xlviii.

† *Edinburgh Philosoph. Journal, N. S.*, vol. vii. p. 24. *Canadian Journal*, vol. ii. p. 405.

This idea received further confirmation from noticing the almost invariable accompaniment of such traces of artificial modification, with more or less inequality in the two sides of the head. In the extremely transformed skulls of the Flathead Indians, and of the Natchez, Peruvians, and other ancient nations by whom the same barbarous practice was encouraged, the extent of this deformity is frequently such as to excite surprise that it could have proved compatible with the healthful exercise of any vital functions. But the aspect in which it is now purposed to review the subject of artificial modifications of the human cranium, in relation to ancient British skull-forms, was suggested, in the same paper above referred to, when pointing out the mistaken idea adopted by Dr. Morton, that such unsymmetrical conformation, or irregularity of form, is peculiar to American crania.* The latter remark, I then observed, is too wide a generalization. I have repeatedly noted the like unsymmetrical characteristics in the brachycephalic crania of Scottish barrows; and it has occurred to my mind, on more than one occasion, whether such may not furnish an indication of some partial compression, dependent, it may be, on the mode of nurture in infancy, having tended, in their case also, if not to produce, to exaggerate the short longitudinal diameter, which constitutes one of their most remarkable characteristics.

The idea thus expressed, in a paper read before the American Scientific Association at Montreal, as well as at the Dublin meeting of the British Association in 1857, was the result of observations made before leaving Scotland in 1853. One section of the *Prehistoric Annals of Scotland* is devoted to a discussion as to the ethnological significance of the crania of Scottish Tumuli; and after its publication I availed myself of every favourable opportunity for adding to the rare materials illustrative of that interesting department. In pursuing such researches my attention was repeatedly drawn to the unsymmetrical proportions of ancient brachycephalic skulls, and to their peculiar truncated form, accompanied, as in the mound skull of the Sciote Valley, by an abrupt flattening of the occiput which I soon began to suspect was due to artificial causes. Since then the facilities derived from repeated examinations of American collections have familiarized me, not only with the extreme varieties of form of which the human head is susceptible under the influence of artificial compression; but also with the less marked changes undesignedly resulting from such seemingly slight causes as the constant

* *Crania Americana*, p. 115. *Types of Mankind*, p. 444.

pressure of the Indian cradle-board. The examination and measurement of several hundred specimens of American crania, as well as of the living head in representatives of various Indian tribes, have also satisfied me not only of the existence of dolichocephalic and brachycephalic heads as tribal or national characteristics, but of the common occurrence of the same exaggerated brachycephalic form, accompanied with the vertical or obliquely flattened occiput, which had seemed to be characteristic of the crania of the Scottish tumuli. There are indeed ethnical differences apparent, as in the frontal and malar bones, but so far as the posterior region of the head is concerned, both appear to exhibit the same undesigned deformation resulting from the process of nursing still practised among many Indian tribes.

The light thus thrown on the habits of the British mother of prehistoric times, by the skull-forms found in ancient barrows, is replete with interest, from the suggestions it furnishes of ancient customs hitherto undreamt of. But it has also another and higher value to the craniologist, from its thus showing that some, at least, of the peculiar forms hitherto accepted as ethnical distinctions, may be more correctly traced to causes operating after birth.

The first example of this peculiar cranial conformation which attracted my attention, as possibly traceable to other causes than inherited characteristics, or natural deviations from the typical skull-form of an extinct race, occurred on the opening of a stone cist at Juniper Green, near Edinburgh, on the 17th of May, 1851. Soon after the publication of the *Prehistoric Annals of Scotland*, in which the special characteristics of the crania of the Scottish tumuli were first discussed, I learned of the accidental discovery of an ancient tomb in a garden on the Lanark road, a few miles to the north-west of Edinburgh, and immediately proceeded to the spot. The cist occupied a slightly elevated site, distant only a few yards from the road; and as this had long been under cultivation as a garden, if any mound originally marked the spot it had disappeared, and no external indication distinguished it as a place of sepulture. A shallow cist formed of unhewn slabs of sandstone enclosed a space measuring three feet eleven inches in length, by two feet one inch in breadth at the head, and one foot eleven inches at foot. The joints fitted to each other with sufficient regularity to admit of their being closed by a few stone chips inserted at the junction, after which they appeared to have been carefully cemented with wet loam or clay. The slab which covered the whole projected

over the sides, so as effectually to protect the sepulchral chamber from any infiltration of earth. It lay in a sandy soil, within little more than two feet of the surface; but it had probably been covered until a comparatively recent period by a greater depth of earth, as its site was higher than the surrounding surface, and possibly thus marked the traces of the nearly levelled tumulus. Slight as this elevation was it had proved sufficient to prevent the lodgment of water, and hence the cist was found perfectly free from damp. Within this a male skeleton lay on its left side. The arms appeared to have been folded over the breast, and the knees drawn up so as to touch the elbows. The head had been supported by a flat water-worn stone for its pillow; but from this it had fallen to the bottom of the cist, on its being detached by the decomposition of the fleshly ligatures; and, as is common in crania discovered under similar circumstances, it had completely decayed at the part in contact with the ground. A portion of the left side is thus wanting; but with this exception the skull was not only nearly perfect when found, but the bones are solid and heavy; and the whole skeleton appeared to me so well preserved as to have admitted of articulation. Above the right shoulder, a neat earthen vase had been placed, probably with food or drink. It contained only a little sand and black dust when recovered, uninjured, from the spot where it had been deposited by affectionate hands many centuries before, and is now preserved along with the skull in the Scottish Museum of Antiquities.

As the peculiar forms of certain skulls, such as one described by Dr. Thurnam, from an Anglo-Saxon cemetery at Stone, in Buckinghamshire, * and another from an Indian cemetery at Montreal in Lower Canada, † as well as those of numerous distorted crania, from the Roman site of Uriconium and other ancient cemeteries, have been ascribed to posthumous compression: the precise circumstances attendant on the discovery of the Juniper Green cist are important, from the proof they afford that the body originally deposited within it, had lain there undisturbed and entirely unaffected by any superincumbent pressure from the day of its interment. Two, if not three, classes of skulls have been recovered from early British graves. One with a predominant longitudinal diameter, in the most marked examples differs so essentially in its elongated and narrow forehead, and occiput from the modern dolichocephalic head, that I was led to assign it to

* *Crania Britannica*, Dec. I. p. 38.
† Edin. Philosoph. Journal, N. S. XVI. p. 269.

a separate class under the title kumbecephalic.* Another has the longitudinal diameter little in excess of the greatest parietal breadth, and is no less strikingly distinguished from the prevailing modern head, whether of Celtic or Saxon areas, by its shortness, than the other is by its length, when viewed either in profile or vertically. The Anglo Saxon type of skull appears to be intermediate between those two forms, with a more symmetrical oval, such as is of common occurrence in modern English skulls.

If cranial conformation has any ethnical significance, it appears to me inconceivable that the two extreme forms above referred to can both pertain to the same race; and the circumstances under which the most characteristic examples of the opposite types have been found, confirm me in the belief which I advocated when the evidence was much less conclusive, that the older dolichocephalic or kumbecephalic skull illustrates the physical characteristics of a race which preceded the advent of the Celtæ in Britain, and gradually disappeared before their aggressions. As, however, the opposite opinion is maintained by so high an authority as Dr. J. Barnard Davis, the comparison of the following measurements, illustrative of the three types of head, will best exhibit the amount of deviation in opposite directions from the intermediate form. The measurements are taken from those furnished in the *Crania Britannica*, and include the *longitudinal diameter, frontal, parietal, and occipital breadth, parietal height, and horizontal circumference.* No. 1, like the majority of the same class, is derived from a megalithic chambered barrow, and has been selected by Dr. Davis as a characteristic example of the class to which it belongs;† though, according to him, that is one of aberrant deviation from the typical British form. No. 2, obtained from a barrow at Codford, in Wiltshire, has also been selected by Dr. Davis as one of three typical British crania. It is of the same type as the Juniper Green skull, and its strongly marked characteristics are thus defined by him: "Its most interesting peculiarities are its small size, and its decidedly brachycephalic conformation. This latter character, which commonly appertains to the ancient British cranium, and even to that form which we regard as typical, is seldom met with expressed in so marked a manner."‡ No. 3, is a skull from an Anglo-Saxon cemetery near Litlington, Sussex, one of two of which Dr. Davis remarks: "There is

* *Prehistoric Annals of Scotland*, p. 177.

† Proceedings of the *Acad. Nat. Sciences*, Philadelphia, 1857, p. 42.

‡ *Crania Britanica*, Dec. ii., pl. 14.

a general indication of good-form in these fine capacious skulls, which is apparent in every aspect. . . On a review of the whole series of Anglo-Saxon crania which have come under our notice, we are led to conclude that this pleasing oval, rather dolichocephalic form, may best be deserving the epithet of typical among them."* All the three examples are male skulls:

	L. D.	F. B	P. B.	O. B.	P. H.	H. C.
1. Uley Chambered Barrow Skull	8.1	4.7	5.7	5.	5.1	21.7
2. Codford Skull.....	6.8	4.6	5.7	5.1	4.7	20.
3. Litlington Skull.....	7.5	4.7	5.3	4.6	4.9	20.9

Each of the above examples presents the features of the type to which it belongs with more than usual prominence, so that if the mean of a large series were taken, the elements of difference between the three would be less strongly defined. The differences are, however, those on which their separate classification depends; and they thus illustrate the special points on which any craniological comparison for ethnological purposes must be based. Of the three skulls, the era and race of one of them (No. 3) are well determined. It is that of a Saxon, probably of the seventh or eighth century, of the race of the South Saxons, descended from Ælla and his followers; and recovered in a district where the permanency of the same ethnic type is illustrated by its predominance among the rural population at the present day. Another of the selected examples, No. 2, is assumed by Dr. Davis, perhaps on satisfactory grounds, to be an ancient British, *i.e.*, Celtic Skull. It is indeed a difficulty, which has still to be satisfactorily explained, how it is that if this brachycephalic type be the true British head-form, no such prevalence of it on modern Celtic areas is to be found, as in the case of Saxon Sussex connects the race of its ancient pagan and christian cemeteries, by means of the characteristic ovoid skull, with the Anglo-Saxon population of the present day. The historical race and era with which Dr. Davis appears to connect the Barrow-builders of Wiltshire, is thus indicated in the *Crania Britannica*:—"Region of the Belgæ, Temp. Ptolemæi, A.D. 120." The Belgæ of that era—then apparently comparatively recent intruders, and by some regarded as not Celtic but Germanic—were displaced, if not exterminated; but the modern Britons of Wales are

* *Crania Britanica*, Dec. iv., pls. 39, 40.

undoubted descendants of British Celts of Ptolemy's age. Though doubtless mingling Saxon and Norman with pure British blood, they probably preserve the native type as little modified by such foreign admixture as that of its supplanters in the most thoroughly Saxon or Anglish districts of England. It is therefore a question of some importance how far the extreme brachycephalic proportions of the so-called British type may be traceable to other than inherited ethnical characteristics; whether in fact it is not entirely due to the undesigned flattening of the occiput, and lateral expansion of the brain and skull, consequent on the use of the cradle-board.

Meanwhile, turning from this supposed British skull of Roman times, to the one derived from Uley chambered barrow, No. 1, the most ancient of the series, and assuming their chronological order to be undisputed, as it appears to be: we find no gradation from an abbreviated to an elongated form, but, on the contrary, an extreme brachycephalic type interposed between the ovoid dolichocephalic Anglo-Saxon of the Christian era, and the extreme dolichocephalic, or kumbecephalic one belonging to a period seemingly so remote that Dr. Thurnam, when noting the recurrence of the same type in another chambered barrow at Littleton Drew, Wiltshire, remarked: "It is not necessary to admit the existence of any pre-Celtic race, as the skulls described may be those of Gaelic, as distinguished from Cymric, Celts; or the long-headed builders of these long, chambered, stone barrows, may have been an intrusive people, who entered Britain from the South-west. Can they have been some ancient Iberian or Ibero-Phœnician settlers?"*

Among the rarer crania of the Morton collection is one to which a peculiar interest attaches, and which may possibly have some significance in reference to this inquiry. Its history is thus narrated in Dr. Henry S. Paterson's Memoir of Dr. Morton: During a visit of Mr. Gliddon to Paris, in 1846, he presented a copy of the *Crania Ægyptiaca* to the celebrated oriental scholar, M. Fresnel, and exited his interest in the labours of its author. Upwards of a year after he received at Philadelphia, a box containing a skull, forwarded from Naples, but without any information relative to it. "It was handed over to Morton," says Dr. Paterson, "who at once perceived its dissimilarity to any in his possession. It was evidently very old, the animal matter having almost entirely disappeared. Day after day would Morton

* *Crania Britannica*, Dec. iii. pl. 24, (4.)

be found absorbed in its contemplation. At last he announced his conclusion. He had never seen a Phœnician skull, and he had no idea where this one came from; but it was what he conceived a Phœnician skull should be, and it could be no other." * Six months afterwards Mr. Gliddon received, along with other letters and papers forwarded to him from Naples, a slip of paper, in the handwriting of M. Fresnel, containing the history of the skull, which had been discovered by him during his exploration of an ancient tomb at Malta. Dr. Meigs refers to this in his catalogue of the collection, (No. 1352,) as an illustration of "the wonderful power of discrimination, the *tactus visus*, acquired by Dr. Morton in his long and critical study of craniology." Such was my own impression on first reading it; but I confess the longer I reflect on it, the more am I puzzled to guess by what classical or other data, or process short of absolute intuition, the ideal type of the Phœnician head could be determined. I suspect, therefore, if we had the statement in Dr. Morton's own words, it would fall short of such an absolute craniological induction. The following is the sole entry made by him in his catalogue: "Ancient Phœnician? I received this highly interesting relic from M. F. Fresnel, the distinguished French archæologist and traveller, with the following memorandum, A. D. 1847:—Crâne provenant des caves sépulchrales de Ben-Djemma, dans l'île de Malte. Ce crâne paraît avoir appartenu à un individu de la race qui, dans les temps les plus anciens, occupait la côté septentrionale de l' Afrique, et les iles adjacentes." The sepulchral caves of Ben-Djemma, are a series of galleries with lateral chambers or catacombs hewn in the face of the cliffs on the south-west side of the island of Malta. Other traces besides the rock-hewn tombs indicate the existence of an ancient town there, although no record of its name or history survives. M. Frédérick Lacroix remarks, in his *Malte et le Gozo*, "Whoever the inhabitants of this city may have been, it is manifest from what remains of their works, that they were not strangers to the processes of art. The sepulchral caves, amounting to a hundred in number, receive light by means of little apertures, some of which are decorated like a finished doorway. In others, time and the action of the humid atmosphere, have obliterated all traces of such ornament, and left only the weathered rock. . . The chambers set apart for sepulture are excavated at a considerable distance from the entrance, in the inmost recesses of

* *Memoir of S. G. Morton; Types of Mankind*, p. xl

the subterranean galleries. The tombs are of admirable design and style of art, and the details of their execution exhibit remarkable ingenuity and purity of taste. The author of the *Voyage pittoresque de Sicile* does not hesitate to declare that they surpass in elegance any that he has seen executed on the same scale. What hand has hewn out these gloomy recesses in the rock? To that we can give no reply. The chronicles of Malta are silent on this point. Time has defaced the vestiges which might otherwise have helped to the solution of the problem."*

Other and very remarkable remains of antiquity abound in Malta and the neighbouring island of Goza, including the cyclopean ruins styled *La tour des Géants*, which have also been assigned by some writers to a Phœnician or Punic origin, as a temple dedicated to Astarte; and the *Tadarnadur Isrira*, a magalithic structure for which a Pelasgic origin is assumed. But in drawing any comparison between the chambered galleries of Ben-Djemma and the megalithic chambered barrows or cairns of the British Islands, we are at best reasoning from the little known to the less known indices of prehistoric races; between whom the points in common may amount to no more than those which admit of a comparison being drawn between the Brachycephali of the British Stone-Period, and the corresponding physical form and rude arts of American gravemounds.

Nevertheless the Ben-Djemma skull in the Mortonian collection is not improbably what it has been assumed it to be; and it is in many respects a remarkable one. A deep indentation at the nasal suture gives the idea of an overhanging forehead, but the superciliary ridges are not prominent, and the peculiar character of the frontal bone is most strikingly apparent in the vertical view, where it is seen to retreat on either side, almost in a straight line from the centre of the glabella to the external angular processes of the frontal bone. The contour of the coronal region is described by Dr. Meigs as "a long oval, which recalls to mind the kumbecephalic form of Wilson."† It it is of more importance, perhaps, to note that the remarkable skull recovered by Dr. Schmerling, from the Engis Cavern, on the left bank of the Meuse, buried five feet in a breccia, along with the tooth of a rhinoceros and other fossil bones, appears to be of the same elongated dolichocephalic type. Its frontal development is long and narrow;

* *Malte et le Goze*, p. 21.

† Catalogue of Human Crania in the Academy of Nat. Sciences of Philadelphia, p. 29.

and its greatest relative proportions, in length and breadth, are 7·7 by 5·25 inches, so that it closely corresponds in those respects to the most characteristic British kumbecephalic crania.*

Whatever be the final conclusion of ethnologists, as to the evidence which led me to adopt that name to indicate the characteristics of a preceltic British race; the necessity appears to be acknowledged for some such term to distinguish this form from the ordinary dolichocephalic type. The Ben-Djemma skull is narrow throughout, with its greatest breadth a little behind the coronal suture, from whence it narrows gradually towards front and rear. The lower jaw is large and massive, but with less of the prognathous development than in the superior maxillary. The skull is, no doubt, that of a man, and the nose has been prominent; but the zygomatic arches are delicate, and the whole face is long, narrow, and tapering towards the chin. The parietals meet at an angle, with a bulging of the sagittal suture, and a slight but distinctly defined pyramidal form running into the frontal bone. The occiput is full, round, and projecting a little more on the left side than the right. The measurements are as follows:—

Longitudinal diameter	7.4
Parietal diameter	5.1
Frontal diameter	4.
Vertical diameter	5.3
Intermeatoid arch	12.3
Intermastoid arch	15. (?)
Intermastoid line	4.3 (?)
Occipito-frontal arch	14.2
Horizontal circumference	20.2

I have been thus particular in describing this interesting skull, because it furnishes some points of comparison with British kumbecephalic crania, bearing on the inquiry, whether we may not thus recover traces of the Phœnician explorers of the Cassiterides in the long-headed builders of the chambered barrows. When contrasting the wide and nearly virgin area with which Dr. Morton had to deal, with that embraced in the scheme of the *Crania Britannica*, I remarked in 1857:—Compared with such a wide field of investigation, the little island home of the Saxons may well seem narrow ground for exploration. But to the ethnologist it is not so. There, amid the rudest traces of primeval arts, he seeks, and probably not in vain, for the remains of primitive European allophy-

* *Natural History Review*, vol. i.

liæ. There it is not improbable that both Phœnicians and early Greek navigators have left behind them evidences of their presence, such as he alone can discriminate.*

Before, however, we can abandon ourselves to the temptations of so seductive a theory,—which, after all, finds only such support as may be deduced from a certain general analogy of cranial form; and derives no confirmation from the works of art accompanying the remains of the long-headed barrow builders;—it has to be borne in remembrance that the question is still disputed with reference to this class of British dolichocephalic crania: are they examples of an essentially distinct type, preserving evidence of the characteristics of a different race, or are they mere exceptional aberrant deviations from the supposed brachycephalic Celtic, or British type? Much stress is laid on the fact that the two forms of skull have occasionally been recovered from the same barrow; from which it may be inferred that the two races to which I conceive them to have belonged, were for a more or less limited period contemporaneous. More than this I cannot regard as a legitimate induction from such premises, in relation to crania of such extremely diverse types. But this amounts to little; for the same is undoubtedly true of the ancient British and the modern Anglo Saxon race; and the discovery of Celtic and Saxon skulls in a common barrow or tumulus of the 6th century is no proof that the latter race was not preceded by many centuries in the occupation of the country, by the Britons, among whom they then mingled as conquerors and supplanters.

But the elongated skulls of the Uley barrow type are no rare and exceptional forms. They have been most frequently found in tombs of a peculiar character, and of great antiquity Many have been recovered in too imperfect a state to admit of more being deduced from the fragments than that these conform to the more perfect examples of this peculiar form. Nevertheless the number already obtained in a sufficiently perfect state to admit of detailed measurement is remarkable, when their great age, and the circumstances of their recovery are fully considered. Of this the following enumeration will afford satisfactory proof. Only two perfect crania from the chambered tumulus of Uley, in Gloucestershire,—of which the proportions of one are cited above,—have been preserved. But in the later search of Mr. Freeman, and Dr. Thurnam, in 1854, the fragments of eight or nine other skulls were recovered, and of these

* *Canadian Journal*, vol. [illegible] p. 445.

the latter remarks: "The fragments are interesting, as proving that the characters observed in the more perfect crania were common to the individuals interred in this tumulus. Three or four calvaria are sufficiently complete to show that in them likewise the length of the skulls had been great in proportion to the breadth."* Again in the megalithic tumulus of Littleton Drew, North Wilts, at least twenty-six skeletons appear to have been found, from several of which imperfect crania were recovered, and of those Dr. Thurnam remarks: "Eight or nine crania were sufficiently perfect for comparison. With one exception, in which a lengthened oval form is not marked, they are of the dolichocephalic class."† So also the four nearly perfect skulls from West Kennet are described as "more or less of the lengthened oval form, with the occiput expanded and projecting, and presenting a strong contrast to skulls from the circular barrows of Wilts and Dorset."‡ To these may be added those of Stoney Littleton, Somersetshire, first pointed out by Sir R. C. Hoare; || and examples from barrows in Derby, Stafford, and Yorkshire, described by Mr. Thomas Bateman in his "Ten Years' Diggings in Celtic and Saxon Grave Hills;" including those from Bolehill, Longlow, and Ringham Low, Derbyshire; from the galleries of the tumulus on Five Wells Hill; and from the Yorkshire barrow near Heslerton-on-the-Wolds. Several of the above contained a number of skulls; and of the last, in which fifteen human skeletons lay heaped together, Mr. Bateman remarks: "The crania that have been preserved are all more or less mutilated; but about six remain sufficiently entire to indicate the prevailing conformation to be of the long or kumbecephalic type of Dr. Wilson."§ The crania occuring in graves of this class mentioned by Mr. Bateman alone, exceed fifty in number, of which the majority are either of the elongated type, or too imperfect to be determined. The others include between thirty and forty well-determined examples, besides a greater number in too imperfect a state to supply more than indications of their correspondence to the same characteristic form. Alongside of some of these are also found brachycephalic crania; but in the most ancient barrows the elongated skull appears to be the predominant, and in some cases the sole type; and of the examples found in Scotland, several

* *Archæol. Journal*, vol. xi. p. 313. *Crania Britannica*, Dec. I. pl. 5, (5).
† *Crania Britannica*, Dec. III. pl. 24, (3).
‡ *Ibid*, Dec. V. pl. 30 (4.)
|| *Archæologia*, vol. xix. p. 47.
§ *Ten Years' Diggings in Celtic and Saxon Grave Hills*. p. 230.

have been recovered from peat bogs, or others under circumstances more definitely marking their great antiquity.

The variations of cranial form are thus, it appears, no gradual transition, or partial modification, but an abrupt change from an extreme dolichocephalic to an extreme brachycephalic type; which, on the intrusion of the new and essentially distinct Anglo-Saxon race, gives place once more to a dolichocephalic form of medium proportions. The three forms may be represented, reduced to an abstract ideal of their essential diversities by means of the following diagram :*—

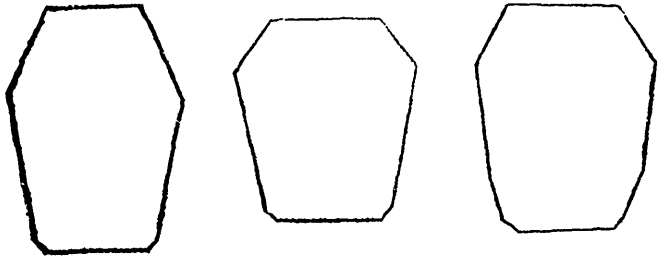

Fig. 1. Fig. 2. Fig. 3.

Leaving, meanwhile, the consideration of the question of distinct races indicated by such evidence, it will be well to determine first if such variations of skull-form can be traced to other than a transmitted ethnical source. The Juniper Green skull, already referred to, presents in profile, as shown in the full sized view in the *Crania Britannica*, the square and compact proportions characteristic of British brachycephalic crania. It also exhibits in the vertical outline, the truncated wedge form of the type indicated in Fig. 2. In the most strongly marked examples of this form, the vertical or flattened occiput is a prominent feature, accompanied generally with great parietal breadth, from which it abrubtly narrows at the occiput. The proportions of this class of crania were already familiar to me before the discovery of the Juniper Green example; but it had not before occurred to me to ascribe any of their features to other than natural causes. But the circumstances attending its exhumation gave peculiar interest to whatever was characteristic in the skull and its accompanying relics, handled for the first time as evidences of the race and age of the freshly opened cist, discovered almost within sight of the Scottish Capital, and yet pertaining to prehistoric times. The skull was carried home in my

* Owing to inaccurate copying on the part of the wood engraver, the diagrams, especially fig. 3, do not correspond on opposite sides, as they ought to do.

hand a distance of several miles, and its truncated outline, and still more, its flattened occiput attracted special attention, and gave rise to conversation with my friend Mr. Robert Chambers, who had accompanied me on this exploratory excursion. With the temptation of a novel discovery, I was at first disposed to recognise the traces of art in this abbreviated form, not only as exaggerating the natural characteristics, but as a possible source of their production. But a comparison with examples of the true dolichocephalic skull, to which I had already assigned priority in point of time, sufficed to dispel that illusion, and to satisfy me—of what the examination of the corresponding classes of Peruvian crania has still more strongly confirmed,—that no artificial modification can entirely efface the distinctions between two such diverse forms. At a subsequent meeting of the Society of Antiquaries of Scotland, I accompanied the presentation of the cranium and urn with an account of the circumstances of their discovery, and some remarks on the novel features noticeable in the skull. Unfortunately the printing of the Society's Proceedings, which had been suspended for some time, was not resumed till the following season; and no record of this communication was preserved beyond the title.

Another skull in the same collection, found under somewhat similar circumstances in a cist at Lesmurdie, Banffshire, has the vertical occiput accompanied by an unusual parietal expansion and want of height, suggestive of the idea of a combined coronal and occipital compression.* A third Scottish skull, procured from one of a group of cists near Kinaldie, Aberdeenshire, also exhibits the posterior vertical flattening. But a more striking example than any of those appears in the one from Codford, South Wiltshire, selected above to illustrate this type.† Dr. Davis remarks in his description of it:—"The zygomatic arches are short, a character which appertains to the entire calvarium, but is most concentrated in the parietals, to which the abruptly ascending portion of the occipital lends its influence. The widest part of the calvarium is about an inch behind, and as much above the auditory foramen, and when we view it in front we perceive it gradually to expand from the outer angular process of the frontal to the point now indicated." The entire parieto-occipital region presents in profile an abrupt vertical line; but when viewed vertically it tapers considerably more towards the occiput than is usual in crania of the same class.

The cause of the vertical occiput, as well as the oblique parieto-oc-

* *Crania Britannica*, Dec. ii. pl. 16.
† *Ibid*, Dec. ii. pl. 14.

cipital flattening in this class of British Crania, I feel no hesitation in believing to be traceable to the same kind of rigid cradle-board as is in constant use among many of the Indian tribes of America, and which produces precisely similar results. Its mode of operation, in effecting the various forms of oblique and vertical occiputs, will be considered, when describing some of the phenomena of compressed Indian crania; but another feature of the Juniper Green skull, which is even more obvious in that from Lesmurdie, in the same collection, is an irregularity amounting to a marked inequality in the developement of the two sides. This occurs in skulls which have been altered by posthumous compression; but the recovery of both the examples referred to from stone cists, precludes the idea of their having been affected by the latter cause; and since I was first led to suspect the modification of the occiput, and the exaggeration of the characteristic proportions of British brachycephalic crania by artificial means, familiarity with those of the Flathead Indians, as well as other ancient and modern artificially distorted American crania, has led me to recognise in them the constant occurrence of the same unsymmetrical inequality in opposite sides of the head.

But another class of deformations, of a less marked character than the well-known distortions produced on many American crania, both by the undesigned action of the cradle-board, and by protracted compression purposely applied with a view to change the form, merits the careful attention of craniologists. The normal human head may be assumed to present a perfect correspondence in its two hemispheres; but very slight investigation will suffice to convince the observer that few living examples satisfy the requirements of such a theoretical standard. Not only is inequality in the two sides frequent, but a perfectly symmetrical head is the exception rather than the rule. The plastic condition of the cranial bones in infancy, which admits of all the strange malformations of ancient Macrocephali and modern Flatheads, also renders the infant head liable to many undesigned changes. From minute personal examination I have satisfied myself of the repeated occurrence of inequality in the two sides of the head, arising from the mother being able to suckle her child only at one breast, so that the head was subjected to a slight but constantly renewed pressure in the same direction. It is surprising, indeed, to how great an extent such unsymmetrical irregularity is found to prevail, when once the attention has been drawn to it. The only example of

the Greek head possessed by Dr. Morton, was a cast presented to him by Dr. Retzius, and which, from its selection by the distinguished Swedish craniologist for such a purpose, might reasonably be assumed to illustrate the Greek type. It is accordingly described by Dr. J. Aitken Meigs, in his "Cranial characteristics of the Race of Man," as very much resembling that of Constantine Demetriades, a Greek native of Corfu, and long a teacher of the modern Greek language at Oxford, as engraved in Dr. Prichard's *Researches*. Its cranial characteristics are thus defined in the Catalogue of the Mortonian Collection: (No. 1354,) "The calvarial region is well developed, the frontal line expansive and prominent, the facial line departs but slightly from the perpendicular." On recently visiting Philadelphia for the purpose of renewed examination of its valuable collections, I was surprised to find this head,—instead of being either oval or as Blumenback describes the example selected by him, sub-globular,—presenting the truncated form, with extreme breadth at the parietal protuberances, and then abruptly passing to a flattened occiput. It measures 6.5 longitudinal diameter; 5.7 parietal diameter; and 19.2 horizontal circumference. But the most noticeable feature is the great inequality of the two sides, the right side is less tumid than the left, while it projects more to the rear, and the whole is fully as unsymmetrical as many American crania. Were it not that this feature appears to have wholly escaped Dr. Morton's attention, as he merely enters it in his catalogue as a "Cast of the skull of a young Greek, Prof. Retzius;" I should be tempted to suppose it had been purposely sent to him to illustrate the phenomena of unsymmetrical development; and of the influence of undesigned artificial causes on skull-forms.

Dr. Morton was not unobservant of such indications of the frequent dissimilarity between opposite sides of the skull, nor did he entertain any doubt as to its cause when occurring as the accompaniment of other artificial changes, though he entirely overlooked its more general prevalence. When first noticing the probable origin of the flattened occiput of certain British skulls, I drew attention to the fact that he had already recognised undesigned artificial compression as one source of abnormal cranial conformation, and he accompanied its demonstration with a reference to the predominant unsymmetrical form in all such skulls. "This irregularity," he added, "chiefly consists in the greater projection of the occiput to one side than the other," and "is not to be attributed to the intentional application of mechanical force." Such want of uniformity in the two

sides of the head is much more strongly marked in the Flathead skulls, which have been subjected to great compression. It is clearly traceable to the difficulty of subjecting the living and growing head to a perfectly uniform and equable pressure, and to the cerebral mass forcing the skull to expand with it in the direction of least resistance. Hence the unsymmetrical form accompanying the vertical occiput in the Lesmurdie and Juniper Green skulls, and, as I conceive also in the Greek skull of Retzius. To me, at least, the study of the latter skull-form has tended strongly to confirm the belief that the extreme abbreviated proportions of many naturally brachycephalic crania are due to artificial causes. Wherever a very noticable inequality exists between the two sides of a skull, it may be ascribed with much probability to the indirect results of designed or accidental compression in infancy; and by its frequent occurrence in any uniform aspect, may, quite as much as the flattened occiput, furnish a clue to customs or modes of nurture among the people to whom it pertains.

Dr. Struthers of Edinburgh has in his collection an interesting example of a modern skull, measuring 7.5 longitudinal diameter, 6.5 parietal diameter, 21.4 horizontal circumference, in which the truncated form is even more strongly marked by the abrupt flattening, immediately behind the parietal protuberances, accompanied with inequality in the two sides of the head. It was obtained from a grave digger in Dundee, who stated it to be that of a middle aged female whom he had known during life. There was nothing particular about her mental developement.

I have also drawn attention in former papers to the fact that such peculiar forms and examples of inequality in the developement of the two sides of the head, are familiar to hat manufacturers. Occasionally the eye is attracted by very unusual cranial forms revealed by baldness; but the hair suffices generally to conceal abnormal irregularities, some of which, as illustrated by hatters' shapes, are extremely odd and fantastical. My attention was originally directed to this familiar test by a remark of the late Dr. Kombst, that he had never been able to obtain an English-made hat that would fit his head. He added that he believed such was the general experience of Germans, owing to the greater length of the English head. I subsequently found the shapes of a Yorkshire hatter to be shorter than some furnished me from Dublin; and I believe that such comparisons of the shapes most

in demand in different parts of the British Islands, and on the Continent, will supply important craniological results.

The novel forms thus occurring in modern heads, though chiefly traceable, as I believe, to artificial causes, are not the result of design. But the same is true of the prevalent vertical and obliquely flattened occiput of many ancient and modern American crania, as well as of the British brachycephalic class already described. Nor are such changes of the natural form necessarily limited to skulls of short longitudinal diameter, in which this typical characteristic is exaggerated by the pressure of the cradle-board in infancy. Now that this source of modification begins to receive general recognition among craniologists, its influence is assumed as a probable source of the most diverse aberrant forms. Dr. Thurnam, when referring to two skulls of different shapes, recovered from the same group of British barrows, of "a somewhat late though pre-Roman period," on Roundway Hill, North Wiltshire, thus indicates their contrasting characteristics, and suggests the probable source of such divergence from the supposed British type: "The general form of the cranium (pl. 43.) differs greatly from that from the adjoining barrow, (pl. 42). That approaches an acrocephalic, this a platycephalic form; that is eminently brachycephalic, this more nearly of a dolichocephalic character. As the eye at once detects, the difference is much greater than would be inferred from a mere comparison of the measurements. The respective peculiarities of form in the two skulls, may possibly be explained by supposing that both have been subject to artificial deformation, though of a different kind,—the one appearing to have been flattened on the occiput, the other showing a depression immediately behind the coronal suture, over the parietal bones, which seems to indicate that this part of the skull was subject to some habitual pressure and constriction, perhaps from the use of a bandage or ligature tightly bound across the head and tied under the chin, such as to this day is employed in certain parts of the west of France, producing that form of distortion named by Dr. Gosse, the sincipital, or *tête bilobée*."* The influence of the recognition of this source of change, is indeed very manifest throughout the fifth Decade of the *Crania Britannica*. An extremely brachycephalic skull of a youth, obtained from a barrow on Ballard Down, Isle of Purbeck, is described as unsymmetrical, and as affording "tolerably clear evidence that this form, if not always produced, was at least

* *Crania Britannica*, Dec. v. pl. 43.

liable to be exaggerated by an artificial flattening of the occiput, such as is practised by many American and Polynesian tribes."* In the same Decade another skull of the type most dissimilar to this, is described and illustrated. It was recovered in fragments from the remarkable chambered barrow at West Kennet, Wiltshire; and its most characteristic features are thus defined by Dr. Thurnam:—"It is decidedly dolichocephalic, narrow, and very flat at the sides, and realizes more nearly than any we have yet had to figure the kumbecephalic or boatshaped form described by Dr. D. Wilson. The frontal region is narrow, moderately arched and elevated at the vertex, but slopes away on each side. The parietal region is long, and marked by a prominent ridge or *carina* in the line of the sagittal suture, which is far advanced towards obliteration, whilst the other sutures are quite as perfect as usual. The occiput is full and prominent; the supra-occipital ridges only moderately marked. There is a deep digastric groove, and a slight paroccipital process on each side. The external auditory openings are somewhat behind the middle of the skull, and very much behind a vertical line drawn from the junction of the coronal and sagittal sutures" Its extreme length and breadth are 7·7 and 5·1, and an inequality in the development of the two sides is obvious in the vertical view. As the brachycephalic skull recalls certain American and Polynesian forms, so such examples of the opposite type suggest the narrow and elongated skulls of the Australians and Esquimaux: and he thus proceeds:—"The Ballard Down skull bears marks of artificial flattening of the occiput; this calls to mind the artificial lateral flattening of the skull characteristic of the ancient people called Macrocephali, or long-heads, of whom Hippocrates tells us, that 'while the head of the child is still tender, they fashion it with their hands, and constrain it to assume a lengthened shape by applying bandages and other suitable contrivances, whereby the spherical form of the head is destroyed, and it is made to increase in length.' This mode of distortion is called by Dr. Gosse the *temporo-parietal*, or '*tête aplatie sur les côtés*.' It appears to have been practised by various people, both of the ancient and modern world, and in Europe as well as the East. The so-called Moors, or Arabs of North Africa, affected this form of skull; and even in modern times, the women of Belgium and Hamburgh are both described as compressing the heads of their infants into an elongate form. Our own observations lead at least to a presumption that this form of arti-

* *Crania Britannica*, Dec. v. pl. 45.

ficial distortion may have been practised by certain primeval British tribes, particularly those who buried their distinguished dead in long chambered tumuli."

Accordingly Dr. Thurnam draws attention to the obliteration of the sagittal suture, both in the skull in question, and to a still greater extent in one figured by Blumenbach, under the name of "Asiatic Macrocephali," and expresses his belief that this "has been produced by pressure or manipulations of the sides of the head in infancy, by which it was sought to favour the development of a lengthened form of skull; to which, however, there was probably, in the present instance at least, a natural and inherent tendency." It is perhaps worthy of note here, that a long narrow head has been observed as characteristic of certain Berber tribes, the occupants of ancient Punic sites in North Africa.

It thus appears that a class of variations of the form of the human skull, which becomes more comprehensive as attention is directed to it, is wholly independent of congenital transmitted characteristics. Kumbecephalic, acrocephalic, and platycephalic, unsymmetrical, truncated, or elongated heads, may be so common as apparently to furnish distinctive ethnical forms, and yet, after all, each may be traceable to artificial causes, arising from an adherence to certain customs and usages in the nursery. It is in this direction, I conceive, that the importance of the truths resulting from the recognition of artificial causes affecting the forms of British brachycephalic or other crania chiefly lies. The contents of early British cists and barrows prove that the race with which they originated was a rude people, ignorant for the most part of the very knowledge of metals, or at best in the earliest rudimentary stage of metallurgic arts. They were in fact in as uncivilized a condition as the rudest forest Indians of America. To prove, therefore, that like the Red Indian squaw, the British allophylian or Celtic mother formed the cradle for her babe of a flat board, to which she bound it, for safety and facility of nursing, in the vicissitudes of her nomade life,—though interesting, like every other recovered glimpse of a long-forgotten past,—is not in itself a discovery of much significance. But it reminds us how essentially man, even in the most degraded state of wandering savage life, differs from all other animals. The germs of an artificial life are there. External appliances, and the conditions which we designate as domestication in the lower animals, appear to be inseparable from him. The most untu-

tored nomades subject their offspring to many artificial influences, such as have no analogy among the marvellous instinctive operations of the lower animals. It is not even unworthy of notice that man is the only animal to whom a supine position is natural for repose; and with him more than any other animal, the head when recumbent, invariably assumes a position which throws the greatest pressure on the brain-case, and not on the malar or maxillary bones. Without, therefore, running to the extreme of Dr. Morton, who denied, for the American continent at least, the existence of any true dolichocephalic crania, or indeed any essential variation from one assumed typical form, it becomes an important point for the craniologist to determine, if possible, to what extent certain characteristic diversities may be relied upon as the inherited features of a tribe or race; or whether they are not the mere result of artificial causes originating in long perpetuated national customs and nursery usages. If the latter is indeed the case, then they pertain to the materials of archæological, rather than of ethnological deduction, and can no longer be employed as elements of ethnical classification.

Every scheme of the craniologist for systematising ethnical variations of cranial configuration, and every process of induction pursued by the ethnologist from such data, proceed on the assumption that such varieties in the form of cranium are constant within certain determinate limits, and originate in like natural causes with the features by which we distinguish one nation from another. By like means the comparative anatomist discriminates between the remains of the *Bos primigenius*, the *Bos longifrons*, and other kindred animal remains, frequently found alongside of the human skeleton, in the barrow: and by a similar crucial comparison the craniologist aims at classifying the crania of the ancient Briton, Roman, Saxon, and Scandinavian, apart from any aid derived from the evidence of accompanying works of art. But if it be no longer disputable that the human head is liable to modification from external causes, so that one skull may have been subjected to lateral compression, resulting in the elongation and narrowing of its form; while another under the influence of occipital pressure may exhibit a consequent abbreviation in its length, accompanied by parietal expansion; it becomes indispensable to determine some data whereby to eliminate this perturbing element before we can ascertain the actual significance of national skull-forms. If, for example,—as appears to be the case,—the crania from British graves of Roman times reveal a different form from that of

the modern Celtic Briton, the cause may be an intermixture of races, like that which is clearly traceable among the mingled descendants of Celtic and Scandinavian blood in the north of Scotland; but it may also be, in part, or wholly, the mere result of a change of national customs following naturally on conquest, civilization, and the abandonment of paganism for christianity.

It is in this respect, that the artificial causes tending to alter the natural conformation of the human head, invite our special study. They appear at present purely as disturbing elements in the employment of craniological tests of classification. It is far from improbable, however, that when fully understood they may greatly extend our means of classification; so that when we have traced to such causes certain changes in form, in which modern races are known to differ from their ethnical precursors, we shall be able to turn the present element of disturbance to account, as an additional confirmation of truths established by inductive craniology. Certain it is, however, whatever value may attach to the systematising of such artificial forms, that they are of frequent occurrence; apart altogether from such configuration as is clearly referrible to the application of mechanical pressure in infancy with that express object in view; or again, as is no less obviously the result of posthumous compression. But, though the deforming processes designedly practised among ancient and modern savage nations lie beyond the direct purpose of the present inquiry, they are calculated to throw important light on the approximate results of undesigned compression and arrested development.

Among the Flathead Indian tribes of Oregon and the Columbia River, where malformation of the skull is purposely aimed at, the infant's head is tightly bound in a fixed position, and maintained under a continuous pressure for months. But it is a mistake to suppose that in the ordinary use of the cradle-board the Indian pappoose is subject to any such extreme restraint. The objects in view are facility of nursing and transport, and perfect safety for the child. But those being secured it is nurtured with a tenderness of maternal instinct surpassing that of many savage nations. The infant is invariably laid on its back, but the head rests on a pillow or mat of moss or frayed bark, and is not further restrained in a fixed position than necessarily results from the posture in which the body is retained by the bandages securing it in the cradle. This fact I have satisfied myself of from repeated observations. But the consequence necessarily is, that the soft and pliant bones of the infant's head are subjected to a slight but con-

stant pressure on the occiput during the whole protracted period of nursing, when they are peculiarly sensitive to external influences. Experiments have shewn that at that period the bones specially affected by the action of the cradle-board are not only susceptible of changes, but liable to morbid affections, dependent on the nature of the infant's food. Lehmann supposes the *craniotabes* of Elsässer to be a form of rachitis which affects the occipital and parietal bones during the period of suckling; and Schlossberger ascertained by a series of analyses of such bones that the 63 per cent. of mineral constituents found in the normal occipital bones of healthy children during the first year, diminished to 51 per cent. in the thickened and spongy bone.* The fluctuations in proportion of the mineral constituents of bones are considerable, and vary in the different bones, but in the osseous tissue they may be stated at from 67 to 70 per cent. It is obvious, therefore, that, under the peculiar physiological condition of the cranial bones during the period of nursing, such constant mechanical action as the occipital region of the Indian pappoose is subjected to, must be productive of permanent change. The child is not removed from the cradle-board when suckling, and is not therefore liable to any counteracting lateral pressure against its mother's breast. One effect of such continuous pressure must be to bring the edges of the bones together, and thereby to retard, or arrest the growth of the bone in certain directions. The result of this is apparent in the premature ossification of the sutures of artificially deformed crania.

At Washington I had an opportunity of minutely examining thirty-four Flathead skulls brought home by the United States Exploring Expedition; some of them presenting the most diverse forms of distortion. In the majority of those the premature ossification of the sutures is apparent, and in some they are almost entirely obliterated.—The same is no less obvious among the corresponding class in the collection of the Academy of Natural Sciences of Philadelphia; and especially in skulls of the Chinooks, who carry the process of deformation to the greatest extent. But I have also been struck, not only with the frequent occurrence of wormian bones in such altered skulls, but also with the distinct definition of a true supraoccipital bone.

It is marvellous to see the extraordinary amount of distortion to which the skull and brain may be subjected without seemingly affecting either health or intellect. The coveted deformity is produced partly

* Schlossberger. Arch. f. phys. Heilk. Lehmann, Physiol. Chem. Vol. III. p. 28.

by actual compression, and partly by the growth of the brain and skull being thereby limited to certain directions. Hales, the Ethnographer of the Exploring Expedition, after describing the process as practised among the Chinooks, remarks: "The appearance of the child when just released from this confinement is truly hideous. The transverse diameter of the head above the ears is nearly twice as great as the longitudinal, from the forehead to the occiput. The eyes, which are naturally deep set, become protruding and appear as if squeezed partially out of the head."* Mr. Paul Kane in describing to me the same appearance, as witnessed by him on the Columbia River, compared the eyes to those of a mouse strangled in a trap. The appearance is little less singular for some time after the child has been freed from the constricting bandages; as shown in an engraving from one of Mr. Kane's sketches of a Chinook child seen by him at Fort Astoria.† In after years the brain as it increases, partially recovers its shape; and in some of the deformed adult skulls one suture gapes, while all the rest are ossified, and occasionally a fracture, or false suture remains open. An adult skull of the same extremely deformed shape, among those brought home by the Exploring Expedition, illustrates the great extent to which the brain may be subjected to compression and malformation without affecting the intellect. It is that of a Nasqually chief, procured from his canoe bier in Washington Territory. (No. 4549.) The internal capacity, and consequent volume of brain, is 95 cubic inches. The head is compressed into a flattened disc, with the forehead receding in a straight line from the nasal suture to the crown of the head, while the lambdoidal suture is on the same plane with the foramen magnum. The sutures are nearly all completely ossified; and the teeth ground quite flat, as is common with many of the tribes in the same region, and especially with the Walla-walla Indians on the Columbia River, who live chiefly on salmon, dried in the sun, and invariably impregnated with the sand which abounds in the barren waste they occupy. I assume the unimpaired intellect of the Nasqually chief from his rank. The Flathead tribes are in the constant habit of making slaves of the Roundheaded Indians; but no slave is allowed to flatten or otherwise modify the form of her child's head, that being the badge of Flathead aristocracy. As this has been systematically pursued since ever the

* Ethnography of the U. S. Exploring Expedition, p. 216.

† Prehistoric Man, Vol. II. p. 320.

tribes of the Pacific coast were brought under the notice of Europeans, it is obvious that if such superinduced deformity developed any general tendency to cerebral disease, or materially affected the intellect, the result would be apparent in the degeneracy or extirpation of the Flathead tribes. But so far is this from being the case, that they are described by traders and voyagers, as acute and intelligent. They are, moreover, an object of dread to neighbouring tribes who retain the normal form of head; and they look on them with contempt as thus bearing the hereditary badge of slaves.

The child born to such strange honours is laid, soon after its birth, upon the cradle-board, an oblong piece of wood, somtimes slightly hollowed, and with a cross board projecting beyond the head to protect it from injury. A small pad of leather stuffed with moss or frayed cedar-bark is placed on the forehead and tightly fastened on either side to the board; and this is rarely loosed until its final removal before the end of the first year. The skull has then received a form which is only slightly modified during the subsequent growth of the brain. But the very same kind of cradle is in use among all the Indian tribes. It is indeed varied as to its ornamental adjuncts, and non-essential details; but practically it resolves itself, in every case, into a straight board to which the infant is bound; and as it is retained in a recumbent position, and thus the pressure of its own weight during the period when, as has been shown, the occipital and parietal bones are peculiarly soft and compressible, is made to act constantly in one direction. This, I assume to have been the cause of the vertical or otherwise flattened occiput in the ancient British brachycephalic crania. The same cause must tend to increase the characteristic shortness in the longitudinal diameter, to produce the premature ossification of certain sutures, and to shorten the zygoma, with probably also some tendency to make the arch bulge out in its effort at subsequent full growth, and so to widen the face.

Dr. J. Barnard Davis has applied the term "parieto-occipital flatness," where the results of artificial compression in certain British skulls extend over the parietals with the upper portion of the occipital; and he appears to regard this as something essentially distinct from the vertical occiput.* But it is a form of common occurrence in Indian skulls, and is in reality the most inartificial of all the results of the undesigned pressure of the cradle-board. This will be understood

* *Nat. Hist. Review*, July, 1862. *Athenæum*, Sept. 27th, 1862, p. 402.

by a very simple experiment. If the observer lie down on the floor, without a pillow, and then ascertain what part of the back of the head touches the ground, he will find that it is the portion of the occiput immediately above the lambdoidal suture, and not the occipital bone. When the Indian mother places a sufficiently high pillow for her infant, the tendency of the constant pressure will be to produce the vertical occiput; but where, as is more frequently the case, the board has a mere cover of moss or soft leather, then the result will be just such an oblique parietal flattenning, as is shown on a British skull from the remarkable tumulus near Littleton Drew, Wiltshire. *Crania Britannica*, Decade III. plate 24.

But there are other sources of modification of the human skull in infancy, even more common than the cradle-board. More than one of the predominant head-forms in Normandy and Belgium are now traced to artificial changes; and by many apparently trifling and unheeded causes, consequent on national customs, nursing usages, or the caprices of dress and fashion, the form of the head may be modified in the nursery. The constant laying of the infant to rest on its side, the pressure in the same direction in nursing it, along with the fashion of cap, hat, or wrappage, may all influence the shape of head among civilized nations, and in certain cases tend as much to exaggerate the naturally dolichocephalic skull, as the Indian cradle-board increases the short diameter of the opposite type. Such artificial cranial forms as that designated by M. Foville, the *Tête annulaire*, may have predominated for many centuries throughout certain rural districts of France, solely from the unreasoning conformity with which the rustic nurse adhered to the traditional or prescriptive bandages to which he ascribes that distortion. All experience shows that such usages are among the least eradicable, and long survive the shock of revolutions that change dynasties and efface more important national characteristics.

But now that attention has been directed to the subject of undesigned changes thus effected on the human head, its full bearings begin to be appreciated; and there is even, perhaps, a danger that more may be ascribed to them than is legitimate. Such was undoubtedly the effect on Dr. Morton's mind from his familiarity with the results of artificial deformation on American crania; and were we to follow his example, we should be tempted to designate all the extreme varieties of the elongated dolichocephalic, acrocephalic, and brachycephalic skulls of British barrows, as mere modifications of the same ethnical form.

In his latest recorded opinions, when commenting on some of the abnormal forms of Peruvian crania, he remarks: "I at first found it difficult to conceive that the original rounded skull of the Indian could be changed into this fantastic form: and was led to suppose that the latter was an artificial elongation of a head remarkable for its length and narrowness. I even supposed that the long-headed Peruvians were a more ancient people than the Inca tribes, and distinguished from them by their cranial configuration. In this opinion I was mistaken. Abundant means of observation and comparison have since convinced me that all these variously-formed heads were originally of the same shape, which is characteristic of the aboriginal race from Cape Horn to Canada, and that art alone has caused the diversities among them."* The repeated opportunities I have enjoyed of examining the Mortonian and other American collections, have satisfied me of the occurrence of both dolichocephalic and brachycephalic crania not only as the characteristics of distinct tribes, but also among the contents of the same Peruvian cemeteries,—not as examples of extreme latitudes of form in a common race, but as the results of the admixture either of conquering and subject races, or of distinct classes of nobles and serfs, most generally resulting from the predominance of conquerors.† Among the Peruvians the elongated cranium pertained to the dominant race; and some of the results of later researches in primitive British cemeteries, and especially the disclosures of the remarkable class of chambered barrows, seem to point to an analogous condition of races. That the Uley and West Kennet skulls may have been laterally compressed, while the Codford barrow and other brachycephalic skulls have been affected in the opposite direction, appears equally probable. But such artificial influences only very partially account for the great diversity of type; and no such causes, even if brought to bear in infancy, could possibly convert the one into the other form.

But as the cranial forms, both of the Old and New World, betray evidences of modification by such artificial means; so also we find in ancient Africa a diverse form of head, to which art may have contributed, solely by leaving it more than usually free from all extraneous influences. Such at least is the conclusion suggested to my mind from the examination of a considerable number of Egyptian skulls. Among familiar relics of domestic usages of the ancient Egyptians is the pil-

* *Physical Type of the American Indian.* Schoolcraft: p. 326.

† *Prehistoric Man*, vol. ii. p. 225.

low designed for the neck, and not the head, to rest upon. Such pillows are found of miniature sizes, indicating that the Egyptian passed from earliest infancy without his head being subjected even to so slight a pressure as the pillow, while he rested recumbent. The Egyptian skull is long, with great breadth and fulness in the posterior region. In its prominent, rounded parieto-occipital conformation, an equally striking contrast is presented to the British brachycephalic skull with truncated occiput, and to the opposite extreme characteristic of the primitive dolichocephalic skull; though exceptional examples are not rare. This characteristic did not escape Dr. Morton's observant eye; and is repeatedly indicated in the *Crania Ægyptiaca* under the designation, "tumid occiput." It also appeared to me after careful examination of the fine collection formed by him, and now in the Academy of Natural Sciences of Philadelphia, that the Egyptian crania are generally characterised by considerable symmetrical uniformity: as was to be anticipated, if there is any truth in the idea of undesigned artificial compression and deformation resulting from such simple causes as accompany the mode of nurture in infancy.

The heads of the Fiji Islanders supply a means of testing the same cause, operating on a brachycephalic form of cranium; as most of the Islanders of the Fiji group employ a neck pillow nearly similar to that of the ancient Egyptians, and with the same purpose in view: that of preserving their elaborately dressed hair from dishevelment. In their case, judging from an example in the collection of the Royal College of Surgeons of London, the occipital region is broad, and presents in profile a uniform, rounded conformation passing almost imperceptibly into the coronal region. Indeed the broad, well rounded occiput is considered by the Fijians a great beauty. The bearing of this, however, in relation to the present argument depends on whether or not the Fiji neck-pillow is used in infancy, of which I am uncertain. The necessity which suggests its use at a later period, does not then exist; but the prevalent use of any special form of pillow for adults is likely to lead to its adoption from the first. In one male Fiji skull brought home by the United States Exploring Expedition (No. 4581), the occiput exhibits the characteristic full, rounded form, with a large and well defined supra-occipital bone. But in another skull in the same collection, that of Veindovi, Chief of Kantavu, who was taken prisoner by the

United States ship Peacock, in 1840, and died at New York in 1842, the occiput, though full, is slightly vertical. The occipital development of the Fiji cranium is the more interesting as we are now familiar with the fact that an artificially flattened occiput is of common occurrence among the islanders of the Pacific Ocean. "In the Malay race," says Dr. Pickering, "a more marked peculiarity, and one very generally observable, is the elevated occiput, and its slight projection beyond the line of the neck. The Mongolian traits are heightened artificially in the Chinooks; but it is less generally known that a slight pressure is often applied to the occiput by the Polynesians, in conformity with the Malay standard."* Dr. Nott, in describing the skull of a Kanaka of the Sandwich Islands who died at the Marine Hospital at Mobile, mentions his being struck by its singular occipital formation; but this he learned was due to an artificial flattening which the Islander had stated to his medical attendants in the hospital, was habitually practised in his family.† According to Dr. Davis, it is traceable to so simple a source as the Kanaka mother's habit of supporting the head of her nursling in the palm of her hand.‡ Whatever be the cause, the fact is now well established. The occipital flattening is clearly defined in at least three of the Kanaka skulls in the Mortonian Collection; No. 1300, a male native of the Sandwich Islands, aged about forty; No. 1308, apparently that of a woman, from the same locality; and in number 695 a girl of Oahu, of probably twelve years of age, which is markedly unsymmetrical, and with the flattening on the left side of the parietal and occipital bones. The Washington Collection includes fourteen Kanaka skulls; besides others from various Islands of the Pacific, among which several examples of the same artificial formation occur: *e.g.* No. 4587, a large male skull, distorted and unsymmetrical; and No. 4367, (female?) from an ancient cemetery at Wailuka, Mani, in which the flattened occiput is very obvious.

The traces of purposed deformation of the head among the Islanders of the Pacific have an additional interest in their relation to one possible source of South American population by oceanic migration, suggested by philological and other independent evidence. But for our present purpose the peculiar value of those modified skulls lies in the disclosures of influences operating alike undesignedly, and with a well defined purpose, in producing the very same cranial conforma-

* *Pickering's Races of Man*, p. 45.
† *Types of Mankind*, p. 436.
‡ *Crania Britannica*, Dec. III. pl. 24, (1.)

tion among races occupying the British Islands in ages long anterior to earliest history; and among the savage tribes of America, and the simple Islanders of the Pacific in the present day. They illustrate, with even greater force than the rude implements of flint and stone found in early British graves, the exceedingly primitive condition of the British Islanders of prehistoric times.

ON THE MAGNETIC DISTURBANCES AT TORONTO DURING THE YEARS 1856 TO 1862, INCLUSIVE.

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A few years prior to the establishment of the Colonial Magnetic observatories in 1839-40, the attention of philosophers in Germany had been directed to certain magnetic phenomona, consisting sometimes in abrupt changes of short duration, and sometimes in a long continued abnormal condition of the magnetic elements. These disturbances as they are termed, at first attributed to variations in atmospheric temperature and other local causes, were discovered by comparing preconcerted contemporaneous observations to prevail simultaneously, and to correspond in direction, and to great extent also in amount, at different and distant parts of Germany. The improbability of local origin which this synchronism in their occurrence indicated, and the probability wherewith it suggested some extra terrestrial influence, was greatly strengthened by the observations at the observatories at Toronto, Hobarton, &c., which first brought to light the fact that the disturbances occurred simultaneously, not only within a small region in Europe, but also at stations widely removed from each other on the earth's surface. It was found, however, that the disturbing influence would frequently affect different elements at two distant stations, or the same element to a different extent or in an opposite direction.

It was further made known that the disturbances, though in the ordinary sense irregular, are subject in their frequency and aggregate amount to definite periodic laws, manifesting a preference, so to speak, for certain hours of the day and night, and for certain months in the year.

The existence and general charactar of this periodicity was exhibited by the approximate methods employed in the earlier volumes of the colonial observations, but it was by the more accurate system first developed by General Sabine, in the 3rd volume of the Toronto observations, and since applied by him to the observations of other stations, that the periodic laws were rendered definite and precise.

In the method referred to, the disturbed values of an element under discussion, are confined to those which differ from the normal value of that element proper to the hour by an amount equal or exceeding a certain definite limit, such normal being the average of the values of the element for that hour, during a month or some other suitable group of consecutive days, excluding all the disturbed values and including all others; the magnitude of the disturbance being measured by the difference between the actual and the normal value of the element.

The disturbance limit for an element, determined on with reference to the amplitude of its regular periodic variations, is generally different at different stations; but for the sake of inter-comparison must be constant at the same station.

Of the facts revealed by discussing the disturbances at several stations, the following are among the most prominent:—

(1,) The frequency and amount of disturbance of the declination, inclination, and force, have a diurnal and an annual period.

(2,) The disturbances of the elements without regard to sign, the disturbances in which the needle is deflected to the east, and those in which it is deflected to the west of its normal position, as well as the disturbances which increase, and those which decrease the force and inclination, have all distinct and often different periodic laws.

(3,) The periodic variations at different stations, though possessing the same general characters, exhibit in their epochs of maximum and minimum, very great diversities.

(4,) In addition to the diurnal and annual periods, the yearly aggregates of disturbance for each element and at every station are subject to a periodic increase and diminution, occupying a cycle of about ten years, which corresponds both in its length and in the epochs of maximum and minimum, with a periodic variation in the number of groups of spots on the surface of the sun. The disturbances discussed, and the results announced by General Sabine, in the 3rd volume of the Toronto observations, relate to the hourly observations from 1st July, 1843, to 30th June, 1848. It is my purpose in the present commu-

nication to give analogous results for the years 1856 to 1862, inclusive, partly to shew that the diurnal and annual variations of the disturbances are substantially the same in the more recent as in the earlier series, but chiefly for the purpose of furnishing materials for discovering the precise character of the so-called decennial period.

In the investigations on which the accompanying tables are based, those disturbances only are included which equal or exceed the limits employed by General Sabine; namely, for the declination, 5'.0; Horizontal force, ·0012; Vertical force, ·00026; Total force, ·0004; Inclination, 1'.0.

In the process of collecting the disturbances of the Horizontal force, additional security has been aimed at, by employing in most instances the observations furnished by two, and in a few cases by three bifilars. The normal for each bifilar being found in the usual way, the difference therefrom of the disturbed readings, and expressed in parts of the Horizontal force, were placed in parallel columns. In the great majority of observations where one instrument gave a disturbed reading the other did so also, but when such was not the case, the blank was filled up by the difference, whatever it might be, between the observed reading and the corresponding normal. The means of the corresponding entries in the different columns being then taken, those were retained as disturbances which equalled or exceeded ·0012.

The disturbances of the horizontal and vertical components of the force being found, the corresponding abnormal deviation $\left(\frac{\Delta\phi}{\phi}\right)$ of the total force and $(\Delta\theta)$ of the inclination were calculated by the formulæ

$$\frac{\Delta\phi}{\phi} = \cos^2\theta \frac{\Delta X}{X} + \sin^2\theta \frac{\Delta Y}{Y}$$

$$\Delta\theta = \tfrac{1}{2} \sin 2\theta \left\{ \frac{\Delta X}{X} - \frac{\Delta Y}{Y} \right\}$$

Where $\frac{\Delta X}{X}$ and $\frac{\Delta Y}{Y}$ represent the contemporaneous abnormal deviations of the horizontal and vertical components of the force, where one or both of them are disturbed. Of the resulting values of $\frac{\Delta\phi}{\phi}$ and $\Delta\theta$, those and those only were regarded as *disturbances*, which equalled or exceeded the limits determined on for these elements, namely, ·0004 for the total force, and 1'.0 for the inclination.

The ratios in tables I. and II. are derived from observations in the seven years, commencing 1st January, 1856, and endin 31st Dec.

1862. For the purpose of comparison, the corresponding ratios for the series 1st July, 1843, to 30th June, 1848, and derived from the 3rd Toronto volume, have been introduced. The ratios in table II. are identical with those in the printed volume, but in table I. the aggregate sums at the separate six observation hours, are expressed in terms of the average of the same *six* aggregate sums, whereas in the printed volume, the unit employed is the average of the *twenty-four* aggregate sums.

In table III. the yearly aggregates relate in every case to the year ending 30th June. It has been thus arranged, partly, that the later series might harmonise better with that of 1844–48, and also for the sake of including the year ending 30th June, 1854, and a few of the later months in 1855. The year ending 30th June, 1856, includes for the declination an approximation to the aggregate value of disturbances in July, 1855, calculated on the supposition that it bore to the aggregates in the concluding months of 1855, the same ratio as that founded by the whole series, 1856 to 1862. Approximate values of the disturbances of the vertical force for July, and of the horizontal force, total force, and inclination, both for July and August, 1855, have been similarly found and employed in calculating the aggregates for the year ending 30th June 1856.

In table IV., the sums in table III. have been expressed in terms of the average of the seven yearly sums, terminating 30th June, 1862. These units of reference are employed to show better the periodic character of the last seven years; and though not adapted to exhibit so distinctly the position of the several years, 1844–48, in the decennial period in which the years are included, they render sufficiently apparent the relative magnitude of the aggregates in the two series. Columns 2 and 3 give the results of the observations of M. Schwabe on the solar spots.

On comparing the series 1856–62, in table I., with that of 1844–48 the general correspondence in the ratio is very apparent, the chief characteristic difference in the later series being, that the distinctive features of different parts of the day, as shown in the earlier series, are somewhat softened down; the ratios that are above unity being for the most part less, and those that are less than unity, being greater in the later than the earlier series. *In one case only, namely, of the disturbances that increase the horizontal force at 8 a. m., do the ratios lie* on opposite sides of unity in the two series; but on referring to table

VIII., *page 14 of vol. 3rd, Toronto Observations*, we find that the ratios at 9 a. m. and 10 a. m. are 0·94 and 1·46, so that the discrepancy amounts simply to a transfer of the passage through unity from about 9 a. m. to 8 a. m.

In table II., giving the annual distribution of the disturbances, while there is a general resemblance in the ratios of the two series, the maxima and minima, in the more recent series, are less distinctly developed, owing in some measure to the fact that they embrace only the disturbances at six hours, instead of at each of the twenty four hours, and are therefore differently affected by the disturbance *diurnal variation*.

Other points of difference in the two series are the following:

(1,) In five instances the September maximum is transferred to October.

(2,) In nearly every case the April maximum occurs in March, and in the general disturbances of declination, and in those of westerly disturbance the ratio is less than unity.

(3) In every case there is an abrupt decrease in the November disturbances with a subsequent increase in December.

The generality of these points of difference, as far as they extend, will be better seen by comparing the means of the ratios, for the declination, horizontal force and vertical force, as given in the following table.

	January.	February	March.	April.	May.	June.	July.	August.	Septemb.	October.	Novemb.	Decemb.
1844—1848	0.57	0.84	1.04	1.47	1.00	0.46	0.75	0.99	1.64	1.36	0.84	0.65
1856—1862	0.70	0.63	1.10	1.03	0.84	0.74	1.05	1.29	1.60	1.44	0.57	1.01

In the following table is shewn the comparative prevalence of easterly and westerly disturbances of declination in the different months. The ratios indicating the preponderance of easterly and westerly disturbances reach a maximum in June, a minimum in December, a second maximum in March, with a second minimum in April.

	January.	February	March.	April.	May.	June.	July.	August.	Septemb.	October.	Novemb.	Decemb.
1844 to 1848 from 24 observations daily.....	1.29	1.27	1.40	1.04	1.29	3.82	1.41	1 96	1.29	1.21	0.77	0.74
1856 to 1862 from 6 observations daily.....	0.85	0.86	2.35	1.29	1.84	3.46	1.87	1 53	1.26	0.54	1.15	0.70

The relative amount of easterly and westerly disturbances of declination, and of the disturbances which increase and decrease the total force and inclination, are indicated by the following ratios, whereby it will be noticed, that while the preponderance of easterly over westerly disturbances has increased the preponderance in the disturbances which decrease the force, and in those which increase the inclination, has become much less in the later series.

	Declination East to West.	Hor'l Force Decreasing to Increasing.	Ver'l Force Decreasing to Increasing.	Total Force Decreasing to Increasing.	Inclination Increasing to Decreasing.
1844 to 1848 from 24 observations daily.	1.23	6.4	1.4	1.9	5.6
1844 to 1848 from 6 observations daily.	0.9	5.4	1.5	1.9	
1856 to 1862 from 6 observations daily	1.28	3.5	1.1	1.4	3.5

In table III. a. IV. containing the absolute and relative amount of disturbance in different years, it appears that 1856-57 were years of minimum, and 1860 a year of maximum disturbance. The year 1859 shows a breach of continuity, its disturbances, excepting those of declination, amounting to less than those of 1858 and 1860. If the years commencing January 1st are compared, 1859 becomes the maximum year, but in this case, the disturbances of 1861, are, in in several instances, slightly less than in 1860 and 1862. One striking peculiarity in these tables, consists in the extraordinary amount of dis-

turbances of all the elements in the year ending 30th June, 1854. The observations during that year were taken under rather unfavorable circumstances. Portions of the building were in the course of reconstruction, and workmen with iron tools were much about the premises, but as I have been informed that great care was always taken to ascertain that no iron was left in dangerous proxmity to the instruments during the observations, I cannot ascribe wholly to this cause, the anomalous character of the results. It will be seen, that of the three instrumentally independent elements, the vertical force was most affected, the aggregate in this year of expected minimum actually exceeding that of 1848, the epoch of maximum.

One clue towards the solution of this difficulty may be sought from an examination of the relative magnitudes of the annual mean ranges of the regular diurnal variations of declination, which, according to past experience, correspond very generally with the annual aggregates of disturbance. Taking the amplitudes or ranges, as the angle between the mean positions of the needle at 8 a. m. and 2 p. m., we have

YEARS.	1844	1845	1846	1847	1848	1853-4	1856	1857	1858	1859	1860	1861	1862
*Amplitudes of diurnal variation of Declination.	7.96	8.60	8.61	8.64	10.66	9.03	8.00	8.30	9.69	11.40	12.14	11.92	10.65

It will be here noticed, that although the range in 1853–54 is larger than those of 1844, '45, '46, '47, '56, '57, the preponderance is not such as to warrant any decided inference in explanation of the anomaly in question. It is possible that the disturbance period, which, during the few years that have been examined, has approximately coincided with the decennial period in the appearance of solar spots, may, in addition to the cause thus suggested, be due to some other variable and less powerful influence, the length of whose period may be nearly equal to or nearly a multiple of ten years. Should such an influence exist, the approximate but not accurate superposition of the maxima of the two periods in some cycles, and their interference and antagonism, in others, together with perhaps *local* causes, would account both for the general correspondence and the occasional anomalies.

* The effects of disturbances are not eliminated from the amplitudes from 1848 to 1860. To render them comparable with those of the subsequent year they should be each increased by about 0'.43.

TABLE I.

Ratios of the aggregate values of the Magnetic Disturbances at each of the six observation hours, derived from a series of years to the average aggregate value of the six hours.

		6 A. M.	8 A. M.	2 P. M.	4 P. M.	10 P. M.	12 P. M.
DECLINATION:							
1844 to 1848	Total	1.03	1.25	0.39	0.51	1.51	1.32
	Easterly	0.50	0.29	0.23	0.35	2.67	1.96
	Westerly	1.53	2.17	0.55	0.67	0.38	0.70
1856 to 1862	Total	1.12	1.07	0.47	0.45	1.46	1.43
	Easterly	0.56	0.35	0.42	0.33	2.40	1.93
	Westerly	1.81	1.97	0.51	0.59	0.29	0.83
HORIZONTAL FORCE:							
1844 to 1848	Total	1.09	1.21	0.69	0.63	1.07	1.31
	Increasing	0.35	0.30	2.08	2.26	0.62	0.39
	Decreasing	1.22	1.38	0.43	0.33	1.15	1.48
1856 to 1862	Total	1.02	1.08	0.79	0.80	1.05	1.26
	Increasing	0.44	1.02	1.53	1.75	0.64	0.62
	Decreasing	1.19	1.10	0.57	0.53	1.17	1.44
VERTICAL FORCE:							
1844 to 1848	Total	1.20	0.80	0.76	1.03	0.84	1.38
	Increasing	0.27	0.41	1.60	2.30	0.91	0.51
	Decreasing	1.86	1.06	0.16	0.14	0.79	1.99
1856 to 1862	Total	1.17	0.83	0.87	1.01	0.88	1.23
	Increasing	0.52	0.54	1.46	1.75	0.98	0.75
	Decreasing	1.79	1.12	0.31	0.30	0.79	1.69
TOTAL FORCE:							
1844 to 1848	Total	1.31	0.83	0.62	0.93	0.79	1.52
	Increasing	0.26	0.34	1.65	2.56	0.75	0.44
	Decreasing	1.87	1.09	0.07	0.07	0.82	2.09
1856 to 1862	Total	1.28	0.81	0.77	0.98	0.79	1 36
	Increasing	0.33	0.40	1.64	2.17	0.86	0.60
	Decreasing	1.96	1.11	0.15	0.13	0.74	1.90
INCLINATION:							
1844 to 1848	Total	0.86	1.12	0.89	0.78	1.22	1.13
1856 to 1862	Total	0.93	1.06	0.86	0.87	1.13	1.15
	Increasing	1.02	1.03	0.73	0.71	1.24	1.26
	Decreasing	0.60	1.15	1.32	1.39	0.76	0.78

TABLE II.

Ratios of the aggregate values of the Magnetic Disturbances in the different Months, derived from a series of years to the average aggregate value of all months.

		January.	February	March.	April.	May.	June.	July.	August.	Septemb.	October.	Novemb.	Decemb.
DECLINATION:													
1844 to 1848	Total ...	0.57	0.84	1.11	1.42	0.98	0.53	0.94	1.15	1.62	1.31	0.78	0.76
	Easterly.	0.57	0.84	1.15	1.29	0.98	0.75	0.98	1.36	1.63	1.28	0.60	0.57
	Westerly	0.57	0.84	1.06	1.59	0.98	0 25	0.89	0.89	1.61	1.35	1.06	0.99
1856 to 1862	Total ...	0.59	0.61	0.96	0.91	0.87	0.52	1.08	1.58	1.76	1.42	0.62	1.09
	Easterly.	0.49	0.51	1.22	0.93	1.02	0.73	1.28	1.74	1.78	0.90	0.60	0.81
	Westerly	0.71	0.73	0.64	0.88	0.68	0.26	0.84	1.39	1.74	2.06	0.64	1.43
HOR. FORCE:													
1844 to 1848	Total ...	0.58	0.94	0.94	1.50	0 90	0.36	0.61	0.75	1.71	1.48	0.98	1.28
	Incr'sing.												
	Decr'sing												
1856 to 1862	Total ...	0.72	0.56	1.06	1.03	0.82	0.81	0 99	1.27	1.71	1 47	0.46	1.10
	Incr'sing.	0.40	0.31	0.89	1.29	1.10	1.37	1.52	1.23	1.50	1.06	0.25	1.07
	Decr'sing	0.82	0.63	1.10	0.95	0.74	0.65	0.84	1.29	1.76	1.58	0 53	1.11
VERTICAL FORCE:													
1844 to 1848	Total ...	0.56	0.74	1.08	1.49	1.12	0.50	0.71	1.08	1.60	1.29	0.75	1.00
	Incr'sing.	0.71	0.77	1.21	1.46	0.99	0.51	0.55	0.76	1.49	1.25	0.82	1.48
	Decr'sing	0.45	0.69	0.98	1.55	1.22	0.50	0.95	1.31	1.65	1.33	0.68	0.63
1856 to 1862	Total ...	0.80	0.72	1.27	1.14	0.84	0.88	1.09	1.03	1.34	1.42	0.63	0.84
	Incr'sing.	0.96	0.75	1.32	1.33	0.70	0.90	1.27	0 91	1.29	1.27	0.50	0.80
	Decr'sing	0.64	0.69	1.22	0.95	0.98	0.87	0 91	1.15	1.46	1.57	0.74	0.87
TOTAL FORCE:													
1844 to 1848	Total ...	0.52	0.74	1.05	1.55	1.08	0.39	0 78	1.06	1.64	1.36	0.77	1.05
	Incr'sing.	0.72	0.70	1.17	1.51	1.08	0.45	0 59	0.65	1.45	1.10	0.89	1.67
	Decr'sing	0.43	0.76	0.99	1.56	1 08	0.36	0.88	1.27	1.73	1.49	0 70	0.74
1856 to 1862	Total ...	0.73	0.66	1.29	1.19	0.85	0.83	1.13	1.14	1.50	1.52	0.47	0.70
	Incr'sing.	0.95	0.69	1.33	1.47	0.71	0.91	1.54	0.90	1.31	1 26	0.35	0.58
	Decr'sing	0.57	0.63	1.27	0.99	0.95	0.77	0 84	1.31	1.63	1.70	0.54	0 78
INCLINATION:													
1844 to 1848	Total ...	0.64	0.94	0.97	1.41	0.85	0.39	0.56	0.74	1.67	1.45	1.02	1.37
1856 to 1862	Total ...	0.80	0.58	1.12	0.98	0.79	0.79	0.90	1.19	1 67	1.52	0.49	1.18
	Incr'sing.	0.89	0.66	1.15	0.94	0.70	0.64	0.80	1.21	1 72	1.58	0.52	1.19
	Decr'sing	0.48	0.29	1.02	1.13	1.09	1.28	1.28	1.13	1.47	1.28	0.38	1.17

TABLE III.

Aggregate values of the disturbances in the different years, each ending 30th June.

Years.	Declination.			Horizontal Force. In parts of the Hor. Force.			Vertical Force. In parts of the V. F.			Total Force. In parts of the Total Force.			Inclination.		
	Total.	Easterly.	Westerly	Total.	Increasing	Decreasing	Total.	Increasing	Decreasing	Total.	Increasing	Decreasing	Total.	Increasing	Decreasing
1844	614′			.1779	.0458	.1321	.1134	.0473	.0661	.1143	.0480	.0663	154.8		
1845	702			.1523	.0236	.1287	.0994	.0325	.0669	.0699	.0155	.0540	138.0		
1846	771			.2015	.0447	.1568	.1333	.0588	.0745	.1008	.0420	.0592	175.0		
1847	1373			.3986	.0597	.3389	.2226	.0646	.1580	.1940	.0422	.1518	303.4		
1848	1582			.9342	.1161	.8181	.3099	.1624	.1475	.2725	.1123	.1602	789.4		
1849-53	Not published.														
1854	1494	846′	648′	.5297	.1051	.4246	.3320	.1444	.1876	.2356	.0892	.1464	464.2	354.4	109.8
1855	Observations suspended.														
1856	366	154	212	.2974	.0912	.2062	.1077	.0412	.0665	.0525	.0144	.0381	259.5	168.9	90.6
1857	423	293	130	.2578	.0470	.2108	.1191	.0533	.0658	.0677	.0236	.0441	218.1	174.7	43.4
1858	961	612	349	.8531	.1811	.6720	.2326	.1161	.1165	.1726	.0713	.1013	725.7	571.5	154.2
1859	1200	792	408	.7490	.1671	.5819	.2129	.1220	.0909	.1523	.0732	.0791	641.1	502.8	138.3
1860	1698	882	816	1.3436	.2886	1.0550	.3669	.1668	.2001	.2845	.1062	.1782	1123.4	875.3	248.1
1861	1465	758	707	.9377	.2134	.7243	.2808	.1415	.1393	.2353	.1027	.1326	772.9	606.4	166.5
1862	1118	570	548	.5740	.1178	.4562	.2020	.1025	.0995	.1401	.0627	.0774	513.9	403.4	110.5

TABLE IV.

Ratios of the aggregate values of the Disturbances in different Years, to the average of the aggregate values of the seven years ending June 30, from 1856 to 1862 inclusive.

Years.	Groups of Solar Spots.	Days free from Spots.	Declination.			Horizontal Force.			Vertical Force.			Total Force.			Inclination.		
			Total.	Easterly.	Westerly.	Total.	Increasing.	Decreasing.	Total.	Increasing.	Decreasing.	Total.	Increasing.	Decreasing.	Total.	Increasing.	Decreasing.
1844	52	111	0.59	..	..	0.25	0.29	0.24	0.52	0.45	0.59	0.72	0.70	0.72	0.25		
1845	114	29	0.68	..	..	0 21	0.15	0.23	0.46	0.31	0.60	0.44	0.23	0.58	0.23		
1846	157	1	0.75	..	..	0.28	0.28	0.28	0.61	0.55	0.67	0.64	0.65	0.64	0.29		
1847	257	0	1.33	..	..	0.56	0.38	0.61	1.02	0.61	1.42	1.23	0 65	1.63	0.50		
1848	330	0	1.53	..	..	1.30	0.73	1.47	1.43	1.53	1.33	1.73	1.73	1.72	1.30		
1849	238	0															
1850	186	2															
1851	151	0	Observations not yet published.														
1852	125	1															
1853	91	4															
1854	67	65	1.45	1.46	1.43	0.74	0.67	0.76	1.53	1.36	1.69	1.49	1.30	1 57	0.76	0.75	0.80
1855	38	146	Observations suspended.														
1856	34	193	0.35	0.27	0.47	0.42	0.58	0.37	0.50	0.39	0.60	0.33	0.22	0.41	0.43	0.36	0.67
1857	98	52	0.41	0.51	0.29	0.36	0.30	0.38	0.55	0.50	0.59	0.43	0.36	0.47	0.36	0.37	0.32
1858	188	0	0.93	1.05	0.77	1.19	1.15	1.20	1.07	1.09	1.05	1.09	1.10	1.09	1.19	1.21	1.13
1859	205	0	1.16	1.36	0.90	1.05	1.06	1.04	0.98	1.15	0.82	0.96	1.13	0.85	1.05	1.07	1.02
1860	..	..	1.64	1.52	1.80	1.88	1.83	1.89	1.69	1.57	1.80	1.80	1.64	1.92	1.85	1.85	1.83
1861	..	..	1.42	1.31	1.56	1.31	1.35	1.30	1.29	1 33	1.25	1.49	1.58	1.43	1.27	1.29	1.22
1862	..	..	1.08	0.98	1.21	0.80	0.75	0.82	0.93	0.97	0.89	0.89	0.97	0.83	0.85	0.85	0.81

SCIENTIFIC AND LITERARY NOTES.

CLASSIFICATION OF THE SALINE SPRINGS OF CANADA.—BY T. STERRY HUNT, F.R.S.

[The following extract, introductory to a very elaborate review of our mineral springs and river waters, is taken from the revised Report on the Geology of Canada, now passing through the press.]

The mineral waters of Canada may for convenience be arranged in six classes, according to their chemical composition. In the first three classes, chlorids predominate; in the fourth, carbonates; and in the fifth and sixth, sulphuric acid and sulphates. The waters of the first, second, and sixth classes are neutral; those of the third and fourth are alkaline; and those of the fifth are acid.

The first class includes saline waters containing chlorid of sodium, with large portions of chlorids of calcium and magnesium, sometimes with sulphates. The carbonates of lime and magnesia are either present only in very small quantities, or are altogether wanting. These waters are generally very bitter to the taste, and always contain portions of bromids and iodids. Examples,—St. Catherines, Ancaster, Whitby, Hallowell.

The second class includes a large number of saline waters which differ from the first in containing, besides the chlorids of sodium, calcium, and magnesium, considerable portions of bicarbonates of lime and magnesia, the latter carbonate generally predominating. Small quantities of oxid of iron, and of baryta and strontia, are frequently present. These waters generally contain much smaller quantities of earthy chlorids than the first class, and are therefore less bitter, and more pleasant to the taste. Examples,—Plantagenet, St. Léon, St. Geneviève.

The third class includes those saline waters which contain, besides chlorid of sodium, a portion of carbonate of soda, with bicarbonates of lime and magnesia. Small amounts of baryta, strontia, and of boracic and phosphoric acids, are often present in these waters; and bromids and iodids are very rarely wanting. Examples,—Caledonia, Varennes, Fitzroy.

The waters of the fourth class differ from the last in containing but a small proportion of chlorid of sodium, while the carbonate of soda predominates. These waters generally contain a much smaller amount of solid matters than those of the previous classes, and have not a very marked taste until evaporated to a small volume, when they are found to be strongly alkaline. Examples,—Chambly, St. Ours.

The fifth class includes acid waters which are remarkable for containing a large proportion of free sulphuric acid, with sulphates of lime, magnesia, protoxide of iron, and alumina. These springs, which are few in number, and characterized by their acid styptic taste, generally contain some sulphuretted hydrogen. Examples,—Tuscarora and Niagara.

In the sixth class may be included some neutral saline waters, in which the sulphates of lime, magnesia, and the alkalies predominate; chlorids being present only in small amounts. To this class belongs a mineral water from Hamilton, and another from Charlotteville.

CANADIAN INSTITUTE.

ANNUAL REPORT OF THE COUNCIL FOR THE YEAR 1862-63.

The Council of the Canadian Institute have the honor to present the following Report of the proceedings of the Society for the past year:

They regret to have to announce a slight falling off in the list of members, arising chiefly from the unusually small number of names that have been added during the year. In the year 1860, twenty-seven new members were elected; in 1861, thirty-seven; in 1862, twelve. The loss, from various causes, has been twenty-nine, so that the decrease amounts to seventeen.

The present state of the membership is as follows:

Members at commencement of Session, 1861-62	464
New members elected, Session 1861-62	11
By the Council during recess—1861-62	1
Total	476
Deduct—Deaths	6
Withdrawn	13
Left the Province	10 — 29
Total 30th November, 1862	447
Composed of Honorary Members	4
Life Members	34
Corresponding Members	6
Junior Members	7
Members	396
Total	447

COMMUNICATIONS.

The following list of Papers, read at the Ordinary Meetings held during the Session, will be found to contain many communications of value, and some of general interest:

7th December, 1861.

Prof. D. Wilson, LL.D., "On indications of an Asiatic Origin for the American Race."

P. Freeland, Esq., "Exhibited and Described Wenham's New Binocular Microscope."

14th December, 1861.

Prof. H. Croft, D.C.L., "Exhibited and Described Griffine's Gas Furnace."

Rev. Prof. Hincks, F.L.S., &c., "On a curious variety of Maize from Oregon, with Remarks on some diseased specimens of Maize."

21st December, 1861.

Prof. H. Croft, D.C.L., "A communication upon an old Chemical Joke."

Prof. E. J. Chapman, "On the peculiar conditions of occurrence of certain Canadian Minerals, illustrated by a series of specimens."

18th January, 1862.

Hon. J. H. Hagarty, read "The Annual Address."

Prof. H. Y. Hind, M.A., F.G.S., "A communication embodying Observations made during his Expedition to the Labrador Coast last summer."

25th January, 1862.

Rev. Prof. E. Hatch, B.A., "The Physical Theory of Heracleitus."

1st February, 1862.

Prof. D. Wilson, L.L.D., "On apparent traces of Works of Art in the American Drift."

T. C. Keefer, Esq., C.E., "On Ice Phenomena."

8th February, 1862.

Prof. H. Croft, D.C.L., "On Toxicology illustrating the application of Chemical Science in elucidating questions relative to Poisoning Cases in Jurisprudence."

Rev. Prof. Hincks, F.L.S., &c., "Note on a Canadian Specimen of the Sula Bassana (Solan Goose or Gannet)."

22nd February, 1862.

Beverley R. Morris, M.D., "On the Habits of some Water Birds."

Prof. G. T. Kingston, M.A., "The Meteorological Report for 1861."

1st March, 1862.

Rev. Prof. E. Hatch, B.A., "A Sketch of the Pre-Socratic Philosophers."

James Bovell, Esq., "Some recent theories of Cell Developement, with Microscopical Illustrations."

8th March, 1862.

Rev. Prof. G. P. Young, M.A., "Remarks on an argument of Dr. Whewell against the claim of the Parmenides to be considered a genuine dialogue of Plato."

Prof. D. Wilson, LL.D., "On the aim of Shakspeare in his Historical Dramas, as illustrated in his King John."

15th March, 1862.

Prof. H. Croft, D.C.L., "On the supposed existence of Benzole in Canadian Petroleum."

Prof. E. J. Chapman, "A communication relative to the occurrence of the phenomena of Mock Suns as observed by Mr. Clifford Thomson, P.L.S., near the mouth of the Muskoka River, in November last."

22nd March, 1862.

Prof. E. J. Chapman, "Remarks on some recent announcements and discoveries in Natural Science."

U. Ogden, M.D., "On an atmospheric cause of Disease."

29TH MARCH, 1862.

Rev. Prof. G. P. Young, M.A., "Note on a passage in the Euthyphro of Plato."

5TH APRIL, 1862.

Rev. Prof. E. Hatch, B.A., "On the relation of the Volscian language to others of the Italian Family."

Prof. D. Wilson, LL.D., "On the influence of Mediæval Art on the subsequent forms of Literature."

3RD MAY, 1862.

Lieut. Ormsby, R.A., "On Modern English Guns."

Rev. Prof. E. Hatch, B.A., "On the light which is thrown by the latest results of the Science of Language upon the Early History of Mankind."

The last two papers were originally communicated to the Institute at the Conversazione, which was held at the Music Hall on the 24th of April. The Council believe that, in most respects, the labors of those who superintended the arrangements, and the liberality of those who furnished them with objects of interest for exhibition, were successful in making the meeting a pleasant and instructive gathering to the members of the Institute and their friends; but, to their great regret, it was found, when it was too late to change the place of meeting, that the partially filled hall is not at all suited for public speaking, and the result was that the gentlemen who had kindly consented to read papers could be heard only by a very few persons. In order to meet a generally expressed wish of the members, the Council appointed an Extra-ordinary Meeting on the third of May, when the authors of two of these papers were good enough to give the Institute another opportunity of hearing their valuable communications.

With regard to the papers generally, the Council regret that so small a number of the members of the Institute are to be found in the list of contributors. During the past Session twenty-seven papers have been read, but the number of writers has been only fifteen; and even these numbers do not show the amount of work which has been thrown upon one or two members. The Council would again urge upon the members in general the necessity of increased exertion in this respect, in order that the meetings of the Society may continue to maintain the high character which they have hitherto held.

The Council have to regret the loss of the valuable services of Prof. Chapman as General Editor of the *Journal*. They trust, however, that under the management of Prof. Cherriman it will continue to hold the high reputation which it has already secured. The thanks of the Institute are also due to Prof. Hincks for discharging the duties of Editor during the summer, in the absence of Prof. Cherriman in England.

REPORT OF THE EDITING COMMITTEE.

The Seventh Annual Volume of the New Series of the CANADIAN JOURNAL is now completed, and the Editing Committee submit to the Council of the Institute their annual Report.

They have continued their labours on the same general plan as during preceding years, and they hope the result will not be found unsatisfactory. They wish the *Journal* to be as far as possible supplied with materials by papers read at the meetings of the Institute, and they gladly publish as many of these as are at all suited to their purpose. They have had occasion to regret that during the last Session the proportion was so great of communications which, although highly interesting to the members present, were not designed by their authors for publication, and were either not committed to writing or not placed at the disposal of the Committee.

They are aware that such communications may be, in some cases, useful and acceptable; but they venture to hope that in general those who contribute to the instruction and entertainment of the members will consider those who are absent as well as those who are able to be present, and will place their papers in the hands of the Committee. They would also again express their earnest desire that a greater number of the members of the Institute would manifest their interest in its prosperity by occasional communications on the subjects connected with Literature, Science, the fine or the useful Arts, which engage their attention.

The change in the general editorship during the year, occasioned by Professor Chapman's resignation, owing to his visit to Europe, was only designed as a temporary provision, Professor Hincks having only undertaken the duty in the expectation of being relieved at the close of the year.

Professor Cherriman has, in the mean time, been appointed to the office, and will commence his duties with the January number of the *Journal*.

The cost of the *Journal* for the past year, including printing and engravings, has amounted to $1249.

WILLIAM HINCKS,
General Editor.

TREASURER'S REPORT.

The following is the Report of the Treasurer:

Statement of the Canadian Institute General Account, for the Year 1861-2,—*from* 1*st December,* 1861 *to* 30*th November,* 1862.

Dr.	£	s.	d.	£	s.	d.
Cash balance from last year	472	19	11½			
" received from Members	187	7	4			
" " for Journals	47	10	0			
" " for Interest on Loans	101		0			
" " Parliamentary Grant for 1862	250	0	0			
" due by Members	422	13	9			
" due for Old Journal	28	5	0			
" due for New Journal	52	16	3			
				1563	2	3½

Cr.	£.	s.	d.			
Cash paid on account of the Journal: 1861, £72 14s.; 1862, £247 8s. 6½d.	320	2	6½			
Cash paid for Library and Museum	96	13	6			
" paid on account of Sundries	252	18	1½			
" due on account of Journal	65	0	0			
" due on account of Sundries	34	4	7			
" due on account of Library	21	16	11			
Estimated Balance	772	6	7½			
				1563	2	8½

The Treasurer in account with the Canadian Institute, for the Year 1861-62,—from 1st December, 1861, to 30th November, 1862.

Dr.	£	s.	d.			
Cash Balance last year	472	19	11½			
" Securities	1500	0	0			
" Interest received on Securities	101	10	0			
" received from Members	187	7	4			
" " on account of Journals sold	47	10	0			
" Parliamentary Grant, 1862	250	0	0			
				2559	7	8

Cr.	£	s.	d.			
Cash paid on account of the Journal: 1861, £72 14s.; 1862, £247 8s. 6½d.	320	2	6½			
Cash paid on account of Library and Museum	96	13	6			
" paid on account of Sundries	252	18	1½			
Securities	1500	0	0			
Balance	389	13	1			
				2559	7	8

Statement of the Building Fund.

Balance from last year	2038	11	9			
Received Interest on Loans	101	10	0			
Subscriptions (uncollected)	534	15	0			
				2674	16	9

D. CRAWFORD, *Treasurer.*

Compared Vouchers with Cash Book, the Securities for Investments exhibited. Balance in the hands of the Treasurer, £309 13s. 1d.

SAMUEL B. HARMAN, G. H. WILSON, } *Auditors.*

10th December, 1862.

In conclusion, the Council think that on the whole they may congratulate the Institute on the results of the past Session. They could wish, indeed, to have had to announce an increase rather than a diminution of numbers; but there

seems no reason to fear that this diminution arises from any loss of the public favour, or that it will not be made up by larger accessions in the future. The numbers of a Society which has passed its early period of rapid growth must be expected to be liable to some amount of fluctuation; and the real prosperity of the Institute depends not so much upon its numerical strength as upon the continued interest taken by its members in its proceedings and publications.

APPENDIX.

DONATIONS OF BOOKS, MAPS, &c., SINCE LAST ANNUAL REPORT.

Marked thus * not bound, or pamphlets.

FROM THE HON. G. W. ALLAN, M.L.C.

Gould's Trochilidæ. Parts 21, 22, 23, 24, and 25..... ..... 5*

FROM THE SECRETARY FOR INDIA.

Magnetical and Meteorological Observations made at the Government Observatory, Bombay, year 1859 1

FROM J. DYKES CAMPBELL, ESQ.

The early Poems of Mr. Tennyson, privately printed. 1862 ..... 1*
Doomsday Book, Cornwall. Photozincographed by Her Majesty's command, at the Ordnance Survey Office, Southampton. 1861..... 1

FROM THE SUPERINTENDENT OF EDUCATION, LOWER CANADA.

Journal de l'Instruction Publique Cinquieme. Vol. 1861. Journal of Education, Lower Canada, for the year 1861, Both bound in one vol. Cloth 1

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Catalogue of the Library. 1861. General Library First Supplement. I. Titles; II. Index of Subjects..... 1
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do.	do.	Band IV.	Jahr, 1854.....	1*
do.	do.	" V.	" 1855.....	1*
do.	do.	" VI.	" 1856.....	1*
do	do.	" VII.	Jahrgang,1857.....	1*
do.	do.	" VIII.	" 1858.....	1*
do.	do.	" IX.	" 1859.....	1*
do.	do.	" X.	" 1860.....	1*

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Memorial of William Law, Jacob Böhme, Dio A. Frether, J. G. Gichtel, Francis Lee, and other Theosophers. Printed for private circulation. London, 1854 1
An Introduction to Theosophy; or, the "Mystery of Christ," that is, of Deity, Nature, and Creature, Col. i., 15–20. Vol. I., complete in itself. London: John Kendrik, 27 Ludgate Street 1

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Professor Hall's rejoinder to the Criticisms of this Journal on his "Contributions to Palæontology"..... 1

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Mr. Russell "On Bull Run," with a Note; from the *Rebellion Record*..... 1

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Report of the Committee of the Overseers of, appointed to visit the Library, for the year 1861..... 1

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Hall's Journal of Health. Vol. IX. 1862..... 1

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GEOLOGICAL SURVEY OF CANADA.

Descriptive Catalogue of a collection of the Economic Minerals of Canada, and of its Crystaline Rocks, sent to the Exhibition at London, 1862. Printed by John Lovell, Montreal..... 1

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Beiträge zur Anatomie und Entwicklungsgeschichte der Algengattung Lemanea, Von B. Wartmann, Dr. Philosopher Bericht über die Thätigkeit der St. Gallischen, Naturwissenschaftlichen Gesellschaft während der Vereinsjahre, 1858–60. (Redaktor: Prof. Dr. Wartmann)..... 1

do do do. 1860–61..... 1

Quarterly Journal, Royal Dublin Society, Oct. 1859..... 1

UNKNOWN SUPPOSED FROM THE AUTHOR.

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Catalogue of the Minerals containing Cerium, by Doctor W. Sarswood, from Proceedings of Boston Nat. His. Soc., Nov. 1861..... 2

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Copy of Regulations and Bye Laws..... 1

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Faculty of Medicine of the University of McGill College, Montreal, 1862-63 1

UNKNOWN.

Poughkeepsie Collegiate School, N. Y..... 1

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Nouvlle Note sur les Antiquités Aborigenes trouves à Montreal 1

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Anniversary Address of the President, 21st Feb, 1862..... 1
Quarterly Journal, Vol. 17, Part 4, Nov. 1861..... 1
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Do " " " 2, May, 1862..... 1

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" " " No. 5, 1861..... 1
" " VI., No. 1. 1862..... 1
" " " No. 2. 1862..... 1

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Journal of. Vol. 19. Part 1. 1861..... 1
" " " 2. " 1
" " " 3. 1862..... 1
" " " 4. " 1

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Catalogue Raisonnè of Rare and Valuable Books..... 12

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Public Meeting of do. at the London Tavern, 13 Aug., 1862..... 1
Letter of Mr. Galt to the Editor of the Times. Published in the daily News, 7th Oct., 1862..... 1

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Journal of Education, Lower Canada, 1862..... 1
Journal de l'Instruction Publique, Lower Canada, 1862..... 1
The proceedings of the Academy of Natural Sciences, Philadelphia, 1862... 1

Historical Recollections of the Essex Institute, 1862..... 1
Annales Des Mines, &c., France.
Tome XX., 4th Livraison, 1861, 3rd Serie.. 1
" " 5th " " " " 1
" " 6th " " " " 1
" XX. 1st " 1862, 6th " 1
" " 2nd " " " " 1
" " 3rd " " " " 1
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The Journal of the Board of Arts and Manufactures..... 1
Proceedings of Session, 1860 61, of the Royal Society of Edinburgh..... 1
Transactions of do. Vol. XXII. Part III..... 1

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Athenæum. July to December, 1861; January to June, 1862..... 2

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The London, Edinburgh, and Dublin Philosophical Magazine. Vol. 22. 1861 1
" " " " " " 23, 1862 1
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Journal of the Board of Arts and Manufactures. 1861..... 1
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Journal of the Franklin Institute. January-June 1862..... 1
Blackwood. July-December. 1861; January-June, 1862..... 2
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Edinburgh New Philosophical Journal. Vol. XV. January-April. 1862.. 1
Quarterly Journal of the Chemical Society. Vol. 14. April, 1861. January, 1862..... 1
Historical Recollections of the Essex Institute. Vols. 1, 2 and 3. 1859, '60 and '61..... 3
Quarterly Journal of the Geological Society. Vol. 17. 1861..... 1
Annales des Mines.....
Journal of the Board of Agriculture, Toronto. 1861..... 1
Verhandlungendes Zoologisch botanischen vereins in Wein:—
Band III. Jahr.....1853. 1
" IV. " 1854. 1
" V. " 1855. 1
" VI. " 1856. 1
" VII. " 1857. 1
" VIII. " 1858. 1
" IX. " 1859. 1
" X. " 1860. 1
Smithsonian Miscellaneous Collections. Vols. 1, 2, 3 and 4 4
Canadian Journal. 1861..... 2
Journal of the Board of Arts and Manufactures. 1861..... 1
Journal of the Royal Geographical Society, England. Vols. 29, 1859; 30, 1860..... 2
Canadian Naturalist. Vol. 6. 1861..... 1

MONTHLY METEOROLOGICAL REGISTER, AT THE PROVINCIAL MAGNETICAL OBSERVATORY, TORONTO, CANADA WEST,—DECEMBER, 1863.

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	M'E'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 AM.	2 PM.	10 P.M.	Result.	M'E'N		
					°	°	°	°	°																				
1	29.532	29.677	29.743	29.6648	33.8	34.9	31.6	33.07	+ 2.28	.173	.159	.156	.162	.89	.78	.87	.85	N N W	N w b N	Calm.	N 44 W	6.1	7.8	0.0	5.14	5.51	...	3.0
2	.858	.908	.827	.8010	21.9	28.4	25.9	24.55	— 5.93	.105	.119	.113	.110	.89	.76	.81	.83	w b N	N W	Calm.	N 63 W	8.5	6.4	0.0	3.80	4.03	...	Inp.
3	.663	.512	.626	.6003	29.8	31.6	23.7	28.03	— 2.00	.147	.147	.105	.131	.88	.83	.82	.84	S E b E	W b S	W	S 12 W	5.4	7.0	1.8	3.10	4.92	...	3.0
4	.608	.518	.477	.5148	28.8	32.7	29.5	29.93	+ 0.17	.121	.143	.136	.130	.76	.76	.83	.78	W b S	W b S	W	S 81 W	6.2	5.8	3.0	5.33	5.45	...	...
5	.478	.366	.238	.3523	24.1	29.1	27.3	26.48	— 2.88	.107	.111	.126	.110	.82	.69	.84	.76	W	W	S W b W	N 73 W	3.3	7.4	7.2	7.86	8.87	...	...
6	.253	.393	.563	.4212	13.6	11.4	4.6	8.97	—20.10	.051	.051	.043	.050	.70	.69	.78	.76	N W b W	N W b W	N N W	N 52 W	22.2	35.5	12.2	21.30	21.52	...	...
7	.702	.769	—	—	—0.8	7.8	—	—	—	.040	.051	—	—	.94	.82	—	—	N W b N	N W b N	N	N 18 W	8.0	6.5	1.5	6 46	6.92	...	...
8	.862	.751	.785	.7968	6.8	24.4	24.8	19.38	— 9.08	.057	.124	.120	.102	.95	.95	.90	.94	N E b N	S S W	S E b S	S 34 E	7.5	9.0	3.8	4.83	7.30	...	3.5
9	.827	.827	.781	.8117	22.3	27.1	27.3	25.53	— 2.62	.107	.128	.126	.122	.89	.87	.84	.88	N E b N	N N W	S W b W	S 70 W	6.5	0.4	14.5	4.72	7.01	...	...
10	.741	.662	.620	.6097	30.6	37.1	36.3	34.72	+ 6.37	.152	.174	.168	.166	.89	.78	.78	.82	S W b W	S W b S	S W	S 49 W	9.0	10.0	9.2	9.91	10.07	...	...
11	.568	.521	.547	.5495	37.4	46.8	42.1	41.60	+13.05	.196	.245	.195	.209	.87	.76	.72	.79	S W	S W	S W b W	S 51 W	13.0	10.8	11.0	11.08	11.68	...	...
12	.716	.777	.785	.7663	38.1	39.9	38.9	38.37	+11.02	.179	.163	.185	.177	.77	.66	.78	.76	N W	S E b S	E b N	N 73 E	7.8	4.0	8.0	5.19	6.10	...	...
13	.747	.604	.609	.6470	37.4	40.3	43.5	40.50	+13.35	.187	.236	.261	.231	.84	.95	.93	.91	E b N	E	S W b S	S 75 E	12.5	2.4	4.2	2.52	5.08	0.240	...
14	.694	.539	—	—	45.4	48.2	—	—	—	.292	.317	—	—	.96	.94	—	—	E S E	Calm.	S E b S	S 22 W	1.5	0.0	1.0	2.14	2.59	0.210	...
15	.336	.203	.135	.2188	47.9	50.9	38.1	44.27	+17.50	.332	.345	.230	.293	.99	.96	1.00	.99	S W	S W b W	N W b N	N 88 W	8.5	0.5	8.4	4.19	6.93	1.250	0.2
16	.125	.206	.469	.2933	34.2	34.9	26.6	31.42	+ 4.85	.135	.125	.119	.135	.93	.69	.82	.75	W b N	W b S	N W b W	N 71 W	8.6	18.5	17.8	14.64	15.09	...	0.5
17	.784	30.014	30.263	30.0313	16.5	19.7	17.2	17.98	— 8.33	.069	.077	.088	.079	.77	.72	.92	.81	N N W	N N W	N	N 23 W	8.6	17.6	5.0	7.33	7.77	...	Inp.
18	30.236	29.922	29.656	29.9132	17.9	29.8	30.2	27.97	+ 0.90	.035	.109	.142	.116	.87	.66	.84	.78	W b N	S W b S	S W	S 30 W	2.5	21.4	13.2	14.63	15.17	...	...
19	29.655	30.011	30.260	30.0045	33.1	17.6	5.3	16.73	— 9.33	.174	.076	.041	.086	.92	.79	.72	.80	W	N W b N	N N W	N 29 W	11.2	24.0	12.5	18.17	18.83	...	...
20	30.393	30.392	30.344	30.3705	—0.8	9.6	8.2	5.30	—20.58	.040	.041	.039	.041	.94	.61	.63	.74	N	N N W	N N W	N 55 W	7.0	2.0	2.2	2.32	3.53	...	...
21	30.184	29.949	—	—	16.5	21.5	—	—	—	.069	.088	—	—	.77	.77	—	—	S S E	E S E	S b W	S 40 E	15.0	7.4	0.8	5.51	5.82	...	0.2
22	29.778	29.587	29.611	29.6547	25.9	33.8	35.6	32 98	+ 7.40	.128	.177	.177	.160	.91	.75	.85	.85	Calm.	W S W	Calm.	S 72 W	0.0	10.2	0.0	4.05	4.58	...	...
23	.732	.848	.932	.8723	33.4	35.6	27.3	31.42	+ 6.05	.171	.167	.126	.143	.89	.80	.84	.82	N N W	N N W	N N E	N 17 E	2.0	3.6	2.2	4.69	6.53	...	...
24	.932	.787	.669	.7778	31.6	33.4	36.0	33.48	+ 8.00	.148	.163	.189	.168	.83	.85	.89	.87	S E b E	E b S	E b N	S 75 E	9.0	11.0	1.0	5.56	5.83	Inp.	...
25	.560	.474	—	—	41.0	46.4	—	—	—	.246	.240	—	—	.95	.76	—	—	S W b S	S W	Calm.	S 52 W	4.5	3.0	0.0	2.47	2.90	...	...
26	.443	.207	.156	.2648	37.1	30.7	35.3	36.30	+11.00	.192	.213	.198	.199	.86	.98	.96	.93	N E	N E b E	N N E	N 23 E	4.8	9.0	3.0	4.14	5.74	0.245	...
27	.346	.460	.495	.4153	35.6	36.3	34.5	34 98	+ 9.70	.193	.176	.181	.178	.93	.82	.90	.88	N W	N W	Calm.	N 76 W	6.5	11.2	0.0	4.15	4.57	...	...
28	.462	.445	—	—	33.8	38.1	—	—	—	.173	.179	—	—	.89	.77	—	—	S W bw	S W b S	S W b W	S 44 W	3.0	10.5	1.5	6.43	6.57	...	...
29	.386	.510	.657	.5457	39.2	39.6	33.1	37.05	+11.88	.190	.176	.167	.177	.79	.72	.88	.80	S W bw	W	N W b N	N 61 W	6.5	9.0	8.8	5.72	7.37	...	...
30	.679	.641	.656	.6612	28.8	28.8	24.8	26.68	+ 1.52	.121	.121	.105	.108	.70	.76	.70	.74	N E b N	N E b E	N N E	N 25 E	6.2	5.2	6.8	7.92	8.20	...	...
31	.760	.857	.980	.8832	16.1	26.2	21.2	21.00	— 4.18	.031	.103	.104	.097	.90	.72	.92	.85	N	S S E	Calm.	N 13 W	7.2	1.8	0.0	0.94	1.98	...	...
M	29.6707	29.6620	29.6902	29.6778	27.73	31.57	28.03	28.78	+ 1.69	.142	.140	.140	.142	.87	.78	.84	.83					7.39	9.00	5.18		7.58	1.945	10.4

Highest Barometer . . . . . 30.453 at 10.30 a.m. on 20th. } Monthly range=
Lowest Barometer . . . . . 29.105 at midnight on 15th. } 1.348 inches.

Self-registering Thermometers.
Maximum temperature . . . 50°1 on p.m. of 14th } Monthly range=
Minimum temperature . . . —3°4 on a.m. of 20th } 53°5

Mean maximum temperature . . 34°11 } Mean daily range=10°54
Mean minimum temperature . . 23°37 }

Greatest daily range . . . . . 23°8 from a. m. to p. m. of 8th.
Least daily range . . . . . 2°0 from a. m. to p. m. of 30th.

Warmest day . . . 15th...Mean Temperature . . .=44°27 }
Coldest day . . . 20th ...Mean Temperature . . .= 5°30 } Difference=38°97.

Maximum { Solar . . . . . 61°5 on p.m of 11th } Monthly range=
Radiation { Terrestrial . . . . . —7°5 on a. m. of 20th } 69°.0

Aurora observed on 0 nights; possible to see Aurora on 7 nights; impossible on 24 nights.
Snowing on 8 days; depth 10.4 inches; duration of fall 30.1 hours.
Raining on 5 days; depth, 1.045 inches; duration of fall, 41.2 hours.
Mean of cloudiness=0.75; Difference from average, 0.0. Most cloudy hour observed, midnight; mean=0.86; least cloudy hour observed, 8 a.m.; mean=0.65.

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

North.	South.	East.	West.
2140.39	1452.08	768.74	3026.44

Resultant direction, N. 73° W.; Resultant Velocity, 3.17 miles per hour.
Mean velocity 7.58 miles per hour.
Maximum velocity 35.5 miles, from 1-30 to 2.30 p.m. on 6th.
Most windy day 6th—Mean velocity 21.52 miles per hour. } Difference 19.54.
Least windy day 31st—Mean velocity 1.98 miles per hour. }
Most windy hour, 10 to 11 a.m.—Mean velocity, 11.13 miles per hour. } Difference
Least windy hour, 10 to 11 p.m.—Mean velocity, 4.76 miles per hour. } 6.37 miles.
6th. Very stormy day; cold and keen.—13th. Mild day; fog 4 to 6 p.m.—14th. Very mild; dense fog all day.—15th. Very mild; dense fog till 9 p.m.—19th. Wind very high, squally and keen.—20th. Almost unclouded; very cold day.—28th. Solar halo 2 p m.; lunar corona 9 p.m.; lunar halo 10 p.m.

RAPID BAROMETRIC MOVEMENT.

December 15th. Midnight = 29.105 }
17th. 10 p. m. = 30.263 } Ascending range = 1.158 in 46 hours.
20th. 10 a. m. = 30.453 }
26th. 10 p. m. = 29.156 } Descending range = 1.297 in 156 hours.

RAPID THERMOMETRIC MOVEMENT.

December 15th. p.m. 50.0 }
20th. a.m. —3.4 } Descending range = 53.4 in 114 hours.
25th. p.m. 46.6—Ascending range 50.0 in 128 hours.

December, 1862, was comparatively mild and calm; it had more than the mean depth of rain, and less of snow. The amount of cloudiness was exactly the average.

COMPARATIVE TABLE FOR DECEMBER.

YEAR.	TEMPERATURE. Mean.	Excess above Average, (26°1).	Maximum observed.	Minimum observed.	Range.	RAIN. No. of days.	Inches.	SNOW. No. of days.	Inches.	WIND. Resultant. Direction.	Velocity.	Mean Velocity
	°		°	°	°							
1840	24.3	— 1.8	41.0	— 4.4	45.4	3	Inap.	18	...	...	...	...
1841	28.7	+ 2.6	45.5	+ 2.4	43.1	7	6.600	5	...	...	...	1.33 lbs
1842	24.7	— 1.4	40.3	+ 3.8	36.5	3	0.830	17	...	...	...	0.60 "
1843	30.0	+ 3.9	41.1	+ 2.7	38.4	6	1.040	8	8.1	...	...	0.53 "
1844	28.2	+ 2.1	48.9	— 0.8	49.7	6	Imp.	6	4.2	...	...	0.40 "
1845	21.1	— 5.0	37.6	— 2.7	40.3	2	Inap.	12	4.7	...	...	0.70 "
1846	27.5	+ 1.4	49.2	+ 3.7	45.5	5	1.215	9	6.0	...	...	0.57 "
1847	30.1	+ 4.0	50.0	+ 6.6	43.4	7	1.185	8	6.8	...	...	0.35 "
1848	29.1	+ 3.0	49.1	+ 0.6	48.5	7	2.750	7	16.5	S 83 W	1.12	5.44 mls
1849	26.5	+ 0.4	41.3	— 5.2	46.5	5	0.840	12	9.6	N 82 W	2.56	6.23 "
1850	21.7	— 4.4	48.3	— 0.7	58.0	2	0.190	18	29.5	N 44 W	2.93	7.40 "
1851	21.5	— 4.6	43.8	—10.5	54.3	6	1.075	15	10.7	N 82 W	4.00	7.37 "
1852	31.9	+ 5.8	51.0	+13.9	37.1	7	3.995	10	20.1	S 69 W	1.03	6.54 "
1853	25.3	— 0.8	42.2	— 5.2	47.4	4	0.625	13	22.3	N 35 W	2.39	4.93 "
1854	21.9	— 4.2	41.8	— 5.9	47.7	5	0.590	12	17.2	N 44 W	4.30	8.56 "
1855	26.8	+ 0.7	45.9	— 2.1	48.0	6	1.845	10	29.5	S 88 W	5.29	11.38 "
1856	22.9	— 3.2	41.2	— 9.1	50.3	6	1.790	20	16.3	S 87 W	4.62	11.56 "
1857	31.9	+ 5.8	45.6	+ 5.7	39.9	7	3.205	14	9.0	N 89 W	2.51	6.84 "
1858	27.4	+ 1.3	43.6	+ 5.0	38.6	11	1.057	18	10.4	N 18 W	1.66	9.36 "
1859	17.9	— 8.2	54.8	— 3.3	58.1	3	1.035	23	37.4	N 53 W	4.29	10.77 "
1860	24.0	— 2.1	38.5	— 7.0	45.5	3	1.362	21	13.5	N 62 W	4.66	10.14 "
1861	31.1	+ 5.0	55.1	+ 5.7	49.4	6	0.560	8	6.8	N 72 W	3.50	7.96 "
1862	28.8	+ 2.7	50.0	— 2.3	52.3	5	1.945	8	10.4	N 73 W	3.17	7.58 "
Results to 1861.	26.11	...	45.26	—0.72	45.98	5.3	1.545	12.9	14.66	N 69 W	2.97	8.18
Exc. for 1862.	+2.67	...	+ 4.74	— 1.58	+ 6.32	— 0.3	+ 0.400	— 4.9	— 4.26	...	...	—0.60

MONTHLY METEOROLOGICAL REGISTER, AT THE PROVINCIAL MAGNETICAL OBSERVATORY, TORONTO, CANADA WEST,—JANUARY, 1863.

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°.				Temp. of the Air.				Excess of mean above Normal	Tens. of Vapour.				Humidity of Air.				Direction of Wind.			Resultant Direction.	Velocity of Wind.					Rain in Inches.	Snow in Inches.
	6 A.M.	2 P.M.	10 P.M.	MEAN.	6 A.M	2P.M.	10PM	MB'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	10PM	Result.	MB'N		
					°	°	°	°													°							
1	29.973	29.893	29.850	29.9067	26.6	35.6	27.3	29.28	+ 4.07	.112	.134	.128	.122	.77	.65	.86	.75	W S W	S W b S	S W b W	S 42 W	6.5	12.0	9.0	8.06	8.18	...	...
2	.758	.672	.626	.6845	29.8	39.9	37.0	35.65	+10.45	.147	.172	.183	.169	.88	.69	.84	.80	Calm.	S S E	Calm.	S 36 E	0.0	1.2	0.0	1.81	2.06	...	...
3	.626	.670	.450	.5373	38.5	43.2	39.9	40.60	+15.45	.199	.235	.233	.219	.86	.84	.95	.86	Calm.	E b S	Calm.	S 78 E	0.0	4.3	0.0	1.25	1.26	0.030	...
4	.230	28.870	—	—	41.7	44.6	—	—	—	.247	.264	—	—	.93	.99	—	—	E b S	E b N	W b S	S 55 W	2.2	3.2	17.0	7.46	11.00	Inp.	...
5	.295	29.282	.221	.2642	35.6	44.3	36.3	38.73	+13.60	.177	.185	.176	.178	.85	.63	.82	.75	S W	S W b S	Calm.	S 56 W	6 5	5.5	0.0	6.01	6.33	0.015	...
6	.166	.183	.302	.2207	36.7	36.0	27.0	32.50	+ 7.37	.197	.118	.129	.146	.90	.66	.88	.79	W b N	W	W N W	N 59 W	9.8	11.0	14.0	16.15	16.92	Inp.	0.1
7	.568	.799	.905	.7828	12.9	18.3	16.1	16.00	— 9.13	.051	.062	.074	.063	.66	.61	.83	.70	N W	N W b N	Calm.	N 33 W	27.5	10.0	0.0	5.93	6.33	...	0.1
8	.954	.914	.955	.9460	18.3	24.4	23.3	22.37	— 2.77	.080	.096	.116	.102	.81	.73	.93	.85	N b E	Calm.	W S W	N 34 E	1.5	0.0	0.6	0.33	1.73	...	4.0
9	.983	.950	.832	.9128	25.2	30.2	32.7	29.72	+ 4.58	.122	.142	.150	.141	.90	.84	.89	.85	N E	S W	S E b E	S 20 E	2.5	0.7	6.5	6.46	6.77	...	0.7
10	.547	.158	.106	.2890	32.7	35.2	34.5	34.63	+ 9.58	.157	.190	.173	.173	.85	.93	.86	.85	S E b E	S b W	W S W	S 37 W	7.7	12.4	13.5	9.54	12.56	0.445	2.0
11	.227	.314	—	—	31.6	30.2	—	—	—	.163	.136	—	—	.91	.80	—	—	W b S	N W b W	N N W	N 59 W	9.0	19.0	15.0	9.31	19.96	...	0.1
12	.771	.660	.885	.7748	12.2	29.1	25.9	23.35	— 1.73	.065	.141	.128	.117	.86	.87	.91	.89	Calm.	S b E	Calm.	N 43 E	0.0	1.2	0.0	1.41	2.31	...	...
13	30.016	.875	.572	.7952	28.4	29.6	33.8	30.70	+ 5.62	.148	.151	.182	.160	.95	.91	.93	.93	N E b E	E	E S E	S 84 E	5.2	16.0	9.0	9.94	10.25	0.250	1.0
14	29.399	.229	.289	.3062	38.5	39.9	35.6	38.13	+13.03	.225	.241	.202	.221	.96	.98	.97	.96	E S E	S W b S	W S W	S 80 W	0.4	5.0	8.0	5.45	7.15	0.255	...
15	.402	.306	.171	.2775	28.8	29.1	24.8	26.47	+ 1.37	.129	.126	.126	.122	.81	.78	.95	.85	N W b N	N N E	N N E	N 10 E	10.0	7.2	12.0	9.89	10.60	...	6.0
16	.061	.164	.525	.2743	8.9	3.1	-0.8	3.08	—21.92	.055	.039	.040	.044	.81	.75	.94	.83	N	N W b N	N W b W	N 21 W	18.0	16.2	6.5	9.73	10.07	...	1.5
17	.888	30.141	30.273	30.1262	-11.2	5.0	6.0	-0.30	—25.32	.024	.044	.049	.039	.86	.79	.85	.86	N W b N	N b E	N N E	N 21 E	0.2	0.8	6.5	4.68	4.18	...	0.2
18	30.348	30.309	—	—	8.2	21.5	—	—	—	.057	.088	—	—	.91	.77	—	—	N E b N	S b E	Calm.	S 33 E	5.0	9.2	0.0	2.41	4.29	...	Inp.
19	30.187	30.134	30.101	30.1385	7.8	30.6	27.0	22.40	— 2.48	.051	.138	.129	.110	.82	.80	.88	.86	Calm.	Calm.	N E b N	N 51 E	0.0	0.0	5.5	1.99	2.28	...	...
20	30.020	29.945	29.820	29.9287	29.1	30.6	30.9	30.07	+ 5.22	.141	.160	.164	.153	.87	.93	.95	.91	E N E	E b N	E b N	N 75 E	11.2	18.0	18.5	15.53	15.54	...	1.5
21	29.821	.861	.893	.8635	28.8	32.4	34.2	31.72	+ 6.03	.144	.161	.177	.161	.90	.87	.89	.90	E b N	E N E	E	N 74 E	13.0	9.4	5.8	7.43	7.55	Inp.	0.4
22	.878	.750	.717	.7793	33.4	35.1	34.9	34.30	+ 9.53	.173	.192	.186	.186	.95	.94	.92	.94	S E b E	S b E	S W b W	S 31 W	2.0	2.3	3.4	3.11	3.97	0.012	...
23	.767	.833	.919	.8490	33.4	39.2	34.5	35.65	+10.38	.180	.180	.157	.173	.95	.75	.78	.85	S W b W	N	E	N 78 E	3.4	4.5	14.0	5.88	7.07	...	...
24	.853	.704	.730	.7668	29.5	36.3	38.1	34.93	+10.35	.144	.193	.204	.180	.87	.90	.88	.88	E b N	E	S W b W	S 42 E	14.0	7.2	6.5	2.02	9.35	...	Inp.
25	.849	.834	—	—	36.3	38.1	—	—	—	.168	.145	—	—	.78	.63	—	—	W b S	S W b S	N W b N	S 59 W	10.0	13.8	3.5	4.93	5.82	...	...
26	.785	.579	.548	.6255	29.8	35.6	33.1	32.80	+ 8.52	.147	.193	.182	.174	.88	.93	.97	.93	N b W	S E b E	N N E	N 23 E	5.0	0.8	2.5	3.04	3.49	0.115	1.0
27	.420	.492	.608	.6209	33.1	30.6	27.7	30.10	+ 5.75	.174	.131	.121	.140	.92	.76	.80	.83	N N E	N	N b W	N 11 E	7.0	13.5	4.3	7.03	7.22	...	1.0
28	.634	.615	.517	.5843	24.4	27.0	14.0	21.37	— 2.93	.117	.129	.074	.103	.89	.88	.91	.89	N N W	N b W	N	N 20 W	3.5	3.5	5.2	4.75	4.84	...	...
29	.353	.253	.308	.3012	12.0	28.4	28.7	23.70	— 0.59	.069	.126	.138	.111	.89	.81	.87	.85	N W b N	S W	W b S	S 76 W	4.0	8.0	4.5	3.29	4.13	...	1.0
30	.317	.376	.567	.4325	28.4	35.3	28.4	29.98	+ 5.88	.142	.138	.134	.137	.90	.67	.86	.83	Calm.	W S W	W b N	S 84 W	0.0	6.9	10.5	8.45	8.90	...	...
31	.576	.499	.606	.5668	27.7	33.1	31.6	30.78	+ 6.80	.121	.145	.148	.138	.80	.76	.83	.80	W S W	S W b W	S W	S 54 W	13.5	16.4	10.4	10.87	11.00	...	...
M	29.6675	29.6238	29.644	29.6466	25.19	31.01	28.24	28.08	+ 3.28	.129	.147	.145	.140	.87	.80	.88	.85					6.41	7.81	6.85		7.23	1.125	20.6

REMARKS ON TORONTO METEOROLOGICAL REGISTER FOR JANUARY, 1863.

Highest Barometer..... 30.378 at 10 a. m. on 18th } Monthly range =
Lowest Barometer ..... 28.846 at 2.30 p. m. on 4th } 1.532 inches.

Self-registering Thermom.
- Maximum Temperature ..... 47°0 on p.m. of 4th } Monthly range=
- Minimum Temperature .....—14°0 on a.m. of 17th } 61°0
- Mean maximum Temperature ..... 33°32 } Mean daily range=
- Mean minimum Temperature ..... 22°93 } 10°38
- Greatest daily range ..... 24°6 from a. m. to p.m. of 19th.
- Least daily range..... 2°2 from a.m. to p.m. of 6th, and a.m. to p.m. of 15th.

Warmest day..... 3rd... Mean temperature..... 40°60 } Difference = 40°90.
Coldest day ..... 17th... Mean temperature.....—0°30 }

Maximum { Solar.....66°0 on p.m. of 5th } Monthly range =
Radiation. { Terrestrial.....—22°0 on a.m. of 17th } 88°0

Aurora observed on 3 nights, viz.,—16th, 24th, and 25th.
Possible to see Aurora on 7 nights; impossible on 24 nights.
Snowing on 17 days, depth 20.6 inches; duration of fall, 87.8 hours.
Raining on 10 days, depth 1.122 inches; duration of fall 29.7 hours.
Mean of cloudiness = 0.83. Above average 0.12.
Most cloudy hour observed, midnight, mean = 0.86; least cloudy hour observed, 6 a.m.; mean, = 0.79.

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

North.	South.	East.	West.
1732.49	1321.11	1515.41	2248.13

Resultant direction N. 61° W.; Resultant velocity 1.13 miles per hour.
Mean velocity .....7.23 miles per hour.
Maximum velocity ..... 30.3 miles, from 3 to 4 a.m. on 6th.
Most windy day .....6th .....Mean velocity, 16.93 miles per hour. } Difference=
Least windy day.....3rd .....Mean velocity, 1.26 ditto. } 15.66 miles.
Most windy hour ...3 p.m. to 4 p.m. .....Mean velocity, 8.59 ditto. } Difference=
Least windy hour...2 a.m. to 3 a.m. .....Mean velocity 6.18 ditto. } 2.32 miles.

1st. Solar halo during forenoon; lunar halo at 10 p.m. and midnight.—2nd. Fog at 8 a.m.—5th. Fog at 10 p.m. and midnight.—9th. Lunar halo from 11 p.m.—14th. Fog from 1 p.m. to 2.30 p.m.—16th. Solar halo at 4 p.m.; auroral light at midnight.—22nd. Dense fog at 2 and 4 p.m.—23rd. Fog at 4 p.m.—24th. Auroral light, arch and streamers, 10 p.m. to midnight.—25th. Auroral light from 8 p.m.; lunar halo 8 to 10 p.m.

January, 1863, was very mild, cloudy, and comparatively calm; it had less rain and more snow than the average; and the total amount of moisture was in excess of the mean by 0.402 inches on the surface.

COMPARATIVE TABLE FOR JANUARY.

Year.	Temperature. Mean.	Excess above aver'ge (45.5)	Max. ob-served.	Min. ob-served.	Range.	Rain. No. of days.	Rain. Inches	Snow. No. of days.	Snow. Inches	Wind. Resultant. Direction.	Resultant. V'y.	Wind. Mean Force or Velocity.
	°	°	°	°	°							
1840	17.0	— 6.5	40.6	—13.8	54.4	4	1.395	11	...	...	...	.....
1841	25.6	+ 2.1	41.7	— 4.1	45.8	2	2.150	14	...	...	...	0.36 lbs.
1842	27.9	+ 4.4	45.8	1.3	44.5	5	2.170	9	...	...	...	0.78
1843	28.7	+ 5.2	54.4	1.5	52.9	6	4.295	12	14.2	...	...	0.69
1844	20.2	— 3.3	44.6	— 7.7	52.3	7	3.003	11	24.9	...	...	0.70
1845	26.5	+ 3.0	43.0	— 3 4	46.4	5	Imp.	9	22.7	...	...	0.70
1846	26.7	+ 3.2	41.2	0.3	40.9	5	2.335	10	6.0	...	...	0.55
1847	23.3	— 0.2	42.6	— 2.2	44.8	7	2.135	5	7.5	...	...	1.09
1848	28.7	+ 5.2	51.5	—12.0	63.5	7	2.245	8	7.1	N 82° W	2.03	5.82mls.
1849	18.5	— 5.0	40.1	—15.2	55.3	4	1.175	10	9.2	N 63° W	3.06	6.71
1850	29.7	+ 6.2	46.3	10.6	35.7	5	1.250	8	5.2	N 37° W	0.69	5.80
1851	25.5	+ 2.0	43.2	—12.8	56.0	4	1.275	10	7.8	S 77° W	3.26	7.69
1852	18.4	— 5.1	37.3	— 7.0	44.3	0	0.000	19	30.9	N 68° W	3.14	7.67
1853	23.0	— 0.5	40.9	— 6.6	47.6	1	0.290	6	7.5	N 27° W	2.52	6.34
1854	23.6	+ 0.1	45.2	— 4.3	49.5	7	1.270	11	7.5	N 77° W	2.44	6.91
1855	25.9	+ 2.4	48.2	— 4.7	52.9	5	0.525	13	23.3	N 73° W	1.91	7.26
1856	16.0	— 7.5	33.1	—12.1	45.2	0	0.000	14	13.6	N 75° W	5.24	10.69
1857	12.8	—10.7	34.6	—20.1	54.7	3	Inap.	16	21.8	N 70° W	4.96	10.31
1858	30.0	+ 6.5	45.8	7.5	38.3	6	1.152	11	4.0	N 71° W	2.33	7.40
1859	26.4	+ 2.9	41.5	—26.5	68.0	6	1.449	19	16.4	S 81° W	3.17	8.76
1860	23.4	— 0.1	45.4	— 5.1	50.5	6	0.740	16	8.7	N 89° W	6.09	9.37
1861	19.9	— 3.6	34.5	— 7.0	41.5	4	0.635	23	20.6	N 86° W	2.92	9.30
1862	21.7	— 1.8	42.8	— 1.9	44.7	5	0.115	19	27.4	N 26° W	2.69	8.83
1863	28.1	+ 4.5	44.6	—11.2	55.8	10	1.122	17	20.6	N 61° W	1.13	7.23
Results 1861-2	23.53	...	42.80	—6.52	49.31	4.5	1.407	12	13.63	N 77° W	2.98	7.86
Exc. for 1863.	+ 4.55	...	+ 1.80	—4.68	+ 6.49	+ 5.5	— 0.285	+ 5.0	+ 6.97	.....	.....	— 0.63