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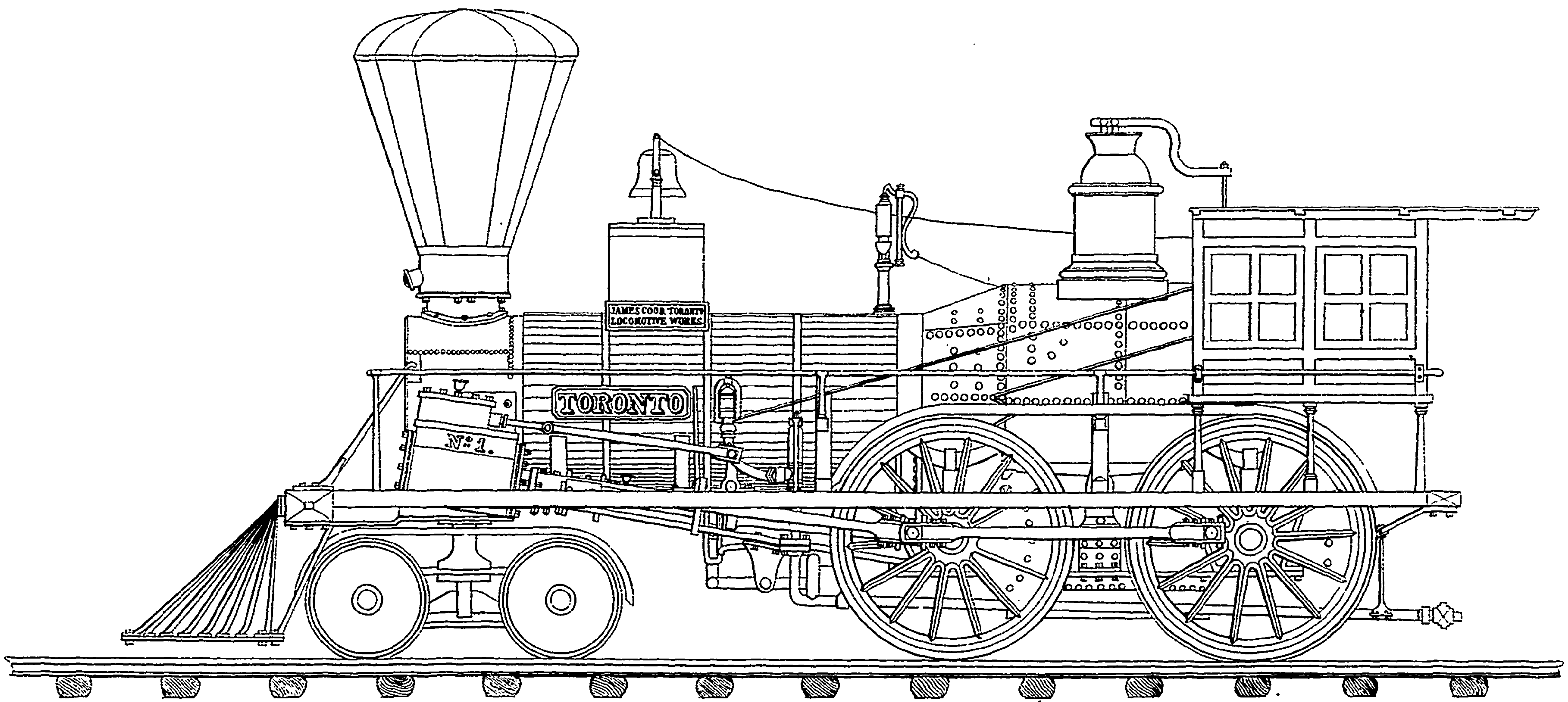

Geo. A. Stewart Del.

10 9 8 7 6 5 4 3 2 1 0 3 6

Scale of Feet.

Mr GOOD'S LOCOMOTIVE ENGINE TORONTO.

Hugh Scobie Lith. Toronto.

The Canadian Journal.

TORONTO, OCTOBER, 1853.

Twenty-Third Meeting of the British Association for the Advancement of Science. Hull, Sept. 7, 1853.

GENERAL MEETING.

The first General Meeting was held in the Saloon of the Mechanics' Institute, at eight o'clock in the evening: when Colonel Sabine took the chair,—but only for the purpose of resigning it to his successor. This he did in the following words:—"In addressing you for the last time from this chair, in which your kindness has been pleased to place me, I have yet one duty to perform,—and it is one which is extremely agreeable. It is to introduce to you a gentleman who by the General Committee has been selected as my successor. It has been considered necessary by gentlemen who have preceded me on several occasions to dwell on the qualifications and on the merits of the gentleman selected; but in this case Mr. Hopkins is so eminently distinguished, his accomplishments in the various branches of science, his general courtesy and amiability, and his kind disposition, have been so long and so universally appreciated, that I feel confident I shall take the course which is most agreeable to your wishes in introducing him to you in the fewest possible words. I will, therefore, with your permission, request Mr. Hopkins to take the chair to which the General Committee has so worthily elected him."

The President for the year then took the chair, and delivered the following inaugural Address on the objects and proceedings of the Association :—

The President's Address.

Gentlemen of the British Association,—Before I proceed to those remarks which I may have to address to you on matters of science, let me avail myself of this opportunity of expressing to you the sense I entertain of the honour which you have conferred upon me in electing me to the Presidency of this Association. When the high office was first proposed to me, I could not but feel the importance of the duties attached to it. I felt, also, that there must be others who had higher claims to the honour than myself. But I was aware how frequently difficulties will occur in the immediate appointment to such offices of the persons most competent to fill them; and after having been invited to the office by those best qualified to decide such points, I conceived it right not to shrink from its responsibilities, but at once to accept it, with the determination of performing the duties it might impose upon me to the best of my ability. I have had the less hesitation in adopting this course from the knowledge of the effective and ready assistance which I should always receive, not only from our excellent Secretary, Mr. Phillips, but also from my predecessor in this chair, who is so intimately acquainted with the whole working of the association, to which he has rendered so long and so cheerfully such invaluable services. After thanking you, gentlemen, as I do most sincerely, for the high compliment you have paid me, and assuring you of my best efforts in the cause of the Association, I proceed to lay before you such statements and remarks on scientific subjects as have presented themselves to my own mind for this occasion. In doing this, I cannot but regret my inability to do justice to many subjects which might be interesting to you; and indeed, the limited time for which I should be justified in demanding your attention to an oral communication, will oblige me to omit this evening several even of those points which I was prepared to bring under your notice.

Astronomical science still continues to prove to us how much more populous is that portion of space occupied by the solar system than was suspected only a few years ago. Between the 23rd of June, 1852, and the 6th of May, 1853, nine new planets were discovered, of which seven were found since the last meeting of the association. Of these nine planets, our countryman, Mr. Hind, has discovered four. The number now known, exclusive of the large planets, but including the four old asteroids, amounts to twenty-six; nor have we any reason to suppose that we have yet approximated to the whole number of these minor planetary bodies. All those which have been recently recognized appear like stars of magnitude not lower than the eighth or ninth, and are consequently invisible to the naked eye. The search for them has now assumed, to a considerable extent, a more systematic form, by a previous mapping of the stars up to a certain magnitude, and contained in a belt of a few degrees in breadth on either side of the ecliptic. Any small planet will in the first instance be inserted in the map as a small star, but will on the re-examination of the same area some time afterwards, be recognized in its true character, from the fact of its having moved from the place in which it was first observed. This mapping of the ecliptic stars from the eighth to higher magnitudes, is still comparatively limited; nor has the length of time during which any one portion, perhaps, of the space which has been thus mapped, been sufficiently great to ensure the passage through it, within that time, of any planet whose period is as long as the possible periods of those which may yet remain unknown to us. Analogy would therefore lead us to conclude in favour of the probability of their number being much greater than that at present recognized. All those which are now known lie between the orbits of Mars and Jupiter, but many may exist more distant, and of much smaller apparent magnitudes, and thus almost the same careful telescopic research may be necessary to make us acquainted with some of our planetary neighbours as with the remoter regions of space. Nor is the telescopic mode the only one by which we may detect the existence of remoter planets; for as Uranus betrayed the existence of Neptune, so may the latter hereafter reveal to us the retreats in which some more distant member of the system has hitherto hidden himself from the observation of man.

There would seem to be a tendency in the human mind to repose on the contemplation of any great truth after its first establishment. Thus, after the undisputed reception of the theory of gravitation, and the complete explanation which it afforded of the planetary motions, men seemed to think little of any further revelations which the solar system might still have to make to us respecting its constitution, or the physical causes which it calls into operation. The recent discovery, however, of so many planets, shows how imperfectly we may yet be acquainted with the planetary part of the system; and the continual discovery of new comets seems to indicate that in this department still more remains to be done. These curious bodies, too, may possibly have to reveal to us facts more interesting than any which the planets may still have in reserve for us. The experience of these latter bodies, if I may so speak, is more limited, and their testimony, consequently, more restricted. But they have already told us a noble tale. In moving, as they do, in exact obedience to the law of gravitation, and thus establishing that law, they have affirmed the highest generalization in physical science which it has been accorded to the human mind to conceive. At the same time, the approximate circularity of their orbits prevents their passing through those varied conditions to which comets are subjected. Thus, while the latter obey, in common with the planets, the laws of gravitation, they frequently present to us, in their apparent changes of volume, form and general character, phenomena, the explanation of which has hitherto baffled the ingenuity of astronomers. One of the most curious of these phenomena has been recently observed in Biela's comet. This comet has a period of about six years and a half, and has been observed a considerable number of times on its periodical return to the neighbourhood of the sun. It appeared in November, 1845, and in the following January, the phenomenon alluded to was observed for the first time. The comet had become divided into two distinct parts with separate nuclei. Sometimes the one and sometimes the other appeared the brighter, till their final disappearance. The elements of the orbits of these twin comets were calulated by Professor Plantamour, from observations made at Geneva in 1845-6, assuming them to be uninfluenced by each other's attractions. The correctness of these elements could be determined only on the next return of the comet, which took place in the autumn of last year, one of the nuclei having been first seen by Signor Secchi at Rome, on the 25th of August, and the other on the 15th of September. The subsequent observations made upon them show that the elements of the orbits, as previously calculated from the Geneva observations, were far from exact. A complete discussion of all the observations which have been made on these comets during their last and previous appearances, is now in progress by Professor Hubbard, of the Washington Observatory. The distance between the two nuclei was much increased on their last appearance. Judging from the apparent absence of all influence and sympathy between these bodies, it would seem that their physical divorcement, though without known precedent, is final and complete.

Stellar Astronomy continues to manifest a vigour and activity worthy of the lofty interest which attaches to it. Bessel had made a survey of all stars to those of the ninth magnitude inclusive, in a zone lying between 45° of north, and 15° of south declination. Argelander has extended this zone from 80° of north, to 31° of south declination. It comprises more than 100,000 stars. Last year was published also the long expected work of M. F. G. W. Struve, containing a catalogue of stars observed by him at Dorpat, in the years 1822—43. They are principally double and multiple stars, which had been previously micrometrically observed by the same distinguished astronomer. Their number amounts to 2874; the epoch of reduction is 1830. The introduction contains the discussion of various important points in stellar astronomy.

Notices have been brought before us from time to time of the nebulæ observed through Lord Rosse's telescope. This noble instrument, so unrivalled for observations of this kind, continues to be applied to the same purpose, and to add yearly to our knowledge of the remotest regions of space into which the eye of man has been able to penetrate. Almost every new observation appears to confirm the fact of that curious tendency to a spiral arrangement in these nebulous masses of which mention has so frequently been made. To those persons, however, who have neither seen the objects themselves, nor careful drawings of them, a mere verbal description must convey very indistinct conceptions of the spiral forms which they assume. I have, therefore had the drawings made which are suspended in the room for your inspection. They will convey to you at once an idea of the spiral forms alluded to. I am indebted to the kindness of Lord Rosse for the use of the original drawings,—and for these large and accurate copies of them, to our excellent Secretary, Mr. Phillips, who, with his usual activity in the cause of the Association, has had them prepared for the purpose of this evening. Most of them are representations of nebulæ which have been very recently observed.

Two pairs of these are respectively drawings of the same objects; the larger one of each pair representing the nebula as seen through the large telescope, the other as seen through a smaller one of Lord Rosse's, of only three feet aperture. You will observe how little resemblance there is between them, except in the external boundary, and how entirely the characteristic details of the larger drawings are lost in the smaller ones; and if I had exhibited to you drawings of some others of these nebulæ, as seen by previous observers with inferior telescopic power, it would have been still more obvious to you how necessary are telescopes with large and perfectly ground mirrors for the development of the real character of these astonishing and enigmatical aggregations of stars.

It is for this reason that it has been thought desirable to have the nebulæ of the southern hemisphere examined with higher telescopic power than has hitherto been brought to bear upon them. You are aware with what a noble devotion to science Sir J. Herschel spent several years at the Cape of Good Hope, in the examination of the southern heavens; but his telescopic power was limited to that of a reflector of 18½ inches aperture. It is now proposed to send out to some convenient station in the southern hemisphere a reflecting telescope, with a mirror of four feet aperture. Mr. Grubb, of Dublin, has undertaken to construct such an instrument, (should the plan proposed be adopted,) under the general superintendence of Lord Rosse, Dr. Robinson, Mr. Lassel, and one or two other gentlemen. The general construction of the instrument, and the best mode of mounting it, have been decided on with careful deliberation, after consulting all the best authorities on the subject.

These important preliminaries being agreed upon, and an estimate of the whole expense of the instrument having been made by Mr. Grubb, the deputation appointed proceeded to wait on Lord Aberdeen, to ascertain whether the Government were willing to bear the expense which the plan proposed would involve. His Lordship expressed himself, without hesitation, as favourable to the undertaking; but said that, since it involved a grant of money, it would be necessary to consult the Chancellor of the Exchequer, who, supposing him to take a favourable view of the subject, would probably bring it before the House of Commons among the estimates of the ensuing year. With this answer, the deputation could not be otherwise than perfectly satisfied, nor could they fail also to be gratified by the perfect courtesy with which they were received. Judging from all we know respecting Mr. Gladstone's enlightened views on subjects of this nature, and the favourable manner in which the House of Commons has always received propositions for the advancement of science, we have, I think, every reason to hope that my successor in this chair may have the satisfaction of announcing to you another example of the liberality of the Goverment in their acceptance of the plan proposed to them. In such case, the result, I doubt not, will afford a new proof that the association is doing effectively what it professes to do as an association for the advancement of science.

The refinement of modern methods of astronomical observation has become so great, that astronomers appear very generally to think that a higher degree of refinement in the calculations of physical astronomy than has yet been attained is becoming necessary. Mr. Adams has been engaged in some researches of this kind. He has corrected an errror in Burckhardt's value of the moon's parallax; and he has also determined to a nearer approximation than that obtained by Laplace the secular variation in the moon's mean motion. The former investigation is published in an appendix to the Nautical Almanac for 1856; the latter has been very recently presented to the Royal Society.

Before I quit this subject, I may state, that an American 'Ephemeris and Nautical Almanac for 1855' has been published this year. It is the first American nautical almanac and is considered to reflect great credit on the astronomers of that country. It is under the superintendence of Lieut. C. H. Davis, assisted in the physical department by professor Pierce.

No one has contributed more to the knowledge of Terrestial Magnetism, during the last few years, than my distinguished predecessor in this chair. Formerly we owed theories on this subject much more to the boldness of ignorance than to the just confidence of knowledge, but from the commencement of the systematic observations which Col. Sabine has been so active in promoting, this vague and useless theorizing ceased,—to be succeeded, probably ere long, by the sound speculative theories of those who may be capable of grappling with the real difficulties of the subject, when the true laws of the phenomena shall have been determined. Those laws are springing forth with beautiful precision from the reductions which Colonel Sabine is now making of the numerous observations taken at the different magnetic stations. In his address of last year, he stated to us that the secular change of the magnetic forces were confirmed by these recent observations,—and also that periodical variations depending on the solar day, and on the time of the year had been distinctly made out, indicating the sun as the cause of these variations. During the present year the results of the reduction of the observations made at Toronto, have brought out, with equal perspicuity, a variation in the direction of the magnetic needle going through all its changes exactly in each lunar day. These results with reference to the sun prove, as Colonel Sabine has remarked, the immediate and direct exercise of a magnetic influence emanating from that luminary; and the additional results now obtained establish the same conclusion with regard to the influence of the moon. It would seem, therefore, that some of the curious phenomena of magnetism which have hitherto been regarded as strictly terrestrial are really due to solar and lunar, as much as to terrestrial magnetism. It is beautiful to trace with such precision these delicate influences of bodies so distant, producing phenomena scarcely less striking either to the imagination or to the philosophic mind than more obvious phenomena which originate in the great luminary of our system.

New views which have recently sprung up respecting the nature of heat have been mentioned, though not in detail, by my two immediate predecessors in the chair of the Association. They are highly interesting theoretically, and important in their practical application, inasmuch as they modify in a considerable degree the theory of the steam-engine, the air-engine, or any other in which the motive power is derived immediately from heat; and it is correct theory alone which can point out to the practical engineer the degree of perfection at which he may aim in the construction of such machines, and which can enable him to compare accurately their merits when the best construction is arrived at.

A theory which proposes to explain the thermal agency by which motive power is produced, and to determine the numerical relations between the *quantity* of heat and the *quantity* of mechanical effect produced by it, may be termed a *dynamical theory of heat.* Carnot was the first to give to such a theory a mathematical form. His theory rested on two propositions which were regarded as axiomatic. The first embodied the abstract conception of a perfect thermo-dynamic engine, and has been equally adopted by the advocate of the new theory of heat.—Again, suppose a given quantity of heat to enter a body by any process, and thereby to change its temperature and general physical state, and then, by a second process, suppose the body to be restored exactly to its primitive temperature and condition,—Carnot's second fundamental proposition asserts that the quantity of heat which passes out of the body into surrounding space, or into other bodies, *in the form of heat*, during the second operation, is precisely the same as that which passed into the body during the first operation. This view does not recognize the possibility of heat being lost by conversion into something else,—and in this particular it is at variance with the new theory, which asserts that heat may be lost by conversion into *mechanical effect.* To elucidate this distinction, suppose a quantity of water to be poured into an empty vessel. It might then be asserted that, in emptying the vessel again, we must pour out just as much water as we had previously poured in. This would equivalent to Carnot's proposition with respect to heat. But suppose a part of the water while in the vessel to be converted into *vapour;* then it would not be true that in emptying the vessel the same quantity of water in the form of water, must pass out of the vessel as had before passed into it, since a portion would have passed out in the form of vapour. This is analagous to the assertion of the new theory with regard to heat,—which may be lost according to that theory, by conversion into mechanical effect, in a manner analagous to that in which water may be said to be lost by conversion into vapour. But the new theory not only asserts generally the convertibility of heat into mechanical effect, and the converse,—but also more definitely, that, whatever be the mode of converting the one into the other—and whether the heat be employed to produce mechanical effect, or mechanical force be employed to produce heat,—the same quantity of the one is always the equivalent of the same quantity of the other. The proposition can only be established by experiment, Rumford, who was one of the first to adopt the fundamental notion of this theory as regards the nature of heat, made a rough attempt to determine the relation between the force producing friction and the heat generated by it; but it was reserved for Mr. Joule to lay the true foundation of this theory by a series of experiments which, in the philosophical discernment with which they were conceived and the ingenuity with which they were executed, have not often, perhaps been surpassed. In whatever way he employed mechanical force to produce heat, he found, approximately, the same quantity of heat produced by the same amount of force; the force being estimated in *foot-pounds* according to the usual mode in practical mechanics,—*i, e,* by the motive power employed in raising a weight of 1 lb, through the space of 1 foot. The conclusion adopted by Mr. Joule is, that 1° Fahr. is equivalent to 772 *foot-pounds.*

These results are unquestionably among the most curious and interesting of those which experimental research has recently brought before us. When first announced some ten or twelve years ago, they did not attract the attention which they deserved; but more recently their importance has been fully recognized by all those who cultivate the department of science to which they belong. Of this Mr. Joule received last year one of the most gratifying proofs, in the award made to him by the Council of the Royal Society of one of the medals placed annually at their disposal. It may be known to many of you that we have in Mr. Joule a pupil, a friend, and fellow-townsman of Dalton.

This theory is in perfect harmony with the opinions now very generally entertained respecting *radiant heat.* Formerly light and heat were regarded as consisting of material particles continually radiating from luminous and heated bodies respectively; but it may now be considered as established beyond controversy that light is propagated through space by the vibrations of an exceedingly refined ethereal medium, in a manner exactly analogous to that in which sound is propagated by the vibrations of the air,—and it is now supposed that radiant heat is propagated in a similar manner. This theory of radiant heat, in accordance with the dynamical theory of which I have been speaking involves the hypothesis that the particles of a heated body, or a particular set of them, are maintained in a state of vibration, similar to that in which a luminous body is believed to be. At the same time, there are remarkable differences between light and heat. We know that light is propagated with great rapidity whether in free space or through transparent media; sound also, is propagated with great rapidity, and more rapidly through most media than air. Heat, on the contrary, whatever may be the velocity with which it may radiate through free space, is usually transmitted with extreme slowness through terrestial media. There appears to be nothing in light analagous to the slow *conduction* of heat. Again, the vibrations which render a body sonorous seem to have no tendency to expand its dimensions, nor is there reason to suppose that luminous vibrations have any such tendency on luminous bodies; whereas, with the exception of particular cases, heat does produce expansion. It is principally from this property of heat that it becomes available for the production of motive power, as for instance, in the expansion of steam. These phenomena of the slow conduction of heat and the expansion of heated bodies, are proofs of differences between light and heat not less curious than the analogies above indicated. They must, of course, be accounted for by any perfect theory of heat. Mr. Rankine has written an ingenious paper on a molecular theory of heat; but before any such theory can be pronounced upon, it will be necessary, I conceive, to see its bearing on other molecular phenomena, with which those of heat are in all probability intimately connected. Prof. W. Thompson has also given a clear and compendious mathematical exposition of the new dynamical theory of heat, fonnded on Mr. Joule's mechanical effect. This is not like Mr. Rankine's, a *molecular* theory, but one which must henceforth take the place of Carnot's theory.

Before leaving this subject, I may add that Prof. Thompson and Mr. Joule are now engagad in further experiments which will serve to elucidate the new theory of heat. Some account of the commencement of these experiments has already been brought before the Royal Society-

Many years ago Gay-Lussac made an ascent in a balloon for the purpose of making observations on the air in the upper regions of the atmosphere; but it is only very recently that systematic observations of this kind have been attempted. Last autumn four balloon ascents were made by Mr. Walsh, under the guidance of the distinguished aeronaut, Mr. Green. Attention was chiefly directed to the determination of the pressure, temperature and the moisture of the air at different altitudes. The decrease of temperature in ascending was very irregular,—being changed even in some cases to an increase; but the mean result gives a decrease of 1 Fahr. for every 348 feet of ascent,—agreeing within 5 or 6 feet with the result obtained by Gay-Lussac. The latter gentlemen ascended 23,000 feet; the greatest height attained by Mr. Welsh was 22,940. A repetition of similar observations in ascents made from different points of the earth's surface could scarcely fail to lead to valuable information for the science of Meteorology.

An immense contribution, of which mention was made by my predecessor, has been made within the last few years to this science, by the publication of Professor. Dove's Isothermal Maps, giving us the temperature of the lowest portion of the atmosphere (that which determines the *climate* of every region) for nearly all accessible points of the earth's surface. An immense number of thermometric observations had been made at fixed stations, or by travellers in almost every part of the globe, but were lying comparatively useless for want of adequate discussion. This task was undertaken some years ago by M. Dove. It was not merely a task of enormous labour, but one requiring great critical acuteness and sound philosophical judgment, and these qualifications M. Dove brought to his work, which has resulted in the excellent maps alluded to, accompanied by a considerable amount of letter-press, full of interesting generalizations, and written in the genuine spirit of inductive philosophy.

His maps present a great number of isothermal lines,—*i. e.*, lines passing through all those places which, at an assigned period of the year, have the same temperature, each line indicating a particular temperature differing a few degrees from those of the adjoining lines. Besides a large map giving these lines for January and July, the months of extreme winter and summer temperature, there are smaller ones giving similar lines for all the different months. An English edition of these maps has just been published.

We may easily conceive how a great ocean current of warm water ftom the tropics may affect the temperature of the atmosphere in the colder regions into which it may penetrate; but it is only since the publication of these maps that we have had any adequate idea of the extent of this influence, or been able to appreciate the blessings conferred on the shores of north-western Europe, and especially on our own islands, by the Gulf-stream. This great current, though not always under the same name, appears, as you are probably aware, to traverse the Atlantic in a north-westerly direction till it reaches the West India Islands and the Gulf of Mexico. It is then reflected by the American coast, and takes a north-easterly direction to our own shores, extending beyond Iceland into the North Sea. It is to the enormous mass of heated water thus poured into the colder seas of our own latitudes that we owe the temperate character of our climate; and the maps of M. Dove enable us not only to assert distinctly this general fact, but also to make an approximate calculation of the amount to which the temperature of these regions is thus affected. If a change were to take place in the configuration of the surface of the globe, so as to admit the passage of this current directly into the Pacific across the existing Isthmus of Panama, or along the base of the Rocky Mountains of North America into the North Sea—a change indefinitely small in comparison with those which have heretofore taken place—our mountains, which now present us to the ever-varying beauties of successive seasons, would become the unvarying abodes of the glacier and regions of the snow-storm; the beautiful cultivation of our soil would be no longer maintained, and civilization itself must retreat before the invasion of such physical barbarism. It is the genial influence of the Gulf-stream which preserves us from these evils. Among its effects on our climate, I may mention one which may not be without its local interest along this coast, especially for those who may wish to visit during the winter for health as well as for pleasure. The temperature of the atmosphere to the north of this island is so ameliorated by the Gulf-stream in the depth of winter, that the isothermal lines for the month of January along the whole eastern coast of Great Britain and the opposite western coast of the Continent, run north and south instead of following their normal east and west direction, thus showing that Scarborough, or any watering-place on the same coast much further to the north, enjoys as temperate a climate in the depth of winter as the coast of Kent. In the early spring, however, it becomes considerably colder than on the latter coast.

My predecessor, in his address, informed us of an application made to our Government by that of the United States, to adopt a general and systematic mode of observing phenomena of various kinds at sea, such as winds, tides, currents, &c., which may not only be of general scientific interest, but may also have an important bearing on navigation. The plan proposed by Lieut.

Maury, and adopted by the American Government, is, to have the required observations regularly made by the commanders of vessels sent out to sea. I am happy to be able to state to you that our Admiralty have given orders for similar observations to be made by those who have command of English vessels; and we trust also that persons will be appointed without delay for the reduction of the mass of observations which will thus soon be accumulated.

The science of Geology may be regarded as comprising two great divisions—the physical and the palæontological portions. The former may be subdivided into its chemical and dynamical branches. The chemical department has never made any great progress, though abounding in problems of first rate interest—such for instance, as the formation of coal, the segregation of mineral matter constituting mineral veins of all descriptions, the processes of solidification and crystallization of rocks, of the production of their jointed and laminated structure, and many others. Interesting experiments are not altogether wanting on points such as these; but not sufficient to constitute, as far as I am aware, a positive foundation and decided progress in this branch of the science. The problems, doubtless, involve great difficulties, both as regards the action of the chemical agencies themselves and the varied conditions under which they may have acted. The accomplished chemist alone can combat the difficulties of the former kind, and the geologist those of the latter. Both these characters must be united in any one who may hope to arrive at the true solution of these problems. We cannot too earnestly invite attention to this branch of geology on the part of those best qualified to contend with its difficulties.

The dynamical, or more strictly, the mechanical department of the science, has received a much larger share of attention. In fact, almost all theories and speculations of geologists, independently of organic remains belong to it, and a large portion of the work of geologists in the field has been devoted to the observation of phenomena on which it treats. *Phenomena of elevation*, those which have immediately resulted from the action of the subterranean forces which have so wonderfully scarred and furrowed the face of our globe, have been made the objects of careful research. It is to this probably violent and desolating action that we owe the accessibility of the mineral sources of our mining districts, as well as all those exquisite beauties of external nature which the mountain and the valley present to us. The absence of all order and arrangement would seem on a superficial view, to be the especial characteristic of mountainous districts; and yet the nice observations of the geologist has detected, in such districts, distinct approximations to general laws in the great dislocations and upheavals in which the mountains and valleys have originated. The more usual law in these phenomena consists in the approximate parallelism of those great lines of dislocation and chains of mountains the formation of which can be traced back to the same geological epoch. That this law is distinctly recognizable throughout districts, sometimes of many hundred miles in extent, is clearly established; but some geologists contend that it may also be recognized as prevailing over much larger geographical areas than any single geological district presents to us. M. Elie de Beaumont was the originator, and has been the great advocate, of this extension of the theory of parallelism. He extends it, in fact, to the whole surface of the earth:—using the term *parallelism* in a certain modified sense, to render it applicable to lines drawn on a spherical instead of a plain surface. His theory asserts, that all great lines of dislocation, and, therefore, all mountain chains originating in them, wherever situated, may be grouped into *parallel systems*, and that all the lines or mountain chains belonging to any one system were produced simultaneously by one great convulsion of the earth's crust. This theory has been advocated by him many years; but he has recently published his latest views respecting it, and has made an important addition, which may, in fact, be regarded as an independent theory. Each of the parallels already mentioned will have its *characteristic direction* to which all the lines of that system are parallel. This new theory asserts that these characteristic directions are not determined, as were, by accident or chance,—but that they have certain relations to each other, so that the respective systems to which they belong are disposed over the earth's surface according to a distinct symmetrical arrangement. For the details of this curious theory, I can only refer to the author's work, or the analysis which I gave of it last February in my address to the Geological Society. I feel it right, however, to add, that after an attentive examination of the subject, the evidence adduced by M. de Beaumont in support of the last mentioned theory has failed to convey conviction to my own mind. With reference to the parallelism of contemporaneous lines of elevation, no one, I conceive, will deny the truth of M. de Beaumont's theory in its application to many geological districts of limited extent; but it will probably be the opinion of most English geologists that, in attempting to extend it to districts far remote from each other, he has overstepped the bounds of legitimate induction from facts with which we are present acquainted. Every one, however, who studies M. de Beaumont's work, in whatever degree he may be disposed to adopt or reject the theoretical views of that distinguished geologist, will admit the ability and knowledge which he has brought to bear on the subject, and the advantages which must result from the ample discussion which he has given it.

One favourite subject of speculation in the physical branch of geology has been, at all times since the origin of science, the state of the interior of our planet, and the source of the high temperature observed at all considerable depths beneath its surface. The terrestial temperature at a certain depth in each locality (about 80 feet in our own region) remains constant during the whole year, being sensibly unaffected by the changing temperature of the seasons. The same, of course, holds true at greater depths; but the lower we descend the greater is this invariable temperature, the increase being proportional to the depth, and at the rate of 1 Fahr. for about every 60 or 70 feet. Assuming this rate of increase to continue to the depth of 50 miles, we should arrive at a temperature about twice as great as that necessary to fuse iron, and sufficient, it is supposed, to reduce nearly the whole mass of the earth's solid crust to a state of fusion. Hence the opinion adopted by many geologists is, that our globe does really consist of a solid shell, not exceeding 40 or 50 miles in thickness, and an interior fluid nucleus, maintained in a state of fusion by the existing remains of the heat to which the whole terrestial mass was originally subjected. It might, at first sight, appear that this enormous mass of molten matter, inclosed in so thin a shell, could scarcely be consistent with the general external condition and temperature of our globe; but it is quite certain that the real external temperature and this supposed internal temperature of the earth are not inconsistent with each other, and that no valid argument of this kind can be urged against the above hypothesis.

The above estimate, however, of the thickness of the earth's solid crust, entirely neglects the possible effects of the enormous pressure to which the terrestial mass at any considerable depth is subjected. Now, this pressure may produce effects of two kinds, bearing directly on the question before us. In the above calculation, terrestrial matter, placed at the depth of 40 or 50 miles, with a pressure of more than 200,000 pounds on the square inch, is assumed to be fusible at the same temperature as if it were subjected merely to the ordinary atmospheric pressure;

whereas the temperature of the fusion may possibly be very much increased by such immense pressure as that which I have mentioned. In such case, the terrestrial matter may be retained in a solid state at much greater depths than it otherwise would be:—*i. e.*, the solid crust may be much thicker than the above estimate of 40 or 50 miles. Again, in this estimate, it is assumed that heat will pass as easily through the most superficial portion of the earth's mass as through the compressed portions at considerable depths. Now in this assumption, there is, I think, a great *à priori* improbability, and especially with reference to those superficial rocks in which observations on the increase of terrestrial temperature in descending have generally been made, for these rocks are, for the most part, sedimentary strata, which are in general, independently of the effect of pressure, doubtless, worse conductors than the older, more compact, and more crystalline rocks. But if heat passes through the lower portions of this terrestial mass with more rapidity than through its uppermost portion—*i e.*, if the *conductive power* be greater at greater depths—the temperature at considerable depths must increase *more slowly* as we descend than it is observed to increase at the smaller depths to which we can penetrate,—and consequently it would be necessary in such case, to descend to a greater depth before we should reach the temperature necessary to produce fusion. On this account also, as well as from the increased temperature of fusion, the thickness of the earth's crust may be much greater than the previous estimate would make it.

It has been for the purpose of ascertaining the effects of great pressure that Mr. Fairbairn, Mr. Joule, and myself, have undertaken the experiments in which we have for some time been engaged at Manchester. The first object in these experiments is, the determination of the effect of pressure on the temperature of fusion of as many substances as we may be enabled to experiment upon. We expected to meet with many difficulties in the use of the enormous pressures which we contemplated, and these expectations have certainly been fully verified; but we were also satisfied that those difficulties might be overcome by perseverance and patience, and in this also we have not been disappointed—for I may now venture to assert that our ultimate success, with respect to a number of substances, is beyond doubt. Without the engineering resources, however, at Mr. Fairbairn's command, success would have been hopeless.

At present our experiments have been restricted to a few substances, and those of easy fusibility; but I believe our apparatus to be now so complete for a considerable range of temperature, that we shall have no difficulty in obtaining further results. Those already obtained indicate *an increase in the temperature of fusion proportional to the pressure to which the fused mass is subjected.* In employing a pressure of about 13,000 lbs. to the square inch on bleached wax, the increase in the temperature of fusion was not less than 30 ° Fahr.,—about one-fifth of the whole temperature at which it melts under the pressure of the atmosphere. We have not yet ascertained the degree in which the conductive power of any substance may be increased when solidified under great pressure. This point we hope to investigate with due care; and also to determine the effects on substances thus solidified, with respect to their density, strength, crystalline forms, and general molecular structure. We thus hope to obtain results of general interest and value, as well as those which may bear more directly on the questions which first suggested the experiments.

Among researches for determining the nature of the earth's crust at greater depths than those to which we can penetrate, I must not omit to mention Mr Mallet's very elaborate report on Eart quakes, contained in the last two volumes of the Reports of the Association. This *Earthquake Catalogue* is preceded by an account of some very interesting and carefully conducted experiments on the transmission of vibrations through solid media. These results will be found of great value, whenever the subject of earthquakes shall receive that careful attention which it so well deserves. Insulated observations, and those casual observations, and those casual notices which are now frequently given of earthquake phenomena, are utterly useless for scientific purposes. There are no observations which require more to be regulated by system and combination than those of the phenomena in question; and I should rejoice to see the influence of the association exerted for this purpose when some efficient mode of proceeding shall have been devised.

Some of the most interesting of recent discoveries in organic remains are those which prove the existence of reptilian life during the deposition of some of our oldest fossiliferous strata. An almost perfect skeleton of a reptile belonging to the Batrachians or Lacertians was lately found in the Old Red Sandstone of Morayshire. The remains of a reptile were also discovered last year by Sir Charles Lyell and Mr. Dawson in the coal measures of Nova Scotia; and a batrachoid fossil has also been recognized in British coal shale. But the most curious evidence of the early existence of animals above the lower orders of organization on the face of our globe, is that afforded by the footprints discovered a short time ago in Canada by Mr. Logan on large slabs of the oldest fossiliferous rocks,—those of the Silurian epoch. It was inferred from the more imperfect specimens first brought over, that these footmarks were the marks of some reptile; but more perfect examples, afterwards supplied by Mr. Logan, satisfied Prof. Owen that they were the impressions of some animal belonging to the Articulata, probably a crustacean. Thus the existence of animals of the reptile type of organization during the carboniferous and Devonian periods is clearly established; but no evidence has yet been obtained of the existence of those animals during the Silurian period. After the discoveries which I have mentioned, however, few geologists will perbaps be surprised should we hereafter find that higher forms of animal life were introduced upon the earth during this early period than have yet been detected in its sedimentary beds.

Many of you will be aware that there are two theories in geology, which may be styled the theories of *progression* and of *non-progression* respectively. The former asserts that the matter which constitutes the earth has passed through continuous and progressive changes from the earliest state in which it existed to its actual condition at the present time. The earliest state here contemplated may have been a fluid, or even a gaseous state, due to the enormous primitive heat of the mass, and it is to the gradual loss of that heat that the progressive change recognized by this theory is chiefly attributed. The theory of *non-progression*, on the contrary, recognizes no primitive state of our planet differing essentially from its existing state. The only changes which it does recognize being those which are strictly periodical, and therefore produce no permanent alteration in the state of our globe. With reference to organic remains, the difference between these theories is exactly analogous to that now stated with reference to inorganic matter. The theory of *progression* asserts that there has been a general advance in the forms of organic life from the earliest to the more recent geological periods. This advance must not be confounded, it should be observed, with that progressive developement according to which animals of a higher organic structure are but the improved lineal descendants of those of the lowest grade, thus abolishing all distinction of species. It is merely meant to assert that the higher types of organic being are far more generally diffused at the present time, and far more numerous and varied than they were at the earlier geological periods; and that, moreover, at the earliest of those periods which the geologist has been able to recognize, some of these higher types had propably no existence at all.

Each successive discovery, like those which I have mentioned, of the remains of animals of the higher types in the older rocks, is regarded by some geologists as an addition to the cumulative evidence by which they conceive that the theory of *non-progression* will be ultimately established; while others consider the deficiency in the evidence required to establish that theory as far too great to admit the probability of its being supplied by future discovery. Nor can the theory derive present support, it is contended, by an appeal to any properties of inorganic matter, or physical laws, with which we are acquainted. Prof. W. Thomson has recently entered into some very interesting speculations bearing on this subject, and suggested by the new theory of heat of which I have spoken. The heat of a heavenly body placed under the same conditions as the sun, must, it has been said, be ultimately exhausted by its rapid emission. This assertion assumes the matter composing the sun to have certain properties like those of terrestrial matter with respect to the generation and emission of heat; but Prof. Thomson's argument places the subject on better grounds, admitting, always, the truth of the new theory of heat. That theory asserts, in the sense which I have already stated, the exact equivalence of heat and motive power; and that a body, in sending forth heat, must lose a portion of that internal motion of its constituent particles on which its thermal state depends. Now we know that no mutual action of these constituent particles can continue to generate motion which might compensate for the loss of motion thus sustained. This is a simple deduction from dynamical laws and principles, independent of any property of terrestrial matter which may possibly distinguish it from that of the sun. Hence, then, it is on these dynamical principles that we may rest the assertion that the sun cannot continue for an indefinite time to emit the same quantity of heat as at present, unless his thermal energy be renovated from some extraneous source. The same conclusion may be applied to all other bodies in the universe which, like our sun, may be centres of intense heat; and, hence, recognizing no adequate external supplies of heat to renovate these existing centres of heat, Prof. Thomson concludes that the dispersion of heat, and consequently of physical energy, from the sun and stars into surrounding space without any recognizable means of reconcentration, is the existing order of nature. In such case the heat of the sun must ultimately be diminished, and the physical condition of the earth therefore altered, in a degree altogether inconsistent with the theory of non-progression.

Mr. Rankine, however, has ingeniously suggested an hypothesis according to which the reconcentration of heat is conceivable. Assuming the physical universe to be of finite extent and surrounded by an absolute *vacuum*, radiant heat (supposing it to be propagated in the same way as light) would be incapable of passing into the *vacuum*, and would be reflected back to foci corresponding to the points from which it emanated. A reconcentration of heat would thus be effected; and any of the heavenly bodies which had previously lost their heat, might, on passing through these foci, be rekindled into bright centres of radiant heat. I have alluded more particularly to this very ingenious, though, perhaps, fanciful hypothesis, because some persons have, I believe, regarded this view of the subject as affording a sanction to the theory of *non-progression;* but even if we should admit its truth to the fullest extent, it may be deemed, I think, entirely inconsistent with that uniformity and permanence of physical condition in any of the heavenly bodies which the theory just mentioned requires in our own planet. The author of this hypothesis did not possibly contemplate any such application of it; nor am I aware how far he would advocate it as really applicable to the actual constitution of the material universe, or would regard it as suggesting a possible and conceivable, rather than a probable, mode of counteracting the constant dispersion of heat from its existing centres. He has not, I think, attempted to work out the consequences of the hypothesis as applied to *light*,—to which it must, I conceive, be necessarily considered applicable if it be so to heat. In such case the foci of the reflected heat would be coincident with those of the reflected light, proceeding originally from the same luminous bodies. These foci would thus become visible as the images of stars; so that the apparent number of stars would be constantly increasing with the increasing number of images of each star produced by successive reflexions. This will scarcely be considered the actual order of nature. It would be easy to trace other consequences of the application of this hypothesis to light; but I would at present merely state that my own convictions entirely coincide with those of Prof. Thomson. If we are to found our theories upon our knowledge, and not upon our ignorance of physical causes and phenomena, I can only recognize in the existing state of things a passing phase of the material universe. It may be calculated in all, and is demonstrably so in some respects, to endure under the action of known causes, for an inconceivable period of time; but it has not, I think, received the impress of eternal duration in characters which man is able to decipher. The external temperature any physical conditions of our own globe may not, and probably cannot, have changed in any considerable degree since the first introduction of organic beings on its surface; but I can still only recognize in its physical state during all geological periods, a state of actual though exceedingly slow progression, from an antecedent to some ultimate state, on the nature of which our limited powers will not enable us to offer any conjecture founded on physical research. The theories, even, of which I have been speaking, may probably appear to some persons as not devoid of presumption; but for many men they will ever be fraught with deep speculative interest:—and, let me add, no charge of presumption can justly lie against them if entered upon with that caution and modesty which ought to guide our inquiries in these remote regions of physical science.

I feel how imperfect a view I have now submitted to you of recent scientific proceedings. I have given no account of the progress of Chemistry, of Practical Mechanics, or of the sciences connected with Natural History; nor have I spoken of Ethnology, a science which, though of such recent date, is become of great interest, and one which is occupying the minds of men of great learning and profound research. I can only hope that the chair which I have now the honor to occupy, will be henceforth filled by men qualified to do full justice to these important branches of science. I trust that what I have said, however, will convey to you some idea of the activity which pervades almost every department of science.

I must not conclude this Address without some mention of what appear to me to be the legitimate objects of our Association—nor without some allusion to circumstances calculated, I think, to give increased importance to its general working and influence.

There are probably few amongst us of whom the inquiry has not been made—after any one of our meetings—whether any striking discovery had been brought forward?—and most of us will also probably have remarked that an answer in the negative has frequently produced something like a feeling of disappointment in the inquirer. But such a feeling can arise only from a misapprehension of what I conceive to be the real and legitimate objects of the British Association. Great discoveries do not require associations to proclaim them to the world. They proclaim themselves. We do not meet to receive their announcement, or to make a display of our scientific labours in the eyes of the world, or to compliment each other on the success that we may have met with. Outwa d display belongs not to the proceedings, and the expression of mutual compliment belongs not to the language, of earnest-minded men. We meet, gentlemen, if I comprehend our purpose rightly, to assist and encourage each other in the performance of the laborious daily tasks of detailed scientific investigation. A great thought may possibly arise almost instantaneously in the mind,—and the intuition of genius may almost as immediately recognize its importance, and partly forsee its consequences. Individual labor may also do much in establishing the truth of a new principle or theory; but what an amount of labour may its multifarious applications involve! Nearly two centuries have not sufficed to work out all the consequences of the principle of gravitation. Every theory as it becomes more and more perfectly worked out embraces a greater number of phenomena, and requires a greater number of labourers for its complete developement. Thus it is that when science has arrived at a certain stage, combination and co-operation become so essential for its further progress. Each scientific society effects this object to a greater or less degree,—but much of its influence may be of a local character, and it is usually restricted by a limited range of its objects. Up to a certain point no means are probably so effective for the promotion of science as those particular Societies which devote themselves to one particular branch of science; but as each science expands, it comes into nearer relations with other sciences, and a period must arrive in this general and progressive advance which must render the co-operation of the cultivators of different branches of science almost as essential to our general progress as the combination of those who cultivate the same branch was essential to the progress of each particular science in its earlier stages. It is the feeling of the necessity of combination and of facility of intercourse among men of science that has given rise to a strong wish that the scientific Memoirs of different Societies should be rendered, by some general plan, more easily and generally accessible than they are at present;—a subject which I would press on your consideration. It is by promoting this combination that the British Association has been able to exert so beneficial an influence,—by bringing scientific men together, and thus placing, as it were, in juxtaposition every Society in the country. But how has this influence been exercised? Not assuredly in the promotion of vague theories and speculative novelties; but in the encouragement of the hard daily toil of scientific research, and by the work which it has caused to be done, whether by its influence over its individual members or on the Government of the country. Regarding our Association, gentlemen, in this point of view, I can only see an increased demand for its labours, and not a termination of them, in the future progress of science. The wider the spread of science, the wider will be the sphere of its usefulness.

We should do little justice to the great Industrial Exhibition, which, two years ago, may be literally said to have delighted millions of visitors, or to the views of the illustrious Prince with whom it originated, if we should merely recollect it as a spectacle of surpassing beauty. It appears destined to exercise a lasting influence on the mental culture, and therefore, we may hope, on the moral condition of the great mass of our population, by the impulse which it has given to measures for the promotion of general education. We may hope that those whose duty it will be to give effect to this impulse, will feel the importance of education in Science as united with education in Art. An attempt to cultivate the taste alone, independently of the more general cultivation of the mind, would probably fail, as it would deserve to do. I trust that the better education which is now so universally recognized as essential to preserve our future pre-eminence as a manufacturing nation, will have its foundations laid, not in the superficial teaching which aims only at communicating a few curious results, but in the sound teaching of the fundamental aud elementary principles of science. Art ought assuredly to rest on the foundation of Science. Will it, in the present day, be contended that the study of science is unfavourable to the cultivation of taste? Such an opinion could be based only on an imperfect conception of the objects of Science, and an ignorance of all its rightful influences? Does the great sculptor or the historical painter despise anatomy? On the contrary, he knows that a knowledge of that science must constitute one of the most valuable elements of his art if he would produce the most vigorous and characteristic expression of the human figure. And so the artist should understand the structure of the leaf, the tendril, or the flower, if he would make their delicate and characteristic beauties subservient either to the objects of decorative art, or to those of the higher branches of sculpture and painting. Again, will the artist appreciate less the sublimity of the mountain, or represent its characteristic features with less truthfulness, because he is sufficient of a geologist to trace the essential relations between its external form and its internal constitution? Will the beauty of the lake be less perfectly imitated by him if he possess a complete knowledge of the laws of reflection of light? Or will he not seize with nicer discrimination all those varied and delicate beauties which depend on the varying atmosphere of our own region, if he have some accurate knowledge of the theory of colours, and of the causes which govern the changeful aspects of mist and cloud? It is true, that the genius and acute powers of observation of the more distinguished artists may compensate, in a great degree, for the want of scientific knowledge; but it is certain that a great part of the defects in the works of artists of every description may be traced to the defect of scientific knowledge of the objects represented. And hence it is that I express the hope that the directors of the important educational movement which is now commencing with reference to industrial objects will feel the necessity of laying a foundation, not in the complicated details of science, but in the simple and elementary principles which may place the student in a position to cultivate afterwards, by his own exertions, a more mature acquaintance with those particular branches of science which may be more immediately related to his especial avocations. If this be done, abstract science will become of increased estimation in every rank of society, and its value, with reference, at least to its practical applications will be far better understood than it is generally amongst us at the present time.

Under such circumstances the British Association could not fail to become of increased importance, and the sphere of its usefulness to be enlarged. One great duty which we owe to the public is, to encourage the application of abstract science to the practical purposes of life—to bring, as it were, the study and the laboratory into juxta-position with the workshop. And, doubtless, it is one great object of science, to bring more easily within reach of every part of the community the rational enjoyments, as well as the necessaries of life; and thus not merely to contribute to the luxuries of the rich, but to minister to the comforts of the poor, and to promote that general enlightenment so essential to our moral progress, and to the real advancement of civilization, But still, we should not be taking that higher view of science which I would wish to inculcate, if we merely regarded it as the means of supplying more adequately the physical wants of man. If we would view science under its noblest aspects, we must regard it with reference to man, not merely as a creature of physical wants, but as a being of intellectual and moral endowments, fitting him to discover and comprehend some part at least of the laws which govern the material universe, to admire the harmony which pervades it, and to love and worship its Creator. It is for science, as it leads to this contemplation of nature, and to a stronger sense of the beauties which God has spread around us, that I would claim your deeper reverence. Let us cultivate science for its own sake, as well as for the practical advantages which flow from it. Nor let it be feared lest this cultivation of what I may term contemplative science, if prosecuted in a really philosophic spirit, should inspire us with vain and presumptuous thoughts, or disqualify us for the due appreciation of moral evidence on the most sacred and important subjects which can occupy our minds. There is far more vanity and presumption in ignorance than in sound knowledge; and the spirit of true philosophy, be it ever remembered, is a patient, modest, and a humble spirit.

The Narcotics we indulge in.*

II. The Hop which may now be called the *English narcotic*, was brought from the Low Countries, and is not known to have been used in malt liquor in this country till after the year 1524, in the Reign of Henry VIII. In 1850 the quantity of hops grown in England was 21,668 tons, paying a duty of £270,000. This is supposed to be a larger quantity than is grown in all the world besides. Only 98 tons were exported in that year; while, on the other hand, 320 tons were imported, so that the home consumption amounted to 21,886 tons, or 49 millions of pounds; being two thirds more than the weight of the tobacco which we yearly consume. It is the narcotic substance, therefore, of which England not only grows more and consumes more than all the world besides, but of which Englishmen consume more than they do of any other substance of the same class.

And who that has visited the hop grounds of Kent and Surrey in the flowering season, will ever forget the beauty and grace of this charming plant? Climbing the tall poles and circling them with the clasping tendrils, it hides the formality and stiffness of the tree that supports it among the exuberant profusion of its clustering flowers. Waving and drooping in easy motion with every tiny breath that stirs them, and hanging in curved wreaths from pole to pole, the hopvines dance and glitter beneath the bright English vineyard, which neither the Rhine nor the Rhone can equal, and only Italy, where her vines climb the freest, can surpass.

The hop "joyeth in a fat and fruitful ground," as old Gerard hath it (1596). "It prospereth the better by manuring." And few spots surpass, either in natural fertility or in artificial richness, the hop lands of Surrey, which lie along the out-crop of the green sand measures in the neighbourhood of Farnham.—Naturally rich to an extraordinary degree in the mineral food of plants, the soils in this locality have been famed for centuries for the growth of hops; and with a view to this culture alone, at the present day, the best portions sell as high as £50 an acre. And the *highest* Scotch farmer—the most liberal of manure—will find himself outdone by the hop-growers of Kent and Surrey. An average of ten pounds an acre for manure over a hundred acres of hops, make this branch of farming the most liberal, the most remarkable, and the most expensive of any in England.

This mode of managing the hop, and the peculiar value and rarity of hop land, were known very early. They form parts of its history which were probably imported with the plant itself. Tusser, who lived in Henry VIII's time, and in the reign of his three children, in his *Points of Husbandry* thus speaks of the hop:—

"Choose soil for the hop of the rottenest mould,
Well doonged and wrought as a garden-plot should:
Not far from the water (but not overflowne,)
This lesson well noted, is meet to be knowne.

The sun in the south, or else southlie and west,
Is joy to the hop as welcommed ghest;
But wind in the north, or else northerly eas,
To hop is as ill as fray in a feast.

Meet plot for a hop-yard, once found as is told,
Make thereof account, as of jewel of gold;
Now dig it and leave it, the sun for to burne,
And afterwards fense it, to serve for that turne.

The hop for his profit, I thus do exalt;
It strengtheneth drink, and favoureth malt;
And being well brewed, long kep it will last,
And drawing abide, if ye draw not too fast."*

The hops of commerce consist of the female flowers and seeds of the *humulus lupulus*, or common hop plant. Their principal consumption is in the manufacture of beer, to which they give a pleasant, bitter, aromatic flavour, and tonic properties. Part of the soporific quality of beer also is ascribed to the hops, and they are supposed by their chemical properties to check the tendency to become sour. The active principles in the hop consist of a volatile oil, and a peculiar bitter principle to which the name of *lupulin* is given.

When the hop flowers are distilled with water, they yield as much as eight per cent of their weight of volatile oil, which has a brownish yellow colour, a strong smell of hops, and a slightly bitter taste. In this "oil of hops" it has hitherto been supposed that a portion of the narcotic influence of the flowers resided, but recent experiments render this opinion doubtful. It is probable that in the case both of tobacco and of the hop, a volatile substance distils over in small quantity along with the oil, which has not hitherto been examined separately, and in which the narcotic virtue resides. This is rendered probable by the fact that the rectified hop oil is not possessed of narcotic properties.

The hop has long been celebrated for its sleep giving qualities. To the weary and wakeful, the hop-pillow has often given refreshing rest, when every other sleep-producer had failed. It is to the escape, in minute quantities, of the volatile narcotic substances we have spoken of, that this soporific effect of the flowers is most probably to be ascribed.

Besides the oil and other volatile matter which distil from them, the hop flowers, and especially the fine powdery grains or dust, which by rubbing, can be separated from them, yield to alcohol a bitter principle (lupulin) and a resinous substance, both in considerable proportions. In a common tincture of hops these substances are contained. They are aromatic and tonic, and impart their own qnalities to our beer. They are also soothing, tranquilising, and in a slight degree sedative and soporific, in which properties well-hopped beer also resembles them. It is certain that hops possess narcotic virtue which beer derives from them;* but in what part of the female flower, or in what peculiar chemical compouud this narcotic property chiefly resides, is still a matter of doubt.

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* Continued from page 22

* *Five Hundred Points of Good Husbandry.* London edition of 1812, p. 167.

* *Ale* was the name given to unhopped malt-liquor before the use of hops was introduced. When hops were added, it was called *beer*, by way of distinction, I suppose, because we imported the custom from the Low Countries, where the word beer was, and is still, in common use. Ground ivy (*Glechoma hederacea.*) called also alehoof and tunhoof, was generall employed for preserving ale before the use of hops was known. "The manifold virtues in hops," says Gerard, in 1596, "do manifestly argue the holesomeness of *beere* above *ale*, for the hops rather make it physicall drink to keep the body in health, than an ordinary drink for the queuching of our thirst."

To the general reader it may appear remarkable, that the chemistry of a vegetable production, in such extensive use as the hop, should still be so imperfect—our knowledge of its nature and composition so unsatisfactory. But the well-read chemist, who knows how wide the field of chemical research is, and how rapidly our knowledge of it, as a whole, is progressing, will feel no surprise, He may wish to see all such obscurities and difficulties cleared away, but he will feel inclined rather to thank and praise the many ardent and devoted men, now labouring in this department, for what they are doing, than to blame them for being obliged to leave a part of the extensive field for the present uncultivated.

Among largely used narcotics, therefore, especially in England, the hop is to be placed. It differs, however, from all others we have mentioned, in being rarely employed alone, except medicinally. It is added to infusions like that of malt, to impart flavour, taste, and narcotic virtues. Used in this way, it is unquestionably one of the sources of pleasing excitement and healthy tonic action, which well-hopped beer is known to produce upon those who drink it. Other common vegetable productions will give the bitter flavour to malt liquor. Horehound, wormwood, and gentian, and quassia, and strichnia, and the grains of paradise, and chicory, and various other plants, have been been used to replace or supplant the hop. But none are known to approach it in imparting those peculiar qualities which have given the bitter beer of the present day so well merited a reputation.

Among our working classes, it is true, in the porters and humbler beers, they consume and prefer, the *Cocculus indicus* finds a degree of favour which has caused it, to a considerable degree, to take the place of the hop. This singular berry possesses an intoxicating property, and not only replaces the hop by its bitterness, but to a certain extent also supplies the deficiency of malt. To weak extracts of malt it gives a richness and *fulness in the mouth*, which usually imply the presence of much malt, with a bitterness which enables the brewer to withhold one-third of his hops, and a colour which aids him in the darkening of his porter. The middle-classes in England prefer the thin wine-like bitter beer. The skilled labourers in the manufacturing districts prefer what is rich, full, and substantial in the mouth. With a view to their taste, it is too often drugged with the *Cocculus indicus* by disreputable brewers; and much of the very beastly intoxication which the consumption of malt liquor in England produces, is probably due to this pernicious admixture. So powerful is the effect of this berry on the apparent richness of beer, that a single pound produces an equal effect with a bag of malt. The temptation to use it, therefore, is very strong. The quantity imported in 1850 was 2359 cwt., equal to a hundred and twelve times as many bags of malt; and although we cannot strictly class it among the narcotics we voluntarily indulge in, it may certainly be described as one in which thousands of the humbler classes are compelled to indulge.

It is interesting to observe how men carry with them their early tastes to whatever new climate or region they go. The love of beer and hops has been planted by Englishmen in America. It has accompanied them to their new empires in Australia, New Zealand and the Cape. In the hot East their home taste remains unquenched, and the pale ale of England follows them to remotest India. Who can tell to what extent the use of the hop may become naturalised, through their means, in these far-off regions? Who can predict that, inoculated into its milder influence, the devotees of opium and the intoxicating hemp may not hereafter be induced to abandon their hereditary drugs, and to substitute the foreign hop in their place? From such a change in one article of consumption, how great a change in the character of the people might we not anticipate?

This leads us to remark, that we cannot as yet very well explain in what way and to what extent the use of prevailing narcotics is connected, as cause or effect, with peculiarities in national character. But there can no longer be any doubt that the soothers and exciters we indulge in, in some measure as the luxuries of life, though sought for at first merely to gratify a natural craving, do afterwards gradually but sensibly modify the individual character. And where the use is general and extended, the influence of course affects in time the whole people. It is a problem of interest to the legislator, not less than to the physiologist and psychologist, to ascertain how far and in what direction such a reaction can go—how much of the actual tastes, habits, and character of existing nations has been created by the prolonged consumption of the fashionable and prevailing forms of narcotics in use among them respectively, and how far tastes and habits have been modified by the changes in these forms which have been introduced and adopted within historic times. The reader will readily perceive that this inquiry has in it a valid importance, quite distinct from that which attaches itself to the supposed influence of the different varieties of intoxicating fermented drinks in use in different countries. The latter, as we have said, all contain the same intoxicating principle, and so far, therefore, exercise a common influence upon all who consume them. But the narcotics now in use owe their effects to substances which in each, so far as is known, are chemically different from those which are contained in every one of the others. They must exercise, therefore, each a different physiological effect upon the system, and if their influence, as we suppose, extends so far, must each in a special way modify also the constitution, the habits, and the character.

Our space does not permit us, in the present number, to speak of the use of opium and hemp; we shall return to these extensively consumed drugs on a future occasion.

Notes of a Short Tour from Montreal to Portland and the White Mountains.

Although we perceive by a paragraph in the *International Journal*, that the *White Mountain Tour* is over, water having, on the night of the 15th ultimo, frozen an inch thick at the Glen House, at the foot of Mount Washington, we have much pleasure in laying before our readers the following Notes of a visit to that quarter *by a Member of the Institute*, in the hope of its being instrumental in inducing many a Canadian tourist to direct his steps to the same interesting region next season.

Having a short time ago paid a hasty visit, per rail, to the finely situated and beautiful city of Portland, and had the gratification of snuffing the exhilirating sea-breeze at Cape Elizabeth, and having also, on my way back, made a detour from Gorham to the lofty summit of the noted Mount Washington, the monarch of the New Hampshire mountains, I would fain recommend to a few of your readers to follow my example, while the season is favourable, as sure to lead to much enjoyment; so accept, if you please, the following rambling memorandum of my tour.

For particulars respecting the different places passed *en route* to Portland, it would be as well to refer to one of the Guide Books.* But lest our tourist should not be provided with so

* The Portland, White Mountain, and Montreal Railroad Guide, published at Portland, and to be had at Mr. Armour's, in Great St. James Street, is recommended, as having been of considerable use to ourselves, in noting down distances, and directing our attention to many interesting objects and facts.

useful a companion, I would recommend to his particular attention in succession, the interesting scenery in the vicinity of Boucherville mountain, 10 miles from Montreal; and 9 miles further, beyond the river Richelieu, the pretty little village of St. Hilaire, and the fine estate and attractive residence of Major Campbell, the Seigneur of Rouville, to the left, with the wood-clad isolated mountain of Belœil to the right; and, 13 miles further, the cheerful looking thriving town of St. Hyacinthe, situated on the river Yamaska, and noted for its Catholic College. About five miles beyond this, you exchange the cultivated prairie land of the St. Lawrence valley, for a gradually ascending forest tract of country which continues more or less until about 42 miles further you cross the fine river St. Francis, where the line of Railway to Quebec turns off to the left, while that to Portland makes a curve to the South, with the village of Richmond on one bank of the river, and that of Melbourne on the other.

From thence you follow the interesting valley of the St. Francis,—not unfrequently close along the banks, for about 24 miles, when you cross it before arriving at the finely "located" and important rising town of Sherbrooke, the highly promising capital of the Eastern Townships, most eligibly situated, at the confluence of the river Magog with the St. Francis,—and at which it would be well worth while to halt a day, to inspect its various manufactures, and take a ramble among the attractive scenery along the noisy but useful Magog, until it plunges down a succession of rocky declivities, to meet the more placid and broader St. Francis.

Renewing yonr rapid journey, about 3 miles on you pass the pretty village of Lennoxville, chiefly noted for its Episcopal College, and immediately afterwards cross the little river Coaticooke, at its junction with the St. Francis, and follow up the course of the latter, past Compton, to near its source, in a pretty lakelet called Norton Pond,—crossing in the meantime the boundary line between Canada and Vermont, about 127 miles from Montreal; and about 16 farther, you reach the picturesque and prospectively important station and village of Island Pond, so called from the small island on the pretty little lake on which it is situated, 143 miles from Montreal. Soon after passing Island Pond you cross the ridge of the Green Mountains, here 1176 feet above the sea, and forming the boundary between the States of Vermont and New Hampshire.

From this interesting point, you proceed through a highly picturesque Highland tract of country, bounded on either hand by the towering peaks of the White Mountains, (two of which, on the left, are particularly remarkable for their bare, hoary fronts,) *via* Stratford, 15 miles, Northumberland, 12 miles, Milan, 18 miles, and Birlin Falls, 7 miles, to what is indiscriminately called the Alpine and Gorham House, when you have attained an elevation of 802 feet above the level of the sea, and are 201 miles from Montreal, and 91 from Portland.

This being a very commodious and agreeably situated hotel it might be well to remain a day or two here, if you can afford it, to enjoy a ramble among the surrounding Alpine scenery; but that not being at present our intention, let us hasten on to Portland, merely noting by the way that among the most attractive points on this still romantic route are Gilead station, 11 miles—a mile or two before arriving at which the railroad crosses the boundary between New Hampshire and Maine, and from whence, it is worthy of remark, the grade is said to have a descent of 60 feet in the mile;—Mechanics' Falls, 19 miles, Danville Junction, 16 miles, the pretty seaports of Yarmouth, 11 miles, and Falmouth, 6,—and, last of all, Portland, 5 miles, crossing half-way a bridge over a creek or inlet of the sea of about 300 feet—making altogether a journey of 291 miles, accomplished in the short space of 12 hours!

Having enjoyed a day or two in rambling about, and admiring the prosperous interior, as well as the interesting and picturesque environs of "the Forest City," a distinctive appellation deservedly acquired by Portland from the numerous shady trees which embellish its fine, broad streets, let us prepare to return homewards, with the intention of devoting at least one day to a detour from Gorham, to scale the lofty summit of Mount Washington.

No sooner did the cars reach Gorham, than we learnt that a covered four-horse waggon was about to start immediately with a load of tourists for the Glen House, about seven miles distant, near the foot of Mount Washington; and therefore no time was to be lost; so, transferring our cloak and carpet bag from the train to this vehicle, we, (consisting of myself and a worthy friend bent on the same expedition,) joined a merry party of some ten or twelve more, and were soon jolting on our sluggish way, "through woods and wilds," up the rather romantic vale of the stony-bedded little river Peabody, to Glen House,—to find in this sequestered spot a very commodious and comfortable hotel situated on a cheerful, open, rising ground, considered 830 feet above the level of Gorham, and hemmed in on every side by an imposing circle of towering mountains, among the most prominent of which rise Mounts Adams and Jefferson, overlooked by their loftier superior, Mount Washington.

Those only who have visited this singularly situated mansion, can well imagine the imposing grandeur of the surrounding Alpine prospect;—and I will therefore not attempt to delineate it. Suffice it to note, that after a comfortable night's rest and a hearty breakfast next morning, we set out with a party of six or seven others, to encounter the toil of a five mile scramble to the top of Mount Washington, on foot; while a few others, and among these several ladies, preferred doing so on horseback—which, steep and rugged as the path was described to be, we could not help thinking would prove the most toilsome and dangerous mode of travel.

Shortly after leaving the Glen House, you descend into the stony bed of the Peabody, and after crossing it dry-shod, by means of stepping stones and a friendly plank, the path enters dense forest, composed of every variety of trees, such as beech, birch, maple, oak, hemlock, mountain ash, spruce and other kinds of firs, with a tangled undergrowth of various shrubs and plants, so as to shut out the view on every side. We had not advanced above a mile or two up our steep and rugged path, amid rocks and roots, and mud and mire, and begun congratulating ourselves on having wisely preferred journeying on foot; when lo! we were startled by the sound of voices in our rear; and soon after approached and passed us the expected party on horseback, threading their way up the craggy defile at a wonderful rate, at the discretion of their singularly sure-footed little nags. "*Chacun a son gout*," notwithstanding, thought I, as I perceived the riders hurried forward, as it were involuntarily, with their eyes anxiously fixed between the ears of their steeds, while we were left at liberty to halt and take breath, or turn to snatch an occasional glimpse at the imposing scenery above and below us. Even this, however, could not be enjoyed until nearly half-way up, after having exchanged the dense forest for a higher zone or belt of stunted vegetation, consisting chiefly of dwarf spruce and cedars, to be succeeded, about two-thirds from the top, by a dreary tract of utterly shrubless, lichen-clad fragments of rock, scattered in wild confusion, all the rest of the way to the summit.

On at last nearing the anxious object of our pilgrimage, the delighted eye meets in the distance a long, low, rough-built shed, snugly nestled among the shapeless masses of rock, and dignified with the imposing name of the "*Summit House*," or "*Hotel*,"—

with a lofty wooden platform behind it, surmounted by the "star-spangled banner." To this welcome though lowly mansion, we gladly directed our weary steps, assured, from report, that we should find in it every reasonable comfort and accommodation, whether for day or night; and we were not disappointed; finding the interior to consist of one long dining apartment, with the table ready spread,—with a sort of sitting or reading room at one end, and the kitchen department at the other; while along the whole of one side extended a range of small bed-closets or state-rooms, with upper and lower berths, steamboat fashion,—sufficient to accommodate 30 or 40 tourists—if wanted, to double upon emergency, in such out-of-the-way quarters, and who, as we can vouch from experience, will, if not too fastidious, find themselves in all other respects very comfortably fed and cared for, at a very reasonable rate, during their sojourn on so very extraordinary a spot.

After a short rest, to recruit our weary limbs,—for though the distance from the Glen House to the summit is not more than five and a half miles, we found we had taken five hours to ascend, including an hour's rest at different intervals, after quitting the viewless forest region, to enjoy the contemplation of the surrounding singularly imposing panorama, and pick up a few geological specimens, we sallied forth to take a more leisurely survey of the utterly bleak and desolate scene immediately before us, compared with the more cheering diversified distant prospect, with the aid of the large telescope on the top of the neighbouring platform; when lo! what should we observe close by, but a rival *hotel*, of lesser dimensions, dignified with the name of "The Tip-Top House,"—of which more hereafter—my business at present being to attempt to give something of a description of the wild Alpine region around us. Well, I have endeavoured to summon all my descriptive powers; but I find myself unable to do justice to the subject; so must be content to confess myself incompetent to the task, and to beg my readers to go and judge for themselves, and they will possibly find themselves in the same embarrassing predicament. Suffice it then to request the tourist to fancy himself occupying the solitary central point of a vast circle of at least 200 miles in diameter, and looking round on every hand on a retiring succession of five or six ranges of lofty mountains, rising behind each other like gigantic waves in a tempestuous ocean, and he will have some slight idea of the extraordinary scene then before us. Let him then take a glance at the few far-stretching intervening valleys within view, and he will be able to count ten or twelve lakes or lakelets sprinkled about in different directions. And, after again contemplating the towering summits immediately round him, let him gradually take a wider range, and among the various particularly noticeable objects, the Green Mountains of Vermont will be pointed out to him in the western distance, on the one hand, while if the day be favourable, a flitting bright speck may sometimes be seen, on the verge of the south-eastern horizon, near 100 miles distant, which he will be told is a white sail on the Atlantic, near Portland.

The morning on which we ascended Mount Washington had been particularly favourable for a distant prospect; but by the time we reached the summit, a thin purple haze had so veiled the remote landscape, that it was all that we could do to recognize the ocean; and such continued to be the case till towards evening, when the wind rapidly increasing, the wild sunset scene became particularly imposing, from being contrasted with a calm, white bed of fleecy clouds that had gradually enveloped and settled round the neighbouring mountain tops and sides, while a second higher stratum of clouds kept rushing wildly past, and down into the intermediate valleys, without at all disturbing the placid surface of the former, until at last the setting sun became obscured, and darkness gradually veiling the solemn scene, the whole mountain region became enveloped in a winding-sheet of cold, dense mist:—but not before an extra interesting object had been added to the awfully sublime landscape, by the opportunity of, for the first time, gazing at the long-tailed stranger—the Comet,—wending his mysterious way down the western horizon.

Not being quite satisfied with one imperfect evening prospect, we determined to enjoy next morning, if possible, the beauties and splendours of dawn and sunrise; but in this we were doomed to be wofully disappointed;—for the angry spirit of the mountain had, during the night, sent forth from the N. W. a perfect gale, accompanied by a driving, drizzling mist of such density, that in the morning we were obliged to console ourselves with a hearty breakfast, and to make the best of our disappointed way to the lower regions before the storm, by the old rugged path, at the occasional risk of being blown down "at one fell swoop" all the way to Glen House, where, however, we fortunately arrived without accident in somewhat more than three hours, just as the clouds began to pour forth a hearty shower.* A renovated toilet and a hearty dinner soon set all right, and in about an hour afterwards we were *en route*, in spite of wind and rain, back to Gorham House, to be soon after whirled comfortably along by rail as far as Sherbrooke—to halt for a day—where I propose bidding my reader adieu, after putting him in possession of a few more hints regarding the wild mountain region which we have left behind us.

To the mere summer tourist, whose only aim is locomotive novelty as a lover of the romantic, a visit to the White Mountains will ever prove sufficiently attractive; but to those of a philosophic turn, and more especially to the botanical and geological student, it will be still more so, from the opportunity it affords of witnessing, during the ascent, the rapid transition from the warm region of stately forests round their base, to the middle zone of dwarfish evergreens higher up, and the bleak, dark hued and utterly shrubless chaos of scattered rocks, extending at least one-third of the distance to the summit; and he will not be the less surprised to find that, instead of any portion of these rocks being *in situ*, the whole consists of dislocated fragments of every size and form, and in every position, as if the upper portion of the mountain had been upheaved, or rather exploded into the air by some internal force, and the shattered materials had been again deposited in utter confusion, where they now lie.†

The general structure of these fragments is a kind of stratified granite, in many instances passing into micaceous schist, of a very brilliant appearance in the fresh fracture, but where weather-beaten, generally vested with crisp short lichens, imparting a dark gloomy character to the whole scene. To this, however, there are some marked exceptions as in is two venerable spurs of the mountain about half way up, the bare rough surface of which has an imposing hoary aspect, distinct from all the rest, arising perhaps from some extra material producing a more rapid decomposition or disintegration of the superabundant Felspar. But to enable me to know more on this point hereafter, I have brought away a few interesting specimens, to be submitted to the inspection of more scientific friends. Being at the time disposed to attribute the convulsive force alluded to to volcanic action, I looked narrowly round in every direction for some indications of traps, but without success.‡

* One solitary tourist had ventured to attempt the ascent of the Mountain this morning, but was obliged to retreat, after having accomplished two-thirds of his weary pilgrimage, for fear of being blown away.

† For the mere tourist, Summer is, of course, the best season. For the more philosophic admirers of nature, the many-tinted Autumn is to be preferred.

‡ NOTE.—Since the above was in type, the writer had very unexpectedly an opportunity of submitting these specimens to the scientific inspection of Mr. Logan, whose remarks upon them are as follows:—"The specimens from Mount Washington are all granitic, being composed of quartz, feldspar and mica. The constituents are generally so arranged as to give the rocks from which they come a gneissoid

To complete this rambling retrospective memorandum, it is proper to add that the patriotism of our American neighbours has progressively given distinctive names to the principal peaks or summits of this Alpine region, derived from successive Presidents and other celebrated statesmen, as will be further mentioned; but that the appropriate appellation usually assigned to them by the Indians is said to be Waumbecthet Methna, signifying "the mountains of the snowy foreheads," and that the whole range is by them regarded as the abode of Genii, or Guardian Spirits, having the controul of the angry mountain tempests, whom it is advisable to propitiate by sacrifices. The name is in all probability derived from their summits being generally clothed with snow about nine months in the year; but it is also possible that both that and the appellation bestowed by Europeans may be derived from certain remarkable mountains of the group, noticed by all passing travellers as retaining a naked, hoary aspect throughout the whole year, similar to the two lower spurs of Mount Washington above described.

The height of the principal summits of the White Mountains above the sea has been determined by the scientific observations of W. A. Goodwin, Esq., to be as follows:—

Mount Washington	6285	feet.
" Adams	5790	"
" Jefferson	5710	"
and Mount Madison	5361	"

and that of others, by previous measurements, as follows:—

Mount Munro	5349	feet.
" Clay	5011	"
" Franklin	4850	"
and Mount Clinton	4200	"

besides Mount Pleasant, 4715 feet, and several other peaks exceeding 3000 feet, such as Mounts Moriah, Webster, Crawford, &c.

The climate of this elevated region of course differs materially from the plains below. The greatest heat indicated on even the bare, rocky summit of Mount Washington, is said to be seldom above 60°. The greatest cold has not, I believe, been yet ascertained. At times during the summer the thermometer descends below the freezing point. As for instance, a week ago it was, at sunrise, as low as 31°; and on the morning of our visit it was said to have been the same, whereas at sunset it stood at 42, and continued so till next morning, when we commenced our descent; and I afterwards learnt that it only rose seven degrees higher during the day. By a memorandum which I found taken of the range of the thermometer from the 21st to the 27th Aug., inclusive, it would appear that it was as follows:—

DATE.	Sunrise.	Noon.	Sunset.	REMARKS.
August 21	36	46	45	To give correct mean, the middle observation ought to have been taken at 2 P.M., instead of at Noon, and the evening observation at 10 P.M.
" 22	39	41	35	
" 23	33	43	42	
" 24	37	46	45	
" 25	44	42	36	
" 26	31	47	42	
" 27	42	47	49	

It may be added that the whole is perhaps rated a little too high, the thermometer being placed within a few inches of the outside of the glazed window of a warm kitchen, and therefore liable to be more or less influenced thereby. Our landlord, however, insisted that it had been proved that such was not the case.

It only remains to observe that, to enjoy as much as possible of the grand and imposing scenery of the White Mountains, it is advisable not to take any luggage to the Glen-House, but either to leave it at the Gorham Hotel, or send it on to Sherbrooke, and thereby leave the tourist at liberty to descend Mount Washington by some new route, such as by the Great Notch, a stupendous narrow rocky portal or chasm between the steep sides of Mount Webster and Mount Willard, near which there is a convenient Hotel kept by Mr. Gibbs; or, by taking pains to enquire beforehand, he can select some other equally inviting and interesting route, taking care, if time be an object, to arrive at the Gorham station in proper season to rejoin the passing cars.

For the benefit of those who study economy in their movements, it may be proper to note, that the usual expense at the Gorham House is \$1½ a day, and at the more secluded and less frequented Glen Honse, \$2; and that at the Summit House it is \$3; and that, too, is a reasonable charge, considering that every article of consumption, including even wood and coal for a constant fire, is obliged to be brought up on horseback, from below; but it is at the same time necessary to be "pretty much" on one's guard against *extras*, as "they contrive to stick it on at an awful rate," whenever an opportunity offers. The usual coach fare from the Gorham to the Glen House is 75 cents; and that of a horse per day for ascending Mount Washington is \$3.

It may also be here added, that the existence of two hotels on the bleak, solitary summit of Mount Washington, though perhaps beneficial to the public, furnishes an opportune illustration of the reckless go-ahead competition common among our American neighbours; it having no sooner been understood that the original enterprising proprietor of the "Summit House" establishment had made a tolerably good speculation out of it, than up starts another competitor this year, in our neighbour of the "Tip-Top House,"—who, not content with taking the hard-earned morsel out of his rival's mouth, was resolved to usurp his very name and title also, which, it appears, last year rejoiced in the double cognomen of "The Tip-Top, or Summit House." This, however, was too much; and was likely to have produced a serious "blow up;" but it was at last amicably settled, by its being agreed that the elder occupant should retain an undisputed right to the title of the Summit House, and that his junior might assume that of the Tip-Top, or any other higher rank that he pleased. And "*Tip-Top House*," is therefore, now, proudly blazoned on his inviting sign-board. It would appear, however, that a discerning public, respecting the rights of primogeniture, or primo "*entemps*," are determined to continue their patronage to the original enterprizing caterer for their comforts,—for a personal inspection of their respective guest-books, exhibits a flood of no less than 2200 visitors to the Summit House during the season, of whom 16 only were from Canada, while at the other, though intended to be the tip-top of the fashion, as well as of the mountain, the number was as yet not more than 300. So much for unnecessary rivalship.

VALE.

character. They are probably metamorphic. The crystals in one or two, however, are confused aggregate; and these are perhaps derived from granite veins. Some of the specimens hold black tourmaline or schorl, and small pink garnets. The specimens from the two remarkable white looking heights observed in the descent from Mount Washington, appear to be true granite. They are composed of opaque, white feldspar, in a state of partial decomposition, colourless, transparent quartz, and silvery mica; and the mass of rock from which they are derived is probably intrusive."

Variations in the Level of the Lakes.*

The year 1819 was one of low water on all the lakes, the low-

* Continued from page 25.

est, indeed, in memory, and was taken by Dr. Houghton† as his zero of comparison; referred to this zero, the highest level of Lake Michigan was,—

	Ft.	In.
In 1819	0	0
1830	2	0
1836	3	8
1837	4	3
1838	5	3
1839	3	11
1840	2	7½

Thus, it was 19 years in attaining its maximum, but only 2½ in reducing it to one-half. The following variations in the level of Lake Erie, in 1852, were recorded by C. Whittlesey, Esq., of Cleveland‡:—

	Monthly Mean. Ft.	In.
January	3	6
February	3	4.2
March	2	11.6
April	1	11.3
May	1	4.0
June	1	1.2
July	1	2.5
August	1	5.1
September	1	9.4
October	2	0.6
November	2	3.3
December	2	4.1

Capt. H. T. Spencer, recorded the variations in the level of Lake Ontario, at the mouth of the Genesee, during the years 1846—1852, both inclusive; they are as follow:

	1846.		1847.		1848.		1849.		1850.		1851.		1852.	
	ft.	in.	ft.	in.	ft.	in	ft.	in.	ft.	in.	ft.	in.	ft.	in.
January 1	3	3	3	0	1	5	3	2	2	9	2	8	3	3
February 1	3	6	2	5	1	10	3	2	2	4	3	6	3	3
March 1	3	0	2	0	2	7	3	4	2	4	3	0	3	0
April 1	2	9	2	0	2	2	2	10	2	4	2	11	2	8
May 1	2	6	1	5	2	2	2	0	1	8	2	8	1	2
June 1	2	3	1	1	2	1	1	9	1	5	2	2	1	2
July 1	2	3	1	1	2	2	2	8	1	10	1	11	0	10
August 1	2	6	1	1	2	3	2	3	2	10	2	2	1	0
September	2	9	2	0	2	8	2	9	2	11	2	6	1	6
October	2	9	2	3	3	1	2	2	3	4	2	11	0	11
November 1	3	0	2	7	3	6	2	2	3	7	3	5	2	2
December 1	2	9	2	10	3	5	2	5	2	7	3	3	1	10
" 31	3	0	1	5	3	2	2	9	2	8	3	8	1	11
Average	2	0	1	11	2	6	2	6½	2	6	2	9½	1	11

The measures were taken from the top of the dock, and reduced to one point of observation. Of course the less the measure, the higher the level of the water of the lake. The highest was in July, 1852, and the lowest in November, 1850; the difference being two feet nine inches.

In continuation of the table of observations by Mr. Stewart, given on page 27 of the last number of this journal, we append those for September and part of October. The present gradual fall of the water is very evident; but if we may reason from the very crude and imperfect observations which we have been able to procure, it will soon become stationary and remain so until it begins again to rise in the spring. The greatest height recently attained by Lake Ontario above the low water mark of October 28, 1849, is four feet five inches, according to measurements made at Toronto. Since June 1st of the present year, it has fallen in four months and fifteen days only twenty-one inches; whereas in 1849, the water fell in three months and twenty days, twenty six inches.

Observations made at Gorrie's Wharf by Mr. G. A. Stewart, 1853:

September.				October.			
Day.	Hour.	Height of Water.	Wind.	Day.	Hour.	Height of Water.	Wind.
7	10 A.M.	3.28	----	1	3 P. M.	3.37	S.W.
8	12 Noon	3.35	W	3	11 A. M.	3.17	N.W.
10	12 Noon	3.28	W	6	3 P. M,	3.06	N.W.
16	11 A.M.	3.40	W	7	5 P. M.	3.20	S.W.
20	12 Noon	3.50	----	8	3 P. M.	3.20	S.W.
24	11½ A.M	3.32	W	15	3 P. M.	2.98	
26	4 P. M.	3.42	E				
27	12 Noon	3.32	E				
29	11 Noon	3.40	S.E.				

Among the most interesting phenomena which may be classed under variations in the level of the lakes, are the sudden elevations and depressions which have been recorded from time to time as occurring chiefly on the shores of Canada and the State of New York. It is much to be regretted that accurate observations of these fluctuations do not appear to have been made. The data at our command are exceedingly meagre, and scarcely do justice to the very interesting phenomena to which they refer.

In a communication to the *Cobourg Star*, dated Grafton, Jan. 9, 1847, the writer, Mr. Thomas Thompson, states that "A most singular phenomenon occurred at this place (Grafton) yesterday afternoon, about three o'clock. The lake was calm, and the wind in the north, when suddenly the lake receded from the shore in one immense wave upwards of 350 feet, leaving the the beach perfectly dry for that distance; it seemed to gather itself into a vast cone, and immediately returned in one unbroken wave, four feet higher than it usually is, burying the wharf completely, and overflowing its usual boundaries upwards of a hundred yards, sweeping everything before it, accompanied by a dreadful noise. This happened eight or nine different times, gradually decreasing in violence, until the lake assumed its natural appearance." The effects of this disturbance were felt as far as Port Hope unaccompanied by any noise.

The same paper records another disturbance as having taken place in Rice Lake, twelve miles north of the town of Cobourg. "Last Thursday, (January 14, 1847,) the lake was seen to be in great commotion, the ice (81 inches thick,) undulating in every direction. Presently it burst with a noise like thunder, and a

† Report of the State Geologist, Michigan, 1841, p. 162.

‡ Extracted from the Regent's Report for 1853.

large piece from the centre of the lake was for a few minutes thrown up in a pile to the height of ten feet, in which position it now lies."

On September 20th, 1845, a very sudden rise occurred at Cobourg. An eye-witness describes the scene in the following words :—"I measured the rise of water at the time, and found it to be two feet seven inches; the lake was quite calm; a strong current, like a tide, ran in and out of the harbour every ten minutes; when the water approached the shore it ran no less than 300 feet up the sloping beach above our usual high water mark. About the same time a similar phenomenon was observed at Grafton, seven miles below Cobourg, but with this difference, the water a few hundred feet from the shore was boiling as you see it in the lesser rapids of the St. Lawrence. When stationed at Whitby Harbour, some years ago, I observed a regular tide rising and falling every ten minutes in a pretty strong current. I have been a good deal on the back lakes, but never observed anything of the kind there."

The 5th July, 1850, witnessed a similar occurrence on the northern shore of Lake Ontario, near the scene of the other convulsions mentioned above.

Robert Stephenson, M. P.*

The Britannia Bridge has usually been considered as the greatest triumph of Engineering skill in existence, and as eclipsing all other of Stephenson's works; in originality and boldness of conception, this is doubtless the case, but we doubt whether, in wonderful results, and in their effects on the progress of the world, it can at all be compared with the "ROCKET;" the result of the determination recorded in our last paragraph, and of which so little is popularly known that our American neighbours have claimed the honours of the Liverpool and Manchester competition in 1829, for Ericson, while many of his own countrymen are ignorant as to whether the success was due to Robert Stephenson or to his Father.

In the Locomotive, as in other machines which have received improvements from various persons, it is difficult—often impossible—to determine the exact amount of merit due to each individual improver, but of this there can be no doubt: to Robert Stephenson belongs the merit of combining and arranging principles—many of which were, without doubt, previously known—into such a form that no essential change in the machine has since been made. As Watt perfected all that is unchangeable in the Stationary Condensing Engine, so did Robert Stephenson combine in the Rocket all the *fixed* principles which obtain in the construction of the most finished and most powerful Locomotive of the present day. Others have contributed to that success, and we believe no one is more ready to acknowledge their merits than is the inventor of the "*Rocket.*"

We have already seen that Trevithick had used the blast pipe, and that Harkworth had subsequently applied it, but its value was of little importance with boilers as constructed by them. Another improvement, however, patented by a French Engineer in 1828, although vital to the success of the machine, was of no value without it.

*Continued from page 40.

The imperfect Locomotives of that date had been introduced into France; the first two were made by George Stephenson, and arrived there in 1829, for the Lyons and St. Etienne Railway, of which M. Siguin was Engineer. Their mean velocity did not exceed 4 miles per hour; to increase this, M. Siguin felt the necessity of increasing the evaporating power of his boiler, and to effect that object resolved to apply the improvement above alluded to, of which he was the patentee, to an Engine he was about constructing (on the model of Stephenson's). His plan consisted in dividing the current of heated air passing through the boiler from the furnace to the chimney, into a number of streamlets, flowing through a series of tubes immersed in the water of the boiler. The amount of heating surface was thus greatly increased. But another difficulty presented itself : the evaporating surface to which we are indebted for our present increased speed was there, but the friction of the air passing through so many small tubes so much impeded the draft that the height of the chimney being unavoidably limited, it became necessary to apply a fan to stimulate it; by this expedient the experiment was rendered partially successful. It is claimed by a French Author that M. Pelletin suggested the application of the steam jet in the chimney; be that as it may, it had long been used in England, though for the reason above named, only partially so, as might be inferred by its absence in the Engines sent to France.

As the success of the Rocket has been considered the commencement of the era of successful steam Locomotion, a description of that Engine, of the others which entered into competition with it, and of the result of the several trials, will not be out of place, we therefore transfer the following particulars of them to our pages:—

Three Locomotives were put in for competition, viz:

Engine.		*Make.*
Rocket,........	by........	R. Stephenson, Newcastle.
Sanspariel......	by........	Timothy Hackworth, of Thildon.
Novelty,........	by........	Braithwaite & Ericeson, London.*

The Rocket was the first locomotive made in England with multitubular boilers. They were adopted by Robert Stephenson, at the suggestion of Mr. Booth, then Secretary of the Liverpool and Manchester line, to whom their invention has commonly been ascribed. The boiler was cylindrical with flat ends, 6 feet long, and 3 feet 4 inches in diameter; the fire-box, at the rear of the engine, was 2 feet by 3 feet broad, and 3 feet deep, inside measure, and was surrounded on the two sides, the front and the top by an external case, affording a three-inch water space. The flue consisted of 25 tubes, 3 inches diameter ; the cylinders, two in number, placed obliquely next the fire-box, and working the fore-wheels, were 8 inch by 16½ inch stroke; driving-wheels 4 feet 8½ inches in diameter; the exhaust pipes were originally arranged to deliver the steam directly into the atmosphere, under the impression, no doubt, that the abundance of heating surface unaided would have commanded an abundance of steam.

After some preliminary trials, however, previous to the competition, during which the superior evaporating powers of the Sanspareil, with a sharp blast from the exhaust directed upwards into the chimney, became apparent, it was resolved to discharge the exhaust steam of the Rocket into the chimney, and on the eve of the first day of the trial the exhaust-pipes were diverted into the chimney, with an upward termination. The fire-grate surface was 6 feet, fire-box surface 20 feet, tube surface 117.75 feet.

* Engravings of these Engines will appear in the next number of the *Journal.*

The Sanspareil had a cylindrical boiler 4 feet 2 inches diameter, and 6 feet long. The grate and chimney were situated at one end of the boiler, and connected by a single flue tube, with one bend, 24 inches in diameter at the grate, and 15 inches at the chimney. The grate was five feet long by two feet broad, and was overhung by the boiler by the addition of semicircular water chambers. The steam was thrown into the chimney to stimulate the draft by means of the blast-pipe as already applied to the Royal George. The violence of the draft so produced became very evident during the experiments, The two cylinders 7 inches by 18 inches stroke, were placed vertically over one pair of wheels, and the four wheels were 4½ feet diameter, coupled. The grate surface was 10 feet; fire-box surface 15.7 feet, and tube surface 74.6 feet.

The Novelty was peculiarly constructed. The fire-box was like that of the Rocket, placed at one end, inveloped in the water of the boiler; it was 18 inches diameter, close at the bottom, and fed through an air tight hopper. The flue was a single tube 4 inches diameter at the fire-box, 3 inches at the chimney, and 36 feet long, traversing the boiler three times. The fire was urged by bellows situated near the chimney. The engine had but one cylinder, 6 inches by 12 inches stroke; placed vertically, and driving one pair of wheels, 4½ feet in diameter, by means of bell cranks. The steam was exhausted directly into the atmosphere. Grate surface 1.8 feet; fire box surface 9.5 feet; tube surface 95 feet.

The respective weights of these Engines and their loads in working order, were as follows:—

	TONS.	CWT.	QRS.	LBS.	TONS.	CWT.	QRS.	LBS.
Rocket Engine weight					4	5	0	0
Tender	3	4	0	2				
Two loaded Carriages	9	10	3	26				
Drawn weight					12	15	0	0
Total weight of Train					17	0	0	0

	TONS.	CWT.	QRS.	LBS.	TONS.	CWT.	QRS.	LBS.
Sanspareil Engine weight					4	15	2	0
Tender	3	6	3	0				
Three loaded Carriages	10	19	3	0				
Drawn weight					14	6	2	0
Total weight of Train					19	2	0	0

	TONS.	CWT.	QRS.	LBS.	TONS.	CWT.	QRS.	LBS.
Novelty Engine, weight, exclusive, of Tank					3	1	0	0
Tank loaded	0	16	0	14				
Two loaded Carriages	6	17	0	0				
Drawn weight					8	13	0	14
Total weight of Train					10	14	0	14

The Drawn Weights attached to the Rocket and the Sanspareil, were the regulation loads—three times the weight of the engines,—as the Novelty had no Tender, the same carrying weight was assigned to it in proportion the exclusive weight of the engine that existed in the experiment with the Rocket.

The Rocket was the only engine that accomplished the distance of 70 miles. Its average speed was 13.8 miles per hour the greatest velocity in any one trip was 29 miles per hour. The consumption of Coke per mile per ton of total load of Train was 0.91 lbs., and per cubic foot of water evaporated 11.9 lbs., the evaporation, 18.24 cubic feet of water per hour."

"The Sanspareil ran a distance of 27.5 miles, average speed, 14 miles; greatest speed, 22.6 miles; Consumption of Coke per ton per mile of total load, 2.41 lbs., and per foot of water evaporated, 28.8 lbs.; evaporation, 24. feet of water per hour."

"The Novelty, by a series of unfortunate accidents, failed twice in the midst of experiments. The engine with its load, traversed the Stage at 15 miles per hour. * * *

* At a subsequent trial on the experimental stage, after some alterations, the engine conveyed a total average load its own weight included, of 28.5 tons, at an average speed on the stage of 8 miles per hour; the Coke consumed per hour, was 84 lbs., during 6¼ hours, the bellows being at work during the whole of that time. The consumption was therefore, equivalent to 0.36 lbs., per ton per mile."

These trials established the advantages of an extended flue surface, which the arrangement adopted by Mr. Stephenson, had brought into useful operation; he now set himself to make further improvements, and these he embodied in two other engines constructed on the same principle as the Rocket.

SECOND REPORT of the Special Committee of the Literary and Historical Society of Quebec, appointed to Report upon Mr. Foucault's Pendulum Experiment.

Your Committee, having undertaken to make this experiment with all the care possible, have much pleasure in submitting the following report on the results obtained by them:—

A carefully turned spherical ball of lead 5.2 inches in diameter, and weighing 17 lbs., was procured for the weight, and suspended in the passage of the "Quebec Music Hall," where a height of 60 feet was obtained. This weight was suspended by a fine steel wire 0.15 inches in diameter, on one end of this wire a fine screw was turned, by means of which the wire was fastened to the plate from which the pendulum was suspended.

The method of suspending the pendulum was similar to that adopted by your Committee in their former experiment. A small spherical ball of brass was ground into a hemisphere in a plate of the same metal; a hole was drilled through the centre of the hemisphere for the wire, and sufficiently large to allow the pendulum to vibrate in the required arc without coming into contact with the plate; the wire was secured into the ball of suspension.

This arrangement being completed, the weight was attached to the lower extremity of the wire, so as to hang within one inch of the floor.

In order to start the pendulum for the experiments, a cotton thread was passed round the ball and tied over two pins on a heavy moveable block. When the weight secured in this manner had been brought to a state of rest, the thread was fired with a taper, and the pendulum commenced vibrating, the thread falling to the ground. A circle 10 feet in diameter was described on the floor from a centre under the point of suspension, and graduated into degrees, by which the progress of the pendulum was measured.

The first experiments gave a deviation from the calculated angle of about 1°40′ an hour. This was subsequently accounted for and corrected, the wire being observed to touch the under surface of the brass plate at the extremity of each vibration. Your Committee consider this worthy of remark, as showing how slight an irregularity at the point of suspension was sufficient to produce an error that would have vitiated the whole of the experiments.

The first observations were made on the night of the 13th May, 1853, but were rejected from the cause mentioned above. The observations recorded were made on the 14th, 15th, 16th, 19th and 20th of the same month. The results are given in detail in the tables.

The first series of observations gives the angle actually moved through in 47 h. 18 m. (after applying the correction for the progression of the apse due to elliptic motion) only 1° 56′ less than that calculated. The second series gives an error of 2° 2′ in 23 h. 10 m. These errors may be represented in time by about 9 and 12 minutes, and your committee consider that these experiments agree so nearly with the calculation as to be very strong corroborative evidence of the correctness of theory that the time taken by the plane of vibration to perform a complete revolution, varies as the line of the latitude.

It may not here be out of place to give a short explanation of the accompanying tables: columns (1) & (2) refer to the times of observation: (3) denotes the nature of the ellipse showing if there be no elliptic motion, or if elliptic motion, whether it is progressing or retarding. Column (4) shows the angle observed (5) the angle moved through, (6) the time between the observations, and (7) the apparent error, (8) shows the angle corrected for elliptic motion, (9) the angle calculated, and (10) the difference+or—between the calculated angle and the corrected angle.

Your committee have great satisfaction in submitting the results of the different experiments. In some instances they have varied considerably from the calculated angles, but in all these, the fact that the pendulum had acquired a corresponding elliptic motion would seem to indicate some local cause of disturbance, while in all the experiments in which there was no elliptic motion, the angles as nearly as could be measured were equal to those calculated by theory.

The whole respectfully submitted.

A. NOBLE,
Lt. R. A. & V. P.
W. DARLING CAMPBELL.

Quebec, July 1853.

From. 1	To. 2	Ellipse. 3	Angle observed. 4	Angle moved through. 5	In what time. 6	Error. 7	Angle corrected. 8	Angle calculated. 9	Difference. 10	
H. M. S.	H. M. S.		° ′	° ′	H. M. S.	° ′	° ′	° ′	° ′	
10 36 0	11 53 0	R.	14 45	14 45	1 17 0	+0 30	....	14 14.1	+0 30	Started N. and S.
12 3 0	2 0 30	N.	35 45	21 0	1 56 30	—0 28.6	....	21 28.6	—0 28.6	
2 0 30	3 36 0	N.	53 20	17 35	1 36 0	+0 8.3	....	17 26.7	+0 8.3	
3 36 0	4 6 0	N.	58 40	5 20	— 30 0	—0 8.9	....	5 28.9	—0 8.9	
4 17 0	5 17 0	R.	71 0	10 0	1 0 0	—0 57.7	10 50	10 57.7	—0 7.7	
5 21 0	6 21 0	R.	84 4	10 10	1 0 0	—0 47.9	11 0	10 57.9	+0 2.1	
6 24 0	7 36 0	R.	98 30	12 30	1 12 0	—0 38.1	13 0	13 8.9	—0 8.9	
7 52 0	8 53 0	N.	113 0	11 0	1 1 0	—0 8	....	11 8	—0 8	
8 53 0	11 10 0	....	136 10	23 10	2 17 0	—1 50	....	25 1	—1 50	No elliptic motion recorded.
11 20 0	4 34 0	N.	193 0	56 50	5 14 0	—0 32	....	57 22	—0 32	
4 34 0	7 22 0	P.	226 0	33 0	3 48 0	+2 45	32 20	30 16	+2 4	
7 46 0	10 30 0	N.	261 0	31 0	2 44 0	+1 46	....	29 55.4	+1 46	
10 30 0	10 40 0	N.	264 30	3 30	— 20 0	—0 8	....	3 38	—0 8	
10 57 0	12 57 0	R.	288 0	21 30	2 0 0	—0 25.8	21 52.8	21 55.8	—0 3	Ellipse ret. slightly.
2 11 0	3 11 0	R.	369 56	19 56	2 0 0	—2 0	20 56	21 55.8	—0 59.8	
3 24 0	5 38 0	R.	332 30	20 30	2 14 0	—3 56.4	21 35	24 28.6	—2 53.6	
5 56 0	9 45 0	R.	18 30	40 30	3 49 0	—1 21.2	41 25	41 51.2	—0 26.2	
10 0 0	12 0 0	R.	43 5	21 40	2 0 0	—0 15.8	21 55.8	21 55.8	....	Ellipse ret. sliightly, for which allow +15′.8.
12 0 0	2 0 0	P.	66 0	22 55	2 0 0	+1 0	23 1	21 55.1	+0 45	
2 12 0	6 12 0	R.	110 30	42 30	4 0 0	—1 21.6	43 51.6	43 51.6	....	
6 33 0	11 53 0	N.	174 10	59 10	5 20 0	+0 42.5	....	58 27.5	+0 42.5	
					47 18 0	—8 8.2			—1 56.8	

From. 1	To. 2	Ellipse. 3	Angle observed. 4	Angle moved through. 5	In what time. 6	Error. 7	Angle corrected. 8	Angle calculated. 9	Difference. 10	Axes. Max.	Axes. Min.
H. M.	H. M.		° ′	° ′	H. M.	° ′	° ′	° ′	° ′		
4 11	7 11	R.	30 46	30 46	3 0	—0 10		32 53	—2 3.5	15	1/6
7 50	9 45	R.	53 14	22 34	1 55	+1 33	22 51.3	21 1	+1 50.3	22	1/4
9 55	10 44	R.	62 12	8 58	— 48	+0 1	8 58	8 57	+0 1	..	—
10 44	1 1	R	86 35	24 23	2 17	—0 39	24 44.1	25 2	—0 17.9	15	1/4
1 29	2 59	R.	100 50	14 15	1 30	—2 11	15 29	16 24	—0 57	30	1
3 8	6 8	R.	129 0	28 10	3 0	—4 43	29 24	32 53	—3 29	15	1
6 20	8 50	R.	151 30	22 30	2 30	—4 54	23 29.2	27 24	—3 54.8	18	4·5
9 20	11 20	R.	172 20	20 55	2 0	—1 0	21 32.8	21 55	—0 22.2	23	1/6
11 34	2 43	P.	209 40	37 20	3 9	+2 54	36 52.8	34 30	+2 22.8	14	3/8
2 55	5 55	P.	248 0	38 20	3 0	+5 27	37 40.5	32 53	+4 47.5	16	1/3
					23 10	—5 45			—2 2.8		

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Library of the Canadian Institute.

Through the liberality of A. H. Armour, Esq., of Toronto, the Library of the Canadian Institute has just received a very valuable addition to its collection of Books and Maps. The volumes presented consist of the magnificent Report of David Dale Owen, U. S. Geologist, on the "Geological Survey of Wisconsin, Iowa, and Minnesota, and incidentally of a portion of Nebraska Territory," accompanied by a quarto volume of Plates and Maps illustrative of the work. Also, of the annual Report of the Superintendent of the Coast Survey, and a quarto volume of sketches accompanying the Report. We understand that Mr. Armour is indebted to the politeness of the Hon. J. M. Brodhead, second Comptroller of the U. S. Treasury, for these valuable documents. The importance of procuring works of this character for the Library cannot be too highly estimated, and we gladly avail ourselves of the earliest opportunity of acknowledging the uniform zeal which Mr. Armour has manifested in promoting the interests of the Canadian Institute.

Twenty-Third Meeting of the British Association for the Advancement of Science.*

The following recommendations were adopted at a Meeting of the General Committee:—

Involving Grants of Money.

That the sum of £200 be placed at the disposal of the Council for the maintenance of the establishment of the Observatory at Kew.

That the Committee appointed to investigate the physical aspect of the Moon be requested to endeavour to procure Photographs of the Moon, from telescopes of the largest size, which can be made available, with £25 at their disposal for the purpose.

That the expense of certain Thermometers constructed for the inquiry on conduction of heat, by Professor Forbes, amounting to £1 2s. be paid.

That Dr. Hodges be requested to continue his investigations on Flax, with £20 at his disposal for the purpose.

That Mr. Rankine, Dr. Robinson, Prof. Hodgkinson, and Mr. Ward, be requested to continue the Report on the Cooling of Air in Hot Climates, with £20 at their disposal for the purpose.

That Mr. Fairbairn be requested to prepare a Report on the effects of Temperature on Wrought Iron Plates, with £30 at his disposal for the purpose.

That Mr. Mallet be requested to continue his experiments on Earthquake Waves, with £50 at his disposal for the purpose.

That Dr. Lankester, Prof. Owen, and Dr. Dickie be a Committee to draw up Tables for the Registration of Periodical Phenomena, with £10 at their disposal for the purpose.

That Dr. Lankester, Prof. E Forbes, and Prof. Bell, be requested to assist Dr. T. Williams in drawing up a Report on British Annelida, with £10 at their disposal for the purpose.

That Mr. Hyndman, Mr. Patterson, Mr. Dickie, and Mr. Grainger, be requested to carry on a system of Dredging on the North and East Coasts of Ireland, £10.

That Mr. H. E. Strickland, Dr. Daubeny, Prof. Lindley, and Prof. Henslow be requested to continue their Experiments on the vitality of Seeds, with £5 10s. at their disposal for the purpose.

That the Committee for providing a large outline Map of the World, consisting of Sir R. I. Murchison, the Lord Bishop of St. Asaph and the Secretaries of the Royal Geographical and Ethnological Societies, be re-appointed with the addition of Sir James Ross and Dr. R. G. Latham, with £15 at their disposal for the purpose.

Not involving Grants of Money or Application to Government or Public Authorities.

That Lieut-Col. Portlock, Prof. James Forbes, Mr. Mallet, Mr. Phillips, Dr. Robinson, Col. Sabine, and Professor Stokes, be requested to consider and report upon the best form of apparatus for registering the direction and amount of Earthquake.

That Dr. Gladstone be requested to continue his inquiries on the Influence of Light on the Vitality of Plants.

That Mr. Robert Hunt be requested to continue his investigation of the Chemical Action of the Solar Rays.

That the following gentlemen be a Committee to report on the best means of preserving Pyritous and other specimens of Organic remains which are liable to decomposition, viz.: J. S. Bowerbank, Esq., Prof. Johnston, J. E. Lee, Esq., H. E. Strickland, Esq.

That Mr. Spence Bate be requested to give a report on the present state of our knowledge of the Lower Forms of British Crustacea.

That Mr. Fairbairn's account of Experimental Researches to determine the Strength of Locomotive Boilers, and the causes which lead to explosion, be printed, entire, among the Reports.

That the Kew Committee be requested to furnish a Report to the Council, on the Definition of the Boiling Point of Water at present adopted in this country, for the Thermometric Scale; and that the Council be requested to communicate with the President and Council of the Royal Society; should any change in that respect be deemed desirable.

That Prof. Johnston be requested to furnish a Report on the relations of Chemistry to Geology.

That the following papers with the consent of the authors, be printed in full in the Transactions of the British Association for the year 1853: —James Oldham, Esq., 'On the Physical Features of the Humber;' 'On the Rise, Progress, and Present Position of Steam Navigation in Hull' J. P. Bell, Esq., M. D., 'Observations on the Character and Measurements of Degradation of the Yorkshire Coast.'

That Mr. John Frederick Bateman, C. E., F.G.S., be requested to Report on the State of our knowledge on the Supply of Water to Towns.

That the thanks of the British Association be given to the Parliamentary Committee for the unceasing attention they have paid to the interest of Science, both in communications to Government, and in proceedings in the Houses of Parliament.

The Members of the British Association have learned with satisfaction that it is the intention of Government to direct, that in future daily Meteorological Observations shall be made at sea, in correspondence with the plan adopted by the Government of the United States, on the suggestion of Lieut. Maury, and take such further steps, in reference to the Mercantile Marine of Great Britain, as may be best suited to stimulate and encourage the Masters of British Merchant Ships to take interest in investigations by which the times of passage between different ports have already, in many instances, been materially shortened, and which may lead to other results of the greatest importance to practical navigation.

The British Association entirely concurs in the opinion that to make the Observations thus contemplated serviceable for the purposes which they are designed, it will be necessary to make provision for their coordination, and for deriving from them the instruction which they may be capable of yielding, primarily for the advantage of navigation and secondarily, for the benefit of Science.

In this view the General Committee requests that the Council will communicate on the subject with the Parliamentary Committee, and will take such steps, either by deputation to Government or otherwise, as may appear to them desirable.

That Col. Sabine be requested to draw up a Report on the principal magnetic results obtained at the Magnetic Observatories.

Involving Application to Government.

That as great inconvenience is frequently occasioned by the injury or destruction of instruments and specimens, arriving from foreign parts arising from careless re-packing at the Custom House, it be referred to the Council to consider of the best mode of representing this to the Government, and of remedying the evil.

SECTION A.—MATHEMATICAL AND PHYSICAL SCIENCE.

Col. Sabine opened the Section by apologizing for the absence of the President.

'*Continuation of Report on Luminous Meteors,' by the* REV. PROFESSOR POWELL.—The Report contained tabulated records of observed meteors

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* *Athenæum.*

classified under three general heads:—I. Older observations recorded of Luminous Meteors. II. Continuation of Catalogue of Luminous Meteors from the Report of 1851-2. III. An Appendix, containing letters and drawings, giving a more detailed account of some more Remarkable Meteors. The number of meteors tabulated under the second head was very large. The records were preserved under the following heads:—1. Date; 2. Hour and minute when seen; 3. Appearance or magnitude; 4. Brightness and Colour; 5. Train, or sparks; 6. Velocity, or duration; 7. Direction, or altitude; 8. General Remarks; 9. Place; 10. Observer; 11. Reference. This report gave rise to a very animated and long sustained conversation.

Mr. Grove explained the three opinions advanced as to the possible origin of these interesting objects. At one time it had been maintained that they were bodies projected upon the earth from the moon; next, it had been supposed that they had a chemical oirgin in our own atmosphere;—and lastly, it was held that they were probably planetary bodies whose orbits traversing that of the earth when they met at a node, the planetary mass falling into our atmosphere ignited and put on one of the varied phases of a meteor. Mr Grove stated, that the first opinion was now universally abandoned;—that the second though still claiming supporters, was not considered the most probable;—and that the third opinion was all but universally now received among scientific men as the most probable account of their origin. He fortified each of these statements, giving the leading reasons which led to the rejection or adoptio nof each.

'*On the Composition and Figuring of the Specula for Reflecting Telescopes*,' by Mr. Sollitt.—The writer commenced by stating that he had given his attention to this subject for years, and that he was more than ever convinced of its importance by the decided conclusion to which facts had led him that reflectors, when once well and carefully made, were far less apt to deteriorate than refractors. In order to be intelligible to the Section, it was necessary for him to go over some ground familiar to the public since the researches of Lord Rosse, Mr. Lassell and Mr. Nasmith. He stated that he considered it to be a matter of prime importance that the copper and tin should be used in exact atomic proportions He, following the numbers given by Berzelius, used the following proportions—copper, 32; tin, 17·4. Lord Rosse's are, copper, 32; tin, 14 9. As the metal when thus composed was very hard, brittle, and difficult to work, he found that he could render it capable of reflecting white light equally well, if not better; and at the same time of taking a very uniform and beautiful polish, by introducing a little nickel in place of the tin,—and the following proportions he found on trial best:—copper 32; tin, 15 5; nickel, 2. He also found the introduction of a very small quantity of arsenic useful in preventing the oxidation of the tin when melting. Silver, as used by Mr. Lassell, he also found excellent; but he was against the use of fluxes, as most injurious. The author passed over the casting and grinding with very slight notice; but dwelt on the composition and figuring of the polisher as of great importance. The composition as used by him was pitch resin, and a small admixture of flour was found useful. The surface he grooved with concentric equidistant circular grooves,—and not in parallel and cross grooves, as used by Lord Rosse and Mr. Lassel.— These concentric grooves he crossed by radial grooves, widening as they receded from the centre, so as to be bounded by curved outlines. By giving proper form and dimensions to these curves the parabolic form could be most accurately given to the speculum in the process of polishing. The form of the curved outlines of these radial grooves he found should be parabolic. He concluded by stating the importance of not having the speculum too thin, and of using proper precautions in mounting and supporting it, to avoid any chance of the form being altered.

Dr. Scoresby regretted that having been in another Section he had not heard the early part of the communication of Mr. Sollitt; but he rather thought Lord Rosse used concentric grooves in his polisher as well as parallel and cross grooves. Prof. Stevelly confirmed the accuracy of this statement: and added that his memory was quite clear that Lord Rosse considered it very important to use the copper and tin in atomic proportions, and said in his papers on it that uniformity of composition could not otherwise be hoped for. He also recognized the importance of using thick specula; the last which he had cast being not less than five inches thick. He also had used and recommended resin to be used to harden the pitch and flour for a purpose by which experience he had learnt to be important. Lord Rosse had also by the several motions and adjustments which he had contrived for the speculum and the polisher reduced the figuring of the speculum to an almost certain function of time; so that after the speculum had been a certain number of hours under the action of the polisher, he was well assured that the proper figure had been attained. Professor Stevelly briefly described these motions and adjustments; and stated that the actual result was, an enormous circular disc of six-feet aperture, without crack or flaw, and of a splendid uniform polish, and reflecting light from objects of a perfectly natural tint.

'*On the Surface Temperature, and Great Currents of the North Atlantic and Northern Ocean*,' by the Rev. Dr. Scoresby.—The author commenced by pointing out the great importance to Physical Geography of the subjects he proposed to discuss, particularly as they tended in the economy of Nature, to furnish a compensating instrumentality against the extremes of condition to which the fervid action of the vertical sun in the tropical regions, and its inferior and more oblique action in the polar regions, were calculated to reduce the surface of the earth. Our knowledge of all the currents of the ocean, with perhaps, one exception; the Gulf-stream, which had been, in its more important features, carefully examined and surveyed, and more especially in the American Coast Survey,—was derived from the comparison by navigators of the actual position of the ship as determined from time to time with its position as calculated from what sailors technically called the "dead reckoning," or the course steered, and the distance run as determined by the log, an instrument by no means perfect. The determination, however, of oceanic currents, to which the present communication referred, depends simply on induction from observation of temperature, on that mainly of the surface. Such observations, indeed, only become available under considerable differences betwixt the mean atmospheric and oceanic temperatures; and where they may seem to indicate the region from which peculiar qualities of the sea are derived, they can afford little, if any, information as to the precise direction or strength of the current so indicated, yet still the general results are found important and useful. The researches of the author embrace those in the Greenland Sea, the North, Sea, and a considerable belt across the North Atlantic. To those in the North Atlantic he wished at present to direct attention; and to a belt of it embraced within the limits of a series of passages chiefly by sailing vessels between England, or some European port, and New York. Of these passages, sixteen in number, four were performed by the author himself, and twelve supplied by an American navigator, Captain J. C. Delano, an accurate scientific observer. The observations on surface temperature discussed amount to 1153, gathered from a total number of about 1400. Usually Captain Delano recorded six observations each day during the voyage, at intervals of four hours. Seven of the passages were made in the spring of the year,—two in the summer,—one in autumn,—and three in winter. Taking the middle day of each passage the mean day at sea was found to be May-18th or 19th,—a day fortunately coincident in singular nearness with the probable time of the mean annual oceanic temperature. The author had laid down the tracks of the ship in each of the voyages on a chart of Mercator's projection, and the principal observations on Surface Temperature were marked in their respective places. The observations were then tabulated for meridians of 2° in breadth, from Cape Clear, longitude 10° W., to the eastern point of Long Island, longitude 72°W.,—embracing a belt of the average breadth of 220 miles on a stretch of about 2,600 miles across the Atlantic. The results were the following:—1. Highest Surface Temperature northward of latitude 40°, 74°; lowest 32°; range 39°.—Mean Surface Temperature, as derived from the means of each meridional section 56°, whilst the mean atmospheric temperature for the corresponding period was 51°·2—3. Range of Surface Temperature within each meridional section of 2°, 8½° at the lowest, being in longitude 20-22° W., and at the greatest 36°, being within the meridian of 62 64°W.—4· Up to longitude 40° the Surface Temperature never descended below 50°;—the average lowest of the sixteen meredional sections being 51°·88, and the average range being 11°·3. 5. In the succeeding fifteen sections, where the lowest temperature was 32°, the average lowest was 37°·1, and the average range 29°·7. This remarkable difference in the Temperature of the eastern and western halves of the Atlantic passage, the author said was conclusively indicative of great ocean currents yielding a mean depression of the lowest meridional temperature from 51°·88 to 37°·1, or 14°·8 and producing a mean range of the extreme of temperature on the western side of almost thrice the amount of the extremes on the eastern side,—or, more strictly, in the proportion of 29°.7 to 11° 3. The author drew attention to a diagram which he had laid down along the entire belt curves showing the whole range of the lowest depressions of temperature and highest elevation, with the means at each longitude distinguished by different shading, and pointed out how the inspection of this as well as of the tabulated results afforded striking indication of the two great currents, one descending from the Polar, the other ascending from the Tropical regions, with their characteristic changes of cold and heat. In classifying the results, the author considered the entire belt of the Atlantic track of the passages as divided into six divisions of 10° of longitude each, and these into meridional stripes of 2° each, omitting the two first degrees next the European end, or about 80 miles westward of Ireland to 72° W., or about the same distance West of New York. To each of these six divisions he directed attention, pointing out the conclusions to be derived from each. The curves approaching each other and running nearly parallel through the western half with great regularity, showing the variations and range to be much less, while throughout the eastern half the widening of the distance, and the irregular form of the extreme curves showed the influences of the two currents very remarkably. The author then proceeded to draw conclusions, showing that sometimes the cold current from the north plunged beneath the warmer current from the south. Sometimes they divided,—the colder keeping in shore along the American coast, the other keeping out and forming the main Gulf-stream. Sometimes where they met they interlaced in alternating stripes of hot and cold water; sometimes their meeting caused a deflexion,—as, where one branch of the Gulf-stream was sent down to the south-east of Europe and north of Africa and another branch sent up past the British Islands to Norway and Scandinavia by the the Polar current setting down to the east of Newfoundland. The author next proceeded to consider the uses in the economy of nature of these great oceanic currents. The first that he noticed was the equalizing and ameliorating influence which they exercised on the temperature of many countries. Of this he gave several examples. Thus, our own country, though usually spoken of as a very variable climate, was subject to far less variations of range of temperature than many others in similar latitudes,—which was chiefly from the general influence of the northern branch of the Gulf-stream setting up past these islands. He had himself on one occasion in the month of November known the temperature to rise no less than 52° in forty-eight hours,—have previously descended in a very few days through a still greater range; while in these countries the extensive range between mean summer and winter temperature scarcely in any instance exceeds 27°, and in many places does not amount to nearly as much. Another advantage derived from these currents was, a reciprocation of the waters of high and low latitudes,—thus, tending to preserve a useful equallizing of the saltness of the waters, which otherwise by evaporation in low latitudes would soon become too salt to perform its intended function. Next he pointed out their use in forming sand-banks, which became highly beneficial as extensive fields for the maintenance of various species of the finny tribes, as in the great banks of Newfoundland. Next, this commingling of the waters of several regions tended to change and renew from time to time the soil of these banks,—which, like manuring and working our fields, was found to be necessary for preserving these extensive pastures for the fish. Lastly, by bringing down from Polar r gions the enormous masses of ice, which under the name of icebergs, were at times found to be setting down towards Tropical regions, they tend at the same time to ameliorate the great heats of those regions, and to prevent the Polar regions from becoming blocked up with accumulating mountains of ice which, but for this provision, would soon be pushed down as extensive glaciers, rendering whole tracts of our temperate zones uninhabitable wilds. Dr. Scoresby concluded by pointing out several meteorological influences of these currents, by causing extensive fogs or winds more or less violent.

'*On Dynamical Sequences in Kosmos*,' *by* W. J. M. WATERSON.—The Dynamic theory of Heat, if accepted as being inductively demonstrated, seems to supply us with a valuable standard of physical causation that in the course of time must have an important influence on the progress of science. That some such standard has hitherto been wanting, seems to be proved by the barren results of the most eminent mathematicians, when directed to molecular physics, offering as they do so great a contrast to the success achieved in the fields of Astronomy. In these reunions of the British Association, it may not perhaps be considered out of place, or as an illegitimate course of inquiry, to assume the theory as proven, and endeavour to realize, as far as our lights at present extend, the conditions and the sequence of action, implied by its existence as a general principle throughout nature. The evidence that supports the theory equally supports many views of natural phenomena that are obviously dependant upon it as corollaries, and which ought therefore to be always associated with it. Among these I would beg attention to a few that seem specially to demand notice at the present stage of our progress. I.—Equilibrium and Sequence of Temperature in relation to a centripetal force.—*The dynamic theory of heat requires that the law of vertical equilibrium of temperature should be different from the law of horizontal equilibrium.* In whatever way conduction may be effected, equilibrium of temperature is by the theory equilibrium of force: maintained by a constant interchange of equal action or impulse between adjacent molecules, in a state of activity. The interchange may take place by direct contact or through an intermedium affected by and capable of affecting the active state of the molecules. In either case, the vertically resolved portion of this active state must be influenced by the centripetal force of the planet which tends to increase a downward impulse and diminish an upward impulse. Thus, the condition of motion once admitted, involves a greater intensity at the lower aspect of a molecular orbit than at its upper, caused by the force of gravitation acting in the interval, which must thus establish a gradient of increasing temperature towards the centre, as the natural condition of a vertical equilibrium. An increasing temperature below the surface of the earth being a recognized fact, it is possible that the condition of permanent equilibrium in our planet is already attained; and if in any mathematical speculations on the interior condition of our globe, we assume that conduction takes place the same in all directions, vertical as well as horizontal, we shall certainly be proceeding on a false assumption if the theory is correct. A vertical gradient of temperature in the atmosphere is another recognized fact impossible to reconcile with any previous theory, but so completely in accordance with these dynamic views, that if we merely assume the molecules of air to be free elastic projectiles, we may deduce its actual numerical value from the specific gravity of the component gases. From this hypothesis, too, all the physical properties of gases may be mathematically deduced. The relation that must subsist between heat and gravitation is extremely interesting, and deserves to be enlarged upon. It is in perfect conformity with the views generally entertained of the progressive formation of the solar system—the nebular hypothesis of La Place. The dynamical sequence may be illustrated as follows. Suppose a 32lb cannon ball to descend through the earth's radius under the influence of the same force of gravity as exists on the surface, the velocity acquired is 36,700 feet per second, or about seven miles. This is the same velocity as the ball would acquire in descending from an infinite height to the surface of the earth. Considering the ball as an ærolite encountering the atmosphere or earth's surface with this velocity, we are now enabled to compute the amount of heat generated by the concussion. 32lb of water falling through a height of about 673 feet obtains an increase of 1° by the concussion, 32lb. of iron about 9°. The concussion due to the velocity of seven miles per second would generate heat enough to raise the temperature of the ball 280,000 degrees. In the same way, it may be computed that if the ball descended to the surface of the sun, it would acquire a velocity of 545 miles per second, and the heat equivalent of the concussion is 1,800 million degrees. We may thus obtain an idea of the vast evolution of heat that might be caused by the process of central aggregation of matter under the influence of its gravitating energy; nor does it seem necessary to look further for the origin or continuance either of the solar heat or for that of the interior of our planet. While gravitation thus generates heat centripetally, radiation may be viewed as the escape of *vis viva* centrifugally. The modes of central collocation and of dispersion are equally mysterious: further than that, they appear as parts of a dynamical cycle. While a body is falling towards the sun, *vis viva* is generated in certain points of space, and conveyed to the centre by the body whose molecules move together in the passage downwards. The shock at the centre puts an end to this species of motion, but generates another apparently of a vibratory kind in the molecular elements, which has the effect of awakening a radiating power through space; or what may be viewed as a centrifugal transference of *vis viva* into the regions of space. While this *vis viva* generated in space is inevitably carried to a centre before it is thus re-issued, we have the residual phenomenon of a central body augmented in mass by the process. The physical circle would be complete if this central body had a motion through space which brought it in contact with another; both, it may be, exhausted of their central *vis viva*, the shock might be supposed capable of dispersing and projecting the component part so far from the common centre of gravity as to renew the original nebulous form. In M. Pouillet's researches (Taylor's 'Scient. Mem.' vol. iv.) we have a striking view of the extreme slowness of the process of radiation from the sun. Making use of the same data, and converting the equivalent of solar radiation into quantity of matter of the density of water falling to the sun from remote regions, we may see by a little calculation that the qantity required in one year would cover its whole surface to the depth of 14·6 feet. Thus, the sun may be supplied with heat by the mere descent of matter as aerolites to its surface. When such bodies encounter our atmosphere, we have experience of the dazzling appearances of ignition or combustion manifested, and may judge of the effects of a continued shower of such bodies sufficient to cover the surface to a sensible depth. Each meteor signals an accession to the earth's mass, and brings also an accession of heat. If the united mass of all such meteors that impinge on our planet throughout one year were made visible to us as one aerolite descending at regular yearly intervals, there is little doubt it would suggest to the mind of the most careless observer the probability of the earth growing in size by such periodical contributions. The geologist, accustomed to the consideration of vast periods of time, might speculate on the possibility of it having thus materially increased in dimensions while the abode of organic life, without in the least disturbing it. From what is already known, we can predicate that a ball of iron entering the atmosphere with a velocity of six or seven miles a second would instantly be melted, burnt, and converted into a red powder, and that before reaching the earth it would probably be scattered by the aerial currents into comparatively so vast an area as never to be afterwards noticed. If we suppose the mechanical force produced by the condensation of the nebulous mass from which a planet is forming to be slower than the equivalent of radiation from the same, it would seem as if there could be no great internal heat; but it is to be remembered that the vertical law of conduction requires an increase of temperature downwards, so that if a planetary mass were exposed perfectly cold to the sun's rays, it must continue to absorb heat until that vertical equilibrium of temperature had been attained :—the centripetal energy enabling it to imbibe a quantity of heat vastly greater than the surface temperature would seem to indicate. In respect to extra-terrestial bodies such subterranean heat is latent. With regard to the sun, on the other hand, the mechanical force generated centripetally must originally have far exceeded the equivalent of radiation. If its present condition is stationary in respect to temperature, its mass must be increasing. If its mass is not increasing, its temperature must be diminishing, the annual loss being represented by about 1·54 millionth of its mass lowered 1,800 million of degrees, per annum, supposing it to have the specified heat of iron: supposing, also that it does not contract or become further condensed, because this would of itself engender *vis viva*. It may be shown that so small an increase of density as would diminish the sun's diameter 860 feet represents the equivalent of the annual radiation. In the bodies that surround us, we remark that cooling and contraction are generally simultaneous. If such is the case in the sun, 33 degrees must be too high an estimate of the yearly loss of temperature. The ratio between the diminution of bulk and of temperature, were it known in the case of the sun, would enable us to compare their mechanical equivalents. The *vis viva* produced by the diminution of bulk would be classed with the phenomena of what is called latent heat in liquids, solids and gases. It would seem from these computations, which rest upon M. Pouillet's data, that the probable annual loss of temperature in the sun is by no means inconsiderable in absolute amount, but its relative value in respect to the temperature of the sun may be, and probably is quite insignificant. Is there any way of arriving at an estimate of the temperature of the sun's radiating surface? Let us consider what meaning is to be given to the expression "temperature of space," occasionally to be met with in the writings of physicists. If heat is the motion of the elementary parts of bodies, and not a subtle species of matter, as certain phenomena of latent heat seem to have suggested the idea, it is hardly correct to speak of vacant space as having a temperature, although the heat force may in various directions and with various intensities be radiating through it. In the same way, space is not considered as luminous, although traversed by most intense light. A thermometer placed in a perfect vacuum although it shows the same temperatnre as the substance that incloses the vacuum, actually exhibits the effect of the intensity of the heat radiations that are passing through it. If we suppose a thermometer situated at the opposite point of the earth's orbit, and subject to the influence of the sun's rays only, it would no doubt rise until the radiation from its surface amounted to what was radiated into its surface; but the temperature indicated by it cannot be accepted either as constant, for it depends on the specific radiating and absorbing qualities of the thermometer; or as affording the means of deducing the sun's temperature, for we are ignorant of the relation between temperature and the rate of emission, also of the absolute value of any given temperature unless we deduce it from the dynamic theory of gases which represents the zero of gaseous tension (—461° Fahr.) as the absolute zero of heat. If the thermometer thus isolated, is supposed to be surrounded, on all sides but the one exposed to the sun, by matter that is kept artificially heated up, to within a few degrees of the temperature shown by the thermometer, it is impossible that it could receive an accession of heat from any other source but the sun; and it seems obvious that when at last it became stationary, the temperature is one that must be independent of any specific quality of the thermometer or its artificially heated envelope, but dependent entirely on the distance and temperature of the sun. Some years ago I made an attempt to imitate the conditions of this hypothetical experiment by inclosing a thermometer within three concentric boxes well protected from external influences, and capable of being equally heated all round to any temperature below 400° Fahr. by means of flues ascending from an Argand lamp. The rays of the sun when near the meridian, (within the Tropi s) were admitted to fall when required on the bulb of a thermometer through a triple glass partition. Before applying the lamp, the temperature of the interior of the box being t, a rise of about 50° took place by exposing the bulb to the sun; when the thermometer had become stationary at $t + 50°$ the sun's rays were excluded and the lamp applied to heat the box to $t +$ 50°. When the temperature was again stationary at this point, the sun was re-admitted upon the thermometer, which again rose 50° or until the temperature was $t + 100°$. The same operations were repeated up to 250°, but without any diminution of the step 50° which seemed to be made with the same alacrity at the higher as at the lower temperature. I had hoped to have detected some very obvious difference, and from its amount to infer the value of the limiting temperature that expressed the sun's power at the earth's distance. I should then have added 460° to this temperature to obtain its absolute value, then increase this in the inverse ratio of the square of the distance from the sun's centre, obtain an approximate value of the sun's temperature. It seemed to me at the time that this experiment, though not made with sufficient means, or perhaps, care to insure much accuracy, proved that the intrinsic force of the sun's rays of heat was much greater than might be inferred from the temperature of the atmosphere. I purpose at a future opportunity to consider the Dynamical Sequence of Latent Heat and Molecular Force.

Mr. Hopkins addressed the Section, pointing out the important hints and valuable lines of inquiry which the paper suggested; but also showing with what caution it was to be be received in many parts as statements of determined scientific truth.

Section B.—CHEMICAL SCIENCE.

'*On the Chemical Action of the Solar Radiations,*' *by* Mr. R. Hunt, —This was a report to the section of the continuation of an examination of the chemical action of the prismatic spectrum, after it had been subjected to the absorptive influences of different coloured media. The mode of examination has been to obtain well defined spectra of a beam of light passing through a fine vertical slit in a steel plate by prisms of flint and crown glass and of quartz. The spectrum, being concentrated by a lens, was received upon a white tablet and submitted to careful admeasurement; the coloured screen (sometimes coloured glass and sometimes coloured fluid) was then interposed, and the alterations in the chromatic image were carefully noted; the chemical preparation was then placed upon the tablet, and the chemical impression obtained. The relation which this image bore to the luminous image was a true representation of the connexion between the colour of a ray, and its power to produce chemical change. In the report made to the Belfast meeting of the British Association, the results of experiments made upon glass plates prepared by the so-called collodion process were alone given. In the present report the examination has been extended to the photographic preparation known as the calotype, and to iodide and bromide of silver in their pure state and when excited by gallic acid. M. Edmond Becquerel, in a paper communicated to the Academy of Sciences, of which an abstract appears in the *Comptes Rendus*, tom xvii. p. 883, states "that when any part of the luminous spectrum is absorbed or destroyed by any substance whatever, the part of the chemical rays of the same refrangibility is also destroyed." The author's experiments, as recorded in the former report and those now detailed, prove that his conclusion has been formed too hastily. Although there are many absorptive media which, at the same time as they obliterate a particular coloured ray, destroy the chemical action of that portion of the spectrum, yet there are still more extensive series which prevent the passage of a ray of given refrangibility, and do not, at the same time, obstruct those rays which are chemically active of the same degree of refrangibility. This is particularly exemplified in the case of glass turned yellow by different preparations. With some of these the blue rays are obliterated, the chemical action of this part of the spectrum not being interrupted, whereas in some other examples, those rays permeate the glass, but are almost entirely deprived of chemical power. A still more curious fact is noticed in this report, for the first time, of some media which have the power, as it were, of developing chemical action in a particular part of the spectrum where the rays did not appear previously to possess this power. Several glasses exhibited this phenomenon to a certain extent, particularly such as were stained yellow by the oxide of silver; but one glass showed this in a remarkable manner. This glass was yellow when viewed by transmitted light, but it reflected pale blue light from one of its surfaces; it obliterated the more refrangible rays down to the green, and rendered the yellow rays far less luminous than usual. In nearly every case the yellow rays are found to be not merely inactive, chemically, but to actively prevent chemical action. After the spectrum has been submitted to the action of this glass, *all chemical power is confined to this yellow ray.* The author has hitherto supported the view that photographic phenomena and the illuminating power of the sunbeam were distinct principles, united only in their modes of motion. He was led to this from observing that where there was the most light there was the least power of producing chemical change; and that as illuminating power diminished, the chemical phenomena of the solar rays increased. The results, however, which he has obtained during the brief sunshine of the present summer, leads him to hold that opinion in suspension. In many of the spectra obtained (copies of which will be appended to the printed report) there appears to be evidence of the conversion of one form of force into another—the change indeed of *light* into *action* or chemical power; and, again, as in Mr. Stokes' experiments, the exhibition of the ordinarily invisible chemical rays in the form of *light*.

Prof. Stokes offered some remarks upon the different effects produced by the spectrum, dividing them into luminous effect, chemical action, calorific power, phosphorescence, and fluorescence. These were different effects resulting from the same cause, and he did not consider that sufficient evidence had yet been given to warrant the idea that there existed any dissimilar agencies in the solar rays.

Prof. Johnston, the Rev. V. Harcourt, Dr. Daubeny, Mr. Claudet, and others, took part in the conversation which followed.

'*On the Employment of the higher sulphides of Calcium as a means of Preventing and Destroying the Oidium Tuckeri, or Grape Disease,*' by Dr. Astley P. Price.—Of the many substances which have been employe to arrest the devastating effects of this disease, none appear to have been so preëminently successful as sulphur, whether employed in the state of powder or flowers of sulphur, or by sublimation in houses so affected. Notwithstanding the several methods described for its application to the vines, I am not aware that any had been offered in 1851, when these experiments were instituted, by which sulphur might be uniformly distributed over the branches, and be there deposited in such a manner as to be to some extent firmly attached to the vine. Three houses at Margate, in the vicinity of the one in which the disease first made its appearance in England, having been for the space of five years infected with the disease, and notwithstanding the employment of sulphur as powdered and flowers of sulphur, no abatement in its ravages could be discovered,—I was induced to employ a solution of pentasulphide of calcium, a solution of which having been found to act in no way injuriously to the young and delicate shoots of plants, was applied to the juices in a dilute condition; the object in view being that the compound should be decomposed by carbonic acid, and that the excess of sulphur should be deposited with the carbonate of lime in a uniform and durable covering on the stems and branches of vines. This was adopted, and although but few applications were made, the stems became coated with a deposit of sulphur, and the disease gradually but effectually diminished, in so much that the houses are now entirely free from any trace of disease or symptoms of infection. The young shoots are in no way injured by its application, and the older wood covered with this deposit of sulphur continues exceedingly healthy. This was, we believe, the first employment of the higher sulphides of calcium as a vehicle for the application of sulphur to the stems and foliage of the diseased vines. Specimens were exhibited from vines which in 1851 were covered with disease, and which have since the autumn of that year received no further treatment. The vines in the immediate neighbourhood, and adjoining one of the houses, are covered with disease, but, notwithstanding their close proximity, no indication of the disease has at present been detected in either of the three houses.

'*On the effect of Sulphate of Lime upon Vegetable Substances,*' by Chevalier Claussen.—About six weeks since I was engaged in making various experiments on the effect of Sulphate of lime upon vegetable substances. A portion of the substances then used by me was thrown carelessly aside, and upon returning to my experiments about a fortnight afterwards, I was surprised that the decomposition had not taken place in those portions of the vegetables which had been subjected to the action of the sulphate, while those which had not been so treated were completely decayed. Among the articles experimented upon were a number of potatoes, each of which was affected by the prevalent disease; some of these remain sound to the present day, the others have some time since completely rotted away. Subsequently I procured some more potatoes, and also some beet-roots, the former being, as far as I could judge, all diseased. I divided the potatoes into three portions. One lot I placed in a vessel with a weak solution of sulphuric acid, and from thence I placed them in a solution of weak lime-water. In the second lot the process was reversed, that is to say the potatoes were first placed in the lime-water, and then in the acid. The third lot was left untouched. Ten days afterwards I examined the potatoes, those whichhad not been treated with the sulphate were rapidly decaying,—those which had been first placed in the solution of lime and then in the acid were more nearly decomposed,—while those which had been treated in the mode first described remained as sound as when first taken in hand. Upon being cut open the diseased part of the potatoes was found to have spread internally, and the flavour of root was in no degree affected by the application of the process nor do I think that its germinating power was injured by the effect of the sulphate. The effects upon the beet roots was similar to that produced upon the potato, and which would seem to be somewhat analagous to that of galanizing metals, viz: protecting the substances from the effect of atmospheric agencies. I may add, that muriatic and other acids have been employed by me on other occasions with equal success, the only agents required appearing to be those which will most readily produce a sulphate in contact with the sutstances required to be preserved. As at present it does not appear that any means can be successfully adopted to prevent the potato from becoming diseased while in the ground and arriving at maturity, it would certainly be of immense advantage if anything could be discovered by the use of which the roots when taken up could be prevented from that absolute decay and irreparable loss to which potatoes affected by the disease are liable. The results which I have described seem to me to point to the possibility of arresting this loss. How far the plan suggested may be practicable or applicable upon a large scale, my present very pressing and numerous engagements have hitherto prevented me from ascertaining. I do not think that any insuperable difficulty exists with respect to the application of the process. The acid employed by me was very weak, about one part to two hundred of water; the lime water was about the consistency of milk. The materials are not, therefore, expensive; and when the value of the crop to be saved is taken into consideration, it would be a matter well worthy of being tested by some of those extensive growers of potatoes in the county in which the British Association is now holding its sittings. For my own part, I should be most happy if any suggestion of mine had merely been the instrument of directing the attention of scientific men to the subject of the possibility of preserving from total destruction a vegetable so valuable and so indispensable as the potato.

'*The results of the Census of Great Britain in* 1851, *with a description of the machinery and processes employed to obtain the Returns,*' by E. Cheshire.—The author commenced by reciting the onerous duties of Registrar General. The objects of the census were explained, and the machinery employed to take it. Great Britain was apportioned into 38,740 enumeration districts, and to each of them a duly qualified enumerator was appointed. The author illustrated the extent of this army of enumerators, and the labour of engaging their services on the same day, by stating that it would take $13\frac{1}{2}$ hours to count them, at the rate of one a second, and that the army recently emcamped at Chobham would not have sufficed to enumerate a *fourth* of the population of Great Britain. The boundaries of the enumeration districts, and the duties of the enumerators, were defined. The number of householders schedules forwarded from the Census Office was 7 000-000, weighing 40 tons. The processes employed to enumerate persons sleeping in barns, tents and the open air, and in vessels, were severally explained; also the means by which the numbers of British subjects in foreign States were obtained. The precautions taken to ecure accurate returns were recited; they involved the final process of a minute examination and totalling, at the Census Office, of 20 millions of entries, contained on upwards of $1\frac{1}{4}$ millions of pages of the enumerators' books. The latter were upwards of 38,000 in number. The boundaries of the fourteen registration divisions were traced, and the plan of publication of the census was explained. The number of persons absent from Great Britain on the night of the 30th of March, was nearly 200.000:—viz. army, navy, and merchant service, 162,490; and British subjects resident and travelling in foreign countries, 33,775. The various causes of displacements of the population were recited; and the general movement of the population on the occasion of the Great Exhibition was alluded to.† The number of *visits* to the Crystal Palace were 6,039,195; and the number of people who visited it was 2,000,000, nevertheless the landing of only 65,233 aliens were reported in the year. The population of Great Britain in1851 is subjoined.

	Males.	Females.	Total
England	8,281,734	8,640,154	16,921,888
Scotland	1,375,479	1,513,263	2,888,742
Wales	499,491	506,230	1,005,721
Islands	66,854	76,272	143,126
Army, Navy and Merchant Service.	162,490	......	162,490
Total	10,386,048	10,735,919	21,121,967

The census illustrated this 21,000,000 of people by an allusion to the Great Exhibition. On one or two occasions 100,000 visited the Crystal Palace in a single day, consequently 211 days of such a living stream would represent the number of the British population Another way of realizing 21,000,000 of people was arrived at by considering their numbers in relation to space; allowing a square yard to each person they would cover 7 square miles. The author supplied a further illustration, by stating that if all the people of Great Britain had to pass through London in procession 4 abreast, and every facility was afforded for their free and uninterrupted passage 12 hours daily, Sundays excepted, it would take nearly 3 months for the whole population of Great Britain to file through at quick march, four deep. The excess of females in Great Britain was 512,361, or as many as would have filled the Crystal Palace 5 times over. The proportion between the sexes was 100 males to 105 females, a remarkable fact when it was considered that the births during the last 13 years had given the reversed proportion of 105 boys to 100 girls The annexed statement exhibits the population of Great Britain at each census from 1801 to 1851 inclusive:—

Years.	Males.	Females.	Total.
1801	5 368,703	5,548,730	10,917,433
1811	6,111,261	6,312,859	12 424,120
1821	7,096 053	7,306,590	14,402,643
1831	8 133,446	8,430,692	16,564 138
1841	9,232,418	9,581,368	18,813,786
1851	10,386,048	10,735,919	21,121,967

The increase of population in the last half century was upwards o 10,000,000, and nearly equalled the increase in all preceding ages, notwithstanding that millions had emigrated in the interval. The increase still continued, but the rate of increase had declined, chiefly from accelerated emigration. At the rate of increase prevailing from 1801 to 1851, the population would double itself in 52½ years. The relation of population to mean lifetime and to interval between generations was then discussed. The effects of fertile marriages and of early marriages, respectively, were stated; also the result of a change in the social condition of unmarried women; likewise, the effect of migration and emigration, respectively, on population; the effect of an abundance of the necessaries of life was indicated, and, on the contrary, the result of famines, pestilences, and calamities. The terms "family" and "occupier" were defined, and some remarks by Dr. Carus, on English dwellings, were cited. The English (says the Doctor) divide their edifices *perpendicularly* in houses, while on the Continent and in many parts of Scotland the edifices are divided *horizontally* into floors. The definition of a "house," adopted for the purposes of the census, was "isolated dwelling or dwellings, separated by party walls." The following table gives the number of houses in Great Britain in 1851:

	Inhabited.	Uninhabited.	Building.
England	3,076,620	144,499	25,192
Scotland	370,308	12,146	2,420
Wales	201,419	8,995	1,379
Islands	21,845	1,095	203
Total	3,670,192	166,735	29,194

About 4 per cent of the houses in Great Britain were unoccupied, in 1851, and to every 131 houses inhabited or uninhabited, there was one in course of erection. In England and Wales the number of persons to a house was 5·5; in Scotland 7·8, or about the same as in London· in Edinburgh and Glasgow the numbers were respectively 20·6 and 27·5. Subjoined is a statement of the number of inhabited houses and families in Great Britain at each census, from 1801 to 1851,—also of persons to a house, excluding the Islands in the British Seas:—

Years.	Inhabited Houses.	Families.	Persons to a House.
1801	1,870,476	2,260,802	5 6
1811	2,101,597	2 544,215	5·7
1821	2,429,630	2,941,383	5·8
1831	2,850,937	3,414,175	5·7
1841	3,446,797	(No returns.)	5·4
1851	3,648,347	4,312,388	5·7

The number of inhabited houses had nearly doubled in the last half century, and upwards of two million new families had been founded. 67,609 families, taken at hazard, were analyzed into their constituent part, and they gave some curious results. About 5 per cent. only of the families in Great Britain consisted of husbands, wife, children, and servants, generally considered the requisites of domestic felicity; while 893 families had each ten children at home, 317 had each eleven and 64 had each twelve. The number of each class of institution, and the number of persons inhabiting them, are annexed:—

Class of Institution.	Number of Institutions.	Number of Persons inhabiting them.		
		Males.	Females.	Total.
Barracks	174	44,834	9,100	53,933
Workhouses	746	65,786	65,796	131,582
Prisons	257	24,593	6,369	30,959
Lunatic Asylums	149	9,753	11,251	21,004
Hospitals	118	5,893	5,754	11,647
Asylums, [&c.	573	27,183	19,548	46,731
Total	2,017	178 041	117,815	295,856

Of these 295,856 persons, 260,340 were inmates, and 35,516 officers and servants. The excess of males in the prisons arose from the fact that crime was four times as prevalent among males as mong females. The number of the houseless classes, *i. e.*, of persons sleeping in barns, tents, and the open air, on the night of the census, was 18,249 The following table gives the number of these classes, together with those sleeping in barges and vessels:—

Persons sleeping in	Males.	Females.	Total
Barges	10 395	2 529	12,924
Barns	7,251	2,721	9,972
Tents or Open Air	4,614	3,663	8,277
Vessels	48,895	2,853	51,748
Total	71,155	11,766	82 921

It was mentioned as a curious trait of gypsy feeling that a whole tribe struck their tents, and passed into another parish in order to escape enumeration. The composition of a town was next described; also, the laws of operating upon the location of families. The number of cities and towns of various magnitudes in Great Britain, was 815:—viz. 580 in England and Wales, 225 in Scotland, and 10 in the Channel Islands. The town and country population was equally balanced:—10½ millions against 10½ millions. The density in the towns was 3,337 persons to the square mile; in the country only 120. The average population of each town in England and Wales was 15,500; of each town in Scotland 6,654. The average ground area of the English town was 4 3-5 miles. The manner in which the ground area in Great Britain was occupied by the population was illustrated by a series of squares The adventitious character of certain towns was alluded to; many had risen rapidly from villages to cities, and had almost acquired a metropolitan character. In 1851, Great Britain contained 70 towns, of 20,000 inhabitants and upwards. There was an increasing tendency of the people to concentrate themselves in masses. London extended over an area of 78,029 acres, or 112 square miles, and the number of its inhabitants, rapidly increasing, was 2,362,236 on the day of the last census. The author illustrated this number by a curious calculation:—a conception of this vast mass of people might be formed by the fact, that if the metropolis was surrounded by a wall, having a north gate, a south gate, an east gate, and a west gate, and each of the four gates was of sufficient width to allow a column of persons to pass out freely four abreast, and a peremptory necessity required the immediate evacuation of the city, it could not be accomplished under four-and-twenty hours, by the expiration of which time the head of each of the four colums would have advanced a no less distance than seventy-five miles from their respective gates, all the people in close file, four deep. In respect to the density or proximity of the population, a French writer had suggested the term "specific population," after the analogy of "specific gravity" in lieu of the terms in common use, "thinly populated" and populous. The statement annexed exhibits the area of Great Britain in acres and square miles, the square in miles, the number of acres to a person, or persons to a square mile, and the mean proximity of the population on the hypothesis of an equal distribution:—

	Area.		Square (in Miles.	Acres to a Person.	Persons to a sq. mile.	Proximity of persons in yards.
	In acres.	In sq. Miles.				
England	32,590,429	50,922	226	1·9	332	104
Scotland	20,047,462	31,324	177	6·9	92	197
Wales	4,734,486	7,398	86	4·7	135	162
Islands	252,000	394	20	1·8	363	99
Great Britain	57,624,377	90,038	229	2·7	233	124

The 624 districts of England and Wales classed in an order of density ranged from 18 persons to the square mile in Northumberland, to 185,751 in the east London district. In all Lnodon there were 19,375 persons to the square mile. In 1801, the people of England were on an average 153 yards asunder, in 1851 only 107 yards. The mean distance between their houses in 1801 was 362 yards, in 1851 only 252 yards. In London the mean proximity in 1801 was 21 yards, in 1851 only 14 yards. The number of islands in the British group were stated at 500, but inhabitants were only found on 175 on the day of the census. The early history of the more celebrated of the islands was given. The population of the chief of the group, Great Britain, had been given. Ireland contained 6,553 357 inhabitants; Anglesey, the next most populous island, had 57,318 inhabitants; Jersey, 57,020; the Isle of Man, 52,344; the Isle of Wight, 50.324; Guernsey, 29 757; eight islands ranged from 22,918 to 5,857, 17 from 4 006 to 1,061, 52 from 947 to 105, and the remaining 92 downwards to an island inhabited by one solitary man. The shires, hundreds, and tythings, were traced to Alfred the Great; the circuits to Henry the Second. The terms "hundreds" and "tythings" had their origin in a system of numeration. The number of reformed boroughs in England and Wales were 196, and contained a population of 4.345,269 inhabitants. Scotland contained 83 royal and municipal burghs, having a population of 752,777 inhabitants. The difficulty of tracing the boundaries of the *ecclesiastical* districts, and consequently of ascertaining correctly their population, was shown. The changes in the ancient boundaries of counties and other divisions were alluded to, and the paper concluded with a general summary of the results of the census. An appendix contained tables, showing the population and number of houses, distinguishing whether inhabited, uninhabited, or building, in England, Scotland, Wales, and the Islands, respectively, at each census from 1801 to 1851; the same in 1851, for each of the 14 registration divisions; for each of the 36 districts of London; and for each county in England and Wales, and in Scotland; also the population of each county in England and Wales, and in Scotland, at each census from 1801 to 1851, and the increase of population in the last half century; the area in acres and square miles, the number of persons to a square mile, of acres to a person, of inhabited houses to a square mile, and of persons to a house, for each county in England and Wales, and in Scotland; the population and number of inhabited houses in the counties, and parliamentary divisions of counties, in England and Wales, and in the counties of Scotland, including and excluding represented cities and boroughs or burghs, also the number of members returned: the population of each island containing above 100 persons; the population and number of inhabited houses in each of the 815 cities, boroughs, and principal towns in England and Wales and in Scotland, distinguishing the municipal and parliamentary limits; the number of each class of public institutions in England and Wales, Scotland, and the Islands, and the number of persons inhabiting them; the number of births and deaths, and the excess of births over deaths, in England and Wales, for each of the ten years of 1841–50; and finally, the number of persons who had emigrated from Great Britain and Ireland in each year from 1843 to 1852 inclusive and the destination of the emigrants. The author concluded by stating that the paper would be immediately printed.

SECTION G.—MECHANICAL SCIENCE

'*Introductory Address on General Improvements in Mechanical Science During the Past Year*,' *by* W. FAIRBAIRN.—The first subject noticed by Mr. Fairbairn was Ericsson's Caloric Engine, from which so much had been expected. It was constructed, he said, on the same principle as the air engine of Dr. Stirling, invented ten years ago:—the engine is passed through wire gauze to take up the heat, instead of through plates of iron. The great objection to the engine appeared to be that two-thirds of the power was wasted in passing the air through the gauze; and though it may be premature to pronounce an opinion before the result of the improvements lately effected were known, yet if so much of the power was required for taking up the heat, Mr. Fairbairn could not but think it must prove a wasteful expenditure of fuel. The improvements that during the last year had been made in the application of the screw propeller were opening a new era in the history of our war and mercantile navy, of which the recent review at Spithead might be considered an indication. We were now in a state of transition between the paddle and the screw, and he had no doubt that in progress of time great improvements would be made in the construction of the engines, and their applicability to the work, which would materially economize space and power in our steam vessels. Mr. Fairbairn next alluded to the construction of an immense steam vessel, which had been undertaken by Mr. Brunel and Mr. Scott Russell, of such vast dimensions that it would stretch over two of the largest waves of the Atlantic, and would thus obtain a steadiness of motion, which would be a preventive against sea sickness. This mammoth steamer is to be 680 feet long, with a breadth of beam of 83 feet and a depth of 58 feet. The combined power of the engines would be that of 2,600 horses. The ship is to be built of iron with a double bottom of cellular construction, reaching six feet above the water line, and with a double deck, the upper and the lower parts being connected together on the principle of the Britannia tubular bridge, so that the ship will be a complete beam. It would thus possess the strength of that form of construction, and not be liable to "hog;" or break its back as had been the case with other ships of great length. The double bottom would be a means of increased safety in other ways, for if by any accident the outer shell were broken, the inner one would prove effectual to keep out the water.—As an additional security, however, it was divided into ten water-tight compartments. The ship would be propelled by paddles and by a screw, which would be worked by separate sets of engines, so that if any accident occurred to the machinery of one, the other would be in reserve. He said he had no doubt that if properly constructed, this ship would answer the expectations entertained of its capabilities and strength, and that it would form, when completed, the most extensive work of naval architecture that had ever been constructed. The next subject to which Mr. Fairbairn adverted, was the improvements making in the locomotive department of railways, particularly to an engine constructed for the southern division of the North-Western Railway, from the designs of Mr. McConnell, which was the most powerful locomotive that had yet been made for the narrow gauge. The peculiarity of construction consisted in the great length given to the fire-box, in which the greatest amount of steam always generated, and in the comparative shortness of the tubes, which were only half the usual length. The steam generated by this boiler was sufficient for any engine of 700 horse power. The engine was intended for an express train that would complete the distance from London to Birmingham in two hours. In manufacturing machinery there had also been great activity and progress during the past year; and it was gratifying, Mr. Fairbairn observed, to find accompanying this improvement in machinery a most prosperous condition in the working classes engaged in those manufactures—a prosperity which had never been equalled within his experience. He attributed this prosperous state of things to the combined operations of improvements in machinery and the removal of commercial restrictions. The improvement which he more especially noticed was that of a new combing machine of French invention applicable alike to cotton, to flax, and to wool. It combs the fibre instead of carding it, a number of small combs being applied in succession to the cotton or flax, by which means a much finer yarn can be produced from the same material than is possible by the former processes. As evidence of the present activity and enterprise in manufacturing industry, Mr. Fairbairn mentioned the erection of a mammoth alpaca woollen manufactory, by Mr. Salt, of Saltaire, near Bradford, which was 550 feet long, 50 feet wide, and six stories high, besides offices, warehouses, and various other buildings connected with it. Their steam engines to drive the machinery would be equal to 1,200 horse power, and the factory would employ upwards of 3,000 hands The cost of the whole would be upwards of £300,000, and the enterprise was that of a single individual. Mr Fairbairn concluded his *resume* of manufacturing progress by noticing the improvements introduced by Prof. Crace Calvert, of Manchester, in process of melting iron by previously removing the sulphureous vapour from coal and smoke. The results had proved most satisfactory, the strength of the iron produced by this process being about 40 per cent. greater than that made in the ordinary way.

'*Report of the Committee appointed in* 1852 *to prepare a Memorial to the Honourable East India Company, on the Means of Cooling Air in Tropical Climates*,' *by* W. J. MACQUORN RANKINE.—In the absence of Mr. Rankine, one of the Secretaries read the Report, which was founded on experiments with apparatus invented by Prof. Smyth, described by him at a previous meeting of the Association. The principle of the invention consists in cooling the air by expansion. The air at the temperature of the atmosphere is first compressed in a bell receiver, and the heat generated by this compression is lowered by passing the air through a number of tubes immersed in water, by which means it acquires in its compressed state the normal temperature of the atmosphere—say 90° of Fahrenheit. The air then passes into another inverted bell receiver, where it is expanded to the ordinary pressure of the atmosphere, and during this expansion, it absorbs so much heat that the temperature is reduced to 60°. It is then admitted into the room to be ventilated. The compression of the air during the experiments in the first cylinder was equal to 3 2-10 inches of mercury per square inch above the pressure of the atmosphere, and the refrigerator exposed a cooling surface of 1,100 square feet, which was considered sufficient to reduce the temperature of the air in passing through the tubes to that of the atmosphere, viz. 90°. The Report stated that by means of this apparatus, 66,000 cubic feet of air per hour might be cooled from 90° to 60°, by a steam-engine of one-horse power which is required to raise and depress the bell receiver. The advantage of cooling the air by mechanical means instead of by evaporation was stated to be, the avoidance of aqueous vapour with which the air is injuriously charged by the evaporating process.

SUPPLEMENT TO THE CANADIAN JOURNAL, FOR OCTOBER.

Monthly Meteorological Register, at the Provincial Magnetical Observatory, Toronto, Canada West.—September, 1853.

Latitude 43 deg. 39.4 min. North. Longitude, 79 deg. 21 min. West. Elevation above Lake Ontario: 108 feet.

Magnet.	Day.	Barom. at tem. of 32 deg. 6 A.M.	2 P.M.	10 P.M.	MEAN.	Temperature of the air. 6 A.M.	2 P.M.	10 P.M.	M'N.	Tension of Vapour. 6 A.M.	2 P.M.	10 P.M.	M'N.	Humidity of Air. 6 A.M.	2 P.M.	10 P.M.	M'N.	Wind. 6 A.M.	2 P.M.	10 P.M.	M'N V.	Rain in Inch.	S'nw in Inch.
						°	°	°	°												Miles		
a	1	29.771	29.780	29.790	29.783	60.7	73.3	60.1	65.97	0.460	0.498	0.412	0.461	89	63	80	75	N b E	E S E	N E b E	4.27	- -	- -
e	2	.814	.712	.707	.752	60.8	77.8	67.6	69.87	.366	.661	.453	.528	69	72	69	73	N b E	S E b E	Calm	2.31	- -	- -
c	3	.722	.697	.689	.711	65.0	80.8	65.9	70.97	.515	.726	.518	.620	91	71	88	81	Calm	S b E	Calm	1.96	- -	- -
c	4	.672	.609			61.1	80.1			.487	.570			92	57			Calm	S E b S		2.18	- -	-
b	5	.633	.577	.514	.579	66.1	85.4	73.9	75.22	.576	.690	.571	.620	93	58	70	71	E b N	S	Calm	4.51	Inap	- -
d	6	.571	.462	.466	.502	69.8	78.1	62.8	70.35	.619	.815	.461	.633	88	86	83	85	Calm	S E b E	N	4.57	1.099	- -
e	7	.510	.609	.714	.617	60.5	66.2	51.7	59.49	.456	.311	.230	.352	88	55	77	72	N N W	N N W	N N W	6.70	- -	- -
b	8	.791	.811	.811	.816	53.1	69.0	58.0	60.65	.322	.423	.325	.358	82	62	69	70	N N W	S b E	N b E	4.18	- -	- -
c	9	.832	.730	.618	.737	53.5	70.7	63.8	63.37	.315	.445	.417	.426	86	61	78	76	N E b N	E S E	S S W	5.55	Inap	-
c	10	.758	.755	.857	.796	59.3	66.2	49.1	51.88	.255	.317	.259	.277	83	51	78	68	Calm	W b N	Calm	4.26	- -	-
c	11	.870	.873			49.3	62.9			.212	.298			70	51			N N W	S b W		1.65	- -	- -
b	12	.904	.813	.762	.830	39.9	61.9	55.5	55.93	.179	.318	.298	.305	73	58	69	63	Calm	S E b S	Calm	1.43	- -	- -
a	13	.717	.625	.599	.621	50.0	66.2	61.9	60.83	.298	.437	.415	.400	81	70	77	78	Calm	S b W	Calm	2.33	0.250	- -
f	14	.494	.283	.082	.278	57.1	61.1	58.7	59.80	.422	.493	.489	.462	92	91	99	92	N E	E N E	N N E	9.80	1.895	- -
d	15	.271	.383	.512	.411	58.1	67.1	56.9	61.28	.435	.401	.327	.394	92	62	72	76	N W b W	N W	Calm	6.61	- -	- -
b	16	.632	.610	.546	.579	50.4	66.4	61.3	61.22	.303	.514	.531	.460	84	82	91	85	Calm	E	E S E	2.41	0.040	- -
a	17	.495	.451	.497	.476	58.8	77.3	70.6	67.52	.430	.751	.655	.589	83	82	90	87	Calm	S E	Calm	1.66	Inap	- -
e	18	.503	.482			67.2	75.7			.587	.679			91	79			E b N	S E		3.70	Inap	- -
c	19	.368	.472	.558	.473	69.8	64.0	60.3	64.52	.611	.517	.481	.515	87	94	95	91	S	S W b W	Calm	4.52	0.359	- -
e	20	.629	.556	.532	.573	59.3	65.2	51.0	56.08	.317	.473	.314	.382	89	78	94	87	S S W	S E	W	3.09	0.115	- -
b	21	.558	.587	.630	.593	49.2	58.1	52.8	53.95	.302	.390	.323	.310	88	83	82	83	W b N	N W	N W	7.07	- -	- -
d	22	.651	.639	.642	.639	49.5	56.0	47.2	59.47	.292	.272	.268	.277	83	62	81	77	N N W	N N E	S b W	2.65	- -	- -
b	23	.625	.589	.551	.585	47.2	66.6	57.8	57.43	.278	.463	.420	.391	87	73	90	81	Calm	S b E	S W b S	2.33	- -	- -
b	24	.422	.575	.591	.614	50.5	62.1	46.4	55.62	.446	.276	.214	.310	87	51	68	69	S W b S	N W	N W b N	8.42	- -	- -
b	25	.903	.905			37.8	51.2			.172	.289			76	70			Calm	S b W		3.02	- -	- -
b	26	.933	.787	.723	.801	47.1	59.4	51.0	53.32	.252	.310	.321	.313	79	69	87	78	N E b N	E	E N E	5.94	Inap	- -
b	27	.720	.599	.493	.599	48.1	48.3	42.7	45.52	.291	.307	.271	.294	88	92	1.00	94	E N E	E b N	N N E	7.77	0.500	- -
e	28	.551	.665	.861	.705	42.3	53.5	41.6	45.92	.252	.197	.193	.206	94	49	75	69	N	N b W	N N W	8.42	- -	- -
b	29	.976	.943	.939	.939	37.4	51.1	35.1	42.30	.165	.227	.184	.188	74	62	87	71	N W b N	S S E	E b N	2.91	- -	- -
b	30	.850	.707	.599	.691	37.0	52.6	42.7	45.77	.207	.270	.214	.230	95	69	79	75	N N E	E	N N E	2.10	- -	- -
	M	29.661	29.632	29.641	29.612	53.40	65.68	55.80	58.81	0.363	0.447	0.382	0.399	86	70	82	79	M's 3.30	M's 6.43	M's 3.26	4.30	5.140	

Sum of the Atmospheric Current, in miles, resolved into the four Cardinal directions.

North, 1513.11; West, 804.37; South, 758.52; East, 872.38.

Mean direction of the wind, North.

Mean velocity of the wind - - 4.30 miles per hour.

Maximum velocity- - - - - 20.7 miles per hour, from 10 to 11 p.m. on 14th

Most windy day - - - - - 14th: Mean velocity, 9.80 miles per hour.

Least windy day - - - - - 12th Mean velocity, 1.43 ditto.

Raining 47.9 hours on 12 days.

14th.—The velocity of the Wind from 10h. 0m., to 10h. 10m. p.m., was at the rate of 40.2 miles per hour, and from 10h. 10m., to 10h. 20m. p.m., at the rate of 46.8 miles per hour, being the greatest velocity ever recorded at this Observatory.

Highest Barometer - - 29.939, at 8 A.M., on 29th. } Monthly range:
Lowest Barometer - - 28.946, at 10.20 P.M., on 14th. } 1.033 inches.
Highest regist'd Temp. - 85.5, at — P.M., on 5th } Monthly range:
Lowest regist'd Temp. - 33.9, at — A.M., on 30th } 51.6
Mean Maximum Temperature - - - - 67.87 } Mean daily range:
Mean Minimum Thermometer - - - - - 49.45 } 18.42
Greatest daily range.- - - - - 32.2 from P. M. 24th to A. M. of 25th.
Warmest day - - 5th - - - Mean Temperature - 75.22 } Difference
Coldest day - - 29th - - - Mean Temperature - 42.30 } 32.92

The "Means" are derived from six observations daily, viz., at 6 and 8 A. M., and 2, 4, 10 and 12, P. M.

Aurora observed on 7 nights. Possible to see Aurora on 19 nights. Impossible to see Aurora on 11 nights.

The column headed "Magnet" is an attempt to distinguish the character of each day, as regards the frequency or extent of the fluctuations of the Magnetic declination, indicated by the self-registering instruments at Toronto. The classification is, to some extent, arbitrary, and may require future modification, but has been found tolerably definite as far as applied. It is as follows:

(a) A marked absence of Magnetical disturbance.

(b) Unimportant movements, not to be called disturbance.

(c) Marked disturbance—whether shewn by frequency or amount of deviation from the normal curve—but of no great importance.

(d) A greater degree of disturbance—but not of long continuance.

(e) Considerable disturbance—lasting more or less the whole day.

(f) A Magnetical disturbance of the first class.

The day is reckoned from noon to noon. If two letters are placed, the first applies to the earlier, the latter to the later part of the trace. Although the Declination is particularly referred to, it rarely happens that the same terms are not applicable to the changes of the Horizontal Force also.

Comparative Table for September.

Year.	Temperature. Mean.	Max. obs'rvd	Min. obs'rvd	Range.	Rain. D'ys	Inches.	Snow. D'ys	Inch.	Wind Mean Velocity
	°	°	°	°					Miles.
1840	54.0	70.2	29.4	40.8	4	1.380	0	--	-
1841	61.3	79.9	37.5	42.4	9	3.310	0	--	--
1842	55.7	83.5	28.3	55.2	12	6.160	0	--	--
1843	59.1	87.8	33.1	54.7	10	9.760	0	--	0.57lb
1844	58.6	81.5	29.6	51.9	4	imperfect	0	--	0.26lb
1845	55.0	78.8	35.3	43.5	16	6.215	0	--	0.34lb
1846	63.6	81.0	39.0	45.0	11	4.565	0	--	0.33lb
1847	55.6	71.8	38.1	36.7	15	6.655	0	--	0.32lb
1848	54.2	80.9	29.5	51.4	11	3.115	0	--	5.81m
1849	58.2	80.6	33.5	47.1	9	1.480	0	--	4.23m
1850	56.5	76.0	31.7	44.3	11	1.735	0	--	4.75m
1851	60.0	85.3	33.4	52.9	9	2.665	0	--	51.5m
1852	57.5	81.8	33.1	45.7	10	3.630	0	--	4.69m
1853	58.8	85.4	36.1	49.3	12	5.140	0	--	4.39m
									0.37 [illegible]
Mean	57.79	80.82	33.61	47.21	10.2	4.301	0		4.56 M's

METEOROLOGICAL OBSERVATIONS.

During the Storm of 14th August, 1853.

Magnetic Observatory, Toronto.

The Barometer has been falling gradually from 29.922 inches on the 12th, at 8 a.m., to 29.082 at 10 p.m., on the 14th. The wind on the 12th and 13th had been mostly calm, or W. and S.W., the motion of the clouds being from W. and S.W., and increasing in extent till 8 a.m. on the 13th, when the sky was overcast, and continued so, the humidity, also, increasing till it reached .93 at 10 p.m. on the 13th. The wind changed on the morning of the 14th, about midnight, to N.N.E., and rain fell during the night.

The 14th was densely clouded, and there was steady rain all day, the wind creeping round to the N., and the velocity increasing from 1.6 miles at 6 a.m. to 22.0 at 10 p.m. At this time the violence of the storm increased the wind N.N.E., Barometer, 29.082, Thermometer, 58.7°, Humidity 99 at 10.12 p.m. Barometer 28.992; from 10 h. to 10 h. 10 m., the wind had traversed 6.7 miles, or at the rate of 40.2 miles per hour; in the previous half hour its rate was 13.4 miles per hour.

At 10h. 20m. Barometer 28.916, from 10h. 10m. to 10h. 20m., the wind had traversed 7.8 miles, being at the rate of 46.8 miles per hour. A sudden lull now took place the Barometer beginning to rise.

At 10h. 30m. Barometer 29.028, rate of wind for this 10m., being 65. miles per hour. The wind now gradually veered round by S., and at 11 p.m. it had got round to N.W. by N. having changed through ¾ of the circle.

At 11h. Barometer 29.112 velocity of wind from 10h. 30m. to 11 p.m. was 10.6 miles per hour, at 10h. 11m. rain ceased, and the storm was over, the Barometer continued to rise steadily.

The quantity of rain which fell during the day was 1.895 inches on the surface.

Monthly Meteorological Register, St. Martin, at Isle Jesus, Canada East, September, 1853,

Nine Miles West of Montreal.

[BY CHARLES SMALLWOOD, M. D.]

Latitude—45 deg. 32 min. North. Longitude—73 deg. 36 min. West. Height above the Level of the Sea—118 ft.

Day.	Barom: corrected and reduced to 32° Fahr. 6 A.M.	2 P.M.	10 P.M.	Temp. of the Air. 6 A.M.	2 P.M.	10 P.M.	Tension of Vapour. 6 A.M.	2 P.M.	10 P.M.	Humi'y of the Air. 6 A.M.	2 P.M.	10 P.M.	Direction of Wind. 6 A.M.	2 P.M.	10 P.M.	Velocity in Miles per Hour. 6 A.M.	2 P.M.	10 P.M.	Rain in Inch.	Weather, &c. A cloudy sky is represented by 10; a cloudless sky by 0. 6 A.M.	2 P.M.	10 P.M.
1	29.592	29.600	29.618	52.1	80.3	65.2	.373	.532	.527	.93	.53	.85	N W b W	W b N	S W	0.12	Calm.	0.10		Clear.	Clear.	Clear, A. Borealis
2	.652	.538	.520	60.0	86.2	70.2	.501	.618	.515	.98	.53	.70	S W	W	S S W	Calm.	0.27	1.51		Clear.	Clear.	Clear, A. Borealis
3	.510	.433	.455	66.2	83.1	71.0	.605	.715	.684	.94	.64	.86	S S W	W S W	W S W	0.37	3.13	3.09	Inap.	Clear.	Slight Showers.	Clear, A Borealis
4	.421	.308	.252	70.1	84.0	74.6	.628	.638	.648	.86	.56	.78	W b S	W b S	W	3 65	10.79	2.87		Clear.	Cirr. Cum. 4.	C. S. 9. Rain 10.28
5	.320	.383	.286	53.1	58.0	53.1	.361	.412	.386	.87	.84	.93	N E	N E	N E	9.42	3.75	2.26	0.236	Cir. Str. 9.	Cir. Str. 10.	Clear, S't L'ning.
6	.285	.212	.263	57.6	82.6	68.0	.422	.787	.652	.89	.71	.96	N E b E	W b S	N E	Calm.	Calm	2.25		Clear.	Str. 4.	Th'er St'm8.15pm
7	.158	.189	.303	59.0	63.8	58.0	.484	.516	.472	.95	.94	.96	N E	N E	E N E	7.62	7.40	0.55	1.873	Rain.	Str. 10.	Clear.
8	.423	.414	.487	47.0	70.9	53.2	.330	.481	.361	.98	.64	.87	N	W	W	Calm.	Calm	3.02		Clear.	Cum. 2.	Clear
9	.614	.472	.391	50.7	71.9	58.1	.326	.481	.389	.87	.61	.79	N E	S E	S b E	5 19	3.75	3 08		Clear.	Str. 2.	Cum. Str. 4.
10	.305	.321	.429	52.7	63.4	50.0	.373	.388	.326	.93	.67	.87	S W b W	W	W	11 75	11 25	8 22	0.420	Cum. Str. 8.	Cum. 4.	Clear.
11	.460	.437	.457	49.1	56.0	46.2	.312	.257	.303	.86	.62	.91	W N W	W N W	W b N	3.25	8 83	5.37		Cum. Str. 3.	Cum Str. 8.	Clear.
12	.537	.427	.427	41.0	64.6	51.1	.264	.357	.349	.96	.59	.8	S W b S	W S W	W S W	2 19	7.12	9.30		Clear, 1st Frost.	Cum. Str. 2	Clear, A. Borealis.
13	.320	.210	.233	52.0	72.1	62.2	.349	.523	.499	.87	.67	.89	W b S	W S W	W	6.29	9.50	6 25		Clear.	Cum. Str. 4.	Clear, A. Borealis.
14	.233	.170	.169	56.8	68 0	55.2	.432	.523	.418	.91	.76	.91	N E b E	N E b E	N E b E	3.53	1.00	8.75	0.150	Str. 4.	Str. 4.	Rain b. at 5.10 p.m
15	28.925	28.911	29.079	52.0	51.0	57.1	.382	.400	.450	.96	.93	.96	N E b E	N N b E	N N E	18.36	15.29	3.87	1.992.	Rain.	Rain ceased 5. 40.	Str. 9.
16	29.275	29.237	.280	51.0	72 0	67.4	.372	.607	.447	.96	.78	.91	N	S W b S	N E b N	0.76	9.07	1.38		Clear.	Cir. Cum. Str. 4.	Cum. St. 7.
17	.296	.140	.243	50 7	65.6	60.0	.319	.499	.467	.93	.80	.89	N E b E	N E b E	S E	10 00	6.62	1.62		Cir. Str. 10.	Cir. Cum. Str. 9.	Cirr. Cum. Str. 9.
18	.221	.176	.145	60.5	73.6	68.3	.491	.659	.646	.91	.82	.91	S E	S E	S b E	1.12	0.93	5 12		Cir. Str. 9.	Cum.Str.9. thund'r	Cir. 2 A. Borealis.
19	.140	.068	.093	68.5	92 6	68.2	.646	.854	.523	.94	.62	.76	S	S	W N W	5 43	8 75	6 25		Clear.	Light Cum.	Cir. Str. 8.
20	.224	.218	.222	58.6	70.5	56.4	.462	.628	.432	.94	.86	.91	W	S W	S S W	6.30	2 10	1.10	0.200	Cum. Str. 10.	Cum. Str.	Cir. Str. 2.
21	.203	.142	.179	56.5	71 3	55.0	.432	.481	.391	.94	.64	.88	E S E	N E b E	N N W	0.12	1.62	1.67	Inap.	Slight Rain.	Cum. 1.	Clear.
22	.161	.138	.201	54.6	68.1	50 2	.400	.5 3	.326	.93	.76	.87	N E b N	W b S	W N W	2 80	1.25	4.30		Cir.Cum. Str. 8.	Cum. Str. 2.	Clear.
23	.267	.263	.218	46.5	69 6	52.0	.3 3	.511	.382	.93	.76	.96	W N W	W b S	S W	1.07	1.30	1.87		Clear.	Clear.	Clear.
24	.107	.033	.277	50 0	61.3	42 6	.319	.501	.225	.93	.81	.79	S E b S	S W b W	W N W	2.75	7.63	15.11	0.303	Clear.	C. S. 6. Showers.	Clear, Ft Aurora.
25	.405	.358	.452	40 0	52.7	39.8	.227	.261	.234	.85	.66	.91	W	W	W b N	7.75	11 90	8.01		Clear.	Clear, with hail	Clear.
26	.543	.505	.487	39.7	43.0	35.5	.231	272	.210	.91	.92	.91	W b N	W b N	W N W	3 85	6 25	5.62	0.100	Cir. Cum. 4.	Overcast.	Shower'd 6.50 p.m
27	.495	.301	.365	36.0	45 2	41.8	.2 0	.272	.213	.91	.86	.86	N E	E N E	N E b E	6.25	6.33	2.50		Str. 10.	Str. 10.	Str. 10.
28	.190	.237	.356	41.8	41.8	40.6	.213	.263	.264	.86	.92	.96	N E b E	N E b N	N E b N	12.12	14.50	11.89	1.843	Rain began 10.20	Rain ceas'd 5 20 P	Clear.
29	.508	.500	.502	33.0	56.0	37.0	.187	.385	.218	.90	.84	.91	N N E	S E b E	S E b E	2.82	2 03	1.37		Clear.	Clear.	Clear.
30	.460	.318	.282	28.3	59.0	45 6	.119	.315	.235	.68	.61	.74	E S E	S. W.	W b S	0 03	0.73	1.56		Clear.	Clear.	Clear.

Barometer.
- Highest, the 2nd day 29.652
- Lowest, the 15th day 28.911
- Monthly Mean, ... 29.325
- " Range 0.741

Thermometer
- Highest, the 19th day . . . . . 94.°0
- Lowest, the 30th day . . . . . 27.°3
- Monthly Mean . . . . . . 58.°04
- " Range . . . . . . 66.°7

Greatest Intensity of the Sun's Rays—143.°0

Lowest point of Terrestial Radiation 26.°1.

Mean of Humidity, 831.

Rain fell in 11 days amounting to 10.117 inches, and was accompanied by thunder and Lightning on two days.

Yellow matter was observed to have fallen on the 24th day.

Amount of Evaporation—2.23 inches.

Most Prevalent wind—N. E. by E.

Least do. do. N.

Most Windy Day—the 15th day, mean—12.51 miles per hour

Least Windy Day—1st day, mean—0.07 miles per hour.

Aurora Borealis visible on 6 nights, and might have been seen on 14 nights.

The amount of Rain during the month has been very great, and during the incessant rain of the 15th, which lasted 24 hours, fell to the depth of 5.142 inches.

First Frost on the morning of 12th day.

The electrical state of the atmosphere has been marked *generally* by very feeble intensity of a Positive character, and during the thunder storms, the Electrometer indicated low tension of a negative character.

Winter Phenomena in the St. Lawrence.*

The island of Montreal stands at the confluence of the rivers Ottawa and St. Lawrence, and is the largest of several islands splitting up these mighty streams, which cannot be said to be thoroughly mingled until they have descended some miles below the whole cluster. The rivers first come in contact in a considerable sheet of water called Lake St. Louis, which separates the upper part of the Island of Montreal from the southern main. But though the streams here touch, they do not mingle. The waters of the St. Lawrence, which are beautifully clear and transparent, keep along the southern shore, while those of the Ottawa, of a darker aspect, though by no means turbid, wash the banks of the island; and the contrast of colour they present strongly marks their line of contact for many miles.

Lake St. Louis is at the widest part about six miles broad with a length of twelve miles. It gradually narrows towards the lower end, and the river as it issues from it, becoming compressed into the space of half a mile, rushes with great violence down the rapids of Lachine, and although the stream is known to be upwards of eight feet deep, it is thrown into huge surges of nearly as many feet high as it passes over its rocky bottom, which at this spot is composed of layers of trap extending into floors that lie in successive steps.

At the termination of this cascade the river expands to a breadth of four miles, and flows gently on, until it again becomes cramped up by islands and shallows opposite the city of Montreal. From Windmill Point and Point St. Charles above the town, several ledges of rock, composed of trap lying in floors, which in seasons of low water are not much below the surface, shoot out into the stream about 1000 yards: and similar layers pointing to these come out from Longueuil on the opposite shore. In the narrow channel between them, the water, rushing with much force, produces the Sault Normand, and cooped up, a little lower down by the island of St. Helen and several projecting patches of trap, it forms St. Mary's current.

The interval between St. Helen and the south shore is greater than that between it and Montreal; but the former is so floored and crossed by hard trap rocks that the St. Lawrence has as yet produced but little effect in wearing them down, while in the latter it has cut out a channel between thirty and forty feet deep, through which the chief part of its waters rush with a velocity equal to six miles per hour. It is computed that by this channel alone upwards of a million of tons flow past the town every minute.

Between this point and Lake St. Peter, about fifty miles down, the river has an average breadth of two miles, and proceeding in its course with a moderate current, accelerated or retarded a little, according to the presence or absence of shoals—it enters the lake by a multitude of channels cut through its delta, and forming a group of low flat alluvial islands.

The frosts commence about the end of November, and a margin of ice of some strength soon forms along the shores of the river and around every island and projecting rock in it: and wherever there is still water it is immediately cased over. The wind, acting on this glacial fringe, breaks off portions in various parts, and these proceeding down the stream constitute a moving border on the outside of the stationary one which, as the intensity of the cold increases, is continually augmented by the adherence of the ice sheets which have been coasting along it: and as the stationary border thus robs the moving one this still further outflanks the other, until in some part the margins from the opposite shores nearly meeting, the floating ice becomes jammed up between them, and a night of severe frost forms a bridge across the river. The first ice bridge below Montreal is usually formed at the entrance of the river into Lake St. Peter, where the many channels into which the stream is split up greatly assist the process.

As soon as the winter barrier is thrown across, (generally towards Christmas,) it of course rapidly increases by stopping the progress of the downward floating ice, which has by this time assumed a character of considerable grandeur, nearly the whole surface of the stream being covered with it, and the quantity is so great, that to account for the supply many, unsatisfied with the supposition of a marginal origin, have recourse to the hypothesis that a very large portion is formed on and derived from the bottom of the river where rapid currents exist.

But whatever its origin, it now moves in solid and extensive fields, and wherever it meets with an obstacle in its course the momentum of the mass breaks up the striking part into huge fragments that pile over one another: or if the obstacle be stationary ice, the fragments are driven under it, and there closely packed. Beneath the constantly widening ice barrier mentioned, an enormous quantity is thus driven, particularly when the barrier gains any position where the current is stronger than usual. The augmented force with which the masses then move, pushes and packs so much below that the space left for the river to flow in is greatly diminished, and the consequence is a perceptible rise of the waters above, which indeed from the very first taking of the "bridge" gradually and slowly increases for a considerable way up.

There is no place on the St. Lawrence where all the phenomena of the taking, packing and shoving of the ice are so grandly displayed as in the neighbourhood of Montreal. The violence of the currents is here so great, and the river in some places expands to such a width, that whether we consider the prodigious extent of the masses moved or the force with which they are propelled, nothing can afford a more majestic spectacle or impress the mind more thoroughly with a sense of irresistible power. Standing for hours together upon the bank overlooking St. Mary's current, I have seen league after league of ice crushed and broken against the barrier lower down, and there submerged and crammed beneath. And when we reflect that an operation similar to this occurs in several parts from Lake St. Peter upwards, it will not surprise us that the river should gradually swell.

By the time the ice has become stationary at the foot of St. Mary's current, the waters of the St. Lawrence have usually risen several feet in the harbour of Montreal, and as the space through which this current flows affords a deep and narrow passage for nearly the whole body of the river, it may well be imagined that when the packing here begins the inundation rapidly increases. The confined nature of this part of the channel affords a more ready resistance to the progress of the ice while the violence of the current brings such an abundant supply and packs it with so much force that the river dammed up by the barrier which in many places reaches to the bottom, attains in the harbour a height usually twenty, and sometimes twenty-five feet above its summer level; and it is not uncommon between this point and the foot of the current, within the distance of a mile, to see a difference in elevation of several feet which undergoes many rapid changes, the waters ebbing or flowing according to the amount of impediment they meet with in their progress from submerged ice.

It is at this period that the grandest movements of the ice occur. From the effect of packing and piling, and the accumulation of the snows of the season, the saturation of these with water and the freezing of the whole into a solid body, it attains the thickness of ten to twenty feet and even more: and after it has become fixed as far as the eye can reach, a sudden rise in the water (occasioned, no doubt, in the manner mentioned) lifting up a wide expanse of the whole covering of the river so high as to free and start it from the many points of rest and resistance offered by the bottom, where it had been packed deep enough to touch it, the vast mass is set in motion by the whole hydraulic power of this gigantic stream. Proceeding onward with a truly terrific majesty it piles up over every obstacle it encounters; and when forced into a narrow part of the channel, the lateral pressure it there exerts drives the bordage up the banks where it sometimes accumulates to the height of forty or fifty feet. In front of the town of Montreal there has lately been built a magnificent revetment wall of cut limestone to the height of twenty-three feet above the summer level of the river. This wall is now a great protection against the effects of the ice. Broken by it, the ice piles on the street or terrace surmounting it, and there stops; but before the wall was built, the sloping bank guided the moving mass up to those of gardens and houses in a very dangerous manner, and many accidents used to occur. It has been known to pile up against the side of a house distant more than 200 feet from the margin of the river, and there break in at the windows of the second floor. I have seen it mount a terrace garden twenty feet above the bank, and crossing the garden enter one of the principal streets of the town. A few years before the erection of the revetment wall, a friend of mine, tempted by the commercial advantages of the position, ventured to build a large cut stone warehouse. The ground floor was not more than eight feet above the summer level of the river. At the taking of the ice, the usual rise of the water of course inundated the lower story and the whole building becoming surrounded by a frozen sheet, a general expectation was entertained that it would be prostrated by the first movement. But the proprietor had taken a very simple and effectual precaution to prevent this. Just before the rise of the waters he securely laid against the sides of the building at an angle of less than 45°, a number of stout oak logs a few feet asunder. When the movement came the sheet of ice was broken, and pushed up the wooden inclined plane thus formed, at the top of which, meeting the wall of the building, it was reflected into a vertical position, and falling back in this manner, such an enormous rampart of ice was in a few minutes placed in front of the warehouse as completely shielded it from all possible danger. In some years the

* Contributed to the Geological Society of London, June 15th, 1842, by W. E. Logan, Esq., Provincial Geologist.

ice has piled up nearly as high as the roof of this building. Another gentleman, encouraged by the security which this warehouse apparently enjoyed, erected one of great strength and equal magnitude on the next water lot, but he omitted to protect it in the same way. The result might have been anticipated. A movement of the ice occurring, the great sheet struck the walls at right angles and pushed over the building as if it had been a house of cards. Both positions are now secured by the revetment wall. Several movements of the grand order just mentioned occur before the final setting of the ice, and each is immediately preceded by a sudden rise of the river. Sometimes several days, and occasionally but a few hours will intervene between them, and it is fortunate that there is a criterion by which the inhabitants are made aware when the ice may be considered at rest for the season; and when it has, therefore, become safe for them to cut their winter roads across its rough and pinnacled surface. This is never the case until a longitudinal opening of some considerable extent appears in some part of St. Mary's current. It has embarrassed many to give a satisfactory reason why this rule, derived from the experience of the peasantry, should be depended on. But the explanation is extremely simple. The opening is merely an indication that a free subglacial passage has been made for itself by the water through the continued influence of erosion and temperature, the effect of which where the current is strongest has been sufficient to wear through to the surface. The formation of this passage shows the cessation of a supply of submerged ice, and a consequent security against any further rise of the river to loosen its covering for any further movement. The opening is thus a true mark of safety. It lasts the whole winter, never freezing over, even when the temperature of the air reaches 30° below zero of Farenheit; and from its first appearance the waters of the inundation gradually subside, escaping through the channel of which it is the index. The waters seldom or never, however, fall so low as to attain their summer level; but the subsidence is sufficiently great to demonstrate clearly the prodigious extent to which the ice has been packed, and to show that over great occasional areas it has reached to the very bottom of the river. For it will immediately occur to every one that when the mass rests on the bottom its height will not be diminished by the subsidence of the water, and that as this proceeds, the ice according to the thickness which it has in various parts attained, will present various elevations after it has found a resting place beneath until just so much is left supported by the stream as is sufficient to permit its free escape. When the subsidence has attained its maximum, the trough of the St. Lawrence, therefore, exhibits a glacial landscape undulating into hills and valleys that run in various directions, and while some of the principal mounds stand upon a base of 500 yards in length by a hundred or two in breadth, they present a height of ten to fifteen feet above the level of those points still supported in the water.

Mr. Good's Locomotive Engine "Toronto."

We have much pleasure in presenting our readers with a drawing of the first Locomotive Engine constructed in Canada, and, indeed, we believe, in any British Colony. The 'Toronto' is certainly no beauty, nor is she distinguished by any peculiarity in her construction, but she affords a very striking illustration of our progress in the mechanical arts, and of the growing wants of the country. The 'Toronto' was built at the Toronto Locomotive Works, which were established by Mr. Good in Oct. 1852, The order for the "Toronto" was received in February, 1853, for the Ontario, Simcoe and Huron Railroad: the Engine was completed on the sixteenth of April, and put on the track the 26th of the same month. Her dimensions are as follow: Cylinder, 16 inches diameter; stroke, 22 in.; Driving wheel, 5 ft. 6 in. diameter; length of internal fire-box, 1 ft. 6 in.; width of do, 3 ft. 5 in.; height of do, 5 ft. 0 in.; weight of Engine, 25 tons; number of tubes, 150; diameter of tubes, 2 inches.

Naturalists' Calendar for August, September and October.—Toronto, 1853.—By Wm. Couper.

		First Seen.
Choke-Cherry, *Prunus Serotina,*	(Fruit ripe,)	August 1.
Wild Grape Vine,	" "	" 27.
Wild Hazel,	" "	September 19.
Butternut, *Juglans Cinerea,*	" "	" 21.
Beechnut, *Fagus Ferruginea.*	" "	" 21.

Miscellaneous.—Passenger Pigeon, *Columba Migratoria,* (in flocks) Aug. 5. *Larvæ,* of the large Whirl Beetles, (*Gyrini*) construct cocoons of sand under logs &c., on the margin of ponds on the Peninsula opposite Toronto, in which they transform into the perfect insect, August 6. Caterpillars of a *Sphinx* (Hawkmoth) found feeding on the leaves of the Persian Lilac, entered the earth, August 8.—changed into a chrysalis. Aug. 10. Caterpillar of a *Sphinx,* (Hawkmoth) found feeding on the leaves of a Wild Grape Vine, changed into a Chrysalis between two leaves, on the surface of moist earth, Aug. 11. Wasps construct the first foundation of their nest, Aug 11 Caterpillar of a large Hymenopterous fly (*Tenthredo*) found feeding on the leaves of the Willow, entered the earth and formed a cocoon, Aug. 15. Caterpillar of the moth *Saturnia Polyphemus* issues from the egg, Aug. 16—formed its cocoon Aug. 24.—This Caterpillar feeds on the leaves of the Soft Maple. A parasite of a lead-grey colour (*Aphis Lanata*) (?) and covered with filaments of white down, clusters round the branches of the Alder, Aug. 27. Needle Ichneumon-fly (*Pelecinus Polycerator,*) first seen, Aug. 27. Caterpillar of a *Sphinx,* (Moth) found feeding on the leaves of the Plumtree, formed its cocoon between leaves, on the surface of moist earth, Aug. 27. Caterpillar of the Great Saturnia Moth, formed its cocoon, Aug. 27. Caterpillar of the Griseous Moth (*Cerura Hastulifera*) found feeding on the leaves of the Willow, constructed its cocoon on a small twig, Aug. 31.—This caterpillar is of a bright green colour, marked with brown lines, and has two tails. Swallows disappear, Sept. 10. The Upper surface of the leaves of the common Hazel separated by sociable Caterpillars of a whitish colour, Sept. 10. Walking-stick insect (*Phasma*) attains its full growth Aug. 14: Female deposits its *ova* on the surface of the earth, September 19. The leaves of the young Sugar Maples change their colour, Sept. 19.—One species is quite an ornament to the forest during the months of Sep. and Oct.—its leaves changes into a brilliant crimson. Caterpillar of a Saw-fly, (*Tenthredo Pini*) found feeding on the Pine, Sept. 19.—This insect is very destructive to the young pines—the *larvæ* from the eggs of two females will strip a tree of its foliage in four days. Aphides of the *Pinus Strobus,* Sept. 19. The Toad (*Bufo Cognatus*) hybernate in the earth, Sept. 20.

Frogs hybernate - - - - - - -	October	11
Migration of the Blue Bird, *Saxicola Sialis,* -	"	13
" " American Goldfinch, *Fringilla Tristis,*	"	13

Many species of Birds of Passage which remain with us during the summer months, apparently take advantage of the Indian Summer to depart from the country. The above mentioned birds migrate in flocks. The flight of the Blue-birds was in a south-west direction—the Finches appeared to be flying directly south.

Two Lizards, measuring about 7 inches in length, and covered with round orange-coloured spots, were taken from under the bark of a decayed tree on the banks of the River Don - October 15

The Musk Rat, *Fiber Zibethicus,* constructs its hut " 20

The fur of this animal constitutes an important item in our market. One man trapped one hundred and twenty-five last week.

Railway Bridge over the St. Lawrence at Montreal.*

The site selected for completing the connection between the eastern and western sections of the Canada Grand Trunk Railway by a bridge at Montreal is upon the "ledges of rock composed of the trap lying in floors," described by Mr. Logan as extending from Point St. Charles diagonally and downward across the general course of the stream to Moffatt's Island and the eastern shore at St. Lambert.

The governing point of the location is the narrow channel, (the only navigable one) abreast of Moffatt's Island, which is here only one hundred yards wide between the lines of ten feet at low water.

The distance of this single navigable channel from the Island of Montreal, measured on the proposed line of the bridge, is 5200 feet, and from the southern main 4800 feet. The height of the banks on either shore is about thirty feet. By elevating the centre arch of the bridge (which spans the navigable channel) 100 feet over summer level of water, and by embanking about ten feet on the natural level at each shore, the gradient to be overcome is sixty-three feet, and as the distance in both cases is nearly a mile, it is one common on railways On account of this gradient, it is important that the bridge should be straight; and starting from the governing point—the navigable channel alluded to,—a straight line which will avoid deep water, the canal, and buildings of the city, must cross the river somewhat diagonally and strike Point St. Charles. This line, although oblique with reference to the general trend of the shores, is in reality at right angles *to the channel.* The bridge location follows the shoal water and the line of the "trap floor" through which the river has cut a passage at the navigable channel (as usual at right angles)—the course

* Extract from the Report of T. C. Keeler, Esq., C. E.

of which is *across* the general direction of the stream, and strikes toward the quays at Montreal.

Considering the " channel " as that portion of the stream having a greater depth than *nine* feet at extreme low water, the width of it on the bridge line as stated is about 360 feet, or about 300 feet between the lines of ten feet water. If the centre span be executed in wood, the piers would encroach upon the " channel " as above defined. It would be better to have the centre span upon any location 400 feet wide, which will involve a tubular beam of iron, at an additional expense of about £43,000. This additional expenditure I would recommend, as this arch will be exposed to the chimneys of passing steamers; moreover, by making it of iron it cuts off the communication in the event of fire—exposing only half the structure.

While the selection of the site has been governed by the accidental conditions of the river, it possesses a variety of advantages, which under such circumstances could hardly have been anticipated.

1st. The location is on the most direct line of connection for the Grand Trunk Railway. This road, without reference to the bridge, would on approaching the city cross the canal at the only convenient point (which is near Gregory's and above all the basins) and proceeded down to Point St. Charles for its freight terminus and for a connection with the harbour independent of the canal. The bridge line is a continuation of the main track coming down to Point St. Charles.

2nd. The line in the river runs upon a rock bottom and in more shallow water than can be found upon any other direct line crossing the St. Lawrence. It is a remarkable fact that the shoalest water to be found in the St. Lawrence below Lake Ontario is on the *last* rapid —the Sault Normand opposite Montreal.

The width of the river and consequent length of the bridge is not only counteracted by this shoal water (fully half of the whole distance being less than five feet deep,) but this width involves little disadvantage, because the distance between the only navigable channel and the shores admits of a gradient, which passing *over* the limits required for the navigation, yet descends at once so as to strike the business level at both of these shores.

3rd. The ice seldom lodges *above* the line of the bridge, although it always does to a greater or less degree immediately below it. Nun's Island gives a direction to the current, which throws the ice against Moffatt's Island where it piles with great force. The shoal, which is suspended from the lower end of Nuns' Island to the centre channel will act as a breakwater to the western half of the bridge against the effect of " bergs " of ice. The average depth of water on this shoal not exceeding seven feet, detached ice-breakers can be constructed upon it at a moderate cost, which will break the momentum of large descending fields,—while accumulations of ice having too great a draught of water to pass under the arches will be " picked up " by this shoal before reaching the piers of the bridge. On the eastern half of the bridge, the greater portion of the work will derive much protection against the effects of descending ice, by the works of the Champlain and St. Lawrence Railway, and by the natural breastwork of Moffat's Island.

4th. The site, while it possesses all the advantages of a line in the rapids where there is but one navigable channel, not only has that channel narrower than any available one in the rapids above, but the rapid is so moderate as not to offer any great impediment to the work of erection, and construction, and for three months in the year is frozen over and accessible at every point upon strong ice.

5th. Terminating at Point Charles in immediate contiguity with the canal basins, the water level of which aided if necessary by an additional supply from the head of the Lachine rapids can be conducted over hundreds of acres both on land and in the river,—the bridge will lead all the railroads from the southern shore to the only point where they can be placed in immediate connection with the navigation and receive supplies " ex-warehouse," or direct from inland or sea craft for distribution to every part of New England or the Lower Provinces. In connection with this subject I have projected a scheme of docks around Point St. Charles, which shews the capabilities of the place in point of extent to be at least equal to that of Liverpool, Glasgow, or London, and which may be taken up in sections and extended as required for the increasing wants of commerce.

The importance of this point, its fitness for a general railway terminus in connection with the sea and inland navigation, is explained at large in the appendix in an extract from my unpublished Report on the Montreal and Kingston Railway, and also an extract from a lecture before the Mechanics Institute of this city.

It will be at once seen on reference to a map, that *the whole* of the channel between Nuns' and Montreal Islands may be filled with water and made available for the navigation. Also by obtaining (upon top of the embankment) permanent access to Nuns' Island, the outer coast of that island presents an extensive frontage and deep water where barges and lake and river craft not drawing over nine feet water may load for ports below.

It is only by an artificial harbor accommodation like this that Montreal can ever hope to share with Quebec any portion of the export trade in deals. Bright deals brought by railway to Point St. Charles and Nuns' Island, could afford this transportation on account of the higher price these command over those which have been floated. This trade by attracting a larger marine to this port could not fail to give an important impulse to our commerce,

Lastly. The excellence of this site,—opposing only a single navigable channel which is trumpet-mouthed and therefore affords safe and easy access to the passage of the bridge,—is strikingly shown in the features of practicability, of economical arrangement. and the minimum of gradient which are here attainable.

If the navigable channel were a quarter of a mile or more in width, as it is both above and below the proposed line of the bridge, it would be necessary to elevate *all* that portion of the bridge which spanned this channel. one hundred feet. This would shorten the distance in which the ascent from the shore to the highest point of the bridge must be made, so as either to increase the gradient to an impracticable figure or augment the cost and length of the bridge. The increased cost might make it commercially impracticable, and the increased length might throw the terminus on shore at a point which would greatly damage if not destroy its commercial usefulness. Again, if there were *several* navigable bays under the bridge these would be separated by piers splitting the current, so as to make the navigation dangerous.

The economical arrangement consists in the fact that it will only be necessary to elevate the two piers embracing the channel to the height of one hundred feet above the water; over these a rectangular tubular beam (30 feet deep, and assisted by arches, if of wood, but without arches and of less depth if of iron) will be laid—*through* which the trains will run The piers immediately on either side of these central ones will only be raised seventy feet above the water, and from these toward either shore the height of the piers will gradually diminish, in proportion to the gradient of the bridge· The trains will run *upon the top* of the bridge in ascending from either shore to the centre arch, and the depth of the tubes (thirty feet) will, *without additional cost*, make up so much of the required elevation of the track, and thus be a substitute for a corresponding amount of masonry in the piers. This dropping of the bridge immediately on either side of the centre span is here admissable—because no masted craft will pass under the side arches—but would obviously be inadmissable if the navigable channel extended over a greater portion of the river.

The comparative lightness of the gradient is due to the existence of of the single narrow channel and its position nearly in the centre of the bridge line, from the combined effects of which the greatest possible distance is obtained for surmounting the level between the shores and summit of the bridge.

PRINCIPLES OF CONSTRUCTION.

In the foregoing part of this report, the plan of the proposed bridge has been partly developed, but in consequence of its relation to the action of the ice, its peculiar position and arrangement, it will be necessary to allude to it more fully.

The importance of retaining the " bordage" ice *in situ* has been explained, and for this purpose, that part of the bridge extending from the shores over the shoals, to the depth of five feet water, being a distance of 450 yards on one side, and 570 on the other, is designed to be a solid causeway or embankment carried above the level of the highest winter flood ; from which point to the level of the rails it may be carried up by a viaduct of arches—an embankment or trestle work for the present. If the scheme of docks which I have proposed at Point St. Charles, be carried out, this causeway would become one of the dock walls, and the arches erected on it to give the proposed ascent to the bridge might be converted into warehouses. If the channel between Nun's Island and Point St. Charles be dammed, an immense amount of ice which now goes down to aid in flooding the water back on Montreal, would be retained harmless until it melted in the spring

On the south-eastern shore the great width and dead shoal water around the Laprairie basin, form square miles of ice, which, so soon as freed from its attachment to the shore, is carried by the throw of the current directly down through the *now* important channel between Moffatt's Island and the St. Lembert side. The works of the Champlain and St. Lawrence Railroad Company, although incomplete and not high enough, retained this bordage *in situ* during last winter, (1851 —1852) and this in connection with the fact that the winter set in with great severity, was one cause why the inundation at Montreal was less than usual,—was unaccompanied either on the formation or departure of the ice with any "shoves"—and that the surface of the river, opposite Montreal, presented the evenness of a mill pond instead of the ragged quarry aspect of broken ice usually seen.

The St. Lambert Approach to the bridge, in conjunction with the work of the Champlain Railroad Company, will have the effect of retaining in its place the ice formed between Moffatt's Island and the south shore, and thus prevent the descent of a bordage of equal width as high up, at least, as a point abreast of Nun's Island. The retained bordage above Moffatt's Island, with that resting on Nun's Island and the south-western abutment of the bridge, will increase in width so as gradually to narrow the passage between the Nun's Island and the eastern shore, and will thus aid in arresting the descending field of the upper bordage and close the Laprairie basin at the earliest date. A few ice breakers judiciously distributed over the shoals, while they would break the shock of fields descending against the bridge, would aid in retaining the bordage and thus expedite the freezing over of this basin.

The solid approaches will be cheaper and more substantial than any other portion of the bridge of equal length; and in fact no substitute which will bring the rails down to the level of Point St. Charles can be devised for them, except that of extending the piers and bays to the shore and carrying the masonry up to the level of the rails. A system of masonry arches giving free passage to the water, would be exposed to the risk of being blocked up and overthrown by the "shoves" of the ice.

To carry out the arrangement of descending from the central arch to each shore on the top of the tubes; it is evident (since the depth of these are 30 feet under the rails) that as the shore is approached the lower side of the tubes would be brought within the reach of the winter flood. Before this point is reached, therefore, the arrangement and character of the structure must be changed, and as it would destroy the effect of the bridge again to elevate the tubes and run *through* them—the solid causeway is necessary. It is true that by abandoning the proposed arrangement of running on top of the tubes, raising the masonry of all the piers to the level of the rails, and continuing the piers and tubes to the shores—the solid approaches can be dispensed with; but I consider that there are objections to such an arrangement exclusive of economical considerations and the loss of the effect of the solid approach in retaining the bordage. If the spans are such that tubes whether of iron or wood are required,—passengers would be confined in a tunnel two miles in length with all its disagreeable connections, and if the spans are so narrow as to admit of an iron bridge open at the top—the side trusses would yet be necessarily so high that it would become a long trough which unless open at the bottom would fill with snow, while it would effectually deprive the passengers in summer of that view from the windows of the train which will constitute one of the great attractions of the bridge. On the other hand by the arrangement proposed, the appearance of the bridge with passing trains is improved—the snow is avoided—the monotomy of the outline is broken by the single elevated tube in the centre, and the channel is thereby clearly displayed to the navigation. The pleasure and comfort of the passengers enhanced—economy and safety to the structure are secured—and, if built of wood, the risk of fire is greatly diminished.

The Piers. The most important question in connection with the structure is that of the piers. The superstructure and approaches are simple matters, and so would the piers be were it not for the ice phenomena. Many persons (astounded by the commotion when a "shove" takes place) entertain the belief that piers cannot be made to stand in the river below the Lachine rapids, or at least below Nun's Island; but the simple contrivance described by Mr. Logan shows how easy it is to *elude* the effects of the ice however difficult it may be to *oppose* them. That the ice is not, as is often remarked, "irresistible," may be proved from the fact that the islands, rocks, wooden wharves and stone quays have not been removed by it. Probably there is no point where the ice strikes with greater force than against the long wharf at the Bonsecour Market—but this cribwork has resisted the shock, and forced into the air a broken heap of fragments. The power required to crush a cubic inch or foot of ice is very much less than that required to crush stone, iron or wood. If therefore there is mass enough or support enough, as is annually proved by the stone quays of Montreal, the ice is broken into fragments or ground into powder; but the simpler, more economical and effective method is that universally employed where ice is to be encountered of *turning the ice back upon itself* and leaving the first arrivals to take the shock of all that following after. By sloping the up-stream face of a pier or ice-breaker so that the ice will ride up upon it, the stability of the pier is increased by the additional weight piled upon it and a heavy rampart of ice receive all future assaults.

But it is to be expected that the violence of the ice shocks will be diminished rather than increased by erection of a bridge. At present when the dam slips and the ice begins to move it is carried on with increasing momentum until it strikes the shore. But if sustained at intervals of 100 yards or less across the stream by piers, the initial velocity would be checked and the ice would rise and fall *in situ* with the variations of the water level.

The plan I have proposed contemplates the planting of very large "cribs" or wooden "shoes," covering an area of about one-fourth of an acre each, and leaving a clear passage between them of about 240 feet—a width which will allow ordinary rafts to float broadside between them. These islands of timber and stone will have a rectangular *well* left open in the middle of their width toward their lower ends, out of which will rise the solid masonry towards supporting the weight of the superstructure, and resting on the rocky bed of the river. The enclosure of solid crib work all round the masonry yet detatched from it, will receive the shock, pressure, and "grinding of the ice, and yield to a certain extentby its elasticity without communicating the shock to the masonry piers. These cribs, if damaged, can be repaired with facility; and from their cohesive powers will resist the action of ice better than ordinary masonry. During construction they serve as coffer dams, and being formed of the cheapest materials—their value as service ground or platforms for the use of machinery, the mooring of scows, &c., during the erection of the works will be at once appreciated. Their application to the sides of the piers is with particular reference to preventing the ice from reaching the spring of the arches which will be the lowest and most exposed part of the superstructure if wood be used.

The class of superstructure proposed for these wide spans, if of wood, would be a strong rectangular open built hollow beam, assisted by a deep open built arch. The two systems of arc and truss, however objectionable in iron bridges, have been proved to be susceptible of advantageous combination in the numerous and excellent bridges built on what is known as the "Burr" or Pennsylvanian principle—decidedly the best class of wooden bridges in existence. The elasticity of timber permits both systems to come into play without injury to either when a strain is upon them, (which is not the case with iron) while the two great elasticity of the wooden arch is counteracted by the rigidity of the truss to which it is attached,

Experiment at Menai proved the superiority of the rectangular form for hollow beams in iron. It is somewhat singular, that the best form of wooden bridge in America for wide spans was, long previous to the Menai experiment, a type in wood of the celebrated tube. The strength of both bridges is collected near the four angles; the sides top and bottom, in the iron wonder, serve chiefly to maintain the relative position of the vital parts. The strength of the wooden tube must be wholly in the top and bottom chords—the inferior capacity of wood for the connection of its parts being in some measure compensated for by the practibility of employing the auxiliary arch.

The wooden railway bridges of America are progressive improvements upon the ordinary road bridges of Pennsylvania and New England, in which there was apparently an excess of strength:—the arc carrying the load and the truss (with plates instead of chords for the top being a mere frame work to preserve its shape. In adapting these structures to the passage of railway trains every part has been from time to time increased in weight and size as experience dictated, but it is questionable whether as a class they are not generally too light, and wanting in that inertia which attempts at stiffness cannot compensate for, and which is requisite to absorb a portion of the momentum communicated to the structure by the sudden impact of locomotives weighing twenty-five to thirty tons, and moving at a speed of thirty miles the hour. These wooden bridges with arcs included, are not more than one-third or one-half the weight of tubular iron ones for the same span.

I have proposed a class of superstructure more weighty than usual, and while recognising the objections to the extra weight to be sustained, I conceived it practicable to build a truss of the long span proposed which shall sustain at least its own weight, and to apply an auxilliary arc to that truss which can at least resist the effect of the load.

While instances are numerous of the failure of wooden bridges not supported by arches, by their in time sinking below the horizontal line, I am not aware of any well built "Burr," bridge having failed from this cause, although many have spans of 200 feet.

Mechanics' Institute New Hall.

We understand that contracts have been entered into by the Committee of the Institute, for the erection of their New Hall, according to plans furnished gratuitously by F. W. Cumberland, Esq., and which we have no doubt will be highly creditable to that gentleman, and also to the Institute, both as to the external appearance and the internal arrangements; the last of which we are assured will be very complete.

The site purchased for the purpose, and on which the excavation for the basement is already completed, is situated on the north-east corner of Church and Adelaide Streets, in the immediate vicinity of St. James's Cathedral and Parochial School House, and St. Andrew's Church. The principal front of the building will be on Church Street, 80 feet by 94 feet front on Adelaide Street, leaving a lane 10 feet in width around the north and east sides of the building.

The ground floor will contain, besides offices for renting, the Library, Reading Room, Committee and Apparatus Room, and the Lecture Theatre, the seats of which will be in circular form, and regularly descending from the level of this floor to that of the basement, thus affording an unobstructed view of the Platform to every person in the room. The basement will also contain the Hall Keeper's apartments, and a number of excellent Class Rooms, the ceilings being high and well ventilated.

On the second floor is the Music Hall, approached by a broad stairway, nine feet in width, in a grand Entrance Hall twenty-five feet in width, and two stories in height. The Music Hall is 76½ feet long by 56 feet broad, with a fine lofty ceiling. Connected with this room, and on the same level, are two ante-rooms, about twenty-five feet square each. Above these rooms, and extending across the building, is a Supper Room, 67 feet long by 35 feet wide, with two small rooms attached.

On the east side of the Building it is intended to erect an extra stairway to the Music Hall, both for the security of the audience in case of alarm, and also for convenience of performers, who will thus have access to a retiring room immediately back of the platform. On the side of the room opposite the platform, will be erected a small gallery for an orchestra.

We believe it is intended to carry on the work as far as the ground-floor this season, prepare as much material as possible during the winter, and proceed in the erection of the building as early in the spring as the weather will permit, the contractors being bound to have the building enclosed and the Lecture, Theatre, Library, Reading-Room and Committee and Apparatus Room completed by the 1st of October, 1854.—*Colonist.*

Notices of Books.

REPORT *of a Geological Survey of Wisconsin, Iowa, and Minnesota; and incidentally of a portion of Nebraska Territory, by David Dale Owen, United States Geologist. Philadelphia, Quarto, pp. 623, together with a Quarto Volume of Plans and Maps.*

The contents of this magnificent Report embrace a very extensive range of science. Besides the results of the observations of Dr. Owen. they comprehend the reports of Dr. Norwood, Col· Whittlesey, and Dr. Shumard on particular portions of the wide region referred to. Also a Memoir by Dr. J. Leidy, on the fossil mammalia and chelonia collected during the survey. The appendix embraces palæontological descriptions, Chemical examinations, Botanical and Onithological Catalogues. The whole work is admirably illustrated by well executed wood cuts, and the supplementary volume of plates contains some very beautiful engravings on steel, executed by the medal-ruling process, together with engravings on copper and on stone. A description of the Mauvaises Terres taken from Dr. Owen's report, is given in the September number of this Journal. We propose to avail ourselves of the present opportunity for making additional extracts from this valuable and interesting work. The introduction to the Report contains a general view of the results of the survey, which are thus recorded by Dr. Owen:—

The country which, during the conduct of this survey, has been more or less carefully examined, and of which the geological features have been determined, and are, on the general map, exhibited by colouring separately each formation, is the most extensive ever reported by any geologist or geological corps in this country; including, as it does, more than four times as much territory as the State of New York, and being about twice and a half as large as the Island of Great Britain.

Wisconsin, except its eastern portion on Lake Michigan, Minnesota, and Iowa, were embraced in my instructions. The maps, it will be seen, extend somewhat beyond these bounds, including a portion of Northern Illinois, and also of Northern Missouri. These additions were necessary to a proper understanding of the formations of the districts expressly required to be explored; and they place before the eye, at once, as well the size and shape of the Iowa and Missouri coal fields, as its relation to that larger coal-basin, heretofore (to wit, in my Report of 1839) laid down by me as the Illinois coal-field.

With these additions, the maps reaches from latitude 31° to latitude 49°; and from longitude 89° 30′ to longitude 96° 30′. In other words, it has a length from north to south of upwards of seven hundred and fifty miles: from St. Louis to the British lines, and an extreme breadth of about three hundred and fifty miles: embracing the Mississippi and all its tributaries, from its source to its junction with the Missouri; the Missouri, as high as Council Bluffs; the Red River of the North, from its source to the northern boundary of the United States; together with the Northern and Southern shores of Lake Superior, from Fond du Lac, North to the British Dominions, and east to the Michigan line.*

The average width of the territory thus laid down being about two hundred and seventy miles; its area extends over two hundred thousand square miles.

Throughout this vast district, all the principal streams which water it have been explored, to the number of ninety-one, and more than a fourth of these have been navigated from their mouth almost to their source; in bark canoes.

An inspection of the maps will give a better idea of the relative size and position of the various formations throughout the district, than could any description by metes and bounds. The Lower Sandstones (lowest protozoic strata) will be seen coming to the surface on the East side of the Upper Mississippi, north of the Wisconsin River. They doubtless underlie, also, the extensive drift and the Red Marls and Clays, of the Lake Superior Country: there assuming a red tint and ferruginous, argillaceous character.

To these succeeds the Lower Magnesian Limestone, which appears on both sides of the Upper Mississippi, south-west of the Lower Sandstones, and partially intersected by narrow belts of the same, where they cross out beneath it in the deep cuts of the streams, or rise to the surface along the bearings of partial axes of upheaval.

Next supervenes the Upper Magnesian Limestone, with its underlying shell-beds, its lead-bearing strata, and its coralline and pentamerus subdivisions, all lying south of the two preceding.

South-west again, we come upon the Cedar Limestones, cotemporary with the Devonian formation of English geologists; separating the Magnesian Limestones of the north from the Carboniferous Limestones and the great coal-fields of Iowa and Missouri.

The intervening country, lying chiefly towards the head waters of the Mississippi and its tributaries and on Red River, is overspread with drift. The latter occupies, in this district, not only a much greater area than any one of the above described formations, but nearly as much as all of them put together.

Underlying the whole of these formations, but showing themselves only over limited tracts, either in cuts of the streams, or where they protrude in dikes or ridges upheaved by igneous action, are the crystalline and metamorphic rocks.

The geological formations of the district proper range, therefore, from the granite to the top of the coal-measures; above which latter, except superficial deposits, no geological group has been detected—no New Red, whether Permian or Triasic—no Cretaceous system—no Tertiary Basin.†

Over this entire region of country, (with the exception of that part of North-western Minnesota which lies between the British line of the north shore or Lake Superior,)‡ it will be wholly unnecessary hereafter to institute further examinations having reference to mineral reservations. The fact has been reliably ascertained, that it contains no lands which, following the usual rules adopted by the Land Office, ought to be reserved from sale for mineral purposes. Coal and iron, in abundance, and also other valuable minerals have, indeed, been found, and their localities carefully determined; but it has not been customary to make mineral reservations on behalf of the United States

* The recently set off reserve, on the Mississippi, South of Crow Wing, and now ceded to the Winnebagoes, must be here excepted. Covered to a great extent with drift, without promise for the geologist, and likely to remain Indian property, its examination would have been little valuable to Science, and useless to the department.

† The cretaceous and tertiary formation, incidentally noticed in this Report, lie beyond the limits of the district West of the Missouri River. It is not improbable, however, that cretaceous strata may underlie the drift in the extreme north-western corner of Iowa, sweeping around the confines of the carboniferous limestone, east and west of Sioux River.

‡ This region of country may, on closer examination, be found to contain valuable minerals, suitable for reservation. But as it is still the property of the Chippewas, no mineral reservations could, with propriety, be made; nor, as it is still undivided, even by meridian lines, were any such reservations, by metes and bounds, practicable within it.

except of tracts promising profitable veins of lead, of copper, or one of the precious metals.*

The coal-measures of Iowa are shallow, much more so than those of the Illinois coal-field. They seem attenuated, as towards the margin of an ancient carboniferous sea, not averaging more than fifty fathoms in thickness. Of these the productive coal-measures are less than a hundred feet thick. The thickest vein of coal detected in Iowa does not exceed from four to five feet; while, in Missouri, some reach the thickness of twenty-five feet and upwards.

In quality, the coal is on the whole inferior to the seams of the Ohio Valley. To this, however, some very fair beds form exceptions.

On the Mankato and its branches, several pieces of lignite were picked up from the beds and banks of the streams. Some of this lignite approaches in character to cannel coal; but most of it has a brown colour, and exhibits distinctly the ligneous fibre, and other structure of the wood from which it has been derived. Diligent search was made to endeavour to trace this mineralized wood to its source, and discover the valuable coal-field. At one point a fragment was found seventy feet above the level of the river, projecting from the drift, but no regular bed could be detected anywhere, even in places where sections of the drift were exposed down to the magnesian limestone.—The conclusion at which those gentlemen who were appointed to investigate this matter arrived was, that the pieces occasionally found throughout the Minnesota country are only isolated fragments disseminated in the drift, but that no regular bed exists within the limits of the district.

The occurrence of strata of brown coal, earthy coal, and bituminous coal and slate, on the west side of Great Bear Lake, as reported by Dr. Richardson, overlying a vast region of magnesian limestone, like those of Iowa and Wisconsin, rendered it possible that this lignite might be found in partial beds also on the Mankato; nevertheless, the observations of the subcrops on that stream do not leave any hope of the existence of even such local carbonaceous deposits. On the contrary, it appears most probable that the pieces found have been transported from the north along with the drift, perhaps from their very beds on the Great Bear Lake; or from the cretaceous or supercretaceous lignite formations which were observed by Nicolet, and others, off towards the Missouri and Rocky Mountains.

In further support of this view of the origin of the lignite of the Minnesota country, I may add that, every piece and fragment which the members of the sub-corps could find was collected and brought away, all of which when put together and weighed, did not exceed ten pounds.

From the confluence of the Waroju, to the mouth of the Red Wood River, which is as far up as the country was explored, different varieties of crystalline rocks, alone, make their appearance, varying in height from a few feet to a hundred and twenty-five feet. After passing Little Rock, twelve principal exposures are seen immediately on the bank of the river, in the distance of eighty miles, the intervals being covered by alluvium and drift, which hides them from view.—The principal varieties are granites and hornblendic rocks, with occasional syenite. No traces of metallic veins worthy of note were observed traversing these formations. In the granite, eight miles below the Red Wood River, some specular iron was found, but only in thin crusts in the joints of the rocks

The only mineral that promises to be of much value in this region of country is a bed of nodular iron stone, found at a number of localities both on the Mankato and Lesueur Rivers, at the base of the drift, resting either on the magnesian limestone or sandstone. This argillaceous bed of carbonate and hydrated brown oxide of iron, varies from one to three feet in thickness.

The middle division of the Iowa coal field affords, at many localities, iron stone of various qualities, associated frequently with hydraulic calcareous cement, and which occurs, either in the form of disconnected *septaria*, or regular beds. In the same geological position, at many localities, crystalized selenite has been observed, which accumulates in quantity high up on the Des Moines; and finally, a few miles below its Lizard Fork, that mineral expands itself into heavy beds of gypsum, or plaster of Paris, which show themselves on both sides of the river, for the distance of about three miles, exposed in horizontal beds with a thickness of from twenty to thirty feet.

The iron stone occurs sometimes in the form concretionary nodules, sometimes in continuous bands of several inches in thickness, interstratified in the shales. In the chapter embracing the detailed description of the carboniferous rocks of Iowa, will be found the analysis of some of this iron ore, together with other more precise information regarding it.

On Soapcreek and its branches, in Davis county, where the middle divison of the coal series prevails, there are several salt springs which were tested qualitatively on the spot, and found to contain a portion of common salt (chloride of sodium). The amount of the precipitated chloride of silver, as well as the taste of the water, indicated, however, only a weak brine. By boring, a stronger water might possibly be obtained; nevertheless, the shallowness of these coal measures, the frequent rupture of the strata and consequent local reversion of the dip, together with the fact of the lowest division being composed chiefly of limestone instead of sandstone, are unfavourable indications of the existence of deep-seated brine, or of nests of salt, whence the percolating waters might become saturated and carry the saline matter to the surface.

Though deficient in productive minerals, such as are reserved by the Land Office, a large proportion of this district consists of rich fertile soil, well adapted to all agricultural purposes. Of such is a large portion of the Iowa coal field; and the region lying north both of that and the Illinois coal field, as far as the falls of the eastern tributary of the Mississippi. Some of the lands of the Des Moines and Cedar Rivers can be scarcely excelled for fertility, perhaps, in the world.

On the other hand there are portions of the district, chiefly in the vicinity of the sources of the Black and Chippewa Rivers, and of the streams flowing north into Lake Superior, which are, in part so hopelessly arid that, in our generation, they will assuredly never be purchased or occupied; in part so covered with erratic boulders that the traveller can step from one to the other for miles, without setting foot on the drift soil on which they lodge, and that a bridle path for a pack horse cannot be picked out over the country they cover; in part, again so intersected by ponds and swamps, that fish, frogs and water, fowl must, in our day at least, be their only inhabitants.

In conformity with my instructions, I have heretofore, from time to time, reported to the Department what portion of these lands are so wholly worthless as not to justify, in my judgment, the expense of sectionizing or surveying at all, except so far as may be necessary to connect the surrounding surveys. These refuse lands amount to fifteen thousand miles. If, in consequence of the recommendation thus made they are excepted from the linear surveys which are usually extended by the Government over all its Indian purchases, without examination or inquiry, the saving to the Land Office will much over-pay the entire cost of the survey, the results of which I am now reporting.

A circumstance which to some may seem trivial, will delay, to a considerable extent, the settlement of a portion of the District. It is the prevalence, especially on the Upper Wisconsin, Chippewa, St. Croix and Black River countries, and thence north to Lake Superior and to the British line, of venomous insects, in such insufferable quantities, that, at certain seasons, they destroy all comfort or quiet by day or by night. Among the pineries of Northern Wisconsin, and more or less throughout the whole of the above designated region, the buffalo gnat, the *brulot** and the sandfly, to say nothing of myriads of gigantic musquitoes, carry on incessant war against the equanimity of the unfortunate traveller. I and other members of the corps, when unprovided with the necessary defence, have had our ears swelled to two or three times their natural size, and the line of our hats marked all round by the trickling blood. It was often necessary to rise many times, in the course of the night, to allay the fever of the head, by repeated cold bathings; and, at some of the worst spots, we could scarcely have discharged our ordinary professional duties at all without the constant protection of musquito-netting worn over our head and face.

The health, even of the more marshy portions of the District, seems better than, from its appearance, one might expect. The long, bracing winters of these northern latitudes exclude many of the diseases which, under the prolonged heat of a more southern climate, the miasm of the swamp engenders. Perhaps the healthiest portion of the whole District is along its northern limit, where it is continuous to the British dominions. At the Pembina settlement, owned by the Hudson's Bay Company, to a population of five thousand there was but a single physician; and he told me that, without an additional salary allowed him by the Company, the diseases of the settlement would not afford him a living. * * * * * *

Before starting on the expedition, I had obtained from Mr. John F. Crampton, of the British Legation at Washington, a letter commending me to the good offices of the officers of the Hudson's Bay Company, and which procured for us a most hospitable reception at the settlement.

On our arrival at the mouth of the Assiboin, Governor Christie, then acting as Superintendent of affairs of the Hudson's Bay Company, and Governor of the Colony, invited us to make his house our home during our stay on Red River, and entertained us in the kindest manner. I have to acknowledge the attentions paid to our party by the officers stationed both at the Upper and Lower Forts.

(To be Continued.)

* A rich vein of lead ore, traversing the Lower Magnesian Limestone, was discovered on the "Half-breed Tract," south of Lake Pepin; but this being an Indian cession, it was not reported to the Department for reservation.

* So called by the voyageurs *bruler*, to burn; the sting producing a burning sensation.