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THE CANADIAN JOURNAL.

NEW SERIES.

No. LI.—MAY, 1864.

ON ERRATA RECEPTA, WRITTEN AND SPOKEN.

BY THE REV. DR. SCADDING,
LIBRARIAN TO THE INSTITUTE.

(Read before the Canadian Institute, April 2nd, 1864.)

In treating of *Errata Recepta*, written and spoken, I shall confine myself principally to specimens of such as are formal, verbal, and phraseological. By formal, is meant those that are involved in the present FORMS of our letters and numerical symbols.

Errata Recepta, in notion and opinion, would be too wide a field, although a legitimate one here, so far as science is concerned, for it is no doubt one of the functions of this and similar Institutions to detect and remove out of the way, so far as shall be practicable, the phantasms,—the *idola*, as Lord Bacon would say—the vulgar errors as Sir Thomas Browne would phrase it,—which still are the plagues of human knowledge.

I use the title *Errata Recepta*, however, with no feeling that a crusade should be proclaimed against the matters in question, but simply to express that while they can now no longer be said to be wrong, they are nevertheless *per se* erroneous.

I might have said "established errors" in English, but this would have been saying too much;—it would have implied that there were things to be deplored and amended. All this we give up when we adopt the designation *Errata Recepta.* We at once confess them to be what they are.

Moreover I had the less scruple in venturing on this title, because the two words Errata Recepta—besides conveying briefly a particular shade of meaning—are both of them almost as familiar to us as English, the one being seen appended, unfortunately, to most printed books; and the other being associated in the well-known phrase by which the common edition of the Greek Testament is indicated, viz., the *Textus Receptus.*

Some of these peculiar usages in our written and spoken English are the astonishment of foreign scholars. They would puzzle many natives, were they suddenly called upon for the *rationale* of them. We have been taught them in our childhood, as so many dogmas, and we use them without thought. We pass them about like well known coin, of which we have no need to read the inscription; we trace them on our luxurious note-papers and in our account books, and their familiar look is no more suggestive of farther research than the ancient but handy quill perhaps, with which we have written them down.

Errata Recepta arrange themselves into numerous classes. (1) There are those that have arisen from the modifications of form in letters and numerical symbols. (2) There are some that appear in the shape of contractions and abbreviations. (3) There are many that have arisen from the Anglicising of foreign words, especially French, Italian, and German. (4) There are some that spring from the vernacularising of unfamiliar expressions—forcing them to say something that shall, at least, seem to convey an idea. (5) Then we have *errata recepta* which arise from wrong etymologies and from misprints. (6) There are some that spring from grammatical misconceptions and confusion in logic, as where the general is put for the special, and the special for the general. (7) Some are variations in the significance of terms, through the lapse of time. (8) We have *errata recepta* in the quantity or time of vowels in the syllables of derived words. (9) We have *errata recepta* in the nomenclature of persons, places, and things. (10) We have *errata recepta* in regard to the drift of certain popular proverbs or sayings.

I. *Errata Recepta* in letters and numerical symbols:

1. Letters.

To begin at the very beginning—with the elements themselves of words—the alphabet itself: what is this, in modern languages at least, but a series of *errata*—departures from original forms and intentions? *Errata Recepta* now, which there is neither need nor desire to correct. The mind fond of analysis, is, nevertheless not disinclined to recover the original forms, where it is possible to do so; and dwells with some interest on the idea that A, for example, is the head of an ox, only inverted; that Alpha, *i.e. Aleph*, is *ox*, and survives in that sense in *Eleph-as, i.e. Aleph-as*, elephant, that animal being designated in early unscientific days as a *bos*, somewhat in the same way as we call the great amphibious creature of the Nile a horse. That B, *beta*, is *beth*—a house—a hut—two wigwams, in fact, now, when you lay the letter on its face. And let it be at once well understood, that the attitudes and postures of letters have been almost infinitely varied. The Easterns generally (the users of Sanskrit excepted) write from right to left; the Westerns (the Etruscans excepted) from left to right: each turning the character accordingly. Hence we must often reverse letters before we can trace their identity. The scribes of intermediate races or tastes, wrote sometimes one line one way, and the next line the other way,—reversing perhaps the letters, as they reversed the direction of the reed. Others, again, arranged their words vertically—column-wise—like the modern Chinese.

From these and other like causes, it is not sufficient even to reverse the letters: we must, in certain instances, lay them on their face—lay them on their back—sustain them at uncomfortable angles—and humour them in other ways, discreetly and patiently, if we would trace the connection between them and their reputed congeners or originals. It is thus that we may, perhaps, at length detect that not only does *aleph* betoken an ox, and *beth* a booth; but that G (*i.e.* hard *c*), is a camel's head and neck; D, a triangular tent door-way; E, a hand in a certain dactylological posture; F (*bau)*, a hook or tent-pin; H, a garth, perhaps a temenos, or sacred enclosure; I (J and Y), again, a hand in proper position; as is also K (C); L, an ox-driver's goad or whip; M, rippling water, the element of its neighbour, N, which is a fish; O (connected with *ayin*), the human eye; P, the mouth seen in profile; Q, the ear; R, the head (also seen in profile), the occiput, as distinguished from the face; S, the teeth seen in front; T, a kind of dancing cobra; U (V), a hook or tent-pole, as said for F; X, a combination of K and S; Y (as J), a hand in right position; Z, a barbed hook, for catching fish.

We cannot, of course, be sure that we thus track our letters to their prototypes; but human instincts everywhere developing themselves in an analogous way, we can easily conceive that all alphabets are pictorial in their origin; that they represented objects to convey an idea either of the objects absolutely, or of the sounds which the objects represented were supposed to symbolize. What is, in fact, the meaning of *litera?* It is something delineated or drawn *(lino)*; the idea conveyed also by γράφω, which is to *pencil* or *draw*—though allied to γλάφω and γλύφω, to hew or carve, as *scribo*, to write, is to *scalpo* and *sculpo*; and the English *write* is to *writan*, properly to cut or engrave, and *wrotan* to plough or root up.

Symbols inscribed by sharp instruments, are strictly not letters (*literæ*) but characters, χαράκτηρες—from χαράσσω—which expresses "scratching," by its very sound. So that in the rude symbols of our Indians, in the canoes, wigwams, and school-boy-fashion figures of men and animals, charcoaled with a burnt stick, or indented with a flint-arrow point on a sheet of birch-bark, we have the veritable *literæ* and *characteres* — the *elementa elementorum* — the simplest forms and originals into which all letters and characters are to be resolved. Examples of the same also, were those sketches on cotton cloth, of the ships, horses, and artillery of Cortez, made by the Mexican Chiefs (1519), for the purpose of giving to Montezuma an idea of the power of the fatal invader.

Interesting specimens of picture-records *in transitu* to letters, may be seen in the beautiful inscription-tablets of Copan and Palenque, represented by Stephens, in his work on Central America. The Chinese and Japanese characters still bear on the face of them the appearance of being sketches of objects, although now conventionally rendered. And the Egyptian phonetic symbols and hieroglyphics, with which we are all more or less familiar, are very slightly disguised. Of these, the enchorial or demotic characters are declared to be modifications.

We can have little doubt, then, that the Chaldaic and Phœnician characters, and with them, for the most part, the Greek and the Latin,—and, through these, the European letters generally have their origin in pictures and sculptures.

When now, in addition to the deliberate drawing and engraving of records on durable substances, there arose the practice of writing with the reed on the papyrus-rind or skins, the celerity of execution which the impetuosity of human thought demands—and demands still in vain, in spite of the assistance of stenography—produced further modifications in letters, until a cursive or script style was formed, which became particularly beautiful in the Greek. What the cursive or script Latin character was we have no means of knowing precisely. We may be sure that Cicero had some convenient and rapid method of securing thought as it wells up within the brain: that he did not make his memoranda in capitals. We may conclude that the familiar Roman script has been in some measure preserved in the traditional styles of the old professional transcribers, who did not always execute their tasks in uncials, but produced MSS. like the Medicean Virgil of the fifth century, in a kind of round hand, which, under the influence of certain peculiar predilections, converted itself, in some nations, into the so-called black letter. This round hand of the *Librarii* was reproduced in the early printed books, in what we call *Italic,* the next remove from the script, in which, in the time of Aldus Manutius, (1516), for example, not prefaces merely, and dedications, but whole volumes were printed. Our present so-called Roman characters, the capitals excepted, are apparently a compromise between this ancient script or Italic, and the black letter or Gothic.

The modern alphabet, then, both as written and printed, is seen to be the result of a series of departures farther and farther from its primitive types—*errata,* indeed, but *errata* which we now willingly describe as *recepta* and no longer *corrigenda:* for as our national speech itself has attained its acknowledged terseness and point by a succession of free clippings in its parts and forms,—so its nimble servitors, the letters, by disencumbering themselves of much that once seemed essential, and was essential, have attained to an efficiency which if not complete is most convenient.

This simplicity of form, involving distinctness, is highly to be esteemed and carefully guarded. English printers of late have been bringing back the style of type, both Roman and Italic, in vogue a century and a half ago, but which had nearly fallen out of ordinary use. A certain feeling of incongruity is at first experienced at meeting with the advanced ideas of the present day in a garb associated in the mind with many obsolete notions of the reign of Anne and the first Georges, and we are moved for a moment to imagine that the art of printing is "regressing,"—to coin a word at least as good as its correlative and opposite—and we think it strange that any art at this era should "regress." But we soon see that the exquisite legibility secured by the round openness of even the smallest sized character in this style of printing will account for its return to public favour. We have also here, perhaps, a visible sign of a begun reaction against the loose un-Addisonian English, of which, as prevalent in certain quarters, Trench and Alford have been for some time complaining. A lately established clever journal entitled "*The Realm*," is wholly printed in the style referred to: its advertisements, all in beautiful clear brevier and diamond, have the air of paragraphs in the "*Gentleman's Magazine*" in Johnson's day.

In connexion with movements apparently retrograde, we may refer to the rather extravagant mediævalism which threatened a few years ago to render monuments and inscriptions unintelligible to the mass. It was especially enamoured of intricate initial letters, with wide-gadding, low-trailing appurtenances, covering an undue proportion of the page or legendal riband. This was a passing foible in a certain class; but it has left traces too durable in a number of works of art, in glass, metal and stone, which, although in themselves, in many an instance, exquisitely significant, yet fail to interpret themselves, as such monuments ought to do, to the eye and mind of the general public.

A collection of all the alphabets, serious and facetious, which have been designed of late years for ornamental and quasi-ornamental purposes, in magazines, advertisements, and books in general, would be exceedingly curious. "*The Builder*" every week throws out an ingenious and graceful initial idea. In some recent numbers of that periodical there have been beautiful developments of such ideas in representations of imaginary ornamental iron work. Over-intricate illuminated capitals continue to be amusingly and very cleverly caricatured by "*Punch*."

But to return from a digression. It is not many years since Lord Palmerston considered the deterioration of form in English cursive script to be an evil so great and so extended as to call for formal condemnation. Since his memorable dictum on this subject, a good deal of attention has been given in public offices and schools to the essential forms of the script letters; and it is now not unfashionable for signatures to be legible. The plain unaffected autographs of the Prince of Wales and Duke of Newcastle will be remembered.

That there may be no exception to the general return of the letters to a condition of propriety and truthfulness, one erratum in the delineation of the capital G may be worth pointing out and marked *corrigendum.* It is seen sometimes as if it had taken a leap in the air, and there been detained, whereas its bulky form should rather be at rest, down among its lesser fellows, with its distinctive but very subordinate little cedilla (so to call it) dropping below the general line. Capital Y is also sometimes seen, in like manner, unduly exalted. Its loop is simply a mark of difference between it and the letter U, and is not to be taken to represent the stem of the printed capital. Capital Q in script has irrecoverably departed from its essential type. Its beautiful circle is destroyed, and the very sub-ordinate little mark, which here again was simply to be diacritical, is flourished out into great conspicuousness. On the whole Q which used numerally to be worth 90, has degenerated into a large 2.

One more *erratum*, also certainly to be marked *corrigendum*, and I close my remarks on the modifications undergone by the letters.

Since our adoption in money-matters of the decimal system, the time-honoured but never-to-be-forgotten £. s. d. have withdrawn a good deal from the public view. About them there was little mistake. It may be remarked as curious that whilst *denarii* were closely associated with the idea of military pay, being the *stips* which formed the *stipend* of the soldier, the term "soldier" itself sprung out of *solidus*, an enduring trophy of success in some strike on a large scale, although after all, again, it is to *solidus* we owe our *sou i.e. sol.*

But what means the symbol $? It ought to be more self-interpreting than it is. An Egyptian or Chinese linguist might detect in it "honesty the best policy"—the upright man standing firm in the midst of a serpentine tortuosity, and resolving so to earn his dollar. Sometimes in script he is seen to incline—to be almost overthrown in the coil. We have here, however, nothing of this sort, but another of our *errata recepta.* The curve which looks like an S in this character is properly no S. It should be made in the reverse way. It will then be seen to constitute, with the vertical or verticals around which it twines, a kind of double P—a character which reads P whichever way it stands This dual P is the initial of the Spanish name of the coin which we call a *dollar*, viz., *Peso*, which is literally *pensum*, all but identical with *pondus*, or *pondo, i.e.*, our *Pound*: so that strangely enough our £, which denotes the same thing, viz., *Libra*, a pound weight, would have answered, at least, as well as $ to represent "dollar." It is manifest that the most rational abbreviation would have been a simple D. And this we occasionally see at the head of Canadian and United States figures in English papers, in the absence probably of the usual symbol in the printing office. In some United States papers this character is seen cut in the right way. Would it not be found universally so in the Mexican papers?

On the *erratum receptum* in the word *dollar* itself, I shall remark in the proper place.

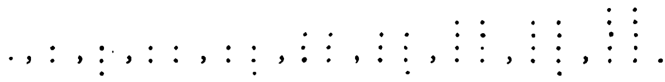
Were D employed for Dollar, it might receive the usual mark of contraction across its stem, as in ℒ, ℔, &c. Had the symbol $ been an abbreviation of *Scudo*, it would have borne this mark transversely. But the silver coins, which we have named *dollars*, were not *Scudi*—were not associated in any way with Italians or their language, but wholly with the Spaniards and their language, in which they are known only as *Pesos*. In the symbol $ rightly formed, then,—which in reality is PP ingeniously monographed into one character, denoting the plural of *peso*, as MSS. denotes the plural of MS.—we have an interesting little historical monument of the early relations of this continent to the native land of its first possessors.

2. We next proceed to consider the Numerals from the point of view selected in this paper. (*a*) And 1st of the Roman Numerals.

The Roman Numerals present some examples of our *errata recepta*. The symbol for ten (X), if not a pictorial representation of the ten fingers outspread, is a conventional mark for ten separate tallies or strokes with a score drawn obliquely across them; whilst V (five) is the half of X, or else one hand expanded; or according to some it is an Etruscan five inverted. The symbol for *fifty*, L, is in reality ⅃, the Etruscan symbol for 50 inverted. D for 500 is really no D, but the half of C I Ɔ written also as an ellipse with its minor axis drawn, a symbol said to be also Etruscan, and denoting 1000, the initial probably, like M for *mille*, of the Etruscan word for that sum. On the principle that IV = 5—1, XL = 50—10, &c.

(*b*) And next of the Arabic Numerals.

Could we compare our Arabic numerals with their native prototypes and these again with their originals, we should see that here also we have a group of our *errata recepta*—of symbols answering their purpose as letters do, albeit they have departed far from their first condition. The first condition of these numerals, however, I think, was not pictorial, but an arrangement of points shewing the numbers to be named. Somewhat thus:



These groups of points rapidly made, and each respectively connected together by a tracing of the calamus as it passed quickly from one dot to the next, may be conceived of as developing at last into our present Arabic numerals, the line connecting the points denoting also perhaps the order which the eye of the enumerator would swiftly follow.

This line itself may have been suggested by the accidental marks left by readers in the act of calculation. The so-called nailed letters in inscriptions are formed by light straight lines connecting bold punctures which mark out the general form of each character. This process of course produces a set of letters that are angular. In an interesting alphabet of the time of the Seleucidæ (about B.C. 250) the characters are marked out by an increased number of dots, with light lines connecting them, forming the letters called *perlées* by the French, from their *beaded* appearance. In these the angles are converted into curves in such letters as B and O. In a similar manner the numerals formed from the dots of computation speedily had their angles converted into curves, approximating thus to the flowing forms of our present cyphers; just as in rapid writing, the angular capitals also become at length the so-called round hand or cursive script.

The symbol for seven, about which on this hypothesis a difficulty may present itself, is either a combination of the written 6, with a connected point below for *plus* one; or an adaptation of the Greek *zeta* which, though standing sixth in the present Greek alphabet, is in notation the symbol for 7, one letter, *bau, i.e.* the digamma or *f*, having been disused as a letter, though retained as a symbol for 6. It will be noticed also that the final cypher has the value of *ten*, which may help to render rational the notation 10, 20, 30, &c.

I am aware of the theory that the original elements of the Arabic numerals were strokes or tallies, corresponding in number with the quantities indicated, productive also, in the first instance, of a set of square or angular characters. As their origination in points was independently conceived, and is at least equally probable, the supposed process has been briefly detailed. It may here be added that although we call our numerals Arabic, they agree more closely in form with the Sanskrit than they do with the present Arabic.

With the revival of the type of the reign of Queen Ann, there has been a return also to the forms of the numerals then in vogue—forms which in some Offices, for some purposes, had never been disused.

For the sake, apparently, of producing evenness and compactness of line,—a praiseworthy object were we still in the habit of writing only in capitals—great liberties had been taken with the relative magnitudes of numerals by scriveners and type-founders—until the historical contour thereof had been sadly interfered with. Figures high and low, long and short, have been by those unphilosophic artists confounded, and made by a kind of Procrustean treatment to touch parallel limits at top and bottom. But clearly there is as much impropriety in making written figures all of a height, as there would be in doing so with the written letters.

The numerals, then, as they have been rendered of late in the *Saturday Review*, and numerous other notable publications, simply reassert the forms of which without authority they had been deprived; and although seniors will, as is their wont, not readily interrupt a custom learnt in childhood, young arithmeticians will prefer to adopt the revived method, and construct figures as well as letters in accordance with their *rationale*. Thus it will not be long before in schools it will be the practice to make 1's, 2's and 4's neither above nor below the general line of a series of words or figures (with the exception of 4 which extends a little way below); whilst in relation to the general line 6's and 8's will be written with the upper half above it, and 3's, 5's, 7's, 9's, with the lower half below it.

In the Procrustean treatment of figures described above, the symbol for "four" lost its essential form. Whilst being unnaturally stretched to reach the altitude of 8, its main stem snapped, and was ever afterwards simply indicated by a mere touch of the pen across what had been the base of a very perfect little triangle.

Symbols Algebraical and Geometrical are generally modern, and so have not had time to vary much from their first intention. They too are mildly pictorial, taxing the imagination but little. The *minus* sign is the track left by the part withdrawn; the *plus* is the obliteration of this, and so its opposite. In the symbol for division the severed parts have shrunk up into two points. A square is a square, a parabola is a parabola, and so on. But in the rapid execution necessary at modern examinations we see the modification begin which shews us how letters and figures have arrived at their present forms. The "rune" for root ($\sqrt{}$) appears to be a written *r* exaggerated and rent asunder to gain room for the index of the quantity sought. The symbol peculiar to the Integral Calculus ($\int$) is a relic of the *fluents* of Newton.

The Zodiacal and Planetary signs have become considerably disguised. Aries, Taurus, Gemini, Sagittarius, Aquarius, and Pisces still speak, in some manner, for themselves. But it requires the aid of an acute imagination to see a crab in *Cancer*, a lion in *Leo*, a virgin (*query* Proserpine, the Kora) with the ears of wheat in *Virgo*, the scales in *Libra*, a scorpion in *Scorpio*, a piscicaudal goat in *Capricorn*.

In Saturn we dimly discern the *falx* of Chronos; in Jupiter Jove seated with the eagle at his feet; in Mars the shield and spear; in Venus her mirror; in Mercury his caduceus; in Ceres her sickle; in Pallas the gilded spear-head of Athené; in Juno her peacock in its pride; Earth, Uranus, Sun, and Moon are self-interpreting. Vesta is a picture confessed, of her ἑστία with the eternal fire thereon.

If planets are still to be represented by symbols, the invention of man is threatened with exhaustion, for asteroids are discovered in almost every year. They now amount to seventy-two.—The ascending and descending Node (☊, ☋) is a dragon, having apparently the geometric caterpillar's habit of progression.

There is nothing of the picturesque about the notation in Music. Sounds and sentiments are interpreted to the eye by bold points at various altitudes in respect to a system of horizontal lines, by spacings and slurs, and a number of arbitrary marks.

II. I arrive at *Errata Recepta* that appear in the shape of contractions and abbreviations.

1. And (first) of contractions.

There are conventional contractions which in themselves are rational enough; but in some instances we have been taught to use them so early, that we live for many years without detecting that they are anything more than mere symbols.

It has been perhaps not an uncommon experience to use for some years *cwt*, *dwt*, for hundredweight, pennyweight, without realizing their intrinsic composition.

The character denoting "and"—by how many of us was *per se*, as associated with this, the first Latin unconsciously learnt?—employed especially in the contraction for *et cetera*, has in modern manuscript and typography lost its organic form. This is reappearing now in the revived type before referred to. In Macmillan's Treasury Series, and in Cassell's new edition of Shakspeare, we see it again printed *Et* (*Etc.*) Although in rapid writing we do not expect this form to be restored, it is quite proper that we should know what it is that we write down when we execute the spirited flourish which occasionally at the end of a sentence symbolizes the indefiniteness conveniently concealed by it.

On old English coins the "et" has converted itself into a character like a "Z." Thus on a coin in the cabinet of the Canadian Institute is read, EDWARD. D. G. REX. ANGL. Z. FRANC. D. HYB.

This pretended *z* is one of the favorite *sigla* of the scribes. We have it in *viz.* for videlicet, in *oz.* for ounces, and in the symbols for drachms and scruples—where what are apparently *z*'s are simply flourishes of contraction. In V for *versicle*, R for *response*, and R again, for *Recipe*, a slight stroke across a portion of the letter gives the hint of abbreviation.

Domes-Day Book is full of such clerical abridgments. These so-called *sigla* became at an early period such a source of misunderstanding in MSS. that Justinian forbade their use in legal documents.* A very common note of contraction, long retained in English books, was a circumflex for the omission of *m* or *n*; as *cômunicatiô* for *communication*. Hence has arisen our *Co.* for *Company*. *No.* for *number*, is the French *numéro*. *Do. ditto*, is Italian for *dictum* "aforesaid." Titular initials are sometimes wrongly written and pointed. The LL. for the plural *Legum* will be thus seen divided by a period. In Macmillan's Magazine, not long since, L. L. O. O. P. for *Literarum Orientalium Professor* was given without comment, the error being

* Vide Justinian. *Codex. Lib. I. Tit. xv. iii.* 22. Eandem autem pœnam falsitatis constituimus et adversus eos qui in posterum leges nostras per siglorum obscuritates ansi fuerint conscribere. Omnia enim, id est, et nomina prudentium, et titulos et librorum numeros, per consequentias literarum volumus, non per sigla manifestari: ita ut qui talem librum sibi paraverit, in quo sigla posita sunt, in qualemcunque locum libri vel voluminis, sciat inutilis se esse codicis dominum: neque enim licentiam aperimus ex tali codice in judicium aliquid recitare, qui in quacunque sua parte siglorum habet malitias. Ipse autem librarius, qui eas inscribere ansus fuerit, non solum criminali pœna, secundum quod dictum est, plectetur; sed etiam libri æstimationem in duplum dominus reddat, si et ipse dominus ignorans talem librum vel comparaverit, vel confici curaverit, quod et antea à nobis dispositum est, et in Latinâ constitutione et in Græcâ quam ad legum professores dimisimus.

considered perhaps too manifest to require remark. There is a tendency of late years—natural enough—to convert into plain English, the Academic titles, which were once supposed to adhere for life only in Latin, having been conferred in that learned dialect. Hence, we have now M.A., B.A., the English forms of A.M., A.B.—D.M. for M.D., has not yet appeared. Why not?

Divinity for *Theology*, (as *Divinitas* for *Theologia*) is an English solecism without any continental or classical authority. Hence have arisen our D.D. and B.D., as representing the Academic designations, common to all the old historic Universities, S.T.P., S.T.B. (*Sacrae Theologiae Professor......Baccalaureus.*)

The three initial R's are notorious: the four P's are not so well known. In John Heywood's drama (temp. Hen. VIII.) so entitled ("The Four P's") they seriously denote Palmer, Pardoner, Potticary, and Pedlar.

The *y* in the humorously-revived Pepysian "*ye*" for "the," is no *y*, but the Anglo-Saxon character for *th*. This make-shift for a disused letter appears *passim* in the early printed books, and old copies of the English Bible. It is admitted in the modern Polyglots of Bagster for the purpose of gaining space, so as to make the matter in the pages of the several versions respectively correspond. Y*r*, y*t*, y*m*, &c., are also common contractions of *their*, *that*, *them*, &c.; the *e*, *r*, *t*, &c., ought to be placed over the *y*.

2. We come now (secondly) to abbreviations, I mean abridged words, as *errata recepta*.

We all know how unallowable the abbreviation of words is, in letters and finished compositions, although in references, foot-notes, indices, business-reports, medical prescriptions, and a few other similar memoranda, the practice for convenience sake *is* permitted.

There is a tendency, in some degree, to employ these abridgments as complete words. We hear of *consols*. In the familiar language of Algebraists and Geometricans such abbreviations are not uncommon. Among booksellers we hear such barbarisms as 12mo's, 32mo's. Lawyers will tell you of *fi. fa.'s*. Musicians speak of *sol-fa-ing*.*

* Guido Aretino (A.D. 1020) observed, that in a certain chant for a hymn in honour of John the Baptist, the voice ascended in regular gradation upon the first syllable of each half line. To represent the sounds at these points, he adopted the first syllables of the half-lines in the following stanza:

Ut queant laxis *re*sonare fibris *Mi*ra gestorum *fa*muli tuorum *Sol*ve polluti *la*bii reatum,
Sancte Johannes!

For *ut*, *do* was afterwards substituted; and *si* was added.

All crafts, I suppose, have similar technical shortenings. In the political arena we see, if we do not hear, *Rep. by pop.** There is a tendency in such abridged terms to become at length actual words. Our language exhibits a few examples of terms which, originating in abbreviations, have in the course of time become legitimised, although in most cases they have not divested themselves of a certain taint of vulgarity. A hundred years ago, *mobile* (excitable, fickle) was a cant term for the populace. The complete phrase, either founded on some such expression as that of Cæsar, in regard to the Gauls (B. G. 4. 5.) "Galli sunt in capiendis consiliis mobiles,"—or obliquely glancing at the much sought for, but never found, "perpetuum mobile"—was "mobile vulgus." This *mobile* was curtailed at length into our familiar word *mob*, followed at first by the period of contraction, but afterwards written without any such distinction, and so it has passed into the language. Again; *Rhubarb* is now a very respectable word,—representing an equally respectable thing—whether drug or esculent. It is properly, however *Rhc. Barb.* manifestly an apothecary's abbreviation of either *Rha Barbaricum*, or *Rheum Barbarum*. *Incog.* and *infra dig.*, have almost lost, in familiar language, their actual character. *Nem. con.* and *crim. con.* are not very ambiguous. We might venture to write *philomath* without a mark of abbreviation. By a kind of synecdoche of the first syllable for the whole term we have made out of *cabriolet*, *Hackney*, and *Hochheimer*, *cab, hack, and hock.* From *Grogram* (*grossa grana*, a coarsely woven material) and *Geniévre* (the French corruption of *Juniperus*—further anglicised by us into *Geneva*)—have come the names of two unmentionable liquids. *Cit.* once passed for citizen; but the modern *Gent.* has not yet succeeded in being recognized as *Gentleman;* nor his *pants* as *pantaloons;* nor his *nobs* as *nobiles*. *Fib.* for *Fabula* is one more abbreviation from the Latin. *Pi* or *pie*, denoting certain old Ecclesiastical rules, is the first syllable of *πί-ναξ*, the Table or Index, which detailed them. Type in *pie*, is type that must be re-arranged—put back into the *πί-ναξ* or case. *Pica* is *litera pica-ta*—letter pitch-black. *Magpie* is properly, as given in Shakspeare, *maggot-pie*, i.e. *pica morosa*, the whimsical *Pie*. *Sub.* for subaltern in the army and elsewhere; *Spec.* for speculation at the Exchange; *phiz.* for physiognomy, in the

* To the "foreign" reader it may be necessary to say that a certain dangerous reef running right across the lake of Canadian politics is thus named. The full form of the appellation is "Representation by Population."

photographic studios; *pos.* for positive, and *mem.* for memorandum, in the office of the Military Secretary, would be all taken as pretty intelligible English. The Germans seem to have adopted the prenomen *Max* for Maximilian. *Cur* has been seriously derived from *curtail*—a hound supposed to be disqualified for the noble chase by caudal abbreviation. *Cheap* is *Cheapside.* Is not *chap* the *chapman* with whom we are transacting business?

At the University, the *hoi polloi* are the *poll; optimes* are *ops;* sophisters are *sophs;* the *domini*—the heads of houses and other magnates—are the dons, *i.e.*, the doms; a vice-chancellor or vice-president is occasionally the *vice,* a term which would have been grievously misunderstood by frequenters of Mysteries and Moralities—and which ought, if anything, to be *vi-ce;* but that, although the correct thing, would sound nearly as bad. At Oxford, Demies are *demi,* i.e., *semi-communarii,* a sort of inferior fellow-commoners. The writers in "Blackwood," by an affectionate and not inelegant prosopopeia sometimes speak of their organ or magazine as *Maga.*

My specimens of words formed in a reverse way, by taking terminations instead of initial syllables, are not so numerous. *Drawing-,* for *withdrawing-room, story* for *history,* are not very striking; and it may be doubted that *brick* is *im-brec.* For the rest, take *cates* from *deli-cates; wig* from *periwig,* an anglicism for *perruque; bus* from *omnibus; bill* from *li-bell;* and finally, *copus,* from *episcopus,* a beverage in certain colleges at Cambridge.*

The few words said to be due to the initials of other words are all doubtful.

Maccabæus, the surname of the Jewish hero, B.C. 168, is attributed to the initials of the Hebrew words which signify "Who among the gods is like unto thee, Jehovah!" AERA has been said to denote "Annus erat, regnante Augusto," although, more probably, it was originally "The Bronzes;" as we sometimes say "The Marbles," meaning the Arundel or other marbles in citing authorities for dates.

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* Better known perhaps as Bishop; not peculiar, however, to Cambridge or England. When Hieronymus Jobs, a German Student, was asked by his examiner in Theology, *Quid est episcopus?* he replied, "an agreeable mixture of sugar, pomegranate juice, and red wine." See Mr. Brooks' late Translation of the Jobsiad, a Germ. poem, temp. 1784. The same young gentleman defined "Apostles" to be. "Tall jugs in which wine and beer are kept in villages."

Hip, the thrice-repeated exclamation which precedes the cheer of onset or victory, is *Hierosolyma est perdita!* and should on this supposition be *Hep!* It was the cry heard in German cities when the unfortunate Jewish quarter was to be assailed. *News* has been derived, scarcely in earnest, it is to be imagined, from the initials of the four "airts," N, E, W, S. Like *Abecedarian*, or the *Abcdarium Naturæ* of Lord Bacon, *Elementa* has been said to be composed of L, M, N, the letters whose sounds seem to be heard in the word. The cabinet of Charles II. (1670) was, in no amiable mood, branded as the *Cabal*, from the initials of its five members, Clifford, Ashley, Buckingham, Arlington, and Lauderdale. *Cabaler*, in French, signifying *to intrigue*, existed long before, and doubtless suggested the *mot*. This party-term of 1670 has rendered the Hebrew word for occult science familiar to English ears. The absurd expression "Teetotalism," is, I think, connected with the well known little toy, in which the letter T denoted *totum*, and signified "Take-all." By a process the reverse of that indicated above, the abbreviation ΙΗΣ, has been, in an age unfamiliar with Greek, resolved into initials, and interpreted accordingly.

Abbreviated, however, though many of our words are, the English language abhors outward signs of curtailment. We repudiate to the greatest possible extent the apostrophe and the circumflex. We like to have our lines look staid and unbroken. In this respect a page of English resembles a page of Latin. There is a solid, sensible air about them both. A page of French or of Greek will exhibit a succession of elisions duly notified, and the words generally, besides, appear to be in a state of flurry and effervescence with accents and other little diacritical touches—

> "As thick and numberless
> As the gay motes that people the sunbeam."

We dot our i's and cross our t's, simply to distinguish them from similar parts of other letters. This is the only weakness in which we indulge. We dismiss even from poetry elisions and contractions which Shakspeare and Dryden considered not at all ungraceful. We tolerate "t'other" for "the other," "on't" for "on it," "'em" for "them," only in Humorous Verse. How compact and unfrivolous the pages of Tennyson look! Even the unpronounced *-ed* is left to be discovered by the ear of the reader. Notes of exclamation are suppressed.

"Doeth" has become "doth;" "do on," "don;" "do off," "doff;" "do out," "dout;" "d' huit," "doit;" and "natheless" gives no sign of its being "ne'er the less." "Sevennight" is now "sennight;" "moneth," "month;" "sithence," "since." "Prithee" and "good bye" we write as we utter, although the first, of course, is "I pray thee;" and the latter, "Deus vobiscum," "God be with you."

Proper names which, as being foreign in their origin, exhibited a few years since, an apostrophe, are now printed without it; and the capital which followed it is reduced to the ranks. Were it the pleasure of Mr. Disraeli to take one more liberty with his patronymic, and terminate it with a *y* instead of an *i*, the next generation would scarcely notice in it any trace of Hebrew origin.

On observing a review lately of the Life of a certain Capodistrias, I by no means recognized in a moment an old acquaintaince, Capo-d' Istrias, whose name was familiar in mens' mouths at the time of the Greek Revolution.

In like manner, Dorsay, Darcy, Doily, Dacier, are now common forms. This Anglicising process in regard to proper names of foreign origin, is, however, nothing new. Dalton, Dexter, Denroche, Dangerfield, and many another family appellation in D, were once written with an apostrophe. Dexter and Dangerfield suffer two violations; the one being properly D'Exter, *i.e.*, of Exeter, and the other D'Aungerville, not involving "field" at all. *Diaper* from *d'Iprès*, and *Dindon* from *d'Inde* are examples well known.

In another set of names which originally began with a vowel, a disguise is produced by the elision of the article; as in Langley, Larcher, &c. In others, again, it is the Anglicised sound only that causes us to forget that they are properly French, as Mallet, Calmet.

In this connexion it may be added that although the pronunciation *Pree-do* may be cultivated in some families, plain Cornishmen, among whom the name is common, persist in making it *Pri-deaux*, with an *x*, just as the rest of England will say *Vaux* and *Jacques*. And so I remember at Cambridge, Professor Prime's name continued as it was, notwithstanding an effort at one time to improve it into de la Prime. So to recal Seymour and Sinclair to Saint Maur and St. Clair is as bootless an undertaking as it would be to resolve back into Hugh de Bras, the immortal Hudibras.

(*To be continued.*)

ON CERTAIN MODERN VIEWS CONCERNING THE ORDINAL ARRANGEMENT OF THE HIGHER MAMMALIA.

BY DAVID TUCKER, M.B., B.A., T.C.D., ETC.

All who have devoted any attention to the science of Zoology must be aware that the two best known systems of classification are those of Linnæus and of Cuvier. They must also be aware that there are some points on which the two systems are at variance. This, of course, was to be expected, as Cuvier had the advantage of travelling for a considerable distance on a track which Linnæus had vastly improved, if not almost entirely created. We have also to bear in mind that, labouring in an epoch in which civilization had become somewhat more advanced—a season of greater intellectual and commercial activity—the opportunities which Cuvier enjoyed of increasing his stock of knowledge, and of verifying his doctrines by the examination of actual specimens, were much more ample than those which fell to the lot of Linnæus.

Linnæus appears to have arranged the Mammalia chiefly with a regard to their dentition, whilst Cuvier, to a certain extent, revived the plan of Aristotle, which had a view to general anatomical distinctions. In the ordinal arrangement of the higher Mammalia there is also a considerable difference between the two systems. The characteristics which Linnæus ascribes to the first order of this class, are—"Front teeth incisors; the superior, four; parallel. Two pectoral mammae." In consequence of the frequent concurrence of these characteristic marks in individuals in the animal kingdom, this order, which he has named *Primates*, extended itself to very large dimensions. It commenced so low as animals of a rodent or insectivore type, and ascended as high as Man himself. The bat, the lemur, the monkey, the anthropoid ape and the Caucasian man were thus grouped together in rather ludicrous proximity. After a time this arrangement ceased to give satisfaction to the scientific world. Naturalists who had devoted some attention to the study of comparative anatomy, amongst whom was John Hunter, perceived that the principles were not correct, which led to this close approximation of all those apparently diverse genera. And when Baron Cuvier, in his justly celebrated "Regne Animal" introduced a new and more scientific system of arrangement, that of

Linnæus, though a wonderful accumulation of knowledge, and a monument of industry, was to a certain extent superseded.

In Cuvier's arrangement, the animals which composed the first order of Linnæus, are scattered throughout three or four other orders. Out of the monkey tribe, apes, and man, he has established two distinct orders. The first order is that of the Bimana: the second, that of the Quadrumana. In the first order there is only one Genus, Homo; in the second there are several Genera.

There can be no doubt that the doctrines which Linnæus propounded were not in all cases established upon firm and incontrovertible data. As regards the character of the anthropomorphous animals he appears to have been particularly ill-informed. From his description of these creatures one would imagine that he had imbibed and given credence to the vague and unscientific notions of the vulgar; and that he had never attempted to find a strict line of distinction between the man and the ape. Modern naturalists are of opinion that, of his own observation, he knew nothing concerning the anthropoid apes of either Asia or Africa. He had a pupil named Hoppius, who published a dissertation, accompanied by a wood-cut, on these animals, in the "Amœnitates Academicæ," and we may reasonably conclude that he had derived his opinions on this subject from his great master. The wood-cut represents four figures, the originals of which never existed, except in the imagination of the delineator. The first of these he styles "Troglodyta Bontii." It represents really a human female with a covering of hair. Bontius had described it as an Ourang Outang, and Linnæus introduces it into his "Systema" as "Homo Nocturnus." The second is styled "Lucifer Aldrovandi." Hoppius is of opinion that it belongs to a cat-tailed and cannibal race of people. Linnæus names it "Homo Caudatus," and ranks it as a third species of man. The third figure is styled "Satyrus Tulpii," and approaches more nearly than the others to the appearance of an ape, save in the head, face and feet, which too closely resemble the corresponding parts of man. The fourth is called "Pygmæus Edwardi." The proportions of its limbs are not at all those which characterise the limbs of an ape, and the face is much too human in its aspect. Buffon enjoyed opportunities of examining live specimens of anthropoid animals which Linnæus did not, and his observations did good service in dispelling the clouds of superstitious ignorance which enshrouded the whole subje . So little was known of the natural history of man in the time of Linnæus, that even that illustrious philosopher, in his Systema Naturæ, has found a separate place for children lost in the woods, and growing up in speechless solitude. These he classes under the title of *Homo sapiens ferus*, and appends the complimentary characteristics of "*tetrapus, mutus, hirsutus*;" thus coinciding to a certain extent with the views of Rousseau, who came to the conclusion that probably many animals of an anthropoid character, which travellers had pronounced to be beasts, were really genuine wild men (*véritables hommes sauvages*), in the primitive state of nature.

The arrangement of Cuvier, that, namely, of placing man in a distinct order by himself, the order comprising only one genus and one species—thus at once establishing his preëminence, and asserting the unity of the human family, appeared to satisfy the most enlightened philosophers of his time. Eminent physiologists supported his doctrine, the great name of Blumenbach being ranged on his side. Indeed Blumenbach has the credit of being the originator of the arrangement of Cuvier. It certainly was gratifying to human beings that Homo, if he must consent to be styled an animal, should stand alone in order, genus and species, the head and monarch of the animal creation. But he has not been allowed to enjoy his dignified solitude without murmurs of dissatisfaction. The close approximation to him in structural characteristics observed in other mammalia, and particularly in the Quadrumana, has led some naturalists to the conclusion that he cannot justly occupy a whole order in the animal kingdom. The hypothesis of development, which has of late years excited much interest in the scientific world, has imparted a stimulus to enquiry on this subject; and we find, as we should naturally expect, that those who regard that theory with favor, are the persons who are most ready to dispute the arrangement of Cuvier.

The object of the present paper is to bring before the members of the Institute, whose studies have not lain in this direction, a brief *resumé* of the arguments adduced to prove that man possesses no right to monopolize an entire, distinct, and preëminent order.

The most concise mode of fairly representing these arguments will be to analyse an essay on "The Relations of Man to the Lower Animals," contained in a work entitled "Evidence as to Man's place in Nature," not long since published by Professor Huxley of London, a gentleman who, however we may differ from him on disputed points, is deserving of our respect and attention. His claim to these is founded on his high attainments, his incessant labours in the field of science, and his apparent desire to arrive at truth. He has embraced, though not fully and unreservedly, the development hypothesis of Darwin. His own admissions on the subject are, "I, for one, am fully convinced that, if not precisely true, that hypothesis is as near an approximation to the truth, as, for example, the Copernican hypothesis was to the true theory of the planetary motions." (p. 127). Again, he says, "I adopt Mr. Darwin's hypothesis, therefore, subject to the production of proof, that physiological species may be produced by selective breeding." (page 128).

Prof. Huxley with very little ceremony throws aside the arrangement of Cuvier, respecting the ordinal position of man. To a certain extent he reverts to the arrangement of Linnaeus, retaining the old Linnaean term for the order in which he places man, namely *Primates*. In this order he finds seven distinct families. These are

Anthropini,	comprehending	Man alone.
Catarhini,	"	the old world Apes.
Platyrhini	"	the new world Apes, except the Marmosets.
Arctopithecini	"	the Marmosets.
Lemurini	"	the Lemurs.
Cheiromyini	"	Cheiromys, of a Rodent type, and
Galeopithecini	"	Galeopithecus, a flying Lemur resembling a bat.

The grand point which it is his aim to establish, and by using which, as an argument, he desires to justify this arrangement, is "that the structural differences which separate Man from the Gorilla and the Chimpanzee are not so great as those which separate the Gorilla from the lower Apes." And in order to make this point clear and credible, he descends to particulars, commencing as low as intra-uterine existence. The following is an abstract of his argument. All animals, save the very lowest, are produced from an ovum. The ovum of a chicken and that of a dog are primarily identical in character. Man himself originates in a similar germ. It is some time before Man, in his embryo state, can be distinguished from the young puppy, but in the course of development, the human embryo comes to differ from that of the dog, in characteristics. The placenta, for example, of the dog assumes a zone-like form, whilst that of Man becomes discoid or cake-like. Strange to say, the same form of placenta is to be found in the Apes as in Man. Man is, therefore, identical with the animals immediately below him in the earliest stages of his formation, as well as in the physical causes by which he originates. The mode of nutrition, both before and after birth, is the same for Man and these animals. Man is, in substance and in structure, one with the brutes.

As regards physical characteristics after birth, by relative admeasurement of the limbs of Apes, we find that in whatever proportion of its limbs the Gorilla differs from Man the other Apes differ more widely from the Gorilla; and consequently such differences of proportion can have no ordinal value. In the Gorilla the total number of vertebrae, taken together, equals the number of the vertebrae of Man, although the numbers of each kind do not agree in both animals. In Man the normal arrangement is 7 cervical, 12 dorsal, 5 lumbar, and 5 sacral (consolidated), to which may be added 4 small bones which join to form the coccyx. The Gorilla has, normally, 13 dorsal vertebrae and corresponding ribs, whilst Man has only 12. But Man has occasionally 13 pairs of ribs, and the Gorilla occasionally 14. Yet the lower *Primates* differ more from the Gorilla in this particular than the Gorilla does from Man. As, for example, the Douroucouli has normally 14 dorsal and 8 lumbar vertebrae, and a Lemur, (Stenops tardigradus), has 15 dorsal and 9 lumbar. The Gorilla and Chimpanzee when young have curves in the vertebral column, to a certain extent resembling those to be observed in Man, whilst in young Ourangs the column is either straight, or the concavity is anterior, instead of posterior. In the Pelvis the distinctions are equally marked. That of the Gibbon has quite a quadrupedal character, and differs much more from that of the Gorilla, than the Pelvis of the Gorilla differs from that of Man. Again, in the matter of the Cranium; the lowest human skull has a capacity nearly double that of the highest Gorilla. Yet the difference in the capacity of the crania of the different races of men is greater, absolutely, than that between the lowest Man and the highest Ape, whilst relatively, it is about the same. Thus the maximum human skull contains 114 cubic inches.

The minimum - - - -	62	"
The difference being - - - -	52	"

Next compare the minimum human skull,	-	62 cubic inches.
With the maximum skull of the Gorilla,		34.5 "
And the difference is only	- - -	27.5 "

Secondly, the adult crania of Gorillas differ among themselves nearly one-third. Thus, the maximum that has been measured

contains	- - - -	34.5 cubic inches,
And the minimum only	- -	24. "
The difference being	- - -	10.5

Thirdly, after making due allowance for difference of size, the cranial capacities of some of the lower Apes fall nearly as much, relatively, below those of the higher Apes, as the latter fall below Man. The conclusion from this is, that as regards cranial capacity, men differ more widely from one another than they do from the Apes, whilst the lowest Apes differ as much from the highest as the latter does from Man. In other parts of the skull corresponding differences (relatively) are to be found. For example, the Gorilla has large superciliary ridges, corresponding to internal sinuses, which the Ourang does not possess at all. The occipital foramen in the Lemurs is situated completely in the posterior aspect of the skull, or as much further back than that of the Gorilla, as that of the Gorilla is further back than that of Man; whilst the Platyrhini contains one member, the Chrysothrix, whose occipital foramen is situated further forward than any other of the *Primates* except Man. In dentition and in the viscera, the differences are as great between the Gorilla and the lower members of his order, as between Man and the Gorilla. Man has been defined as the only animal possessing two hands terminating his fore-limbs, and two feet terminating his hind-limbs; but the termination of the fore-limb of the Ape is a true hand, and that of the hind-limb a true foot, with a very moveable great-toe. It differs from the foot of Man in mere proportions—in the degreee of mobility—and in the secondary arrangement of its parts. Every Ape, Monkey, and Lemur possesses a flexor brevis muscle, an extensor brevis, and a peronæus longus in the hind extremity. These muscles are never found in a hand. The thumb and great toe of the Ourang differ more from those of the Gorilla than those of the Gorilla do from the corresponding organs of Man. As regards the Brain, there is a great difference in the different members of the order *Primates*, but the greatest hiatus does not lie between Man and the anthropoid Apes, but between the Apes and Monkeys and the Lemurs. The Lemur has its cerebellum partially visible from above, and the posterior lobe, with the contained posterior cornu and hippocampus minor rudimentary. All the other members of the order have the cerebellum entirely hidden by the cerebral lobes, and possess a posterior cornu and hippocampus minor well developed. Although the volume of the brain is much greater, proportionally and absolutely, in Man than in the Apes —the brain of the heaviest Gorilla weighing 20 ounces, whilst the largest human brain weighs 65 ounces, and the smallest adult human brain weighs 31 to 32 ounces—yet we must not lay too much stress on these facts, as intellectual power does not depend altogether on the brain. That organ is only one condition on which "intellectual manifestations" depend. The cerebral differences between Man and the Apes are not of more than generic value, his family distinction resting chiefly on his dentition, pelvis and lower limbs.

The conclusion, then, formed from all these particulars is, that Man differs in structure no more from the higher Apes, than the higher Apes differ from the lower *Primates*—that this Order leads us "insensibly from the crown and summit of the animal creation, down to creatures from which there is but a step, as it seems, to the lowest, smallest, and least intelligent of the placental Mammalia."

Pursuing the argument, Prof. Huxley continues—"If man be separated by no greater structural barrier from the brutes than they are from one another, then it seems to follow that if any process of physical causation can be discovered by which the genera and families of ordinary animals have been produced, that process of causation is amply sufficient to account for the origin of Man. In other words, if it could be shown that the Marmosets, for example, have arisen by gradual modification of the ordinary Platyrhini, or that both Marmosets and Platyrhini are modified ramifications of a primitive stock, then there would be no rational ground for doubting that Man might have originated, in the one case, by the gradual modification of a Man-like Ape; or in the other case, as a ramification of the same primitive stock as those Apes."

On first reading Prof. Huxley's views on this important subject, it is really difficult to discover how far he intends his preliminary argument to carry him. It will be observed that the conclusion just quoted is an hypothetical one. It all depends upon an "if." The plain and bare argument, so far carried, appears to be something like the following:—"I regard man as an animal only. The anatomical differences between him and the higher Apes are not greater than between these and certain other animals, some of a rodent, and some of an insectivore character, which I include in the same Order: *ergo*, the Apes, Monkeys, and Lemurs, must be placed in the same Order as man; and *if* Mr. Darwin's hypothesis of development be correct, there is no rational ground for doubting that Man was, originally, an Anthropoid Ape." This is the real argument as far as I can extract it, after patient examination. But strange to say, in his subsequent remarks, Prof. Huxley seems to throw aside that important "if," and speaks of mankind as though our origin was unquestionably identical with that of the brutes. He asks, for example, (p. 30), "Could not a sensible child confute by obvious arguments the shallow rhetoricians who would force this conclusion upon us?" And what is the conclusion to which he refers? "That the belief in the unity of the origin of Man and the brutes involves the brutalization and degradation of the former." Again, he says (p. 131), "Thoughtful men once escaped from the blinding influences of traditional prejudices, will find in the lowly stock whence Man has sprung, the best evidence of the splendour of his capacities, and will discern in his long progress through the Past, a reasonable ground of faith in the attainment of a noble Future." And in the concluding paragraph of his essay, he goes so far as to state of Man that upon it, (namely, an accumulated experience), he stands as upon a mountain-top, far above the level of his humble-fellows.

From such language as this it is impossible to avoid the conclusion that the writer of it would willingly accept all the consequences of the development hypothesis as regards our race, if the difficulties connected with it, and which he appears to consider by no means formidable, were taken out of the way.

But, to proceed with the tangible portions of Prof. Huxley's argument, supposing that he had established his preliminary position that Man differs less in *structure* from the higher Apes than these differ from the lower ones, does it necessarily follow that Man must be arranged in the same Order with these, and they styled his "fellows?" The question resolves itself into this,—Are we to classify all animals merely according to their anatomical phenomena, with no regard to aspect, habits, powers, capacities, and structural or typical perfection? Are we to ignore the fact, pressed upon our attention from within and from without, in a thousand different ways, that Man is a compound being, compound in a sense in which no other animal is so?

Those who have paid any attention to the natural history of Man must be acquainted with the list of distinctive characteristics which are pointed out as forming a barrier between him and all other animals. Lawrence, who has studied the subject closely, gives sixteen of these. But all of these sixteen may not be absolutely necessary for the purpose required. A few of them so signally mark Man's preëminence over the brutes, as to be sufficient to establish him in his true position as Archon of the whole animal kingdom.

Modern naturalists who are not prepossessed with the hypothesis of development, lay much stress on Man's pre-eminence in the matter of that wonderful organ, his Hand, which vindicates his claim to be ranked by himself in the order of *Animalia Bimana*. The term which they apply to the hands of Man, in contradistinction to those of the Quadrumana, (which name, by the way, Prof. Huxley attempts altogether to explode), is *Cephalic*. That is, they belong to the head, they are used by cerebral guidance, and are not, in the adult, organs of progression, whilst the corresponding organs of the Quadrumana always are. Although the fore-limb of the Quadrumana is furnished with a hand, yet it is a much less useful and capable organ than that which Man possesses. The thumb of the Quadrumana is short and weak, in the Ourang and Chimpanzee reaching no further than the metacarpo-digital articulation. The human thumb is so powerful and useful, acting in opposition to the fingers, that Albinus has described it as a smaller hand aiding the larger one—"*manus parva, adjutrix majori*."

Secondly, Man's smoothness of integument, particularly marked in the female, distinguishes him from the quadrumanous animals. The absence of all means of defence and of covering, supplied by nature, shows that he must rely on his superior mental qualifications, as an inventor and mechanician, for a supply of these.

Thirdly, Man possesses a capability of adapting himself to external circumstances, atmospheric, climatic, and dietetic, which no other animal can lay claim to. The Quadrumana are all natives of warm climates, and when removed to a certain distance from the equator, usually pine away and become diseased. Man is found in all latitudes from above 70° to the equator. He can thrive and propagate in all these latitudes, and bears a change from intense heat to intense cold often with apparent impunity. He can subsist on a vegetable diet, or on one almost exclusively animal.

Fourthly, The conformation of the human body amply proves that the erect attitude is natural to Man. The absence of facial projection, the mode in which the head is articulated with the spine, the length of the lower limbs when compared with the upper, the depth and thickness of the superior lip of the acetabulum, and the painful efforts necessary, when on all-fours, to fix the eyes on an object directly in front, are sufficient to establish this fact, which is still further confirmed by the uniform erect progression of all savages, even when first discovered by civilized men. Among the ancients the erect position was regarded as a very important mark of Man's superiority to the lower animals; and their poets have some finely expressed ideas on the subject.

It is true that some of the Anthropoid Apes occasionally attempt a sort of erect attitude in progression, but their efforts to maintain it are exceedingly awkward. The Gibbon has to hold the upper extremities over the head to balance itself, or fix them occasionally on the ground to render its gait steadier. The Gorilla is said to raise itself to the erect attitude when about to make an attack; but the Ourang is incapable of the erect posture. Linnæus could not have been well informed on this subject when he wrote of the Simiæ—"*erecto corpore binis æque ac homo pedibus incedentes.*" There is no ground for such an assertion. When Apes attempt to walk erect they tread on the outside edge of their feet, rocking and wavering from side to side. The gait of the Gibbon is a succession of hops; and the natural mode of progression adopted by the Gorilla is a shuffling or swinging gait, the fore-limbs being used much in the same way as crutches are used by a lame person. When he attempts the erect position his hands are employed in balancing his body. On the other hand, the feet of Man are firm, broad, solid and strong. The crural, femoral, and pelvic muscles, are sufficiently powerful to keep him in the erect position, leaving his hands at liberty to carry out the commands of his head. Man is the only animal known which has a foot with toe and heel that plant themselves firmly and at the same time upon the earth. None of the Apes, Monkeys, or Lemurs, can support themselves, in equilibrio on one foot, as Man easily does. The Quadrumana are all hylobatic animals. All their limbs are prehensile, and, as such, are used as organs of progression. It is true that the extremities of the fore-limbs are employed as hands for conveying food to the mouth, but the same may be stated of several other animals, such as the squirrel, the rat, and the racoon, which, for lack of a thumb, are obliged to make the one fore-paw oppose the other. The length of the digits and the existence of a thumb enable the Quadrumana to grasp tolerably large articles in one extremity.

Fifthly, Man possesses an acquired voice, or power of articulation for the conveyance and record of ideas. The lower animals, in common with Man, have a natural voice, but where an attempt has been made to teach an acquired voice to any of these, although the physical organs might respond to the effort, yet the want of mental power, to form a continuous succession of ideas, has always limited their speech to a very few words or phrases, which they repeat without any conception of their meaning. They are quite incapable of acquiring language, properly so called. This distinction between Man and the other animals, being so striking, has been insisted on from a very early period. Readers of Homer will remember how very frequently he applies the adjective μέροψ to human beings, and to these alone. Indeed the word is sometimes used in the plural as a noun, signifying "men."

The last distinctive characteristic which I think necessary to allude to is the superior mental powers and capabilities of Man. These it would, of course, be idle to dwell upon. Although Prof. Huxley tells us that "even the highest faculties of feeling and of intellect begin to germinate in the lower forms of life," and asks with apparent indignation, "Is mother-love vile, because a hen shows it, or fidelity base, because dogs possess it?"—yet the power and capability of Man's intellect are utterly unapproachable by the lower animals. Leaving out of view Man's capacity for civilization—his delight in beauty, truth, and goodness—his ability to interpret the laws of Nature—and his aspirations after immortality—does not that being rightfully claim to be segregated from all fellowship with brutes, who can turn his thoughts inwards and investigate the mysteries of those laws which regulate the actions of the mind itself, as if the objects of his inquiry were solid and tangible substances lying in the hollow of his hand; and who can, above all, not only reason reverentially concerning the character and essence of the Animating Spirit of the universe, but hold an invisible communion with that beneficent Parent?

It is upon these six characteristics that Man may base his right to repudiate all fellowship with the lower animals, save in the fact of his enjoying an animal existence and submitting to the laws which govern the animal kingdom. Many other distinctive marks can be adduced, but can hardly be considered necessary, if full value be accorded to the six above enumerated. Those, however, which depend upon Man's superior cerebral organization, and which have been so ably demonstrated by Owen, are well worthy of examination.

However ingeniously Prof. Huxley has reasoned upon the fellowship of Man with the brutes, there are many who will not appreciate his argument as highly as he does himself. They will naturally reason on this wise. If Nature chooses to bring Man into existence through the medium of an ovum, in the same way as she introduces to the world a dog or a chicken, and if, before and after birth, man is nourished as other placental mammals are, this only proves the consistency and uniformity of Nature in her laws. If man be in his corporeal part an animal, why should Nature, in his case, depart from the law of animal reproduction and nutrition? That, up to a certain point of embryonic life he cannot be distinguished from a dog, is not to be regarded as a proof of the characteristic and essential identity of the two up to that point, but of our inability to penetrate deeply enough into the mysteries of Nature to perceive a distinction. As to Prof. Huxley's position, that Man is one in substance and in structure with the brutes, it may be replied—If Man was created a denizen of the same planet as these animals, with organs of animal life suited to his position, should we not expect his substance to be similar to theirs? If he had to breathe an atmosphere and feed on organic substances of the same chemical composition, his bone and his muscle and his blood would, in accordance with natural laws, present characteristics similar to those of other animals. And so of anatomical structures. In this particular we might justly expect a similarity corresponding with the similarity of position in which both, as living beings are placed. The laws of pneumatics are obeyed in respiration, of hydraulics in circulation, of optics in vision, of mechanics in muscular action. If these laws are suitable to Man as an animal, why may they not regulate the economy of the brute, and his structure also be arranged for the action of these laws? It appears unworthy of a philosopher when reasoning of such a being as Man to identify him in origin with the brutes, because the bony and muscular system may, to a certain extent, correspond in both. If man was destined to inhabit this earth in the character of an animal, how could we expect that he should be utterly diverse from every other living being on its surface?

Now upon the subject of cranial capacity, if there are 52 cubic inches of difference between that of the largest and the smallest human skull (probably that of an idiot), which can be found, and only 27½ between this smallest human and the largest quadrumanal—the weight of whose body may have been double that of the owner of the small human one—what a proof this is of the vast superiority, proportionally, of the capacity of human crania! Let us change the arrangement provided for us and compare the highest human, 114 cubic inches, with the highest quadrumanal, 34½, and we find the difference to be 79½ cubic inches. This is a great superiority in point of cranial capacity over the brutes. Next let us look at the conformation of the crania themselves. Man's towering over his visage, and presenting a large surface in proportion to his facial development—the Ape's retreating behind, and not properly above his face at all. What if the dentition of the highest Apes differs less from Man than it does from the lower and lowest Apes, when the highest Ape possesses canines which are absolute tusks, and those of the Cynocephalus, or Baboon, rival the tusks of the Boar? As to the hind limb of the Gorilla being terminated, not by a hand, but by a true foot, Prof. Huxley has to acknowledge that, though, as in Man, every Ape, Monkey, and Lemur, possesses a flexor brevis, an extensor brevis, and a peronæus longus, yet in the Gorilla, and much more in the lower Apes, there is a different arrangement in the insertion of the muscles. But if the presence or absence of certain muscles, or the arrangement of certain bones are to decide us in pronouncing on an organ, whether it is a hand or a foot, some regard ought certainly to be paid to function. If, speaking with strict anatomical precision, the termination of the hind extremity of the Gorilla is a foot, yet it is a strong prehensile organ, which the foot of Man is not. It was this prehensile character which caused Tyson to apply the term "Quadrumana" to such creatures, and whatever may be the osteological and muscular arrangement of the foot of the Ourang, it is evident from its conformation and use that it is *de facto* a hand.

Nor is it easy to assent to Prof. Huxley's assertion, that the cerebral differences between Man and the Apes are not of more than generic value. The vast and unapproachable development of the hemispheres, and their lofty proportions, would appear to establish a greater difference than this. Even the amount of cerebral substance itself places comparison almost out of the question. Let us, as before, change the formula provided for us, and compare the highest man with the heaviest gorilla. The proportion then, in ounces, is 65 to 20. The surface of the human brain is furnished with many more convolutions, than that of the Chimpanzee, which Prof. Huxley figures, (the opportunity of examining the brain of the Gorilla being rare). And it will be perceived, in examining Prof. Huxley's plate, that if a posterior cornu of the ventricle and a hippocampus minor exist in the brain of this animal, they appear by no means so well defined or developed as in the human brain figured alongside.

The fact of the great gap that exists between the Apes and Monkeys and the Lemurs, in this, that the cerebellum in the Lemur is partially visible from above, would rather lead some naturalists to conclude that the Lemur had less business than ever, this being known, to intrude itself into the Order in which Homo occupies a place. But in reference to the actual preponderance of brain, Prof. Huxley places less value on this as a characteristic of Man, than most other writers on the subject. He states that "the brain is only one condition out of many, on which intellectual manifestations depend; the others being chiefly the organs of the senses and the motor apparatuses, especially those that are concerned in prehension, and in the production of articulate speech." Now this doctrine certainly sounds strangely to those of us who have been taught in the old-fashioned system of physiology, that the brain is the organ of mind, and to those of us who have seen all "intellectual manifestations" suddenly stopped by a blow upon the cranium. It certainly sounds strangely to myself, who have seen the action of the "motor apparatuses"—as Prof. Huxley styles them—as well as the sensitive ones—the sense of the organ of touch and the powers of motion including that of articulation—simultaneously and permanently arrested by dislocation of the cervical vertebrae, and consequent pressure on the spinal cord, whilst there was no reason to suppose that intellectual power was wanting in the brain during the days in which the wretched sufferer survived. Such a case, surely, demonstrates the paramount importance of the brain, and the utter inefficiency of the motor and sensitive nervous systems as intellectual manifestors, when their connection with that organ is interrupted. If "intellectual manifestations" ever depend on them it must be in a mediatory sense, their own efficiency depending on that of the brain, and their connection with that great centre of power and intelligence. The doctrine sounds strangely also to those who have learned from the principles of a long established philosophy that the brain is the seat of the mental faculties, and that the organs of the senses are but avenues which lead up to "the dome of thought."

But it is Man's endowment with articulate speech which Prof. Huxley regards as the preëminent advantage which he enjoys over those whom he designates "his humble fellows." "Our reverence" says he "for the nobility of manhood will not be lessened by the knowledge that he is one in substance and structure with the brutes, *for* he alone possesses the marvellous endowment of intellectual and rational speech, whereby in the secular period of his existence he has slowly accumulated and organized the experience which is almost wholly lost with the cessation of every individual life in other animals." Is not this, if the expression be allowed, an argument of a somewhat *hysteron proteron* nature? Which is necessary first, the mind to frame rational speech, that is, language, or the speech to form the mind? Is it by the mind or on the tongue that experience is organized—if by that term is meant its arrangement for future use? And let us ask, what would be the value of mere animal experience without mental capacity to profit by it? Does the bird construct her nest less accurately for her primal incubation than she does for her seventh? Does the beaver or the bee improve by experience in the science of architecture? Is the spider less expert in deceiving and destroying the unwary insect in the month of May than in the month of June? And do we not find that even when articulate speech is denied, intelligent beings can profit by the results of their experience? Do not mutes, whose mental organization is unimpaired, when left in the society of each other, devise certain modes of communicating ideas and recording experience though the organs of speech, as such, be abnormal and useless? The doctrine of Prof. Max Müller, that language is "the outward expression of an inward power," is much more philosophical than the theory we are now glancing at.

In a highly poetic strain Prof. H. draws an analogy between Man and the Alpine mountains, which, he says, though of one substance with the dullest clay, have been raised "by inward forces to that place of proud, and seemingly inaccessible glory" which they occupy. We naturally ask—what does he imply by drawing such an analogy? Regarding the general tone and apparent aim of his essay, we can form no other deduction from this simile, or analogy, or poetic sentiment, than that Men, modified from Brutes, through the aid of inward forces have raised themselves to their present preëminence. Such "inward forces" as existing in the anthropoid Quadrumana are contrary to experience, within the records of man, and until some proof be adduced of their ever having existed, we should richly merit the application of Prof. Huxley's own neat expression,—"shallow rhetoricians"—if we advocated a theory so chimerical.

To return to the question of Man's proper place in the animal kingdom, on this subject we find a great diversity of opinion amongst naturalists. Swainson, who carried out the Macleay system of classification, has gone to the very opposite extreme from Prof. Huxley, and altogether denied him a place in that kingdom. He could not locate him in any of the various circles into which he had arranged living creatures. There was no circle into which he could thrust him where he could have affinities on each side of him. He therefore concluded to thrust him out altogether, and regard him as a sort of demi-god. But the author of the "Vestiges," with his "development" instincts fully alive, though approving of Swainson's arrangement in other respects, condemns this one. He proposes that the typical order of mammalia should be designated Cheirotheria, the possession of hands being their most prominent characteristic. In this order he included Man, not very happily, considering the etymology of the term, which would represent him as a wild and predatory beast.

Regarding man as a compound animal, it is probable that Cuvier's arrangement will be found to afford the most general satisfaction. The six leading marks of distinction between him and the other mammalia appear of sufficient value to entitle him to a solitary place in the highest order of animals—leaving out of consideration that position which has been assigned to him by Revelation and confirmed by human experience—the position of Lord and Governor and Subduer of all other animals, however powerful and however fierce. Nor ought we to consent to regard Apes and Monkeys as members of the highest Order of living creatures till we find some well authenticated instance of any such animal possessing sufficient mental power to make at least an attempt at intelligible language—or manifesting some sense, however vague, of a future life—or acknowledging by adoration, or in some other intelligible mode, the existence of a supreme and spiritual Being.

NOTE ON THE PRESENCE OF PHOSPHORUS IN IRON WIRE.

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(Read before the Canadian Institute, March 12, 1864.*)*

UPWARDS of twenty years ago, thin iron wire was stated by Griffin, in his "Chemical Recreations," (Ed. 8, p. 154), to exhibit, in burning, a green light. This statement is repeated by Prof. Galloway in the various editions of his useful little work on chemical analysis: iron wire being placed in one of the tables, given in that manual, amongst the substances which impart a green coloration to the blowpipe-flame. In this connexion, it is curious that neither Berzelius, Plattner (*Löthrohrprobirkunst:* 1834, 46, 53), Dr. Harald Lenz (*Die Löthrohrschule:* 1848), Scheerer (*Löthrohrbuche,* 1849, 57), Bruno Kerl (*Leitfaden bei qual. und quan. Löthrohr-Untersuchungen,* 1859, 62), nor any other of the numerous workers with the blowpipe on the continent of Europe, have ever alluded to this reaction. Lenz gives a minute account of the action of the blowpipe-flame on iron wire, and points out that the fusion of the wire is always accompanied by oxidation; but he makes no allusion to any coloration of the flame.

Struck by this apparent omission, I have lately examined a great number of iron wires by the blowpipe. I find that all the light-coloured and comparatively hard wires exhibit the reaction very distinctly—a bright green flame streaming from the point of the wire during the oxidation and fusion of the latter, whilst a rapid scintillation, or emission of sparks, accompanies the phenomenon.

On the other hand, the soft and dark wires fuse much less readily, and do not occasion the slightest coloration of the flame.

On investigating the subject more fully, I have discovered that the green coloration, produced by the hard and light-coloured wires, is due to the presence of a minute amount of phosphorus—this being converted into phosphoric acid during the combustion or oxidation of the wire. After the solution of a sufficient quantity of wire in nitro-hydrochloric acid, and the precipitation of the iron by ammonia and sulphide of ammonium, the phosphoric acid may be thrown down, by a magnesian salt, as phosphate of ammonia and magnesia. This latter compound can then be tested farther by nitrate of silver, molybdate of ammonia, &c.

As iron wire is often employed in blowpipe experiments as a reagent for phosphoric acid, and as it is also occasionally used in the estimation of phosphorus in cast iron (Regnault: *Chimie* iii. 127), the publication of this note may not be without its use.

MEAN METEOROLOGICAL RESULTS AT TORONTO, FOR THE YEAR 1863.

BY G. T. KINSTON, M.A.,
DIRECTOR OF THE MAGNETICAL OBSERVATORY.

THE mean temperature of the year 1863 was 0°.45 in excess of the average annual temperature of twenty-two years. The oscillations of the monthly means, above or below their respective average monthly means, had an average amplitude of 1°.81, which, though slightly greater than the corresponding number (1.°42) for the year 1862, was considerably less than the average amplitude of the monthly oscillations (2°.44) in twenty-two years.

The mean deviations of temperature in the four seasons, with their proper signs, and regarding the winter as including December, 1862, were +2°.22 in winter, —0°11 in spring, +0°.02 in summer, and +0°.28 in autumn. Hence as regards its temperature, the year, though beginning with a mild winter, was regular in the other seasons.

There was a deficiency in the rain and snow, amounting to 3.715 inches of water. A deficiency occurred in the spring, summer, and autumn; but an excess in the winter, commencing December, 1862, as well as an excess in December, 1863. The deviations in the amount of precipitation, with their proper signs, in the four seasons, were +1.187 inches in winter, —0.755 inches in spring, —2.263 inches in summer, and —2.569 inches in autumn.

In the following summary, several of the results for the year 1863 are compared with the averages derived from a series of years, as well as with the extreme values of analogous results that have occurred during the same series.

TEMPERATURE.

	1863.	Average of 22 years.	Extremes.	
Mean temperature of the year ..	44°.57	44°.12	46°.36 (in 1846)	42°.16 (in 1856)
Warmest month..............	July	July	July, 1854	Aug. 1860
Mean temperature of the warmest month	67°.57	66°.85	72°.47	64.46
Coldest month	February	February	Jan. 1857	Feb. 1848
Mean temperature of the coldest month	22°.41	22°.98	12°.75	26°.60
Difference between the warmest and the coldest months	45°.16	43°.87	—	—
Mean of deviations of monthly means from their respective averages of 22 years, signs of deviations being disregarded.	1°.81	2°.44	3°.55 (1843 & 1857)	1°.35 (in 1853)
Months of greatest deviation, without regard to sign	January	January	Jan. 1857	—
Corresponding magnitude of deviation	4°.5	3°.9	10°.7	—
Warmest day	July 1	July 20	July 12, 1845	July 31, 1844
Mean temperature of the warmest day	75°.12	77°.28	82°.32	72°.75
Coldest day	Feb. 4	Jan. 24	Feb. 6, 1855 Jan. 22, 1857	Dec. 22, 1842
Mean temperature of the coldest day	—4°.52	—0°.87	—14°.38	+9°.57
Date of highest temperature ..	Aug. 19	July 22	Aug. 24, 1854	Aug. 19, 1840
Highest temperature........	88°.0	90°.4	99°.2	82°.4
Date of lowest temperature....	Feb. 4	Jan. 25	Jan. 26, 1859	Jan. 2, 1842
Lowest temperature	—19°.8	—12°.2	—26°.5	+1°.9
Range of the year............	107°.8	102°.6	118°.2 (in 1855)	87°.0 (in 1847)

BAROMETER.

	1863.	Average of 18 years.	Extremes.	
Mean pressure of the year	29.6536	29.6133	29.6679 (in 1849)	29.5880 (in 1852)
Month of highest mean pressure	February	Sept.	June, 1849	Sept. 1860
Highest mean monthly pressure	29.7922	29.6629	29.8030	29.6733
Month of lowest pressure	June	June	March, 1859	Nov. 1849
Lowest mean monthly pressure	29.5523	29.5624	29.4215	29.5868
		Average of 9 years.		
Date of highest pressure in the year	Feb. 4 (11 A.M.)	—	Jan. 1855	Dec. 1854
Highest pressure	30.502	30.372	30.552	30.245
Date of lowest pressure in the year	April 2 (6 A.M.)	—	March, 1859	March, 1858
Lowest pressure	28.704	28.592	28.286	28.849
Range of the year	1.798	1.780	2.106 (in 1859)	1.429 (in 1860)

RELATIVE HUMIDITY.

	1863.	Average of 20 years.	Extremes.	
Mean humidity of the year	77	78	82 (in 1851)	73 (in 1858)
Month of greatest humidity	January	January	Jan. 1857	Dec. 1858
Greatest mean monthly humidity	85	83	89	81
Month of least humidity	April	May	Feb. 1843	April, 1849
Least monthly humidity	68	72	58	76

EXTENT OF SKY CLOUDED.

	1863.	Average of 10 years.	Extremes.	
Mean cloudiness of the year	0.61	0.60	0.63 (in 1862)	0.57 (in 1853 & '56)
Most cloudy month	January	Dec.	Dec. 1858 Dec. 1860 Feb'y 1861 Jan. 1863	Dec 1857
Greatest monthly mean of cloudiness	0.83	0.75	0.83	0.73
Least cloudy month	Sept.	August	July, 1853	June, 1861 May, 1862 Aug. 1862
Lowest monthly mean	0.42	0.45	0.34	0.45

WIND.

	1863.	Result of 14 years.	Extremes.	
Resultant direction	N 41°. W	N 60°. W		
Mean resultant velocity in miles	1.34	1.82		
Mean velocity, without regard to direction	7.13	6.78	8.55 (in 1860)	5.10 (in 1853)
Month of greatest mean velocity	February	March	March, 1860	Jan. 1848
Greatest monthly mean velocity	10.13	8.60	12.41	5.82
Month of least mean velocity	July	July	Aug. 1852	Sept. 1860
Least monthly mean velocity	3.89	4.91	3.30	5.79
Day of greatest mean velocity	Dec. 14			
Greatest daily mean velocity	21.41			
Day of least mean velocity	July 10			
Least daily mean velocity	0.18			
Hours of greatest absolute velocity	March 31 9.30 to 10.30 P.M.			
Greatest velocity	39.0			

RAIN.

	1863.	Average of 21 years.	Extremes.	
Total depth in the year in inches	26.483	30.324	43.555 (in 1843)	21.505 (in 1856)
Number of days in which rain fell	130	106	136 (in 1861)	80 (in 1841)
Month in which the greatest depth of rain fell	Nov.	Sept.	Sept. 1843	Sept. 1848
Greatest depth of rain in one month	3.656	3.973	9.760	3.115
Month in which days of rain were most frequent	October	June	June, 1857	May, 1841
Greatest number of rainy days in one month	16	12	21	13
Day in which the greatest amount of rain fell	July 20	—	Oct 6, 1849	
Greatest amount of rain in one day	1.665	2.138	3.360	
Hour of heaviest rain	July 20, 6 to 7 P.M.			
Greatest amount of rain in one hour	0.420			

SNOW.

	1863.	Average. 19 & 22 years.	Extremes.	
Total depth in the year in inches ...	62.9	61.6	99.0 (in 1855)	35.4 (in 1851)
Number of days in which snow fell	74	57	87	33
Month in which the greatest depth of snow fell..........................	February	February	Feb. 1846	Dec. 1851
Greatest depth of snow in one month	22.0	18.0	46.1	10.7
Month in which days of snow were most frequent................	Jan. Dec. & March	Dec.	Dec. 1859 / Jan. 1861	Feb. 1858
Greatest number of days of snow in one month	17	13	23	8
Day in which the greatest depth fell	Feb. 4			
Greatest depth of snow in one day..	16.0			

RAIN AND SNOW COMBINED.

Where ten inches of snow are reckoned as equivalent to one inch of rain.

	1863.	Average of 19 and 22 years.
Total depth in the year in inches of water............	32.773	36.488
Number of days in which rain or snow or both fell	184	160
Month in which the greatest fall of rain or snow occurred	December	September
Greatest amount of rain or snow in one month.........	3.670	3.973
Month in which occurred the greatest number of days of rain or snow	January	December
Greatest number of days of rain or snow in one month	22	18

The accompanying table is a general abstract of the Meteorological Observations made at the Magnetic Observatory, Toronto, during the year 1863:

GENERAL METEOROLOGICAL

Provincial Magnetical Observ

LATITUDE, 43° 39' 4" North; LONGITUDE, 5h. 17m. 33s. West.—Elevation above

	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.
Mean temperature	28°.08	22°.41	23°.84	42°.03	54°.30	60°.13	67°.57
Difference from average (22 years)	+4.55	— 0.57	— 4.29	+ 1.05	+ 2.91	— 1.23	+ 0 72
Thermic anomaly (Lat. 43° 40' N.)	—4.72	—12.29	—14.26	— 8.17	— 3.80	— 4.47	— 1.13
Highest temperature	47.0	41.5	42.2	69.0	79.0	84.8	83.5
Lowest temperature	—14.0	—19.8	— 4.0	8.6	36.4	37.4	48.0
Monthly and annual ranges	61.0	61.3	46.2	60.4	42.6	47.4	35.5
Mean maximum temperature	33.32	30.06	32.81	49.99	63.42	69.23	74.88
Mean minimum temperature	22.93	15.47	19.42	33.42	46.26	51.99	59.69
Mean daily range	10.38	14.58	13.39	16.57	17.15	17.24	15.19
Greatest daily range	24.6	35.6	39.6	30.5	34.8	27.2	23.5
Mean height of barometer	29.6466	29.7922	29.6649	29.6453	29.6170	29.5523	29.5963
Difference from average (18 years)	+.0132	+.1800	+.0826	+.0583	+.0324	—.0101	—.0051
Highest barometer	30.378	30.502	30.180	30.078	29.901	29.844	29.912
Lowest barometer	28.846	29.037	29.129	28.704	29.011	28.982	29.390
Monthly and annual ranges	1.532	1.465	1.051	1.374	0.890	0.862	0.522
Mean humidity of the air	.85	.83	.78	.68	.69	.71	.78
Mean elasticity of aqueous vapour	.140	.110	.116	.181	.299	.373	.535
Mean of cloudiness	.83	.66	.63	.54	.48	.54	.64
Difference from average (10 years)	+.12	—.5	+.4	—.4	—.5	+.1	+.19
Resultant direction of the wind	N 61 W	N 23 W	N 27 W	N 14 E	N 56 E	N 50 W	N 18 W
" velocity of the wind	1.13	2.27	2.62	3.75	0.41	2.26	0.40
Mean velocity (miles per hour)	7.23	10.13	9.27	9.20	5.89	5.24	3.89
Difference from average (14 years)	—0.63	+2.05	+0.67	+1.33	—0.73	—0.03	—1.02
Total amount of rain	1.122	1.450	0.687	2.210	3.363	1.662	3.408
Difference from average (21 & 22 yrs)	—0.285	+0.404	—0.861	—0.188	+0.122	—1.438	—0.082
Number of days rain	10	7	4	8	14	13	15
Total amount of snow	20.6	22.0	11.4	1.6	0.1	...	...
Difference from average (19 years)	+ 6.97	+ 3.97	+ 2.26	— 0.91	0.00	...	...
Number of days snow	17	12	17	4	1	...	...
Number of fair days	9	11	13	19	17	17	16
Number of auroras observed	3	4	5	5	0	4	6
Possible to see aurora (No. of nights)	7	14	18	19	18	19	14
Number of thunderstorms	0	0	0	1	3	3	7

REGISTER FOR THE YEAR 1863.

atory, Toronto, Canada West.

Lake Ontario, 108 Feet; approximate Elevation above the Sea, 342 Feet.

Aug.	Sept.	Oct.	Nov.	Dec.	Year 1863.	Year 1862.	Year 1861.	Year 1860.	Year 1859.	Year 1858.	Year 1857.
66.58° + 0.56 − 1.92	55.88° − 2.03 − 5.62	45.95° + 0.43 − 7.85	39.13° + 2.44 − 4.07	27.00° + 0.89 − 9.00	44.57° + 0.45 − 6.43	44.35° + 0.23 − 6.65	44.22° + 0.10 − 6.78	44.32° + 0.20 − 6.68	44.19° + 0.07 − 6.81	44.74° + 0.62 − 6.26	42.73° − 1.39 − 8.27
88.0 42.4 45.6	80.0 31.4 48.6	66.4 30.5 35.9	67.0 17.8 49.2	53.4 − 1.5 54.9	88.0 −19.8 107.8	95.5 − 5.2 100.7	87.8 −20.8 108.6	88.0 − 8.5 96.5	88.0 −26.5 114.5	90.2 − 7.3 97.5	88.2 −20.1 108.3
75.72 57.98 17.74 35.5	64.49 46.99 17.50 27.1	52.79 40.54 12.25 23.8	44.82 33.34 11.49 23.0	34.00 20.70 13.30 28.5	... ... 14.73 39.6	... ... 14.43 37.0	... ... 14.42 33.3	... ... 14.24 30.7	... ... 13.66 39.8	... ... 13.84 31.2	... ... 16.38 37.0
29.6453 +.0240	29.7324 +.0695	29.6972 +.0472	29.5357 −.0582	29.6975 +.0495	29.6536 +.0403	29.6248 +.0115	29.6008 −.0125	29.5923 −.0210	29.6209 +.0076	29.6267 +.0134	29.6054 −.0079
29.989 29.321 0.668	30.140 29.259 0.881	30 218 29.272 0.946	30.181 29.096 1.085	30.313 28.769 1.544	30.502 28.704 1.798	30 469 28.805 1.664	30.330 28.644 1.686	30.267 28.838 1.429	30.392 28.286 2.106	30.408 28.849 1.559	30.361 28.452 1.909
.76	.75	.80	.80	.83	0.77	0.77	0.78	0.77	0.74	0.73	0.79
.506	.350	.260	.198	.129	.266	.262	.262	.260	.249	.259	.254
.45 .00	.42 −.08	.64 +.03	.71 −.03	.72 −.03	0.61 +.01	0.63 +.03	0.62 +.02	0.60 .00	0.61 +.01	0.60 .00	0.60 .00
S 61 W 1.80 4.83 −0.28	N 16 W 0.92 6.46 +1.06	S 71 W 0.48 6.16 +0.30	N 88 W 3.50 7.86 +0.37	N 41 W 1.61 9.40 +1.22	N 41 W 1.34 7.13 +0.36	N 48 W 2.03 7.33 +0.56	N 56 W 2.11 7.47 +0.70	N 60 W 3.32 8.55 +1.78	N 61 W 2.24 8.17 +1.40	N 41 W 1.59 7.64 +0.87	N 74 W 2.54 7.99 +1.22
2.208 −0.748 12	1.235 −2.738 8	2.522 +0.037 16	3.636 +0.516 13	2.960 +1.415 10	26.483 −3.841 130	25.529 −4.795 118	26.995 −3.329 136	23.434 −6.890 130	33.274 +2.950 127	28.051 −2.273 131	33.205 +2.881 134
... ...	... ...	0.0 − 0.84 0	0.1 − 3.00 6	7.1 − 7.56 17	62.9 + 1.27 74	85.4 +23.77 72	74.8 +13.17 76	45.6 −16.03 75	64.9 + 3.27 87	45.4 −16.23 67	73.8 +12.17 79
19	22	15	12	11	181	189	165	174	169	178	171
5	8	3	1	0	44	48	43	58	53	59	26
19	21	13	16	10	182	276	186	190	199	198	189
8	2	0	0	0	24	24	27	30	30	19	28

FACTS TENDING TO SHOW A DAILY DEVELOPMENT AND TRANSFORMATION OF SEVERAL KILOGRAMMES OF FIBRINE IN THE HUMAN BODY, AND ALSO WHERE THIS DEVELOPMENT AND TRANSFORMATION TAKE PLACE.

BY E. BROWN-SÉQUARD.

(*Translated from the "Journal de la Physiologie de l'homme et des animaux." Tome premier. Paris,* 1858.)

From the researches of Bidder and Schmidt we learn that the quantity of organic matter undergoing transformation in the animal economy, judging of it by the amount of the secretions is very great. The following facts, established by these able physiologists, enable us to form some idea of it: the dog, for example, secretes an amount of gastric juice during the twenty four hours equal in weight to one-tenth of the weight of the animal, nearly twenty grammes of bile are secreted for each kilogramme of the dog's weight in the course of one day. The other secretions, (saliva, pancreatic fluid, succus entericus) are also very large.

We are indebted to Colin of Alfort for numerous experiments confirmatory of the results obtained by Bidder and Schmidt in reference to these various secretions.

The existence of these secretions, and the absorption of a great part of their component elements, imply that extensive modifications are continually taking place in the blood.

The facts about to be submitted lead to the same conclusion.

Lehmann has proved, by experiments made upon horses, and by others, more recently on dogs, that the blood issuing from the liver does not contain fibrine, whilst the blood of the vena portæ contains from 4·24 to 5·92 parts in a thousand in the case of the horse, and from 3·98 to 5·07 in the case of the dog. I have, upon several occasions, satisfied myself that the blood of the supra hepatic veins, in the dog, does not spontaneously coagulate, and yields no fibrine when whipped. Once or twice I have seen a few flocculent fibres in blood from these veins, (not mixed with that from the vena cava.) Lehmann has upon two occasions observed the same thing, but the quantity of fibrine of which these flocculi are composed is too insignificant to be worthy of consideration.

Upon three occasions, I have indeed found a genuine fibrinous clot, in blood coming from the liver, very small it is true; but the conditions under which this has been noticed render it highly probable that the functions of the liver were at that time partly suppressed. Moreover, after death the blood of the supra hepatic veins is usually found coagulated or coagulable; due to the admixture of the blood from the liver with that of the vena cava.

Nevertheless it is shown, by the analyses of the eminent chemist of Leipzig, and by my own observation, that during life and in a normal condition, the blood of the supra hepatic veins is devoid of fibrine, or contains only an inappreciable quantity, showing that this element of the blood is transformed in the liver; or loses, at least, its chief characteristic property.

The same may be said in reference to the fibrine of the blood passing through the kidneys, it almost wholly or entirely disappears; F. Simon asserts that fibrine is not to be found in the blood of the renal vein. Claude Bernard has also stated that this element is wanting in the blood of the renal vein. I have made researches upon this subject, and have very frequently obtained the negative result recorded by Simon and Bernard. But it is well to know that there exist in this matter, sources of error, which, if not avoided would infallibly lead to the conclusion, that there is as much, or nearly as much, fibrine in the blood of the renal vein as in arterial blood. If, in order to obtain the blood coming from the kidneys, we wound the renal vein, without having previously placed a ligature upon it at its opening into the vena cava, we obtain a mixed blood, a large part of which comes from the vena cava, and must contain fibrine. On the other hand, it sometimes happens, that the urinary secretion is suddenly suppressed when the abdomen is opened. Under these circumstances, the blood returning from the kidneys, has assumed the venous colour, contains fibrine and speedily coagulates. After death in the case of man and other animals the blood of the renal veins is found coagulated or coagulable.

In order to prove that the venous blood from the kidneys does not usually contain fibrine, or only a trace of it, it is necessary, immediately after opening the abdomen to seize with the forceps the two extremities of the renal vein.

By this method, it is true, only a very small quantity of blood is obtained, but it can be satisfactorily shewn that this blood is neither coagulable spontaneously nor by whipping. If a larger quantity be desirable, one pair of forceps only should be applied at the point of termination of the renal veins in the vena cava, then divide the renal vein, and collect the blood which flows from it. In a few minutes, more than sufficient is obtained than is necessary to prove by the method of whipping, that there is no fibrine in the collected blood. If the blood be allowed to flow for more than three or four minutes, sometimes it may be found to contain a small amount of fibrine, and after seven or eight minutes, this element is almost always present in considerable quantity.

My experiments were made upon dogs and rabbits. It is difficult to succeed, especially with rabbits, on account of the disturbance of the renal function produced by the opening of the abdomen.

The non spontaneous coagulability, the negative results afforded by microscopical examination and by the method of whipping, have satisfied me of the absence of fibrine. Of course I do not mean to say that a substance more or less analogous to fibrine, or resulting from it, does not exist in the blood of the renal vein and of the supra hepatic veins. It is for the chemist to show what transformation fibrine undergoes in the liver and kidneys. What I mean is, that usually, if not always, true fibrine, the element endowed with the property of coagulating, spontaneously, or by whipping, with a free supply of air, and at a moderate temperature, disappears from the blood which traverses the liver and the kidneys. But whether this substance has only lost its chief characteristic property, retaining others, or whether it has suffered complete modification I do not pretend to say, nor for the present to enquire.

If it be so that the metamorphosis of fibrine into one or several substances takes place in the liver and kidneys, it must follow in the case of man, considering the quantity of blood which traverses these organs in the course of twenty-four hours, that probably not less than four or five kilogrammes of fibrine undergo transformation daily. Moreover, as the amount of this constituent does not vary in the normal blood of the general circulation, it must be admitted that there is a daily formation of from four to five kilogrammes of fibrine. This is now to be demonstrated.

Admitting that the left ventricle is completely emptied at each systole, of which, since the researches of Haller, there can be no doubt, from 120 to 180 grammes of blood are expelled at each contraction of the heart in the human adult. Now the human heart contracts, in a condition of health, at least from 72 to 78 times in a minute, (according to Guy, Volkmann, &c.,) whence it follows, assuming the lowest figure, 120 grammes and 72 pulsations, in order to be rather under the mean than to take numbers that might be thought too high, that (72 × 120) 8640 grammes of blood are expelled from the left ventricle every minute. In one hour (60 × 8640) 518,400 grammes, and in twenty-four hours (518,400 × 24) 12,441,600 grammes, or in round numbers, 12,440 kilogrammes (1000 kilogrammes are nearly equal to an English ton).

Of these 12,440 kilogrammes of blood leaving the left ventricle in the course of one day, how much passes through the liver and the kidneys? It is impossible to say what this quantity may be exactly, but an approximation may be arrived at sufficiently near the truth for the purposes of our enquiry. According to Ferneley, Paget, Valentin, and Volkmann, the sum of the sectional areas of the branches of an arterial trunk is somewhat greater than the sectional area of the trunk itself.

In reference to the aorta, Paget, adopting the mean of twelve measurements, gives the following proportions:—

The area of a section of the aorta where it emerges from the pericardium, is to the sum of the sectional areas of the three first large branches, and of its thoracic branch, as 1 is to 1.055. Disregarding this slight difference, it may be said from what is known at the present day, that the quantity of blood which flows in a given time, through a large arterial branch, is (nearly) to the quantity of blood which flows through the aorta before it gives off its first branches, as the sectional area of this large branch is to the sectional area of that part of the aorta. Again, the areas of circles being to one another as the squares of their diameters, if the diameter of an artery arising from the aorta, and also the diameter of the aorta before giving off its first branches be known, the quantity of blood flowing through the artery in the course of one day can be readily determined. The diameter of the human aorta at its origin (according to Paget, Valentin, and myself), is about 28 millimetres, the square of which is 784; hence the quantity of blood which flows through the aorta at its origin, and which amounts to, at least, 12,300 kilogrammes, is to the quantity of blood flowing through the cœliac axis in the same time as 784 : the square of the aortic diameter, is to 25, the square of the diameter of the cœliac axis:—

$$12300 : x :: 784 : 25$$

$$x = \frac{12300 \times 25}{784} = 392 \text{ kilogrammes.}$$

About 392 kilogrammes of blood flow in 24 hours therefore, through the cœliac axis.

A similar calculation gives for the superior mesenteric artery, 384 kilogrammes, and for the inferior mesenteric 343 kilogrammes.

Respecting this latter artery, since a portion of its blood does not traverse the liver, we will subtract 43 from the 343 kilogrammes, and consequently admit that only 300 kilogrammes of blood are supplied to the liver by the inferior mesenteric artery: on adding these quantities of blood which the liver receives daily by the three channels mentioned, we find,—

1. From the cœliac axis....................	392	kilogrammes.
2. From the superior mesenteric	384	"
3. From the inferior mesenteric	300	"
Total	1076	"

Let it be observed that this sum is assuredly not too high, because, in order to arrive at it, very low figures have been assumed (72 pulsations in a minute, and 120 grammes as the amount of blood leaving the left ventricle at each systole).

It may be therefore held that in the adult probably at least 1076 kilogrammes of blood enter the liver daily. Admitting that there are only 2.5 parts in a thousand of fibrine in the blood, from the three arteries which supply the liver, it is evident that this blood loses 2690 grammes of fibrine, in one day, whilst traversing the digestive organs and the liver.

It is difficult to decide whether this amount of fibrine undergoes transformation solely in the liver or partly here and partly elsewhere; but certainly the liver is the chief site of this transformation. Nothing can be learnt with certainty from the analyses of the blood of the vena portæ which shew that it contains relatively less fibrine than arterial blood, and the blood of the superficial veins, because of the changed condition of the blood of the vena portæ, due to the absorption of water, salts, &c.

If instead of allowing 2.5 parts of fibrine, we take 2.3 as being nearer the mean in a normal condition, it will be found that 2475 grammes of fibrine disappear in the course of one day in the blood traversing the digestive organs and the liver; and 2152 grammes if we assume that there are but 2 parts in a thousand of fibrine in the blood. If we make a calculation in reference to the blood supplied to the kidneys, similar to that just made with respect to the blood going to the liver, it will be found that the left kidney receives 457 kilogrammes and the right 481 kilogrammes, whence it follows that the two kidneys receive daily 938 kilogrammes of blood.

Assuming that arterial blood contains 2.5 parts in a thousand of fibrine, there will be a transformation of 2345 grammes of fibrine in the kidneys in one day. If only 2.3 parts of fibrine, the amount would be 2107 grammes; if only 2.2 parts there would be transformed 1876 grammes.

Now, on adding together the amount of fibrine transformed in the liver (and in part also, perhaps, in the other organs of the digestive apparatus), and in the kidneys, we obtain the following results:—

2690 + 2345 = 5035	grms. of fibrine,	assuming	2.5	parts	in 1000
2475 + 2107 = 4582	" "	"	2.3	"	"
2152 + 1876 = 4028	" "	"	2.0	"	"

Whence it follows that an amount of fibrine, varying between four and five kilogrammes at least, undergoes transformation in the course of the circulation of the blood through the digestive and venous viscera every twenty-four hours.

It has been objected by some to whom I have made known these conclusions, that perhaps the fibrine of the blood, instead of suffering transformation, passed in company with the lymph through the liver and kidneys. However puerile this objection may appear, yet since it has been seriously advanced by serious and learned men, I feel bound to reply. According to the researches of Bidder and Schmidt, 10 kilogrammes of lymph flow into the subclavian vein in the course of one day.

Of these 10 kilogrammes, certainly not more than 3 are derived from the liver and the kidneys, however numerous may be the lymphatics of these viscera. In order to give the largest possible support to the objection, let us admit that 5 kilogrammes of lymph are derived from those organs where we suppose the transformation of the fibrine of the blood to take place. Now admitting that there are 2 parts in a thousand of fibrine in lymph, there would be 10 grammes of it derived from the liver and the kidneys. But double this quantity, or treble it, and only an insignificant quantity would result when compared with that which represents the quantity of of fibrine destroyed, or rather metamorphosed, in one day, in the liver and the kidneys. In fact, what is this quantity of 10, 20, or 30 grammes in comparison with 4000 or 5000 grammes? The trifling amount of fibrine, therefore, which passes by the way of the lymph through the kidneys and the liver may be safely neglected in the question under consideration.

If there be a daily transformation of 4 or 5 kilogrammes of fibrine in the blood traversing the digestive organs, the kidneys and the liver, it is manifest that there must be a formation of a similar amount of this element of the blood, since the proportion of fibrine in the normal condition remains nearly the same in the blood of the arteries and superficial veins.

But where is this large amount of fibrine produced? Experiments made in 1851, by myself, and the observations of Lehmann, two years since, appear to indicate the chief site of its formation. I have demonstrated that fibrine is developed in the limbs of the lower animals and of man, when separated from the body, if we inject them with defibrinated blood. Moreover, I have found that a larger quantity is formed, when the limbs are galvanized, during the process of injection. As the amount of fibrine produced under these circumstances is extremely small, and as, on the other hand, chemists had almost universally allowed that a larger amount of fibrine, both in man and the lower animals, is to be found in arterial than in venous blood, I was unable to draw any conclusion from my experiments. Lehmann has since shewn, however, that comparative experiments are fallacious in this respect, and that the blood of the lesser veins contains a notably larger amount of fibrine than arterial blood.

The following figures showing the proportion of fibrine, are the result of experiments upon five horses.

	I.	II.	III.	IV.	V.
Arteries	0.446	0.413	0.047	0.507	0.407
External abdominal Vein..........	0.639	0.604	.....	.....	....
Jugular Vein	.....	0.337	.....	0.568	.....
Vein of the head.................	.....	.....	0.219	.....	.....
Digital Vein	.....	.....	.....	0.677	.....
Abdominal Vena Cava above the hepatic veins...............	.....	0.323	.....	.....	0.085

Several facts result from these analyses:—First, that the blood of the lesser veins (the external abdominal, a vein of the head, and a digital vein) contains from one to two parts in a thousand more fibrine than arterial blood; Secondly, that the blood of the inferior vena cava, after admixture with non fibrinous blood of the renal veins and of the supra hepatic veins contains from one to five parts in a thousand less fibrine than arterial blood. This latter result is confirmatory of the evidence which shows that fibrine disappears from the blood traversing the kidneys and the liver.

An increase of only six, seven, or eight parts in ten thousand, in the blood returning from the limbs, and from the surface of the head and trunk, would be sufficient in man to compensate for the loss of fibrine which takes place in certain abdominal viscera. I leave it for others to determine what influence any disturbance of the functions of the kidneys and of the liver may exert in the transformation and production of fibrine. My object has beeen to show that in all probability several kilogrammes of fibrine disappear daily in certain organs, and that an equivalent quantity of this constituent of the blood is produced in other organs. In accordance with these results, one of the functions of the kidneys and the liver would be to free the blood of its contained fibrine, and the formation of this element of the blood would take place in the capillaries of several organs but especially in those of muscular tissue. These several points, constituting a fertile field for exploration, are commended to the consideration of chemists.

M. B.

EXPERIMENTAL CRUISE OF THE FRENCH IRON-CLAD SQUADRON.

(*La campagne d'essais de l'escadre cuirassée.* By Admiral Xavier Raymond, in the *Revue des deux-mondes*, 1st January, 1864).

After a toilsome cruise of two months, the iron-clad squadron returned to Cherbourg on November 25th, 18 3, bringing a rich freight of new ideas and studies, and fortunate in results obtained by it, and demonstrated by such an abundance of investigations and proofs as to leave us no longer in doubt as to the merits of the new navy. But a very short time ago, this navy was still much discussed. It was not uncommon to meet with very worthy officers, who, without denying its qualities as an instrument of war, thought, however, that they ought to make prudent reserves as to its nautical capabilities. Sceptical persons declared that these ships would not have sufficient height of battery, and that the least sea would stop their fire; that they would roll frightfully by reason of the enormous weight which they carried on their sides; that they would steer badly on account of their too great length; that they would find much difficulty in rising on a wave; that they would very rapidly go to pieces under the threefold influence of the weight of their hull, of the mutual action which iron and wood exercise, and of the galvanic currents which would certainly be set up between the iron of their plates and their copper sheathing; and other objections of the like nature. All this was said, and in good faith, not only because it is in the nature of things that every innovation should be opposed at its outset, but also because the Admiralty, with a jealousy which it is hard to account for, forbade any access to these new vessels, not only to people in general, but even to the officers who might any day be called to take command of them; and if rumors, incorrect, or even wholly unfounded, have been spreading through our navy about these iron-clad vessels, the Admiralty may take the blame entirely to themselves, for they have done their utmost for a long time past to hinder the truth being known. To believe in one's own infallibility is common enough on earth; but to imagine that it is possible to inspire others with the same belief, without taking any pains for that purpose, requires a dose of ingenuousness which can only be attributed to a set of people who, like the Admiralty, enjoy an experience doubly or triply non-professional. Why conceal one's works, if it were true that they had been successful? That was the thought which naturally occurred to the minds of most people. It was in vain that against this reasonable distrust it was attempted to set up the reports of officers who had sailed in these vessels, and were therefore almost the only persons who had a right to speak with authority. These reports were, and are to this day, kept secret, and though it was understood that they were in general very favourable to the iron-clads, still it was asked whether they did not contain some respectful criticism, some little postscript which reduced all their praise to a trifle. Besides, having regard to the instincts and sentiments of the profession, it was said that the command of these iron-clads had been very much sought after, and that it was no wonder that the officers who had gained them should reply to such a favor by a good will which made much of the good, and treated the weak points with indulgence. Add to this that while the sailor is always wedded to his frigate or his ship, the officer only too often looks but at the qualities of the vessel in which he sails. Besides, how could any one be so hardy as to advance an opinion about ships which had been constructed specially for line of battle, that is, for service in a squadron, and yet which had hitherto sailed only singly, and had thus, in their mysterious trials, seemed to set themselves to avoid all control or comparison? Certainly the wisest had better wait before expressing an opinion.

To-day the veil is torn down. Our squadron of iron-clads has returned from a cruise which has put them to all the chances of the sea,—from a calm to one of the most violent gales which it is possible to encounter in the stormy waters of Brittany and England. During two months, and every hour of the day, they have been compared with each other and with the most renowned models of the old navy; and they have had for witnesses the three or four thousand men embarked in this trial-squadron, and the hundred and fifty officers in command, so that there is no longer any mystery about the matter. The superior authorities will doubtless trust us as little with the reports which will be addressed to them on this occasion as they have done in the past, but they cannot pretend to make secrets of results which have been accomplished under the eyes of thousands of spectators whom a lawful curiosity is to-day earnestly interrogating. Plenty of facts have already been brought before the public, and by adding to what has already been related all that we have been able to collect, we now propose to study in our turn this interesting cruise, and to endeavour to draw from it the chief instruction it has furnished us. The national vanity will not suffer by this study; the expectations which had been formed of this squadron have been surpassed even more than confirmed, and the officers who had given it their confidence will have nothing to regret. The composition of the commission named by the ministry to direct or overlook this great experiment gave every guarantee that the investigation would be conducted with zeal and activity, with intelligence and impartiality; for if, on the one hand, there are found among the names we are going to cite, some whom we must consider personally interested in the success of iron-clad ships, on the other there are some who cannot be regarded as fanatical partizans of the new style. The commission consisted of Vice-Admiral C. Penaud, President of the Council of Works to the Admiralty, President also of the Commission and Commander of the Trial Squadron; M. Dupuy de Lôme, Councillor of State, Director of Material to the Fleet; Rear-Admiral Labrousse; Captains Bourgois, Chevalier, Lefèvre; and MM. Mariel and Robert, master shipwrights of the first class. The number of commissioners was thus equal to that of the ships of the division, so that there was always one on board of each, and all in turns were aboard of each, so as to study all the types and make all comparisons, thus placing themselves in a position to command a view of the whole and to control the calculations and reports, the work and observations which were made specially on each vessel under the care of its own *état-major*. In order to possess in the material itself the means of control and comparison which could not be disputed, the ministry added to the five iron-clads two old steamships of the line whose reputation was established in the fleet, and a corvette of 250 horse-power, the *Talisman*, commanded by Capt. Desaulx, and built by M. Normand, of Havre, on the model of Prince Napoleon's yacht, the *Prince Jerôme*. The name of the builder and the model of this corvette are enough to indicate the confidence felt in her qualities. During the whole cruise she performed the very laborious service of tender (*mouche*) to the squadron. Of the two ships of the line, the first which arrived to take its place in the division was the *Napoleon*, commanded by Capt. M. A. Pichon. Ten years ago she was the pride of the French navy, and even foreigners acknowledged her as the most redoubtable and the finest, as well as the swiftest and most powerful ship that had ever figured in any squadron. I have elsewhere spoken of the exceptional service she did during the Crimean war, and it is not necessary to repeat it. After thirty years of a most active existence, and after having been employed with more success than any other in the hard work of towing, which tries vessels so severely, she is still remarkable for the perfect preservation of her form and lines, and is always distinguished for the strength she puts forth against wind and wave. During the heavy weather that the squadron encountered on its departure from Cherbourg, when this ship was seen, with its lofty masts, its three tiers of guns, and its bulwarks so high out of the water, attaining a speed of ten knots, more than eighteen kilometres, an hour, against a very strong sea, more than a sailor might regret the abdication, after so short a reign, which this noble specimen of naval architecture has had to undergo by reason of the progress of engineering art. Superfluous regret! The *Napoleon* has no armour; her guns, notwithstanding their number, would be of no avail against the iron sides of the meanest of the frigates which are sailing in her company. Her wooden walls would be set on fire or destroyed in an instant by the artillery of the weakest of the iron-clads. She was not attached to the experimental squadron in order to run this chance. Though she has lost her military *prestige*, she has preserved the nautical qualities for which she has always been celebrated; and she was intended to serve in this respect as a means of comparison with vessels whose fighting power is not disputed, but which are accused of not being good sailers. We shall see the results which a minute comparison has produced, but in order to appreciate them properly it must not be forgotten what the *Napoleon* is. She is a wooden two-decker of 90 guns of calibre 30, carrying a war complement of 920 men, having the same masts as our old sailing vessels of the second class, with a surface of sail of 2800 metres. Her engine is of 900 horse power, similar in every respect to that of the vessels against which she was going to be tried; her length is 70 metres, breadth 16 metres 80–100, her mean draught of water 7 metres 8–100, tonnage 5800, heighth of battery 1 metre 8–100; she carries one month's water, three months' stores and provisions, and 600 tons of coal.

The other vessel, which only joined the experimental squadron in the Brest roads, was the *Tourville*, and if what has been told me is true, the reason why she was attached to the squadron is an excellent proof of the sincerity and good faith with which these investigations have been conducted. During the few days which they spent at Brest after the gale of the 1st October, 1863, the experiment which they were going to make was naturally much talked of, and the advocates of new ideas showed themselves very well satisfied, as is also natural, but there were still some sceptical people, who were not willing to give in; they argued on grounds which seemed to a sailor's eye not to be altogether in fact unreasonable;

they said that this experiment was not to them so conclusive as it appeared to others, inasmu ' as all the vessels which were going to be tried, being all the sons of one father, would necessarily, while they had the good qualities of the family, share also in its defects; it was by comparison with other models of different families that the virtues or the vices of the new constructions would be decisively brought to light; that the *Napoleon* was a very great sailer nobody disputed, but they did accuse her of having a very considerable roll; it was asserted, and this opinion was widely enough spread among our officers, that in the twofold respect of rolling and readiness of handling, the *Napoleon* was inferior to our old ships, those of the illustrious Sané, and particularly to his *Jéna*, the favorite vessel of Admiral Lalande. There was no way of getting the *Jéna* to compare, for she has been erased from the list of the fleet; but by happy chance, when these questions were being agitated with all the warmth of professional men, there happened to be at Cherbourg in the first class of the reserve, that is to say, capable of being fitted out in 24 hours, a ship which is a scrupulously exact reproduction of the *Jéna*. This was the *Tourville*; she differs from her predecessor only in the engine of 650 horse-power which had been put into her, but such is the respect that was paid to this celebrated model, that when it was necessary to transform the *Tourville* to a steamer, she was spared the operation of lengthening, which nearly all her mates then underwent. It was with the identical form of the *Jéna* and the same position of the centre of gravity, that after being razeed (for originally she was a three-decker of 110 guns) she achieved such a great reputation in the naval world. The *Tourville* has deserved the esteem in which she was held. In the Baltic expedition, she carried the flag of Admiral Penaud, and her performances there shewed her not to have degenerated from her glorious original. In effect she is a wooden two-decker carrying 82 guns and 850 men, one month's water three months stores and provisions, and 520 tons of coal. Her length is 61 metres, breadth 16 metres 88-100, mean draught of water 7 inches 80-100, and 4550 tonnage. She carries the masts of our old ninety-gun ships—the third class—as for instance the *Suffren*, with surface of sails 2650 square metres, and height of battery 1 metre 81-100.

Having thus within reach a vessel which afforded the means of solving once for all the questions so warmly disputed even by the most distinguished officers, a representation was made to the Admiralty who judiciously gave orders to fit out the *Tourville* under command of Capt. Lacombe. It was not however with the design of studying the military capability of the *Tourville*, nor her speed, nor the extent of her sphere of action; it was known before hand that she was certainly in these respects inferior to the ships of the new model, but she was reputed to roll relatively much less and to be handled with infinitely more readiness. In these two points, almost exclusively, she was employed as a means of comparison with the others, and to furnish data on them for our instruction.

So much for the wooden vessels and the reasons why they were added to the experimental squadron. To go on now to the iron-clads. They were five in number, and presented in their form and lines very perceptible marks of their parentage, formed however on three different models.

There was 1st the *Invincible*, under the command of Capt. Tabuteau. She is an exact copy of the *Gloire* which we have elsewhere described at sufficient length, so that there is less need to enter into details in this place. We may merely repeat that she is a frigate of 36 rifled guns of calibre 30 (corresponding to Sir W. Armstrong's 100), and her engine is nominally of 900 horse power. Her length on the water line is 78 metres, breadth 17, mean draught of water 7 metres 75-100, height of battery 1 metre 82-100, weight of armor (including bolts) 840 tons, tonnage 5260, with a complement of 570 men, she carries one month's water, two and a half months' stores and provisions, and 675 tons of coal. Her ammunition is at the rate of 155 rounds for each gun, instead of 110, as in our last vessels, or 70 which was the regular allowance for the vessels of the first empire. A comparison between the *Invincible* and the *Gloire* shews only a slight modification of the masts and sails. Instead of being rigged entirely schooner fashion, the *Invincible* carries on her fore-mast a complete set of square sails (fore-sail, fore-top-sail, and fore top gallant sail). On the other masts the rigging remains as it was, and the whole surface of sail is 1400 metres.

2nd. The *Normandie* commanded by Capt. Jauregmberry is also a copy of the *Gloire*, and under the command of the late lamented M. de Russel, she had, as is well known, the honor of being the first iron-clad which crossed the Atlantic. She went to Mexico in 1862, and on her return she met near Madeira a violent gale which lasted for two whole days, and from which she came out in a way which proved her nautical qualities, and the solidity of her construction. Since this voyage she has had some changes in her arrangements; the cabins of her officers, which were previously placed along the sides of the frigate in deep darkness, have been brought amidships, under the light and air of the hatchways. It is now possible to read and write in the cabins without need to light the lamps, and the ventilation is much better; this is a great improvement to the comfort of the officers. At the same time it is more important for the investigation that concerns us, to note the reduction from 30 to 15 tons which the block-house she carried on her deck has undergone in weight and size, and also in her masts as compared with the *Gloire* and *Invincible*. The surface of her sails is still 1400 metres, but they are fitted as square sails on three masts of diminished height, and the length and scantling of the yards have also been reduced; the trim has also been slightly modified in furtherance of the same object, namely the lowering of the centre of gravity of the frigate by lightening her above and throwing a greater quantity of weight below; this is one of the most important points to remark for the sequel.

3rd. The *Couronne*, commanded by Captain Penhoat, a forty-gun frigate of a special type; her form and dimensions differ from those of the *Gloire*, though it is easy to see that she has been created by the same genius. She has the bow and stern less sharp and more rounded, giving her a look more pleasing to the eye, her length is 80 metres, breadth 16 metres 70-100, her mean draught of water 7 metres 60-100, tonnage 6076, height of battery 1 metre 98-100, and with this draught of water she carries three months' stores and provisions, one month's water, and 650 tons of coal which could easily, in case of need, be extended to 1000 tons. Her surface of sail is 1620 metres, carried on three masts, two of which are square rigged. The especial distinguishing feature of the *Couronne* is that her hull is of iron, built wi' plates two centimetres thick. To arrange the armour on this shell, it has been strengthened on the outside by a framework of ribs, the intervals of which are filled up by a thickness of teak of 28 centimetres, on which is placed a thickness of iron of 34 millimetres, which is itself separated by a second wainscoating of teak, 10 centimetres thick, from the plates of the armour proper, which is 10 centimetres thick on the water-line, and 8 above. So that at last we find the defensive system of this frigate to consist of a double thickness of wood of 38 centimetres and a triple thickness of iron of 13½ centimetres on the water line, reckoning in the thickness of the shell. She was proved at Vincennes in 1857, and gave good results as regards strength and solidity; it was expected that if she had to undergo the trial of artillery, she would resist better, by reason of the momentum of the projectiles being more easily dissipated by the difference of the successive media they would have to cross. On the other hand, it is proper to add that this ingenious system, whatever its defensive virtues may be in other respects, has the inconvenience of being sufficiently costly, so far that the *Couronne*, though its capacity differs little from that of its predecessors, has cost 20 and possibly 25 per cent more than the *Gloire*. However this may be, the *Couronne* is a very fine and elegant ship, and has distinguished herself in many respects during the trip. Not one single time, it is said, during the 36 days of actual sailing, did this frigate leave her place, or check the course of the squadron, to repair any one of those little damages which so frequently disturb the order of a squadron consisting of steamers, and affect the accuracy of their movements, and this is no mean title of glory for the *Couronne*. She was built at Lorient according to the plans, and under the personal superintendence of M. Audinet, naval architect. Her engine, which is of the type that naval genius has made common to such a large number of our vessels, and particularly on all our iron-clads, was made by M. Mazzeline of Havre.

4. The *Solferino*, and 5, the *Magenta*. We must speak of these two ships under the same title, for what is true of the one is true of the other. They have been built on the same plan, and any difference between them can only have arisen from difference in the mode of execution on the stocks. To exhibit the features which they have in common with the other ironclads, we may say that they are ships with wooden hulls. 86 metres in length, breadth 17 metres 30-100, draught of water when loaded 7 metres 90-100, tonnage 6796, height of battery 1 metre 82-100, engines nominally of 1000 horse-power, armament 50 breach-loading rifled guns of calibre 30, stored for 155 rounds apiece; carrying one month's water, 75 days' provisions, and 700 tons of coal by regulation; they have three masts which are rigged exactly as we have described for the *Invincible*, except that they have about 50 metres more surface of sail, 1450 instead of 1400. Lastly, the plates of their armour, having a total weight of 900 tons for each, are like those of the *Gloire*, of a single thickness of iron, varying from 11 to 12 centimetres.

The *Solferino* and *Magenta* differ, however, in many respects from their predecessors. Although we continue, I know not why, to class them as frigates, they are in reality ships of the line in the strict sense that the term has always borne in the navy, that is to say, they have two covered gun-decks, 26 guns in the lower, 24 on the main deck, and two chasers *en barbette* on deck. Their battery is more numerous, and also more concentrated, which may possibly be an advantage in some points of view; it may also be of service, partly at least, in certain states of the sea, when the lower guns, or those of frigates, would be paralyzed by the swell, although it seems little likely that under such circumstances the fire of the main-deck guns could be of real use, and I do not know any example of a sea-fight where such was the case. At all events, this armament by reason of its upper guns has certainly, in close combat, the advantage over frigates of a plunging fire, and this is not to be despised at the present day when the most vulnerable points of the ironclads are undoubtedly the shell below the water-line and the upper deck. The superiority of these ships over frigates, as far as artillery is concerned, is then a manifest and accomplished fact, as well on account of the number as the arrangement of the guns. At the same time, to obtain this superiority, it has been necessary to make some concessions to the natural force of circumstances. The most important of which is that the ship is not completely armed. Along the water-line, and over all the height of the orlop deck it is so, but above this it is only the guns which are covered by the armour. The fighting portions are without doubt under shelter; but forward and abaft, in both main and lower gun-decks, there are vast spaces which are no more protected than were the ships of long ago, and which offer considerable opportunity to the incendiary projectiles of the enemy. These are the weak points of the *Solferino* and *Magenta*. They could have been protected like the others only by adding three or four hundred tons to the weight of their armour; that is to say, it would have been necessary to change all the conditions of their build, and that, too, by increasing the size of vessels which are already greater than anything that had been seen before them. It should not be forgotten that the .n tonnage of the three-deckers, the kings of the sea ten years ago, did not exceed 5000 tons, and we have now reached nearly 7000 in the *Solferino*, 8800 in the *Warrior*, 10,000 or 11,000 in the *Agincourt*, (built by Messrs. Laird and Birkenhead) and 22,000 in the *Great Eastern*. This is very quick work, and we may be permitted to doubt whether the English have much to congratulate themselves on by trying to make more rapid springs than ours. The *Great Eastern* has not turned out prosperously either as an instrument of traffic or of navigation; and the other day the *constructor in chief* of the English navy, the able M. Reed, confessed publicly at Greenwich that the *Warrior* was not a success, owing to this very exaggeration of size. M. Reed said frankly (using the figures that I here repeat) that the *Warrior* would be a better sea-boat if she had 100 feet less length, that she would roll much less, and above all would steer much better. In every art where results are to be obtained, not by the exercise of the imagination, but by the application of the principles of the exact sciences, real and safe progress can only be made step by step, proceeding always from the known to the unknown, and not by abrupt jumps. This is especially true of the labors of the naval architect. He has not merely to deal with his own special art, and with the varying chances of the sea, but he must also deal with a crowd of other special arts, which may sometimes be mutually exclusive, and are almost always contrary in their requirements; and in this way the true spirit of his art is rather one of conciliation and perpetual compromise with all the advances which are being made around him by the different branches of human science and industry. It may happen that, when some great discovery has been made in one direction, it would not be prudent for an artist to apply it in practice, because he may not know the means of making it harmonise with the other data of his art. In order to advance with any success in his own path, he must not only always base his calculations on acquired certainties, but, and it is here the most delicate point lies, he must never attempt anything beyond the limits of the mutual accordances which these certainties present. Thus the wish to get the double advantage of two gun-decks, and more guns than a frigate (properly speaking) carries, has necessitated the leaving large spaces unprotected by armour, both in the bow and stern and in the main and lower decks. It is to be feared that this is not very consonant to sound military principles, for, despite the excellence of the arrangements which have been made to combat this danger, the chance of fire is always there, and this is at once the most formidable and the most dreaded enemy of the sailor. No cannonade, be it as deadly as it may, produces in the sailor's mind anything like the effect of the simple cry of "fire!" And fire on board of an iron-clad would produce all the more effect on their minds because a belief in its incombustibleness is almost necessarily attached to the idea of the armour, and the sailors would fancy that they had been deceived. I know quite well what the remedy will be. Our builders, if they are not at present ready to build ships completely armour-plated, will soon be so, and the force of circumstances is pushing them on to it in spite of the resistance which financial considerations oppose to the project. In war the only economy is to ensure victory; and whatever be the price that ships completely clad in armor may amount to, it will have to be borne when our builders know how to make them. The same thing will happen as already has happened with the old sailing vessels and wooden steamers, which, starting in 1830 with the *Sphinx*, of 120 horse-power, and four guns, became, in 1846, the *Napoleon*, of 900 horses and 90 guns, and, in 1850, the *Bretagne*, of 1200 horses and 180 guns. In the same way, at the commencement of this century, there was in all the European navies a large number of 50-gun ships of the line, two-deckers, like the *Solferino;* and since 1827 we have been putting on the stocks two-deckers mounting 100 guns. And again, in the same way, we have seen the merchant steamers starting from 600 tons and 160 horse power, which was their highest up to the year 1830, and now reaching 4000 tons and 1000 horses in the vessels of the great transatlantic lines. But I repeat that all this has only been done, and can only be done, progressively, by the advantage of time and investigations patiently pursued from step to step. Meanwhile, if there be a necessity of copying the model of the *Solferino*, would it not be possible to substitute iron for wood in the unprotected part of the side above the water-line? Unless there be some stronger reasons for avoiding this combination, it would have the very great advantage of considerably lessening the chances of fire. Be this as it may, and even if it cannot be considered very military to leave a part of the ship's side exposed without the defence of the armor to the incendiary missiles of the enemy, it is in fact quite certain that the *Magenta* and the *Solferino* have lost absolutely nothing, in a naval point of view, from carrying their two decks of guns. Much to the contrary, the sailing qualities they have shewn exceed what their warmest admirers had expected of them, and, (which is not less valuable than their swiftness or the easiness of their roll) their decks afford accommodation for the men on board which is exceptional for comfort and healthiness. The unprotected part forward serves on the lower deck as the warrant-officers' cabin, and on the main deck for hospital; while the corresponding part aft contains the captain's cabin above, and the officers' below, each cabin having a port hole for air and light. Officers and warrant officers have never before been so comfortably accommodated on board a man of war.

This is not all; these vessels are further distinguished from their predecessors by the form of their bow which is quite peculiar. Instead of forming, as in the *Gloire*, a kind of iron axe edge, the bow of the *Solferino* and *Magenta* is prolonged perpendicularly in the shape of an angle of which the vertex lies about a metre below the water line; or, in other words, their stem, instead of continuing its projection forward when parting from the keel, as is usually the case, takes on the contrary a direction backwards towards the interior of the ship, commencing from a point about a metre below the surface of the water. This arrangement has been made on these vessels in order to arm them with a beak or ram, and it is the most novel of their characteristic traits. The ram is fixed on the vertex of the angle we are speaking of, at the end of the armour which envelopes the whole ship along the water line, and in such a manner as to form one body with it and to gain from this union the greatest possible amount of solidity; it consists of a mass of cast iron of about 12,000 chilogrammes and appears at about 6 metres in front of the stem, in the shape of a hollow cone, with two long flaps attached, like the cheeks of a helmet, to the sides of the ship. Except at the extremity, the cone is hollow, but its walls, which are not less than 12 centimetres thick in their weakest point, are shaped on the inside so as to fit exactly to the wood-work of the vessel; the ram in fact is one with it.

This weapon, although it has not undergone the test of experience inspires naval men with very great confidence. Imagine a projectile of 7 millions of chilogrammes in weight; yet such is the part the *Solferino* would play in running down an enemy's vessel, and if she struck it on the beam there is no need to say what would happen. Further, the *Solferino* possesses a swiftness such that there are very few ships, (perhaps there are hardly 10 in the world that could be named) which could escape by flight from the shock of her ram; to fly would, in fact, be to place themselves at her mercy; the true plan of defence would, on the contrary, be to wait for the shock, and to manœuvre to avoid it at the very instant when the collision seems most imminent. The party seeking to avoid the shock should consider himself the centre of a circle, the circumference of which the assailant would be compelled to follow before finding his opportunity, and in this position the waiting vessel would probably have the advantage of facility in evolutions which would be relatively more rapid because much less space will suffice for his escape than the enemy would have to traverse before delivering his stroke.

In any great naval battle—and whatever may be the weapons employed all serious actions have always ended in a melée—the *Solferino* would certainly be able to fight with her ram; but we have yet to learn what damage she might do herself by this audacious enterprise. This is an experiment which has not yet been made by any body with an exactness, and under the conditions sufficient to enable us to guess at the results even approximately. In other respects the ram does not seem to injure any of the nautical qualities of the ship unless it be during changes of course very slowly executed, and then it sensibly retards the quickness of the operation; but this is not a defect that we need practically take into account.

Such are the ships of which the experimental squadron consisted. It is only right to add, that the *Solferino* and *Magenta*, as well as the *Invincible*, the *Normandie* and the *Napoleon* are the work exclusively of a builder, M Dupuy de Lôme, who has been designated in a document distributed by order of the Queen of England and signed by Admiral Spencer Robinson, Comptroller of the Navy, as "the most able designer of ships of war in Europe whose success has been so remarkable."

On the 27th September, at one o'clock, p m., the squadron sailed from the channel of Cherbourg in search of one of the gales which almost always rage about the equinoxes, and which it was destined to meet sooner perhaps than it desired. For not only were the complements of men not completed, failing indeed of one-third of the regulation number, but they had hardly yet got into order, and many of the men on board were altogether strange to the new models, while some of the mechanics even among the masters, had never before seen fittings like those they had to superintend. Nobody would have disliked to have a few days of fine weather before them to enable them to look about them. From the 28th, however, the sea became so rough, and the breeze freshened with such strength that the vessels of the squadron in sight were all under their foul-weather canvass. On the 29th there was a lull; the sea went down, leaving only a heavy swell, and the wind fell, but changed during the day nearly all round the compass from N.W. to E., through S., which is an almost infallible sign of the weather they were going to have next day, and of the gale which was let loose with its full force during the night of the 30th Sept. to the 1st October, blowing steadily from the N.W. The squadron which had now sighted the lights of Ushant, and were then standing out to sea towards the Scilly islands, that is to say, going with the wind directly in their teeth, was dispersed by its violence and could not reassemble till the morrow, entering Brest on the 3rd to repair the damages inflicted by the storm.

The test was everything that could be desired, for they had certainly encountered one of the most violent of atlantic gales. The disasters which it caused on the coasts of Brittany and England are unhappily only the too certain proofs of its violence. The waves reached a height very rarely attained in these seas. By measurement on board the *Solferino* and *Magenta*, they gave a result of from 9 to 10 metres. This would be very considerable in any sea, and I find some memoranda of my own experience which do not leave me in any doubt of the value of such a figure. In the month of April, 1844, while doubling the Cape of Good Hope, that is to say at the beginning of the bad weather in those latitudes, I had the annoyance of being disagreeably knocked about during 16 consecutive days of foul weather, in the *Sereine* frigate. At that time the naval mind was much piqued at M. Arago who had allowed himself some rather lively pleasantry at the expense of Admiral Dumont d'Urville, about a figure which the latter had given him (perhaps a little loosely) for the height of the waves in the neighbourhood of the Agulhas bank. The Academician did not dispute what the sailor alleged, namely, that that is possibly the part of the globe where the waves in bad weather reach their greatest height, but the figures themselves he made fun of. We were all very anxious to try and decide the question, and the sea itself served us to the extent of our desires; the officers were animated with the most laudable zeal, and would doubtless have been very well satisfied if they could have been able to satisfy the Admiral, but, spite of all their good will, aided by the circumstances of the weather, it was not possible to exceed the maximum of 12 metres.

The storm, then, of the 1st October, was one of the most serious, and it did some damage. Let us now see what this amounted to.

Of the five ironclads which were attached to the squadron, there is not one which has undergone any damage that can be attributed either to their form or to the present plan of their construction, or to the workmanship or materials employed on their construction. All that they have suffered,—and on the whole it is but a trifle,—is independent of the question of the ship being of wood or iron, of the ship being armor-plated or not. They had some boats carried away. Granted; this is a proof only of the violence of the sea. The *Napoleon*, notwithstanding its advantage of a greater height above the water, lost two of them, while the *Invincible* did not lose one, and besides did not undergo damage of any kind; so also with the *Couronne*, except the loss of four boats. The *Magenta* and, still more, the *Solferino*, experienced accidents which might have become serious, but they arose entirely from damages in the system of pipes and secondary parts of their engines, so that these accidents prove nothing in the question. The *Normandie*, which experienced the roughest handling of any, shipped some water while she was in the trough of the sea, having been intentionally put there when the storm was at its height, and she carried away her fore top-gallant mast and jib-boom; but can we call these damages serious? And when, after having met with them, she was again put head on to the sea, she no longer shipped a drop of water.

This is the complete bill of costs against the iron clads. All their hulls have remained uninjured, and after the most minute inspection it cannot be discovered that they have been at all shaken or have undergone any deflection.

The fate of the vessels not armour-plated was very different. The *Napoleon* had her bows stove in, while making head against the sea, and was compelled to go into port to repair. The *Talisman*, being less solid and strong, could not follow the evolutions of the squadron on the 28th, when it was making 10 knots against a head sea somewhat less than that which rose during the storm; she was then shipping water fore and aft, and her screw suffered so on that day that her captain during the gale was compelled to lay to and continue his course without engine to the rendezvous off Ushant. By a chance, curious enough, but especially instructive, the *Talisman* was the only vessel of the squadron fitted with a "well"—that is to say, a contrivance intended theoretically to unship her screw for the purpose of examining it, of preserving it in case of danger and repairing it in case of damage, and she was the only vessel of the squadron which had to go into dock, and that just in consequence of accident to her screw which it was impossible to remedy even in the still waters of the harbour. They had to dry-dock her before she could again be put into condition to continue the cruise. May not this failure in the screw system proceed from a weakness or failure of connection caused in the stern of the ship by the very construction of the well?

On the whole, speaking as yet only of the casualties of the storm, the test that had been made shewed that the iron-clads had resisted the storm better than the others; that the damages undergone were in no way peculiar to them, and that they would have been able to repair them on the first return of calm weather. The wooden vessels, on the contrary, which had been compelled to bear up, that is to say, to abandon the struggle against the storm sooner than the others, had undergone damage which was special to themselves, and were forced to re-enter not merely the roads but the harbour and dock, and would have detained the squadron for seventeen days, while the others (even admitting that they would have found much advantage in re-entering the roads), would have been able to set out again after the time necessary to take in their coal, an operation which is, unfortunately, not yet an easy matter in the Brest roads in bad weather.

We have already obtained results of great importance, but the remainder of the cruise went to shew that our iron-clads possessed many other qualities which the chances of this first assay would already have led us to suspect without permitting us to consider them proved. The weather was singularly favourable during this second part of the cruise; it was always fine enough to proceed with all the investigations which entered into the programme of the commission, and it was sufficiently varied, both as regards force and direction of the winds, and state of the sea, for trustworthy experiments to be made under every combination. Lastly, the voyage was long enough in duration (35 days) and extent (about 1200 leagues, from Brest to Cherbourg, touching at Madeira and the Canaries) to authorize us in regarding the results obtained as being practical ones. We now proceed to mention the most important.

In the first place we may repel the accusation brought against the iron-clads of being deficient in height of battery, and in this respect being inferior to their predecessors. The figures quoted above have replied in advance to this objection; they show, in fact, that while the height of battery, in metres, was for the *Napoleon* 1.80 and the *Tourville* 1.81; for the iron-clads they were as follows:—*Normandie*, 1.82; *Invincible*, 1.82; *Couronne*, 1.98; *Solferino*, 1.82; *Magenta*, 1.82; and with these figures they carry from 650 to 700 tons of coal, the consumption of which would make them rise between 60 and 70 centimetres. Hence there is no reason for them to envy their predecessors in this respect. Doubtless if this dimension could be further augmented without doing injury to the other qualities of the ship, it would be better, but possibly too much importance is attributed to this advantage. The squadron fired their guns every day, and were able to do so in states of the sea where fighting would have been next to impossible. A sea fight only takes place in calm weather; when the sea is rough enough to cause a roll of from 10 to 12 degrees on each quarter, the fire of the guns becomes almost illusory, even with the best guns and gunners. In all naval history I do not know, either in a single fight or a great battle, of a defeat undergone in consequence of one of the combatants having his fire stopped by the sea, while the other was able to continue it by reason of the height of his batteries above the water.

The roll of a vessel plays an important part in this question, but before speaking of it, let me first say a word of the pitching (that is, of the oscillations in direction of the ship's length), because it is a point on which I think, at the present day, all are agreed. The pitching of the iron-clads, is, by universal testimony mild and easy beyond comparison. They have proved that they can keep their head up against the heaviest sea without falling off, even at a low speed, and can go before the wind without shipping seas over the stern, notwithstanding the sharpness of their build, and in both cases their roll is extraordinarily moderate. This was found to be the case for all of them under all circumstances of weather, wind, and sea. It is to these characteristic qualities they owe the comparative immunity with which they encountered the gale of October 1st, while the *Napoleon* had her bows stove in, and the *Talisman* labored heavily, shipped water over stern and bows, and experienced damage enough to send her to dock. This point may then be held settled.

The subject of the "roll," that is, the motion of the vessel transversely from side to side, has been much already and will doubtless yet be more discussed, but the present facts prove that the ironclads need not fear comparison on this head. Neither during the gale, nor during the fine weather that succeeded, did they roll more than the others; the transversal oscillations were not more in number, or larger in extent for them than the others. In fact, the problem is apparently altogether independent of the armour. For many reasons I consider it does not devolve on me to form a complete theory of the roll, its causes and effects; but one in particular would be sufficient to stop me from attempting it, which is, that the most competent men of the present day seem to be much divided on the subject. Our predecessors had only to deal with sailing vessels, and did not find themselves called upon to study this question deeply; it has become really of great importance only to steamers which have to keep their course independent of the direction of the wind and current, and of the state of sea and weather, or rather, to put it more strongly, have almost always to make headway in contradiction more or less complete to these elements. The reason why the modern ship is subject to a roll greater than the ancient, is that it is a steamer, having its propelling power within itself, and not that it is clad in armour. This is the first point that results from the trials we are speaking of.

Since then the question of the roll has acquired real importance, only within a short time back, it is not wonderful that the persons who have studied it should be, notwithstanding their merits, yet disagreed on the subject. With the public generally, and even with sailors, the belief is still firmly held that the number of rolls is determined by the more or less rapid succession of waves that lift the vessel, and that the magnitude of the roll is inversely proportional to the "stability" of the vessel. This is in fact the theory which would first naturally occur to the mind; but we now find some eminent men proclaiming that this theory is altogether false, and they draw from the results obtained during this cruise of the iron-clad squadron some very forcible conclusions. In certain respects they have already upset the old theory by shewing that the most stable vessel is not that which rolls the least, and even that it may be one which has a very lively and distressing roll. The fact is now accepted, at least by the most distinguished sailors, but we may expect a very warm discussion when we assert, as the new theory does, that the number of a ship's rolls is absolutely independent of the state of the sea, and of the greater or less rapidity of succession in the waves; that each vessel ought to be considered as a pendutum for which, under a given arrangement of weights there is a certain invariable number of oscillations which is peculiar to itself, and that the intensity and rapidity of the waves do not affect the number but only the magnitude of the rolls; lastly, that the vessel which compared with others, has rolled the most one day, may be that which will roll the least on the morrow. This is what happens in the case of the pendulum oscillating normally, when it meets by chance in the agitation of the sea, a cause of motion concordant, harmonizing with, and isochronous to its own; the vessel will then astonish by the magnitude of its movements those who the day before, and yet, possibly, in worse weather, but less sympathetic somehow with her particular constitution, were admiring the gentleness of her roll.

If these notions are correct—and I repeat there has been observed during the trip a great number of facts in confirmation, and not one in contradiction of them; —If these notions are correct we see the bearing they have on the question of the roll of the iron-clads. They put the armour itself altogether out of the question, and reduce the discussion to bear only on the shape and on the position of the general centre of gravity of the vessel, including hull and loading. The question then being stated in these terms, is it true that the new ships, especially the *Magenta* and *Solferino*, which ought to be regarded as developed and perfected copies of the first models of the *Gloire*, have given in comparison to the vessels with which we are studying them differences in magnitude or frequency of roll, which would constitute in this respect a real cause of inferiority? No!—Such assertions cannot be maintained. Next to the *Talisman*, it is the *Normandie* which, of all the ships of the squadron, had the worst roll, and the example of this frigate will give us a useful lesson. When it was proposed to fit out the *Normandie* a report was generally spread, one knows not how or why, that this latter had a very heavy roll, and consequently it was wished to remedy this supposed defect, but opinions differed as to the nature of the remedy to be used. Some, and they were the smaller number, asserted that if it were true that the frigate rolled too much, this must be because she had too great stability, that is to say, that the weight accumulated in the lower part of the vessel was sensibly in excess compared to that above; it was necessary to bring about a better equilibrium by increasing the weight she carried aloft. Others, on the contrary, maintained that the frigate rolled because she had not stability enough; the motion of which she was accused was appealed to as proof of this deficiency, and to remedy it they proposed to do exactly the opposite of what the others advised, that is to say, to lighten the frigate above and thus lower her centre of gravity and consequently render her more stable. This last advice gained the day; the weight of the masts was lessened, and the block-house she carried on deck was reduced from 50 tons to 15; but what happened? The frigate far from having gained anything, showed herself during her voyage to Mexico, and the first part of this experimental cruise, more sensitive than even the *Gloire* had been to the motion of the sea, and only became more quiet when they reversed the previous operation. In the Funchal roads they brought out from her magazine and gun deck, and put upon deck, a quantity of guns and balls to the weight of about 200 tons, and from that time to her return to Cherbourg, her centre of gravity having been raised by this operation, she had a shorter and easier roll, and thus recovered part of the mean difference which in this respect distinguished her from the other ships of the squadron. If this experiment is not conclusive it is at least very instructive, and has besides been confirmed by what was observed in the *Magenta*. This ship, constructed on the very same plan as the *Solferino*, gave, as regards rolling, results differing from hers, and less advantageous. They were attributed to two causes, namely, that the *Magenta* carried in her lower bunkers 50 tons more coal than the *Solferino*, and her upper works had been constructed with timber of less section than that which had been used on her consort, thus producing another difference in weight of about 50 tons more. She was not, therefore, loaded in as satisfactory a manner, having more below and less above.

Be this as it may, the following is the order in which the ships of the squadron are classed in respect of rolling. It is the mean result of very numerous observations made with extreme care, under conditions the same for all, and carried on from hour to hour, the figure set down for each hour being that of the greatest roll observed during that period.* Beginning with that of the least roll, they are, *Solferino, Magenta, Napoleon, Tourville, Couronne, Invincible, Normandie.* This classification has some exceptions; for example, I may quote the 26th October, when the squadron, steering W.S.W., with four furnaces in blast, and a speed varying from seven to eight knots, was subject to a very heavy swell on the beam coming from the N.W., and had to make head against a tolerably fresh breeze from the southern quarter. The observations from hour to hour during this day from 6 A.M. to 6 P.M., give the order of the ships as regards increasing magnitude of roll, which was naturally under the circumstances very heavy.

	Inclination to		
	Starboard.	Port.	Total.
Solferino	17°.03	17°.25	35°.08
Magenta	18.12	17.58	36.
Napoleon	19.83	17.29	37.12
Couronne	17.95	19.73	37.68
Tourville	20.85	19.72	40.57
Invincible	19.91	21.54	41.45
Normandie	21.33	22.50	43.83

Besides the change in the order of classification, what is further remarkable in this table is the amount of the difference between the least roll, that of the *Solferino*, and the greatest, that of the *Normandie*. This difference is 8.°75, or only

4.°37 on each quarter, and this was previous to the redistribution at Funchal of the *Normandie's* loading. Compared with the *Invincible*, the amount of the total difference is no more than 6.°47, or only 3.°18 on each quarter. The observations which had already at different times been made on the number of rolls corresponding to each vessel, were continued on this day, and gave the following number per minute: *Solferino*, 9¾; *Magenta*, 10; *Napoleon*, 10½; *Tourville*, 10¾; *Couronne*, 12; *Invincible*, 12; *Normandie*, 12½; *Talisman*, 15. These figures are very nearly the same as had been observed under very different circumstances of weather and sea, notably on Sept. 28th. In the various notes communicated to me, I observe that attention is particularly called to this almost constant recurrence of the same numbers. One of them, written by a most distinguished officer, contains a sentence which I will quote verbatim. "These numbers are sensibly constant for the same vessel, whatever be the magnitude of the rolls, from the least to the greatest. I have observed it repeatedly." But one day occurred (probably an exception) which totally upset the order of classification determined by the greatest mean. On Wednesday, 18th Nov., after the departure from Funchal, the squadron were steering N.E., with two furnaces in blast up to 3 p.m., and then with three till evening, and a light breeze between S. and S.E. was blowing on the quarter beam. With the help of its sails, it attained in the morning a speed of 7 or 8 knots, and in the evening 8 or 9 The weather was very fine, and the sea quiet, with only a long and gentle swell on the beam. Under these circumstances (and I think it of use to particularise the details because it touches on a problem in navigation, very curious and little known) the magnitude of the rolls observed from hour to hour were as follows:

Rolls.	Morning, A. M.						Mean.	Afternoon, P.M.						Mean.
Observed at	7	8	9	10	11	12	A. M.	1	2	3	4	5	6	P. M.
	°	°	°	°	°	°	°	°	°	°	°	°	°	°
Invincible	5	5	4	5	8	8	5·83	8	7	7	8	10	13	8·83
Couronne	4½	4	4	4	4	5	4·25	9	11	9	9	19	21	13·
Magenta	4	4	3	7½	9	·8	5·92	7	11	14	11½	14	20	11·25
Solferino	5	5	5	7	10	10	7·	8½	11	15	14	13	11	12·
Normandie	8	8	6	7	7	7	7·16	8	12	8	15	13	13	11·50
Napoleon	4	3½	4	6½	10	8	6·	9	11	12	16	17	17	13·76
Tourville	4	5	5	7	9	10	6·66	9	10	14	16	23	21	15·50

The result of this table is to class the ships in the following order of increasing magnitude of roll, for the 12 hours: *Invincible*, 7°.33; *Couronne*, 8.12; *Magenta*, 8.58; *Normandie*, 9.33; *Solferino*, 9·37; *Napoleon*, 9.83; *Tourville*, 11.08.

The abundance of these details will I hope be excused, but as they have never before been studied with such care and completeness, and as they tend to throw a new light on one of the most important and most controverted questions of naval architecture, I have thought it necessary to enter into them. Now let us leave aside the theoretical question. After what we have noted, we may be permitted to assert that ships of the new model, even such as they are, are not subject to a roll greater or more distressing than that of the best of their predecessors. Without discussing the assertions to the contrary, I think they depend, that is so far as they are correct, on exceptional facts which would require to be carefully studied and analysed. Such facts occur as frequently in the life of the sailor as in that of other men, and without wandering from my subject I may here quote an example striking enough. The log of the *Tourville* shows that on the morning of Oct. 28th, the weather being quite calm, she was struck by several seas which would not only have flooded both the gun-decks, if the ports had been open, but actually rose above the nettings, and wetted the chimney in the very centre of the ship. None of her consorts experienced anything of the kind. How was this? I cannot give an answer, but I should be very chary of drawing a conclusion unfavourable to the qualities of the *Tourville,* and yet I suspect that if the same had happened to the *Normandie*, which has been so severely attacked, she would probably have been much abused for it.

It has then been demonstrated that our iron-clads have an infinitely more easy pitch and a not larger roll than the best vessels before them, which is a very satisfactory result; but better still remains behind. It seems also to have been demonstrated that they would doubtless be improved, even in this simple point of view, if we increase to some amount the weight they at present carry aloft, and this may have results of extraordinary importance by increasing greatly not only their nautical qualities, but also their power in a military point of view. They have displayed, under canvass, qualities altogether unexpected, even by their warmest partisans, and it would therefore naturally occur to any one that if there is a certain amount of weight to be added to them in their upper parts, it could not be disp ed of with more usefulness than by increasing the strength of their masts and the surface of their sails. That this would be well worth while, we see from the results that have been obtained relative to speed and facility of evolution. Previous to this, the sails of an ironclad had been generally considered as a last resource in case of injury, when by the disabling of her engine, the ship would be forced to make for the nearest port before the wind. To the great astonishment of all the world, we have, however, seen the iron-clads under canvass for whole days and nights, and keeping their regular distances in the squadron without disarrangement. It might possibly be imagined that in order to secure the pleasure of having to state facts so little foreseen, certain courses were chosen which are easier to keep than others, but it was nothing of the sort in fact; the iron-clads were kept under canvass on every course, even close to the wind. In beating to windward, they were able to go about with the utmost ease, and to wear more slowly, but still surely, without using their engines, and under the sole action of their sails. So well did they succeed, that in the channel between the Azores and the Canaries, although surrounded by land, and therefore in the midst of dangers, the Admiral put them under canvass and made them tack and wear night and day, the squadron being in two lines at intervals of three or four cable lengths—(600 to 300 metres)—without a single accident occurring. Is it necessary to add that the *Tourville* herself many times missed stays, while the ironclads made the evolution easily? One circumstance which will seem still more extraordinary is that at the height of the gale of October 1st, the *Solferino*, having disabled her engine through some damage in its piping, lay to with her sails alone from 9.30 a.m. to 1 p.m. So little had the possibility of such a feat been contemplated, that the Solferino had not even been fitted with the sails ordinarily used for this purpose, and it was only after her return to Brest that they troubled themselves to give her the set of sails proper for this case.

There is no need to enlarge on this point, so I shall quote but one of the tables where the speed under canvass is noted in knots per hour: *Napoleon*, 8·3; *Tourville*, 7·4; *Magenta*, 7·2; *Couronne*, 7·1; *Solferino*, 7; *Normandie*, 6; *Invincible*, 6. If we take into account the difference of displacement, that is, the weight carried, and of the surface of sail, that is, the means of propulsion, these results are more than satisfactory.

As success makes people ambitious, we can easily understand the readiness with which sailors seize on the idea of enlarging the masts and sails on the iron-clads. On the one hand, this would augment the sources of safety, speed, and freeness of motion, and regain, at least, in part, the advantages which were thought to be lost. On the other, it would develope to an amount hard to judge of, the sphere of action of the new vessels. All this is true, but there is a limit which military considerations will not allow us to overstep at any price. It is known that the screw has the dangerous property of attracting to itself everything that floats alongside a vessel, and that small objects, of little consistence or hardness, may, precisely because they are so, disable this organ of propulsion when they get entangled in its parts. Consequently, the screw-ship of war should have the power before going into action of unshipping in a few minutes her masts and rigging.—Consequently, also, her masts and rigging must be of a very simple character, admitting of being shipped and unshipped with the utmost ease. This necessity points out a limit to be observed, and I may be here permitted to recommend to the notice of those whom it concerns, an idea of English origin which enjoys a large share of favor among our neighbours. The English, on their iron-clads, make the lower masts of cast-iron, and these not only satisfy all nautical and military requirements, but, being hollow, are also used as a means of ventilation, another condition to which we cannot pay too much attention, as it exercises a very important influence on the health of the crews.

To make our account of the manœuvring of these vessels complete, we must add a few words as to the experiments made in turning them. They obey their helms in the most satisfactory manner, and in all the letters I have seen, I have not found a single observation which can be interpreted to their disadvantage. Their extreme length, however, causes them to describe in their evolution circles of larger radii than shorter vessels do. This was known beforehand, and the only ground for surprise is that the difference was not greater, especially in the ships armed with the ram. A comparison of the vessels of the squadron classes them as follows, in this respect: the *Tourville* in the first place; second, *Couronne* and *Napoleon*; third, *Invincible* and *Normandie*; fourth, *Solferino* and *Magenta*. The radius of the least circle described by the last two was 380 metres, while that of the *Couronne* was only 305.

As I have already described the engines elsewhere, I shall only revert to them here for the purpose of confirming the axiom of steam navigation, that the most powerful engine is also that which while giving the highest speed yet practically costs the least. The *Napoleon* had proved this in the Crimean war, where she alone did more service than many vessels together; and the present experiments have made this truth still clearer if possible. The *Napoleon*, with tonnage 5200 and engine of 900 horse power, that is, one horse power to 5·8 tons, was beaten in the trials of speed by the *Magenta* and *Solferino*, whose engines of 1000 horses give 7 tons to the single power. In all the trials, with 2, 4, 6, or 8 furnaces, these two vessels invariably headed the list, and in comparing the others with them, not at their highest (for the others could not have kept up then) but at a moderate speed, the consumption of coal was remarkably in their favor; thus there was more effect produced and less expenditure. Relatively to the *Tourville*, of 650 horse power and 4550 tons, the difference is surprising. It turned out that, during the whole cruise, the *Tourville* was obliged to have a greater number of furnaces in blast than the rest of the squadron, so much so that when the rest, at the completion of the experiment, had still enough coal in store to return to Cherbourg with four furnaces going, the *Tourville* had exhausted her stock, and was obliged to make for Lisbon to take in more. This advantage even in ordinary navigation cannot be too highly estimated, and still more so in a real campaign, for the sphere of action of a steamer is one of the most important elements of its power. The *Solferino* with two furnaces going, and a rate of 10 knots, consumes 22½ tons of coal per day; this makes her sphere of action 4500 marine miles or 1500 geographical leagues, and her regulation provision of 700 tons would be enough for thirty days' consumption at this rate. With the same number of furnaces, but increasing the fires so as to attain a rate of 9 knots (which she has actually done), her consumption is increased to 1560 kilogrammes per hour, or 37.440 per day, and the above provision would serve for a consumption of more than 18 days, and a run of 4050 miles, or 1350 leagues. With four furnaces she attained a speed of 11 knots, averaging 47 tons of coal per day, and this would last for 15 days, and a run of 3960 miles, or 1320 leagues. With six furnaces her mean rate was 12.4 knots, and her consumption 94 tons, reducing her time to 7½ days, and her run to 2235 miles or 745 leagues. With all eight furnaces going she reached a mean speed of 13.9 knots with a daily consumption of 138 tons, under which circumstances her regular provision would last five days, and her run be reduced to 1668 miles or 556 leagues. During her trial with eight furnaces, she maintained, by keeping up her fires, for more than an hour a speed exceeding 14 knots, her engine making 57 turns of the screw per minute; and on the other hand, by reducing the action of her engine to the lowest, the point it could not exceed without stopping altogether, she still reached a speed of 8 knots with only 12 turns in the minute.

All this is very encouraging, but there is one point on which I must exercise some reserve. Beyond doubt, the nautical qualities of the ships, their speed, their facility of evolution, the ease with which their engines accommodate themselves to a number of combinations, the amount of resources of all kinds they can accumulate between their own sides, are important, or even the principal, conditions of their military value; nevertheless, there is another question which, on the great day of trial, will rise to the first rank in importance. I mean the power of their guns. I still firmly believe that the guns with which our iron-clads are armed, are superior to those employed in any other navy, but I am sorry to see that for two years past we do not hear of any process recorded as having been made in marine artillery, and I am still much more sorry to hear that we are departing from the fruitful path we were treading with so much profit to ourselves. It is said that we are quitting this path in order to throw ourselves upon guns of such weight and calibre that no engineer at present, I believe, could construct them except indeed as experimental studies, devoid of practical value. I feel a very strong current which is carrying us in this direction and which threatens to paralyse completely the progress we had made in following the only course which in this class of facts can conduct us to sure results. Within a very short time, by proceeding at each step from the known to the unknown, we had successively given to the navy the rifled cannon, the *grain de lumière* which preserves the piece indefinitely, the hooped cannon which allows an immense economy of material, and the loading at the breech, which has undergone the test of more than 20,000 shots with but one accident, and that arose from inexperienced gunners forgetting to close the breech; and lastly we had the real piece for power in the *Marie-Jeanne* which with 30 calibre and a weight of only 5800 chilogrammes, pierced without fail plates 12 centi-metres thick at 1000 metres distance. Up to the present time no other gun has effected this, and after firing 300 shots she is not yet the worse for it to a degree worth mentioning.

This was the point we had reached in August, 1861, but there we appear to have stopped, and it is now proposed to abandon all this in order to learn from the Americans and English how to make at the first jump guns weiging 15 or 20 tons, or even more. Foreign example is exercising on our lively imaginations an influence which threatens to destroy our equilibrium. The large figures that are quoted to us are turning a number of heads who forget to ask what serious result these large figures have produced. I know of only one, and that is our proved incapacity for making guns of 20 tons which shall be actual weapons of war, just as we are also incapable as yet of building ships of 20000 tons which shall practically succeed. Ought not, for instance, what has passed at the siege of Charleston to open everybody's eyes, and disabuse the most darkened understanding? Is there no lesson in the figure of 440 pounds given as the weight of projectiles which bombarded for 150 days the old fort Sumpter without rendering it untenable by the Confederates? Is it in France that we ought to be discussing such things—in France, where we saw at Fort Liédot some light but powerful pieces of the modest calibre of 24, at 1300 metres distance, and in 260 strokes, open a breach in a rampart of masonry, which they could not even see, because it was hidden from view by the glacis having been elevated nearly to the height of the crest of the parapet? Or ought we to allow ourselves to be turned out of our progressive course by the alleged 300 and even 600 pounders which Sir W. Armstrong constructs by manipulation in profound secrecy, when we see that in England his 110-pounder, corresponding to our calibre 36, is declared at the least "suspect" in the most solemn investigations, and that, in their own despite, the English navy is reduced to arm its frigates with the old smooth-bore 68 pounder? The English government has published on this question two enormous volumes of official investigations and reports, and what do we find there? We find that Sir W. Armstrong himself never claimed to offer to the government anything more than a large rifled light piece (*grosse carabine rayée*), loading at the breech, and discharging a 12-pound ball, which corresponds to our calibre 4; but when, after the success of this piece had been established to the satisfaction of the government, he was pressed to make a gun of 32, he replied that he was not prepared, and requested 7 or 10 years to study the question. If he has meanwhile attempted still greater calibres, it has been under the pressure of government, and not with his own good will, except that he did not wish it to be said he had declined a service which others believed themselves able to render. His language on all these points is as modest as it is sensible. Let us pay respect to his patriotism, but let us not launch headlong on the course the English government has so rashly pursued. If this course was the correct one, the Turks, with their big guns of the castle of the Dardanelles, ought to be considered the first gun-makers in the world. To recur at the present day to their traditions seems to me as little reasonable, as if we were to let ourselves be influenced by what the Americans relate of their iron-clads, and were to abandon the magnificent ships which have given us such unexpected results in order to copy the *Monitors*, which cannot keep the sea, or the *Weehawkens*, which founder in the smooth waters of a roadway, or the *Keokuks* which are sunk at 750 yards distance by the round balls of General Beauregard, who refused the guns said to be 800 pounders which they wanted to send him from Richmond.

In order to complete our task, it would have been necessary to compare the results obtained by our ironclads with those obtained by the English; but the means of this comparison are wanting. The English government has not, to our knowledge, published any report of the two cruises that the *Warrior* and her mates made in the same seas as our own. Whenever the government has been questioned on the matter, it has replied that the reports were very satisfactory, but beyond this, its reserve has been almost complete. We cannot then institute this comparison, but, after what has been said, we think ourselves authorised in asserting that our navy need not fear *any* comparison; that its progress has been continuously in advance, and that its works, while being developed as they have been, from the *Gloire* and *Solferino*, and incessantly enriched by the adoption of every valuable invention, preserve a harmony and unity which are also very precious qualities. Certainly we have not reached perfection, but it seems to me that it is not presumption to believe, that if we had our choice from the navies of the whole world of the best they can offer, we should not find five ironclads which could do all that the five ships we have been speaking of have done, and especially with the same uniformity. It is only just to add that a great part of this success has been due to Admiral Penaud and the officers under his command. The activity, talent, and good-will which have been displayed are worthy of all praise, and we are happy in the acquisition of such men to teach us all that the works of our naval architects are worth.

J. B. C.

REVIEWS.

Geological Survey of Canada. Report of Progress from its Commencement to 1863. By Sir W. E. Logan, LL.D., F.R.S., F.G.S., Director; Alexander Murray, Esq., Assistant Geologist; T. Sterry Hunt, M.A., F.R.S., Chemist and Mineralogist; and E. Billings, F.G.S., Palæontologist. Montreal: Dawson Brothers; London, Paris, and New York: Baillière. 1863.

This important volume, so eagerly looked for both at home and abroad, amply sustains the expectations created by its announcement. Of a far more complete character than the ordinary Reports of Progress which have preceded it, the present Report exhibits a condensed view of the results of our Geological Survey, from the commencement of this work in 1843, to the close of 1862. The results in question, methodized and systematically arranged, form a complete treatise on the geology and mineral wealth of the Province: only requiring a little preliminary knowledge of geological details—such as may be gained in the lecture-room, or by the study of explanatory works—to be properly understood and appreciated by the general reader. The presence of a large number of woodcuts, chiefly illustrative of organic remains, adds much to the value of this Report, and a series of maps will shortly be issued in connection with it. One of these, already completed, is a coloured geological map of Canada; and another will exhibit the distribution of the surface or Post-Tertiary formations—the clays, sands, calcareous tufas, and other comparatively modern deposits, which make up the principal portion of our soils. A map of this kind has long been a desideratum. Apart from its utility in engineering, draining, and other similar operations, it will prove most serviceable in an agricultural point of view. In its compilation, the officers of the survey have been materially assisted by Mr. Robert Bell, a young Canadian naturalist, first brought prominently forward by Sir William Logan, and lately elected Professor of Natural Sciences in the University of Queen's College, Kingston.

As constant reference has been made to this Report, and many of its conclusions noticed, in a series of popular communications on the Geology of Canada, published in recent numbers of our Journal, we purpose, in the present place, to give merely a general analysis of the contents of the volume, and thus to take our part in calling attention to the great claims of the work to public recognition.

After a preface of considerable length, explanatory of the origin, organization, and general progress of the Survey, the Report opens with a very elaborate sketch of the physical characteristics of the country, from the Gulf of the St. Lawrence and bleak wastes of Labrador, to the plains and forests of the far north-west, beyond the shores of Lake Superior. This interesting and exceedingly instructive sketch, from the pen of the Director of the Survey, is followed by a series of chapters in which the various Azoic and succeeding rocks of the Province are described in great detail. Amongst other new facts, a point of much interest, in connexion with the Laurentian strata, is the announcement of a probable want of conformity between the lower gneissoid beds and the overlying anorthosites, leading to the recognition of a third Azoic subdivision, or one of an intermediate position between the Laurentian and the Huronian series. Much interesting information is also given with regard to the upper copper-bearing series of Lake Superior, and the apparent identity of these rocks with the Potsdam and Quebec groups of the east. The abnormal position of the Quebec strata is likewise distinguished and illustrated very fully; and the subject is still further elaborated in a subsequent chapter. The materials for this portion of the Report have been collected chiefly by Sir William Logan, Mr. Murray, and Mr. Billings; and the fossil illustrations (with the exception of some figures by Dr. Dawson, in illustration of the Devonian plants of Gaspé), are by the latter observer. Towards the close of the volume, Mr. Billings has also furnished a complete and most useful list of all the fossils of our Lower Silurian series. Those of our succeeding formations will undoubtedly be given in forthcoming Reports.

In the seventeenth and three following chapters of the present work, the mineral species of Canada, and the springs and waters of the Province, together with the chemistry of our Sedimentary, Metamorphic, and Eruptive Rocks, are brought under review. This portion of the Report, due to Professor Sterry Hunt, exhibits much accurate research, and contains a large amount of information of an exceedingly interesting character. The numerous analyses given in connexion with these questions, are not the least important part of Professor Hunt's contributions. To the same author, also, belongs the credit of a large portion of the succeeding chapter of this Report, comprising a detailed view of the economic geology of Canada. Readers who seek especially for practical results, will find all they can desire in this chapter. Full details are given respecting the distribution of our metallic ores, the metallurgy and general working of these, together with a large amount of information on the applications, &c, of phosphate of lime, iron ochres, peat, and other economical materials occurring within the Province.

Finally, the Report closes with a long and systematically arranged description of the Post Tertiary or surface formations. In connection with this, a useful table is appended of the directions of glacial striæ, as observed throughout a wide range of Canadian localities, extending from west longitude 84° 29′ to 59° 12′, and from the parallel of 43° 2′ to that of 50° 36′. In our popular exposition of the Post-Tertiary deposits of Canada, published in a recent number of the *Journal*, and written some months before this portion of the Report came into our hands, we subdivided the deposits in question into three series, viz: 1, *Glacial* deposits (Lower Drift clays, sands, and boulders); 2, *Post-glacial deposits* (upper clays, gravels, and sand, or re-arranged glacial materials, containing fresh-water shells in Western Canada, and marine remains in the eastern part of the Province); and, 3, *Recent deposits* (Calcareous tufa, shell marl, bog iron ore, ochres, peat). The same order of arrangement, but with necessarily fuller elaboration, is followed by the Survey, as exhibited in the annexed table, extracted from page 887 of the Rport:

III.

Shell marl, calcareous tufa, peat,
Ochres, bog-iron and manganese ores.
Modern alluvions.

II.

Western Canada.	*Eastern Canada.*
2. { Algona sand. Artemisia gravel. Saugeen fresh-water clay and sand.	2. { St. Maurice and Sorel sands. Saxicava sand of Montreal, Upper sand and gravel of Beauport Upper Champlain clay and sand of Vermont.
1. Erie clay.	1. { Leda clay of the St. Lawrence and Ottawa. Lower shell-sand of Beauport. Lower Champlain Clay of Vermont.

I.

Boulder formation or glacial drift.
Auriferous Drift of Eastern Canada

The undoubted value of the earlier Reports of the Survey has long been recognised, both at home and abroad, by all whose judgment, in matters of this kind, can have any claim to our acceptance. The present Report, embracing, as it does, the results of all earlier explorations, and comprising in itself so much that is new to science, cannot fail to meet with equal recognition; and to attract, still farther, the attention of industrial art to the vast stores of mineral wealth that yet remain unworked within the limits of the Province.

CANADIAN INSTITUTE.

SESSION—1863-64.

FIRST ORDINARY MEETING—*5th December*, 1863.

REV. H. SCADDING, D.D., in the Chair.

I. *The following Gentlemen provisionally elected by the Council during the recess were balloted for, and their election confirmed,—viz.:*

JOHN GORDON, Esq., Toronto.
M. MCDERMOTT, Esq., Chicago.
JOHN HALL Esq., M.D., Toronto.

II. *The following Papers were read:*

1. By the Rev. Prof. W. Hincks, F.L.S.. &c.:
"On Weboitchia."

2. By Prof. E. J. Chapman, Ph. D.:
"On the detection of ordinary metals, in mineral bodies, by the aid of the common blowpipe and other cheap, portable and easily procurable apparatus, with illustrative experiments."

SECOND ORDINARY MEETING.

12th December, 1864.

REV. J. MCCAUL, LL.D., President in the Chair.

I. *The following Gentlemen were elected Members:*

CHARLES P. WILLIAMS, Esq, Philadelphia, U.S.
A. M. ROSEBRUGH, Esq., M D, Toronto.
FRANCIS L. CHECKLEY, Esq., Toronto.

II. *List of donations for the Library received during the recess was laid on the table,—See Annual Report.*

III. The nomination of office-bearers for the ensuing year took place.

IV. *The following Papers were read:*

1. By the President:
"On ancient Glandes."

2. Doctor Morris exhibited and made some remarks on insects captured by him during the last summer.

THE ANNUAL GENERAL MEETING.

19th December, 1863.

The President Rev. J. McCaul, LL.D., in the Chair.

I. *The following Gentleman was duly elected a Member:*
David Tucker, Esq., M D., Toronto.

II. A ballot having been taken for officers of the Institute for the ensuing year, the following Gentlemen were declared duly elected,—viz.:

President,	Rev. J. McCaul, LL.D.
1st Vice-President,	S. Fleming, Esq., C.E.
2nd "	Rev. Prof. G P. Young, M.A.
3rd "	B. R Morris, Esq., M.D.
Treasurer,	D. Crawford, Esq.
Recording Secretary,	G. H. Wilson, Esq.
Corresponding Secretary,	U. Ogden, Esq, M.D.
Curator,	H. Y. Hind, M.A., F.L.S.
Librarian,	Rev. H. Scadding, D.D.
Council,	D. Wilson, LL.D.
"	M. Barrett, Esq., M.D.
"	Rev. Prof. W. Hincks, F.L.S., &c.
"	T. C. Keefer, Esq, C.E.
"	Prof. H. Croft, D.C.L.
"	J. Bovell, Esq. M.D.

III. The Report of the Council for the year 1862-63 was read and unanimously adopted.

THIRD ORDINARY MEETING.

9th January, 1864.

The President, The Rev. J. McCaul, LL.D., in the Chair.

I. *The following Gentlemen were elected Members;*
W. Howland, Jr., Esq., Toronto.
J. Langstaff, Esq., M.D., Richmond Hill.

II. *The following donations for the Library were announced, and the thanks of the Institute voted to the donors:*

From the office of Routine and Record, Quebec. The statutes of Canada, 1863 1 Vol.

From Sir W. Logan, F.G.S., Montreal. The Geology of Canada, 1863. 1 Vol.

III. *The following Papers were read :*

1. By the President :
"The Annual Address."

2. By Prof. G. T. Kingston, M.A.
"On the annual and diurnal distribution of the wind at Toronto."

FOURTH ORDINARY MEETING.

16th January, 1864.

The President, The Rev. J. McCaul, LL.D., in the Chair.

I *The undermentioned Gentleman was elected a Member :*

F. T. Jones, Esq , Barrister, Toronto.

II. A donation to the Museum was presented by John Laidlaw Esq., per S. Spruell, Esq.

A specimen of Coal from Dunn Mountain near Nelson, New Zealand.

III. *The following Papers were then read :*

1. By Doctor Rosebrugh :
"On the ophthalmoscope, a new instrument for viewing and photographing the deep structures of the living eye, with illustrations."

2. By J. P. Clarke, Mus. Bac.
"On a new method of propelling steam vessels and canal barges, with models."

FIFTH ORDINARY MEETING.

23rd January, 1864.

Vice-President, S. Fleming, Esq , C.E., in the Chair.

I. *The following Gentleman was elected a Member :*

Hon. John Ross, M.L.C., Toronto.

II. *The following donations were announced, and the thanks of the Institute voted to the donors :*

FOR THE LIBRARY.

By James Hubbert, B.A.

"Ancient Gems" 1 Vol.

FOR THE MUSEUM.

By His Excellency the Governor of New Brunswick, per S. Fleming, Esq. C.E.

Specimen of albutite and other minerals. 5.

III. *The following Papers were then read :*

1. By the Rev. Prof. Hincks, F.L.S.,
"On continuation of observations on the systematic position and affinities of certain tribes of Birds, the Fissarostræ Group."

2. By James Hubbert, B.A. :
"On the Latex and Laticiferous vessels of Plants."

MONTHLY METEOROLOGICAL REGISTER, AT THE PROVINCIAL MAGNETICAL OBSERVATORY, TORONTO, CANADA WEST,—FEBRUARY, 1864.

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

Day.	Barom. at temp. of 32°.				Temp. of the Air.				Excess of mean above Normal.	Tens. of Vapour.				Humidity of Air.				Direction of Wind.			Result't. Direction.	Velocity of Wind.					Rain in inches.	Snow in inches.
	6 A.M.	2 P.M.	10 P.M.	Mean.	6 A.M	2 P.M	10 PM	ME'N		6 A.M	2 P.M.	10 P.M.	M'N	6 A.M	2 P.M.	10 P.M.	M'N	6 A.M.	2 P.M.	10 P.M.		6 A.M.	2 PM.	10 P.M.	Result't.	ME'N		
					°	°	°	°	°												°							
1	29.262	29.230	29.530	29.3452	36.3	37.4	36.7	36.88	+13.00	.202	.187	.171	.186	.94	.84	.78	.85	E b N	S W	W S W	S 50 W	15.3	21.0	14.5	12.53	14 81	0.365	..
2	.450	.328	.333	.3467	34.5	36.3	34.5	34.52	+10.67	.174	.160	.175	.165	.87	.75	.87	.83	S W b S	S W b S	Calm.	S 71 W	3.0	11.0	0.0	6.98	8.38	...	...
3	.340	.351	.388	.3615	29.5	33.1	28.4	30.20	+ 6.43	.144	.130	.134	.136	.87	.69	.86	.81	W S W	W b N	W S W	S 74 W	6.5	15.5	10.2	10.48	11.75	...	0.2
4	.207	.042	.081	.1060	25.5	35.2	32.7	31.15	+ 7.47	.118	.172	.172	.155	.86	83	.92	.87	S	S S W	Calm.	S	16.0	10.2	0.0	7.30	8.82	...	1.2
5	.113	.230	.379	.2517	32.7	34.5	31.6	32.47	+ 8.88	.172	.157	.156	.161	.92	.79	.87	.87	S W	W b S	E b N	N 9 W	8.2	0.5	5.0	1.30	4.31	...	0.2
6	.408	.409	.495	.4440	27.7	30.2	27.0	28.17	+ 4.65	.128	.157	.129	.135	.84	.93	.88	.87	N b E	N N W	N W b N	N 26 W	6.6	11.5	7.2	6.64	7.36	...	3.0
7	.412	.223	—	—	24.1	32.4	—	—	—	.107	.146	—	—	.82	.79	—	—	W	S W b S	S W b S	S 38 W	4.5	16.2	20.0	14 13	14.65	...	0.5
8	.064	.212	.390	.2420	28.8	25.5	15.0	22.68	— 0.68	.144	.104	.075	.104	.90	.75	.87	.83	W b S	W b N	W b N	N 89 W	9.5	23.8	6.6	13.30	13.36	...	0.1
9	.481	.537	.702	.5982	8.6	18.3	8.2	10.97	—12.30	.053	.068	.037	.038	.82	.68	.91	.81	W N W	N W b W	N W b W	N 49 W	4.6	20.0	6.8	7.51	7.91	...	...
10	.877	.978	30.013	.9648	1.7	8.9	2.4	4.63	—18.63	.044	.049	.047	.046	.91	.75	.96	.85	N N W	N W	N N W	N 47 W	2.0	9.5	1.8	4.04	5.16	...	...
11	.889	.519	29.391	.5840	16.1	28.7	34.9	27.12	+ 3.85	.056	.116	.161	.111	.61	.73	.79	.69	S W	S W b S	W S W	S 62 W	12.0	20.0	9.0	11.92	13.63	...	0.1
12	.471	.464	.408	.4410	25 1	33.4	29.8	29 63	+ 6.38	.116	.157	.125	.131	.86	.82	.75	.80	W	W	S W	S 77 W	8.2	16.5	9.5	11.60	12.27	...	...
13	.318	.257	.203	.2530	28.4	35.2	26.6	33.42	+10.17	.126	.157	.173	.150	.81	.76	.79	.78	S W b W	S W b S	W S W	S 52 W	13.0	9.0	13.4	9.88	10.01	...	...
14	.039	.519	—	—	33.4	22.6	—	—	—	.171	.096	—	—	.89	.79	—	—	S W	N W	N b E	N 38 W	5.6	22.5	10.0	13.55	15.63	...	...
15	.624	.292	.035	.2975	13.6	27.3	30.2	24.98	+ 1.73	.067	.111	.121	.106	.83	.74	.71	.77	N E	S E	W S W	N 20 E	7.0	11.2	4.0	0.40	9.57	...	0.5
16	.016	.122	.366	.1848	21.9	14.3	3.9	12.40	—10.97	.104	.058	.040	.064	.89	.70	.76	.79	W N W	N W b W	W b N	N 57 W	17.5	24.0	21.5	20.41	21.27		1.2
17	.531	.703	.918	.7393	-12.1	—1.2	0.6	-4.62	—27.97	.024	.039	.010	.034	.91	.94	.88	.91	N N W	W N W	W b S	N 70 W	10.0	27.0	9.6	10.83	11.32	...	...
18	.978	30.015	30.110	30.0418	—5.9	5.0	—0.1	-0.40	—23.83	.031	.046	.044	.039	.93	.84	.97	.89	W b N	W S W	W S W	S 81 W	4.0	13.6	9.5	9.63	9.74	...	...
19	30.116	29.913	29.728	29.9035	—5.2	12.5	15.8	8.50	—15.03	.031	.067	.065	056	.90	.88	.74	.83	W b N	S W	S W b W	S 49 W	4.2	19.8	16.0	14.98	15.28	...	0.1
20	29.705	.623	.533	.6262	21.5	28.8	30.6	27.32	+ 3.70	.095	.121	.115	.116	.82	.76	.67	.77	S W b W	S S W	S S W	S 28 W	8.2	13.2	12.4	9.02	9.30	...	0 1
21	.472	.478	—	—	31.6	34.5	—	—	—	.140	.144	—	—	.78	.72	—	—	S S W	S b W	S b W	S 14 W	7.0	5.0	1.0	4.07	4.10	...	...
22	.366	.208	.392	.3223	35.6	40.3	37.4	37.63	+13.82	.178	.201	.196	.189	.85	.80	.87	.83	S b W	S	W	S 37 W	4.0	5.2	9 8	5.33	6.67	0.032	...
23	.352	.142	.172	.2150	33.1	43.9	38.1	38.67	+14.73	.167	.200	.179	.182	.88	.70	.77	.78	S S W	S S W	S W	S 42 W	3.4	3.0	9.0	5.58	5.86	...	...
24	.197	.364	.532	.3785	33.4	38.9	35.3	36.22	+12.03	.163	.152	.164	.161	.85	.63	.80	.76	S W b W	W N W	W b S	N 69 W	5.4	19.4	4.5	8.72	9.48	...	...
25	.489	.358	.438	.4375	30.9	33.3	31.6	31.50	+ 7.17	.149	.182	.178	.162	.86	.93	1.00	.91	W N W	E N E	N b W	N 14 E	0.8	12.0	11.6	8.38	10.23	...	2.5
26	.708	.757	.804	.7650	21.2	26.6	18.3	22.33	— 2.20	.092	.105	.087	.095	.81	.73	.87	.79	N N W	N W	N W	N 35 W	12.2	21.5	2.0	7.56	9.14	...	...
27	.837	.669	.470	.6395	13.6	32.0	33.8	27.75	— 3.03	.072	.158	.173	.138	.90	.87	.89	.87	N W	S S E	E b S	S 57 E	2.4	6.0	3.8	2.05	2.64	...	Inp.
28	.882	.460	—	—	36.5	39.2	—	—	—	.201	.190	—	—	.92	.79	—	—	Calm.	W b S	W	S 89 W	0.0	14.0	14.5	12.27	12.99	..	...
29	.699	.814	.854	.7950	23.3	26.2	22.6	23.82	— 1.20	.110	.103	.103	.106	.87	.73	.85	.82	W b W	W b N	Calm.	N 83 W	12.0	15.5	0.0	7.41	7.50	...	Inp.
30	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
31	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
M	29.4999	29.4623	29.5074	29.4914	20.79	27.40	24.64	24.32	+ 0.65	.110	.126	.123	.119	.86	.78	.84	.82	....	....	....	....	7.35	14.40	8.39	......	10.11	0.397	9.5

REMARKS ON TORONTO METEOROLOGICAL REGISTER FOR FEBRUARY, 1864.

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

Highest Barometer . . . . 30.124 at 8 a.m. on 19th. } Monthly range=
Lowest Barometer . . . . 29.009 at mid't. on 15th. } 1.115 inches.

Self-registering Ther.:
- Maximum temperature . . . . 45°0 on p.m. of 23rd } Monthly range=
- Minimum temperature . . . . —15°0 on a.m. of 17th } 60°0
- Mean maximum temperature . . 31°52 } Mean daily range=12°58
- Mean minimum temperature . . 18°94 }
- Greatest daily range . . . . . . 37°4 from a. m. to p. m. of 11th.
- Least daily range . . . . 3°3 from a. m. to p. m. of 8th.

Warmest day . . . 23rd...Mean Temperature . . . 38°67 } Difference=43°29.
Coldest day . . . 17th...Mean Temperature . . . —4°62 }
Maximum Radiation { Solar (Vacuum) . . . . 105°6 on p. m of 26th } Monthly range=
{ Terrestrial . . . . . . —15°8 on a. m. of 17th } 121°.4
Aurora observed on 4 nights, viz.:—on 1st, 8th, 9th, and 10th.
Possible to see Aurora on 11 nights; impossible on 18 nights.
Snowing on 14 days; depth 9 5 inches; duration of fall, 55.6 hours.
Raining on 2 days; depth, 0.397 inches; duration of fall, 7.5 hours.
Mean of cloudiness=0.72; above average, .01. Most cloudy hour observed, 4 p.m; mean=0.80; least cloudy hour observed, mid't.; mean=0.56.

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

North.	South.	East.	West.
1705.92	2141.01	348.10	4844.54

Resultant direction, S. 84° W.; Resultant Velocity, 6.48 miles per hour.
Mean velocity 10.11 miles per hour.
Maximum velocity 37.0 miles, from 10 to 11 a.m. on 14th.
Most windy day 16th—Mean velocity 21.27 miles per hour. } Difference 18.63.
Least windy day 27th—Mean velocity 2.64 miles per hour. }
Most windy hour, 1 to 2 p. m.—Mean velocity, 15.03 miles per hour. } Difference
Least windy hour, 4 to 5 a.m.—Mean velocity, 7.02 miles per hour. } 8.01 miles.

1st to 7th inclusive, very gloomy and mild.—9th, Solar Halo and Parhelia at 5 p.m.—11th, Solar Halo at 10 a.m. and noon, pleasant.—16th to 19th inclusive, very cold and stormy days.—17th, Lunar Halo at 9 p.m.—23rd, Solar Halo noon to 2 p.m. Lunar Halo at 10 p.m.—25th, Fog 6 to 8 a.m. Very gloomy day.—27th, Fog 8 a.m. Very gloomy.

Great range of Temperature.

13th p.m. = 39.°0 } Descending range in 86 hours = 54.°0
17th a.m. = —15.°0 }
23rd p.m. = 45.°0—Ascending range in 150 hours = 60.°0
Movement in 236 consecutive hours = 114.°0

February 1864 was comparatively mild, dry, windy, and cloudy.

COMPARATIVE TABLE FOR FEBRUARY.

YEAR.	TEMPERATURE.					RAIN.		SNOW.		WIND.		
	Mean.	Excess above Average, (45°5).	Maximum observed.	Minimum observed.	Range.	No. of days.	Inches.	No. of days.	Inches.	Resultant. Direction.	Resultant. Velocity.	Mean Force or Velocity
	°		°	°	°							
1840	28.0	+ 5.0	49.1	— 8.3	57.4	8	1.47	6	...	...	...	...
1841	22.4	— 0.6	43.4	— 0.3	43 7	1	Inap	9	...	...	...	0.61 lbs
1842	26.9	+ 3.9	48.7	+ 2.5	46 2	8	3.62	9	...	...	...	1.03 "
1843	14.5	— 8.5	37.5	—10.2	47.7	1	0.47	21	14.4	...	...	1.05 "
1844	26.0	+ 3.0	47.1	— 0.4	47.5	4	0.43	7	10.0	...	...	0.43 "
1845	26.0	+ 3.0	46.6	— 3.9	50.5	5	Imp	9	19.0	...	...	0.99 "
1846	20.4	— 2.6	41.4	—16.2	57.6	0	0.00	13	46.1	...	...	0.65 "
1847	21.5	— 1.5	42.2	— 1.0	43.2	2	0.55	13	27.3	...	...	0.60 "
1848	26.6	+ 3.6	46.9	— 0.6	47.5	4	0.77	8	10.8	N 65 W	2.53	5.69 ms
1849	19.5	— 3.5	41.1	— 9.2	50.3	2	0.24	13	19.2	N 41 W	1.48	6.58 "
1850	26.0	+ 3.0	49.2	+ 1.3	47.9	7	1.23	9	23.1	N 89 W	3.43	7.61 "
1851	27.6	+ 4.6	50.2	+ 1.3	48.9	7	2.60	4	2.4	N 64 W	1.99	6.94 "
1852	23.4	+ 0.4	41.2	— 3.2	44.4	3	0.65	11	13.0	S 75 W	3.34	6.42 "
1853	24.1	+ 1.1	43.4	— 0.6	44.0	4	1.03	15	12.6	N 49 W	2.51	7.30 "
1854	21.1	— 1.9	42.7	— 5.7	48.4	5	1.46	15	18.0	N 7 E	1.73	6.91 "
1855	15.4	— 7.6	37.3	—25.0	62.3	2	1.77	14	21.8	N 40 W	4.34	8.17 "
1856	15.7	— 7.3	35.3	—18.7	54.0	0	0.00	8	9.7	N 81 W	7.70	10 71 "
1857	28.5	+ 5.5	51.2	— 5.9	57.1	11	3.05	11	11.7	S 78 W	3.68	9.82 "
1858	17.0	— 6.0	40.9	— 6.6	47.5	1	Inap	16	26.7	N 72 W	3.22	9.12 "
1859	26.0	+ 3.0	43.3	+ 3.9	39.4	6	0.45	14	8.3	N 54 W	2.72	8.50 "
1860	22.8	— 0.2	48.1	— 8.4	56.5	7	1.33	13	18.8	N 61 W	3.28	8.73 "
1861	26.1	+ 3.1	44.6	—20.4	65.0	4	0.81	17	29.7	N 77 W	3.86	10.58 "
1862	22.5	— 0.5	35 6	— 3.7	39.3	3	0.18	17	23.1	N 55 W	3.93	8.52 "
1863	22.4	— 0 6	38.9	—19.8	58.7	7	1.450	12	22.0	N 23 W	2.29	10.13 "
1864	24.3	+ 1.3	43.9	—13.0	56.9	2	0.397	14	9.5	S 84 W	6.48	10.11 "
Results to 1864.	22.99	...	43.59	—6.88	50.48	4.2	1.000	11.9	18.05	N 70 W	3.15	8.34
Exc. for 1864.	+1.33	...	+0.31	—6.12	+6.42	— 2.2	— 0.603	+ 2.1	— 8.55	...	...	+1.77

MONTHLY METEOROLOGICAL REGISTER, AT THE PROVINCIAL MAGNETICAL OBSERVATORY, TORONTO, CANADA WEST,—MARCH, 1864.

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

Day.	Barom. at temp. of 32°.				Temp. of the Air.				Excess of mean above Normal.	Tens. of Vapour.				Humidity of Air.				Direction of Wind.			Resultant Direction.	Velocity of Wind.					Rain in Inches.	Snow in Inches.
	6 A.M.	2 P.M.	10 P.M.	MEAN.	6 A.M.	2 P.M.	10 P.M.	ME'N		6 A.M.	2 P.M.	10 P.M.	M'N	6 A.M.	2 P.M.	10 P.M.	M'N	6 A.M.	2 P.M.	10 P.M.		6 A.M.	2 P.M.	10 P.M.	Resul't.	ME'N		
1	29.759	29.561	29.570	29.6217	15.1°	25.9°	23.0°	22.22°	− 3.00°	.074	.107	.106	.100	.86	.76	.86	.81	Calm.	W b S	W b S	S 86° W	0.0	0.5	5.2	3.01	3.18	...	0.2
2	.525	.689	.915	.7287	23.0	26.6	23.7	24.37	− 1.05	.106	.105	.098	.101	.86	.73	.77	.76	W b N	W N W	W	N 65 W	1.5	27.0	8.0	10.73	10.90	...	0.1
3	.937	.850	.624	.8080	17.6	33.4	29.5	27.20	+ 1.48	.088	.143	.144	.129	.92	.78	.87	.85	Calm.	S b E	E b S	S 16 E	0.0	5.6	2.5	2.85	4.43	...	...
4	.409	.222	.186	.2678	31.3	45.4	29.9	39.93	+13.93	.152	.199	.190	.185	.86	.64	.77	.75	S W b W	S W b S	W S W	S 54 W	3.0	10.0	3.2	4.17	5.99	0.305	...
5	.167	.170	.310	.2235	35.3	30.9	29.1	31.65	+ 5.45	.198	.149	.141	.163	.96	.86	.87	.90	N N E	N b E	N W b N	N 16 W	5.8	15.5	8.0	9.78	10.81	0.300	1.0
6	.388	.440	—	—	24.4	34.5	—	—	—	.103	.149	—	—	.78	.74	—	—	W N W	N W	N N W	N 36 W	6.0	7.8	5.0	3.97	4.26	...	...
7	.450	.347	.354	.3803	25.2	40.3	30.6	32.55	+ 5.73	.115	.159	.094	.131	.85	.63	.54	.70	N W b N	N W	N W b W	N 48 W	7.5	18.5	10.0	10.67	10.91	...	...
8	.398	.467	.645	.5137	24.8	39.2	29.1	31.32	+ 4.08	.098	.120	.133	.118	.73	.49	.82	.68	N W b W	S W	N W b N	N 50 W	2.0	0.5	4.5	3.17	3.81	...	...
9	.799	.823	.800	.8100	24.4	37.0	33.4	31.80	+ 4.28	.110	.114	.171	.135	.84	.51	.89	.76	W N W	W N W	S W	N 17 E	4.8	6.0	3.0	2.65	6.80	...	...
10	.630	.374	.201	.3758	32.7	32.4	37.0	34.02	+ 6.20	.157	.161	.219	.178	.85	.87	.99	.90	E b N	E b N	E	N 85 E	18.0	15.6	9.5	12.17	12.23	0.080	...
11	.088	28.852	28.928	28.9543	37.4	41.0	40.7	39.33	+11.10	.223	.247	.224	.226	.99	.95	.87	.93	E b N	N E b E	W b S	S 86 W	7.0	3.5	13.5	4.81	9.62	0.480	...
12	.187	29.370	29.524	29.3793	32.7	36.3	33.4	33.92	+ 5.37	.143	.157	.141	.147	.76	.74	.74	.75	W	W	N W b W	N 86 W	20.5	14.5	7.2	7.84	8.45	...	..
13	.545	.628	—	—	27.7	35.3	—	—	—	.135	.138	—	—	.89	.67	—	—	N	N	N N W	N 17 W	1.0	6.5	14.0	8.24	8.53	..	...
14	.690	.658	.610	.6545	23.3	36.0	33.1	80.85	+ 1.53	.103	.137	.153	.133	.82	.65	.81	.76	N N W	S	S W b S	S 35 W	3.5	4.0	5.5	4.27	5.62	...	Inp.
15	.594	.619	.658	.6218	27.3	25.1	17.2	22.90	− 6.82	.133	.116	.081	.109	.89	.86	.85	.87	W b S	N W b N	N W b N	N 43 W	12.5	13.8	14.5	12.73	13.56	...	0.1
16	.568	.481	.499	.5118	18.6	30.9	26.2	25.85	− 4.18	.090	.134	.110	.116	.89	.77	.77	.82	N W b W	W b N	W S W	N 83 W	10.2	12.4	7.4	7.86	8.23	...	Inp.
17	.435	.298	.224	.3078	27.3	36.0	33.1	31.65	+ 1.20	.126	.153	.160	.147	.84	.73	.85	.82	W b S	S W b S	S W b S	S 30 W	0.5	18.0	18.4	16.29	16.41	...	0.5
18	.009	.009	.308	.1152	33.4	32.4	17.9	27.18	− 3.67	.178	.146	.067	.121	.93	.79	.67	.76	S b W	W	N W b W	S 87 W	21.0	31.8	21.0	16.49	20.68	...	0.4
19	.417	.420	.462	.4292	12.5	20.5	14.0	16.13	−15.13	.068	.061	.068	.071	.88	.55	.83	.79	W b N	W b S	N E b N	N 79 W	6.8	17.6	4.8	7.95	9.06	...	Inp.
20	.484	.516	—	—	6.8	16.8	—	—	—	.051	.061	—	—	.86	.63	—	—	N N W	W b S	W N W	N 65 W	9.5	15.4	6.0	9.57	10.50	...	...
21	.699	.755	.897	.8010	3.9	16.9	13.2	11.92	−20.17	.045	.060	.066	.059	.86	.62	.83	.79	W	W	N N W	N 77 W	5.5	16.6	6.5	8.74	10.58	...	...
22	30.032	30.032	.900	.9862	3.5	16.9	12.9	11.75	−20.73	.044	.053	.057	.049	.87	.56	.73	.66	N b E	E S E	N E b N	N 48 E	4.0	9.2	6.0	4.95	5.95	...	...
23	29.850	29.773	.746	.7902	11.4	29.1	24.1	21.87	−10.92	.062	.104	.074	.080	.86	.65	.55	.67	N b E	N E b N	W S W	N 21 W	4.8	6.0	1.5	1.97	3.27	...	...
24	.765	.716	.649	.7062	17.9	40.3	29.5	30.85	− 2.32	.079	.105	.129	.104	.80	.41	.78	.62	W	S b W	S W	S 35 W	2.5	10.5	3.0	4.76	5.01	...	...
25	.582	.374	—	—	26.6	37.4	—	—	—	.126	.162	—	—	.87	.72	—	—	S W	E N E	Calm.	N 69 E	2.8	9.6	0.0	3.26	3.84	0.010	...
26	.477	.596	.708	.6038	36.0	39.9	31.3	35.62	+ 1.63	.196	.206	.152	.183	.93	.84	.86	.87	Calm.	E	S E b S	S 3 W	0.0	1.6	4.0	0.68	1.80	Inp.	...
27	.764	.776	—	—	29.1	36.3	—	—	—	.155	.193	—	—	.96	.90	—	—	Calm.	W S W	S W b W	N 49 E	0.0	2.5	2.0	1.33	2.66	...	...
28	.800	.676	.533	.6442	31.3	34.5	38.1	35.12	+ 0.40	.166	.173	.187	.175	.94	.86	.81	.85	E N E	E b N	E	N 82 E	8.6	19.5	22.0	17.99	18.03	...	...
29	.393	.364	.339	.3703	37.8	37.8	38.5	37.30	+ 2.20	.183	.183	.225	.195	.80	.80	.96	.87	E b N	E	E b N	N 86 E	16.5	12.4	15.4	14.90	15.07	0.255	1.0
30	.257	.229	.244	.2468	36.0	34.5	33.4	34.70	− 0.80	.154	.145	.178	.162	.74	.72	.93	.81	E	N E b E	N N E	N 60 E	16.5	10.6	6.0	8.77	9.59	0.065	0.2
31	.287	.338	.422	.3577	33.8	37.4	34.5	35.23	− 0.68	.184	.214	.200	.199	.95	.95	1.00	.97	N N E	E N E	Calm.	N 64 E	3.5	1.5	0.0	1.03	1.06	0.125	0.2
M	29.5262	29.4880	29.5099	29.5082	25.13	32.95	28.71	29.12	− 1.26	.126	.141	.137	.135	.86	.72	.82	.80	....	....	....	....	6.64	11.11	7.66	......	8.41	1.620	3.7

REMARKS ON TORONTO METEOROLOGICAL REGISTER FOR MARCH, 1864.

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

Highest Barometer.........................30.067 at 8 a.m. on 22nd } Monthly range =
Lowest Barometer ....28.829 at 4 p. m. on 11th } 1.238 inches.

Self-registering Thermom.
Maximum Temperature ....50°2 on p.m. of 4t } Monthly range =
Minimum Temperature .... 3°0 on a.m. of 21st & 22d } 47°2
Mean maximum Temperature .... 35°59 } Mean daily range =
Mean minimum Temperature .... 22°44 } 13°16
Greatest daily range ......28°4 from a.m. to p.m. of 24th.
Least daily range......... 3°3 from a.m. to p.m. of 15th.

Warmest day .... 4th .. Mean temperature.......... 30°93 } Difference = 28°18.
Coldest day .... 22nd... Mean temperature......... 11°75 }
Maximum Radiation. { Solar.................................. 100°0 on p.m. of 7th } Monthly range =
{ Terrestrial......................... —4°0 on a.m. of 21st } 104°0
Aurora observed on 2 night, viz.,—on 6th and 7th.
Possible to see Aurora on 15 nights; impossible on 16 nights.
Snowing on 12 days, depth 3.7 inches; duration of fall, 35.6 hours.
Raining on 9 days, depth 1.620 inches; duration of fall 60.1 hours.
Mean of cloudiness = 0.66; above average 0.06.
Most cloudy hour observed, 4 p.m; mean = 0.75; least cloudy hour observed, 6 a.m.; mean, = 0.59.

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

North.	South.	East.	West.
1072.27	938.08	1731.97	3081.23

Resultant direction N. 53° W.; Resultant velocity 2.29 miles per hour.
Mean velocity ....8.41 miles per hour.
Maximum velocity .... 31.8 miles, from 2 to 3 p.m. on 18th.
Most windy day ......18th............Mean velocity, 20.68 miles per hour. } Difference =
Least windy day ...31st.............Mean velocity, 1.06 ditto. } 19.62 miles.
Most windy hour .... 2 to 3 p.m..............Mean velocity, 11.35 ditto. } Difference =
Least windy hour ...4 a.m. to 5 a.m.........Mean velocity 6.52 ditto. } 4.83 miles.

4th. Solar halo at 4 p.m.; mild day.—6th. Solar halo and parhelia from 10 a.m. to 2 p.m.—7th. Faint auroral light from 7 p.m. to midnight.—9th. Solar halo and parhelia 1 to 2 p.m.—18th. Stormy day; wind very high and in violent squalls.—22nd. Lunar halo at 10 p.m. and midnight.—26th. Fog at 2 p.m.; mild.—27th. Dense fog nearly all day.—28th. Fog at 6 and 8 a.m.; sheet lightning in S.W. at 8 and 9 p.m. (first of the season).—31st. Fog at 10 p.m.; slight rain to 3.30 p.m.; snow from 11 p.m. to 2 am. of 1st April.

March, 1864, was comparatively cold, calm, and cloudy; it had more rain and less snow than the average, and with regard to total precipitation may be recorded as a dry month.

COMPARATIVE TABLE FOR MARCH.

YEAR.	TEMPERATURE.					RAIN.		SNOW.		WIND.		
	Mean.	Excess above aver'ge (26.1)	Max. ob-served.	Min. ob-served.	Range.	No. of days.	Inches	No. of days.	Inches	Resultant. Direction.	Resultant. V'y.	Mean Force or Velocity.
1840	° 35.3	+ ° 3.4	° 56.9	° 8.7	° 48.2	8	1.640	8	...	...	...	....
1841	27.7	— 2.2	53.5	— 6.9	60.4	5	1.170	7	...	...	...	0.51lbs.
1842	35.8	+ 5.9	68.7	14.9	53.8	4	3.150	8	...	...	...	0.70
1843	21.3	— 8.6	38.6	— 2.8	41.4	2	0.625	18	25.7	...	...	1.18
1844	31.3	+ 1.4	50.3	9.6	40.7	8	2.470	8	14.0	...	...	0.57
1845	35.4	+ 5.5	61.7	9.9	51.8	5	Imp.	8	2.8	...	...	0.66
1846	33.1	+ 3.2	49.3	7.6	41.7	0	1.965	5	2.3	...	...	0.30
1847	26.2	— 3.7	44.3	4.8	39.5	5	0.850	6	4.2	...	...	0.71
1848	28.6	— 1.3	58.9	0.9	58.0	5	1.220	6	9.7	N 66° W	2.03	5.80mls.
1849	33.5	+ 3.6	53.4	15.4	38.0	7	1.525	2	2 3	N 3° W	1.48	5.37
1850	29.8	— 0.1	46.0	6.0	40.0	2	0.745	7	11.2	N 52° W	2.62	7.62
1851	32.4	+ 2.5	58.7	13.1	45.6	3	0.770	9	8.8	N 21° W	1.93	7.65
1852	27.7	— 2.2	44.8	— 3.2	48.0	8	3.080	12	19.5	N 8° W	0.71	5.81
1853	30.6	+ 0.7	56.3	— 0.1	56 4	6	1.080	8	7.1	N 58° W	2.60	5.96
1854	30.7	+ 0.8	52.8	10.4	42.4	9	2.425	3	2.8	N 53° W	3.39	8.03
1855	28.5	— 1.4	48.6	— 2.9	51.5	5	1.485	11	18.1	N 88° W	4.76	9.95
1856	23.1	— 6.8	39.3	—13 6	52.9	0	0.000	12	18.2	N 71° W	7.68	11.39
1857	27.8	— 2.1	56.5	— 3.9	60.4	4	0.335	15	11.3	N 63° W	6.63	10 84
1858	28.4	— 1.5	54.1	— 5.5	59.6	10	0.917	6	0.2	N 58° W	5.45	8.56
1859	36.3	+ 6.4	53.7	10.4	43.3	15	4.051	8	1.0	N 64° W	1.96	10.39
1860	34.5	+ 4.6	66.4	14.2	52.2	5	0.882	11	2.4	N 64° W	7.61	12.41
1861	26.9	— 3.0	43.2	— 4.1	47.3	8	2.125	14	7.1	N 51° W	4.33	10.56
1862	28.8	— 1.1	41.4	9.3	32.1	8	2.560	11	18.5	N 12° W	2.50	9.38
1863	25.8	— 4.1	41.4	— 3.4	44.8	4	0.687	17	11.4	N 27° W	2.62	9.27
1864	29.1	— 0.8	45.7	3.5	42.2	9	1.620	12	3.7	N 53° W	2.29	8.41
Results to 1864.	29.86	...	51.38	3.69	47.69	6.2	1.557	9.3	9.10	N 57° W	3.35	8.67
Exc. for 1864.	— 0.74	...	— 5.68	— 0.19	— 5.47	+ 2.8	+ 0.063	+ 2.7	— 5.40	....	.. ..	— 0.26