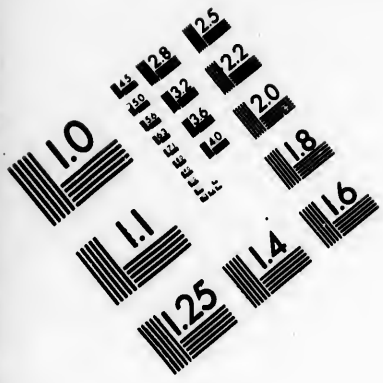

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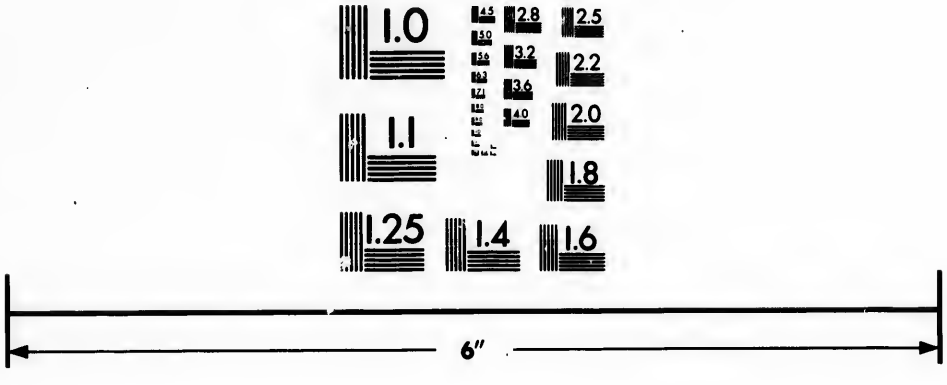

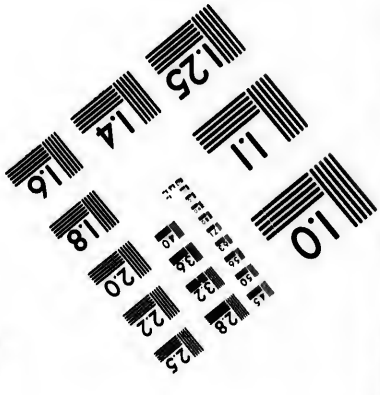

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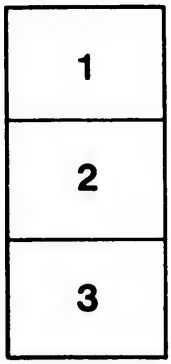

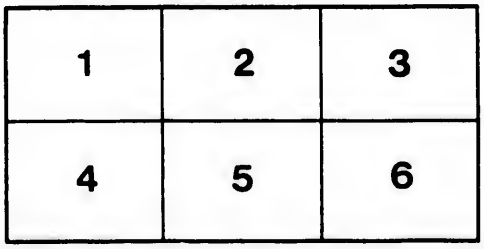

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EARLY RECORDS

OF THE

MAGNETIC DECLINATION

IN

NORTH AMERICA.

By JOHN LANGTON, M.A., President.

Read before the Literary and Historical Society, Quebec.

QUEBEC:
PRINTED BY HUNTER, ROSE & CO., ST. URSULE STREET.
1865.

SOME EARLY RECORDS OF THE MAGNETIC DECLINATION IN NORTH AMERICA.

By JOHN LANGTON, M.A., President.

(*Read before the Society, 17th May,* 1865.)

Mr. Fletcher having announced his intention of reading to the Society a paper upon the change in the variation in Canada, as deduced from the records of the Crown Lands Department, I thought it might not be uninteresting to call attention to some very much more ancient observations, which I have met with in the accounts of the earlier explorers of this part of North America. The attention which of late years has been given to all magnetic phenomena, and the care with which observations are made in almost all parts of the globe, bid fair to give us some insight into the causes which influence the change in the magnetism of the earth, and into the laws which regulate it. But as the secular change in the variation is very slow, and even if it is really periodic in its character, it has a cycle embracing some centuries, we must look back to the records of the past to obtain any accurate idea of its progress. With this view, collections have been made of all recorded observations for more than two hundred years, and maps have been published as deduced from them, shewing the isogonal lines as they existed at different dates during the interval. The earlier observations, however, are both few in number, and surrounded with much uncertainty, from the imperfection of the instruments in use, and from the doubt how far they may have been affected by local attraction, the influence of which seems hardly to have been appreciated till a much later period. Observations made on board ship, before the subject of the ship's compass error had been studied, and detached observations where no others have been recorded at nearly the same time

or in the same neighborhood, must be received with considerable caution, and it is only when we have a series of observations, consistent with themselves, that we can place much reliance upon the results.

In looking over the declinations, as observed by the various land-surveyors in Upper Canada, which were obligingly communicated to me by Mr. Fletcher, one could not fail to be struck with the extraordinary differences obtained by different surveyors, and often by the same person in the same neighborhood. Much of this is no doubt owing to carelessness in the observations, and imperfection in the instruments used, but, in a great measure also, it evidently arises from local attraction. But if for this reason we can place no great faith in an isolated observation, if we take a number of them, nearly about the same period, and in various parts of the same region, we may obtain a sort of average, which may be depended upon as nearly correct. The whole surveyed portion of Canada forms such a narrow strip of land, that it hardly affords space enough to determine with any accuracy the direction of any isogonal line; but the locality in which such a line crosses Canada may be given with tolerable precision, and the direction may be obtained by comparing it with the ascertained declination on the coast. Thus, from 1819 to 1823, there appear to have been about twenty townships surveyed, in which the needle did not deviate as much as a degree either to the east or west of north; and the line of no declination, about 1820, passed through the counties of Brant, Waterloo and Wellington. Similarly at the same date the line of 5° westerly variation, passed through the counties of Leeds and Lanark.

By thus multiplying observations, both in different places, and at successive dates, we may also conclude that some remarkable discrepancies which present themselves are not mere errors, or the effects of immediate local attraction; but that some considerable sections of country really differ in their declination from the general course of the lines. Thus it would appear as if the line of no variation about 1820 bifurcated as it approached the shores

of Lake Erie, and that the whole region about Lake Simcoe has had, over a period of many years, a less westerly declination than one would expect from that which prevails in the country adjoining it.

It is principally for this reason that I think the conclusions of Mr. Fletcher may have considerable value, though many of the individual observations are doubtless not very trustworthy; and this is also one of the reasons why I attach some importance to the determinations which form the subject of this communication—because they are a series, and consistent with each other. Moreover, rude as the method was by which they were made, it could only have been practised on shore, and they are therefore free from the disturbing effects of local attraction, which, without the greatest precautions, are liable to occur on board ship.

Their early date is also an important feature. In Europe trustworthy observations are recorded from a somewhat earlier period, though not in any great number; but in the list given by Hansteen, from which his map for 1600 is compiled, there are none recorded in this part of North America nearly so far back. The earliest in the list is that of Bressani for Quebec, which is evidently taken at second hand, for the date is not quite correctly assigned, whilst the declinations as recorded by him on the Great Bank, and in the country of the Hurons, are omitted.

Indeed, when Champlain explored the coasts of North America, in the very commencement of the 17th century, the subject was only just commencing to attract attention amongst navigators and men of science. It is often stated that the variation of the compass was not known until it was noticed by Columbus, and that the discovery that the needle no longer pointed to the north, almost gave rise to a mutiny amongst his crew. This, however, is a mistake, for the variation is distinctly alluded to by Petrus Peregrinus, in the latter part of the 13th century, and the amount of it is mentioned, though too vaguely to base any conclusions upon it. It is probable that we do owe to Columbus the first distinct information, that the variation is not the same in all parts of the

world, and that the needle which pointed east of north on the shores of Europe, had pointed very much to the west of north before he reached those of America. From this time the fact was no doubt familiar to navigators; but I believe that the first known work, in which the importance to keeping a register of the variation in different parts of the world is enforced, is a treatise on navigation by Prince Maurice of Nassau, published in 1599. Only four years after this Champlain was exploring the coasts of New England and Nova Scotia, and that he was deeply impressed with the value of such observations is evident from the instructions he gives in his *Traité de la Marine*, and in the explanation of his maps. It had, indeed, in his eyes a greater importance then than it would have had, if he had pursued his explorations some thirty years later, for it was not until after his death that the next great fact in magnetism was discovered, viz., that the variation was not constant in any place, but itself varied from year to year. This discovery we owe to three independent English observers, between 1633 and 1640; but when Champlain was making his survey of the coast, it was thought that, however much the declination might vary in different places, in any one place it was always the same. Had this really been the case the declination would have materially assisted in determining the position of important points, and under favorable circumstances it might even now be a guide to the mariner, as Basil Hall describes himself, whilst sailing along the coast of Peru, in thick weather, to have found his latitude with considerable accuracy by observations on the dip. But in Champlain's time, when the navigator had no means of checking his dead reckoning, except by an observation for latitude, the declination, had it been constant, would have been a most important addition to his knowledge. It is with this view, rather than with the object of correcting his compass-bearings, and certainly not with the intention of investigating the laws of terrestrial magnetism, that Champlain includes amongst his instructions to mariners :—" N'oublier souvent à apprendre les déclinaisons de la guide aymant en tous lieux, qui est de sçavoir combien elle

décline du méridien vers l'est et ouest, ce qui peut servir aux longitudes—ayant ces observations et retournant au mesme lieu d'où vous les aurez prises, trouvant les mesmes déclinaisons vous sçauriez où vous seriez, soit en l'hemisphère de l'Asie ou de la Pérou, et de ce on ne doit estre négligent."—He accordingly records several observations with this object, and upon one occasion, whilst endeavoring to identify a river which he enters (the modern Penobscot) with one described by former navigators as the Norembegue, he says that he cannot be sure of it, as, though the latitude corresponds, none of them have given the declination—speaking of it much as a modern geographer would of the longitude in a similar case. The coast which he was exploring was indeed peculiarly favorable for such a use of the declination as he found nearly 5° of change of declination in about 1° 30′ of latitude.

In connection with this subject there are some curious observations in the notice entitled *Intelligence des deux cartes géographiques*, in the edition of his voyages published in 1813. The smaller of the two maps, the only one preserved I believe in any copy of the edition on this continent, he describes as being constructed on the true meridian. It may be used, he says, when on the Great Bank by placing the needle from 12° to 15° or 16° to the west of the north point of the card of the compass—a vague enough determination certainly. But the other map, which is wanting, must be rather a curiosity. Although the separate ports, bays and capes were alike in each, the general configuration of the shores, he says, is quite different, because this larger map is constructed to suit a compass made like those of France, where the needle points to the east of north. It seems that the needle was not usually placed under the north point of the card, though Champlain recommends that as an improvement, but it was fixed about 8° 30′ to the east of it, so that on the coast of old France the card pointed due north. But when the earlier mariners shaped their course for New France, steering always west by their compass, they found themselves after a while several degrees too far south, to their great astonishment. Champlain himself appears to

have a confused notion that the difference arises from the spherical form of the earth—that if they had been sailing on a plain surface the compass would have been a correct guide, but that as the surface of the earth is curved the compass varies, and the further north you go, and the greater the curvature of a parallel of latitude, the more rapidly the declination varies.

To return, however, to Champlain's records of observed declinations. His method of making the observations is described in his *Traité de la Marine*, and it is a rude kind of observation of equal altitudes. He placed a board perfectly horizonal in which was a perpendicular pin. In the morning he marked the place of the shadow of the top of the pin on the board, and describing a circle from the pin, he marked the point in the circle where the shadow of the pin touched it again in the afternoon. The line bisecting the angle thus formed was due north, and with this he compared his compass.

The localities where the observations were made are the following:—

Isle Madame, apparently in the entrance to the Gut of Canso, for which he gives lat. 45° 45′; dec. 14° 50′.

Cap La Heve, which retains its name with a somewhat different spelling, lat. 44° 11′; dec. 16° 15′.

Ste. Marguerite, clearly from the description inside of Digby Neck in the Bay of Fundy, probably the small bay called Sandy Cove, for which he gives lat. 45° 30′; dec. 17° 16′; but there appears to be an error of a whole degree of latitude, the real latitude being about 44° 30′. The error is probably a clerical one, for he is generally pretty correct in his latitudes.

Port Royal, in Annapolis Basin, lat. 45°; dec. 17° 32′.

Isle Ste. Croix, in Passamaquoddy Bay. I do not know that the exact situation of the small island has been ascertained. Lat. 46° 20′; dec. 17° 22′.

The entrance to the Norembegue or Penobscot river, lat. 44°; dec. 18° 40′.

Isle aux Tortues, at the entrance of Kennebec river, lat. 44°; dec. 19° 12′.

Mallebarre.—The name is still preserved in that of Cape Malabar, to the south of Cape Cod; but the exact locality of the small harbor to which he gives this name is difficult to identify, and the latitude seems incorrect—lat. 40°, decl. 18° 40′.

The only other determinations of declination which I have noticed in Champlain, except the very vague one of from 12° to 15° or 16° for the Great Bank already mentioned, is where he states that the greatest amount he had observed was 21° in 45° lat. in the St. Lawrence. As a trifling difference in the latitude, which is only given in round numbers, would make a considerable difference in the longitude, the locality indicated cannot be satisfactorily ascertained.

The Jesuit Father Bressani, who seems to have paid more attention to scientific matters than most of his confrères, gives the following declinations :—

The Great Bank, rather a vague description, 22°; Quebec, 16°; the country of the Hurons, that is, the small peninsula bounded by Lake Huron, Matchedash Bay and Lake Simcoe, 12°.

I know not upon what ground the date, 1649, is given by Hansteen. Bressani first came out to America in 1642 and returned in 1644; he came out again in 1645, returning in 1650, and he says that in all his voyages he observed a similar change of declination. As at the period of the three latter voyages he was maimed from the effects of the tortures of the Indians, and oppressed by the recent calamities of his brethren, I should, in the absence of any better information, be inclined to take the date of the earlier observation, 1642.

It will be perceived that the declinations, as observed by Champlain, regularly increased as he proceeded south-west, and, as they thus seem to follow a definite law, we may look upon them as substantially correct. But it is remarkable that the case is now exactly reversed along the same coast, the declination decreasing pretty uniformly from Cape Breton to Cape Cod. It is not very easy at first sight to understand what position of the isogonal lines would have given rise to the variation as he found it. The main

features of a magnetic chart for any period will be best understood by conceiving that over about one-half of the globe the variation is easterly, and over the other half westerly. There are, therefore, two lines of no variation, removed from each other by nearly half of the circumference of the earth. One of these, at which, if you are sailing to the west, you will pass from an easterly to a westerly declination, is now situated in Asia, and is very irregular in its outlines. The other, where you pass from a westerly to an easterly declination, which forms a much more regular curve, is situated in America, and just touches upon the western extremity of Canada. The lines where the variation is 5°, 10°, 15°, &c., westerly, may be drawn to the eastward of the American line of no variation, and to the westward of the Asiatic one, and following the same general direction; but as these lines occur at greater intervals near the equator than towards the poles, the lines of equal variation proceeding from its two neutral lines, soon meet towards the equator, after which the next set of lines return upon themselves, and the variation increases as you go to the north or the south. These lines are constantly changing their position, and the question is, where were they situated in the time of Champlain? Now, as in Champlain's time the declination in France was about 8° 30′ east, and in sailing to America he passed the line of no declination, and then increased his westerly variation as he approached America, the neutral line which he so crossed would appear at first sight to have been that now situated in Asia. It is by no means impossible that this may have been the case, as we have no means of tracing it over the continent of Asia, from where we find it at the same date in China and Australia; but if so, instead of reaching the Northern Ocean, as now, near Archangel, it must have stretched very far over the Northern Atlantic; for if on the coast of Nova Scotia he had been nearer to the American line, the declination would have decreased as he sailed to the west and to the south instead of increasing as he found it. This position of the isogonal lines would also correspond very well with the increased declination observed by him in the St. Lawrence, and it

would not be inconsistent with the amount of declination assigned to the Great Bank.

Hansteen, however, in his map of 1600, imagines the American neutral line to have made a loop, somewhat similar to what existed in the Asiatic one at the close of last century, within which England and France were situated, so that the navigators, in proceeding to America, would cross the American neutral line where it returns upon itself to the southward, and they would thus pass from an easterly to a westerly variation, which could not be in any other part of the American line. It would be a case analogous to an overturn of geological strata, which appear to rest upon each other in the reverse order of their age. It is true that the position of the isogonal lines as laid down by Hansteen would accord very well with Champlain's observations, if the lines were made to run rather more north and south at that point; but the observations upon which he relies for his conclusions are very few in number, and there is some difficulty in imagining the changes by which the map of 1600 could be converted into that of 1700, particularly when we take into consideration the facts ascertained for intermediate periods, such as Bressani's, in whose time the declination in France was 3° 30′ E., the line of no variation, being, as he says, about the Azores, and the westerly variation decreasing, as it does now, as you proceed to the south and west from Newfoundland up the St. Lawrence. Whichever solution of this difficulty we may adopt, there is one fact connected with the localities we are considering which is very remarkable, and which may not be without its significance —that from the earliest observations to the present time there has hardly been any sensible change in the variation in the neighborhood of Cape Breton. It appears to be a true neutral point as far as the secular variation is concerned. Round this point the line of 15° westerly variation has revolved, in the direction of the hands of a watch, through about a quadrant of a circle in about 250 years; its direction having been in Champlain's time nearly S.S.W. and N.N.E., and at present, W.N.W. and E.S.E. About the close

of the last century, though the exact date varies in different localities, a change appears to have occurred in the direction of magnetic oscillation in almost all parts of the world. In Canada, the line of no variation seems to have been advancing towards the east, during the last century, till almost all our western peninsula had easterly variation, but it has since been moving towards the west, till it has almost entirely passed off our boundaries, and the declination is now increasing westerly over all Canada. At Toronto it has increased from 1° 14′ 3″, in 1841, to 2° 21′ 9″, in 1864, or at the average rate of 3′ annually, and at Quebec the rate is apparently rather greater. The exact period of the change in Upper Canada cannot be well ascertained; at Quebec it appears to have nearly coincided with the commencement of this century, as may be seen from the following table:—

1642	16° 00′	Bressani.
1686	15° 30′	Des Hayes (Hansteen).
1785	12° 35′	Surveyor General Holland.
1793	12° 05′	do do
1805	11° 35′	Smallest observed.
1840	13° 35′	Surveyor General Bouchette.
1860	16° 00′	

We have thus returned to the same amount of declination which Bressani observed 220 years ago.

It is the same all along the Atlantic coast, as may be seen from the following table, extracted from the reports of the United States Coast Survey.

Cambridge, Massachusetts:—

	DECLINATION.	
1708	9° 00′	Earliest recorded observation.
1782	6° 48′	Smallest recorded.
1842	9° 34′	

Providence, Rhode Island:—

1717	9° 36′	Earliest.
1790 } 1795 }	6° 10′	Smallest.
1848	9° 15′	

New York:—

1750	6° 22′	Earliest.
1789	4° 20′	Smallest.
1845	6° 25′	

Hatboro', Pennsylvania:—

	DECLINATION.	
1680.....	8° 23′.....	Earliest.
1790.....	1° 50′.....	Smallest.
1850.....	4° 25′.....	

From the observations at 18 stations in the United States, as given by C. A. Schott, United States Coast Survey, 1859, App. 24, the period of the change in the oscillation varies from 1765 to 1815, and the conclusion is drawn that the period is later the further you go South and West, the change of oscillation not having yet occurred on the western coast. It is to be observed that that in the same paper the date of the change at Quebec is given as 1769, which does not, by any means, accord with the observations which we have recorded.

One of the great uses of societies like our own, is to afford opportunities to persons who have neither the leisure nor the attainments necessary to conduct sustained scientific investigations, to contribute, nevertheless, occasionally a stray fact, of which the working men of science may take advantage. I had seen only an imperfect notice of Brossani's determinations of declination, and none at all of those of Champlain, which appear to me important, not only from their early date, and the character of the man for accuracy, but also from their remarkable deviation from the law now regulating magnetic variations in the same region. I desired to make this Society the medium of putting them on record in a more accessible shape, than when buried in two rather rare books, and I have taken the same opportunity of treating upon some of the general features of a rather complex subject.