

## THE DEVELOPMENT OF ASTRONOMY IN FREDERICTON, NEW BRUNSWICK, BETWEEN 1847 AND 1876\*

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### ABSTRACT

During the mid-19th century, astronomy in Fredericton was advanced primarily through the efforts of William Brydone Jack. Four main phases comprise his contributions to this science: the building and equipping of the first astronomical observatory in Canada, the preparation and presentation of the first public lectures on astronomy given in Canada, the improvement of land surveying in New Brunswick through the establishment of methods for standardizing surveyor's chains and checking magnetic compasses, and the application of "galvanism" or the electric telegraph to the determination of differences in longitude between centres in New Brunswick and the United States. In this last enterprise, Brydone Jack was assisted by Dr. J. B. Toldervy, a Fredericton physician.

Brydone Jack is well known to JOURNAL readers (Kennedy 1972) as the first Canadian astronomer. He was born and educated in Scotland; his birthplace was not far from Dumfries, his early schooling took place at Bankend, and he graduated from the University of St. Andrews with a distinguished academic record, winning many prizes and scholarships. In 1973–74, I visited these localities in Scotland. A few days were spent in the archives at the University of St. Andrews, obtaining information on Brydone Jack's education and the outstanding professors under whom he studied. As a result of this search, nothing has emerged which permits me to pinpoint with certainty where his dedicated interest in astronomy was first kindled.

As a young man, Brydone Jack was appointed as professor of mathematics and natural philosophy at King's College and arrived in Fredericton in September, 1840. The faculty was not large, consisting of three professors and Rev. Edwin Jacob as President of the College. In 1847, Dr. Robb, who taught geology, chemistry and biology, cooperated with Brydone Jack in submitting a list to the College Council of additional apparatus required "for the illustration of their respective branches of instruction". The first action taken by the Council was to appoint a committee and refer their request to it! Brydone Jack had prepared his submission in more detail than Robb, asking for telescopes, theodolites, a sextant and a camera. The committee could not find adequate funds to meet all of their requests but recom-

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mended that £550 be devoted to the object in view with £300 appropriated “for the Mathematical Department—to be applied in the purchase of a good 7 feet Achromatic Telescope and such other apparatus as may be more immediately necessary”.

The Lieutenant Governor of New Brunswick corresponded with Colonel Sabine,\* then stationed at Woolwich, and sought his opinion as to where the best telescope could be obtained. A summary of the various possibilities outlined by Sabine was prepared by Brydone Jack and forwarded to the Chief Justice of the province who was also Chancellor of King’s College:

“The first is, to order the instrument from Dolland, who is universally acknowledged as the best London maker:— The 2nd to try to procure a second hand Telescope of the requisite size and of good reputation, and send it to Dolland to remount:— and the 3d to order the instrument from Merz of Munich. The first course is recommended by Mr. Bishop, who enjoys a high reputation as an Amateur Astronomer. The second is proposed by Sir John Herschel and Mr. Airy, the Astronomer Royal, both of whom, however, think that a most superior object glass could be procured from Munich, but that the obtaining of it would be attended with considerable trouble.”

Colonel Sabine gave additional supporting evidence in his letter, and indicated from correspondence with Dr. Robinson of Armagh that he also recommended Merz as the supplier of the telescope. Brydone Jack advised the College Council that it could not do better than to leave the matter entirely in the hands of Colonel Sabine, “allowing him to act as it seems best to him, and granting him a little latitude by not confining him too closely to the sum already voted, as he may thus be enabled to make a better choice”.

The “considerable trouble” did not arise from dealings with Merz of Munich as Herschel and Airy had visualized, but rather with the Board of King’s College, which, shortly after an order had been placed with Merz, passed this resolution:

“After full consideration of the whole matter that the Telescope now proposed by Professor Jack at an original cost of £336 sterling with the building and apparatus necessary for its proper use are more than the wants of the College require—or the funds will warrant—that the Lord Bishop of Fredericton and Mr. Justice Carter be a Committee of this Board authorized to make arrangements for annulling the order given for such a Telescope on the best terms in their power and

\*Sabine was president of the Royal Society from 1861 to 1871. In his early life, he devoted himself to astronomy and physical geography and was appointed astronomer to various expeditions. Two phases of his scientific work are noteworthy. These were: (i) the determination of the figure of the earth from pendulum measurements made at several coastal stations in the north and south Atlantic regions, and (ii) his researches on terrestrial magnetism, establishing magnetic observatories at various locations in British territories and reducing the observational data obtained at these. During the 1830’s, Sabine was in charge of the magnetic observatory at Toronto.

to secure the best instrument which can be obtained at a charge not exceeding £100 sterling over and above the sum of £110 sterling already advanced to the Manufacturers & that the said Committee do confer with Sir Wm. Colebrooke & Col. Sabine on the subject—”

Brydone Jack was incensed over this development. He wrote to the Chancellor of King's College assuring the College Council “that the Telescope now ordered will be as superior to an inferior instrument in the limited use to which they mean to put it, as it would be for every other purpose; and that even had I been aware of the inadequacy of the funds at their disposal to make the most of its capabilities all at once, I should still have recommended its purchase, ...”

Merz and Sons of Munich were astonished and clearly indicated their situation in a letter to Mr. Justice Carter. The firm acted shrewdly, wrote directly to Colonel Sabine and implored him “to be pleased to set right this afflicting affair”. In September, 1848, Sabine communicated with Professor Jack stating “that I cannot for a moment doubt the intention of the gentlemen who form the Council to King's College to conclude the transaction in a manner which shall be satisfactory to Mr. Merz”. It must have been satisfying for Brydone Jack to take delivery on behalf of King's College of the superior telescope.

In the midst of all this turmoil, Brydone Jack was convincing the members of the College Council that an observatory was needed for this telescope as opposed to housing the instrument in a converted room of the existing College Building. He sensed that strong opposition to the expenditure of money for a separate structure might be forthcoming and outlined valid reasons for such an expenditure (figure 1) :

“1st The Students of the College would be incited to prosecute the study of Astronomy with greater zeal and assiduity, as they would have the means within their reach of obtaining data for the solution of many interesting Astronomical problems, and also be enabled by direct observation, to test the truth of the conclusions to which they are led in physical Astronomy.

2nd Great benefit would result to Astronomical science, if a regular series of observations could be made at Fredericton; and much credit would thereby be reflected on New Brunswick.

3d It would be greatly to the advantage of the Province to have one fixed point, whose position is accurately determined; and to which surveyors and the inhabitants generally could refer, and thence deduce with precision the position of others.

4th The pleasure it would afford to many amateur Astronomers would tend to foster a taste for, and diffuse a knowledge of the most sublime, most perfect and most interesting of all human sciences.”

The Council in its wisdom appointed a Committee to superintend the erection of an observatory. In 1851, this committee reported that the building had been completed and the telescope placed therein. However, it was

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FIG. 1—In a letter written to the Chancellor and the Members of the Council of King's College in February, 1848, Brydone Jack clearly outlined his various reasons for building an observatory to house the telescope purchased from Merz and Sons of Munich (reproduced by permission and with the cooperation of the Archives Department, Harriet Irving Library, University of New Brunswick, Fredericton).

found that “the whole expense of the building and other things connected with the final completion of the Observatory, has somewhat exceeded the original estimate of £150. The actual expense incurred, as appears by the Registrar's account hereto annexed is £170.19.7”. (Further details of the observatory itself have been given by Kennedy (1955b).)

This first astronomical observatory was commemorated with a plaque by the Historic Sites and Monuments Board of Canada in 1955 (Kennedy 1955a). On the occasion of the unveiling ceremony, Dr. Jack Heard, in his commemorative address, referred to the problems of the early observatories in attempting to measure longitude, describing it as “elusive, especially at sea and beyond the continent of Europe”. While the development of an accurate chronometer by Harrison provided the impetus for the solution of this problem, the application of “galvanism” through the electric telegraph to the measurement of differences of longitude was one of the more outstanding

achievements of mid-19th century astronomy. Brydone Jack was a pioneer in the introduction and application of this technical development.

In the measurement of differences of longitude between Fredericton and Harvard College Observatory at Boston, and later between centres in New Brunswick, Brydone Jack relied on the assistance of a close associate, Dr. J. B. Toldervy, who had a private observatory situated near the telegraph office. A record of an accurate traverse from King's College Observatory to Dr. Toldervy's observatory has been preserved. Early in 1855, Brydone Jack and Dr. Toldervy exchanged telegraphic signals with Harvard College Observatory, through the cooperation of Professor W. C. Bond. The longitude of Fredericton with reference to Boston was thus established and an account of this work was published (Toldervy and Jack 1855).

Encouraged by this initial success, Brydone Jack travelled in the summer of 1856 to Little Falls and Grand Falls on the upper portion of the Saint John river about 175 miles from Fredericton and, with the assistance of Dr. Toldervy, determined the longitude of these centres with reference to Fredericton. Grand Falls and Little Falls are located relatively close to the border between the United States and the province of New Brunswick. In this report, the values are listed which had been found at Little Falls by the American Commission on the boundary survey, the British Commission and by Brydone Jack and Dr. Toldervy. A difference of about 9 seconds of time appeared between the American and British determinations, with the results of the telegraphic method of Jack and Toldervy being in close agreement with the value arrived at by the American Commission.

When this report was read by the Astronomer Royal, Sir. G. B. Airy, an exchange of correspondence was initiated with Brydone Jack to resolve these differences (Kennedy 1976). Airy had little choice but to support the determinations made by the British Commission, based on lunar transits. Brydone Jack and Dr. Toldervy believed that the longitude of Boston was accurately determined through the chronometer transfers from Liverpool. With the Fredericton longitude determined with reference to Boston, and the Grand Falls and Little Falls longitude with reference to Fredericton, the longitude of the Canada-United States boundary depended on the accuracy of the longitude of Boston as a starting point. As Airy phrased it in his letter, "which is the more trustworthy determination? that by the British lunar transits, or that by the American chronometers?"

Brydone Jack obtained data from Professor W. C. Bond on the methods which had been used in the determination of the longitude of Harvard College Observatory. Bond's letter provides an excellent historical summary of the various approaches which had been used in establishing this value. When this information was forwarded to Airy, his views were modified slightly, but for political reasons he could not give much ground. On the

specific questions of “What should be adopted then for the longitude reference point in the British Provinces?”, Airy stated “that the United States result ought to be received without any qualification for the British provinces”. His reasons were: “First, it cannot be very erroneous. Secondly, whether it be right or wrong, it is far more important that conterminous districts (British and U.S.) of North America should agree in their basis of longitude than that the British Provinces should agree with Greenwich.”

The pioneering work of Brydone Jack, assisted by Dr. Toldervy, in applying the electric telegraph to longitude determinations between Boston and Fredericton, and later to other centres in New Brunswick was the most significant scientific contribution made by Brydone Jack in the field of astronomy during his forty-five years at King’s College and the University of New Brunswick.

During the 1850’s King’s College was under close scrutiny by the members of the legislative assembly of New Brunswick, with criticism directed to the training of students in the classical tradition. In an attempt to improve the public image of the College, Jack gave an extensive series of lectures on astronomy and related topics to audiences in Fredericton and Saint John.

Correspondence between Brydone Jack and the Astronomer Royal shows that Jack was favourably impressed by the copy of the *Series of Lectures Delivered at Ipswich* by Airy in 1848. As he prepared his lectures on astronomical topics, Brydone Jack relied on the substance and style of the Ipswich lectures. In both, explicit illustrations are found of those topics in astronomy receiving scientific attention in mid-19th century England. Airy discussed the form and dimensions of the earth, measurement of distance by parallax, transits of Venus across the sun’s disc, velocity of light by eclipses of Jupiter’s satellites, pendulum experiments, the Schehallien\* experiment, weight and density of the earth. In Brydone Jack’s lectures on astronomy, a coverage of similar topics appears.

Yet whether you turn to Airy’s Ipswich lectures or to Brydone Jack’s lectures, a style may be found which has regretfully disappeared from scientific writing. The evening lecture of 5th January, 1857, opened with the following paragraph:

“Gentlemen:

In my last lecture, after enumerating the arguments previously advanced for the rotation of the Earth on an Axis from West to East, in order that we might thereby explain the apparent diurnal revolution of all the heavenly bodies from East to West, I proceeded to state that, notwithstanding the convincing nature of these arguments, and the vast preponderance which even a slight knowledge of the actual circumstances of the case seemed to assign to them, there still appeared something wanting to convince the mass of mankind—some visible and tangible proof

\*Mountain in Perthshire, Scotland, used in 1772 to demonstrate the deviation of a plumb-line from the vertical, due to the attraction of a nearby massive body.—Ed.

needed—to enable the generality of men to realize the fact that they were assuredly whirled round with the prodigious velocity asserted, while they remain utterly unconscious of any movement whatever.”

A second illustration may be taken from a period when the celestial bodies still retained the male-female designation. Brydone Jack expressed clearly his views on the sun:

“Having now ascertained not only the distance of the Sun from our Earth but also the magnitude and mass of that great central and presiding luminary of our planetary system, we have next to enquire whether he remains in dignified repose, calmly controlling the motions of his attendant worlds and nourishing and cherishing them by the light and heat which he imparts, or whether he also has not a motion of rotation and translation such as has been proved to exist in the case of our Earth, and may be observed to characterize all the sister planets. It is clear that were it possible in any way to distinguish distinct and well-defined marks on the disc of the Sun, we could from them infer whether or not he turned upon an axis. For, if he did not, they would always maintain the same apparent position on the face he presented to us, however much they might alter in aspect, or even disappear altogether. But if he did, they would appear to move from one side to the other with a variable velocity over the supposed spherical surface.”

Among Brydone Jack’s lectures on astronomical topics and closely related areas may be found such titles as *Telescopes, Space and Its Contents, Popular Astronomical Fallacies, Comets, and Remarks on Land Surveying, with Tables and Suggestions for Improving the Method Practised in New Brunswick*.

In the last of the above lectures Brydone Jack expressed concern over “the low prices of the land and the smallness of the remuneration which on this account can be afforded for surveying it. The fact will of course discourage men of eminent ability and superior education from entering the profession (a land surveyor) ... A great part of the business must, therefore, be entrusted to incompetent and perhaps dishonest persons, ...”.

Brydone Jack’s knowledge of the instruments required for accurate surveying was clearly shown in the following passages dealing with the errors inherent in the *chain* and *circumferentor* (surveyor’s magnetic compass, see figure 2).

“In regard to the Chain: – it is liable to be stretched or lengthened by use, and ought therefore to be examined from time to time and compared with some standard measure. Such a measure Mr. Inches of the Crown Land Office has procured for the purpose; but whether he has the power to insist upon every Surveyor submitting his Chain for examination within a certain stated interval – say of one or two years I am somewhat uncertain. If he has not this power he ought to have it; ...

“In regard to the Circumferentor: – it is obvious that in consequence of all the angular measurements being dependent on the movements of the magnetic Needle, it is liable to very grave objections and can never give very trustworthy results. As I have already said however there appears little chance of its being

superseded by the more reliable Theodolite, and therefore it will be well to examine more closely into its defects, and see how far and in what way they can best be obviated.”

The suggestions brought forward in this lecture came to fruition in 1874 when Brydone Jack was among those appointed to the Board of Examiners for the examination of candidates for admission to practise as Land Surveyors in the province of New Brunswick. The legislative act which outlined the qualifications of Candidates for Surveyor, specified that the instruments in use must be tested within one year, and for testing and verifying these

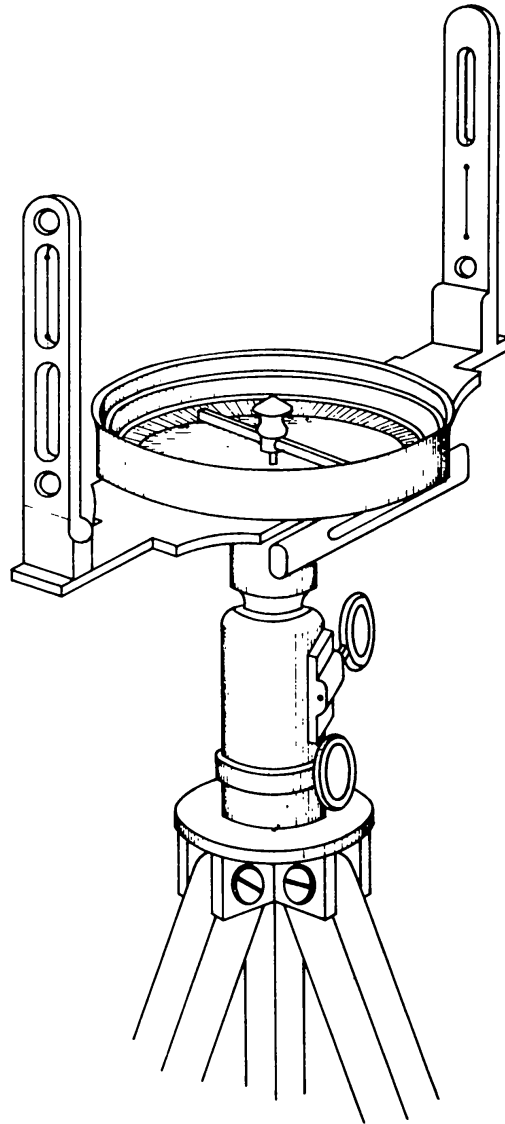


FIG. 2—An artist's drawing of a circumferenter made from an illustration in an 1882 catalogue of optical, mathematical, meteorological and surveying instruments (James Parkes and Son, Birmingham). The instrument was described as a Plain Six Inch Circumferenter, or Miners' Dial, with numerous features, priced at £10-10-0. Circumferenters of a similar type may well have been used in the land surveying of New Brunswick in the 1870's.

instruments, the length of a standard chain was to be laid down and marked. In order to check the accuracy of compasses, the true meridian line was established with reference to the Observatory on campus and a stone pillar erected at a distance of 8.82 chains from the transit pier (Kennedy 1956). In recent years, the first step towards preserving this historic stone pillar where numerous magnetic compasses had been checked by Brydone Jack was to protect it by erecting a small enclosure consisting of four wooden corner posts joined by heavy link iron chains. This ensured that further testing of magnetic compasses at that site was ended!

The length of a standard chain was laid down in the Great Hall of the Arts Building at the University of New Brunswick by inserting brass plugs into the floor. The location of these pins has not been found, so the first "standards laboratory" in Canada is awaiting discovery.

The question remains to be answered as to whether these suggestions of the 1875 period for the improvement of land surveying provided guidance or assistance to Dr. W. F. King in Ottawa who faced formidable problems in the accurate survey of the provinces of western Canada before large numbers of settlers arrived there in the late 19th century and early part of the 20th century.

The geographical location of New Brunswick has isolated this area from central Canada; the other Maritime provinces share in this isolation. Developments which have taken place there, both in the sciences and the arts, have failed in many instances to make a significant impression on parts of this vast country. Brydone Jack found in Fredericton an atmosphere conducive to the development of his various scientific pursuits during the period 1847–1876. For these outstanding contributions he must be recognized as one of the great Canadian pioneers in astronomy.

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NOTE: Other sources of reference material were the Brydone Jack letters, housed in the Library Archives at the University of New Brunswick, Fredericton, particularly that correspondence pertaining to the procurement of the telescope from Munich and the building of the observatory at King's College. Extracts have also been taken from the Brydone Jack public lectures on astronomy; the original lectures form part of the extensive Jack papers in the Archives of the New Brunswick Museum, Saint John.