Our Record of Canadian Earthquakes.

By Sir J. William Dawson.

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In the "Canadian Naturalist," 1st series, vol. v., on occasion of the earthquake of October 17, 1860, an account was given by the writer of this article of all previously recorded Canadian earthquakes, with remarks on their periodicity, local peculiarities and probable causes. In the same periodical, new series, vol. i., the record was kept up to 1864. In vol. v. of the same series it was continued to the earthquake of October 20, 1870; and in vol. viii. to that of November 4, 1877, which was the most considerable since that of May, 1871. The severity of the shock of Nov. 27th, 1893, has again attracted public attention to the subject, and furnishes a suitable occasion for continuing the record.

Subsequently to 1877, the following earthquakes have been noted at Montreal, but have not been recorded in this journal. They are given as reported in the newspapers of the time, and the dates are of course very imperfect:

1879—April 7—St. Paul's Bay, at midnight, slight and local.
June 11—Montreal and elsewhere in the Province of Quebec; smart shock with rumbling noise.
Aug. 21—Various places in Ontario; slight shock (in the morning.)

1880—Feb. 8—Ottawa, slight shock.
April 3—Quebec and Ottawa, 10 p.m., slight.
Nov. 24—Quebec, 11.45, smart shock.
Nov. 29—Bay St. Paul, smart shock.
Dec. 30—Cap des Monts, smart shock.

1881—May 31—Lower St. Lawrence, at L'Islet, 4.30 a.m.; Murray Bay, 3.30 a.m.

1882—Oct. 10—Montreal, at daybreak, slight.
Dec. 4—Various places in Ontario and Eastern Townships of Quebec, smart shock; at Welland, 6.30 p.m.

1883—Jan. 1—Various places in the Maritime Provinces. At St. John, four minutes before 10 a.m., slight.

March 11—10h. 57m. and 11h. 7m.—Two distinct shocks at Waterloo, P.Q., St. Johns and Cowansville (R).[1]

March 23—21h. 25m., at Huntington, P.Q., slight (R).

April 1—Hamilton, Ont., smart shock at 1h.

Oct. 15, Nov. 5, Nov. 22, Dec. 32—Slight shocks at Point des Monts, P.Q.

1884—Jan. 29—Three light shocks at Rothesay, near St. John, N.B. (R).

Feb. 16—Very slight, Point des Monts, P.Q.

March 18—South-eastern Newfoundland (R).

Aug. 10—Strong in New England and Middle States, light in Canada (R).

Sept. 16—Moderate in Ohio and neighbouring States; felt slightly in Western Ontario (R).

Oct. 24, 0h. 14m.—Huntington, P.Q., slight.

1885—March 11, 10h. 57m.—Two very light shocks; 11h. 7m., a third at St. Johns and Waterloo, P.Q., in a severe snowstorm.

March 18, 19h. 45m.—Very light, at Point des Monts, P.Q.

March 23—Very light and rumbling noise, various places, P.Q.

April 16, 9h.—Light, St. Fidèle and Murray Bay, P.Q.

1886—This was a remarkable year for earthquakes and volcanic eruptions. In June occurred the terrible eruptions at Mount Taracuera, in New Zealand. On July 23 there was a violent eruption of Cotopaxi, in the Andes. On August 28 began the great series of earthquakes so destructive at Zante and elsewhere in Greece, and which were felt throughout the Mediterranean region. On August 31 and following days occurred the severe earthquakes which, centering at Charleston, South Carolina, extended over a great part of the United States, and were felt slightly even in the Lake region of Canada. From the observations of Prof. McLeod, of McGill

[1] Those marked thus (R) are from the printed Reports of Prof. Rockwood, of Princeton.

University, it would appear that on August 31 earthquake shocks were felt at Toronto, London, St. Catharines and Petrolia, but none were recorded in Eastern Canada; nor does the year 1886 appear to have been one of unusual seismic activity in Canada. At Montreal it would appear that no earthquake shock was observed in 1886. For the other slight shocks experienced in Canada in 1886 reference is made to the report of Prof. McLeod, appended.

1887—Murray Bay and elsewhere in the Lower St. Lawrence, several slight shocks at different dates.

1888—Jany. 11—Ottawa Valley, several smart shocks.

Feby—Slight shock at Ottawa.

July 1—Montreal, slight shock.

Nov.—Lower St. Lawrence, several shocks at different dates.

1890—Sept. 26—Montreal, 2.45 a.m., perceptible shock and rumbling noise.

1892—July 26—10 p.m., observed by Dr. Ells between Petite Nation and Lievre River, a smart shock.

1893—Nov. 27—Montreal (McGill College), 11.47 a. m. Ottawa, as observed at Geological Survey, began 11 47′ 05″ continued 15 seconds, ended 11 47′ 20″. Several observers report it as double, the second being most severe. Quebec, 11.47 a.m. At all the above places the shock was a smart one, shaking buildings and causing some alarm and displacing unstable objects. As observed by Prof. McLeod at the Observatory, McGill College, the barometer stood at 30 in. 15 and falling, the thermometer 24° 5′, the wind was from the north-east and the sky overcast. The vibration seemed to be propagated from the N. E. This was a shock sufficiently violent and widely extended to excite much public attention.

The following extracts from the newspapers show the effects which the earthquake produced, as noticed at the time in the public press. At 11.47 o'clock this forenoon, the city and the country generally round about felt

the most severe shock of earthquake that has visited this part of the continent for several years. Buildings rocked and trembled as if about to be thrown down by the percussion of an explosion. At first came a heaving sensation like that of a ship rising over a heavy dead swell; the buildings creaked as if every joint and fastening was being tested by some invisible force, and then a dull, muffled deep-toned sound like that of a subterranean explosion. The shock was felt from foundation to turret of the most substantially built edifice in the city, and then came the settling back, and for an instant it felt as if everything was going down—then a moment of suspense and the earthquake had passed. Prof. McLeod, of McGill Observatory, noted the time; it was just thirteen minutes to twelve o'clock, and the shock apparently came from the north-east and moved towards the south-west. It was distinctly felt in the Observatory and all through the College buildings, but not so severely as in the lower part of the city. Perhaps that part of the city situated along the brow of the hill between Dorchester and St. Antoine street felt the shock most distinctly, and there the people were the most frightened. Many offices and public buildings were rapidly emptied of their occupants, and in others persons ran into the corridors, but had not time to get farther before the shock was over. As usual in such cases, animals were much frightened, and some horses on the cab stands ran away.—(Montreal Evening Papers, Nov. 27.)

ORMSTOWN—About this place the earthquake shock on Monday appears to have been most severely felt. The foundation and brick work of the school were cracked. The iron bridge rattled and some stones fell out of the abutments. John Ligget's brick house was cracked in three places. Cattle huddled together in great fright. Wells were disturbed, some chimneys toppled over, and window glass was broken. In Mr. Dewar's drug shop some bottles were upset and broken. Those who were in the woods state that the ground had a waving motion for about a minute. It was the heaviest earthquake for thirty-five years.

VAUDREUIL, P.Q.—Several chimneys were thrown down and the walls of houses were cracked. The people were much excited.

The earthquake seems to have been felt throughout Quebec and Ontario and in the New England States and New York. So far as appears from the newspaper accounts it seems to have been most severe in Western Quebec and Eastern Ontario.

In Montreal it was sufficiently violent to cause a perceptible movement in buildings, enough in many cases to produces a panic among the inmates, the effect being described as resembling that of a violent explosion within the building, or the fall of some heavy object from the ceiling. The higher buildings in the lower part of the city were naturally the most affected, but no serious damage is recorded except in one instance, from the fall of planks from a scaffolding. In a few instances cracks were produced in the walls of buildings.

Dec. 1—Another shock was felt at several places on the Lower St. Lawrence. Moisie, Labrador, 5 a.m.; Seven Islands, Saguenay, 5.30 a.m. The shock is said to have been strong.

The following hints as to recording the intensity of earthquake shocks, based upon the Rossi-Forel scale, adopted by the Italian and Swiss seismologists, are taken from Prof. Rockwood, for the benefit of future observers, (*American Journal of Science*, July, 1886):

General Designation.	*More Particular Classification.*
Microseismic shock	I. Recorded by a single seismograph or by seismographs of the same model, but not putting in motion seismographs of different patterns; reported by experienced observers only.
Very light.....	II. Shock recorded by several seismographs of different patterns; reported by a small number of persons at rest.
	III. Shock reported by a number of persons at rest; duration or direction noted.

Light	IV. Shock reported by persons in motion; shaking of movable objects, doors and windows; cracking of ceilings.
Moderate	V. Shock felt generally by every one. furniture shaken; some bells rung; VI. General awakening of sleepers; general ringing of bells; swinging of chandeliers; stopping of clocks; visible swaying of trees; some persons run out of buildings.
Strong	VII. Overturning of loose objects; fall of plaster; striking of church bells; general fright, without damage to buildings.
Severe	VIII. Fall of chimneys; cracks in the walls of buildings.
Destructive	IX. Partial or total destruction of some buildings. X. Great disasters; overturning of rocks; fissures in the surface of the earth; mountain slides.

To these may be added the following questions addressed to the public, on behalf of the Geological Survey of the United States, on occasion of the Charleston earthquake of 1886 (*Science*, Sept. 10, 1886):

"1. At what hour, minute and second of standard time was it felt? When this can be accurately given, it is of the very greatest importance. Be particularly careful to state whether it is standard (railway) time or local time; whether the watch or clock was compared with some standard clock at a railway station or elsewhere, how soon, what the error was, and whether you corrected your observation by this comparison or not.

"2. How long did its perceptible motion continue?

"3. Was it accompanied by any unusual noise? If so, describe it.

"4. Was there more than one shock felt? If so, how many? When several were felt, give accurately, or even roughly, the number, duration and character of each, and the interval between them.

"5. Which of the following measures of intensity would best describe what happened in your vicinity?—No. 1. Very light; noticed by a few persons; not generally felt. No. 2. Light; felt by the majority of persons; rattling of windows and crockery. No. 3. Moderate; sufficient to set suspended objects, chandeliers, etc., swinging, or to overthrow light objects. No. 4. Strong; sufficient to crack the plaster in houses or to throw down some bricks from chimneys. No. 5. Severe; overthrowing chimneys and injuring the walls of houses.

"6. Do you know of any other cause for what happened than an earthquake? Give also any further particulars of interest, stating whether they are from observation or hearsay: for instance, whether the shock seemed like a tremor or jar, or an undulatory movement; and whether it seemed to come horizontally or vertically; whether any idea of direction of shock was formed, and if people agreed in their idea as to such direction. Mention any unusual condition of the atmosphere; any strange effects on animals (it is often said that they will feel the first tremors of a shock before people notice it at all); character of damage to buildings; general direction in which walls, chimneys, etc., were overthrown. Springs, rivers and wells are often noticeably affected by even slight shocks, and such facts are especially interesting. If a clock was stopped, give the time it indicated, and some idea as to how fast or how slow it was, its position, the direction in which it was standing or facing, and the approximate weight and length of the pendulum. If a chandelier was noticed to swing decidedly, describe it and state direction of swing. If pictures swung, state direction of wall, and whether pictures on the wall at right angles to it were also put in motion. If doors were closed or opened, state the direction of the wall in which they were set. All such little facts, if noticed, remembered and recorded, are of great value."

By attending to these directions, persons of ordinary observation, and without the aid of instruments, may contribute valuable information, which, if sent to the editors of

this journal, or to the Meteorological Office at Toronto or the Geological Survey, Ottawa, would probably be recorded. Even if published in any local newspaper, it will be likely to reach persons interested in the subject.

As to the causes and general phenomena of earthquakes, and the best methods of observing them, reference may be made to the excellent little work of Milne on "Earthquakes and other Earth-movements," (International Scientific Series.)

The following record, consisting largely of reports to the Meteorological office, Toronto, kindly furnished by Prof. McLeod, of McGill College Observatory, is appended, as containing many additional notices of slight and local shocks between 1883 and 1894.

STATEMENT OF EARTHQUAKE SHOCKS FELT IN CANADA.

YEAR.	MONTH & DAY.	PLACE.
1884.	March 18.	St. John, Nfld., Trinity Bay, Harbor Grace, Heart's Content, Bay Robert and Holywood at 1.30 to 1.45 p.m, movement nort'i to south.
	Feby. 16.	Point des Monts, 9 a.m.
	Sept. 19.	London, Ont., 3.21 p.m.
	"	Dresden, Ont., 3.20 p m.
	Oct. 24.	Huntingdon, Que., 9 a.m.
	Nov. 21.	Point des Monts, two shocks, 6.30 p.m. and during night.
	" 22.	Shock felt between St. Flavie and Gaspé last night, lasting 45 to 50 seconds.
1885.	April 26.	Point des Monts, 5.30 a.m.
	Feby. 3.	Huntingdon, 0.20 a.m.
	" 25.	do 0.30 p.m.
1886.	Feby. 13.	Port Hope, Ont.
	March 16.	Victoria, B.C., 0.35 p.m.
	" 21.	Point des Monts, 5 p.m.
	May 16.	do 10.25 a.m.
	" 18.	do 2.30 p.m., strong.
	Aug. 12.	St. Marguerite, St. Adele, St. Sauveur, shock early in morning, lasting over six minutes.
	" 19.	Cooksville, Ont., 3 a.m., shock felt along banks of Credit River.
	" 31.	Toronto, London, St. Catharines, and Petrolia, shocks felt at 9.45 a.m.
	Oct. 14.	Sydney, N.S., 10.30 p.m., lasting ten seconds.
	" 27.	Point des Monts, slight shock.
	Sept. 2.	St. Catharines, Petrolia, Ont. [1]

[1] There is no record of a shock at Montreal in 1886.

EARTHQUAKE SHOCKS FELT IN CANADA.—Continued.

YEAR.	MONTH & DAY.	PLACE.
1887.	Jany. 7.	Point des Monts, 6.40 a.m.
	" 21.	do 2.47 p.m.
	Feby. 15	St. Anne des Monts, 1.30 p.m., N.W. to S.E.
	" 16.	Point des Monts, 2.08 p.m.
	" 22.	do 5.59 p.m., strong.
	" 19	Joly, Parry Sound, Ont., 11.45 p.m., W. to E.
	March 19.	do do 10.50 p.m., slight.
	June 30.	Point des Monts, 10.20 p m.
1888.	Jany. 6.	Huntingdon, 2.30 p.m., slight.
	" 11.	Pembroke, Ont., 4 a.m.
	Feby. 5.	Ottawa, early morning.
	March 2.	Huntingdon, 4.30 p.m., slight.
	April 19.	River du Loup, 0.40 a.m., N. to S., 3 to 4 secs.
	" 19.	St. Paul's Bay, 0.30 a.m., strong, 3 mins. (?
	July 1.	Montreal, slight shock, 4.00 to 4.01 p.m.
	July 10	Shock felt in district between Belleville and Kingston, 11 p.m. Felt at Tamworth 11.15 p.m.; also at Newburgh, Moscow, Yarker and Napanee.
	Dec. 7	Father Point, 9.26 a.m.
		St. Flavie, 9.25 a.m., strong, 30 secs.
		Trois Pistoles, 9.35 a.m.; also at Rimouski.
1889.	None.	
1890.	May 17.	Point des Monts, 8.30 p.m.
	Sep. 26.	Montreal, slight shock at 3.3 a.m.
	Oct. 29.	Meach Lake, 12 miles from Hull, Q., 5.30 p.m.
1891.	Sept. 21..	Esquimalt, B.C., two distinct shocks, 3.30 p.m, N. to S.; 3.50 p.m., E. to W.
	Nov. 29	Esquimalt, B.C., 3.20 p.m.
1893.	July 30.	Carmanah, 3.15 p.m., two shocks.
	Nov. 12.	Masset, Queen Charlotte Island, sharp shock at daybreak.
	" 27.	Alexandria, Ont., 11.49 a.m., sharp.
		Montreal at 11.47, sharp shock.
1894.	Jany. 11.	Godbout, Point des Monts, Pentecost, Seven Islands and Moise, P.Q., between 4.07 and 4.30 a.m., lasting 10 seconds.
	Feby. 23.	Toronto, 11 p.m., felt in eastern part.