Prescott, 5 30 a. m.
Belleville, 5.30 a. m. One shock.
Hamilton, 4.45, a. m.

In all or nearly all of the above places the earthquake was preceded by a rumbling noise which gradually decreased after the vibrations had passed. The difference of duration ascribed to the shocks appears to arise mainly from the circumstance that some observers include the continuance of vibration in buildings, &c., as well as that of the subterranean sound; and in this way it is probable that by some persons two or more shocks have been regarded as one.

The following graphic account of the phenomena as observed at River Ouelle appeared anonymously in a Quebec paper, and is the most detailed statement we have seen of the effects of the earthquake in those localities in which it was most violent.

Rivière Ouelle, 17 octobre, 1860.

"Ce matin trois fortes secousses de tremblement de terre sont venues jeter la frayeur au milieu de nos populations.

"Les batisses situees de chaque côté de notre rivière ont souffert généralement. Une cheminée chez E. Chas. Têtu, deux chez M. C. Casgrain, une chez M. Frenette, une chez Auguste Casgrain, une chez madame Frs. Casgrain, et chez une dizaine d'autres personnes ont été renversées. La croix de notre Eglise et le coq qui la surmontait sont à terre; les murs de notre belle église sont lézardés. Les secousses étaient effrayantes; la première, la plus violente, a commencé à six heures et quart, et a duré quatre minutes et 40 secondes, très violentes durant dix secondes et s'affaiblissant graduellement; la secousse la plus faible à six heures et vingt minutes, a duré trois à quatre secondes, et la troisième à commencé a six heures et demie, et n'a duré que deux à trois secondes; mais, comme la première, c'était un choc saccadé faisant danser les meubles, décrochant les cadres, les horloges, etc

"Les secousses ont été plus faibles sur les hauteurs, que dans les plaines, de sorte que mes bâtisses se sont trouvées à l'abri des accidents.

"Jamais de mémoire de nos habitants, nous n'avons eu des coups aussi forts. Je suis demeuré devant mon horloge tout le temps pour m'assurer de sa durée, afin de pouvoir computer avec d'autres endroits la marche de ce grand et terrible phenomène.

"Un bruit sourd et fort nous a d'abord averti et ensuite sont venus les secousses et les craquements."

The observation of Dr. Smallwood that the wave proceeded from east to west accords with that of some other observers and may be regarded as correct. At the same time the nearly simultaneous occurrence of the shock throughout Canada, perhaps indicates that the wave did not move horizontally but reached the surface from a great depth and at a high angle as Perry seems to suppose the earthquakes of Eastern America have usually done. It must however be observed that at the rate of propagation given by Mallet for earthquake waves through hard rock, which is not less than 10,000 feet per second, it is quite possible that even a horizontal wave may appear to be felt at the same instant at great distances.(1)

All the observers agree that the sound preceded the shock and continued after it, and that the first shock was the most violent; and it is also very generally noted that it was most severely felt on low ground and least so on rocky eminences. This last character which belongs to earthquakes generally, seems to arise from the greater resistance opposed to the vibrations by loose materials as compared with hard rocks.

It appears from the published lists that the late earthquake is the last of at least twenty-nine that have visited Canada since its discovery by Europeans, and we now proceed to give some account of these previous instances, availing ourselves mainly of the facts and conclusions stated by Mallet and Perry, the two most extensive and laborious collectors of earthquake statistics.

Mallet defines an earthquake as "the transit of a wave of elastic impression in any direction from verticality upward to horizontality in any azimuth through the crust of the earth, from any centre of impulse, or from more than one, and which may be attended with tidal and sound waves dependent upon the impulse and upon the circumstances of position as to sea and land" Such "earth-waves" travel outward from the centre of impulse with immense velocity and appear as upward shocks or undulating rolls according to the greater or less verticality of the motion. They may also be complicated with indirect shocks arising from unequal or circuitous transmission of the vibrations, and these complex shocks usually occur in great and destructive earthquakes.

The causes of these vibratory waves, are too deep-seated to be directly known to us, but they must occur when any part of the crust of the earth is subjected to tension, and when this is suddenly relieved by fracture or otherwise, and again when any part of the earth's crust is left unsupported and collapses under the force of gravity. Geology teaches us to refer such effects to the slow expansion or contraction of great masses of rock under the influence of heat, to the disengagement of elastic gases under pressure, to the removal of matter from the interior to the surface by volcanoes, to the transference of sediment from the land to the sea basins. Such causes are constant and secular, and of course the precise time at which the tension or unsupported weight shall give way can scarcely be calculated, and may occur with suddenness and at irregular intervals; and so nice may be the balancing of opposing forces, that observation shows us that the attraction of the moon or an unusually low state of atmospheric pressure may overset the equilibrium an induce an extensive vibration of the solid crust of the earth, yet the actual causes of the phenomenon may have been for ages slowly preparing for it.

The fractured condition of the rocks of the earth shows that earthquakes have been occurring throughout all geological time, and they are by no means rare phenomena at present. For the whole earth their rate of occurrence is stated to be nearly 3 per month or 36 per annum; and no doubt very many are unrecorded and would considerably increase the average. But their distribution locally is very unequal. While in some spots slight earthquakes are of almost constant recurrence and in others great agitations of the earth are not infrequent, in other extensive regions no earthquakes are known to have occurred. Earthquakes are manifestly connected with the causes of volcanic action, and follow the same law of distribution on the surface of the globe; though in volcanic regions earthquakes and volcanic eruptions sometimes alternate, as if the suppression of the latter gave increased energy to the former. Hence volcanic vents have been regarded as safety valves to those pent-up *Seismic* agencies, as they have been called, which shake the pillars of the solid land.

In Mallet's map of the distribution of earthquakes, in the Report of the British Association for 1858, a belt of intense seismic activity runs from the Falkland Islands and Cape Horn along the Andes and Rocky Mountains, giving off a branch through Colombia to the West India Islands. It crosses over to Asia by the Peninsula of Alaska and the Alutian Islands, and runs down through Kamtschaska, the Kurile and Japan Islands, from which it gives off a branch along the Ladrone Islands, but the main body crosses over to the Philippines, and from these a great crescent shaped patch stretches around Celebes, Java, and Sumatra. This crescent of the East India Islands seems to be the most intense seat of earthquake force in the world. It sends off branches in different directions. One of these passes eastward and southwest through New Guinea and the New Hebrides to New Zealand, and probably beyond it to the Antartic continent, giving off a long branch through the Polynesian Islands. Another goes northward and spreads itself in Central Asia. A third running up the Malayan Peninsula and through northern India, Persia and Asia Minor, passes along the south of Europe and extends to the Azores, giving off a faint branch through France and the British Islands to Iceland. The great eartquake band thus traced, includes nearly all the active volcanoes, except a few apparently isolated spots in the Ocean, like the Sandwich Islands. There are however broad sheets of the earth's surface traversed by the earthquake vibrations proceeding from this band of maximum action, and there are also subordinate bands of small intensity which have not been noticed in the above sketch. To the latter belongs the east coast of America, which seems to constitute a continuation of the West Indian branch, extending upwards along the Appalachian chain to Labrador, and perhaps completing the circle of the North Atlantic by a submarine continuation to Iceland.

We of course known nothing certainly of eartquakes in eastern America until after its colonisation by Europeans, yet this does not constitute a difference between America and the old continent so great as might at first sight be supposed. We know comparatively little of earthquakes even in the old world until the 16th century. Nothing more strongly indicates the little attention given to natural phenomena in the middle age of the earth's history, than the fact that while the recorded earthquakes even in Europe and the neighbouring parts of Asia and Africa are only from 10 to 68 per centuary in the first 15 centuries of our era, they rise in the 18th century to 660 and in the 19th already amount to

(1) See Mallet on the Dynamics of Earthquakes.—*Transactions Royal Irish Academy, Vol. XXI.*