the force of vapour was the greatest, being 20·10 m., and on the same day the relative humidity was at 100 or saturation. Ninety-four and a half inches of snow fell on 65 days; none fell in May, June, July, August or September. The snow and rain together measured 59·75 inches of water, and this quantity would weigh 5980 tons to the acre. The average number of wet days in a month was 12½.

The anemometer recorded 8,110,903 revolutions, in the course of the year, equal to 162,218 miles, and a mean velocity for the wind of 18·5 miles per hour. July was the calmest month when the average was 13 miles per hour; November was the windiest when the average rose to 24 miles per hour.

On the 22nd November the mean velocity for the 24 hours was as high as 50 miles per hour. The winds prevailed for 129 days from S. to W.; 107 days from W. to N.; for 76 days from N. to E., and for 54 days from E. to S.

Fog was recorded only on 28 days, and thunder and lightning on 12 days. The drift ice came on the coast as early as the 7th January. Robins were first seen on the 6th April. Grey birds began to sing on the 8th April. On the 22nd April the first herrings were caught in Glace Bay. Frogs croaked on the 1st May. The white coltsfoot came into bloom on the 8th; and on the 11th May the first butterfly, "the Camberwell beauty," was seen.

Art. VIII. Notes on the Structure of the Nova Scotia Gold Districts. By Henry Y. Hind, M. A.

[*Read April* 13, 1869.]

The wide distribution of auriferous quartz in the form of beds throughout Nova Scotia, suggests a uniform origin extending simultaneously over many thousand square miles. Gold, however, is not confined to beds of quartz, but is found in slates without any quartz being visible, and there is good reason to suppose that it is distributed in exceedingly fine particles throughout many beds of quartzite.

The auriferous rocks which are worked in the Province bear a

certain relation to a series of ferruginous blue-black slates which overlie them, several thousand feet thick.

As the ferruginous slates are easily distinguished, are unlike any other known rock in the Province, and possess immense thickness, they form an excellent clue to the locality where the underlying quartzite groups may be found, to the north or south according to the dip of the slates.*

No gold bearing leads are at present worked in the ferruginous slates, although gold-bearing leads have been found in them, as at Wine Harbour, where they are well exposed to view on the coast at low tide, and at Sherbrooke three miles below the village. The city of Halifax is in part built upon the slates, and fine exposures may be seen in some of the streets, and particularly at the railway station. These slates lie above the great mass of worked gold-bearing rocks, which are upwards of nine thousand feet thick, and consist of quartzites interstratified with thin bands of green and blue-black slate, numerous thin beds of auriferous quartz, and some beds of sandstone and coarse grit.

The summit of the quartzite series is characterized by thin bands of green and greenish slates, in which cubic pyrites is abundant. The lower portion is distinguished by blue-black, banded, and plumbaginous slates in which arsenical pyrites is nearly always present in greater or less quantities, as well as in the form of large crystals in the quartzites, and sometimes in nodular masses in the slates and quartzites.

Lower down in the quartzite series coarse sandstones passing into a grit holding grains of a blue hyaline quartz, occur at Mount Uniacke, at Waverly, and at the mouth of St. Mary's River. At the first named district the band is 380 feet thick, very coarse at the base, and gradually passing into a very fine sandstone weathering white; at St. Mary's it is very characteristic.

The sandstones and grits at this horizon are fossiliferous, and of great importance in determining the relation which one gold

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* These slates occur in several parts of New Brunswick, forming part of the Quebec group, (Lower Silurian.) They are noticed on pages 147 and 154 of my Official Report on the Geology of New Brunswick. Fredericton, 1865. Gold has also been found in quartz veins in schists underlying these blacks slates in that Province.

district bears to another. Thin "chiastolite" slates are also found at the base of the entire series.*

Underlying the quartzite group is a gneissoid series, overlying beds of granite interstratified with hornblendic schists, gneiss and granite. The uppermost granitic beds hold masses of hornblendic schists, sometimes in such numbers and quantity as to make it a conglomerate. It also contains crystals of arsenical pyrites. Its bedded structure is well seen on the Halifax and Windsor railway about four miles north of mount Uniacke. The quartzite group lies unconformably upon the granitic series, and contact is visible for more than a mile at Sherbrooke. Hence, while the quartzite series is regarded as Lower Silurian, the underlying granitic group may be Huronian or Laurentian. No limestones have been found in any of the gold districts, but a thin band of blackish limestone is found near the summit of the black slate.

A close inspection of the granitic conglomerate, especially when roughly polished, as when used for building purposes, discloses besides pebbles and unworn masses of schist, small fragments of schist which would escape detection in rough blocks or on weathered surfaces. The granite used in some of the public buildings at Halifax often exhibits small masses imbedded, and numerous fragments of schist which appear to have originated from an underlying thick bed which probably may be seen *in situ* about three miles north of Mount Uniacke with the granite overlying it. The whole gneissoid series is a sedimentary deposit, but intrusive masses of igneous origin, and commonly distinguished by large crystals of felspar, exist in or near most of the gold districts, and near Halifax.

At Sherbrooke several hundred feet of the gneissoid series are exposed below the quartzite group and lying uncomformably beneath it. Intrusive granite has broken through the gneissoid series, and forms bold escarpments about two miles to the east of Goldenville.

In order to form a proper conception of the structure of our gold districts, we must suppose that much of the gold was deposited from oceanic waters simultaneously with the minerals forming the rocks in which it is found. At a period subsequent to the deposition of the ferruginous slates, the gneissoid, quartzose and slaty

* See Note at the end of this Article.

strata were slowly undulated and thrown into a series of roughly parallel mountain ranges, constituting the east and west anticlinals.

Denudation to the extent of several thousand feet probably occurred during the folding. At a much later period another folding supervened from east to west, producing the low north and south anticlinals with numerous extensive dislocations. The effect of these combined movements was to produce all over the country a large number of elliptical domes, as if a force from beneath had elevated detached portions of the country in symmetrical lines or ranges. Denudation always continuing, the caps or crowns of these domes were removed and the outcropping edges of the slates, quartzites and thin beds of quartz assumed at the surface the forms we generally find them to have at present in the gold districts, namely, that of long ellipses or semi-ellipses more or less regular. Whenever the dome-shaped elevations attained an unusually high altitude the whole of the ferruginous slates and the quartzites were denuded and the underlying gneissoid series exposed; thus apparently favouring the view that these are intrusive masses of granite, instead of the exposed edges of gneissoid strata, standing out in bold relief owing to the resistance they have offered to the denuding forces, which have worn away the more yielding slaty and quartzite series symmetrically disposed above them.

The thin beds of quartz, called lodes, necessarily partook of all the movements to which the strata with which they are associated were subjected, and their study in the field as far as their present arrangement is concerned becomes a question belonging altogether to stratigraphical geology.

Waverley gold district presents us with an excellent illustration of the structural geology of the gold districts of the Province. The strata at Waverley are arranged in the form of an elongated elliptical dome tilted over to the north. The longest axis of this dome has a course N. 85° E. The force which produced the anticlinal operated from south to north and was prolonged until it assumed the form of an overturn, hence on the south side the dips are much less than on the north side, and at the depth of four or five hundred feet the strata on the north side will have an overturn dip, and a vertical section would show the beds to have been thrust over in the form of a pot-hook or letter *S*.

At Mount Uniacke, the reverse of this arrangement occurs. The overturn is here to the south, and the dips to the north are at a low angle. The same disposition is seen at Wine Harbour and Sherbrooke. At Mount Uniacke, Wine Harbour, Sherbrooke and Waverley, the lower gneissoid series stands out in bold outline to the north or east, the auriferous quartzite series reposing on it.

The low north and south anticlinals giving origin to the dome-shaped arrangement of the strata, cause the denuded gneissoid series sometimes to appear as detached masses, and serve to increase the illusion that they are all intrusive rocks. An unbroken area of these lower rocks occurs for many miles near the height of land between the Atlantic and Bay of Fundy, but on either side of this axis the auriferous quartzite group and the ferruginous slates are to be found in regular sequences, and occasionally intrusive granites penetrate the series.

Dislocations are numerous in most of the gold districts, and in many of the cracks true veins are seated.

If no break or fracture had taken place in the strata when the low north and south anticlinal was in process of folding, West Waverley, as part of a gold district, would remain unrecognized. At the east dislocation or line of fracture, an upthrow to the extent of 570 feet took place, and five thousand one hundred feet west of this the upthrow at the west dislocation was upwards of 750 feet. Nor were these the only movements which resulted from the fracture, the entire country between the great dislocations, comprising nearly the whole of West Waverley, was moved as it were on a pivot or centre of motion; the thrust being to the north on the Lake Thomas side for about 520 feet, and on the west or Fishing Lake side, 180 feet to the south. The pivot or centre of the twist lay between areas 200 and 221.

Simultaneously with this oscillatory motion, the strata were squeezed from west to east in the form of an arch, causing an upthrow of the crown of the arch about areas 222 and 223 to the extent of fifteen hundred feet, and bringing the walls of the dislocations three hundred and seventy feet nearer to one another; that is to say—if no squeeze from west to east had taken place, the walls of the break would have been 370 feet further distant from one another than they now are.

The several movements which have led to the present structure of West Waverley may be recapitulated as follows :—

1st. The great East and West overturn anticlinal.

2nd. The low North and South Cross anticlinal, which produced a fracture in the strata 5100 feet from one wall to another, as well as—

3rd. An upthrow of 570 feet on the east side, with a shove to the north of 520 feet, and on the west side an upthrow of 780 feet, and a shove to the south of 180 feet.

4th. A squeeze of the strata between the walls of the break to the extent of 370 feet, by lateral pressure, probably from west to east, and causing—

5th. An upthrow of the crown of the arch, resulting from the lateral pressure, to the extent of fifteen hundred feet.

The west dislocation is sharp and well defined, the line of fracture dipping easterly at an angle of about 60 degrees. The east dislocation is distinguished by a broad belt of disturbed strata, the rock having a brecciated structure. The barrel quartz. of Laidlaw Hill, if it had maintained its dip undisturbed to a point 600 feet west of the centre of the bridge, ought to be about 500 feet below the surface on the axis of the anticlinal, and dipping westerly at an angle of 25 degrees ; it is, nevertheless, found at the surface in a vertical position, or nearly so, with a strike S. 79 E. Throughout this broken belt, which may be 200 feet broad, the rock is much disturbed, the irregularity being caused by the grinding effect of the combined upthrow and shove to the north.

It may be described as a ‘ breccia ’ or rock composed of angular fragments cemented together.

Low down in the quartzite group fossil forms are abundant. They are seen on the weathered surfaces of the grits and coarse sandstones, rarely in the interior of the strata, although casts resembling a modiolopsis have been found in the quartzites as well as obscure stems of encrinites, and worm tracks. The most remarkable forms are found in the gritty sandstones at Waverley. Similar forms occur at Gold River, Sherbrooke, Fifteen Mile Stream, &c.

The occurrence of strata possessing specific characters in different districts many miles apart, enables us to identify the groups of

leads or beds of auriferous quartz associated with them, and as a consequence, possessing probably considerable economic importance, we may eventually be able to predicate with certainty the existence of groups of auriferous leads in districts where no evidence is visible at the surface that such auriferous beds of quartz exist there.

As an illustration of this probable identity, in other words of the continuation of the same strata over a vast extent of country with their associated auriferous beds or leads of quartz, the following may be cited.

Beds of sandstone several hundred feet thick, and holding peculiar concretionary and supposed fossil forms, have been identified at Mount Uniacke, Waverley, Gold River, Sherbrooke and Fifteen Mile Stream. The distance between Gold River and Sherbrooke is 120 miles in an air line. The precise relation which this belt of sandstone bears to the summit and the base of the series is now known. At Sherbrooke the gold bearing quartzose series is not less than seven thousand feet thick, and the concretionary sandstones lie about sixteen hundred feet above the gneissoid series. Nearly all the worked leads at Sherbooke lie below this great mass of sandstone. At Waverley nearly all the important worked leads lie above it. At Wine Harbor the worked leads are wholly above it, and leads are worked in different districts in a belt of the quartzite group six thousand feet thick, thus showing the wide-spread distribution vertically and horizontally of the beds of auriferous quartz.

NOTE.—Since the above was in type, I have received the subjoined remarks from Mr. Billings, to whom I sent some specimens from the Sherbrooke Gold District.

"*Casts*.—These have the form that would be made by an *Orthis*, almost the size of *Orthis pectenella*, Conrad: some of the cavities have one side flat and the other convex, which would answer very well for the species cited. In one of the cavities there are several radiating ridges corresponding to the ribs of *O. pectenella*.

"These appearances are not sufficient to enable me to say positively that the impressions are of organic origin, while, at the same time they prevent one from asserting the opposite opinion, i. e. that they are not organic.

"No. 5.—I think this is an *Eospongia*, but as it does not show any minute structure, will not say so positively.

"No. 2. Which is no doubt the "Chiastolite" mentioned by Dr. Dawson, (Acadian Geology, 2nd Ed. p. 620,) appears to me to have been important, for the reason that it occurs in the gold-bearing leads of Australia.

"I showed your specimens to Mr. Selwyn, and he says the mineral has exactly the same form as that which occurs in the Australian rocks holding the Quebec graptolites. It is always found there in the vicinity of the granitic or gneissoid rocks. He does not think it to be Chiastolite proper, but whatever it may be, it is, in his opinion, the same as that of Australia.

"*Eospongia* occurs in the same horizon in Canada, and thus we have a concurrence of two facts which seems to throw some light on the age of the rocks of your district."

Art. IX. Meteorological Observations at Halifax, N. S., during the Year 1868. By Frederick Allison.

[*Read May* 10, 1869.]

January. In its clouding the first month of the year preserved its average mean. The whole quantity of precipitation was large, being chiefly in the form of snow which fell to the depth of 21 inches; though, besides the rain storm of the first night of the year we had two others. The range of temperature was not great, neither the maximum 38° nor the minimum—5° being extreme figures. The whole month was, with very little exception, intensely cold; and the mean fell below the great cold of January 1867—that month was 19°.10, this 18°.2—which is the coldest I have ever recorded in Halifax, and 3°.43 below the average of 6 years—4 times the thermometer marked below 0,—giving the same number as in January 1867. N. W. wind prevailed as customary and the mean estimated force was great, 2·8. Two gales were recorded; that on the night of the 1st, from S. E. being the heaviest. The other occurred on the 22nd morning and blew from N. E. to N. There was neither fog nor Aurora Borealis in January, and