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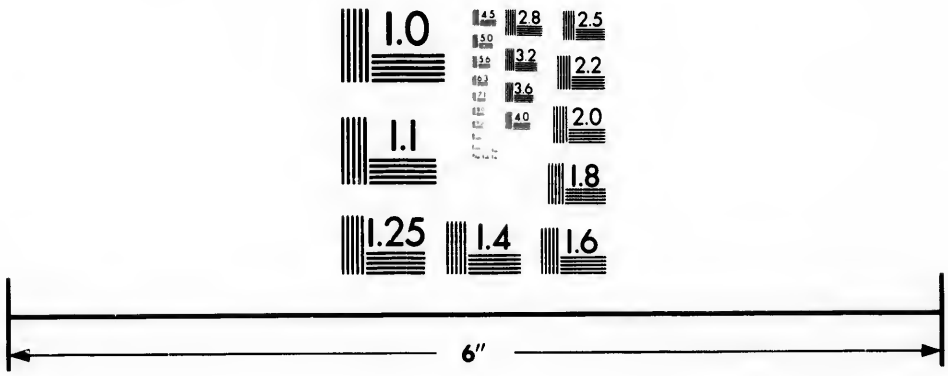

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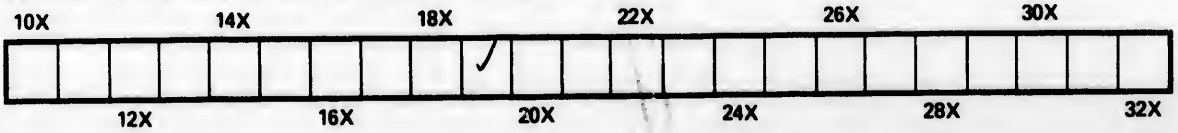

The Stratigraphy of the Quebec Group

and the

Older Crystalline Rocks of Canada.

BY ALFRED R. C. SELWYN, F.R.S., F.G.S.,

Director of the Dominion Geological and Natural History Survey.

THE STRATIGRAPHY OF THE QUEBEC GROUP

AND THE

OLDER CRYSTALLINE ROCKS OF CANADA.

By Alfred R. C. Selwyn, F.R.S., F.G.S.,
Director of the Dominion Geological and Natural History Survey.

I propose in this paper to state as briefly as possible the conclusions I have arrived at from examinations made in the field during the seasons of 1876 and 1877 with the object of satisfying myself, before publishing the geological map of the Eastern Townships, respecting the much-discussed questions of the structure and the age of the rocks in the region on the south-east side of the St. Lawrence, extending from the Vermont, New Hampshire and Maine boundaries north-easterly to Gaspé. I shall also make some remarks on the results of the work of the Geological Survey in connection with the stratigraphy of the Laurentian rocks on the north side of the St. Lawrence valley and the conclusions at which they seem to point.

In some respects my views are in accordance with those of others, while as regards some points they are I believe new. Whether they eventually prove correct or otherwise, I can say that they have been arrived at solely upon and after careful consideration of the evidence and the facts collected by myself and colleagues, and without any bias or pre-conceived ideas, which, had I allowed these any weight, would have led to conclusions entirely different.

All who have taken any interest in Canadian geology are aware that the whole of the region referred to has been described by the Canadian Geological Survey as occupied by only four great formations or groups of strata, which in descending order are: —

1. Devonian.
2. Upper Silurian.
3. Lower Silurian.
4. Laurentian.

No. 3 includes:

a. Utica slates.
b. Hudson River or Lorraine Shales.
c. Trenton limestone.
d. Bird's-eye and Black River limestone.
e. The Quebec group and its equivalents, Chazy and Calciferous.
f. Potsdam.

Subdivision *e*, the Quebec group, is the one about which so much discussion has arisen and so many different opinions have been expressed. Indeed so varied have these been that it is now almost impossible to suggest anything which some one has not already suggested, but most of these opinions have been advanced on palæontological, mineralogical or theoretical grounds, without any study of the actual stratigraphy in the field. According to the latest determination, by the geological corps, under my predecessor Sir W. E. Logan, the Quebec group is divided into three conformable formations, viz. in decending order:—

The Sillery.
The Lauzon.
The Lévis.

These have been supposed to occupy the whole of the region lying south of the St. Lawrence between the great St. Lawrence and Champlain fault and the Upper Silurian overlap, notwithstanding the very diverse mineralogical, palæontological, and physical conditions under which they appear in different parts of the area. The base and the summit of the middle division, which was only introduced in 1866, has been supposed to be characterised by copper ores, dolomites and serpentines, and it would really seem that in mapping the structure the presence of any one of these has almost invariably been made to determine the limits of this division. It is not, however, my object now to refer to the past, or to recapitulate the opinions of others, and I shall confine myself as much as possible to a statement of my own views respecting the stratigraphy of the Quebec group.

First, then, I may say that I recognize in it three distinct groups, which in descending order may be enumerated as

1. The Lower Silurian group, Levis formation.
2. The Volcanic group, probably Cambrian.
3. The Crystalline Schist group.

No. 1 consists of a great variety of slates or shales (argillites), red, green and black; limestones, in thin bands; limestone conglomerates, sandstones and quartzites. In every part of their distribution from the Vermont boundary to Gaspé, 500 miles, they hold a large number of genera and species of characteristic Lower Silurian fossils, full descriptions of which have been given in the reports of the Geological Survey. This fossiliferous belt occupies a strip of country on the south side of the St. Lawrence, which in its widest part, in the valleys of the Chaudière and the Etchemin does not exceed twenty-five miles, and in this portion the structure presented is that of a broad crumpled and folded synclinal with prevailing south-easterly dips on the north-western side, and north-westerly dips on the south-eastern side; the characteristic Point Lévis limestone conglomerates coming up near the base on both sides. There are doubtless a number of local and unimportant overturn dips, but there seems to be no evidence whatever of a general inversion of the strata.

On the north-western side this belt is bounded by the St. Lawrence and Champlain fault, or overlap, which brings the even-bedded shales and limestones of the Hudson River or Lorraine Shale group into contact with the crumpled and twisted strata of the Lévis formation. The line of this dislocation, or unconformity—whichever it may be—has been supposed to pass in rear of the Quebec citadel. This I hold to be a mistake, and I think it can be distinctly shewn that it passes from the south-west end of the Island of Orleans under the river and between Point Lévis and Quebec; it appears again on the north shore about one mile north of Point Pizeau, passes north of St. Foy, and thence in a direct course to where it again crosses the river south-west of Cap Rouge. The entire absence of Levis fossils in the Citadel rocks is thus easily explained. I have traced this break carefully from the last-named point on the north shore of the St. Lawrence to the north-east end of the Island of Orleans, where on the beach the actual contact of the two formations is well seen, and a short distance inland we find the characteristic Levis limestone conglomerate. *Salterella* and *Archæocyathus* occur both at Point Lévis and on the Island of Orleans, and the graptolite (*Phylograptus*) shales are interstratified both above and below the limestone conglomerates. *Obolella* occurs also in shales clearly above the conglomerates and below other shales holding graptolites, and in some beds both occur together.

As regards the belt of Potsdam rocks—upper, middle and lower—which have been described in the Geological Survey Report for 1866–69, pp. 119–141, I must state, that after having carefully examined some portions of these supposed Potsdam rocks, I hold that there are no reasons whatever for separating them from the Lévis formation, either stratigraphical or palæontological. Obolella, graptolites, and fragments of other fossils, too indistinct to be determined, have been found in them.

On the south-eastern side, the fossiliferous belt is bounded by a line which, commencing on the United States boundary near St. Armand, runs on a course nearly parallel with the St. Lawrence, passing through the townships of Dunham, Brome, Shefford, Stukeley, Melbourne, Cleveland, Tingwick, Chester, Halifax and Leeds, to the vicinity of St. Marie on the Chaudière. Between St. Marie and St. Claire on the Etchemin River, the strata which I have referred to division 2 increase greatly in width, cropping out, apparently unconformably, from beneath the fossiliferous belt and separating it from division 3. The boundary we have been tracing of the Lévis formation is here suddenly deflected to a course nearly north for some sixteen or eighteen miles, viz. from St. Claire to St. Vallier, where it again turns north-east, and beyond this it has not yet been defined with certainty. It may be that this apparent unconformity is really a fault which running transverse to the strike brings the Lévis black slates and limestone conglomerates into contact with a set of strata which lithologically can not in this part well be distinguished from the typical Sillery sandstones of New Liver pool, Sillery Cove, &c., above Quebec, or from those of Acton, Roxton and Granby, which they still more nearly resemble, and which there are some reasons for supposing may occupy a similar unconformable position beneath the Levis formation. The distribution of these sandstones as indicated on the unpublished map of the Eastern Townships very forcibly suggests this idea.

Division No. 2 embraces a great variety of crystalline and sub-crystalline rocks; coarse, thick bedded, felspathic, chloritic, epidotic and quartzose sandstones, red, grey and greenish siliceous slates and argillites, great masses of dioritic, epidotic and serpentinous breccias and agglomerates, diorites, dolerites, and amygdaloids, holding copper ore; serpentines, felsites, and some fine grained granitic and gneissic rocks, also crystalline dolomites and calcites. Much of the division, especially on the south

eastern side of the axis, is locally made up of altered volcanic products, both intrusive and interstratified, the latter being clearly of contemporaneous origin with the associated sandstones and slates. The greatest development of these volcanic rocks appears to occur, as above stated, on the south-eastern side of the main axis, to which I shall presently refer, and about the summit of Division 3, of which they may perhaps be only an upward extension, as we have at present no evidence of any unconformity between these two divisions. The rocks composing it have hitherto nearly all been included in the Sillery sandstone formation, and supposed to be everywhere the highest member of the "Quebec group"; represented by a yellow color on the geological map of Canada and on the unpublished map already referred to. It appears to me, however, that neither their true stratigraphical position nor their geological characters have been correctly defined, and they have, regardless of these, been confounded and incorporated with the true Sillery sandstones, which are only a local development of thick sandstones at several horizons in the Quebec group or fossiliferous Lévis formation. At Sillery above Quebec, and at various points thence northeastward to Gaspé, good exposures of these sandstones may be examined, and it has now been shewn that at Little Metis at Ste. Anne (the Pillar sandstones of Mr. Murray's report of 1844) and elsewhere they are characterized by graptolites and other Levis fossils, whereas in the massive red and green sandstones and slates which are associated with the volcanic rocks, and which the stratigraphy, as I think, clearly shews to be a lower unconformable formation, no fossils of any description have yet been found. Certain fucoid markings in slates near Actonvale may perhaps, however, belong to this division. Further examination will probably afford other fossils, but if so I should expect them to indicate a lower horizon than the Lévis formation, probably not far removed from that of the St. John group and the Atlantic coast series of Nova Scotia. In describing this belt of sandstones and slates which extends north-eastward from St. Claire on the Etchemin river, Sir W. Logan writes: "The area over which these strata occur commences in a point near the Chaudiere; it has been traced to the north-eastward across the Seignories of St. Mary and Joliette into St. Gervaise, and it probably extends much further. . . . . The distance between this area and its equivalent to the south is about ten miles."

"The sandstones in the two areas on the opposite sides of the Rivière du Sud are massive; on the northern side they are often very coarse grained, and in general of a green color, while the shales which separate the masses are usually red. Very coarse beds are not so frequent on the south side, and there the red color is not confined to the shales, but characterizes the sandstones also, which are as often red as green." *

There are two other distinctions not pointed out by Sir W. Logan. The one is that fossils, *obolella* and *graptolites*, characterize the northern area, and are apparently absent in the southern area. Another is that the sandstones in the latter frequently present a peculiar schistose structure, not, so far as I know, to be seen in the true Sillery sandstones of the Levis formation, to which the northern of these two sandstone areas clearly belongs.

I shall now pass on to the consideration of Division 3, which, however, as I have already stated, may be intimately related to the preceding. The rocks composing it are chiefly slaty and schistose, and embrace a great variety of chloritic, micaceous, siliceous and magnesian strata with copper ores, also imperfect gneisses, white and gray micaceous dolomites and magnesian limestones. They constitute the main anticlinal axis of the region, which axis may be traced from Sutton Mountain, east of Lake Memphremagog, on a gently curving line, northeastward to the counties of Montmagny and L'Islet—a distance of 150 miles. Between the St.Francis and the townships of Chester and Wolfestown, a very considerable dislocation crosses the axis transversely, and the structure here is exceedingly complicated, and is rendered still more obscure by the overlapping of the Upper Silurian rocks, and by the interposition, in the magnesian belt—by a complication of faulting and unconformable superposition—of a long, narrow band of the black shales and dark earthy limestones of the fossiliferous Levis formation. Further north, however, the magnesian belt again assumes its normal relation to the overlying divisions 1 and 2. And on page 258 of the Geology of Canada, we find its course thus described: "The general course of the magnesian rocks on the south side of the *synclinal* is, however, pretty well determined by a band of dolomite occasionally passing into serpentine, which has been traced from the

* Geology of Canada, p. 258.

13th lot on the line between Chester and Halifax to the Chaudière, near the line between St. Mary and St. Joseph." The synclinal spoken of is a purely theoretical one, and if we lay the above described line down on the map, it will be found to cross diagonally not only this Sillery synclinal, but likewise the Lauzon and the Lévis formations, as shown on the map; while, on the other hand, it runs entirely parallel with the line which, without any previous knowledge of the above quoted description, I had myself carefully traced on the ground, in 1867, as the upper limit of the magnesian belt and division 2, and the unconformably overlying fossiliferous Lévis formation.

The gneissic mica schists of Sutton Mountain are probably the deepest exposed portion of this great anticlinal. To the northeast, between the county of l'Islet and the Trois Pistoles River, the rocks of the anticlinal have not been traced. They will, however, doubtless be found to continue till they pass beneath the overlapping Upper Silurian strata which on the Rimouski River are stated to rest directly on the fossiliferous Levis formation. Rocks which clearly belong to the upper part of the division, with associated traps, emerge from beneath the Upper Silurian all along the northern shore of Matapedia Lake, and I think it will be found that they extend thence into the Shickshock Mountains, which on the north are flanked by the Lévis fossiliferous rocks, and on the south by strata of Upper Silurian age. The investigation of the structure of these mountains presents a fine field for any active and enterprising geologist.

The copper ores of the region under consideration, to which too much importance has, I think, been attached, in determining the limits of the divisions of the Quebec Group, appear to me to belong to two distinct periods, and to occur under conditions almost, if not quite, as distinct as they do in the Huronian and "Upper Copper-bearing" rocks of Lake Superior. Those of the first period belong to the crystalline, magnesian schist group, and occur both in beds and in lenticular layers parallel with the stratification, and also in veins cutting the strata transversely, but in no case accompanied by intrusive crystalline rocks. The Harvey Hill mine, the Viger mine and the Sherbrooke mines are examples of this mode of occurrence. Those of the second period seem to be cheifly confined to the rocks of Division 2, but occur also within the limits of the Lévis fossiliferous belt. They are in almost every instance more or less closely associated with cer-

tain highly crystalline rocks: diorites, dolcrites, amygdaloids and volcanic agglomerates, with bands of white, grey and mottled dolomites and calcites which have much more the appearance of great lenticular, vein-like, calcareous masses than of beds belonging to the stratification. No traces of organic forms have been found in them, and yet many of them are scareely more crystalline than certain Devonian and Carboniferous limestones in which fossils are abundant. The Acton mines, and the numerous openings that have been made in searching for copper ore in that vicinity and in the neighbouring townships of Roxton, Milton, Wickham and Wendover, may be cited as instances of this second elass. And it certainly appears as if the copper ore in these upper divisions were in some way connected with the intrusion or segregation of the crystalline rocks which everywhere accompany it. In any case, I think, there are very few who would agree with Dr. Hunt in the general proposition that the diorites and serpentines of the Quebec group are of sedimentary origin, and the amygdaloids altered argillites; and, unless all contemporaneously interbedded voleanic products are to be considered as of sedimentary origin, the Quebec group might be said to present some of the most marvellous instances on record of "*selective metamorphism.*" But whether this is so or not, there seem to be no good grounds for assigning either an age or an origin to the cupriferous diorites, dolerites, and amygdaloids of the Eastern Townships different from that of the almost identical rocks of Lake Superior, which Dr. Hunt * states have been shewn to overlie *unconformably* the Huronian and Montalban series, but which at Keeweenaw Point are stated by Professor Pumpelly† to rest *conformably* on the Huronian; and Prof. Pumpelly justly remarks that "the question would still seem to be an open one, whether the cupriferous series is not more nearly related to the Huronian than to the Silurian." The same may certainly be said of the cupriferous rocks of the Eastern Townships. Brooks does not, in his paper ‡ quoted by Dr. Hunt, give any very conclusive reasons for his change of views since 1872, and writes altogether as if the question of the unconformable superposition of the copper-bearing rocks on the Huronian were still undecided; and so late as 1877, Professor

* 2 G. S. of Penn., Special Report on Azoic Rocks and Trap Dykes, § 458.

† Geo. Survey of Michigan, Vol. I, 1873.

‡ Am. J. of Sc., Vol. XI, 1876, pp. 206-207.

Roland Irving writes: the unconformity between the Huronian and the upper copper-bearing rocks "*is not certainly proven.*"*

A very considerable amount of careful investigation and laborious work in the field is yet required before the indicated divisions can be correctly delineated on the map. The two maps exhibited shew respectively the supposed distribution of the old divisions of Levis, Lauzon and Sillery, and that of the new divisions (so far as they have been determined), which I now propose to adopt. These latter have at least the advantage of simplicity; they also obviate the necessity of invoking any of the numerous almost impossibilities in physical and dynamical geology which are required to explain the previous theory of the structure, and they are, moreover, very closely in accord with the views entertained by Professor Hitchcock as regards the general succession of the formations in the adjoining States of New Hampshire and Vermont.

Laurentian.—I shall now make some observations on the results of the recent work of the Survey in unravelling the complications of the stratigraphy of the older "*crystallines*" on the north side of the St. Lawrence Valley. Since 1866, Mr. H. G. Vennor, of the Geological Corps, has been occupied in a careful examination of the stratigraphical relations of the Laurentian rocks. His observations, commencing in Hastings county, north of Lake Ontario, have now extended across the Ottawa River, eastward, to Petite Nation and Grenville, embracing a band of country 200 miles in length, with an average breadth of 55–60 miles. Throughout this tract of country, Mr. Vennor has followed and mapped, in all their windings and convolutions, the great series of Laurentian limestone bands first investigated and described by Sir W. E. Logan, in the years from 1853 to 1856, more particularly in the Grenville region, and in 1865, by Mr. Macfarlane, in the Hastings region. The results and conclusions of all these earlier examinations are given in detail in the Geological Survey Reports. And these shew that the classification then adopted by Sir W. E. Logan was regarded by him as provisional. (See Note, p. 93, G. S. R., 1866.)

Thus, at the commencement of Mr. Vennor's investigation in 1866, it was supposed that the limestones and calcareous schists of Tudor and Hastings holding eozoon, together with certain

* Am. J. of Sc., Vol. XIII, 1877.

associated dioritic, micaceous, slaty and conglomerate rocks, were a newer series than those already examined and described by Sir W. E. Logan, and they were accordingly designated, in the report published in 1870, the *Hastings series*, and it was further supposed, from its apparent stratigraphical position and from certain lithological resemblances, that it might be of Huronian age. The gradual progress of the work, however, from west to east has now, I think, conclusively demonstrated that the Hastings group, together with the somewhat more crystalline limestone and gneiss groups above referred to, form one great conformable series, and that this series rests quite unconformably on a massive granitoid gneiss—the gneiss 1*a* of Sir William Logan's Grenville map, published in 1865, in the Atlas to the Geology of Canada. I wish it to be understood that I have not personally examined this region, and I am therefore expressing the views of Mr. Vennor, from which, however, I have no reason to dissent.

Of the actual distribution of this lower or "Ottawa" gneiss very little is at present known with certainty, though it probably occupies very extensive areas from the eastern shores of Lake Winnipeg to Labrador. And between these same localities there will doubtless yet be found many large areas of the so-called Norian System. The first suggestion of this unconformable Upper Laurentian series, which, it seems to me, is intimately connected with the Hastings and Grenville series, appears to occur in the supplementary chapters to The Geology of Canada, 1863, pages 838-839; but the evidence there given by no means proves the subsequent assumption of this unconformity; while the careful descriptions by Sir W. Logan, both in the supplementary chapter above cited and likewise in chapter III, shewing the intimate association and interstratification of the orthoclase gneisses, quartzites and crystalline limestones with these supposed unconformable Upper Laurentian anorthosites, much more strongly favor the supposition that they are part and parcel of the great crystalline limestone series.

The exhaustive History of the labradorite rocks by Dr. Hunt, in the volume already cited,* while giving much valuable and interesting historical information, does not advance us a single step beyond the position taken by Sir W. E. Logan, in 1863, as regards their true stratigraphical relations. In not one of the

* 2nd G. S. of Penn., Special Report on Azoic Rocks and Trap Dykes.

several areas where they are known to occur in Canada, have they yet been mapped in detail, and even their limits, as indicated on the geological map, are more or less conjectural. This appears to be likewise the case as regards the areas where they have been noticed in Essex and adjoining counties in New York State and in New Hampshire, where Professor Hitchcock shews that they rest unconformably on the upturned edges of the "Montalban" gneisses,* leading to the conclusion that the gneisses of the White Mountains are older than the "Norian," whereas Dr. Hunt, solely, I believe, on mineralogical considerations, supposes these same "*Montalban*" gneisses to constitute a system newer than the Huronian. Here then, as in the Hastings region, we find theory and experience at variance. But the question suggests itself, may we not have labradorite rocks belonging to systems younger than Laurentian? Dr. Hunt refers (§ 318), to the valuable chemical and microscopic examination of these rocks in Essex county, New York, by Mr. Albert Leeds, the results of which are given in the *American Chemist*, March, 1877; but Mr. Leeds does not appear to have studied the stratigraphy of the region, and his general conclusions are stated as follows:

"That these norites are a stratified rock but have undergone a metamorphosis so profound as to have caused them to be regarded by Emmons and earlier observers as unstratified. The dolerites which are formed of the same constituent minerals, and are of the mean specific gravity of these norites, have probably been formed from a portion of these stratified deposits, by deeply seated metamorphic action and have further modified and greatly tilted the superposed rocks in the course of their extrusion."

Prof. James Hall in 1868† has stated his conclusions that the limestones of Essex and adjoining counties in New York State "do not belong to the Laurentian system either lower or upper." The facts, on which a part of this conclusion is based, viz. the unconformity of the Laurentian limestone series to the lower orthoclase gneisses agree with those of Mr. Vennor, and there is, I think, but little doubt that all these crystalline limestone groups—that is those of Essex and St. Lawrence Counties, U. S

* Geology of New Hampshire, Vol. II, pp. 217-218.

† A. J. of S. Vol. XII, p. 298.

and Rawdon, Grenville and Hastings in Canada—are parts of one great series, and at present I see no evidence for excluding from this series the associated Norian rocks. Whether the series as a whole will eventually retain the name Upper Laurentian or whether it will be found to be more convenient to designate it Huronian System does not much signify.

We can, however, confidently state that this series occupies an unconformable position between a massive gneiss formation below and unaltered Potsdam or Lower Silurian rocks above, and this may likewise be stated respecting the stratigraphical position of the typical "Huronian series" of the Georgian Bay, which together with its close proximity to the western-most known exposures of the crystalline Laurentian limestone series which we now know, extends from Parry Sound to Lake Nippising, and includes some Labradorite gneiss, renders it very probable that a connection will eventually be traced out between even these supposed greatly different formations, similar to that now, as already stated, proved to exist between the Hastings and Grenville series.

Prof. Hall in his note already referred to, states that the Labradorite formation is "associated" with bands of crystalline limestone, and further on that the limestones do not belong to either the upper or lower Laurentian. He does not however say what the upper Laurentian he alludes to is, though in another paragraph we find it stated that the "lower Laurentians are succeeded by massive beds of Labradorite," which we may infer are considered upper Laurentian, in which case there would seem to be, in New York State two sets of Labradorite rocks, one associated with the limestones which are "altogether newer than Laurentian," and another massive and representing upper Laurentian. There is, however, so far as I am aware, no evidence of this being the case in Canada. If it is admitted—which, in view of the usual associations of Labrador feldspars, is the most probable supposition—that these anorthosite rocks represent the volcanic and intrusive rocks of the Laurentian period then also their often massive and irregular and sometimes bedded character and their occasionally interrupting and cutting off some of the limestone bands as described by Sir W. Logan, is readily understood by any one who has studied the stratigraphical relations of contemporaneous volcanic and sedimentary strata, of palæozoic, mesozoic, tertiary and recent periods. Chemical and microscop-

ical investigation both seem to point very closely to this as the true explanation of their origin. That they are eruptive rocks is held by nearly all geologists who have carefully studied their stratigraphical relations. But I am not aware of any one having suggested that they are the products of volcanic action in the Laurentian or perhaps lower Huronian epoch; doubtless, as Mr. Leeds says "*profoundly metamorphosed*" as of course they would be from having suffered all the physical accidents which have resulted in producing the associated gneisses quartzites, dolomites, serpentines and schists.

When we recall the names of Dahl. Kerulf and Torrell in Norway, Maculloch and Geike in Scotland, Emmons, Kerr, Hitchcock, Arnold Hague, and others in America, all of whom consider these norites as of eruptive origin, we may well pause before accepting Dr. Hunt's conclusions respecting them, and that they should often appear as "bedded metamorphic rocks" (the opinion expressed respecting those of Skye by Prof. Haughton of Dublin) is quite as probable as that we should find the mineralogically similar dolerites occurring in dykes and bosses and in vast beds interstratified with ordinary sedimentary deposits of clay, sand, etc.

In conclusion I may say that I fail to see that any useful purpose is accomplished, in the present stage of our knowledge of the stratigraphical relations of the great groups of rocks which underlie the lowest known Silurian or Cambrian formations, by the introduction of a number of new names such as those proposed by Dr. Hunt for systems which are entirely theoretical, in which category we may in my opinion include the Norian, Montalban, Taconian and Keeweenian. These, one and all, so far as known, are simply groups of strata which occupy the same geological interval, and present no greater differences in their physical and mineralogical characters than are commonly observed to occur both in formations of the same epoch in widely separated regions, and when physical accidents, such as contemporaneous volcanic action or subsequent metamorphism have locally affected the general character and aspect of the formation within limited areas.

No better instances of such differences could be cited than the Mesozoic and Carboniferous formations of British Columbia and those of the same periods in Eastern America, and the Silurian and Cambrian formations of Australia, Europe and America.

It seems to me that the well-known and recognized names

Laurentian
Huronian
Cambrian and Silurian

—with the introduction, where found desirable, to denote some local break, of the terms upper, middle and lower—meet all present requirements so far as systems are concerned.

Unfortunately in Canadian geology, hitherto the stratigraphy has been made subordinate to mineralogy and palæontology, and as the result we find groups of strata which the labours of the field geologist during the past ten years have now shewn all to occupy a place between Laurentian and Cambrian, assigned to Carboniferous and Upper Silurian in New Brunswick and Nova Scotia, to the peculiar palæontological Lévis group and its subdivisions Lauzon and Sillery in the Eastern Townships; and to lower and upper Laurentian, Huronian, lower Silurian and Triassic on the north side of the St. Lawrence valley and around Lake Superior. The same system of mineralogical stratigraphy is now further complicating and confusing the already quite sufficiently intricate problem by the introduction of the new nomenclature I have referred to, and in some cases these names are applied regardless of and in direct opposition to well ascertained stratigraphical facts. A similar unfortunate instance of *palæontological* stratigraphy is found in the history of the Quebec group; and especially in the late introduction in it of the belt of supposed Potsdam rocks, about which I have already stated my opinion.

In the reconstruction of the Geological map of Eastern Canada, —and in this I include the country from Lake Winnipeg to Cape Breton and Labrador—rendered necessary by the present state of our knowledge, I should propose to adopt the following divisions of systems to include the groups enumerated:

I. Laurentian: To be confined to all those clearly lower unconformable granitoid gneisses in which we never find interstratified bands of calcareous, argillaceous, arenaceous and conglomeratic rocks.

II. Huronian: To include 1. The typical or original Huronian of Lake Superior and the conformably—or unconformably as the case may be—overlying upper copper-bearing rocks.
2. The Hastings, Templeton, Buckingham, and Grenville groups.
3. The supposed upper Laurentian or Norian.
4. The altered Quebec group as shewn on the map now exhibited, and certain areas not yet defined between Lake Matapedia and and Cape Maquereau in Gaspé.
5. The Cape Breton, Nova Scotia and New Brunswick, pre-primordial sub-crystalline and gneissoid groups.

III. Cambrian: In many of the areas especially the western ones, the base of this is well-defined by unconformity, but in the Eastern Townships and in some parts of Nova Scotia it has yet to be determined. The limit between it and Lower Silurian is debatable ground upon which we need not enter.

The apparent great unconformity of the Nipigon group to the Huronian around Lake Nipigon may perhaps be explained by our having here the deep-seated parts of an ancient volcanic crateriform vent greatly denuded and the crater now occupied by the waters of the lake. The eruptions from this crater may have commenced in the Huronian epoch and been continued at intervals even up to the Triassic period; but in the meantime we have no evidence of any of the eruptions being newer than Cambrian. One point I wish particularly to insist on is that great local unconformities may exist without indicating any important difference in age, especially in regions of mixed volcanic and sedimentary strata, and that the fact of crystalline rocks (greenstones, diorites, dolerites, felsites, norites, &c.,) appearing as stratified masses and passing into schistose rocks, is no proof of their not being of eruptive or volcanic origin—their present metamorphic character is as the name implies a secondary phase of their existence, and is unconnected with their origin or original formation at the surface.

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