

be thoroughly appreciated by those who keep pace with the advance of geological theory, and *time*—for ever *time*—will be the burthen of their thoughts; for first comes unconformity, telling of upheaval, contortion, and long-continued waste and denudation of the lower formation before the commencement of the deposition of the overlying strata, and then comes the question of the metamorphism itself. Were the Lower Laurentian masses metamorphosed before the deposition of the unconformable beds, or were they both subjected to metamorphic action together? If the former, then not only were the older rocks denuded before the commencement of the later epoch, but they must, after disturbance, and long before that denudation, have been buried deep towards the so-called central heat, under many thousands of feet of other strata; for if modern theory be good for anything, it is only far from the surface of the earth that heat, aided by alkaline waters, produces a widespread crystalline metamorphism. If, however, it happened that the metamorphosis of both series took place at once, where are the other formations under which they lay when the metamorphic action was going on? No man has seen them in all Lower Canada, for the whole Laurentian series had changed from common sediments into gneissic rocks and crystalline limestone, and had been bared and formed a most ancient land long before those Lingula beds (Potsdam sandstone) began to be deposited above them which have been fondly termed the Primordial Zone—primordial no more if the corals of the Lower Laurentian limestone are true.

There is another theoretical question that readily rises to the mind from the consideration of these phenomena. Most persons conversant with stratigraphical geology will incline to believe that both series of metamorphic rocks are altered marine strata. Their great thickness tends to this belief, and the corals, if proved, confirm it for the lower series. Neither, in any set of marine strata, is it easy to conceive how thick and wide-spreading bands of limestone could have been formed except as organic sediments; and, if this surmise be correct with regard to the metamorphic strata in question, then what relation is it likely that the fossils of the upper formation had to those of the lower, on which they rest quite unconformably? The answer is, that if inferences recently drawn from detailed examinations of British palaeozoic and secondary formations are correct, then marked unconformity is always accompanied with a *break* in the succession of life; or, in other words, the species in the upper unconformable formation are to a great extent or altogether distinct from those found in the strata on which it rests. It requires little reflection to understand that time is the accompaniment of this change of species, especially if we adopt Darwin's theory of descent with the modification; for it is almost impossible to over-estimate the length of the period implied by the consolidation, disturbance, contortion, and denudation of an older set of strata before a newer set were fairly laid on their denuded edges. Where are the formations, and the fossils, if any, that represent the period when the old land stood for unknown epochs above these ancient seas and received no deposits on its surface? We do not know, for with us they are not represented by any strata, and the time thus unrepresented was of great but unknown duration. If so, then—from our experience of unconformable rocks in which fossils are common—the chances are overwhelming that the fossils, the remains of which formed the Laurentian limestones both of the lower and the upper series, were nearly, if not altogether, distinct; the old life having died out by slow gradations long before the beginning of the new. Deposits of graphite in the same series possibly point to the existence of vegetable life at the same early period.

A third series of rocks is found in Western Canada between the Laurentian and the base of the Lower Silurian strata. These, which have been termed the Huronian series, are the supposed equivalents of our Cambrian rocks, and spread out along the northern shores of Lake Huron and Lake Superior, and extend into the interior. Mapped by that veteran geologist Mr. Murray, they have been shown by him to consist of strata more than 10,000 feet thick, of quartzites, diorites, and slates, with interstratified limestones, and they are intersected by numerous and important copper-lodes; but the rocks in which these lodes occur are quite distinct from the formations on Lake Superior bearing native copper, which belong to the part of the Lower Silurian series which are known as the Quebec group.

We approach this Quebec group with something like awe, for since the name first reached this side of the Atlantic, it has been enveloped in a cloud of geological dust which, beginning in size like a man's hand, has spread from Montreal and Albany, through Paris all the way to Bohemia. Now, let us hope, that it has fairly settled down, we may venture to say that, lying above the Potsdam sandstone (on Lingula beds), they are considered by Mr.

Billings, the palaeontologist of the Canadian Survey, to be of an age between the first and second faunas of Barrande, or approximately equivalent to the Llandovery rocks of Murchison. Consisting of the calciferous and Chazy subdivisions, this formation occurs in great force near Lake Champlain, and ranges through Eastern Canada all the way to Newfoundland, lying on the south-east side of a vast dislocation (perhaps the longest and greatest known fault in the world) that ranges all the way from Champlain along the shores of Gaspé, into regions yet only half explored. These strata in Eastern Canada form a fourth great metamorphic series, intersected by veins of quartz, and there is reason to suppose that the superficial detritus in which gold was found in considerable quantities has been derived from their waste; nor is it improbable that another great influx of gold from those regions may some day surprise us, if ever the country should be scientifically explored.

Space will not permit us at present to notice the Black River, Trenton, Utica, and Hudson River formations of the Lower Silurian series, nor all the other subdivisions that range through Middle and Upper Silurian and Devonian rocks to the Bonaventure formation that lies at the base of the Carboniferous strata. On a future occasion we may return to this subject; and at the same time discuss the careful studies of Mr. Sierry Hunt on the metamorphic rocks, the results of which are contained in this volume. But, before concluding this notice, we may mention, for the benefit of those interested in the subject, that half a chapter of the book has been devoted to the superficial formations of the country; and those who are versed in the progress of glacial geology within the last two years, or who have been accidentally attracted by a brisk correspondence that has lately been carried on in the pages of a literary contemporary, will be interested in learning that one who has been styled the first physical geologist in America has not ignored the subject of the excavation of rockbounded lake-basins by ice. This theory, early in 1862, was propounded by Professor Ramsay for the lakes, not only of Switzerland, but, including North America, for a great proportion of those parts of the Northern hemisphere the rocky surface of which had been moulded and ground by glacier ice; and any one who is attached to the hypothesis that such lake basins lie in great rents and fissures, or are caused by special subsidences, of disturbed strata, may perhaps be able to explain how it is that such disturbances occur by the thousand in those northern, but often far from mountainous, regions in which ice has prevailed, while in warmer latitudes, or at lower levels uninvaded by ice, but in which the strata have been equally disturbed, these disturbances have failed to produce similar lake basins. In the meanwhile, the author of the theory need not, perhaps, quite despair. It was many a year before the glacial theory of Agassiz, to which this may be considered a mere pendant, made way; and if the author is too apathetic seriously to fight his own battles, it may afford him some satisfaction to find his views already advocated by such distinguished physical geologists as Sir William Logan and Dr. Newberry in America, and Professor Jukes and Mr. Geikie on this side the Atlantic.

EDUCATION.

ARITHMETIC.

I give one other example to show the less experienced teacher how to train and perfect his scholars in going over processes.

Repeat, repeat, repeat adding and subtracting till correctness and dexterity are acquired.	First adding up and down.	Second adding up and down.	Subtracting up and down.
45675—	46	46	5 41
12347—	41 12		5 34
48789—	34 21	21	12 25
95724—	25	25	21 21
87474 }	21 29		25 17
78472 }		17 31	29 15
51327 }	15 38		31 8
65698 }	46	46	38 8
485506.	46 46	46 46	46 46