Certain Australian lizards present teeth with large rounded obtuse crowns, like those of certain *Placodi*, and have on that account received the name of *Cyclodus*, for their genus.

The author next proceeds to describe certain specimens of the mandible or under jaw of the genus *Placodus*. The first of these he refers to a species for which he proposes the name of *Placodus pachygnathus*. The second may probably be the lower jaw of the *Placodus Andriani*, Ag.; but should it prove to belong to a different species, the term *bombidens* would best express the specific peculiarity in the shape of the grinding surface of the teeth. A third species is named *Placodus bathygnathus*, in reference to the great vertical extent of the mandibular ramus.

All the above-described fossils are from the Muschelkalk member of the triassic series, near Bayreuth, Germany, and have been recently acquired for the Palæontological Series in the British Museum.

The Memoir is accompanied by numerous drawings.

March 18, 1858.

The LORD WROTTESLEY, President, in the Chair.

The following communications were read:—

I. "On the probable Origin of some Magnesian Rocks." By T. Sterry Hunt, Esq., of the Geological Survey of Canada. Communicated by Thomas Graham, Esq., Master of the Mint. Received July 10, 1857.

The deposits of mineral matters from natural waters offer many points of interest to the geologist. Besides the rock-salt and gypsum, which in many cases have doubtless been formed by the spontaneous evaporation of saline waters, it is well known that many mineral springs charged with carbonic acid under pressure, deposit great quantities of earthy salts when they come to the surface, and that the travertines thus formed often constitute extensive masses. The

deposit from the hot alkaline saline springs of Carlsbad, which forms great beds, was found by Berzelius to consist chiefly of carbonate of lime, with portions of oxide or carbonate of iron, and small quantities of silica, strontia, phosphoric acid and fluorine; the analyses of other chemists have added to the list of elements met with in these and similar precipitates, manganese, zinc, cobalt, nickel, chromium, arsenic, antimony, tin, copper and lead. Carbonate of magnesia is however wanting, or present only in very small proportion in these deposits, and the same is true of the calcareous sinter from cold springs. The Carlsbad water, however, contains for 17 parts of carbonate of lime, 10 parts of carbonate of magnesia; but this latter salt, according to Berzelius, is only deposited after evaporation.

The analyses by Berzelius and Struve of the various carbonated waters of Germany, show that carbonate of lime is generally present in much larger quantities than carbonate of magnesia; and it is only in the waters of Püllna and the Elisenbrunnen of Kreuznach, which contain very little carbonic acid, that we find a large amount of carbonate of magnesia, with a small portion of carbonate of lime. The water of Püllna, according to Struve, contains in 1000 parts, 32·72 of solid matters, consisting of sulphates and chlorides of sodium, magnesium and a little calcium, besides ·10 of carbonate of lime and ·83 of carbonate of magnesia; it contains only $\frac{7}{100}$ths of its volume of carbonic acid gas.

In my analyses of the waters of the western basin of Canada, I have found many brine-springs, which, although rising from Lower Silurian limestones, hold no appreciable amount of earthy carbonates, but contain besides common salt, large quantities of chlorides of calcium and magnesium; they are in fact veritable bitterns. The mineral springs of these palæozoic strata appear to be in all cases connected with undulations producing disruptions of the strata, through which the subterranean waters find egress. In the almost undisturbed region of the west, the springs are consequently rare, but in the disturbed country further east, along the north-western limit of the Green Mountains, which are composed of these same palæozoic strata in an altered condition, the mineral waters become very abundant. Five or six springs, often differing in kind, may sometimes be found within a short distance along the same line of fault, but

where the strata become crystalline, the mineral waters are no longer met with.

In this eastern region the saline waters issuing from the same limestones as the springs just described, are generally more dilute than those of the west, and although, like them, containing but very little carbonic acid, deposit by boiling or evaporation large quantities of earthy salts, chiefly carbonate of magnesia. Many of these waters contain earthy chlorides, and are analogous to the Püllna spring, while others, still strongly saline, are alkaline from the presence of carbonate of soda. The solubility of the carbonate of magnesia in these waters is explained by the observations of H. Rose, who has shown that the partial precipitate produced in the cold, by carbonate of soda in a solution of a neutral salt of magnesia, is redissolved by an excess either of the magnesian salt or the alkaline carbonate, and is only thrown down from these solutions by heat. Longchamp has further remarked, that the precipitation by heat is rendered less complete in proportion as the carbonate, sulphate or hydrochlorate of the alkali is in excess, and that the precipitate at first formed under these circumstances is redissolved on cooling. I have verified this last observation in the case of these natural waters, from which the magnesian carbonate is only separated, when they are evaporated to a small volume. When thus evaporated, even at a very gentle heat, these mineral waters yield large quantities of granular carbonate of magnesia, often nearly pure.

With these facts in view, it is very easy to trace a relation between the saline waters, containing carbonate of magnesia, and another class of springs in which the predominant element is carbonate of soda, with small quantities of common salt, borax and earthy carbonates. These waters, although wanting in the west, are very abundant in eastern Canada, and rise from the same formations as the saline springs, but are most abundant in the argillaceous strata immediately overlying the lower limestones, which appear to be the source of the salines. These alkaline waters probably owe their origin to the slow decomposition of felspathic *débris* in presence of earthy carbonates. By the mingling of these solutions of carbonate of soda with the bitterns of the limestones, the carbonate of lime would be precipitated, except so far as an excess of carbonic acid were present, while car-

bonate of magnesia would remain in solution, as in the Carlsbad waters. The mixture of these alkaline springs with sea-water would yield similar results.

From my analyses of more than sixty of the different mineral springs of Canada, to be found in the published reports of the Geological Survey, I select a few characteristic waters of each class, giving here only approximatively the determinations of the principal ingredients for 1000 parts.

A. Saline waters, containing little or no earthy carbonate.

B. Alkaline waters, feebly saline.

C. Saline waters, holding abundance of earthy carbonates.

a. Neutral, containing earthy chlorides.

b. Alkaline, containing carbonate of soda.

Springs.	Solid matters.	Carb. soda.	Chlor. calcium.	Chlor. magnes.	Carb. lime.	Carb. magnes.
A. Whitby	46·30	...	17·53	9·54	·06	
„ Hallowell	68·00	...	15·90	12·90	...	...
„ Hallowell	36·00	...	9·20	9·40	...	...
B. Chambly	2·13	1·06	...	...	·04	·07
„ Nicolet	1 56	1·13	...	...	not determined	
„ Saint-Ours	·53	·13	...	...	·17	·13
„ Jacques-Cartier	·34	·19	...	...	·07	·03
„ Joly	·75	·23	...	...	·06	·02
C. *a*. Caledonia (V.)	14·64	...	·28	1·03	·12	·86
„ Saint-Léon	13·83	...	·07	·66	·35	·94
„ Caxton	13·65	...	·05	·37	·21	1·06
„ Plantagenet	13·16	...	·13	·24	·03	·89
„ Sainte-Geneviève	20·99	...	·60	2·05	·01	·75
„ Berthier	9·06	...	04	·08	·05	·83
C. *b*. Varennes	9·58	·32	...	...	·35	·35
„ Fitzroy	8·34	·59	...	...	·15	·78
„ Caledonia (1)	7·75	·05	...	...	·15	·52

Few of the above waters contain sulphates, but baryta and strontia are present in very many of them; the amount of these two bases in the Varennes spring is equal to ·016, while in that of Lanoroie, a water of the class B, containing 12·88 of solid matters, there were found ·030 of baryta and ·021 of strontia. Small quantities of silica, alumina, phosphoric acid, manganese and iron are present in all of these springs, and in the alkaline and many of the saline waters a portion of boracic acid; the borate is included with the carbonate

of soda in the above analyses. Bromine and iodine are found in all the saline waters. I have shown, in my analyses of five alkaline saline waters from Caledonia and Varennes, that the amount of carbonic acid is much less than is required to form bicarbonates with the soda, lime and magnesia which these waters contain, so that the magnesia must be held dissolved as a mono-carbonate. In the water of Chambly, on the contrary, there is no deficiency of carbonic acid, and the bases exist as bicarbonates. The temperatures of these springs range from 46° to 53° F.; some of them are therefore to be regarded as slightly thermal.

Interstratified with the shales and sandstones of the Quebec division of the Lower Silurian rocks, which immediately overlie the strata yielding these alkaline waters, are found thick beds of pure limestone, sometimes presenting the agatized structure and semi-translucency which characterize certain travertines, but at other times opaque, homogeneous, and including remains of orthoceratites, trilobites and other fossils. Associated with these beds of pure carbonate of lime are others which are magnesian, and contain considerable quantites of carbonate of iron, which causes them to weather reddish brown. These beds are always granular in texture, and contain a variable portion of siliceous sand; they often become conglomerate, enclosing pebbles of quartz and schist, or more frequently fragments of a pure compact limestone, seemingly identical with that of the beds just described. Thin layers of the ferruginous magnesian rock sometimes separate beds of the pure carbonate of lime, or form lenticular masses in its midst, and seem to replace its fossils. The pure limestones also sometimes form the base of a conglomerate, or are mixed with sand and argillaceous matters.

These magnesian rocks, like the pure limestones of this formation, occur in irregular and interrupted beds; they often attain a thickness of many yards, are destitute of fossils, and contain from ten to forty per cent., and even more, of sand or clay. The portion soluble in acids is sometimes a dolomite with carbonate of iron; at other times the lime is wanting, or present only in traces, and we have a ferruginous magnesite. In two previous notes presented to the Society, I have already explained the manner in which I suppose these siliceous carbonates to have been, in some parts of the forma-

tion, transformed into silicates, such as serpentine, talc, chlorite and pyroxene, by the subsequent intervention of heated solutions of alkaline carbonates.

It appears to me that we may explain the origin of these magnesian deposits, by the spontaneous evaporation of magnesian waters. If the waters of Carlsbad were to become stagnant above their deposited travertine, they would yield by evaporation beds of ferruginous dolomite, and waters like those of Caxton, Plantagenet, and Sainte-Geneviève would furnish carbonate of magnesia nearly free from lime. Nothing forbids us to suppose the existence of waters more highly charged than these with magnesian carbonate, formed perhaps by the action of carbonate of soda upon lagoons of sea-water, whose lime may be removed as carbonate, or by previous evaporation as sulphate. The lagoons in Bessarabia, supplied with the waters of the Black Sea, deposit annually large beds of rock-salt; and it would require only the intervention of waters like those of the natron lakes of Hungary and Egypt, to produce deposits of magnesian carbonate.

The conditions of these deposits at Pointe-Lévis and elsewhere in the Quebec group, seem to point to the existence of basins along an ancient sea-shore, which probably marked the first upheaval of the older Silurian strata. Beds of travertine were there formed, and then the sea flowed over these deposits and gave rise to the fossiliferous limestones; but there were intervals of disturbance, indicated by the conglomerates, and these movements, or the deposition of bars along the shore, gave rise to lagoons or basins cut off from the sea, where, by evaporation under the conditions which we have supposed, magnesian precipitates would be deposited. The absence of fossils in these beds is probably connected with the peculiar composition of the waters.