may then include the Potsdam, Calciferous and Chazy, and thus be equivalent in part to the Quebec group hereafter to be described.

Passing westward into the Mississippi valley we again find a sandstone formation, which forms the base of the palæozoic series, and is considered by Mr. Hall to be the equivalent of the Potsdam. Here it occasionally exhibits intercalated beds of silicoargillaceous limestone, in which occur abundant remains of trilobites of the genera Dikelloccphalus, Menoccphalus, Arionellus, and Conocephalus. Passing upwards this sandstone is succeeded by the Lower Magnesian limestone, which is the equivalent of the Calciferous sandrock of New York, and in Missouri, where it is the great metalliferous formation, alternates several times with a sandstone, constituting the Magnesian Limestone series, which in Missouri attains a thickness of 1300 feet. The same thing is observed to a less degree in Wisconsin and Iowa; throughout this region the higher beds of the Potsdam sandstone are often composed of rounded oolitic granules, and the beds of passage are frequently of such a character as to lead to the conclusion that they have been deposited from silica in solution, and are not mechanical sediments.* For a discussion of many silicious rocks, see Am. Journal of Science, (2) xviii. 381. some facts with regard to the chemical origin of

Evidences of disturbance during the period of its deposition are to be found in the brecciated beds, sometimes fifty feet in thickness, which occur in the calciferous sandrock of the north-west, and are made up of the ruins of an earlier sandstone. In Missouri, the Birdseye and Black River limestones repose directly upon the Lower Magnesian limetone, while further north a sandstone intervenes, occupying the place of the Chazy limestone.

The Potsdam sandstone of the St. Lawrence valley, has for the most part the character of a littoral formation, being made up in great part of pure quartzose sand, and offering upon successive beds, ripple and wind marks, and the tracks of animals. Occasionally it includes beds of conglomerate, or as at Hemingford, encloses large rounded fragments of green and black shale; it also exhibits calcareous beds apparently marking the passage to the succeeding formation, which although called a Calciferous sandrock, is for the most part here, as in the west, a magnesian limestone, often geodiferous, and including calcite, pearl spar, gypsum, barytes and quartz. Sir William Logan had already shown that the fauna of the Potsdam and Calciferous in Canada are apparently identical (Canadian Naturalist, June 1860, American Journal of Science [2] xxxi. 18), and Mr. Hall has arrived at the same conclusion with regard to the more extended fauna of these formations in the valley of the Mississippi, so that these two may be regarded as forming but one group. While in the west Dikellocephalus occurs both in the lower sandstones and the magnesian limestones, Cenocephalus minutus, found in the Potsdam on Lake Champlain, and identified by Mr. Billings, has lately been detected by him in specimens from the sandstones of Wisconsin with Dikellocephalus, which genus has there been found to pass upwards into the magnesian limestones. On the other hand, the sandstones of Bastard in Canada, having the charac-

ters of the Potsdam, contain Lingula acuminata and Ophileta compacta, species regarded as characteristic of the Calciferous, together with two undescribed species of Orthoceras, and in another locality a Pleurotomaria resembling P. Laurentina. The researches of Mr. Billings have extended the fauna of the Calciferous in Canada to forty-one species, and the succeeding Chazy formation to 129 species. The thickness of this latter division in the St. Lawrence valley is about 250 feet, and it includes in its lower part about fifty feet of sandstones with green fucoidal shales and a bed of conglomerate. The Calciferous has a thickness of about 300 feet, while the Potsdam may be estimated at not far from 600 feet.

We have then seen that along the north-eastern outcrop of the great American basin in Canada and New York, the base of the palæzoic series is repre-sented by less than 1000 feet of sandstones and dolomites, reposing directly upon the Laurentian system. A very different condition of things is, however, found in the more central parts of the basin. According to Prof. Rogers, the older Primal slates, which form the base of the palæozoic system, attain in Virginia a thickness of 1200 feet, and are succeeded by 300 feet of Primal sandstone marked by Scolithus, which he considers the Potsdam, followed by the upper Primal slates, consisting of 700 feet of greenish and brownish talco-argillaceous shales with fucoids. To these succeed his Auroral division, consisting of sixty feet or more of calcareous sandstone, the supposed equivalent of the Calciferous sandrock, followed by the Auroral limestone, which is magnesian, and often argillaceous and cherty in the upper beds. Its thickness is estimated at from 2500 to 5500 feet, and it is supposed by Rogers to include the Chazy and Black River limestones, while the succeeding Matinal division exhibits first, from 300 to 550 feet of limestone (Trenton), secondly, 300 to 400 feet black shale (Utica), and thirdly, 1200 feet of shales with red slates and conglomerates (Hudson River group), thus completing the Lower Silurian series.

In Eastern Tennessee, Mr. Safford describes (1st) on the confines of North Carolina, a great volume of gneissoid and micaceous rocks similar to those of Pennsylvania, succeeded to the west by (2nd) the Ococee conglumerates and sandstones, with argillites, chloritic, talcose and micaceous slates, and occasional bands of limestone, all dipping, like the rocks of the 1st division, to the S. E. In the 3rd place we have the Chilhowee sandstones and shales, several thousand feet in thickness, including near the summit, beds of sandstone with Scolithus, and considered by Mr. Safford the equivalent of the Pots-dam. (4th.) The Magnesian limestone and shale group, also several thousand feet thick, and divided into three parts; first, a series of fucoidal sandstones approaching to slates and including bands of magnesian limestone; second, a group of many hundred feet of soft, brownish, greenish and buff shales, with beds of blue colitic limestone, which as well as the shales, contain trilobites. Passing upward these limestones become interstratified with the third sub-division, consisting of heavy bedded magnesian limestone, more or less sparry and cherty near the summit. The limestones of Knoxville belong to this group, which with the 3rd or Chilhoweo group is designated by Mr. Safford as Cambrian, corresponding to the Primal and Auroral of Rogers, or to the Potsdam and Calciferous sandrock, with the possible addition of the Chazy, being equivalent

^{*} See Mr. Hall's Introduction, to which we are indebted for many of these facts regarding the formations of the west, and also the Reports of the Goological Survey of Missouri.