

In addition to the two grand classes of formations, igneous and aqueous it is necessary to establish two orders of mixed formations. Where the materials were formed in the interior of the earth, and ejected by the action of fire, but subsequently modified by the action of water, which transported and deposited them in stratified beds, such as *trap-tuff*, *peperino*, &c., often enclosing organic remains; these are called **PLUTO-NEPTUNIAN**

On the other hand, those rocks which were deposited by water, and afterwards modified by the action of heat, changing their character and causing them to resemble igneous formations, such as the *crystalline schists*, *saccharoidal marbles*, &c., these are called **METAMORPHIC**. Thus far the arrangement of M. Prevost.

Each system of detrital rocks in this district, if we except the drift, is characterized by the presence of igneous products, which differ as much, one from another, as the sedimentary systems. Thus, the oldest class of igneous products consists of hornblende and feldspar rocks, and serpentine rocks, and may be regarded as contemporary with the azoic system. Next in order are the granites and syenites, which are intermediate in age between the azoic and Silurian systems. These are traversed by at least two systems of greenstone dykes which are anterior to the purely sedimentary deposits. Contemporaneous with the lower portion of the Silurian system, are the bedded traps and amygdaloids of Keweenaw Point, Isle Royale and the Ontonagon region; and, although composed of nearly the same constituents as many of the older igneous rocks, there is no difficulty, from the diversity in external characters, in drawing the line of demarcation between them,—the older being compact or crystalline, but never amygdaloidal.

Below all the fossiliferous groups of this region, there is a class of rocks, consisting of various crystalline schists, beds of quartz and saccharoidal marble, more or less metamorphosed, which we denominate the Azoic system. This term was first applied by Murchison and de Verneuil to designate those crystalline masses which preceded the palæozoic strata. In it, they include not only gneiss, but the granitic and plutonic rocks by which it has been invaded. We adopt the term, but limit its signification to those rocks which were detrital in their origin, and which were supposed to have been formed before the dawn of organized existence. This, however, is a mooted point. Lyell, on the one hand, maintains that animal organisms may yet be detected below what is now regarded as the oldest fossiliferous group; while, on the other hand, Murchison contends that it is highly probable we have reached the point where organized existence first started. We incline to the latter view; and are disposed to regard these deposits as having been accumulated before the dawn of animal life, rather than that organisms flourished, died and were entombed in the rocks, and that their remains have become obliterated by the long-continued action of heat.

The Silurian, or protozoic system, as it is sometimes called, since here we find the first traces of organized existence, is represented in this district from its summit to its base. Much confusion prevails with regard to the nomenclature of the different groups composing it. The various State surveys, while they have developed many valuable facts, have, also, originated a multitude of local names. They started about the time that Murchison first promulgated his subdivision of the *Transition* rocks; and while American geologists recognized the great leading features of that subdivision, they failed to detect subordinate groups. There existed in this country, no standard of comparison, and hence arose a variety of names, local in their ap-