

erals which had appeared so variable, was governed by a general law, to which he gave the name of *isomorphism* (from *ισος*, *isos*, equal, and *μορφη*, *morphe*, form). According to this law, the ingredients of a given species of mineral are not absolutely fixed as to their kind and quality; but one ingredient may be replaced by an equivalent portion of some analogous ingredient. Thus, in augite, the lime may be in part replaced by portions of protoxide of iron, or of manganese, while the form of the crystal, and the angle of its cleavage planes, remain the same. These vicarious substitutions, however, of particular elements cannot exceed certain defined limits.

*Pyroxene*, a name of Haüy's, is often used for augite in descriptions of volcanic rocks. It is properly, according to M. Delesse, a general name, under which Augite, Diallage, and Hypersthene may be united, for these three are varieties of one and the same mineral species, having the same chemical formula with variable bases.

*Amphibole* is in like manner a general term under which Hornblende and Actinolite may be united.

Having been led into this digression on some recent steps made in the progress of mineralogy, I may here observe that the geological student must endeavor as soon as possible to familiarize himself with the characters of five at least of the most abundant simple minerals of which rocks are composed. These are felspar, quartz, mica, hornblende, and carbonate of lime. This knowledge cannot be acquired from books, but requires personal inspection, and the aid of a teacher. It is well to accustom the eye to know the appearance of rocks under the lens. To learn to distinguish felspar from quartz is the most important step to be first aimed at. In general we may know the felspar because it can be scratched with the point of a knife, whereas the quartz, from its extreme hardness, receives no impression. But when these two minerals occur in a granular and uncrystallized state, the young geologist must not be discouraged if, after considerable practice, he often fails to distinguish them by the eye alone. If the felspar is in crystals, it is easily recognized by its cleavage; but when in grains the blow-pipe must be used, for the edges of the grains can be rounded in the flame, whereas those of quartz are infusible. If the geologist is desirous of detecting the varieties of felspar above enumerated, or distinguishing hornblende from augite, it will often be necessary to use the reflecting goniometer as a test of the angle of cleavage, and shape of the crystal. The use of this instrument will not be found difficult.

The external characters and composition of the felspars are extremely different from those of augite or hornblende; so that the volcanic rocks in which either of these minerals play a conspicuous part are easily recognizable. But there are mixtures of the two elements in very different proportions, the mass being sometimes exclusively composed of felspar, and at other times largely of augite. Between the two extremes there is almost every intermediate gradation; yet certain compounds prevail so extensively in nature, and preserve so much uniformity of aspect and