

in the year 1772, Romé Delisle, a pupil of Linnæus, shewed that the various shapes possessed by crystals of the same substance, natural or artificial, are all intimately related to each other. He formed a large collection of natural crystals which he carefully studied and was particularly interested by the fact that the same mineral often occurred in widely different forms. His studies led him to the conclusion that the shape of every crystal of the same substance is such as can be derived by a particular process from a certain fundamental figure called the *Primitive Form*, the shape and angles of which depend only on the nature of the substance itself. All the multitudinous forms which a substance such as pyrite (sulphide of iron) assumes, he found could be produced by replacing the edges or the solid angles of the primitive form by single planes or groups of planes, but always in such a manner that the total alteration is similarly related to all parts of the primitive form which are geometrically similar.

Thus, as a simple example, by cutting off the angles of a cube it may be converted into an octahedron. These planes of replacement were regarded by him as being secondary and more or less accidental.

Werner in his treatise "On the External Characters of Minerals" had employed the terms *Abstumpfung* = truncation, *Zuscharfung* = beveling, *Zuspitzung* = acumination, in speaking of similar variations or changes from the fundamental form of crystal, but it is thought that Delisle did not know of this at the time he wrote. Delisle set to work to determine the primitive forms of all substances, which work was greatly facilitated by the invention at this time of the goniometer. This instrument was invented by a Frenchman named Carangeau, who prepared the clay-models used by Delisle to illustrate his theory. It was designed for the measurement of solid angles, particularly those of crystals, and was of the form known as the common or *contact goniometer*.

A much more elaborate and accurate instrument for the same purpose is the *reflecting goniometer* of Dr. Wollaston, devised by him in 1809, of which several elaborate modifications are now employed by crystallographers. Carangeau's goniometer consisted essentially of a graduated arc and two moveable arms. Its form may be learned by referring to the figures given in almost all text-books of mineralogy. The great