among the sandgrains of sandstones which have thus had their rounded forms converted into crystallographic faces.[80]

Crystalline minerals are seldom free from extraneous inclusions. These are occasionally large enough to be readily seen by the naked eye. But the microscope reveals them in many minerals in almost incredible quantity. They are, a, vesicles containing gas; β, vesicles containing liquid; γ, globules of glass or of some lithoid substance; δ, crystals; ϵ, filaments, or other indefinitely-shaped pieces, patches, or streaks of mineral matter.

a. Gas-filled cavities—are most frequently globular or elliptical, and appear to be due to the presence of gas or steam in the crystal at the time of consolidation. Zirkel estimates them at 360,000,000 in a cubic millimetre of the hauyne from Melfi.[81] In some instances the cavity has a geometric form belonging to the crystalline system of the inclosing mineral. Such a space defined by crystallographic contours is a *negative crystal*. A cavity filled with gas contains no bubble, and its margin is marked by a broad dark band. The usual gas is nitrogen, with traces of oxygen and carbon-dioxide; sometimes it is entirely carbon-dioxide or hydrogen and hydrocarbons.

β. Vesicles containing liquid (and gas).—As far back as the year 1823, Brewster studied the nature of certain fluid-bearing cavities in different minerals.[82] The

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[80] H. C. Sorby, Presidential Address, Geol. Soc. 1880, p. 62. R. D. Irving and C. R. Van Hise "On secondary enlargements of Mineral Fragments in certain rocks." Bull. U. S. Geol. Surv. No. 8 (1884). J. W. Judd, Quart. Journ. Geol. Soc. xlv. (1889), p. 175.

[81] "Mik. Beschaff." p. 86.

[82] Edin. Phil. Journ. ix. p. 94. Trans. Roy. Soc. Edin. x. p. 1. See also W. Nicol, Edin. New Phil. Journ. (1828), v. p. 94; De la Vallée Poussin and Renard, Acad. Roy. Belg. 1876, p. 41; Hartley, Journ. Chem. Soc. ser. 2, xiv. 137; ser. 3, ii. p. 241; Microscop. Journ. xv. p. 170; Brit. Assoc. 1877, Sect. p. 232.