

ature likewise modify the direction in which the different particles arrange themselves in the act of crystallization, and also affect the form of the crystal.* Even when a body is not in a fluid condition, the smallest particles may undergo certain relations in their various modes of arrangement, which are manifested by the different action on light.† The phenomena presented by devitrification, and by the formation of steel by cementation and casting—the transition of the fibrous into the granular tissue of the iron, from the action of heat,‡ and probably, also, by regular and long-continued concussions—likewise throw a considerable degree of light on the geological process of metamorphism. Heat may even simultaneously induce opposite actions in crystalline bodies; for the admirable experiments of Mitscherlich have established the fact§ that calcareous spar, without altering its condition of aggregation, expands in the direction of one of its axes and contracts in the other.

If we pass from these general considerations to individual examples, we find that schist is converted, by the vicinity of Plutonic erupted rocks, into a bluish-black, glistening roofing slate. Here the planes of stratification are intersected by another system of divisional stratification, almost at right angles with the former,|| and thus indicating an action subsequent to the alteration. The penetration of silica causes the argillaceous schist to be traversed by quartz, transforming it, in part, into whetstone and silicious schist; the latter sometimes containing carbon, and being then capable of producing galvanic effects on the nerves. The highest degree of silicification of schist is that observed in ribbon jasper, a material highly valuable in the arts,¶ and which is produced in the Oural Mount-

* On the dimorphism of sulphur, see Mitscherlich, *Lehrbuch der Chemie*, § 55-63.

† On gypsum as a uniaxal crystal, and on the sulphate of magnesia, and the oxyds of zinc and nickel, see Mitscherlich, in Poggend., *Annalen*, bd. xi., s. 328.

‡ Coste, *Versuche am Creusot über das brüchig werden des Stabeisens*. Elie de Beaumont, *Mém. Géol.*, t. ii., p. 411.

§ Mitscherlich, *Ueber die Ausdehnung der Krystallisirten Körper durch die Wärmelehre*, in Poggend., *Annalen*, bd. x., s. 151.

|| On the double system of divisional planes, see Elie de Beaumont, *Géologie de la France*, p. 41; Credner, *Geognosie Thüringens und des Harzes*, s. 40; and Römer, *Das Rheinische Uebergangsgebirge*, 1844, s. 5 und 9.

¶ The silica is not merely colored by peroxyd of iron, but is accompanied by clay, lime, and potash. Rose, *Reise*, bd. ii., s. 187. On the formation of jasper by the action of dioritic porphyry, augite, and by