

Sulphur. — The element *sulphur* has great importance in the mineral kingdom, but more so in connection with the ores of various metals than among ordinary rock materials. Sulphur is a common volcanic product. Sulphur dioxide, or *sulphurous acid* (SO_2), is abundant in the vapors of volcanoes; and sulphur trioxide with water ($\text{SO}_3\text{H}_2\text{O}$), the so-called sulphuric acid, enters into combinations with other oxides, making *sulphates*.

Phosphorus. — Phosphorus forms an acid with oxygen, phosphorus pentoxide (P_2O_5), which combines with calcium and oxygen and makes calcium phosphate, a chief constituent of bones, of guano, and of the mineral apatite. There are also phosphates of iron, lead, copper, etc.

Nitrogen. — Seventy-nine per cent of the atmosphere is nitrogen, the rest being oxygen. Nitric acid (N_2O_5) forms nitrates; common saltpeter is a potassium nitrate. Nitrogen is an essential constituent of animal tissues, and of fungoid plants, or those that are not green in color, as the mushroom; and it is present also in the seeds and some other parts of higher plants.

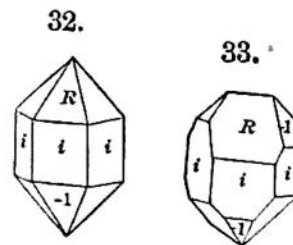
Chlorine, Bromine, Fluorine, Boron. — Chlorine combined with sodium, 60·7 per cent to 29·3, forms common salt, of which the ocean is the great depository. There are also among ores, chlorides of silver, lead, and copper. Bromides occur in the ocean's water and in some minerals. Fluorine is a constituent of the common mineral, fluor spar or fluorite (CaF), and also exists in the minerals, topaz, chondrodite, and a few others. Boron occurs in boracic acid, in borax, which is a sodium borate, and in the mineral silicates, tourmaline, danburite, and datolite.

THE CHIEF ROCK-MAKING MINERALS.

The following brief descriptions of minerals are intended as notes of reference. A sufficient knowledge of the subject for the geologist can be obtained only by a special study of mineralogy.

1. *Silica.*

QUARTZ. — Hardness 7 (not scratched with the point of a knife-blade). $G=2\cdot65$. Infusible and insoluble, but fusible to glass when mixed with soda and heated (quartz sand and soda being constituents of common glass). No cleavage. Often like glass in luster and transparency, but varying to dull and opaque, and from colorless to yellow, red, purple, brown, black, etc. Often in crystals like Figs. 32,¹ 33, the crystals, six-sided prisms with pyramids at one or both ends; often closely covering the surfaces with the pyramids. Composition: Silicon 46·67, oxygen 53·33=100. Common in massive forms, either glassy or of various dull colors, and of little luster. The stones and sand-grains of the fields and beaches are mostly quartz. This is due to the fact that nearly all other kinds of common stones are softer and get worn down to earth before quartz. Among massive varieties: *flint* and *chert* are dull-lustered, with usually a smoky or blackish color, but varying to yellowish, brownish, and other shades.



¹ In the figures of crystals *O* indicates the basal plane; *I, I*, the prismatic faces of the fundamental prism; and *R*, a face of the fundamental rhombohedron in rhombohedral forms.