onyx and sard, together with opal *(qq.v.)* are examples. Amorph­ous silica can be obtained from a silicate (a compound of silica and a metallic oxide) by fusing the finely powdered mineral with sodium carbonate, decomposing the sodium silicate thus formed with hydrochloric acid, evaporating to dryness to convert the colloidal silicic acid into insoluble silica, and removing the soluble chlorides by washing with hot water. On drying, the silica is obtained as a soft white amorphous powder, insoluble in water and in all adds except hydrofluoric; it dissolves in hot solutions of the caustic alkalis and to a less extent in alkali carbonates. It melts at a high temperature, and in the electric furnace it may be distilled, the vapours condensing to a bluish- white powder. By heating a solution of sodium silicate in a glass vessel the glass is attacked (an acid silicate being formed) and silica separates at ordinary temperatures in a hydrated amorphous form, at higher temperatures but below 1800 as tridymite, and above 180° as quartz.

*Silicates.*—These compounds are to be regarded as salts of silicic acid, or combinations of silicon dioxide and metallic basic oxides; they are of great importance since they constitute the commonest rock-forming and many other minerals, and occur in every petro­graphical species. The parent acid, silicic acid, was obtained by T. Graham by dialysing a solution of hydrochloric acid to which sodium silicate had been added; a colloidal silicic acid being re­tained in the dialyser. This solution may be concentrated until it contains about 14% of silica by open boiling, and this solution on evaporation in a vacuum gives a transparent mass of metasilicic acid, H2SiO3. The solution is a tasteless liquid having a slight acid reaction; it gradually changes to a clear transparent jelly, which afterwards shrinks on drying. This coagulation is brought about very quickly by sodium carbonate, and may be retarded by hydro­chloric acid or by a solution of a caustic alkali. Several hydrated forms have been obtained, *e.g.* 2SiO2·H2O, 3SiO2·H2O, 4SiO2∙H2O, 8SiO2·H2O; these are very unstable, the first two losing water on ex­posure whilst the others absorb water. The natural silicates may be regarded as falling into 5 classes, viz. orthosilicates, derived from Si(OH)4; metasilicates, from SiO(OH)2; disilicates, from Si2O3(OH)2j trisilicates, from Si3O6(OH)2; and basic silicates. These acids may be regarded as derived by the partial dehydration of the ortho-acid. Another classification is given in Metallurgy ; a list of mineral silicates is given in Mineralogy, and for the synthetical production of these compounds see also Petrology.

**SILICON** [symbol Si, atomic weight 28·3 (O=16)], a non- metallic chemical element. It is not found in the uncombined condition, but in combination with other elements it is, with perhaps the exception of oxygen, the most widely distributed and abundant of all the elements. It is found in the form of oxide (silica), either anhydrous or hydrated as quartz, flint, sand, chalcedony, tridymite, opal, &c., but occurs chiefly in the form of silicates of aluminium, magnesium, iron, and the alkali and alkaline earth metals, forming the chief constituent of various days, soils and rocks. It has also been found as a constituent of various parts of plants and has been recognized in the stars. The element exists in two forms, one amorphous, the other crystalline. The older methods used for the preparation of the amorphous form, namely the decomposition of silicon halides or silicofluorides by the alkali metals, or of silica by magnesium, do not give good results, since the silicon obtained is always contaminated with various impurities, but a pure variety may be prepared according to E. Vigouroux *(Ann. chim. phys.,* 1897, (7) 12, p. 153) by heating silica with magnesium in the presence of magnesia, or by heating silica with aluminium. The crystalline form may be prepared by heating potassium silicofluoride with sodium or aluminium (F. Wohler, *Ann.,* 1856, 97, p. 266; 1857, 102, p. 382); by heating silica with magnesium in the presence of zinc (L. Gattermann, *Ber.,* 1889, 22, p. 186); and by the reduc­tion of silica in the presence of carbon and iron (H. N. Warren, *Chem. News,* 1888, 57, p. 54; 1893, 67, p. 136). Another crystalline form, differing from the former by its solubility in hydrofluoric acid, was prepared by H. Moissan and F. Siemens *(Comptes rendus,* 1904, 138, p. 1299). A somewhat impure silicon (containing 90-98% of the element) is made by the Carborundum Company of Niagara Falls (United States Patents 745122 and 842273, 1908) by heating coke and sand in an electric furnace. The product is a crystalline solid of specific gravity 2∙34, and melts at about 1430° C. See also German Patent 108817 for the production of crystallized silicon from silica and carborundum.

Amorphous silicon is a brown coloured powder, the crystalline variety being grey, but it presents somewhat different appear­ances according to the method used for its preparation. The specific gravity of the amorphous form is 2·35 (Vigouroux), that of the crystalline variety varying, according to the method of preparation, from 2∙004 to 2∙493. The specific heat varies with the temperature, from 0∙136 at -39° C. to 0·2029 at 232° C. Silicon distils readily at the temperature of the electric furnace. It is attacked rapidly by fluorine at ordinary temperature, and by chlorine when heated in a current of the gas. It undergoes a slight superficial oxidation when heated in oxygen. It combines directly with many metals on heating, whilst others merely dissolve it. When heated with sodium and potassium, appar­ently no action takes place, but if heated with lithium it forms a lithium silicide, Li6Si2 (H. Moissan, *Comptes rendus,* 1902, 134, p. 1083). It decomposes ammonia at a red heat, liberating hydrogen and yielding a compound containing silicon and nitro­gen. It reduces many non-metallic oxides. It is only soluble in a mixture of hydrofluoric and nitric acid, or in solutions of the caustic alkalis, in the latter case yielding hydrogen and a silicate: Si+2KHO+H2O = K2SiO3+2H2. On fusion with alkaline car­bonates and hydroxides it undergoes oxidation to silica which dissolves on the excess of alkali yielding an alkaline silicate.

*Silicon hydride,* SiH4, is obtained in an impure condition, as a spontaneously inflammable gas, by decomposing magnesium silicide with hydrochloric acid, or by the direct union of silicon and hydrogen in the electric arc. In the pure state it may be prepared by decom­posing ethyl silicoformate in the presence of sodium (C. Friedel and A. Ladenburg, *Comptes rendus,* 1867,64, pp. 359,1267) ; 4Si(OC2H6)3 = SiH4+3Si(OC2H6)4. When pure, it is a colourless gas which is not spontaneously inflammable at ordinary temperature and pressure, but a slight increase of temperature or decrease of pressure sets up decomposition. It is almost insoluble in water. It burns when brought into contact with chlorine, forming silicon chloride and hydrochloric acid. It decomposes solutions of silver nitrate and copper sulphate. A second hydride of silicon, of composition Si2H6, was prepared by H. Moissan and S. Smiles *(Comptes rendus,* 1902, pp. 569, 1549) from the products obtained in the action of hydrochloric acid on magnesium silicide. These are passed through a vessel surrounded by a freezing mixture and on fractionating the product the hydride distils over as a colourless liquid which boils at 52° C. It is also obtained by the decomposition of lithium silicide with concentrated hydrochloric acid. Its vapour is spontaneously inflammable when exposed to air. It behaves as a reducing agent. For a possible hydride (Si2H3)n see J. Ogier, *Ann. chim. ρhys.,* 1880, (5), 20, p. 5.

Only one oxide of silicon, namely the dioxide or silica, is known (see Silica).

*Silicon fluoride, SiF4,* is formed when silicon is brought into contact with fluorine (Moissan) ; or by decomposing a mixture of acid potas­sium fluoride and silica, or of calcium fluoride and silica with concen­trated sulphuric acid. It is a colourless, strongly fuming gas which has a suffocating smell. It is decomposed with great violence when heated in contact with either sodium or potassium. It combines directly with ammonia to form the compound SiF4∙2NH3, and is absorbed by dry boric acid and by many metallic oxides. Water decomposes it into silicoiluoric acid and silicic acid: 3SiF4+3H2O = 2H2SiF6+ H2SiO3. With potassium hydroxide it yields potassium silicofluoride, whilst with sodium hydroxide, sodium fluoride is produced: 3SiF4 = 4KHO = SiO2+2K2SiF6+2H2O; SiF4+4NaOH= SiO2+4NaF+ 2H2O. It combines directly with acetone and with various amines. *Silicon fluoroform,* SiHF3, was obtained by O. Ruff and Curt Albert (*Ber.,* 1905, 38, p. 53) by decomposing titanium fluoride with silicon chloroform in sealed vessels at 100-120° C. It is a colourless gas which may be condensed to a liquid boiling at -80-2° C. On solidification it melts at about -no® C. The gas is very unstable, decomposing slowly even at ordinary temperatures, into hydrogen, silicon fluoride and silicon: 4SiHF3 = 2H2+3SiF4+Si. It burns with a pale-blue flame forming silicon fluoride, silicofluoric acid and silicic acid. It is decomposed readily by water, sodium hydroxide, alcohol and ether:

2SiHF3+4H2O=H4SiO4+H2SiF6+2H2; SiHF3+3NaOH+H2O=H4SiO4+3NaF+H2 ; 2SiHF3+4C2H6OH=Si(OC2H6)4+H2SiF6+2H2i SiHF3+3(C2H3)2O≡SiH(OC2H5)3+3C2H5F.

*Silicofluoric acid,* H2SiF6, is obtained as shown above, and also by the action of sulphuric acid on barium silicofluoride, or by absorbing silicon fluoride in aqueous hydrofluoric acid. The solution on evaporation deposits a hydrated form, H2SiF6·2H2O, which decom­poses when heated. The anhydrous acid is not known, since on