reduce any platinum nitrate that may be present to metal. The fused mass is dissolved in dilute ammonia and diluted to about fifty times the weight of the silver it contains. The filtered (blue) solution is now mixed with an excess of solution of ammonium sulphite, and allowed to stand. After twenty-four hours about one-half of the silver has separated out in crystals; from the mother-liquor the rest comes down promptly on application of a water-bath heat. The rationale of the process is that the sulphite hardly acts upon the dis­solved oxide of silver, but it reduces some of the cupric oxide to cuprous oxide, which reduces its equivalent of silver oxide to silver and reforming cupric oxide which passes through the same cycle.

*Alloys of Silver.—*Silver readily alloys with many metals, and the admixture generally differs in physical properties from the pure metal. Thus arsenic, antimony, bismuth, tin or zinc render the metal brittle, so that it fractures under a die or rolling mill; copper, on the other hand, increases its hardness, makes it tougher and more readily fusible. Consequently copper-silver alloys receive extensive application for coinage and jewelry. The composition of the alloy is stated in terms of its “ fineness,” the proportion of silver in 1000 parts of alloy. Generally copper-silver alloys separate into two layers of different composition on fusion; an exception is the alloy Ag3Cu2, investigated by A. I. F. Levol, corresponding to a fineness of 719, which remained perfectly homogeneous.

The extent to which the properties of silver are modified by addition of copper depends on the fineness of the alloy produced. The addition of even three parts of copper to one of silver does not quite obliterate the whiteness of the noble metal. According to Kamarsch, the relative abrasion suffered by silver coins of the degrees of fineness named is as follows :—

Fineness .... 312 750 900 993

Abrasion I 2∙3 3∙9 9∙5

The same observer established the following relation between fine­ness *p* and specific gravity of alloys containing from 375 to 875 of silver per 1000:—sρ. gr. =0∙001647 *p*+8∙833.

The fusing points of all copper-silver alloys lies below that of pure copper; that of British standard silver is lower than even that of pure silver.

*Compounds of Silver.*

Silver forms one perfectly characterized oxide, Ag2O, from which is derived a series of stable salts, and probably several less perfectly known ones. *Argentic* or *silver oxide*, Ag2O, is obtained as a dark brown precipitate by adding potash to a solution of a silver salt; on drying at 60°-80° it becomes almost black. It is also obtained by digesting freshly precipitated silver chloride with potash. It is sparingly soluble in water (one part in 3000) ; and the moist oxide frequently behaves as the hydroxide, AgOH, *i.e.* it converts alkyl haloids into alcohols. It begins to decompose into silver and oxygen at 250°. *Silver peroxide,* AgO, appears under certain conditions as minute octahedra when a solution of silver nitrate is electrolysed, or as an amorphous crust in the electrolysis of dilute sulphuric acid between silver electrodes. It readily decomposes into silver and oxygen. It dissolves in ammonia with the liberation of nitrogen and the formation of silver oxide, Ag2O; and in sulphuric acid forming a fairly stable dark green liquid which, on dilution, gives off oxygen and forms silver sulphate. It is doubtful whether the pure compound has been obtained. The compound obtained from silver nitrate always contains nitrogen; it appears to have the constant composition Ag7NO11, and has been named silver peroxy nitrate. Similarly the sulphate yields 5Ag2O2, 2Ag2SO7, silver peroxysulphate, and the fluoride the peroxyfluorides Ag15F3O16, Ag7FO8. The sesquioxide, Ag4O3, is supposed to be formed when silver peroxide is treated with ammonia (Watson, *Jour. Chem. Soc.,* 1906, 89, p. 578).

*Silver chloride,* AgCl, constitutes the mineral cerargyrite or horn silver; mixed with clay it is the butter-milk ore of the German miners. Early names for it are *Lac argenti* and *Luna cornea,* the first referring to its form when freshly precipitated, the latter to its ap­pearance after fusion. It is readily obtained as a white curdy precipitate by adding a solution of a chloride to a soluble silver salt. It is almost insoluble in water, soluble in 50,000 parts of nitric acid, and more soluble in strong hydrochloric acid and solutions of alkaline chlorides. It readily dissolves in ammonia, the solution, on evapora­tion, yielding rhombic crystals of 2AgCl∙3NH3; it also dissolves in sodium thiosulphate and potassium cyanide solutions. On exposure to light it rapidly darkens, a behaviour utilized in photography *(q.v.).* Abney and Baker have shown that the pure dry chloride does not blacken when exposed in a vacuous tube to light, and that the blackening is due to absorption of oxygen accompanied by a loss of chlorine. Hydrogen peroxide is also formed. It melts at about 460° to a clear yellow liquid, which, on cooling, solidifies to a trans­lucent resinous mass. It is reduced to metallic silver by certain metals—zinc, iron, &c.—in the presence of water, by fusion with alkaline carbonates or cyanides, by heating in a current of hydrogen, or by digestion with strong potash solution, or with potassium carbonate and grape sugar. *Silver bromide,* AgBr, constitutes the mineral bromargyrite or bromyrite, found in Mexico and Chile. It is obtained as a yellowish white precipitate by mixing solutions of a bromide and a silver salt. It is very slightly soluble in nitric acid, and less soluble in ammonia than the chloride. It melts at 427°, and darkens on exposure to air. The minerals embolite, mega­bromite and microbromite, occurring in Chile, are variable mixtures of the chloride and bromide. *Silver iodide.* AgI, occurs in nature as the mineral iodargyrite or iodyrite, forming hexagonal crystals, or yellowish green plates. It is obtained as a light yellow powder by dissolving the metal in hydriodic acid, or by precipitating a silver salt with a soluble iodide. It is very slightly soluble in acids and ammonia, and almost insoluble in alkaline chlorides ; potassium iodide, however, dissolves it to form AgI∙KI. Silver iodide is dimorphous; at ordinary temperatures the stable form is hexa­gonal; on heating to about 138° the colour changes from deep yellow to yellowish-white with the formation of cubic crystals. *Silver fluoride,* AgF, is obtained as quadratic octahedra, with one molecule of water, by dissolving the oxide or carbonate in hydrofluoric acid. It is deliquescent, and dissolves in half its weight of water to form a strongly alkaline liquid. It is not decomposed by sunlight. It melts at 435° and, on cooling, forms a yellow transparent mass. In addition to the salts described above there exist sub-salts. *Silver nitrate,* AgNO3, one of the most important silver salts, is obtained by dissolving the metal in moderately dilute nitric acid; on evaporation it separates in the anhydrous form as colourless triclinic plates. It dissolves in water, alcohol and ether. It stains the skin and hair black: an ethereal solution having been employed as a dye for the hair. Mixed with gum arabic it forms a marking ink for linen. It fuses at 218°; and when cast in quill-like moulds, it constitutes the lunar caustic of medicine, principally used as a cauterizing agent.

*Silver sulphide,* Ag2S, constitutes the mineral argentite or silver glance, and may be obtained by heating silver with sulphur, or by precipitating a silver salt with sulphuretted hydrogen. Thus ob­tained it is a brownish solid, which readily fuses and resolidifies to a soft leaden-grey mass. It forms with silver nitrate the yellowish green solid, Ag2S∙AgNO3, and with silver sulphate the orange-red powder, Ag2S∙Ag2SO4. *Silver sulphate,* Ag2SO4, is obtained as white crystals, sparingly soluble in water, by dissolving the metal in strong sulphuric acid, sulphur dioxide being evolved, or by adding strong sulphuric acid to a solution of the nitrate. It combines with ammonia to form the readily soluble 2NH3∙Ag2SO4. *Silver selenide,* Ag2Se, resembles the sulphide. It occurs in the minerals naumannite, PbSe∙Ag2Se, and eukairite, Ag2Se∙Cu2Se. The *telluride,* Ag2Te, occurs in nature as the mineral hessite.

*Fulminating silver* is an extremely explosive black powder, first obtained in 1788 by Berthelot, who acted with ammonia on silver oxide (prepared by adding lime water to a silver solution). When dry it. explodes even on touching with a feather. It appears to be silver nitride Ag3N, but it usually contains free silver and sometimes hydrogen. It is to be distinguished from silver fulminate (see Fulminic Acid). The nitride AgN3, silver azoimide *(q.v.),* is also highly explosive.

See J. Percy, *Metallurgy of Silver and Gold* (London, 1880), part i.; T. Egleston, *The Metallurgy of Silver, Gold and Mercury* (New York, 1887 1890), part i.; Μ. Eissler, *The Metallurgy of Silver* (London, 1891); H. F. Collins, *The Metallurgy of Lead and Silver* (London, 1900), part ii. ; H. O. Hofman, *Hydrometallurgý of Silver* (1907); C. Schnabel, *Metallurgy,* translated by H. Louis, 2nd ed. vol. i. (1905).

*Medicinal Use.*

Two salts of silver are used in the British pharmacopoeia. (1) *Argenti nitras* (United States and British pharmacopoeia), lunar caustic, incompatible with alkalis, chlorides, acids, except nitric and acetic, potassium iodide and arsenical solutions. From the nitrate are made (*a*) *argenti nitras indurata,* toughened caustic, containing 19 parts of silver nitrate and one of potassium nitrate fused together into cylindrical rods; (*b*) *Argenti nitras mitigatus,* mitigated caustic, in which 1 part of silver nitrate and 2 parts of potassium nitrate are fused together into rods or cones. (2) *Argenti oxidum,* incompatible with chlorides, organic substances, phenol, creosote, &c., with which it forms explosive compounds.

*Therapeutics.—*Externally the nitrate has a caustic action, de­stroying the superficial tissues and separating the part acted on as a slough. Its action is limited. It may be employed to destroy warts or small growths, to reduce exuberant granulations or it may be applied to bites. In granular lids and various forms of ophthalmia solutions of silver nitrate (2 grs. to 1 fl. oz.) are employed. A I % solution is also used as a prophylactic for ophthalmia neonatorum. The effects of the nitrate being both astringent and. stimulating as well as bactericidal, solutions of it are used to paint indolent ulcers and in chronic pharyngitis or laryngitis. Salts of silver are most useful as an injection in subacute and chronic gonorrhoea, either the nitrate (1 to 5% solution) being employed, or protargol, which is a proteid compound containing 8% of silver nitrate, is used in 1% solution; they also benefit in leucorrhoea. In pruritus of the