sandbath, and are heated by the same fire. As the temperature of the boiling liquid and of the vapour rises at the end to beyond 300° C., a sudden draught of cold air might cause rupture of a retort ; the apparatus is therefore placed in a special room accessible only through double doors, and the inner door is not permitted to be opened before the outer has been shut. The acid, as it is boil­ing down, gets stronger and stronger, because, although the vapour is very strongly acid from the first, its percentage *p'* of real H2SO4 at any given stage is less than the value *p,* whieh obtains in the boiling liquid as it is at the time. *p'* at a given barometric pres­sure is a fixed function of *ρ* only, and increases as *p* increases ; the difference *ρ -p'* accordingly gets less and less. It becomes nil, not when the acid has become pure H2SO4, but when it has come up to the composition 12SO3+13H2O (Marignac). This particular hydrate only boils without change of composition ; even pure H2SO4 when distilled, by giving up more than 1SO3 for 1H2O, becomes reduced to that hydrate 12SO3 + 13HO, which then boils without further change of composition. A stronger acid than “ Marignac,” as we may call it, cannot be produced by the concentration of weaker acid, and even its production (from 1·7 acid) involves a very con­siderable loss of acid as distillate. Hence practically the process is stopped when the acid in the retorts has come up to some 96 per cent. of H2SO4, which is ascertained by the specific gravity of the last runnings being at a certain value. As soon as this point is reached the retorts are allowed to cool till the contents can be withdrawn with safety by means of lead siphons into glass carboys. This, however, means a considerable loss of time and fuel ; besides, the process of distilling from out of glass vessels is not free from danger, and for these reasons it is preferred in many establishments to con­centrate the pan acid in large platinum stills, although these are extremely expensive. The great advantage of the platinum still is that it admits of continuous working ; while pan acid (containing say 1 lb of water per *N* lb of full strength—96 per cent. or so—acid) runs in, and a far weaker acid (containing for the same period of time 1 lb of water and *n* lb of full strength acid) is distilling over, the balance *N-n* lb of finished acid is being withdrawn by means of a platinum siphon. The outer limb of the siphon in its middle portion divides into a system of four narrower tubes and is cooled down by means of a cold-water jacket surrounding it, so that the acid can be run directly into carboys.

The platinum retort in its latest form has a large undulating bottom made of strong metal, on which a rapidly converging low body joins, made of thinner metal because it is not so directly ex­posed to the flame. Along with this still a flat platinum pan is used with an undulating bottom similar to that of the still for the preliminary concentration of the acid. As platinum is not liable to fuse or be attacked by any strength of boiling acid, a relatively small platinum pan does as much work as a far larger one made of lead.

*Sulphates.*

Several of these are treated of under the heads of the respective bases. Thus, for the sulphates of ammonia, see Nitrogen, vol. xvii. p. 515 *sq.* ; for Potassium and Sodium, see these articles ; for calcium, see Lime (vol. xiv. p. 648) and Gypsum (vol. xi. p. 351) ; for barium, see Barytes (vol. iii. p. 406) ; for magnesium, see Epsom Salts (vol. viii. p. 496) and Magnesium (vol. xv. p. 217) ; and for iron, see Copperas (vol. vi. p. 352).

Sulphate of aluminium, Al2(SO4)3 +18H2O, the active ingredient of Alum (vol. i. p. 643), is now being produced industrially in a state of perfect freedom from iron, and is more and more taking the place of alum. Paper-makers, at least, no longer use anything else for the production of alumina soap, which in machine-made paper serves as the principal ingredient of the size. The crude salt is easily produced by treatment of relatively pure bauxite (native hydrated alumina) or china clay with chamber acid at a suitable temperature. The resulting mass is dissolved in water, the undis­solved matter (silica, &c.) allowed to settle, the clear liquor drawn off, and from it an apology for what is wanted is obtained by evapo­ration to a small volume and allowing to crystallize. But the salt thus obtained is always contaminated with a variety of foreign sulphates, including sulphate of iron, and this last-named impurity, for the majority of applications, cannot be suffered to remain. One of the best methods for its removal, if not the best, is that dis­covered by Semper and Fahlberg : the solution, which must contain all its iron as ferric salt and contain somewhat less than the normal proportion of sulphuric acid, is digested with hydrated binoxide of lead. In the course of about a week all the iron is completely precipitated. The better qualities of sulphate of alumina nowadays have at most only a few thousandths per cent. of iron.

Sulphate of copper (blue vitriol) is made technically in chiefly two ways. One method is to heat metallic copper to redness in air until it is almost completely oxidized, and to dissolve the oxide by means of dilute sulphuric acid. The Cu2O present behaves like a mixture of metal and CuO. Another process starts from the sub­sulphide Cu2S (produced metallurgically as “mat,” or perhaps ex­pressly from its elements), and converts this into sulphate and

oxide by careful roasting. The product is dissolved in dilute sul­phuric acid. Large quantities of blue vitriol are produced incident­ally in the “ parting ” of auriferous silver (see Gold, vol. x. p. 749) by means of oil of vitriol. Sulphate of copper crystallizes from its aqueous solution in large transparent blue crystals of the triclinic system their composition is CuSO45H2O. The crystals are stable in the air. At 100° C. they lose 4H2O, the last H2O requiring a temperature of 200° C. for its expulsion. The anhydrous salt is dirty white ; it readily reunites with water, and consequently is available as a dehydrating agent, for instance, for the preparation of absolute alcohol from spirit of wine. 100 parts of water dissolve at 0° 10° 20° 50° 100° C.

31·6 37·0 42·3 65·8 203·3 parts of crystallized salt (Poggiale). The salt is insoluble in alcohol. Blue vitriol is used largely in electrotyping and for many other purposes.

Subjoined are two general tests for sulphur. (1) All sulphur compounds when brought in contact at a red heat with a mixture of nitre and carbonate of soda (or some other equivalent alkaline oxidizing mixture) are changed so that the sulphur assumes the form of alkaline sulphate, which can be extracted by means of water. From the (filtered) solution the SO3 is precipitated by addition of chloride of barium as BaSO4,—a white powdery precipi­tate characteristically insoluble in water and in dilute acids. (2) Any non-volatile sulphur compound, when heated on charcoal in a reducing flame with carbonate of soda, yields sulphide of sodium (“hepar”), which, when moistened with water on a silver coin, produces a black stain of metallic sulphide. (Compare Selenium vol. xxi. pp. 631-632.) (W. D )

SULPICIUS SEVERUS. See Severus.

SULTÁNPUR, or Sultanpoor, a district of British India, in the Rái Bareli (Roy Bareilly) division of Oudh, under the jurisdiction of the lieutenant-governor of the North-Western Provinces, lying between 26° 39' and 27° 58' N. lat. and 81° 36' and 82° 44' E. long. With an area of 1707 square miles, it is bounded on the N. by Faizábád, on the E. by Jaunpur, on the S. by Partábgarh, and on the W. by Rái Bareli. The surface of the district is generally level, being broken only by ravines in the neighbourhood of the rivers by which its drainage is effected. The central portion of the district is highly cultivated, while in the south are widespread arid plains and swampy jhils and marshes. The principal river is the Gumti, which passes through the centre of Sultánpur and affords a valuable highway for commerce. Minor streams are the Kándu, Pili, Tengha, and Nandhia, the last two being of some im­portance, as their channels are deep, though narrow, and form the outlet for the superfluous water of the extensive series of jhils. There are no forests in the district, the only tree-covered tracts being stunted ***dhák*** jungles used for fuel. Wild animals are very few, chiefly wolves, nylghau, and wild hog. There are some good roads in the district, chief of which is the imperial high road from Faizábád to Allahábád, which intersects it from north to south. The Oudh and Rohilkhand Railway traverses the district for a few miles in the extreme east. The climate is considered mild, temperate, and healthy; the average annual rainfall is about 46 inches.

The population, according to the census of 1881, was 957,912 (males 475,125, females 482,787), of whom 856,329 were Hindus and 101,524 Mohammedans. The only town with a population exceeding 5000 is Sultánpur, the administrative headquarters of the district, which is situated on the right bank of the Gumti, and in 1881 contained 9374 inhabitants. Of the total area 571,795 acres were returned as cultivated in 1884-85 aud 368,911 as cultivable ; the total area under crops in the same year was 672,058 acres, wheat and rice being the principal products. The trade of the district deals principally with grain, cotton, molasses, and native cloth, and its manufactures—which, however, are unimportant—comprise coarse cotton cloth, brass vessels and other metal work, sugar, and indigo. The only incident worthy of note in the history of the district since the British annexation of Oudh is the revolt of the native troops stationed at Sultánpur during the mutiny. The troops rose in rebellion on 9th June 1857, and, after filing on and murdering two of their officers, sacked the station. L pon the restoration of order Sultánpur cantonment was strengthened by a detachment of British troops ; but in 1861 it was entirely aban­doned as a military station.

SULU ISLANDS. See Philippines, vol. xviii. p. 752.

SUMACH. See Leather, vol. xiv. p. 382.