with the nitrous vitriol. Although this method appears more troublesome, it allows the amount of nitre to be more easily and more accurately regulated. The size of the Glover towers, and more especially that of the Gay-Lussac towers, has been progressively increased, and thereby the cube of the lead chambers themselves has been diminished to a much greater extent. By improved

“ packing ” the towers have been rendered more durable, and in thc case of the Gay-Lussac tower the loss of nitre has been diminished by avoiding the use of a coke packing, which acts upon that substance as a reducing agent. Many attempts have been made to reduce the chamber space by apparatus intended to bring about a better mixture of the gases, and to facilitate the interaction of the misty particles of nitrous vitriol and dilute acid floating in the chamber with each other and with the chamber atmosphere. The earliest really successful, and still the most generally applied apparatus.of this kind, is the Lunge-Rohrmann “ plate columns ” or “ reaction towers ” placed between the chambers, but though this and similar apparatus has proved to be very useful in the later stages of the process, it has not been found practicable to do away with the lead chambers, entirely. The pumping of the acids up to the top of the towers is now always performed by means of com­pressed air, either in the old “acid eggs,” or more economically in “ pulsometers.”

. Most of the sulphuric acid manufactured is not required to be of higher strength than is furnished by the vitriol chambers, either directly (65 to 70%), or after a passage through the Glover tower (78 to 80%). This, for instance, holds good of the acid employed in the manufacture of sulphate of soda and hydrochloric acid from common salt, and in the manufacture of superphosphates. But for many purposes more highly concentrated acid is required. Formerly all such acid was made by boiling down the dilute acid, for which purpose a great variety of apparatus was invented. The first question is always that of material. Lead can be used for the purpose only when the boiling-point of the acid is reduced by means of a vacuum—a plan which has not met with much success. Formerly glass vessels were generally employed and they still sur­vive in England, but elsewhere they are not much used. Porcelain, enamelled iron, for high concentrations even cast-iron without any protection, are also in use. On the continent of Europe platinum vessels have been for a long time almost universal, and they have been greatly improved by an internal lining of gold. The second

consideration is the form of the vessels; these may be open pans or dishes, or closed retorts, or combinations of both. We also note the Faure and Kessler apparatus, which consists of a platinum pan, surmounted by a double-walled leaden hood, in such a manner that, while the hood is constantly cooled from the outside by water, thc thin acid condensing on its inside is carried away without being allowed to flow back into the pan. The majority of acid makers, however, prefer retorts made entirely of platinum, preferably pro­vided by the Heraeus process with a dense, closely adherent coating of gold, including the top or “ dome.” The new Kessler furnace is a very ingenious apparatus, in which the fire from a gas-producer travels over the sulphuric acid contained in a trough made of Volvic lava, and surmounted by a number of perforated plates, over which fresh acid is constantly running down; the temperature is kept down by the production of a partial vacuum, which greatly promotes the volatilization of the water, whilst retarding that of the acid. This furnace is also very well adapted for impure acids, unsuitable for platinum or platinum-gold stills on account of the crusts forming at the bottom of the retorts; and it is more and more coming into use both in Great Britain and on the Continent. A third consideration is the condensation of the vapours formed in the con­centrating process; the further the concentration proceeds the more sulphuric acid they contain. Condensation is a comparatively easy task in the case of platinum apparatus, but with glass or porcelain beakers or retorts it presents great difficulties. In this respect the Kessler furnace has also proved to be very efficacious, so that it is at the present time considered the best apparatus for the concentration of sulphuric acid found in the trade.

The highest strength of sulphuric acid practically attainable by boiling down is 98% H2SO4, and this is only exceptionally reached, since it involves much expenditure of fuel, loss of acid and wear and tear of apparatus. The usual strength of the O.V. of commerce, mostly designated by its specific gravity as 168° Twaddell, is from 93 to 95, or at most 96 % H2SO4. When attempts are. made to push the process beyond 98 % it is found that the acid which distils over is as strong as that which remains behind. Real “ monohydrate ” or acid approaching 100 % can be made by Lunge’s process of cooling strong O.V. down to -16° C. when H2SO4 crystallizes out, or by the addition of anhydrous SO3 in the shape of fuming acid.

Since the development of the contact processes the fuming acid has become so cheap that it is now exclusively used for the prepara­tion of the acids approaching the composition of “ monohydrate.”

*Fuming or Nordhausen Oil of Vitriol,* a mixture or chemical com­pound of H2SO4, with more or less SO3, has been made for centuries by exposing pyritic schist to the influence of atmospheric agents, collecting the solution of ferrous and ferric sulphate thus formed, boiling it down into a hard mass (“ vitriolstein ”) and heating this to a low red heat in small earthenware retorts. Since about 1800 this industry had been confined to the north-west of Bohemia, and it survived just till 1900, when it was entirely abandoned—not because its product had become any less necessary, but, quite on the contrary, because the enormously increasing demand for fuming sulphuric acid, arising through the discovery of artificial alizarine and other coal-tar colours, could not possibly be supplied by the clumsy Bohemian process. Other sources of supply had accordingly to be sought, and they were found by going back to a reaction known since the first quarter of the 19th century, when J. W. Döbereiner discovered the combination of SO2 and O into SO3 by means of spongy platinum. This reaction, now known by the name of the catalytic or contact process, was made the subject of a patent by Peregrine Phillips, in 1831, and was tried later in many ways, but had been always considered as useless for practical purposes until 1875, when it was simultaneously and independently taken up by Clemens Winkler in Freiberg, and by W. S. Squire and R. Messel in London. . Both these inventors began in the same way, viz., by decomposing ordinary sulphuric acid by a high temperature into SO2, O, and H2O (the last of course being in the shape of steam), absorbing the water by sulphuric acid, and causing the SO2 and O to combine to SO3 by means of moderately heated platinum in a fine state, of division.. Winkler showed that, this division was best obtained by soaking asbestos with a solution of platinum chloride and reducing the platinum to the metallic state, and he described later a specially active kind of “ contact substance,” prepared from platinum chloride at a low temperature. This revival of the synthetical production of SO3, at a period when this article had. suddenly become of great importance, caused the greatest excitement among chemists and led to numerous attempts in the same direction, some of which were at once sufficiently successful to compete with the Bohemian process. It was soon found that the production of a mixture of SO2 and O from sulphuric acid, as above described, was both too troublesome and costly, and after a number of experiments in other directions inventors went back to the use of ordinary burner-gas from pyrites and sulphur burners. For a good many years the further development of this industry, was surrounded by great mystery, but it is now known that a satisfac­tory. solution of the difficulties existing in the above respect was attained in several places, for instance, at Freiberg and in London, by the labours of the original inventors, Professor Winkler and Dr Messel. These difficulties were mostly caused by the solid impurities