XXIV.—*Toughened Filter-papers.*

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IN attempting to prepare pyroxylin filters, the writer found that paper was remarkably toughened by the action of nitric acid, the product being pervious to liquids, and quite different from parchment-paper made with sulphuric acid. Simple immersion in, or mere moistening with nitric acid of density 1·42, and subsequent washing with water, are sufficient to produce the effect, and no particular precautions are necessary.

The toughened paper can be used like the ordinary kind, filtration being but little retarded, whilst the closeness of its texture and the absence of all pin holes render its action very efficient. It can be washed and rubbed without damage like a piece of linen, and is therefore likely to prove useful for the collection of substances that have to be removed from the filter whilst wet. Comparative trials were made of the strength of wet Swedish paper before and after being toughened. A strip of each 25 mm. wide was made into a loop, and the ends held in a vertical clamp; through the loop was passed a glass rod 5 mm. in diameter, to which by strings at each end a

scale-pan was attached. Ordinary filter-paper broke with a weight that varied from 100 to 150 grams, whilst the toughened paper bore a weight of about 1.5 kilos. before it gave way, and is therefore more than ten times as strong as the other. In consequence of its great tenacity the toughened paper can be used in ordinary funnels with the vacuum pump. Several trials were made, and it was found to bear the greatest pressure produced by the pump employed (a common exhausting syringe), whilst a single stroke of the piston broke the ordinary paper. The treatment with nitric acid producing but little change in texture, the toughened paper fits sufficiently closely to the funnel to prevent undue access of air, and is therefore not open to the objection made against the parchment filters recommended by C. Tichborne (*Pharm. J. Trans.*, 1871, 881). An admirable way of preparing filters for the pump is to dip only the apex of the folded paper into nitric acid, and then wash with water; the weak part is thus effectually toughened, whilst the rest remains unaltered.

The paper contracts in size under the treatment, and the ash is diminished. Thus circles 11.5 cm. in diameter became reduced to 10.4 cm., or about one-tenth, whilst the ash was reduced from 0.0026 to 0.0011 gram. The toughened paper contains no nitrogen. To determine this point, a portion was gently heated in a test-tube with strong sulphuric acid, by which it was almost immediately decomposed and carbonised. Water was added and the mixture filtered, a clear white filtrate being obtained. On this, when cold, solution of ferrous sulphate was carefully poured, but no coloration was produced, nor were brown fumes or a nitrous odour perceived at any stage of the testing. On the other hand, similar paper that had been converted into pyroxylin with the same nitric acid mixed with an equal bulk of oil of vitriol, dissolved in warm sulphuric acid without blackening, abundance of brown fumes being evolved, and the solution after dilution reacted strongly with ferrous sulphate. Moreover, the toughened paper gave no evidence of containing nitrogen by Lassaigne's test, and it burns like ordinary paper, and not at all like pyroxylin.

Subjected to the action of nitric acid of the strength specified, paper undergoes no increase in weight, as is the case when pyroxylin is formed, but, on the contrary, there is a slight decrease. Thus, a circle of Swedish paper 11.5 cm. in diameter weighed 0.6795 gram before treatment with nitric acid, and afterwards it weighed only 0.6749 gram, showing a loss of 0.68 per cent.

The effect of nitric acid on paper does not appear to have been studied very completely. Gmelin states (*Handbook*, 15, 135), apparently on his own authority, that "cotton, linen, or paper immersed for two or three minutes in nitric acid of sp. gr. 1.5 acquires the

texture of parchment, and is rendered impervious to light and water because it becomes covered with a film of xyloïdin," and further, that "paper immersed in cold strong nitric acid swells up to a jelly, which gives a blue colour with iodine on isolated spots, and therefore contains starch;" and, on the authority of Mitscherlich, that "Swedish paper is not at all decomposed by immersion in cold nitric acid of sp. gr. 1.2, and but slightly in the acid heated to 100°." No further information than this has been found by the writer.