XXX.—*The Polymerisation of Cyanic Acid: Cyanuric Acid, and Cyamelide.*

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When liquid cyanic acid is allowed to polymerise at 0°, or just above that temperature, it changes, as is well known, into a snow-white solid, the "insoluble cyanuric acid" or cyamelide of Liebig and Wöhler (*Ann. Phys. Chem.*, 1830, **20**, 384). This solid is not, however, cyamelide only, as is generally supposed, but a mixture of the two isomerides, cyamelide and cyanuric acid. The two compounds are readily separated by treatment with water, in which cyamelide is very sparingly soluble. Having prepared, in this way, cyamelide in a state of purity not hitherto described, we made determinations of its solubility and compared it with the solubility of cyanuric acid. We also made numerous attempts to cause it to enter into reaction with other compounds. The results, although negative, are in some instances interesting as bearing on the theory of its constitution.

Polymerisation of Cyanic Acid.—The liquid cyanic acid employed was prepared by distilling dry cyanuric acid in an apparatus made of hard glass tubing similar to that used by von Baeyer (*Annalen*, 1860, **114**, 165). The horizontal sealed end of the tube containing the cyanuric acid was heated in a short Hofmann combustion furnace, and so arranged that the bend leading to the U-shaped condenser portion was kept hot by the furnace. The condenser was kept at a temperature a few degrees below 0°. Liquid cyanuric acid, which was always slightly turbid, collected. When the temperature was allowed to rise to 0°, the liquid changed into a white solid. The polymerisation became violent and was accompanied by loud reports when a higher temperature was employed. 0·839 gram of this white solid, which had been

obtained from some cyanic acid almost free from turbidity, was finely powdered and treated with excess of hot water. The insoluble residue, after drying, weighed 0·253 gram and was about 30 per cent. of the substance taken. The washings on evaporation yielded crystals of cyanuric acid which gave the characteristic pink ammonio-cupric salt of Wöhler.

Solubility of Cyamelide and of Cyanuric Acid.—Some of the less soluble portions of the mixed polymerides were placed in a wash-bottle made of a large test-tube; boiling water was added and the contents were agitated for 2 hours by a current of air; the apparatus was then placed for 12 hours in water kept at about 15°; afterwards the contents were again agitated for an hour and the proportion of solid in solution was determined. As the result of numerous experiments, it was found that the percentage of solid dissolved decreased after each successive treatment with water in the case of every specimen examined, until it attained to from 0·008 to 0·01 per cent., when it became constant. The residues from the washings until the solubilities mentioned were attained responded in all cases to Wöhler's test for cyanuric acid, but after that point was reached the residues ceased to give that reaction. The solubility of cyamelide in water may therefore be taken as 0·01 per cent. at 15°. Determined in the same manner, as the result of very many experiments, we find the solubility of cyanuric acid to be from 0·145 to 0·160 per cent. at 15° (compare Lemoult, *Compt. rend.*, 1895, **121**, 351). A specimen of cyamelide having the solubility mentioned was submitted to elementary analysis:

0·2762 gave 0·2845 CO_2 and 0·0678 H_2O. C = 28·09; H = 2·72.
$(CONH)_3$ requires C = 27·9; H = 2·32 per cent.

Further Experiments with Cyamelide.—Cyamelide was treated with phosphorus pentachloride, but without any change occurring. Cyanuric acid yields, under the same circumstances, cyanuric chloride, and this was verified by an experiment. It was suggested by Klason (*J. pr. Chem.*, 1885, [ii], **33**, 129) that cyamelide is *iso*cyanuric acid related to the *iso*cyanuric esters, just as cyanuric acid is related to the normal cyanuric esters. It is interesting, therefore, as evidence of this view that as the normal esters and normal cyanuric acid yield a chloride with phosphorus pentachloride, so the *iso*-esters, and now it is proved cyamelide, do not do so.

Attempts were made to prepare silver, bromine, and other derivatives, but they were not successful.

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