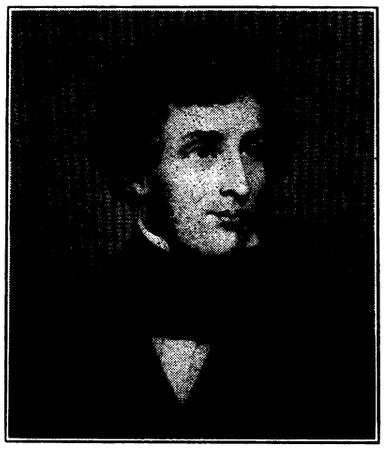
Classics of Science: Synthesis of Urea



Wohler's experiments in organic chemistry were made into a text-book by Rudolf Fittig, himself an eminent discoverer in the field, and were translated by Ira Remsen for use in the colleges in America, at the time when organic chemistry was only beginning to be studied outside Germany The quotation below gives full directions for preparing this interesting compound.

WOHLER'S OUTLINES OF ORGANIC CHEMISTRY, by Rudolph Fittig, Tr. from 8th German Edition by Ira Remsen, Philadelphia, 1873.

$$O{=}C{<}\begin{matrix}NH_2\\NH_2\end{matrix}$$

Organic Compounds

Organic Chemistry is the chemistry of the compounds of carbon. It includes those compounds of carbon which have had their origin in the organs of plants and animals, as well as those which have been produced exterior to the living organism. . . .

The processes, more intimately connected with the formation of the primitive organic compounds in the living organism of plants and animals, are almost entirely unknown to us. We only know with certainty that all organic material is originally formed in plants, that for this purpose plants make use of the elements of existing compounds particularly of carbonic acid, water, ammonia, and the inorganic acids of nitrogen, and that this process of formation takes place only under the influence of sunlight and of certain inorganic salts, which are absorbed from the soil; the manner in which this takes place is, however, up to the present, inexplicable. The animal organism, on the other hand, receives its constituents in the food in the form of organic compounds already existing.

A great many of the organic compounds occurring in nature can be produced artificially from the elements, but in by far the most cases the conditions and the chemical processes are entirely different from those through the instrumentality of which the formation occurs in nature.

The Artificial Product

For the artificial preparation of urea, crude potassium cyanate is prepared as follows:

A mixture of 8 parts of previously dehydrated iron ferrocyanate and 3 parts of potassium carbonate is heated to fusing, and 15 parts of red lead added gradually to the somewhat cooled, but still liquid mass. After the reduced lead has been separated, the salt-mass is poured off, and the potassium cyanate extracted by means of alcohol.—Lamellae, similar to potassium chloride; easily soluble in water, yielding potassium carbonate and ammonia.

The crude potassium cyanate is dissolved in water without the aid of heat, and to the solution as much ammonium sulphate is added as potassium ferrocyanide was employed; the liquid is evaporated down to a small volume, the potassium sulphate, that crystallizes out on cooling, filtered off, and the filtrate evaporated to dryness. The urea is extracted from the residue by means of alcohol.

The Natural Product

Extraction of urine: Urine is evaporated to syrupy consistence, and, when cool, mixed with an excess of strong nitric acid. Urea nitrate separates in the form of dark brown crystalline masses. It is now filtered off, pressed, and purified by recrystallization from moderately strong nitric acid. It is most easily obtained colorless, but not without loss, by gradually adding small quantities of finely powdered potassium chlorate to the hot concentrated solution in nitric acid, then allowing to cool and recrystallizing the almost colorless crystals which now separate, either from water or nitric acid. The urea nitrate, purified in this manner, is now decomposed by heating with water and barium carbonate, the filtrate evaporated to dryness and the urea extracted from barium nitrate by means of cold alcohol. It crystallizes from the solution, when concentrated by distilling off a portion of the alcohol.

Properties of Urea

Properties: Colorless, four-sided prisms, without odor, of a cooling taste; fuses at 130°. Easily soluble in water and alcohol.

Heated above its fusing point, it is decomposed, ammonia is given off, and, according to the duration of the heating, the residue consists either of *biuret* or *cyanuric acid*.—By heating with water in fused tubes above 100°; by boiling with alkalies; by heating with concentrated sulphuric acid; by evaporation of the solution, to which is added lead acetate, urea is resolved into carbonic anhydride and ammonia, water being assimilated. . . When heated for some time with alcoholic carbon bisulphide, ammonium sulphocyanate and carbonic anhydride are formed.

Urea combines with bases, acids, and salts, forming crystallizing compounds.

Friedrich Wöhler was a life-long friend of Liebig, and performed most of his researches in organic chemistry with him, at other times turning his energies toward extraction of the rarer metals, including aluminum, in the pure state. The synthesis of urea, for which he is most famous, was the first preparation in the laboratory of a product of the living organism, and was the work of Wöhler alone. Wöhler was born July 31, 1800, near Frankfort-am-Main, Germany, and died September 23, 1882, at the University of Göttingen, where he had taught for 46 years. The synthesis of urea was accomplished when Wöhler was 28 years of age.

Science News-Letter, October 15, 1927

Mosquito Fish in Italy

Gambusia, the little fish that befriends man by devouring mosquito "wigglers," is finding things even more to his liking in the ponds and ditches of Italy than in his native American home, according to reports received here from Rome. Carried first to Spain and thence to Italy to combat the malarial mosquitoes, this hungry little minnow has multiplied enormously throughout the region around the mouth of the Tiber, where it was first introduced, and has also been transplanted into shallow waters throughout the peninsula and along the Dalmatian coast. More favorable food and other environmental conditions, and probably the absence of natural enemies that take toll of its numbers in America, are credited with the gratifyingly abnormal rate of increase.

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