

One hesitates, however, to compare the heated crystals with a heat denatured protein because, despite many efforts, no denatured protein has been crystallized. And yet it can be shown that the heated, insoluble crystals are indeed crystals of denatured protein. The crystals, washed free of sodium sulfate by repeated centrifugation, readily dissolve in a pH 9.2 borate buffer. Crystals prepared from 0.3 ml of the serum albumin preparation mentioned above can be dissolved in 0.4 ml of a 0.1 M pH 9.2 borate buffer. If to this solution at 45° are added 5 ml of the sodium sulfate-acetate mixture used for crystallizing serum albumin, no crystals form. Instead all the protein immediately precipitates amorphously, and this precipitate does not dissolve when the salt solution is diluted with an equal volume of water. The albumin dissolved by placing crystals previously heated at 80° in the pH 9.2 borate buffer has the characteristic properties of a denatured protein. Denaturation is not caused by the pH 9.2 buffer, for if this buffer is added to native, unheated serum albumin, there is no difficulty in crystallizing the albumin and subsequently dissolving the crystals in water.

It is clear, then, that the heated crystals of serum albumin that are insoluble in water are crystals of denatured protein. Denaturation does not destroy the crystal pattern (although crystallographic analysis will probably show that it has been changed) but once the denatured albumin molecules are released from their confinement within the crystal by being dissolved in a pH 9.2 buffer it is impossible to replace them in the ordered pattern characteristic of a crystal of native protein. It is possible to obtain crystals of denatured protein by denaturing a protein while it is in the crystalline state, but it does not seem to be possible to crystallize a denatured protein.

A. E. MIRSKY

THE HOSPITAL OF THE ROCKEFELLER

INSTITUTE FOR MEDICAL RESEARCH, NEW YORK

### N<sup>1</sup>-(β-AMINOETHYL)SULFANILAMIDE AND N<sup>1</sup>-(β-DIETHYLAMINOETHYL) SULFANILAMIDE

THESE compounds were prepared from monoacetylenediamine<sup>1</sup> and β-diethylaminoethylamine,<sup>2</sup> respectively. The amine in an aqueous solution containing 1.5 molecular proportions of sodium bicarbonate was shaken for five hours (ten hours for the second compound) with a chloroform solution of 1.2 molecular proportions of acetylsulfanilyl chloride.<sup>3</sup> The insoluble material was separated by filtration (in the case of the second compound, after evaporating off most of the water and chloroform) and was hydrolyzed by boiling with 6 normal hydrochloric acid (8 cc per gram of the precipitate; in the case of the second compound, 4 cc per gram of the precipitate) under a reflux condenser for twelve hours. The compounds were isolated as the dihydrochlorides by evaporation of the solutions to dryness with a current of warm air and were purified by crystallization from ethyl alcohol-water mixtures (85 per cent. alcohol for the first compound; 95 per cent. for the second).

*N<sup>1</sup>-(β-Aminoethyl)sulfanilamide dihydrochloride.* Yield (based on monoacetylenediamine): 90 per cent. Calculated for C<sub>8</sub>H<sub>15</sub>O<sub>2</sub>N<sub>3</sub>SCl<sub>2</sub>: N, 14.58 per cent.; Cl, 24.61 per cent. Found: N, 14.37; Cl, 24.04. M.p. 217–220°.

*N<sup>1</sup>-(β-Diethylaminoethyl)sulfanilamide dihydrochloride.* Yield (based on β-diethylaminoethylamine): 30 to 65 per cent. Calculated for C<sub>12</sub>H<sub>20</sub>O<sub>2</sub>N<sub>3</sub>SCl<sub>2</sub>: N, 12.20 per cent.; Cl, 20.60 per cent. Found: N, 12.03; Cl, 20.59. M.p. 190–195°.

The synthesis of additional N<sup>1</sup>-(β-dialkylaminoethyl)sulfanilamides is in progress. These compounds will be tested for chemotherapeutic activity.

LAWRENCE H. AMUNDSEN

LENA A. MALENTACCHI

UNIVERSITY OF CONNECTICUT

## SCIENTIFIC APPARATUS AND LABORATORY METHODS

### ANOTHER CIRCUIT FOR TEMPERATURE CONTROLS

NUMEROUS articles have appeared in the literature recently describing circuits intended for use with thermostatic devices to control closely the temperature of ovens and chambers used for biological and chemical processes. Two of these have appeared within the last three months in SCIENCE.<sup>1, 2</sup>

Most of the circuits so far described require the use of one or more thermionic tubes to amplify the cur-

<sup>1</sup> A. C. Hall and L. J. Heidt, SCIENCE, 92: 2380, 133, August 9, 1940 and SCIENCE, 92: 2400, 612, December 27, 1940.

<sup>2</sup> Charles Butt, SCIENCE, 92: 2389, 339, October 11, 1940.

rent passing through the control device. This greatly amplified current is caused to operate a commercial relay. The satisfactory use of these tubes often involves the use of transformers, condensers and numerous resistances. Occasionally it has been found that changes in atmospheric conditions alter the values of

<sup>1</sup> Prepared by the method of Arthur J. Hill and Samuel R. Aspinall, *Jour. Am. Chem. Soc.*, 61: 822–5, 1939.

<sup>2</sup> Prepared as described by Lawrence H. Amundsen and Karl W. Krantz, *Jour. Am. Chem. Soc.*, 63: 305–7, 1941.

<sup>3</sup> Prepared by the method of S. Smiles and Jessie Stewart, "Organic Syntheses," collective vol. 1, edited by Henry Gilman, pp. 8–9. New York: John Wiley and Sons, 1932.

<sup>4</sup> Melting point ranges were somewhat indefinite. The compounds seemed to be undergoing decomposition, as gas appeared to be evolved.