

The structures of *cis-cis* pellitorine and *cis-cis* herculin have been confirmed by complete hydrogenation and oxidative degradation, when results identical with those recorded for the natural products² were obtained.

The various *isobutylamides* prepared are in process of being tested for insecticidal properties by the Agricultural Research Council. The synthesis of the remaining stereoisomers of I ($n = 2$ and 4) by various methods is now under investigation.

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R. A. RAPHAEL
F. SONDEHEIMER

Department of Organic Chemistry,
Imperial College of Science and Technology,
London, S.W.7.
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¹ *Chem. Eng. News*, 27, 2355 (1949).

² Jacobson, M., *J. Amer. Chem. Soc.*, 70, 4234 (1948); 71, 366 (1949).

Cross-Linking Reduced Animal Fibres

ONE of the more important aspects of the chemistry of protein fibres is the study of cross-linking reactions, each of which may be regarded as a potential process for industrial use. Low-temperature setting processes, for example, consist in cross-linking the mercapto groups of reduced wool fibres with oxidizing agents, metal salts or organic compounds containing two or more reactive halogen atoms in the molecule¹. It has now been found that even more successful cross-linking of reduced fibres may be obtained with allyl *isothiocyanate*, presumably because it is capable of combining with amino- and hydroxyl- as well as mercapto-groups².

After determining their load-extension curves up to 30 per cent extension in distilled water at 22.2° C., human hair fibres were reduced for 2 hr. at 50° C. in a molar solution of thioglycolic acid adjusted to pH 4.5 with potassium hydroxide³. The fibres were then washed in running water for 15 min., in pH 8 phosphate buffer for 15 min., followed by running water for 150 min. Some of the fibres were afterwards treated for 6 hr. at 50° C. with either 100 c.c. of the pH 8 buffer solution, or 2.5 c.c. of allyl *isothiocyanate* suspended in 100 c.c. of either the buffer solution or water. Finally, all the fibres were washed in running water overnight before re-determining their load-extension curves in distilled water. From the two load-extension curves for each fibre, the percentage change in resistance to 30 per cent extension, due to the treatments, was calculated. The results are given in the accompanying table.

Treatment	Percentage reduction in resistance to extension
Reduced and washed	52.9
Reduced, treated with pH 8 buffer, and washed	29.7
Reduced, treated with allyl <i>isothiocyanate</i> and buffer, and washed	9.2
Reduced, treated with allyl <i>isothiocyanate</i> in water, and washed	10.3

Although allyl *isothiocyanate* is so successful in strengthening reduced fibres, its use is likely to be limited because the cross-linkages are ruptured by

0.1 *N* hydrochloric acid in the cold and by a boiling 5 per cent solution of sodium bisulphite.

W. J. P. NEISH
J. B. SPEAKMAN

Textile Chemistry Laboratory,
Department of Textile Industries,
University of Leeds.
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¹ Speakman, *J. Soc. Dyers and Colourists*, 52, 423 (1936); B.P. 453,700; B.P. 453,701.

² Taylor and Baker, "Sidgwick's Organic Chemistry of Nitrogen", 337 (Oxford Univ. Press, 1937).

³ Patterson, Geiger, Mizell and Harris, *J. Res. Nat. Bur. Standards*, 27, 89 (1941).

Combustion of Droplets in a Fuel Spray

A FUNDAMENTAL investigation is in progress at the National Gas Turbine Establishment of the mechanism of the combustion of droplets in a fuel spray. In particular, the factors influencing the rate of burning, that is, the rate of evaporation of the burning drops, are being investigated. This preliminary note summarizes briefly some of the main results obtained to date, which are to be reported in full elsewhere.

Measurements have been made of the burning rates, in grams per second, of single drops of a series of commercial fuels and pure hydrocarbons. The experimental technique adopted has been to suspend a single drop of the fuel on a fine silica filament, and to measure with a cinematograph camera the rate of decrease in size during combustion in still air. Brief reference to this technique has already been made by Lloyd¹. In addition to the above experimental investigation, a detailed theoretical analysis has been made of the mechanism of the burning process under these conditions.

The process of evaporation of a drop into an atmosphere of the same temperature has already been well investigated. Maxwell², Stefan³, Sresnewski⁴ and Morse⁵ found theoretically and experimentally that the rate of evaporation, in grams per second, of a drop into still air is directly proportional to the first power of the radius of the drop, and to the difference in the vapour pressure at the surface of the drop and in the surrounding atmosphere. A detailed discussion of the process of evaporation under these conditions has been given by Fuchs⁶. Frössling⁷ extended these results to the case of a drop evaporating in a moving air-stream of the same temperature.

During the process of combustion of droplets in a fuel spray, the difference in temperature between the drop and the surrounding atmosphere is, of course, considerable. So far as I know, there has hitherto been no published work dealing specifically with the factors governing the evaporation process of an individual droplet under such conditions. Reference should, however, be made to the work published recently by Wolfhard and Parker⁸ on the evaporation processes occurring in a burning kerosine spray.

The results of the present investigations show that, in any event over the range of drop-size investigated (approximately 1,000–200 μ) and under the given conditions, burning drops also evaporate at a rate proportional to the first power of their radii. These results thus provide experimental justification for the assumptions used by Probert⁹ in his mathematical analysis of the process of evaporation of a fuel spray. Further, the experimental results show that in the case of a burning drop the vapour pressure does not