

chiefly uridine monophosphate. In both cases a sugar was also set free. The degradation products were identified by paper chromatography and electrophoresis. Hydrolysis of I with 0.05 N HCl for 10 minutes at 100° yielded a substance which reacted as an N-acetylhexosamine.⁶ It was identified as acetylglucosamine by paper chromatography,^{2,7} and by paper electrophoresis at pH 5.8 (ammonium acetate) and pH 8.6 (borate).⁸ Hydrolysis of I with 2 N HCl for 2 hours at 100° liberated a substance giving a positive reaction for hexosamine. This was identified as glucosamine by paper chromatography,^{7,8} electrophoresis,⁸ and by degradation to arabinose with ninhydrin.⁷

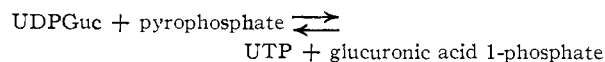
Mild acid hydrolysis of II set free a hexuronic acid (carbazole test) which was shown to be glucuronic acid by paper chromatography⁹ and by electrophoresis at pH 3.5.^{4,5} The analyses of the two nucleotides are presented in Table I. It is thus shown that substances I and II are UDPaG and UDPGuc, respectively.

TABLE I
ANALYSES OF NUCLEOTIDES FROM MUNG BEAN SEEDLINGS

	(I) $\mu\text{mole}/\mu\text{mole}$ uridine ^a (II)			
	Found	Calcd. for UDPaG	Found	Calcd. for UDPGuc
Total P ^b	2.10	2.00	2.02	2.00
Acid labile P ^c	0.98	1.00	0.95	1.00
Glucosamine ^d	0.97	1.00
Glucuronic acid ^e	0.93	1.00
Reducing value ^f	0	0	0	0
Reducing value after hydrolysis ^g	0.90	1.00	0.71	1.00

^a Uridine moiety identified by characteristic ultraviolet spectrum at pH 2, 7 and 11. Concentration was determined by the optical density at 260 m μ (pH 7) calculated on the basis of a molar extinction of 9.9×10^3 . ^b C. H. Fiske and Y. SubbaRow, *J. Biol. Chem.*, **66**, 375 (1925). ^c Hydrolysis with 0.1 N HCl for 10 minutes at 100°. ^d Z. Dische and E. Borenfreund, *J. Biol. Chem.*, **184**, 517 (1950). ^e Z. Dische, *ibid.*, **167**, 189 (1947). ^f J. T. Park and M. J. Johnson, *ibid.*, **181**, 149 (1949). ^g Hydrolysis with 0.1 N HCl for 10 minutes at 100°.

When UDPGuc (0.25 μmole) was incubated with a 55–65% ammonium sulfate fraction from a mung bean seedling extract in the presence of 0.5 μmole of sodium pyrophosphate, 2.5 μmoles of KF and 0.25 μmole of MgCl₂ in 0.02 M Tris buffer, pH 7.5, at 24° in a total volume of 17.5 μl . the formation of UTP could be demonstrated by electrophoresis at pH 3.5.^{4,5} In analogy with other known UDP-sugar pyrophosphorylases,¹⁰ the reaction may be formulated as



(6) D. Aminoff, W. T. J. Morgan and W. M. Watkins, *Biochem. J.*, **51**, 379 (1952).

(7) P. J. Stoffyn and R. W. Jeanloz, *Arch. Biochem. Biophys.*, **52**, 373 (1954).

(8) P. W. Kent and M. W. Whitehouse, "Biochemistry of the Amino Sugars," Academic Press, Inc., New York, N. Y., 1955, p. 166.

(9) F. G. Fischer and H. Dörfel, *Z. physiol. Chem.*, **301**, 224 (1955).

(10) E. F. Neufeld, V. Ginsburg, E. W. Putnam, D. Fanshier and W. Z. Hassid, *Arch. Biochem. Biophys.*, in press.

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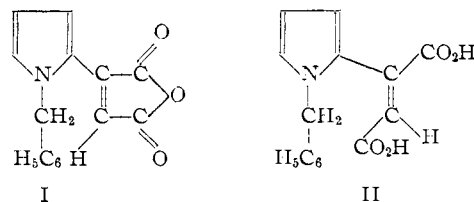
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THE REACTION OF N-BENZYLPIRROLE WITH ACETYLENEDICARBOXYLIC ACID¹

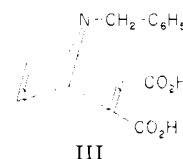
Sir:

The reaction of pyrroles with dienophiles has been shown to lead to substitution in the α -position of the pyrrole and, in some cases, to poly-substitution products such as dihydroindoles.² There has been no authenticated report of a pyrrole undergoing a normal Diels–Alder type of addition in the sense that, for example, furan will partake of Diels–Alder addition to dienophiles.³

We have found that refluxing an ether solution of N-benzylpyrrole and acetylenedicarboxylic acid for 24 hours gives rise to three products which were separated readily by taking advantage of their varying solubility properties. Two of these products, which had characteristic yellow colors, were shown to be α -substituted pyrroles on the basis of their elemental analyses, neutral equivalents, infrared spectra, common conversion by hydrolysis and hydrogenation to pyrrolidinesuccinic acid, and thus were assigned the structures I and II. This is in accord with the findings of Diels and Alder.²



The third compound, which was colorless, was assigned structure III on the basis of the data given below.



The material had an elemental analysis (Calcd. for C₁₈H₁₃O₄N: C, 66.4; H, 4.8; N, 5.2. Found: C, 66.0; H, 4.9; N, 5.1) and neutral equivalent (Calcd. for III: 135.5. Found: 133) which corresponded to a one-to-one adduct. The substance is amphoteric, being soluble in the cold in both dilute sodium bicarbonate and dilute hydrochloric acid, the latter indicative that the pyrrole moiety is no longer intact. On hydrogenation over 5% palladium on carbon at atmospheric pressure and room temperature, *three moles* of hydrogen were absorbed (in contrast to compounds I and II which take up *four moles* of hydrogen under these conditions) thus indicating the presence of a bicyclic skeleton. The material exhibited only end absorption in the ultraviolet (from 210 to 330 m μ) and its infrared spec-

(1) This work was supported by a Frederick Gardner Cottrell grant from Research Corporation.

(2) O. Diels and K. Alder, *Ann.*, **470**, 62 (1929); **486**, 211 (1931); **490**, 267 (1931); **498**, 1 (1932).

(3) H. Hopff and C. W. Rautenstrauch, U. S. Patent 2,262,002 [C. A., **36**, 1046 (1942)] have reported without citing evidence, that N-isobutylmaleimide reacts with pyrrole to yield a tetrahydro-endo-phthalimide.

trum (in KBr) indicated the presence of zwitterion formation.

In accord with this structural assignment, refluxing III for 12 hours in 10% sodium carbonate solution gave rise to N-benzylpyrrole and I.

This represents the first recorded Diels-Alder addition with a pyrrole acting as a diene. We hope

to report shortly on further rearrangements of the adduct and its hydrogenation products.

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BOOK REVIEWS

Organic Syntheses. Vol. 36. By N. J. LEONARD, Editor-in-Chief, John Wiley and Sons, Inc., 440 Fourth Avenue, New York 16, N. Y. 1956. vi + 120 pp. 15.5 × 23.5 cm. Price, \$3.75.

"Tried and true" directions for preparing 35 organic compounds are reported in Volume 36 of "Organic Syntheses." This volume maintains the high standards of its predecessors in its editing, experimental directions and indexing. The compounds treated range from the very simple, such as propionaldehyde, to the somewhat more complex, such as 2-hydroxycyclodecanone. The editors wisely refrain from including syntheses of very complex compounds, which would have limited applicability and interest.

Probably one of the most useful preparations will be the one for diazomethane from *p*-tolylsulfonylethylmethylnitrosamide. The advantage of this method is that the starting material is stable and soluble in organic solvents.

This new volume will take its place as a worthy addition to the "Organic Syntheses" series, which has for many years been one of the most valuable reference works for the organic chemist.

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The Chemistry of Petrochemicals. By MELVIN J. ASTLE, Professor of Chemistry, Case Institute of Technology, Cleveland, Ohio. Reinhold Publishing Corporation, 430 Park Avenue, New York 22, N. Y. 1956. v + 267 pp. 16 × 23.5 cm. Price, \$6.50.

This volume is a valuable source of general information and literature references on organic chemical compounds produced from petroleum. The 14 chapters contain 255 pages of text, many equations and tables of data, and 582 literature references. However, there is no author index and the bibliographies for each chapter are not alphabetically arranged.

The discussion is reminiscent of the books of Carleton Ellis. There is much useful information presented in sufficient detail to introduce the reader to the subject. For example, alkylation is covered in 9 pages, 7 on alkylation of paraffins and 2 on alkylation of aromatics. Two and one-half pages are devoted to the theory of alkylation. This section is based almost entirely on the work of Schmerling. The bibliography omits some important papers in this field, particularly those of Dr. P. D. Bartlett and associates.

The discussion of alkylation with hydrogen fluoride starts off with the statement, "Hydrogen Fluoride is increasing in importance as an alkylation catalyst." There is no mention of the fact that HF alkylation was an important process for producing aviation alkylate during World War II, and that nearly all of these HF alkylation plants were shut down, or converted to other use, at the end of the war. In regard to the Ziegler process (p. 103) for poly-

olefins, it is now more or less generally known that mixed catalyses are better than aluminum alkyls alone.

There are other spots in the text which indicate a lack of familiarity with what has actually been going on in industry. For example, on page 155, a process for concentrating benzene by adsorption is described as though the plant had been built and operated. Actually this process for concentrating benzene by adsorption never got beyond the drawing board stage.

On the scientific side, there is a tendency toward rather loose statements, such as the introductory sentence of chapter 2, which reads, "Inasmuch as petroleum is made up largely of paraffin hydrocarbons, these compounds must be considered to be the ultimate starting materials for the preparation of petrochemicals." Benzene and toluene occur in natural petroleum and have been separated commercially as noted on page 153. It is quite clear that paraffins and cycloparaffins naturally occurring in petroleum are not the "ultimate" starting materials for all petrochemicals. However, it is probably true that on a tonnage basis, the chemicals produced from the paraffin and cycloparaffin constituents of petroleum will probably be more important than those produced from the naturally occurring aromatics in petroleum.

The title of this book illustrates the fact that the word "petrochemical" is better adapted to economic rather than scientific discussion. On page 2 there is an estimate that there will be 35 billion pounds of "petrochemicals" produced in 1956 of which 10.5 billion pounds will be "inorganic petrochemicals." However, the book omits entirely any discussion of the chemistry of the "inorganic petrochemicals" such as ammonia and sulfur.

The word "petrochemical," as used in the petroleum industry, brings together products which are economically related, but not chemically related.

In spite of a certain degree of superficiality, which is perhaps unavoidable in a book covering so wide a range of topics, this book should prove of real value to those who need an introduction to the field of the organic chemistry of hydrocarbons, and the more simple organic compounds derivable from hydrocarbons.

RESEARCH AND DEVELOPMENT DEPT.

SUN OIL COMPANY
MARCUS HOOK, PA.

STEWART S. KURTZ, JR.

Polymer Solutions. By H. TOMPA. Academic Press, Inc., 111 Fifth Avenue, New York 3, N. Y. 1956. xiv + 325 pp. 10.0 × 16.5 cm. Price \$8.50.

This is a comprehensive review of current concepts of the solution properties of high polymeric substances. The author has wisely omitted a treatment of polyelectrolytes since this is more properly in the domain of electrolyte theory. Throughout, Dr. Tompa compares theory with experimental results. The book is practically self-contained. All the basic formulas of the thermodynamics of solutions and of the statistics of coiled molecules are derived from first principles. When the author discusses