

TABLE I  
SYNTHESIS OF ANTHRANILIC ACID FROM SHIKIMIC-5-P AND L-GLUTAMINE

Cell-free extracts were prepared by subjecting cells of freshly harvested *E. coli* mutant B-37 to sonic vibration.<sup>11</sup> The incubation mixtures contained 0.2 ml. of extract (4 mg. of protein), 5  $\mu$ moles of  $MgCl_2$ , 40  $\mu$ moles of Tris buffer pH 8.2, 1.0  $\mu$ mole of shikimic-5-P or 5  $\mu$ moles of glutamine (as indicated), + additions in a final volume of 1 ml. Following incubation at 37° for 2 hours aliquots were removed for the assay of anthranilic acid.<sup>12,13</sup>

Substrates and additions	Yield of anthranilic acid, $\mu$ moles
Shikimic acid-5-phosphate (1.0 $\mu$ mole)	0
+ 5.0 $\mu$ moles L-aspartic acid	0.10
+ 5.0 $\mu$ moles L-glutamic acid	0.20
+ 5.0 $\mu$ moles L-glutamine	0.86
+ 5.0 $\mu$ moles L-asparagine	0.17
+ 5.0 $\mu$ moles $NH_4Cl$	0.18
L-glutamine (5.0 $\mu$ moles)	0
+ 1.0 $\mu$ mole SA	0
+ 1.0 $\mu$ mole SA + 1.0 $\mu$ mole ATP	0.18
+ 1.0 $\mu$ mole shikimic-5-P	0.80
+ 1.0 $\mu$ mole Z1	0

(11) The organism was grown for 24 hours with aeration at 30° in minimal medium A (B. D. Davis and E. S. Mingioli, *J. Bact.*, **60**, 17 (1950)) supplemented with 0.2% Difco yeast extract and 0.2% Difco Casamino acids.

(12) A. C. Bratton and E. K. Marshall, *J. Biol. Chem.*, **128**, 537 (1939).

(13) H. W. Eckert, *ibid.*, **148**, 197 (1943).

ably the 5-enolpyruvate of shikimic acid<sup>14,15</sup>), and the two isomers of 6-amino-3,4,5-trihydroxycyclohexane carboxylic acid,<sup>16</sup> could not replace shikimic-5-P.

The formation of anthranilic acid also requires the oxidized form of pyridine nucleotide (DPN<sup>+</sup> or TPN<sup>+</sup>). Treatment with charcoal destroys the capacity to form anthranilic acid from shikimic-5-P and L-glutamine. The addition of DPN<sup>+</sup>, TPN<sup>+</sup>, or DPNH,<sup>17</sup> restores the activity. Furthermore, the addition of DPNase<sup>18</sup> completely abolishes anthranilate formation.<sup>19</sup>

It is a pleasure to acknowledge my indebtedness to Professor J. S. Gots for the mutant strain, and to Professor B. D. Davis for the shikimic-5-P and Z1.

(14) B. D. Davis and E. S. Mingioli, *J. Bact.*, **66**, 129 (1953).

(15) C. Gilvarg and B. D. Davis, unpublished observations.

(16) The two isomers were kindly supplied by Professor H. Plieninger, University of Heidelberg.

(17) These extracts contain an active DPNH oxidase.

(18) The Neurospora DPNase was a kind gift of Professor N. O. Kaplan.

(19) Some extracts were found to be inactive unless they were fortified with yeast extract. DPN<sup>+</sup> alone was unable to substitute for the yeast extract, suggesting a possible requirement for another cofactor.

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## BOOK REVIEWS

**Annual Reports on the Progress of Chemistry for 1957. Volume LIV.** R. S. CAHN, Editor. The Chemical Society, Burlington House, London, W. 1, England. 1958. xx + 445 pp. 14.5 × 22 cm. Price, £2.

The authors of *Annual Reports* face a huge task in their effort to summarize the significant advances in chemistry reported during a year. They acquit themselves of this task very well.

To the specialist within an area the reports provide a perspective to the year's progress which is difficult to achieve from the reading of individual papers. For workers interested in undertaking more intensive study on a topic, the Reports provide an outstanding source of references both to original papers and to recent reviews. For those wishing to survey recent developments in areas outside their own special interests, the Reports serve as an authoritative up-to-date summary which is, for the most part, readable without reference to the original work and without special knowledge in the field.

There are twelve topics in the table of contents which were reviewed last year as well. When, due to space limitations, a topic is covered only after a two or three year accumulation of work, the result is an especially useful review. Such topics in the 1957 Reports and the years since their last appearance are: Radiofrequency Spectroscopy (2), Electrochemistry (3), Thermochemistry (3), and Amino Acids, Peptides and Proteins (2). Other topics appear to be simply summaries of the current status of work and are not restricted to a particular time span. These include: Dielectric Measurements, Stereochemistry, The Mechanism of Enzyme Action Studied with Isotopes, Neuramic Acid, The Biosynthesis of the Purine and Pyrimidine Ring Systems, and the Biosynthesis of Penicillin and Some Other Antibiotics.

The text is adequately, but not abundantly, illustrated with structural formulae. This reviewer particularly ap-

preciated the frequent use of Arabic, rather than the time honored but unwieldy Roman, numerals to refer to the structural formulae. This speeds reading comprehension to a marked degree.

This volume continues the excellent tradition established by the series of *Annual Reports* and is recommended to the attention of every chemist.

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**Reaktionmechanismen. Erste Folge.** BY VOLKER FRANZEN, Privatdozent an der Universität Heidelberg. Dr. Alfred Hüthig Verlag, Wilckensstrasse 3, Heidelberg, Germany. 1958. 160 pp. 16 × 23.5 cm. Price, DM 18,—.

This book is a collection of papers on reaction mechanisms which appeared in *Chemiker-Zeitung*, 1955-1957. Titles of the chapters are: Hydride Shifts (Carbinol-Carbonyl Equilibrium, Meerwein-Oppenauer Reduction-Oxidation, Cannizzaro Reaction, Quinone Dehydrogenation, Sommelet Reaction, Leuckart-Wallach Reaction, Reduction with Carbonium Ions, Stereochemistry of Hydride Reductions); Electron-deficient Rearrangements (Wolff, Hofmann, Lossen, Curtius, Schmidt and Baeyer-Villiger Rearrangements and Ozone Cleavage); Carbonyl Reactions (Addition Reactions, Aldol, Perkin and Grignard Reactions); Friedel-Crafts Reaction (Alkylation and Acylation); Ester Pyrolysis; Prius Reaction; Wolff-Kishner Reaction; Silver Salt-Bromine Reaction and Decarboxylation. Many of the original papers have been revised and all of the older ones have been brought up to date. The literature is covered through 1956 and in some cases (such as the Grignard equilibrium), where particu-