Amino end group analysis by Sanger's method[6] gave DNP-aspartic acid from Glycopeptide 3. Glycopeptide 2, containing one additional glutamyl residue, yielded DNP-glutamic acid, and Glycopeptide 1, with two additional glutamyl residues, also gave DNP-glutamic acid. The only other DNP compound found in all three peptides in more than trace amounts was O-DNP-tyrosine. This suggests that Glycopeptide 1 has the structure: Glu.Glu.Asp.(Tyr, Glu, Asp, (CHO)), where the carbohydrate group (CHO) and the residues in parentheses are of undetermined sequence. Leucine aminopeptidase[7] released 2 residues of glutamic acid, 1 of asparagine and 0.8 of tyrosine from Glycopeptide 1. This is consonant with the above N-terminal sequence and indicates that tyrosine follows asparagine. The aminopeptidase liberated one residue each of aspartic acid, tyrosine and glutamic acid from Glycopeptide 3. This suggests the sequence Asp.Tyr.Glu; the only remaining residue is aspartic acid which must be at the C-terminal end of Glycopeptide 3 and bound to the carbohydrate.

The carbohydrate probably is attached to the β-carboxyl group of the aspartic acid by an amide or ester linkage. If it were attached by an α-amide bond, both leucine aminopeptidase and papain would hydrolyze such a bond. If it were attached by an α-ester bond, it would probably be split by papain. Incubation of Glycopeptides 1 and 3 with carboxypeptidase resulted in release of only traces of amino acids; this provides additional evidence that the carbohydrate is linked to the C-terminal residue.

(6) F. Sanger, *Biochem. J.*, **39**, 207 (1945).
(7) R. L. Hill and E. L. Smith, *J. Biol. Chem.*, **228**, 577 (1957).

TABLE I

COMPOSITION OF GLYCOPEPTIDES FROM A HUMAN γ-GLOBULIN[a]

Constituent	Glyco-peptide 1	Glyco-peptide 2	Glyco-peptide 3
Hexose	8.3	8.7	8.9
Glucosamine	6.0	6.0	3.1
Fucose	2.0	2.1	2.0
Sialic acid	1.0	0.6	0.2
Aspartic acid	2.1	1.8	1.8
Glutamic acid	3.3	2.4	0.90
Tyrosine[b]	0.95	1.0	1.15

[a] Residues are computed from a weighted average for the amino acids listed, on the assumption that each peptide contains one tyrosine residue. [b] Other amino acids were present in less than stoichiometric amount and varied in different preparations.

Present evidence indicates an over-all structure for Glycopeptide 1 as follows: Glu.Glu.Asp (NH_2).Tyr.Glu.Asp(CHO). Presumably the variations in the three glycopeptides are produced by the digestion procedure and the purification methods. The relatively good yield of the peptides indicates also that a single prosthetic group is present in this fraction of γ-globulin. Further studies are in progress to determine the structure of similar glycopeptides obtained from γ-globulins of other species and from specific antibodies.[8]

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BOOK REVIEWS

The 1,2,3- and 1,2,4-Triazines, Tetrazines and Pentazines. The Chemistry of Heterocyclic Compounds. Volume 10. A Series of Monographs. ARNOLD WEISSBERGER, Consulting Editor. By JOHN G. ERICKSON, Avochem, Inc., Minneapolis, Minnesota; PAUL F. WILEY, Lilly Research Laboratories, Eli Lilly and Company, Indianapolis, Indiana; and V. P. WYSTRACH, Stamford Research Laboratories, American Cyanamid Company, Stamford, Connecticut. Interscience Publishers, Inc., 250 Fifth Avenue, New York 1, New York. 1956. xi + 261 pp. 23.5 × 16 cm. Price, $10.50. Subscription price, $9.50.

In this latest volume of the Weissberger series on heterocyclic compounds, the 1,2,3-triazines, 1,2,4-triazines, 1,2,3,5-tetrazines and the pentazines are presented in chapters by Erickson; the 1,2,3,4-tetrazines by Wystrach; and the 1,2,4,5-tetrazines by Wiley. The compilation of this encyclopedic reference work is the result of a thorough and conscientious search of the literature through 1950. There is no question but that this is a very worthwhile contribution to the literature on heterocyclic compounds.

The compounds discussed in this review have received only sporadic attention in recent years, and the bulk of the work described was done thirty to fifty years ago. For anyone wishing to gain a background in these areas, the book will be a real help, for there is no other adequate review of the subject and independent searches of the literature of this vintage present some formidable obstacles. As is clearly pointed out in the text in each case, there has been no uniformity of nomenclature in the past and most of the compounds have been named in a variety of ways depending on the preferences of the individual authors. Secondly, our knowledge of organic chemistry has increased a good deal in the past thirty years and assignments of structure, which seemed sound at the time, no longer appear rational. A good deal of time is spent in reinterpreting the older work in the light of modern theory. In many instances no rational interpretation of the older experiments can be made and it is simply noted that additional experiments are needed. For anyone casting about for research problems, the book could be a veritable storehouse.

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