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Amino-acids Peptides and Proteins

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Amino-acids, Peptides, and Proteins
Volume 4

A Review of the Literature Published during 1971

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Abbreviations

Abbreviations for amino-acids and their use in the formulation of derivatives follow with some exceptions the revised (1971) Recommendations of the I.U.P.A.C.–I.U.B. Commission on Biochemical Nomenclature, which are reprinted in Chapter 5 of this volume.

Other abbreviations which have been used without definition are:

Adoc	adamantyloxycarbonyl
Aoc	t-amyloxycarbonyl
Asu	α-aminosuberic acid
Asx	aspartic acid or asparagine (not yet determined)
ATP	adenosine 5′-triphosphate
Bpoc	2-(4-biphenylyl)-isopropoxycarbonyl
BSA	bovine serum albumin
c.d.	circular dichroism
Cha	cyclohexylamine
Cm	carboxymethyl
Cmc	*S*-carboxymethylcysteine
Dce	2,2-diethoxycarbonyl
Dcha	dicyclohexylamine
DMF	*NN*-dimethylformamide
DMSO	dimethyl sulphoxide
DNA	deoxyribonucleic acid
Dnp	2,4-dinitrophenyl
Dns	1-dimethylaminonaphthalene-5-sulphonyl (dansyl)
Dopa	3,4-dihydroxyphenylalanine
DP	degree of polymerization
Ec	ethylcarbamoyl
edta	ethylenediamine tetra-acetate
e.p.r.	electron paramagnetic resonance
e.s.r.	electron spin resonance
Gal	galactose
g.l.c.	gas–liquid chromatography
Glc	glucose
Glp or Pca	pyrrolid-2-one-5-carboxylic acid
Glx	glutamic acid or glutamine (not yet determined)
GTP	guanosine 5′-triphosphate
i.r.	infrared

Man	mannose
NAD	nicotinamide-adenine dinucleotide (NAD^+, oxidized; NADH, reduced)
n.m.r.	nuclear magnetic resonance
ONSu	succinimido-oxy
OPcp	pentachlorophenoxy
OPic	4-picolyloxy
o.r.d.	optical rotatory dispersion
OTcp	2,4,5-trichlorophenoxy
Pca	*see* Glp
Pipoc	piperidino-oxycarbonyl
Pth-Gly	the phenylthiohydantoin derived from glycine, *etc.*
RNA	ribonucieic acid
SDS	sodium dodecyl sulphate
Ser(P)	*O*-phosphorylserine
t.l.c.	thin-layer chromatography
u.v.	ultraviolet
Ztf	1-benzyloxycarbonylamino-2,2,2-trifluoro-ethyl

Preface

This fourth Report reviews papers relevant to the chemistry of amino-acids, peptides, and proteins, appearing in the main journals during 1971; the literature continues to increase, and this volume contains nearly 3,000 references. Metal derivatives are reviewed biennially in this series and are not covered this year; volume 5 will survey papers in this field appearing in 1971 and 1972. As in Volume 3, work on the structure and synthesis of cyclic peptides will be found in Chapter 4 (Peptides with Structural Features Not Typical of Proteins). In Chapter 5 we reprint for the convenience of readers the 1971 revision of the recommendations of the I.U.P.A.C.–I.U.B. Commission on Biochemical Nomenclature, 'Symbols for Amino-acid Derivatives and Peptides', together with their recommendations 'Abbreviations and Symbols for the Description of the Conformation of Polypeptide Chains'.

For the new reader, we would note that in place of a subject index (the preparation of which would delay publication unduly) there is an extended list of contents from which the sections relevant to a search can be ascertained. Some overlap between sections will be found, and within limits is no doubt desirable.

Finally, I express my gratitude here to the contributors who in these first four volumes have established this series as a service to their colleagues in research.

G. T. YOUNG

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Amino-acids

BY B. W. BYCROFT

The past twelve months have witnessed interesting developments in amino-acid chemistry, but pride of place must be taken by the isolation, characterization, and synthesis of the amino-acid derivative from phenylalanine t-RNA. This work also reflects the growing sophistication in the application of physical methods in general. The interesting advances reported last year on asymmetric synthesis have been extended, and a staggering number of new amino-acids continues to be synthesized for a variety of reasons. The established pattern of coverage for this chapter is maintained, attention being focused on a broad selection of topics with the significant developments highlighted where necessary.

1 Naturally Occurring Amino-acids

A. Occurrence of Known Amino-acids.—A large number of papers which are concerned with the free amino-acid content of a wide variety of living organisms is published annually. Since the emphasis for the majority of this work is on biological aspects, it is not considered appropriate to cover them in this section and only those amino-acids which are rarely encountered or are interesting from the chemical viewpoint have been included.

The presence of amino-acids in extra-terrestrial material as well as their synthesis under simulated prebiotic conditions (see Section 2B) has attracted a considerable amount of attention. Examination of samples from the Apollo 11 and Apollo 12 missions has revealed extremely low concentrations of amino-acids (*ca.* 20—70 p.p.b.);[1–3] ultra-sensitive analytical techniques were employed for these investigations and, because of the presence of a considerable number of non-protein amino-acids, the investigators maintain that they are not due to terrestial contamination. Similar conclusions have been made concerning the presence of amino-acids in the Murray [4] and

[1] B. Nagy, J. E. Modzeleski, V. E. Modzeleski, M. A. J. Mohammad, L. A. Nagy, W. M. Scott, C. M. Drew, J. E. Thomas, R. Ward, P. B. Hamilton, and H. C. Urey, *Nature*, 1971, **232**, 94.
[2] K. Harada, P. E. Hara, C. R. Windsor, and S. W. Fox, *Science*, 1971, **173**, 433.
[3] C. W. Gehrke, R. W. Zumwalt, D. L. Stalling, D. Roach, W. A. Aue, C. Ponnamperuma, and K. A. Kvenvolden, *J. Chromatog.*, 1971, **59**, 305.
[4] J. G. Lawless, K. A. Kvenvolden, E. Peterson, C. Ponnamperuma, and C. Moore, *Science*, 1971, **173**, 626.

Murchinson [5] meteorites. In the case of the Murray meteorite, seventeen amino-acids were identified of which seven were conclusively shown to be racemic and eleven to be non-protein in origin. An earlier report [6] that the amino-acid content of the Orgueil meteorite was due solely to terrestrial contamination has been questioned, and it is now suggested that there are amino-acids indigenous to the meteorite in addition to those present as contaminants.[7]

The presence of amino-acids in the North Atlantic ocean has been the subject of a detailed examination and the distribution appears to be non-uniform and varies qualitatively with depth.[8] In marine sediments the degree of racemization of free amino-acids shows a progressive increase with the age of the sediment,[9, 10] and the ratio of *allo*-isoleucine to leucine is a reliable indicator of age for samples less than 400 000 years old. In samples older than about 15×10^6 years the amino-acids are completely racemic.

The stereochemistry of the α-hydroxy-analogue of cysteine present in the urine of certain mentally retarded patients has been established by comparison with synthetic material.[11] The work reported initially last year on the isolation of the methylated derivatives of arginine and lysine has been extended and it has been noted that, in patients with malignant tumours, the relative urinary level of *guanidino-NN*-dimethylarginine to that of arginine is markedly increased.[12] Bovine and rat brain tissue has been shown to contain appreciable amounts of N^G-monomethylarginine as well as $N^G N'^G$-dimethylarginine.[13]

Further spectral evidence on the aldol condensation product isolated on alkaline hydrolysis of elastin provides strong support [14] for the previously assigned structure (1).

Interest in plants containing L-Dopa continues, and a widespread investigation has shown that several *Mucuna* species contain up to 5% of this important amino-acid.[15] The neurotoxin α-amino-β-oxalylaminopropionic acid has been isolated from *Lathyrus sativus* [16] and the major alkaloid of *Aotus subglauca* has been identified as *S*-(+)-N^α-methyltryptophan methyl ester.[17] The previously unidentified amino-acid from *Peganum harmala* is

[5] J. R. Cronin and C. B. Moore, *Science*, 1971, **172**, 1327.
[6] J. Oro, S. Nakaparksin, H. Lichenstein, and E. Gil-Av, *Nature*, 1971, **230**, 107.
[7] J. G. Lawless, K. A. Kvenvolden, E. Peterson, and C. Ponnamperuma, *Nature*, 1972, **234**, 66.
[8] R. Pocklington, *Nature*, 1971, **230**, 374.
[9] R. O. Brinkhurst, K. E. Chua, and E. Batoosingh, *Limnol. Oceanogr.*, 1971, **16**, 555.
[10] J. Wehmiller and P. E. Hare, *Science*, 1971, **173**, 907.
[11] M. Wälti and D. B. Hope, *J. Chem. Soc. (C)*, 1971, 2326.
[12] S. Akazawa, *Osaka Daigaku Igaku Zasshi*, 1970, **22**, 461.
[13] T. Nakajima, Y. Matsuoka, and Y. Kakimoto, *Biochim. Biophys. Acta*, 1971, **230**, 212.
[14] G. Crombie, B. Faris, P. M. Gallop, and C. Franzblau, *Biochemistry*, 1971, **10**, 4145.
[15] E. A. Bell, J. R. Nulu, and C. Cone, *Phytochemistry*, 1971, **10**, 2191.
[16] K. Bahadar and S. P. Billa, *Indian J. Appl. Chem.*, 1970, **33**, 168.
[17] S. R. Johns, J. A. Lamberton, and A. A. Sioumis, *Austral. J. Chem.*, 1971, **24**, 439.