

**PROGRESS IN  
BIOORGANIC CHEMISTRY  
AND MOLECULAR BIOLOGY**

**Editor**

**Yu. A. Ovchinnikov**

# **PROGRESS IN BIOORGANIC CHEMISTRY AND MOLECULAR BIOLOGY**

Proceedings of the International Symposium on Frontiers in Bioorganic Chemistry and Molecular Biology held in Moscow and Alma-Ata, USSR, on 19-24 June, 1984. Sponsored by the Federation of European Biochemical Societies, the International Union of Biochemistry and the International Council of Scientific Unions.

Editor

**Yu. A. Ovchinnikov**

1984



**ELSEVIER SCIENCE PUBLISHERS**  
Amsterdam · New York · Oxford

**ICSU PRESS**  
Paris

© 1984 Elsevier Science Publishers B.V.

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system or transmitted in any form or by any means, electronic, mechanical, photocopying, recording or otherwise without the prior written permission of the publisher, Elsevier Science Publishers B.V., Biomedical Division, P.O. Box 1527, 1000 BM Amsterdam, The Netherlands.

Special regulations for readers in the USA - This publication has been registered with the Copyright Clearance Center Inc. (CCC), Salem, Massachusetts. Information can be obtained from the CCC about conditions under which photocopies of parts of this publication may be made in the USA. All other copyright questions, including photocopying outside the USA, should be referred to the copyright owner, Elsevier Science Publishers B.V., unless otherwise specified.

ISBN 0 444 80643 1

*Published by:*

Elsevier Science Publishers B.V.  
P.O. Box 211  
1000 AE Amsterdam  
The Netherlands

*Sole distributors for the USA and Canada:*

Elsevier Science Publishing Company Inc.  
52 Vanderbilt Avenue  
New York, NY 10017  
USA

*Library of Congress Cataloging in Publication Data*

International Symposium on Frontiers in Bioorganic  
Chemistry and Molecular Biology (1984 : Moscow,  
R.S.F.S.R., and Alma-Ata, Kazakh S.S.R.)  
Progress in bioorganic chemistry and molecular biology.

"Sponsored by the Federation of European Biochemical  
Societies, the International Union of Biochemistry, and  
the International Council of Scientific Unions."

Includes indexes.

1. Bioorganic chemistry--Congresses. 2. Molecular  
biology--Congresses. I. Ovchinnikov, I. A. (Iurii  
Anatolévich), 1934-. II. Federation of European  
Biochemical Societies. III. International Union of  
Biochemistry. IV. International Council of Scientific  
Unions. V. Title.

QP550.I58 1984 574.19'2 84-25859  
ISBN 0-444-80643-1 (U.S.)

Printed in The Netherlands

## PREFACE

*There is nothing new in the statement that the scientist nowadays has to spend more and more of time and effort simply trying to follow what is being done by his colleagues all over the world. Daily library work is essential for this, but there is one more effective (and pleasant) way to be constantly in touch with the latest advances in your field - that is to meet your colleagues during scientific meetings - to exchange information, to establish new contacts. The number of such conferences, national and international, is growing every year. This book deals with the one of such meetings, which is memorable in many ways.*

*The International Symposium "Frontiers in Bioorganic Chemistry and Molecular Biology" was held in Moscow and Alma-Ata, June 19-24, 1984 as a satellite conference of the 16th FEBS Meeting. It was also co-sponsored by the International Council of Scientific Unions and the International Union of Biochemistry. The Symposium which in fact became a "summit" meeting of world top scientists in the rapidly developing field of physicochemical biology, was also meant to commemorate the 25th anniversary of the Shemyakin Institute of Bioorganic Chemistry of the USSR Academy of Sciences.*

*The Symposium programme covered a wide range of aspects of modern physicochemical biology and biotechnology: investigations into structure-functional relations in peptides and proteins, nucleic acids, carbohydrates, lipids, and other bioregulators, elucidation of the structure, synthesis, study of conformational peculiarities, mechanism of biological action, membrane and receptor systems responsible for transfer of genetic information, regulation, as well as the most challenging problems of immunology, neurobiology, oncology, endocrinology, in order to solve them novel approaches and methods of chemistry and physics are employed.*

*Naturally, fundamental researches in these areas have become vitally important for modern medicine, agriculture, and industry. The advances of genetic and cell engineering, chemical and enzymatic synthesis, hybridom analysis, that is of biotechnology, are widely applied to facilitate their development.*

*The global geography of the countries represented, the variety of the areas discussed, together with an exceedingly high level of presentation, make this book particularly valuable.*

*I believe, the atmosphere of the Symposium promoted mutual understanding, strengthening of friendly ties and collaboration among scientists throughout the world. The Organizing Committee of the Symposium "Frontiers in Bioorganic Chemistry and Molecular Biology" expresses deep gratitude to all participants for their activity and interesting presentations.*

*Professor Yu.A. Ovchinnikov*

## LIST OF PARTICIPANTS

N.G. Abdulaev	USSR	Yu.A. Chizmadzhev	USSR
G.I. Abelev	USSR	A. Caldas	Spain
V.I. Agol	USSR	M. Cortijo	Spain
Yu.B. Alakhov	USSR	T.B. Darkanbaev	USSR
A.D. Alshtein	USSR	S.P. Datta	Great Britain
S.A. Andronati	USSR	V.G. Debabov	USSR
L.N. Andreev	USSR	V.I. Deigin	USSR
R. Arnon	Israel	V.V. Demin	USSR
I.G. Atabekov	USSR	P. Desnuelle	France
M.A. Aytkhozhin	USSR	B.A. Dmitriev	USSR
A. Azzi	Switzerland	V.N. Dobrynin	USSR
Ph.C. Babychev	USSR	N.P. Dubinin	USSR
B.K. Bachhawati	India	K.M. Dyumaev	USSR
A.A. Baev	USSR	J.P. Ebel	France
S.B. Balmukhanov	USSR	V.A. Efimov	USSR
E.A. Barnard	Great Britain	G.B. Elyakov	USSR
L.I. Barsukov	USSR	N.M. Emanuel	USSR
S.V. Belyaev	USSR	V.A. Engelhardt	USSR
N.D. Beklemyshev	USSR	L. Ernster	Sweden
L.D. Bergelson	USSR	A. Eschenmoser	Switzerland
S.G. Van den-Bergh	The Netherlands	R.P. Evstigneeva	USSR
A.J. Birch	Australia	P. Fasella	Belgium
E. Blout	USA	N. Fedoroff	USA
A.A. Bogdanov	USSR	L.D. Frye	Japan
P.D. Boyer	USA	S. Fukui	Japan
A.E. Braunstein	USSR	I.M. Gelfand	USSR
E.I. Budowsky	USSR	G.P. Georgiev	USSR
E.B. Burlakova	USSR	I.I. Gitelzon	USSR
R.G. Butenko	USSR	V.I. Goldansky	USSR
V.F. Bystrov	USSR	S.I. Gorodetsky	USSR
E. Carafoli	Switzerland	E. Grell	FRG
R. Castro de la Mata	Peru	E.Ya. Gren	USSR
D. Chapman	Great Britain	N. Grubhofer	FRG
E.I. Chazov	USSR	M. Grunberg-Manago	France
O.Yu. Chertov	USSR	M.V. Gusev	USSR
O.S. Chizhov	USSR	M.S. Gylyarov	USSR

## VIII

E.V. Grishin	USSR	A.A. Lev	USSR
B.P. Gottikh	USSR	C. Liebecq	Belgium
E.V. Gvozdev	USSR	C. Lin	China
P.J. Henderson	Great Britain	A.W. Linnane	Australia
B. Hess	FRG	V.M. Lipkin	USSR
R.D. Henriques	Cuba	V.K. Lishko	USSR
R.L. Hill	USA	W.R. Loewenstein	USA
D. Hodgkin	Great Britain	E.M. Lukanidin	USSR
F. Hucho	W.Berlin	L.G. Magazanick	USSR
A.N. Ilyaletdinov	USSR	W. Manz	Great Britain
G.R. Ivanitsky	USSR	L.N. Markovsky	USSR
S.G. Inge-Vechtomov	USSR	I.V. Martynov	USSR
O. Jardetzky	USA	J. Mathieu	France
J. Jaz	France	G.Kh.Matsuka	USSR
P. Jorgensen	Denmark	F. Mayor	Spain
V.A. Kabanov	USSR	N.N. Melnykov	USSR
Y. Kagawa	Japan	B.R. Merrifield	USA
Yu.T.Kalinin	USSR	H. Metzner	FRG
D. Kanazir	Yugoslavia	P. Minakakis	Greece
K.P. Kashkin	USSR	A.D. Mirzabekov	USSR
E. Katchalski-Katzir	Israel	H. Mislin	Switzerland
A.S. Khokhlov	USSR	E.N. Mishustin	USSR
A.Ya.Khorlin	USSR	Yu. Miyazaki	Japan
M. Kikutani	Japan	N.N. Modyanov	USSR
L.L. Kiselev	USSR	G.S. Monastyrskaya	USSR
L.K. Klyshev	USSR	A.V. Muranov	USSR
D.G. Knorre	USSR	T.A. Muranova	USSR
N.K. Kochetkov	USSR	T. Nagatsu	Japan
M.N. Kolosov	USSR	S.M. Navashin	USSR
J.K. Kostrzewski	Poland	N.K. Nadyrov	USSR
P.G. Kostyuk	USSR	O.M. Nephedov	USSR
A. Kotyk	CSSR	V.A. Nesmeyanov	USSR
A.A. Krasnovsky	USSR	V.I. Ogarkov	USSR
E.M. Kreps	USSR	D. Oesterhelt	FRG
V.G. Korobko	USSR	V.M. Okudzhava	USSR
V.P. Kukhar	USSR	M.A. Ostrovsky	USSR
A.M. Kunaev	USSR	L.P. Ovchinnikov	USSR
M. Lazdunski	France	Yu.A.Ovchinnikov	USSR
Yu.S.Lazurkin	USSR	T. Ozawa	Japan
E. Lederer	France	A.C. Paiva	Brazil

F. Palmieri	Italy	M.Kh.Shagaeva	USSR
Yu.A.Pankov	USSR	G.K. Skryabin	USSR
S. Papa	Italy	K.G. Skryabin	USSR
G. Pasternak	GDR	V.P. Skulachev	USSR
L. Pauling	USA	V.N. Smirnov	USSR
R.V. Petrov	USSR	E. Smith	USA
A.V. Phokin	USSR	G. Snatzke	FRG
Th. Photakis	Greece	V.E. Sokolov	USSR
R.J. Planta	The Netherlands	A.A. Sozinov	USSR
V. Prelog	Switzerland	A.S. Spirin	USSR
M.A. Prokophyev	USSR	S. Stendah!	Sweden
A. Pullman	France	F.B. Straub	Hungary
B. Pullman	France	E.D. Sverdlov	USSR
E. Quagliariello	Italy	K.M. Sytnik	USSR
K. Rajewsky	FRG	J. Szentagothai	Hungary
S.M. Rapoport	GDR	R. Thunberg	Sweden
O.A. Reutov	USSR	J. Tigyi	Hungary
A. Rich	USA	A. Toepfer	FRG
J. Riman	USSR	J. Tooze	FRG
A.B. Rubin	USSR	I.V. Torgov	USSR
R.S. Rychkov	USSR	R. Tsanev	Bulgaria
A.S. Sadykov	USSR	V.I. Tsetlin	USSR
R.I. Salganik	USSR	T.M. Turpaev	USSR
R.K. Salyaev	USSR	A.M. Ugolev	USSR
L.S. Sandakhchiev	USSR	D. Vazquez	Spain
A. Sato Sato	Peru	B.K. Vainstein	USSR
J.C. Schell	FRG	Yu.M.Vasiliev	USSR
K. Scherrer	France	R.G. Vasilov	USSR
E. Schram	Belgium	M. Villavicencio Nunez	Peru
K. Šebesta	USSR	E. Vogel	FRG
M. Sela	Israel	V.L. Voeykov	USSR
G. Semenza	Switzerland	M.V. Volkenstein	USSR
E.P. Serebryakov	USSR	Y. Wang	China
S.E. Severin	USSR	J.E. Walker	Great Britain
E.S. Severin	USSR	J.H. Weil	France
A.K. Sharma	India	Th. Wieland	FRG
Z.A. Shabarova	USSR	M. Wiewiorowski	Poland
M.F. Shemyakin	USSR	R.J. Williams	Great Britain
V.N. Shibaev	USSR	H.G. Wittmann	W.Berlin
O.G. Shirokov	USSR		



X

B.	Wittmann- Liebold	W.Berlin	M. Yomtov	Bulgaria
	Woodward	USA	H.G. Zachau	FRG
K.	Wuthrich	Switzerland	H. Zahn	FRG
K.	Yagi	Japan	S.Z. Zairov	USSR

# CONTENTS

Preface	v
List of participants	vii
PEPTIDES AND PROTEINS. SPATIAL ORGANIZATION AND FUNCTION	
Peptide and protein research at the Shemyakin Institute Yu.A. Ovchinnikov	3
Understanding the surfaces of proteins R.J.P. Williams, G.R. Moore and G. Williams	31
NMR analysis of large peptide and small protein conformation in solution V.F. Bystrov	41
A method for the definition of the solution structure of proteins from NMR and other physical measurements: The <i>lac</i> -repressor headpiece O. Jardetzky	55
Solution conformation of <i>E. coli lac</i> -repressor DNA binding domain by 2D NMR: Sequence location and spatial arrangement of three $\alpha$ -helices E.R.P. Zuiderweg, M. Billeter, R. Kaptein, R. Boelens, R.M. Scheek and K. Wüthrich	65
Compartmentation of proteins of the translation machinery on eukaryotic polyribosomes A.S. Spirin and L.P. Ovchinnikov	71
Crystallization of membrane proteins T. Ozawa	83
Labeling of hydrophobic segments of intrinsic membrane proteins by means of a photogenerated carbene J. Brunner and G. Semenza	91
Solid phase peptide synthesis: The role of sequence and conformation in the action of the cecropins R.B. Merrifield, D. Andreu, H.G. Boman and H. Steiner	101
Thermodynamic characterization of the conformational transition induced by the allosteric activator in glycogen phosphorylase P.L. Mateo, C. Baron, J.S. Jimenez and M. Cortijo	109
Three-dimensional organization of catalases B.K. Vainshtein, W.R. Melik-Adamyany, V.V. Barynin and A.A. Vagin	117
Importance of substrate conformation for renin activity M.C.F. Oliveira, C.R. Nakaie, J.L. Pesquero and A.C.M. Paiva	127
Receptor-mediated mutual regulation of tyrosine-hydroxylase activity and the bipterin cofactor level T. Nagatsu, Y. Hirata and T. Yamaguchi	133
Carbohydrate binding proteins (lectins) in rat macrophages M.A. Lehrman, R.S. Haltiwanger, A.E. Eckhardt and R.L. Hill	141

The specificity of neurons and neuron connexions in the light of more exact localization of mediators and brain peptides J. Szentágothai	151
Prospects for therapeutic application of peptides E.I. Chazov	157
BIOENERGETICS, BIOMEMBRANES AND TRANSPORT	
Dynamics as basic attributes of living states B. Hess, M. Markus and D. Kuschmitz	165
Active site in proton translocating ATPase Y. Kagawa, M. Yoshida, H. Kihara and V.R. Ramakrishnan	175
Respiration and energy conversion in biomembranes S. Papa	183
Energy-linked changes of enzyme conformation in ATP formation and other bioenergetic processes P.D. Boyer	191
Cytochrome <i>c</i> oxidase: Molecular aspects of a proton pump A. Azzi, M. Muller, G. Petrone, P. O'Shea and M. Thelen	199
On sodium energetics V.P. Skulachev	207
Structure, mechanism and differentiation of voltage-dependent ionic channels which generate action potentials M. Lazdunski, J. Barhanin, M. Borsotto, M. Fosset, J.-P. Galizzi, G. Romey and H. Schmid	213
Theoretical studies on ion-channel interactions: Gramicidin A A. Pullman	219
Ionic channels - New problems P.G. Kostyuk	225
Membrane transport in the messenger function of calcium E. Carafoli	233
Specificity and dynamic aspects of cation transport systems in membranes E. Grell, G. Krause, E. Lewitzki, G. Mager and H. Ruf	239
Intracellular pH distribution and driving forces for secondary active transport in yeast cells A. Kotyk and J. Slavík	247
Sugar-proton transport proteins of <i>Escherichia coli</i> P.J.F. Henderson, E.O. Davis, H. Hirata, Y. Kagawa, M.C. Jones-Mortimer and A.J.S. Macpherson	255
The active phosphate carrier from heart mitochondria corresponds to a single band of the hydroxylapatite eluate F. Palmieri, F. Bisaccia, G. Prezioso, A. Rizzo and G. Genchi	267
The GABA receptor complex: Purification, analysis and reconstitution of the proteins and their production from messenger RNA E.A. Barnard, G. Bilbe, C. Mamalaki, E. Sigel and F.A. Stephenson	275

Transport mechanisms of neurotransmitter amino acids and of neurotransmitter precursors in the CNS F. Mayor, F. Valdivieso, C. Gimenez, M.C. Aragon, F. Mayor Jr, J.G. Marvizon, J. Diez-Guerra, E. Herrero and F. Zafra	287
Transport of nuclear coded proteins into mitochondria E. Marra, M. Greco, M.R. Montemurro, E. Perlino, S. Passarella, S. Doonan, C. Saccone and E. Quagliariello	295
Biochemistry of oxygen toxicity L. Ernster	303
Teleonomic regulated oxidative damage - The role of lipoxygenase in the maturation of reticulocytes S. Rapoport	311
Activity control of the hepatic endoplasmic cytochrome P-450 dependent monooxygenase system W. Scheler, H. Rein, J. Blanck and K. Ruckpaul	319
Pyruvate degradation in archaebacteria: Radicals, ferredoxins and evolutionary aspects D. Oesterhelt, L. Kerscher, S. Mathews and F. Lottspeich	327
Characterization of photopolymerized, diacetylenic phospholipids in liposomes and reconstituted systems J.A. Hayward, F. Castelli, M.A. Whittam, D.S. Johnston and D. Chapman	335
STRUCTURE AND FUNCTION OF NUCLEIC ACIDS	
Affinity chemical modification of nucleic acids D. Knorre	345
Total synthesis of yeast alanine transfer RNA Y.L. Wang	353
Nucleotide sequence of four chloroplast transfer RNA genes from <i>Vicia faba</i> J.-H. Weil, G. Bonnard, F. Michel and A. Steinmetz	363
Structure and evolution of small nuclear RNAs J.-P. Ebel, A. Krol, E. Myslinski, E. Lazar, H. Gallinaro, B. Haendler, M. Jacob and C. Branlant	371
Right-handed and left-handed double helical DNA A. Rich	381
Recognitory interaction of non-intercalating ligands with DNA B. Pullman	395
Comparative structural analysis of selected salts of putrescine, spermidine and spermine in the aspect of their stereochemical interactions with nucleic acids M.D. Bratek-Wiewiórowska, M. Jaskólski, M. Alejska, A. Perkowska and M. Wiewiórowski	403
Regulation of gene expression of <i>E. coli</i> phenylalanyl and threonyl tRNA synthetases M. Grunberg-Manago, M. Springer, J.A. Plumbridge, C. Sacerdot, M. Graffe, G. Fayat, P. Lestienne, J.-F. Mayaux and S. Blanquet	411

## XIV

Immunoglobulin genes: Rearrangements, clustered point mutations, amplification, transpositions, and gene conversion H.G. Zachau, M. Pech, H.-G. Klobeck, H.-R. Jaenichen, P.S. Neumaier, H.-D. Pohlenz and B. Straubinger	423
MOLECULAR IMMUNOLOGY	
The immune system and its molecular engineering M. Sela	433
Lymphocyte reactivity in normal and malignant cell proliferation against a phylogenetically conserved fetal antigen G. Pasternak, B. Schlott, G. Gryschek, S. Albrecht, J. Reinhöfer, E. Matthes and B. von Broen	439
Muramyl-peptides as immunomodulators, sleep factors and vitamins E. Lederer	447
Highly immunogenic artificial complexes based on synthetic poly-ions (artificial antigens and vaccines) R.V. Petrov	455
New trends in non-isotopic immunoassays S. Stendahl and E. Soini	463
LOW MOLECULAR WEIGHT BIOREGULATORS	
Inorganic 'enzymes': A new approach to organic synthesis A.J. Birch	471
Metabolism of flavins in mammals K. Yagi, N. Ohishi and H. Ohkawa	479
Structure-function relationship of vitamin B <sub>12</sub> coenzyme (adenosylcobalamin) in the diol dehydrase system. Function of the adenine moiety of the CoB (upper) ligand in the coenzyme activity S. Fukui and T. Toraya	487
A bio-organic walk through the world of mushrooms T. Wieland	495
Study of nerve conduction with spin-labelled anesthetics J. Tigyi, K. Hideg and T. Lakatos	501
Psychosocial (emotional) stress, steroid hormones and carcinogenesis. Molecular aspects. Facts and speculations D.T. Kanazir, R. Djordjević-Marković and R. Grossarth-Maticek	509
Author index	521
Subject index	523

**PEPTIDES AND PROTEINS  
SPATIAL ORGANIZATION AND  
FUNCTION**



## PEPTIDE AND PROTEIN RESEARCH AT THE SHEMYAKIN INSTITUTE

YURI A.OVCHINNIKOV

Shemyakin Institute of Bioorganic Chemistry, USSR Academy of Sciences,  
ul. Vavilova 32, Moscow V-334 (USSR)

The 50s are marked by great advances of the world science in protein-peptide chemistry. Since 1949 the  $\alpha$ -helix proposed by L.Pauling triumphed all over the world that opened wide the doors for penetrating into the structure of protein molecules.

V. du Vigneaud completed the chemical synthesis of the most important peptide hormone, oxytocin, later F.Sanger deciphered the amino acid sequence of the first protein, insulin. Undoubtedly studies of peptide-protein substances occupied a prominent place and captured scientists' attention. Just that time the USSR Academy of Sciences faced the necessity of organizing an Institute engaged in studies of life science, especially its chemical aspects and in 1959 the Institute for Chemistry of Natural Products was founded.

The impetuous progress in the protein and peptide chemistry made us change the traditional trends in the study of natural low molecular weight compounds of alicyclic or heterocyclic series: steroids, alkaloids, antibiotics of chloramphenicol or tetracycline groups, etc., and side with those for whom the main notions were amino acid, peptide bond,  $\alpha$ -helix,  $\beta$ -structure.

M.M.Shemyakin initiated the study of peptides of a new type and since the first years of the Institute's foundation systematic investigations of atypical naturally occurring peptides, depsipeptides, containing hydroxy and amino acid residues started. Antibiotics-depsipeptides, valinomycin and enniatins, were the first in this row. In 1955 H.Brockmann and G.Schmidt-Kastner<sup>1</sup> isolated valinomycin from extracts of the strain *Streptomyces fulvissimus*. The structure (cyclo-octadepsipeptide) proposed by H.Brockmann and H.Geeren<sup>2</sup> was erroneous. As shown valinomycin is a cyclododecadepsipeptide, built of three identical tetra-depsipeptide moieties<sup>3</sup>. The structures for enniatin antibiotics isolated by P.Plattner in 1947<sup>4,5</sup> from cultural liquids of *Fusarium* turned out to be also incorrect. The total synthesis showed that enniatins A and B were not cyclotetra-depsipeptides, but cyclohexadepsipeptides<sup>6,7</sup>. The Institute developed a novel synthesis of depsipeptides: natural cyclodepsipeptides, valinomycin (Fig. 1), enniatins A, B, C, beauvericin (Fig. 2), and their numerous analogues<sup>8</sup>.

The structure-functional studies of cyclodepsipeptides permitted the use of a topochemical principle of the peptide molecule modification for the analysis of many biologically active peptides. Now active analogues are constructed by changing the molecule as a whole, but not local regions, to maintain stereoelectron



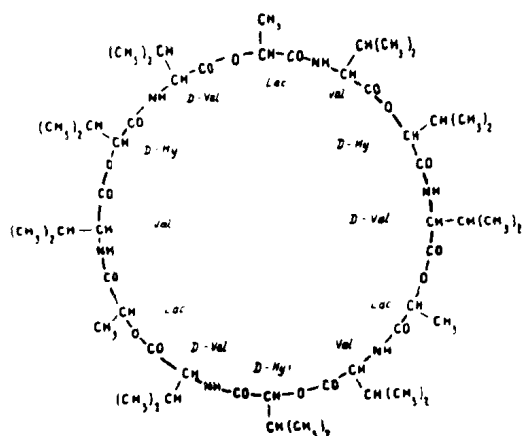


Fig. 1. Valinomycin.

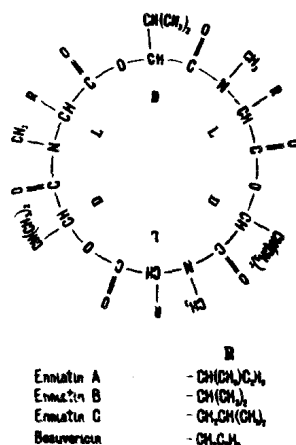


Fig. 2. Enniatin ionophores.

characteristics of the peptide. Topochemical transformations include change in the direction of acylation of residues (retro-isomers), in configuration of asymmetric centers (enantiomeric), make possible obtaining retroenantiomers, cyclization of linear peptides, and other transformations. The topochemical approach was successfully used for investigation of structure-functional dependence for membrane-active cyclopeptides, valinomycin, enniatins, gramicidin S, and antamanide<sup>9-11</sup>.

The work in the laboratory of Prof. V. Prelog (Switzerland), a world-known stereochemist, stimulated this approach to the peptide system modification. First publications summarize data on simple cyclopeptides, built of glycine and alanine residues<sup>12,13</sup>.

The proper studies of depsipeptides of valinomycin and enniatin groups resulted in their wide use when studying ion permeability of artificial and biological membranes. That became possible only when B. Pressman<sup>14</sup> discovered the effect of valinomycin on mitochondria. American and Soviet investigators developed the concept of ionophore action of depsipeptides<sup>15,16</sup>. The elucidation of the mechanism of K<sup>+</sup> ion-binding to valinomycin, the bracelet structure for the valinomycin K<sup>+</sup>-complex proposed in the USSR crowned the research<sup>15</sup>. Just this elegant molecule decorates the entrance to the Shemyakin Institute of Bioorganic Chemistry.

As established later<sup>17</sup> enniatins are also effective complexones of Na<sup>+</sup>, K<sup>+</sup>, Rb<sup>+</sup>, and Cs<sup>+</sup> ions, correlation between their antimicrobial and complexing activities was discovered. Spectral methods were employed to determine enniatin B conformations in solutions in free state as well as in complexes with alkali metal ions. Enniatins A, B, C and beauvericin in solutions are characterized by equilibrium of two forms, polar (P) and nonpolar (N)<sup>18</sup>. Conformation of enniatin B complexes