Brush border membranes

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Brush border membranes

Ciba Foundation symposium 95

1983

Pitman

London

ISBN 0 272 79659 x

Published in March 1983 by Pitman Books Ltd, London. Distributed in North America by CIBA Pharmaceutical Company (Medical Education Administration), Summit, NJ 07006, USA.

Suggested series entry for library catalogues:
Ciba Foundation symposia.

Ciba Foundation symposium 95
x + 340 pages, 104 figures, 17 tables

British Library Cataloguing in publication data:

Brush border membranes.—(Ciba Foundation symposium; 95)
1. Cell membranes—Congresses
2. Cell physiology—Congresses
I. Porter, Ruth II. Collins, Geralyn
III. Series
611'.0781 QH601

Text set in 10/12 pt Linotron 202 Times, printed and bound in Great Britain at The Pitman Press, Bath

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Brush border membranes
Editors: Ruth Porter (Organizer) and Geralyn M. Collins

Chairman's introduction

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Several of the participants at this symposium were also present at Ciba Foundation symposium 50 (Peptide transport and hydrolysis). On that occasion the emphasis was on functional questions such as whether peptides were hydrolysed at the cell surface, in the lumen or inside the cell, and whether hydrolysis preceded transport. Consequently only a minority of the papers were concerned with structure and topology. In the six years that followed that symposium our attitudes and understanding have developed in such a way that we can now concentrate with profit on the molecular aspects of this topic. I believe this is an important development. Major progress in the biological sciences has usually depended on clarifying molecular interactions that were formerly considered to be very mysterious events.

Among the group of people assembled here, some, like me, are mainly concerned with the group of hydrolases in the brush border membrane that face towards the lumen, anchored to the lipids by only a very small portion of the polypeptide chain. During the symposium this group of participants should also try to look below the membrane, into the cytoplasm, and ask what interactions may take place with the cytoskeleton. Others, whom I may refer to as cytoosteologists, and who have for different reasons become enamoured of the brush border, have recently made remarkable progress in defining the proteins of the cytoskeleton. But possibly they may know little about the membrane proteins and may, therefore, be inspired to look outwards towards the cytoplasmic domains of these membrane proteins to ask if any of them interacts with the cytoskeleton, and what this means functionally. I would guess that the *raison d'être* of the microvillus relates to the function of the membrane proteins—the hydrolases, the transport proteins, receptors and so on. Yet microvilli become shapeless vesicles once the cytoskeleton is disorganized. So we do need to ask why the cytoskeleton exists in the form it does, and how its components interact with each other and with the membrane.

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Others here are currently concerned with activities deeper in the cell, in particular the molecular events in the biosynthesis of the brush border enzymes. There is a need to define the primary translation product of the membrane proteins, and to understand how the polypeptide chain becomes associated with a membrane, as well as the details of the post-translational processing and the membrane pathway in the cell through which the precursor forms move. Much has been done in this area in the last few years, and I have no doubt that it is one of the fast moving topics at present.

One topic that some may think is missing from the symposium is a molecular description of the systems concerned with transport of small solutes such as amino acids, sugars and anions. It seems to me that this subject has not really broken out from the confines of its 'black box', and hence it is difficult for us to describe the events in precise molecular terms. Our compromise has been to include in our discussions one well defined transport protein, Na^+,K^+-ATPase (see p 253–272). We must overlook the fact that it is not in the brush border membrane but situated at the opposite pole of the cell. However, it will serve to focus our thoughts on the architecture of a well researched transport protein.

Macromolecules cross the membrane by the process of receptor-mediated endocytosis. We are beginning to learn something about the nature of the molecules involved in, say, the uptake of immunoglobulin across a brush border. Receptors are involved, the cytoskeleton is implicated and questions also arise about the pathway of the coated vesicles through the cell. Again we are concerned with events that are analogous to those concerned with the assembly of newly synthesized or recycled membrane proteins.

I am optimistic that as each section of the symposium develops, it will be the hitherto uncharted border areas between the different approaches that may provide the greatest interest. I hope we shall all try to see where our own area of research links with that of the next person. The apparent differences between the various organs that contain brush borders—the kidney, the intestine and the placenta—will, I hope, become unimportant in these discussions. All microvilli have the same basic architecture in common, and all share some functions, though there are important specializations, too. At this stage in our understanding it may be more profitable to concentrate on the similarities before we try to explain the differences.