# Growth Factors in Cell and Developmental Biology

The cover illustration taken from the paper by E. Hafen and K. Basler is a histological section through the compound eye of *Drosophila* showing the pattern of rhodopsin-containing rhabdomeres in the photoreceptor cells.

ISBN: 0 948601 27 2

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Proceedings of the British Society for Cell Biology –
Journal of Cell Science Symposium
Manchester, April 1990

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SUPPLEMENT 13 1990
JOURNAL OF CELL SCIENCE
Published by THE COMPANY OF BIOLOGISTS LIMITED, Cambridge

*Typeset, Printed and Published by*
THE COMPANY OF BIOLOGISTS LIMITED
Department of Zoology, University of Cambridge, Downing Street,
Cambridge CB2 3EJ



ISBN: 0 948601 27 2

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# PREFACE

Major advances are taking place in our ability to elucidate the role of growth regulatory molecules, including those often referred to as growth factors, in the control of the generation of cell diversity, the proliferation of cells and in the specification of the overall patterns which determine embryological development and eventually produce the adult organism. The chapters of this volume illustrate the diversity of systems and the wide range of complementary experimental approaches that are playing a role in the elucidation of growth regulator structure, function and biology.

The introduction into growth factor studies of reporter molecules which can monitor changes in cytosolic ions and messengers in living cells illustrates how the sophisticated organic synthesis of such molecules used in conjunction with optical imaging techniques can reveal the intimate physiological changes in a single cell and identify new details of events – previously only seen as an average response in a population of cells. The use of techniques which are familiar to the biophysicist, but with which the biologist must become conversant, is illustrated by the series of papers on the structural characterisation of growth factors. Knowledge of 3-dimensional features which determine function is essential to understand and manipulate interacting proteins such as factors and receptors and will surely govern future experimental directions – particularly in the design of molecular anatgonists for use in the analysis or treatment of growth and differentiation that occurs in cancer and other diseases.

The use of recombinant DNA techniques to modify growth factors or their receptors is an essential adjunct to the biophysical and biochemical analysis of growth regulation, and the application of such technology to manipulate platelet derived growth factors is described in section II. Also in this section, we see the application of detailed cell biology and biochemical analysis to probe the receptor signal transduction process for the Bombesin system inside the cell. Such studies, which are representative of mitogenic stimulation and response systems, serve to probe the mechanisms which occur following receptor–ligand binding at its external surface.

An enormous number of growth regulatory polypeptides are now known to exist, but as the numbers grow we find that many fall into families which either have a functional (and not necessarily structural) or structural (and not necessarily functional) relationship to each other.

Some of the most important and clinically relevant advances have taken place in our understanding of the role of growth factors in haemopoiesis. Recent progress in this area, which is focused on the myeloid haemopoietic cells, is described in section III. Analysis of the biology of stem cells using embryological systems has provided remarkable overlaps with the study of haemopoiesis. The

discovery of leukemia inhibiting factor which is described in section IV provides a striking example of the way different approaches and systems can lead to the charactisation of a multifunctional growth regulator.

The discovery of an ever-growing number of fibroblast growth factor- and transforming growth factor $\beta$-related genes, and the characterization of their biological roles in normal and cancer cells, illustrates the way that variants on a basic molecular theme provided by a growth regulator gene can arise and serve as a family of subtly diversified signal molecules.

Section VI provides key examples of the advantages to be gained for the analysis of growth regulation in the *Drosophila* system, which is amendable to molecular genetic as well as biochemical analysis.

Finally the importance of developmental regulators which are not peptides is well illustrated by recent advances that have taken place in our understanding of the control of limb development in the chick. Here in the final section (V) we see described the importance of retinoic acid–receptor interactions that provide a basis for a new definition of the term growth regulatory molecule that must include both polypeptide and non-polypeptide molecules.

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