PREFACE

This is the second course in Biology organized by the School of Theoretical Physics, in Les Houches. The first one was held in 1979, and was devoted to cellular membranes. The present one is even more ambitious, since it intends to explore the various facets of the most fundamental domain of life science, that of developmental Biology, trying to understand how each step of cellular differentiation, from the original multipotent cell to the emergence of the highly sophisticated functions, can be programmed and realized in a living organism.

The course on "cellular and molecular aspects of developmental biology" has been divided into three parts, of unequal lengths. The first one is intended to update the basic elements of morphogenesis, and of molecular and cellular biology. The second part deals with the analysis of several representative models in developmental biology, from yeast to mammals. The third section is devoted to three examples of highly specialized systems, representing the highest level of sophistication in differentiation.

Françoise Dieterlen-Lièvre first recalled the basic elements in embryology, focusing mostly on birds. She showed, among other things, how some aspects of cell–cell interactions during development, and the first steps of the ontogeny of the hemopoietic system in vertebrates, set up clear examples of early events in ontogeny.

Molecular biology on the other hand offers a powerful way of approach, by providing both technical tools and biological models. François Cuzin explained how some virus models (polyma and SV40) might help in understanding eukaryotic gene organization. A study of the oncogenic transformation induced by viruses and an analysis of cellular oncogenes complete this approach. Basic elements of the regulation of expression of a "simple" genome were given by Harvey Eisen, who analyzed in detail the bacteriophage model.

Gert Kreibich gave a comprehensive series of lectures on the compart-

mentalization of cell function, with special emphasis on the intracellular transport of proteins, and biogenesis of plasma membranes.

The second series of lectures, devoted to the analysis of some models in developmental biology, started off with lectures by Günther Gerisch, who discussed some aspects of *Dictyostelium* development, thus offering a nice example of an eukaryotic micro-organism that develops by cell aggregation from a unicellular to a multicellular organism.

Ira Herskowitz discussed some basic patterns of regulation in yeast, mostly centered on determination of the yeast cell type by the mating locus. A more general model of gene activation by rearrangement ("genetic cassettes") was also presented. Harvey Eisen gave another example of complex gene activation linked to rearrangement by discussing the organization and expression of gene coding for surface antigens of parasites, as illustrated by the Trypanosome model.

The highly sophisticated programmation of the development of a nematode (*Caenorhabiditis elegans*), was explained by Jonathan Hodgkin. Combining genetics and fine morphology allows a very handsome pattern of differentiation to be defined, which will undoubtedly be of general value to elucidate developmental genetics in other organisms.

Antonio Garcia-Bellido discussed developmental genetics in *Drosophila*. The functional aspects of homeotic genes were discussed in detail, providing another approach to elucidating how a developmental pattern might be programmed.

A much more complex organism was addressed by Hubert Condamine, who first described the morphological early events of mouse embryogenesis and then analyzed how the teratocarcinoma model might help in understanding the normal development of mouse embryo, which can finally be approached at a molecular level, well reflecting the general evolution of developmental biology itself.

Some basic features of cell function were discussed by Christian Frelin and Keith Yamamoto. Christian Frelin explained the functioning of ionic channels, with a major emphasis on the gating mechanisms, systematically analyzed with pharmacologogical drugs that selectively block the opening or closing of these structures. Keith Yamamoto on the other hand addressed the regulatory aspect of gene expression, as modulated by the steroid hormones and the chromatin function.

Several examples of pathways of differentiation leading to the emergence of highly specialized cell functions were then discussed. Norman Iscove explained how hemopoietic cells emerge from stern cells, with the possibility of selecting specific markers that allow the path of

specialization to be followed. Characteristics of muscle and heart cells were reviewed by Christian Frelin.

Various aspects of the development of the nervous system were dissected by Jean-Paul Thiery and Christo Goridis. Jean-Paul Thiery discussed the early events represented by the formation of the neural primordium in vertebrates, and gave a comprehensive lecture on the ontogeny of the peripheral nervous system in birds. Christo Goridis explained how cell–cell interactions could be organized by specialized molecules, in the course of neuronal differentiation. The emergence of cell lineage, the problem of cell migration and axonal growth were also extensively discussed.

The last integrated system to be discussed was the immune system. Michel Fougereau gave the basic elements of this sophisticated system, highly specialized in specific recognition of self–non-self in organisms.

Lee Hood analyzed the organization, expression, function and evolution of the three major families of genes which constitute the framework of the immune system, i.e., the antibody genes, expressing the B-cell repertoire, the T-cell receptor coding genes representing the counterpart of immunoglobulins, and the major histocompatibility complex (MHC) genes which are important in several aspects of recognition and regulation of the system. Some more functional aspects of MHC in the human system were discussed by Bernard Mach, with particular reference to pathology.

Jacques Urbain explained how immunoglobulins would interact in the idiotypic network, bringing evidence of a system which could autoregulate and contain its own built-in driving forces in selecting its repertoire in evolution.

All lectures were supplemented by analytical seminars, which were prepared and given by participants, thus contributing to make this session a very lively one.

This course has gathered some fifty participants, professors, lecturers, students, belonging to thirteen nations, whose tight cooperation resulted into Session XLII of the Les Houches Summer School of Theoretical Physics, most of the highlights of which are reported here, in writing. Our thanks go to all of them for their contribution in keeping up the high spirits of this four week long session.