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Bone Biodynamics

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HENRY FORD HOSPITAL INTERNATIONAL SYMPOSIUM

Bone Biodynamics

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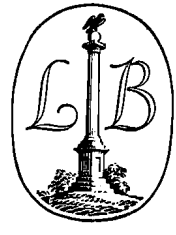

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Preface

The purpose of the Bone Biodynamics Symposium was to stimulate a greater diversity and volume of research in the orthopaedic basic sciences, in part by bringing together representatives of a number of disciplines who, in composite, had a broad biological interest. The structure of the program and the material in it were arranged on a biological and dynamic basis instead of being oriented toward a single disease or group. Some of the participants and persons attending had worked with bone previously and some had not.

The field of biology is at present undergoing a major upheaval in its methods of study, in its concepts and language, in methods of approaching problems, and in the motivation and philosophy underlying the activities of biologists.

Since bone is a part of biology, its study is similarly affected. Being somewhat aside from the mainstream of biological investigation, the newer modalities and philosophical orientation to the study of bone have not been applied to the fullest extent possible.

There is a great need for expanded and more diversified research activity in the fields of bone, which include physiology, pathology, genetics, tissue repair, tissue regeneration, growth, and other aspects of physiology in its broad sense.

The program participants were asked to provide the audience—and, through this text, the reader—with examples of philosophy, methodology, interpretation of the meaning of data, and relation of studies to problems of clinical or conceptual interest and importance.

When this symposium was first planned, an integral part of the concept was publication of its papers in a book which would extend the reach of the symposium's objectives as far as possible. The orthopaedic basic science field needs more investigators willing to leave the classic approaches in order to cope with the still pupal molecular biology so rewarding in many other divisions of biology and medicine. It needs more thinkers, men willing to concoct a new (and therefore in some quarters automatically and hopelessly wrong) concept or theory but at the same time willing and able to put it to the test, to distinguish fact from thought. As Dr. Danielli said during the symposium, our problem is not that we need more data;

there is a data surplus of awesome magnitude now. Rather, we need better theories and concepts in the light of which this data can be sorted, organized, and understood.

The young investigator should find much food for thought in these pages, as well as useful information and insight. There are ample examples of theorizing, model building, experimental design, interpretation of data, methodology, and the actual digging out of data from the raw stuff: tissue. There are ample examples of unsolved—or uninvestigated—problems.

The book begins with a summary or précis of the symposium which is intended to orient the specialist who may not be acquainted with the details of some of the participants' work. The précis should help to fit the various pieces into context, to show why the participants were following their chosen paths.

It is my feeling that the participants achieved more success in executing the objectives of the symposium than reasonably could be expected through the medium employed. It is my pleasure here to submit to the reader a truly impressive collection of papers, arranged on a skeleton which progresses from the molecule at the bottom, through time, through ultrastructure and microstructure, through problems involving regulation and mineral kinetics to practical clinical problems at the head.

It is deeply regretted that the valuable contributions of Sylvia Fitton-Jackson, M.D., and Howard Hatcher, M.D., were not available in manuscript form at the time this material went to press.

H. M. F.

Detroit

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Orientation

Chairman: HAROLD M. FROST, M.D. (*Detroit, Michigan*)

I

The Bone Biodynamics Symposium: A Précis

HAROLD M. FROST, M.D.

(*Detroit, Michigan*)

Evolution

It used to be thought that skeletal evolution began with the development of hyaline cartilage, followed in order by the development of calcified cartilage, replacement of this with fibrous or woven bone, replacement of this with circumferential lamellar bone, and, last, the appearance of Haversian remodeling of bone.

Certain aspects of the fossil record have led paleontologists to question this view and to propose in its place a scheme in which lamellar bone appeared first, to be followed in time by the development of woven bone and then cartilage. Certainly the first known exoskeletons were lamellar bone, and endoskeletons appeared later.

Significantly, the first mineralized skeletons did not reveal evidence of accompanying resorptive capability, cell-mediated resorption of calcified tissues appearing afterward. The first animals could form but not destroy, and so they could not remodel. The appearance of calcified skeletons was presumably accompanied by changes in internal osmoregulation, and the ability to resorb calcified skeletal material was presumably accompanied by changes in internal regulation of plasma calcium and phosphate ion concentrations, especially by the kidney.

Curiously enough, in present day animals with bony skeletons, resorption usually precedes the formation of bone. On two counts then—"devolution" of the skeleton and primacy of resorption over formation—the inference is suggested that ontogeny and cytodynamic activity can be the reverse of phylogeny.

Cytophysiology

Time-lapse motion pictures of cell cultures, taken during various modifications of the medium embedding the cells, dramatically show that cells