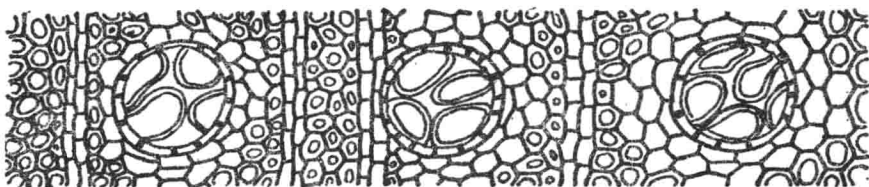


# CONTRIBUTIONS *to* PLANT ANATOMY

by IRVING W. BAILEY, Sc.D.

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Research in General Plant Morphology, Harvard University*

1954



## IRVING WIDMER BAILEY

### *A Biographical Sketch*

In the history of botanical science in the United States few individuals have made so many contributions to so many diverse areas of botany as has IRVING W. BAILEY. Attracted first, professionally, by the more practical applications of plants to human affairs, especially in forestry and silviculture, his interests and basic contributions have ranged widely from the pragmatic to the abstract; from the observational to the analytical. A continuing intellectual absorption with major questions involved in the origin, organization and evolution of plant life, coupled with a keen alertness to the fortuitous and unforeseen factors revealed in the solution of biological problems have made IRVING BAILEY's contributions a lasting addition to botanical knowledge. It is the purpose of this volume to draw together and to make more readily accessible certain selections of Professor BAILEY's work which are representative of the breadth and depth of his scientific interests, and also to make better known among students of plant life the many facets of his personality as a botanist and as a scientist.

IRVING WIDMER BAILEY was born in Tilton, New Hampshire, August 15, 1884, son of SOLON IRVING and RUTH POULTER BAILEY. Several years after his birth his father was appointed to the staff of the Harvard College Observatory and later became Acting Director of the Observatory and Phillips Professor of Astronomy in Harvard University. One of his father's early responsibilities was the management of the Observatory's southern hemisphere station near Arequipa, Peru. These duties necessitated many years residence in the high Andes. Numerous botanical interests manifested in later years doubtless stem from BAILEY's boyhood spent in the coastal lowlands, the eastern jungles, and the high mountains of Peru. As attested by the writings of DARWIN, HUMBOLDT, SPRUCE and many other naturalists, there are few parts of the world which provide more diverse climate, more varied geologic features and greater range in types of vegetation than this relatively small geographic area of western South America. As a boy, keenly interested in the natural phenomena of his environment, IRVING BAILEY learned early what many botanists learn only in their later years, viz., the extraordinary and bizarre development of plant life in tropical regions. He also, as a result of his years in South America, achieved a lasting interest in archeological and ethnological problems of early man in the Americas,

through exploration with his father of the then imperfectly known remains of ancient Peruvian cultures. These boyhood impressions, frequently renewed by return to the temperate environment of New England, have extended their influence both on BAILEY's scientific interests and on his personal, avocational interests throughout his life.

IRVING BAILEY entered Harvard College in 1903, not yet certain of his field of special interest, though he soon chose botanical science as an area of specialization. A latent interest in organic chemistry shows in many of his later scientific papers, but fortunately he chose to specialize in botany and forestry and entered the Graduate School of Harvard University in the Fall of 1907. He received the degree of Master of Forestry in 1909. It is significant that his first paper, "The Structure of the Wood in the *Pineae*" was published in this second year of graduate study. In the autumn of 1909, BAILEY became Instructor in Forestry in the Graduate School of Applied Science and began his long career in the many and varied activities into which Harvard's botanical development has led him. He was appointed Professor of Plant Anatomy in 1927.

During a period of World War I, BAILEY was in charge of the Wood Section, Materials Engineering Division of the Bureau of Aircraft Production stationed at Wright Field near Dayton, Ohio. His assignment here was in connection with the then critical problem of selection of wood for the manufacture of airplanes, a practical application of his extensive knowledge and experience with the structure and physical properties of wood.

At the close of World War I, BAILEY returned to the staff of the Bussey Institution and began his intensive studies on the histology and cytology of the cambium, a field of botanical interest which held his attention for many years and which lead him eventually into his pioneer researches on the structural organization of the plant cell wall.

During this period of his career BAILEY also began collaborative studies with his senior colleague at the Bussey, the distinguished entomologist and Dean of the Bussey Institution, Professor WILLIAM MORTON WHEELER. In 1920 they worked together in British Guiana, Trinidad and the West Indies, investigating the curious relationships which exist between ants and certain tropical plants. Resulting from these field studies is a unique series of papers dealing with the minute structural and anatomical features of myrmecophytes, or the so-called "ant plants" of the American tropics.

Resulting from his many years of productive research and teaching in forestry Professor BAILEY was appointed in 1926 as a member of the Committee on Forestry Research of the National Academy of Sciences. This committee, formed by the National Academy at the request of Colonel W. B. GREELEY, then chief of the United States Forest Service, was established to study the national resources and future needs in production of timber and wood products. In connection with this work, in which he took a leading part for several years Professor BAILEY travelled extensively in the United States, Canada, and Europe, surveying laboratories, tree plantations, and forest experiment stations with a view to formulating a long range program for research in American forestry. The result of this study was published

jointly with Dr. HERMAN A. SPOEHR of the Carnegie Institution of Washington in 1929, in a book entitled *The Role of Research in the Development of Forestry in North America*, portions of which are reprinted in this volume.

Although his contributions to botany are featured by a wide diversity of interests, a central theme may be discerned in many of BAILEY's investigations. This theme, which occupied his attention from early professional years became focused on the problem and enigma of the origin and evolution of the Angiosperms. A deeply embedded interest in phylogeny is certainly the most important factor in giving coherence to his numerous descriptive studies on the comparative anatomy of vascular plants. The interpretative, analytical, and essentially phylogenetic viewpoint strongly expressed in BAILEY's anatomical and cytological contributions has resulted in a unique synthesis of knowledge regarding the evolution of vascular tissues in land plants. Of especial interest and importance is elucidation of the progressive sequences in complexity which have characterized the evolutionary specialization of cells and tissues in the wood of arboreal flowering plants. These studies firmly established the significance of the structure of the secondary xylem as an essential tool in solving problems of phylogeny in the angiosperms, and demonstrated that one of the most outstanding evolutionary documents to be found in the plant kingdom lies in the progressive modification of the secondary body. Interest in the evolution of structure logically led into questions concerning the anatomy and morphology of plants of the past, and among his papers are a number of highly individual and significant contributions to paleobotany.

Long experience, accruing from a quarter century of study of the anatomy of woody plants prepared BAILEY for his investigations of the microstructure, histochemical, and physical organization of the plant cell wall. These studies, which were begun in 1933-34 in collaboration with THOMAS KERR, extended over a period of 10 years and resulted in the clarification of controversial interpretations concerning the organization and physical relationships of cellulose, lignin, and other constituents of the plant cell wall. It is a significant tribute to Professor BAILEY's acuteness as an investigator that newer techniques developed in very recent years for the study of organic microstructures, especially improvement in X-ray photomicrography and the development of electron microscopy have confirmed, and little altered, his interpretation of cell wall structure in woody plants based on optical and histochemical studies.

To students of taxonomy and comparative morphology of the Angiosperms it is probable that BAILEY's later contributions will have the greater appeal and interest. These investigations are based on the utilization of the totality of anatomical evidence available in all organs and tissues of the plant to solve problems of phylogenetic relationship within families and orders of the Dicotyledons. With the collaboration of graduate students and other co-workers, intensive studies have been made of many families of the Ranalean complex, with special emphasis on delineating the structural organization of the primitive carpel, stamen, pollen and leaf in this group of the least specialized of living Angiosperms. Investigations of the floral morphology of certain monotypic and problematic families in the Ranalean

complex have revealed much that is new concerning the structure and morphology of the primitive carpel and the primitive pollen bearing organs among Angiosperms. Establishment of these morphological criteria represents a major advance in the solution of that ultimate and persistent botanical riddle: the origin of the Angiosperms from their geologically ancestral stock.

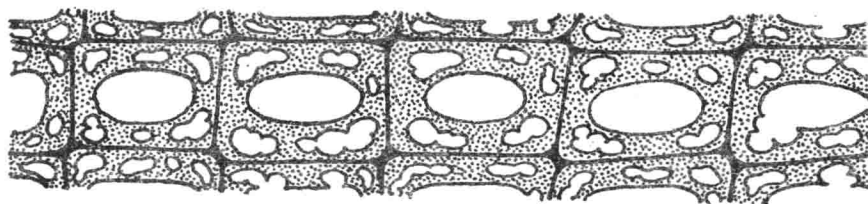
During World War II Professor BAILEY accepted the responsibility, delegated to him by the Dean of the Faculty of Arts and Sciences of Harvard University, to draft a plan for the re-organization and closer integration of Harvard's botanical resources both in the morphological-taxonomic and in the experimental areas. The result of this effort, in which he was generously and enthusiastically assisted by many of his colleagues, was a report entitled *Botany and its Applications at Harvard*, submitted in June, 1945. This report, subsequently approved by the Harvard Corporation, contained a recommendation for the erection of a botanical building, centrally located in Cambridge, and designed to house the herbaria, associated libraries and other botanical collections. The new botanical building, recommended in his report, was erected in 1953-54. As a result of the reorganization plan of 1946, two botanical budgetary and administrative areas were created, the *Institute for Research in Experimental and Applied Botany* and the *Institute for Research in General Plant Morphology*, Professor BAILEY was appointed chairman of the latter by the Corporation of Harvard University in 1946, a position which he has held since.

Many honors have been conferred upon IRVING BAILEY in recognition of his contributions to botanical science. Among these honors are election to the National Academy of Sciences, the honorary degree of Doctor of Science conferred by the University of Wisconsin in 1931, election to Foreign Member of the Swedish Royal Academy of Sciences, President of the Botanical Society of America in 1945 and Vice President of the Seventh and Eighth International Botanical Congresses.

It is perhaps appropriate to close this brief record of Professor BAILEY's career with a few words regarding his approach toward scientific problems. Much of his success in the clarification of both practical and theoretical questions and in discerning their essential and significant factors has been due to an awareness of the variables which characterize biological phenomena and to an ever present alertness to the significance of the unexpected and seemingly irrelevant. His intellectual qualities, scientific curiosity and capacity for sustained effort have always been manifest throughout his career. It is hoped that these excerpts from long and fruitful years of work will serve to make better known to botanists and other biologists IRVING BAILEY's diverse and lasting contributions to botanical science.

July 1954

ELSO S. BARGHOORN



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99. *Amborella trichopoda* Baill. A new morphological type of vesselless dicotyledon (Jour. Arnold Arb. 29: 245-254) (with B. G. L. SWAMY).

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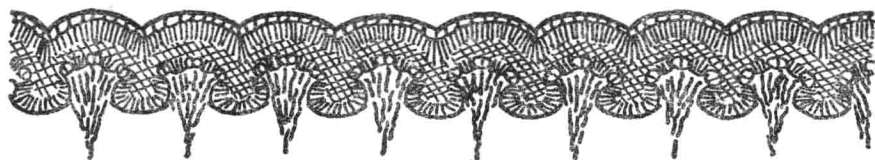
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## AUTHOR'S PREFACE

When approached by Doctors BARGHOORN and VERDOORN with the request that I make a selection of my papers for publication in book form, it soon became evident that some central theme was essential to bind such a selection together. Historically, the first half of the 20th Century — the period during which I received my scientific training and have conducted my investigations — has witnessed a gradual and significant change in the fundamental concepts and methodologies of Plant Anatomy. At the beginning of the century, the older botanical disciplines had become rigidly compartmentalized and concerned with the application of stereotyped techniques. At present, the fixed boundaries between scientific disciplines are rapidly breaking down and diversified new techniques are being commonly applied. Thus, the papers in this book have been selected and arranged to illustrate successive attempts between 1909-1953 to bridge the gaps between Plant Anatomy and other fields of scientific endeavor. Obviously, little could have been accomplished in these directions without the willing and active cooperation, not only of numerous botanists, but also of entomologists, biochemists, biophysicists and others, to whose helpful assistance I owe so much.

As indicated in the Table of Contents, the selected papers are grouped in eight parts, each of the first seven of which is concerned with the relation of Plant Anatomy to some other discipline or disciplines. At the end of each of these parts, references are listed to additional papers of the author dealing with this particular aspect of his work. Throughout the book, figures in italics between parentheses refer to the numbered list of the author's publications on pages xiii-xviii. In general, the selected papers have been reprinted with only minor changes in the text and text-figures. However, it was essential to reduce the plates to approximately one half of the original number. This necessitated the elimination of some and the combination and rearrangement of others, with concomitant changes in magnification and numbering.

I am greatly indebted to Dr. B. G. L. SWAMY for the preparation of the sectional title pages, headpieces and vignettes (cf. p. 259), to Dr. ROBERT C. FOSTER for his laborious help in reading the page-proof, and to Mrs. VERDOORN for the compilation of the index of plant and animal names, the author index, and miscellaneous proofreading.

Autumn 1954

J. W. Bailey



## CONTENTS

The figures in *italics*, between parentheses throughout this book, as well as the end of each part of this table of contents, refer to the numbered list of papers by Dr. BAILEY ("Author's Bibliography") on p. xiii-xviii.

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