

Cambridge University Press
0521830818 - The Department of Plant Biology, Volume IV
Patricia Craig
Frontmatter
[More information](#)

Centennial History of the Carnegie Institution of Washington Volume IV The Department of Plant Biology

From humble beginnings as a small desert laboratory in Tucson, Arizona, at the beginning of the twentieth century, the Carnegie Institution's Department of Plant Biology has evolved into a thriving international center of plant molecular biology that sits today on the campus of Stanford University. In the last hundred years it has witnessed immense changes in biological thinking, and been at the forefront of innovative research. This fourth in a series of five histories of the Carnegie Institution touches on the tangled beginnings of ecology, the baroque complexities of photosynthesis, the great mid-century evolutionary synthesis, and the adventurous start of the plant molecular revolution.

PATRICIA CRAIG is a freelance science writer based in Bozeman, Montana. After receiving her M.S. degree in science communication from Boston University in 1979, she joined the Carnegie Institution as assistant editor. She became associate editor in 1985 and served as editor from 1996 until 1999. In that capacity she wrote many articles and booklets about Carnegie scientists and their work, and has since maintained close ties with the Institution.

Cambridge University Press
0521830818 - The Department of Plant Biology, Volume IV
Patricia Craig
Frontmatter
[More information](#)

CENTENNIAL HISTORY OF THE
CARNEGIE INSTITUTION OF WASHINGTON

Volume IV
THE DEPARTMENT OF
PLANT BIOLOGY

PATRICIA CRAIG



CAMBRIDGE
UNIVERSITY PRESS

Cambridge University Press
0521830818 - The Department of Plant Biology, Volume IV
Patricia Craig
Frontmatter
[More information](#)

CAMBRIDGE UNIVERSITY PRESS
Cambridge, New York, Melbourne, Madrid, Cape Town, Singapore, São Paulo
Cambridge University Press
The Edinburgh Building, Cambridge CB2 2RU, UK
Published in the United States of America by Cambridge University Press, New York

www.cambridge.org
Information on this title: www.cambridge.org/9780521830812
© Carnegie Institution of Washington 2005

This book is in copyright. Subject to statutory exception
and to the provisions of relevant collective licensing agreements,
no reproduction of any part may take place without
the written permission of Cambridge University Press.

First published 2005

Printed in the United Kingdom at the University Press, Cambridge

A catalog record for this book is available from the British Library

ISBN-13 978-0-521-83081-2 hardback
ISBN-10 0-521-83081-8 hardback

Cambridge University Press has no responsibility for the persistence or accuracy of URLs for external
or third-party internet websites referred to in this book, and does not guarantee that any content on
such websites is, or will remain, accurate or appropriate.

Cambridge University Press
0521830818 - The Department of Plant Biology, Volume IV
Patricia Craig
Frontmatter
[More information](#)

CONTENTS

<i>Foreword by Richard A. Meserve</i>	<i>page</i> vii
<i>Preface</i>	ix
<i>Acknowledgments</i>	xi
1 An outpost in the desert	I
2 Early years at the Desert Laboratory	II
3 Daniel MacDougal: engineer of life	37
4 A decade of change	57
5 Terminations and taperings	75
6 A mythic collaboration	99
7 The black box of photosynthesis	119
8 Years of duty	135
9 The decade of chlorophyll	145
10 Defining a new ecology	163
11 The emerging complexity	175
12 An integrative approach	191
13 Common ground	211
14 The molecular era	237
<i>Notes</i>	253
<i>Bibliography</i>	273
<i>Index</i>	277

FOREWORD

In 1902 Andrew Carnegie, a steel magnate turned philanthropist, had a brilliant idea. Carnegie was prescient in recognizing the important role that science could play in the advancement of humankind. He also believed that the best science came by providing “exceptional” individuals with the resources they need in an environment that is free of needless constraints. He created the Carnegie Institution as a means to realize these understandings, directing the Institution to undertake “projects of broad scope that may lead to the discovery and utilization of new forces for the benefit of man.” Carnegie was confident that this unusual formula would succeed. And he was right.

For over a century, the Carnegie Institution has sponsored creative and often high-risk science. Some of the luminaries who were supported by the Institution over the years are well known. For example, Edwin Hubble, who made the astonishing discoveries that the universe is larger than just our galaxy and that it is expanding, was a Carnegie astronomer. Barbara McClintock, who discovered the existence of transposable genes, and Alfred Hershey, who proved that DNA holds the genetic code, both won Nobel Prizes for their work as Carnegie scientists. But many other innovative Carnegie researchers who are perhaps not so well known outside their fields of work have made significant advances.

Thus, as part of its centennial celebration, the Institution enlisted the help of many individuals who have contributed to the Institution’s history to chronicle the achievements of the Institution’s five major departments. (Our newest department, the Department of Global Ecology, was started in 2002 and its contributions will largely lie ahead.) The result is five illustrated volumes, which describe the people and events, and the challenges and controversies behind some of the Institution’s significant accomplishments. The result is a rich and fascinating history not only of the Institution, but also of the progress of science through a remarkable period of scientific discovery.

Andrew Carnegie could not have imagined what his Institution would accomplish in the century after its founding. But I believe that he would be very proud. His idea has been validated by the scientific excellence of the

Cambridge University Press
0521830818 - The Department of Plant Biology, Volume IV
Patricia Craig
Frontmatter
[More information](#)

viii

Foreword

exceptional men and women who have carried out his mission. Their work has placed the Institution in a unique position in the world of science, which is just what Andrew Carnegie set out to do.

Richard A. Meserve
President, Carnegie Institution of Washington

PREFACE

It was with a grand sense of expectation that the Carnegie Institution set up a laboratory devoted to desert plants outside of Tucson, Arizona in 1903. There existed nowhere else in the world a laboratory dedicated to desert environments. No one in Tucson or at headquarters in Washington, DC could know whether a department so far outside of the scientific mainstream would survive. Indeed, the Institution's trustees provided a founding grant good for only five years. But the department did survive. While the Institution no longer owns the land or buildings it erected in Tucson, the Carnegie Department of Plant Biology – the ultimate successor of the Desert Laboratory – lives on in Stanford, California.

The Department of Plant Biology today is a small, modern research establishment located on the campus of Stanford University. The labs are filled with sophisticated microscopes, gene analyzers, a variety of analytical instruments, state-of-the-art growth facilities, and powerful computers. The atmosphere is intense, the mission profound. Chris Somerville, the department's leader, directs the resources of the department as much as possible to three great, interrelated goals: problems of overpopulation, world hunger, and environmental degradation.

The department's geneticists, biochemists, cell biologists, and pathologists are a critical mass of individuals with overlapping interests and complementary skills. Most are focused on the experimental plant *Arabidopsis*, using this plant as a model system to learn in detail how plant genes work – how they control growth and development, and how they ward off pests and pathogens. Several members of the department also study how algae and cyanobacteria adapt to variations in environmental conditions with the goal of understanding how all plants adapt to environmental variation. Because all higher plants are closely related, Somerville believes that understanding basic biological process in these model organisms will provide the tools to unlock the yield potential not only of plants we currently cultivate but also the thousands of other species not now available for our use.

While the applications of much of the work in the department are readily apparent, it is not, and never has been, the intention of the Department of Plant Biology to develop its discoveries commercially. The department's research is conducted at a basic level. Nonetheless, Somerville's goal-oriented

basic research approach is taking the department in new directions. The historical roots of the department lie in studies of ecology and photosynthesis. Like two intertwining vines, these subjects sometimes wove together and sometimes grew apart, but always, as time progressed, they served as backdrop. Today, only a relatively small program of photosynthesis research remains, and ecology departed with the formation of a new Department of Global Ecology in July 2002.

This is the Carnegie way. The Institution has always placed its faith and its vision in the hands of individuals. It has given to its department directors – the “exceptional” individuals in Andrew Carnegie’s dream – the freedom to direct a department’s resources to goals they deem significant and possible. The tug between tradition and novelty has often meant those goals remain within a certain circumscribed area. Change, when it happens, has usually been slow. But today, under Chris Somerville’s leadership, the department stands on the threshold of an entirely new beginning.

How the Department of Plant Biology evolved from a dusty outpost in the Sonoran Desert to the dual modern research center it is today is the story told in the following pages. This history is not intended to be a new analysis of Carnegie’s role in plant biology throughout the twentieth century, though certainly it will attempt to bring this role into focus. Neither is it intended to be the definitive work on the subject. The scope of the history of the Department of Plant Biology is huge. It moves with the stream of biological discovery and revolution of the twentieth century. It touches on the tangled beginnings of ecology at the turn of that century, the great evolutionary synthesis in mid-century, the origins and continuing effort to understand photosynthesis, and the adventurous start of the plant molecular revolution in the 1970s.

Given this scope, a history of the Department of Plant Biology can not claim to be complete. It offers only a microcosm of twentieth-century plant biology within the context of a single funding source, the Carnegie Institution. It is a story that is rough around the edges, especially in the middle years, for little archival information exists beyond the Desert Laboratory’s demise. It changed as the 1960s and 1970s dawned, for it was then no longer concerned with people long gone, but with individuals alive and still doing research. The archival correspondence dwindles to nothing, and the historical narrative all but drops. Time has not tested the recent work and, as history, the story broadens and slows. The research, however, continues unabated at ever increasing speeds.

ACKNOWLEDGMENTS

As a former editor of the Carnegie Institution, I began the project with an obvious bias. I sought, however, to be dispassionate in my writing, and to present the history of the Department of Plant Biology in the voices of the participants and their compatriots as much as possible. The Carnegie Year Book, archival correspondence, and interviews with Carnegie scientists and former postdoctoral fellows played a large role in the source material I used. So, too, did outside source material. I am indebted to the professional historians and historically inclined plant biologists whose writings I freely robbed, and I am grateful to those who read my early drafts, especially Joel Hagen, Winslow Briggs, and Chris Somerville. I am indebted also to all the Carnegie plant biologists, past and present, whose love of nature and fascination with their subjects illuminated their science and made my task both rewarding and enjoyable.

Preparing this history involved a fair amount of travel, as the department archives are not conveniently located in one place. While the department itself maintains a few file drawers of correspondence and photographs, the bulk of the archives resides at the institution's headquarters in downtown Washington, DC. More is found at the Missouri Botanical Gardens in St. Louis, where in addition to many of Herman Spoehr's and Jens Clausen's papers, dozens of boxes of the Clausen, Keck, and Hiesey lab and field notes exist. Stacy French's surprisingly few papers are found at the Stanford University Archives, while MacDougal's voluminous correspondence is deposited at the Arizona Historical Society in Tucson. The University of Arizona Library in Tucson (Special Collections) houses most of the remaining archives of the Desert Laboratory.