

HORMONAL AND ENVIRONMENTAL REGULATION  
OF PLANT GROWTH AND DEVELOPMENT

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by

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(The publications within each sub-section follow a sub-sectional title page.)

## PREFACE

The 65 papers herein are divided into two major sections, the hormonal and the environmental regulation of plant growth, and the two sections are further subdivided according to aspect. A majority of effort has been devoted to the different facets of regulatory behaviour exercised by the plant hormones, the gibberellins, and to the effects of light and water on plant growth. The arrangement of the papers within each subsection is essentially chronological, though an attempt has been made to group conceptual units.

More than in most other widespread types of biological control mechanisms, the influence of hormones is out of proportion to their endogenous levels. It was this, and their (by definition) "action at a distance" that fired my imagination and prompted the intensive exploration of plant hormones and their effects, started more than twenty years ago, and represented by this thesis. My early goal was to help illuminate the role of gibberellins, particularly in germination of cereal seed. This was gradually supplemented by the desire to contribute to the definition of the hormonal mechanism, the biochemical or biophysical event or trigger that initiates the chain of events resulting in the observable physiological phenomena.

To these ends joint projects developed where areas of interest of colleagues overlapped mine. In addition, from time to time specific technical assistance was required and colleagues with the

necessary expertise were consulted and brought into the programme. The contributions of these collaborators were always acknowledged through the medium of co-authorship. In the case of paper 44, Professor C.A. West contributed the first two sections.

Contrary to the investigation of hormonal regulation, the exploration of the influence of the environment (papers 49-65) was conceived and executed as a genuine joint collaborative effort with Dr. D. Aspinall. Each of us has contributed to the original ideas, their planning and execution, and to the preparation of the manuscripts.

Papers 45 and 46 were based on work done while a Post-doctoral at Argonne National Laboratory, Argonne, Illinois; numbers 8 and 9 were carried out while a Visiting Lecturer at the Hebrew University, Jerusalem; publications 11 and 28 were initiated as a Special N.I.H. Fellow at California Institute of Technology, Pasadena, California; and number 44 was initiated while a Visiting Professor at the University of California in Los Angeles, Los Angeles, California. All other work was conceived and executed in Australia.

SUMMARY

During the latter part of the nineteenth century, a subject of considerable controversy was the way in which the insoluble starch and protein reserves of the cereal seed endosperm became available to the germinating embryo. H.T. Brown, G. Haberlandt and J. von Sachs all examined the problem but were unable to reach unanimity. The prevailing view for the first sixty years of the twentieth century was graphically stated in 1953 by W.O. James in his book "Plant Respiration", "The relationship of the germinating embryo to the endosperm is virtually that of a parasite extruding exo-enzymes into the host tissues, much as a spider treats a fly". The past fifteen years have seen a profound change in the concept if not the rhetoric, and the modern-day integrated view includes an hormonal role for gibberellin in the mobilization of endospermal reserves. In fact, perhaps more clearly now than for any other hormonally-regulated plant system, have the relationships between the various parts of the cereal seed during germination been described. The definition of the system started with publications 2-4, and the exploration of the effects of gibberellin outlined in papers 1-21 helped lay the foundation for what has today become an area of intense and major physiological and biochemical concern. Perhaps my major contribution to plant physiology has been in helping to elaborate the regulation by gibberellin of the growth