

# **SOIL CONDITIONS AND PLANT GROWTH**

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Soil Conditions and Plant Growth by Edward J. Russell

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**EDWARD J. RUSSELL**

**SOIL CONDITIONS  
AND  
PLANT GROWTH**



# MONOGRAPHS ON BIOCHEMISTRY

EDITED BY

R. H. A. PLIMMER, D.Sc.

AND

F. G. HOPKINS, M.A., M.B., D.Sc., F.R.S.

## GENERAL PREFACE.

THE subject of Physiological Chemistry, or Biochemistry, is enlarging its borders to such an extent at the present time, that no single text-book upon the subject, without being cumbersome, can adequately deal with it as a whole, so as to give both a general and a detailed account of its present position. It is, moreover, difficult, in the case of the larger text-books, to keep abreast of so rapidly growing a science by means of new editions, and such volumes are therefore issued when much of their contents has become obsolete.

For this reason, an attempt is being made to place this branch of science in a more accessible position by issuing a series of monographs upon the various chapters of the subject, each independent of and yet dependent upon the others, so that from time to time, as new material and the demand therefor necessitate, a new edition of each monograph can be issued without re-issuing the whole series. In this way, both the expenses of publication and the expense to the purchaser will be diminished, and by a moderate outlay it will be possible to obtain a full account of any particular subject as nearly current as possible.

The editors of these monographs have kept two objects in view: firstly, that each author should be himself working at the subject with which he deals; and, secondly, that a *Bibliography*, as complete as possible, should be included, in order to avoid cross references, which are apt to be wrongly cited, and in order that each monograph may yield full and independent information of the work which has been done upon the subject.

It has been decided as a general scheme that the volumes first issued shall deal with the pure chemistry of physiological products and with certain general aspects of the subject. Subsequent monographs will be devoted to such questions as the chemistry of special tissues and particular aspects of metabolism. So the series, if continued, will proceed from physiological chemistry to what may be now more properly termed chemical physiology. This will depend upon the success which the first series achieves, and upon the divisions of the subject which may be of interest at the time.

R. H. A. P.  
F. G. H.

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# SOIL CONDITIONS AND PLANT GROWTH

BY

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*WITH DIAGRAMS*

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PLANT PATHOLOGY  
BIBLIOGRAPHICAL NOTE



## PREFACE TO THE THIRD EDITION.

CONSIDERABLE alterations have been made in the text and a new chapter has been added discussing the colloidal properties of the soil. It is abundantly clear that the soil investigator of the future will have to be thoroughly familiar with the ways of colloids, and I fully expect that much of the older work will require careful re-examination in the light of what has been done in this direction by chemists and physicists.

Although the volume has necessarily expanded I have tried to keep it as a monograph: I have not attempted to turn it into an extended card index by referring to every paper published on the subject since the first edition came out. Many papers have been omitted: the guiding principle has been to include only those that brought in some new idea or profoundly modified an old one. Some of the papers omitted from the last edition have been included in this because they now fall into their place, while before they did not. Doubtless this will happen again.

Continued progress is being made. Since the book was first begun two Journals have sprung up devoted entirely to soil: *Soil Science*, under the editorship of the indefatigable J. G. Lipman, and the *International Mitteilungen für Bodenkunde*. Another Journal, the *Journal of Ecology*, has also arisen and is vigorously developing another aspect of the same subject, while the older agricultural journals are finding more and more of their space taken up by soil papers. The subject now only lacks a name, and though many have been proposed—pedology, agrogeology, edaphology, etc.—I have not felt drawn to any of them.

I am indebted to many friends for calling my attention to omissions from the last edition and for much useful criticism; and, above all, I have to thank Miss Helen Adam and Miss Ruth Gimingham, who have been good enough to read all the proofs and to help in verifying references.

HARPENDEN, 1917.

## PREFACE.

I HAVE endeavoured in the following pages to give a concise account of our present knowledge of the soil as a medium for plant life. At first sight the subject appears very simple; in reality it is highly complex and trenches on several different subjects with which no one individual can claim to have any adequate knowledge, and, what is perhaps a greater disadvantage, it has grown up very unsystematically. Chemists, botanists, bacteriologists, geologists, and agriculturists have all contributed something, but usually in connection with their own special problems and not with the idea of developing a new subject. It has usually been reckoned part of the somewhat vague mixture known as agricultural chemistry, and has often been considered more suitable for farmers' lectures than for pursuit for its own sake.

As a result of its history the subject is now in a rather confused state. Suggestions thrown out by men eminent in some other branch of science have been accepted without much serious examination; illustrations used in farmers' lectures to drive home some important point to an audience before whom lucidity is above all things necessary, have acquired the force of established facts; whilst statements, and sometimes even substances, have come to be believed in for no better reason than that people have talked a great deal about them.

In recent years, however, its recognition as a basis of national wealth has given the soil a high degree of technical importance, whilst the remarkable constitution it appears to possess, the variety of its microscopic inhabitants and their close connection with plant life, all impart to its study unusual scientific interest. The time, therefore, seems ripe for a critical examination of the foundations for our beliefs, and this task is rendered easier by the advances made of late years on the Continent, in America and in this country. As the foreign literature is not generally available for English readers I have given the evidence in some detail, so that my fellow agricultural chemists may see it for themselves and the student of pure science may be able to tell us how far we are justified in using the data as we do.

E. J. R.

HARPENDEN, *January*, 1912.

## PREFACE TO THE NEW EDITION.

THE second impression of this book was called for so soon after the first was published that there seemed no occasion to make any alterations beyond the correction of a few misprints, but now that a third is required the opportunity is taken of adding a new chapter on the relationship between the micro-organic population of the soil and the growth of plants, and also numerous sections dealing with recent developments of other parts of the subject. It is satisfactory to be able to record that continued progress has been made, and that some of the difficulties that obstructed the way when the book was first written have now been overcome.

In this revision I have been greatly helped by Dr. Hans Brehm, who translated the first edition into German, and who very kindly placed at my disposal his complete and critical knowledge of the continental work on the subject.

ROTHAMSTED EXPERIMENTAL STATION,  
HARPENDEN, 1915.