

**MORTON'S HANDBOOKS
OF THE FARM; NO.1; THE
CHEMISTRY OF THE FARM**

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Morton's Handbooks of the Farm; No.1; The chemistry of the farm by R. Warington

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R. WARINGTON

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MORTON'S HANDBOOKS OF THE FARM.

No. 1.

THE CHEMISTRY OF THE FARM

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PREFACE

TO THE FOURTH REVISION.

As "The Chemistry of the Farm" is now pretty widely known, and has been translated into several languages, a few words as to its origin will perhaps be of interest.

It is probably not generally known that the present work was originally undertaken by Sir J. B. LAWES. It was in the summer of 1878 that the late Mr. J. CHALMERS MORTON began to make arrangements for the preparation of a little Handbook of Agriculture for the use of Schools. The book he desired was to be similar to the "notes which a sharp lad would take home from a course of lectures." It was intended to be the work of several writers, and Sir J. B. LAWES was asked, and undertook, to contribute the part relating to the scientific application of manures. In November, 1878, Sir J. B. LAWES asked me to take his place in writing the chemical part of the proposed book; and he, at the same time, handed me the notes which he had already prepared. My contributions were first printed in "The Agricultural Gazette," and appeared at intervals during 1879-80. The work had then grown far beyond the limits originally assigned, and was finally published in 1881 as a separate volume.

"The Chemistry of the Farm" has doubled in size during the twenty-one years that have elapsed since its original publication. The alterations that have

been made for the present revision are very considerable, the largest changes being made in the sections relating to the nutrition of animals. These alterations have been rendered necessary by the publication of the epoch-making investigations of ZUNTZ and HAGEMANN on the nutrition of the horse,¹ and of the equally important researches of KELLNER, KÖHLER, and their associates, on the nutrition of the ox.² By these laborious researches many important problems have been solved, and a foundation laid on which a really accurate science of feeding may be constructed.

In the new work of these German investigators, both the value of the food, and of the work which it undergoes, or accomplishes, is reckoned in units of heat. The fundamental facts established by their investigations have been brought together in a separate chapter (VII.). The discussions in this chapter, while introductory to much that follows, unavoidably assume a knowledge of some facts afterwards mentioned; students using the book will therefore do well to refer to this chapter several times in the course of their subsequent reading.

The chapter on Dairy Chemistry has been considerably enlarged; and here the writer has been indebted to the work of Mr. H. DROOP, RICHMOND, for much of the new matter which has been introduced.

As this book is intended for the use of students,

¹ Untersuchungen über den Stoffwechsel des Pferdes bei Ruhe und Arbeit, von N. Zuntz und O. Hagemann, Berlin, 1898.

² Untersuchungen über den Stoff- und Energie-Umsatz, des erwachsenen Rindes bei Erhaltungs- und Produktions-futter, von O. Kellner, Berlin, 1900.

no apology seems needed for the cross references which frequently appear; their object is to enable the student to bring at once together all the scattered facts and statements bearing upon the subject under discussion.

The metric system has been employed to some extent, as well as the ordinary English weights and measures. The former has been used chiefly for the expression of scientific ideas, the latter for practical purposes.

It is undoubtedly true that as science advances it becomes more complicated, and less capable of appreciation by the general reader. The modern student needs a more thorough training than one of bygone years, if he is to be able to grasp and put to practical use the new facts and ideas which scientific investigations are continually bringing forward. Agricultural education must proceed side by side with scientific research, if the latter is to be turned to any practical use by the farmer.

R. WARINGTON.

HARPENDEN,
September, 1902

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THE CHEMISTRY OF THE FARM.

CHAPTER I.

PLANT GROWTH.

The Constituents of Plants.—Water—The combustible elements of vegetable matter—The proportion of ash constituents in various parts of plants—The essential and non-essential elements of the ash—Composition of a crop of grass. *Function of the Leaves.*—Assimilation of carbon from the air—Formation of vegetable substance—Plant respiration—The transpiration of water. *Function of the Roots.*—Absorption of ash constituents from the soil—The selective power of plants—Absorption of nitrogenous matter. *Co-operative Nutrition.*—Root fungi—The organisms of leguminous tubercles. *Destination of Ash Constituents.*—History of essential and non-essential ash constituents—Variations in ash due to soil, manure, and season—Composition of typical ashes. *Germination.*—General structure of seeds—The conditions and processes of their germination. *Plant Development.*—Annual plants—The order in which plant constituents are assimilated—Exhaustion of roots and stem during formation of seed—Biennial and perennial plants—The storing up of food for a second season—Spring sap rich in sugar.

THE first step towards a knowledge of plant chemistry must be an acquaintance with the materials of which plants are built up.

The Constituents of Plants.—The most abundant ingredient of a living plant is *water*. Many succulent vegetables, as turnips and lettuce, contain more than 90 per cent. of water. Timber felled in the driest time seldom contains less than 40 per cent. of water.