

FOOD INSPECTION *and* ANALYSIS

FOR THE USE OF PUBLIC ANALYSTS, HEALTH OFFICERS,
SANITARY CHEMISTS, AND FOOD ECONOMISTS

BY

ALBERT E. LEACH, S.B.

*Late Chief of the Denver Food and Drug Inspection Laboratory, Bureau of Chemistry,
U.S. Department of Agriculture; Late Chief Analyst of the Massachusetts
State Board of Health*

REVISED AND ENLARGED BY

ANDREW L. WINTON, Ph.D.,

*Formerly Chief of the Chicago Food and Drug Laboratory, Bureau of Chemistry, U.S.
Department of Agriculture; Formerly in Charge of the Analytical Laboratory,
Connecticut Agricultural Experiment Station*

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PREFACE TO FOURTH EDITION.

THE present revision has been carried out after a thorough search of the literature. A large amount of new material has been added or substituted for that in previous editions and the size of the book increased by 90 pages. While a somewhat different arrangement of the chapters may seem more logical, it was decided to retain the old order to which those who have hitherto used the book have become accustomed. The lists of references at the end of the chapters, which never aspired to be complete bibliographies, have been dropped and more attention has been given to footnote references.

The reviser is indebted for criticisms and notes to many friends, especially the following: Prof. E. H. Farrington, Prof. E. S. Guthrie, and Dr. L. L. Van Slyke (dairy products), Prof. H. S. Grindley (meat), Mr. F. C. Atkinson, Mr. Carl S. Miner, and Prof. Harry Snyder (cereal products), Mr. M. C. Albrech, Mr. F. M. Boyles, and Mr. A. E. Paul (spices), Mr. H. S. Bailey, Prof. E. F. Ladd, and Dr. David Wesson (oils), Dr. C. S. Browne, Mr. A. Hugh Bryan, Dr. W. D. Horne, and Mr. W. E. Rice (sugar), Mr. H. M. Loomis and Mr. W. E. Mathewson (colors), and Dr. A. R. Albright (flavoring extracts).

A special feature is a final chapter by Prof. Gerald L. Wendt, on the determination of acidity by the hydrogen electrode, a method which seems destined to play an important part in food analysis.

So far as possible original papers have been consulted, but whenever this was not possible owing to the war or other conditions the abstracts in the Experiment Station Record and Chemical Abstracts have proved invaluable.

A. L. W.

WILTON CONN., January, 1920.

PREFACE TO FIRST EDITION.

IN the preparation of the present work, the requirements of the public analyst are mainly kept in view, as well as of such officials as naturally cooperate with him in carrying out the provisions of the laws dealing with the suppression of food adulteration in states and municipalities. To this end special prominence is given to the nature and extent of adulteration in the various foods, to methods of analysis for the detection of adulterants, and to some extent also to the machinery of inspection.

While the analyst may not in all cases have directly to deal with the *minutiae* of food inspection, his work is so closely allied therewith that this branch of the subject is of vital interest and importance to him. Indeed, in many smaller cities one official often has charge of the entire work, combining the duties of both inspector and analyst.

Endeavor has been made, furthermore, to deal with the general composition of foods, and to give such analytical processes as are likely to be needed by the sanitary chemist, or by the student who wishes to determine the proximate components of food materials.

It has been thought best to include brief synopses of processes of manufacture or preparation of certain foods and food materials, in cases where impurities might be suggested incidental to their preparation.

In view of the fact that Massachusetts was the pioneer state to adopt, over twenty years ago, a practical system of food and drug inspection, and for many years was the only state to enjoy such a system, no apology is perhaps needed for more frequent mention of Massachusetts methods and customs than those of many other states, in which the food laws are now being enforced with equal zeal and efficiency.

Considerable attention has been paid in the following pages to the use of the microscope in food analysis. Of the figures in the text illus-

trating the microscopical structure of powdered tea, coffee, cocoa, and the spices, fifteen have been reproduced from the admirable drawings of Dr. Josef Moeller, of the University of Graz, Austria. Acknowledgment is gratefully given Dr. Moeller for his kind consent to their use.

The photomicrographs in half-tone, forming the set of plates at the end of the volume, were all made in the author's laboratory, and may be divided into three classes: 1st, illustrations of powdered pure foods and food products, as well as of powdered adulterants; 2d, types of *adulterated* foods, chosen from samples collected from time to time in the routine course of inspection; and 3d, photographs of permanently mounted *sections* of foods and adulterants.

While recent works covering the whole field of general food analysis are comparatively few, the number of treatises, monographs, government bulletins, and articles scattered through the journals, dealing with special subjects relative to food and its inspection, is surprisingly large, and from a painstaking review of these much information has been culled, for which it has been the author's intention at all times to give credit.

Special mention should here be made of the valuable publications of the U. S. Department of Agriculture, both the bulletins issued from Washington, and those from the various experiment stations, an ever-increasing number of which are becoming engaged in human food work. The author has freely drawn from these sources, and especially from the data and material furnished by his coworkers in the recent and still pending labor of preparing food methods for the Association of Official Agricultural Chemists, and he wishes to extend his thanks to all of them for their assistance. Appreciation is also expressed for the care and discrimination shown by Mr. L. L. Poates in the preparation of the cuts. Thanks are especially due to Mr. Hermann C. Lythgoe, Assistant Analyst of the Massachusetts State Board of Health, for his invaluable cooperation, and to Dr. Thomas M. Drown for helpful hints and suggestions.

BOSTON, MASS., July 1, 1904.

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FOOD INSPECTION AND ANALYSIS.

CHAPTER I.

FOOD ANALYSIS AND OFFICIAL CONTROL.

INTRODUCTORY.

THE general subject of food analysis, in so far as the public health is concerned, is to be considered from two somewhat different standpoints: first, from the outlook of the government, state, or municipal analyst, whose mission it is to ascertain whether or not the food may properly be considered pure or free from adulteration; and second, from the point of view of the food economist, whose aim is to determine its actual composition and nutritive value. The one protects against fraud and injury, the other furnishes data for the arrangement of dietaries and for an intelligent conception of the rôle which the various nutrients play in the metabolism of matter and energy in the body. The two fields are as a rule distinct each from the other, often involving, in the examination of the food, different methods of procedure.

Official Control of Food.—In view of the importance of the consideration of food with reference to its purity, an ever-increasing number of states have realized the necessity of protecting their citizens from the unscrupulous manufacturers who in various lines are seeking to produce cheaper or inferior articles of food in close imitation of pure goods. Many of the states have laws in accordance with which the sale of such impure or adulterated foods is made a criminal offense, and some, but not all of these, are provided with public analysts and other officers to enforce these laws and punish the offenders. Numerous communities are awake to the importance of municipal control of such commonly used articles of food as milk, butter, and vinegar, and in many cases have machinery of their own for regulating the sale of these foods.

Since January 1, 1907, the federal government has been actively engaged in the enforcement of the national food law of June 30, 1906, through the Bureau of Chemistry of the U. S. Department of Agriculture. In addition to the central laboratories of this Bureau at Washington, a number of branch laboratories have been established in the principal cities of the United States to enforce the provisions of the national law which regulates interstate commerce in foods, as well as their manufacture and sale in the territories and the District of Columbia, and their importation from foreign countries.

Food Analysis from the Dietetic Standpoint.—The study of the principles of dietetics has been given increased attention during the last decade in the curricula of many of the technical schools and colleges. Much has been accomplished by certain of the state experiment stations working as a rule in connection with the United States Department of Agriculture along this line. Investigations of this character are especially valuable, and are indeed rendered necessary by the general tendency of the modern physician to regard the hygienic treatment of disease, especially with reference to the matter of diet, as often of far greater importance than the mere administering of drugs.

The food economist studies the varying conditions of age, sex, occupation, environment, and health among his fellow men, with a view to showing what foods are best adapted to supply the special requirements of various classes. The quantity and proportion of protein, fat and carbohydrates, or of fuel value best suited for the daily consumption of a given class or individual having been determined, dietaries are made up from various food materials to supply the need with reference as far as possible to the taste and means of the consumer.

Experiments are made on families, clubs, or individuals, representing various typical conditions of life, and extending over a given period, during which records are kept of the available food materials on hand and received during the term of the experiment, as well as of those remaining at the end. In the case of individuals, additional records may be kept of the amount and composition of the urine and feces. From such data the physiological chemist calculates the amount of nutrients utilized, and studies the metabolism of material in the human body.

Up to this point no very extensive apparatus is required, but if in addition the income and outgo of heat and energy are to be studied, which are important to a complete investigation of the economy of food in the body, the student will require a respiration calorimeter and its appurte-