MANUAL OF PHYSIOLOGICAL AND CLINICAL CHEMISTRY

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BY

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PREFACE TO THE SECOND EDITION.

That there is considerable difference of opinion among teachers of chemistry as to what portions of the science can, with most profit, be presented to the medical student, is evidenced by the number and variety of small laboratory manuals for the use of medical students that have appeared within the past few years.

Some of these books deal largely with the detection of poisons, a subject that in actual practice is always entrusted to the professional chemist.

Others devote a great deal of attention to training the student in analytical methods, to sanitary analysis, or to the examination of foods or drugs. Another class devote most attention to the chemistry of the tissues and secretions and proximate principles of the human body. All of them, however, recognize the importance of the gross analysis of urine, many however, treating the subject from the purely chemical side.

While it will be admitted that all these subjects are important for medical students to know, it must also be admitted that the time usually given to the subject of chemistry is too limited for such an extensive course.

A medical college is a technical school for the training of young men or women in the science of the prevention or the diagnosis and treatment of disease.

The chemical teaching should, therefore, be directed to this purpose, and should consist in teaching the fundamental principles and the application of these principles to the science of medicine, especially to the diagnosis and treatment of diseased conditions. Such applications of the science of chemistry can rightfully be grouped under the head of *clinical chemistry*.

This little manual, the second edition of which is now presented, is the outcome of this idea gradually developed during the past twenty years of teaching in the Long Island College Hospital.

In preparing this edition the author has thoroughly revised the book, added much new matter including many new processes, some of which are original. It has been the aim of the author to give the

processes in sufficient detail to serve as working directions and yet to make them as concise as possible. Explanatory notes and a brief statement of the clinical significance of results obtained in the laboratory accompany the description of methods of procedure.

No attempt has been made to give a complete guide to the microscopic study of blood or to enter the field of general microscopic diagnosis.

While such a manual must of necessity be largely a compilation, many of the processes are either original or modified by the author. How well the aim of the author has been carried out others must determine. Credit has been given to the authors of special processes where possible. The author would here express his indebtedness to Dr. F. Blumenthal for several illustrations of urinary deposits from his work on "Die Pathologie des Harnes," and to the Publishers for the loan of illustrations from Landois' Physiology.

It is believed that this manual will be found to contain all that the physician will need as a guide to the ordinary clinical examination of urine, gastric contents, blood, feces and milk.

E. H. BARTLEY.

BROOKLYN, June, 1904.

CLINICAL CHEMISTRY.

EXERCISES IN EXPERIMENTAL PHYSIOLOGICAL CHEMISTRY.

The student should refer to the descriptive part of the text-book for the subjects treated of here.

THE SACCHARIDS OR CARBOHYDRATES.

1. Note the general appearance of the specimens of cane-sugar, milk-sugar, grape-sugar or dextrose, dextrin, and starch which are passed around.

2. *Solubility.*—Put some of each into cold water. Starch is insoluble; dextrose, lactose, and dextrin slowly dissolve, but more readily in hot water.

3. *Furfural Test. Molisch's Test.*—To 4 c.c. of a weak solution of any one of the above sugars, add three drops of a 15 per cent. alcoholic solution of alpha-naphthol, and then pour this carefully down the side of a test-tube containing about 2 c.c. strong H_2SO_4. There is formed a violet ring at the line of contact of the two liquids, which becomes more intense on gentle agitation.

This reaction is a general one for all the soluble carbohydrates.

THE PENTOSES, $C_5H_{10}O_5$.

1. Dip a pine splinter in some strong HCl, and then moisten with anilin acetate. The pentosane in the wood is converted into pentose by the HCl, and this into furfural, which gives a bright red color with anilin acetate, or with a solution of phloroglucin.

2. To about 2 grms. of crushed malted barley in a test-tube, add 2 c.c. HCl, dilute with 5 c.c. of water and boil. Hold over the mouth of the test-tube a piece of anilin acetate paper. The paper is reddened if pentoses are present.

THE HEXOSES, $C_6H_{12}O_6$.

These tests may be performed with a 2 per cent. solution of commercial glucose, or with a solution of cane-sugar of the same strength, which has been inverted by heating on a water-bath for 15 minutes with 4 or 5 drops of H_2SO_4 to 50 c.c. of the solution.

1. *Moore's Test.*—To 4 c.c. of the solution in a test-tube add 2 c.c. of a strong NaOH solution and boil. The liquid changes color, first becoming yellow and then brown. The depth of color increases with the quantity of sugar present.

2. *Fehling's Test.*—Boil 4 c.c. of Fehling's solution diluted with twice its volume of water and add 1 c.c. of the solution. Red cuprous oxide, Cu_2O, is precipitated.

3. To 10 c.c. of the solution add 5 c.c. of Barfoed's copper solution, and boil for three to five minutes. A red precipitate forms with the hexoses, but not with cane-sugar, lactose, maltose or dextrin.

Barfoed's Solution is prepared by dissolving 7 grms. of copper acetate in 100 c.c. of water and adding 2.5 c.c. of 38 per cent. acetic acid.

4. Rub up some of the solution with a small lump of yeast. Fill a test-tube with this mixture, close the tube with a perforated cork stopper, excluding all air, invert the tube in a vessel containing a little water, and let set from 12 to 24 hours, in a warm place. Fermentation takes place generating CO_2, which collects in the upper end of the tube.

$$C_6H_{12}O_6 + \text{yeast} = 2C_2H_5OH + 2CO_2.$$

5. To 15 c.c. of the solution in a wide test-tube add about 0.5 grms. of phenyl-hydrazin hydrochloride, and 1 grm. sodium acetate. Set the tube in boiling water for half an hour and cool. Yellow crystals separate on cooling, which under the microscope appear as rosettes or bundles of fine needles. If the precipitate appears amorphous, under the microscope, filter, dissolve the residue on the paper in hot alcohol, dilute with water, boil off the alcohol and cool, when the characteristic yellow stellate crystals will be formed. Williamson applies this test as follows:

Fill a test-tube to a depth of one half inch, with phenyl-hydrazine hydrochloride, then to the same depth with sodium acetate, then half full, with the liquid to be tested. Boil the liquid for two or three minutes, and set aside to cool, when the crystals of phenyl-glucosazone will be found in the bottom of the tube. The reaction is:

$$C_6H_{12}O_6 + 2C_6H_5N_2H_3 = C_{18}H_{22}N_4O_4 + 2H_2O + H_2.$$