A LABORATORY OUTLINE OF COLLEGE CHEMISTRY

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BY

ALEXANDER SMITH

PROFESSOR OF CHEMISTRY, AND HEAD OF THE DEPARTMENT,
COLUMBIA UNIVERSITY

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PREFACE.

THE present Laboratory Outline follows the order of topics in the second edition (1916) of the author's *General Chemistry for Colleges*. A number of new experiments, such as those on hard water, colloids, foods, baking powder, dyeing, and Bunsen's film and match tests, have been introduced.

It is not intended that the whole of the experiments should be performed by any one class. The sub-division into small paragraphs will make omissions easy. The choice will depend upon the preferences of the instructor and upon the purpose for which the course is being given.

The weakest point in most, if not in all, forms of education is the resulting lack of a sense of quantity. A few quantitative experiments will have no effect, if hundreds of other experiments are performed without reference to this feature. The quantitative sense must be cultivated until it is used habitually in all connections. The students should be urged to note the quantity of each material taken, and the concentration of each reagent used (normal, as a rule), and consciously to add equivalent amounts. Where a smaller amount, or an excess, is required, the fact is specified in the directions. In adding sodium hydroxide solution to alum, for example, not one student in a hundred will avoid adding an enormous excess, before studying the result. If the student continues in chemistry, training of the sense of quantity will be of immense value. If he does not pursue chemistry, as the majority do not, the training will still be most useful to him in other studies and, in business, will make all the difference between success and failure.

The list of reagents, in the Appendix, indicates concentrations which are convenient.

This outline may be employed also along with the *Introduction to Inorganic Chemistry*. To facilitate this, a table at the end gives the equivalents of the references to pages in the *College Chemistry* which are used exclusively in the text of the outline.

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GENERAL DIRECTIONS.

NOTES 1–17.

Read the "Regulations" posted in the laboratory. Read also, attentively, the following notes:

Note 1. — Provide yourself with a **note-book** and make a careful permanent record immediately after each experiment. Enter the numbers and titles of the paragraphs of the outline systematically. State (1) what you did, if anything beyond the directions, but do not copy the printed directions themselves, (2) what you observed, (3) what conclusions you drew. A sketch of the apparatus will enable you to recall the circumstances of the experiment, if later reference to it is necessary. This note-book, when called for, is to be handed in for inspection.

The directions have been expressed with the utmost care and brevity. Every word is significant. Italics are therefore nowhere employed for the purpose of emphasis.

Note 2. — Whenever an **interrogation point** or a direct **question** appears, a corresponding note should appear in the note-book. The "(?)" indicates something to be observed and recorded.

Note 3. — The very numerous **questions** asked in the course of this outline are intended to be answered, not by speculation, but by careful observation and reasoning based on the results of this. Very often the student will find it necessary to devise and carry out further experiments of his own before a satisfactory answer is obtained. When a question occurs to you, endeavor by reflection and study to answer it yourself before consulting an instructor.

Note 4.— In many cases the work outlined could not in itself furnish the basis for an answer, and fuller investigation of the point would require work beyond the time or ability at the disposal of the beginner. Such questions are distinguished by an [R], indicating that Reference to some authority (lecture, book, or assistant) must be made. The number following the R is that of the page in Alexander Smith's *General Chemistry for Colleges* (Second Edition), where the necessary information may be obtained. The authority should be consulted, however, only after the experiments have been made and the notes written up as far as possible.

Note 5. — When a chemical change has been observed the **equation** should always be given in the notes, but an equation alone is never a sufficient record.

Note 6. — Where the word [Instructions] appears, consult the instructor before going further.

Note 7. — In quantitative experiments, marked [Quant.], use the finer balance, in all other cases the rough scales in the laboratory.

Note 8. — The expression [Storeroom] indicates that the necessary apparatus is not included in the individual outfits.

Note 9. — When the word [Hood] appears, the operation is not to be conducted in the open laboratory. The apparatus must be at once placed close to the desk-ventilator, or be transferred to the hood.

Note 10. — Where exact quantities are not indicated, very small amounts of solutions (1 c.c. or less) should be taken. This advice is given, partly to secure saving of material, but chiefly to avoid the waste of time which working with large quantities always entails.

Note 11. — To **obtain the necessary chemical substances,** if the chemicals are not furnished in "kits" to each student, do not carry the bottles from the side-shelf to the desk. Bring a clean test-tube for liquids and a watch-glass for solids. For the latter, a piece of the paper, provided near the side-shelf, may also be used. When too much of any reagent has been taken, do not return it to the bottle.

Note 12. — The **chemicals,** if on a side-shelf, are divided into two sets, each arranged alphabetically according to the scientific names. The first set consists of solids in small bottles, the second of liquids. The bottles and their places are numbered consecutively to facilitate accurate replacement, and scrupulous care must be taken not to disarrange them. Read the labels attentively, as there are frequently several kinds of the same substance (*e.g.*, pure, and commercial, dilute, concentrated, and normal).

All **materials** are supplied through the storeroom service. Do not therefore take bottles, when found **empty,** to the instructor, but to the storekeeper for refilling.

Note 13. — The expression [From Instructor], however, indicates one of a few special substances for which the student must apply to an instructor.

Note 14. — The **bottles on the desk,** if there are any, contain certain substances which are frequently used. These substances will not be found on the side-shelf.

Note 15. — When any **acid gets upon the clothing,** apply ammonium hydroxide solution at once.

Note 16. — **Burns,** whether caused by contact with hot objects, by acids, or by corrosive liquids like bromine, are rubbed gently with a paste of sodium-hydrogen carbonate and water. All burns, save the slightest, must afterwards be dressed with an aqueous solution of boric acid (half-saturated) to prevent infection. Obtain the assistance of an instructor.

Cuts must be washed in running water and dressed with boric acid as above, or with lanolin containing 2 per cent of boric acid.

Note 17. — All students **work independently,** except where coöperation of two students is expressly directed.