A MANUAL OF BLOWPIPE-ANALYSIS, AND DETERMINATIVE MINERALOGY

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BLOWPIPE-ANALYSIS,

AND

DETERMINATIVE MINERALOGY.

BY

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SECOND EDITION,
REVISED AND GREATLY ENLARGED.

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PREFACE.

THE present edition of this "Manual," is, like the preceding, designed to serve as a text-book in the instruction in Blowpipe-Analysis and Determinative Mineralogy in the Rensselaer Polytechnic Institute.

In the first three chapters, but few alterations and additions have been made, fearful of injuring the practical usefulness of the book by an accumulation of too much material. The fourth chapter, containing the characteristics of the most important ores, has been considerably enlarged by increasing the number of species, and by adding an appendix containing the description and blowpipe reactions of the various kinds of fossil fuel; additions which, I trust, will be especially acceptable to the Mining-Engineer and Geologist. In the selection of the newly added species I have paid particular regard to those occurring in the American Continent; for this reason, many less important ores have found a place in the list to the exclusion of others, which, though more valuable, have not hitherto been found in America.

The fifth chapter, containing a systematic method for the discrimination of inorganic compounds, is a translation, but slightly altered, of the "*Division dichotomique pour reconnaître les minéraux*," as given in Laurent's "*Analyze au Chalumeau*." It is of no great value to the experienced analyst, but very useful for beginners, and it is on their account that I have given it a place in the Manual.

The sixth chapter is not contained in the first edition. It is hardly necessary to allege any reason for its introduction into this edition. The admirable method of Professor von Kobell for the discrimination

of minerals is, almost beyond dispute, the most practical and most reliable that has ever been published. The sixth chapter is nothing but an extract from Prof. v. Kobell's treatise on this subject. It contains all the well-known mineral species, and leads to their determination with almost unerring certainty.

The appended tables, taken from Plattner's work on the Blowpipe, have remained unchanged.

For the material of this compilation, the author is principally indebted to the following works:

C. F. Plattner: The Use of the Blowpipe in the Examination of Minerals, Ores, &c. Translated by J. S. Muspratt, 3d ed., London.

J. J. Berzelius: The Use of the Blowpipe in Chemistry and Mineralogy. Translated by J. D. Whitney, Boston.

F. von Kobell: Tafeln zur Bestimmung der Mineralien. 5th ed. München. 1853.

J. D. Dana: A System of Mineralogy. 4th ed., New York, 1854.

John Mitchell: Manual of Practical Assaying. 2d ed., Lond., 1854.

The author, finally, begs to tender his thanks to his friend, Professor Chandler, of Union College, for the valuable suggestions he has received at his hands, and which he has acted upon to the best of his ability, being fully convinced that by adding the improvements recommended by his friend, the practical utility of this little Manual will be greatly increased.

WILLIAM ELDERHORST.

Troy, N. Y., March, 1860.

INTRODUCTION.

In preparing this little Manual, it has been my principal care to adapt it to the use of the beginner. The use of the blowpipe, though elaborately studied and extensively written on by some of the first chemists and mineralogists of the preceding and the present century, has not yet been duly appreciated. This neglect is, perhaps, owing to the rapid advancement of chemical analysis in the humid way, which furnishes, on the whole, more reliable results, and allows of an easy quantitative determination of the various constituents of a body. But it was overlooked that this mode of analysis absorbs much more time, and requires the use of an extensive set of apparatus, whereas an examination before the blowpipe is sooner performed; requiring scarcely as many hours as an examination in the humid way requires days, and that, with the aid only of a few reagents and instruments of small size. It is for this reason that a knowledge of blowpipe-operations is less valuable for the Chemist by profession than for the Mining-Engineer, the Mineralogist, and the Geologist. A small portable box will hold all the necessary reagents and instruments, so that he may carry them with him on his expeditions and travels, and examine on the spot the minerals which he meets with on his explorations; an advantage which ought, truly, not to be overlooked.

For teachers who have not hitherto devoted much time to instruction in this department, a short exposition of the course which I have followed for a number of years may, perhaps, be desirable. For elementary instruction, the students are only furnished with the principal re-

agents, viz., carbonate of soda, salt of phosphorus, borax, and solution of cobalt; of apparatus they want a fluid-lamp, blowpipe with platinum point, platinum-pointed forceps, platinum wire, charcoal, and closed and open glass-tubes. After having explained to them the action of the two cones of the flame, and instructed them in making beads, and conducting the processes of oxidation and reduction, I make them perform the most important operations, and study the behavior of the most commonly occurring substances, with and without fluxes. I give the substances in somewhat the following order:

Sesquioxide of iron, all the reactions given in Table II, 10.
Peroxide of manganese, Table II, 13.
Sesquioxide of chromium, Table II, 6.
Oxide of cobalt, and nickel, Table II, 7, 16.
Protoxide of copper, Table II, 8, and § 37.
Oxide of zinc, Table II, 27, and metallic zinc §§ 25, 45.
Oxide of tin, Table II, 22, and metallic tin § 26.
Oxide of lead, Table II, 12, and metallic lead § 23.
Oxide of bismuth, Table II, 3, and metallic bismuth §§ 17, 22.
Antimonous acid, Table II, 1, and metallic antimony §§ 16, 21.
Arsenous acid, Table II, 2, §§ 9, 15.
Oxide of mercury, Table II, 14.
Alumina, Table I, 5, and § 44.
Magnesia, Table I, 4, and § 44.
Silica, § 39.
A sulphide, §§ 10, 14, 107.
A borate, § 60.
A chloride, §§ 65, 66.

Having performed all these operations, the student will be qualified to enter upon the analysis of substances of not too compound a character. If he meets on his way with bodies, the behavior of which before the blowpipe he has not previously studied, he will not have any difficulty in determining their character if he follows the directions given in the second chapter. The *modus operandi* will be best understood by a few examples.

1. The substance under examination is sulphide of antimony:

Examination in a matrass: At a very high temperature, a black sublimate is obtained, becoming reddish-brown when cold. In reading over the list in § 10 we find this character belonging to sulphide of antimony.

Examination in an open glass-tube: gives sulphurous acid, detected by the odor and action on blue litmus-paper, and white fumes which partly condense in the tube. On examining the sublimate with a magnifying glass, it is found to be amorphous, hence must be antimonous acid (§ 16).

Examination on charcoal alone: is completely volatilized with emission of sulphurous acid, and deposits a white volatile coating, possessing the properties of the coating of antimony (§ 21).

These few operations are quite sufficient to establish the nature of the substance under trial, since the absence of the more fixed metals is proved by the volatility of the substance on charcoal and in the open tube, and the absence of metals giving coatings by the purity of the antimony-coating. The presence of arsenic would have been betrayed by an alliaceous odor when heated on charcoal. The only substance which would have escaped detection by these operations is sulphide of mercury. In order to ascertain its presence or absence, we perform the operation given under "*Mercury*" in Chapter III.

The result giving an answer in the negative, the body was "sulphide of antimony."

2. The substance under examination is chromate of lead.

Examination in a matrass: } fuses and changes color, but gives
Examination in an open tube: } nothing volatile.

Examination on charcoal alone: fuses, gives small metallic globules, and deposits a coating which is lemon-yellow while hot, and sulphur-yellow when cold, indicative of lead (§ 23). It is always desirable to collect the metal to a large globule, and to study its physical properties. This end is best attained by mixing the substance with carbonate of soda and a little borax, and exposing the mixture to the reduction-flame on charcoal. In this particular case, a metallic button is obtained which