conditions proposed by Classen (see quotation above) should be modified to accord with facts, as stated by us, and with his own personal observation, as recorded in the *Ber. d. chem. Ges.* (1886), **19,** 325:

"Von *Wismuth* konnte das Quecksilber auf diese Weise nicht getrennt werden. Beide Metalle scheiden sich gleichzeitig aus der sauren Lösung aus."

CHEMICAL LABORATORY OF
THE UNIVERSITY OF PENNSYLVANIA.
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# THE ELECTROLYTIC SEPARATION OF COPPER FROM ANTIMONY.

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The separation of these two metals, in the electrolytic way, has long presented difficulties. These were first noticed by Wrightson (*Ztschr. anal. Chem.*, **15,** 297). Operating upon solutions containing 1.2075 per cent. of metallic copper and 0.280 per cent. to 0.800 per cent. of antimony, in the presence of twenty cc. of nitric acid of sp. gr. 1.21, and total dilution of 200 cc., he found that more or less antimony was precipitated together with the copper. Wrightson remarks, however, that in the presence of much less antimony (*e. g.*, in impure copper) it is possible to throw down the copper free from antimony. Classen corroborates this statement, and finds that the separation of copper and antimony may be made in a solution of the double oxalates (*Quantitative Analyse durch Elektrolyse*, dritte Auflage, p. 125), provided that the antimony content is very slight, and that the current is not permitted to act any longer than absolutely necessary for the complete deposition of the copper.

From the preceding statements it is manifest that a better, more certain, separation is desirable. In conjunction with Muhr (*J. Anal. Appl. Chem.*, **5,** 488) one of us (S) found that iron, cadmium, copper, nickel, and other metals could be completely precipitated from ammoniacal tartrate solutions. The iron carried down carbon with it; this was not the case with the other metals. Antimony, it was discovered, could also be deposited from an ammoniacal and alkaline tartrate solution quite rapidly, but after it had been converted into a higher oxide by means of bromine, and its solution then mixed with tartaric acid and ammonia sufficient to render it strongly alkaline it was no longer precipitated by the current. With this difference in behavior toward the current before us we combined copper and antimony solutions in the presence of tartaric acid and ammonia, then electrolyzed the same. The results we obtained show that the separation is possible and very satisfactory. We purposely varied the quantities of the two metals to render it certain that we could rely upon the method even under varying conditions.

| | Copper present in grams. | Antimony present in grams. | Current in cc. O-H gas per minute. | Total dilution, cc. | Copper found in grams. |
|---|---|---|---|---|---|
| 1. | 0.1341 | 0.1087 | 1.4 | 175 | 0.1341 |
| 2. | 0.1341 | 0.1449 | 1.4 | 175 | 0.1343 |
| 3. | 0.1341 | 0.2898 | 0.8 | 175 | 0.1344 |
| 4. | 0.1341 | 0.1449 | 1.0 | 175 | 0.1340 |
| 5. | 0.0134 | 0.1449 | 1.0 | 175 | 0.0142 |
| 6. | 0.0268 | 0.1449 | 1.0 | 175 | 0.0274 |
| 7. | 0.0670 | 0.1449 | 1.0 | 175 | 0.0670 |
| 8. | 0.1341 | 0.1449 | 1.0 | 175 | 0.1341 |
| 9. | 0.1341 | 0.1449 | 1.0 | 175 | 0.1341 |

The volume of ammonia present in each of these determinations equaled fifteen cc. (sp. gr. 0.932). The tartaric acid varied from three to four grams. The dishes in which the copper was precipitated ranged in weight from sixty to seventy grams. An examination of the deposited metal showed no antimony. It may be remarked that the strength of current maintained in these determinations was that indicated by the voltameter before the introduction of the electrolyte into the circuit of decomposition.

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