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WITH IX PLATES.

gave no indications of a separation of traces of sulphuric acid
under its action. It is to be remarked that this test is more
decisive than if a solution of sodium sulphate had been used
and had been tested afterwards. For in this last case, on re-
lease of the pressure, the reaction might readily be reversed
with recombination of sulphuric acid, had any been liberated.
But with the test liquid present during the pressure this re-
versal could not take place.

Carbonic anhydride, therefore, does not even under pressure,
set free any portion of sulphuric acid from sodic sulphate.

The reactions described in this paper indicate :

1st. That when to free sulphuric acid a salt is added in
sufficient quantity to cause the whole of the sulphuric acid to
saturate itself with the salt-base, it is possible by means of the
herapathite test to determine the exact point of such satura-
tion. At this point there will necessarily be as much of the
acid at first combined with the base, now free in the solution,
as corresponds to one molecule of a bibasic acid, that is two of
a monobasic acid, half a molecule of a quadrobasic acid, etc.
From this we can deduce the exact nature of the resulting
equilibrium.

2. That a series of equilibria thus obtained with different
salts, enables us to determine the comparative strength of the
affinities of the acids of those salts.

3. That the fact, already proved in other ways, that even
small quantities of weak acids, added to sulphates will set free
a certain quantity of sulphuric acid, can by means here given
be for the first time rendered visible to the eye by a well
marked chemical reaction.

ART. LVI.—*On Argyrodite and a new Sulphostannate of
Silver from Bolivia ;* by S. L. PENFIELD.

IN the August number of this Journal, 1893, page 107, the
author described as a new species a germanium mineral from
Bolivia, to which the name canfieldite was given. It was
shown that the mineral was identical with argyrodite in chem-
ical composition, but differed apparently in crystallization,
canfieldite being isometric while argyrodite was monoclinic,
according to the description of Weisbach.* The discovery of
the isometric mineral was communicated by letter to Professor
Weisbach, and soon after the publication of the author's article
a reply was received from him, in which it was stated that

* Jahrb. f. Min., 1886, ii, p. 67.

better crystals of the Freiberg argyrodite than those originally described had been examined, and the results had shown that they were isometric and tetrahedral. These conclusions have since been published.* The forms m and o of Weisbach† are regarded as the dodecahedron (110), f and k as the tetrahedron $x(\bar{1}11)$, $\frac{1}{2}$ and v as the negative pyramidal-tetrahedron $z(3\bar{1}1)$ — $\frac{3-3}{2}$. Argyrodite being isometric it is evident that the Bolivian mineral is not a new species and the name canfieldite is therefore withdrawn. For the sake of simplicity it is a satisfaction to have the Bolivian mineral identical with that from Freiberg, and it is regretted that the isometric character of argyrodite was not made known before the publication of the canfieldite paper. It was hoped that by the present time some definite information could be given concerning this new occurrence of argyrodite, but as yet no data have been received other than that it is a well known silver ore in the mines at Potosi.

There has also recently come into the authors possession, through the kindness of Mr. Wm. E. Hidden of New York, a specimen from La Paz, Bolivia, which was supposed to be argyrodite. Its total weight was a little over seven grams and it consisted of a few attached octahedrons, modified by dodecahedron planes, the largest crystal measuring 13^{mm} in axial diameter. The only visible impurity was a very little metallic silver in wire form, deposited in a few places on the outside of the crystals. The mineral is almost identical with argyrodite in all of its physical properties. The luster is brilliant metallic. Color black with the same bluish to purplish tone observed on argyrodite. The fracture is irregular to small conchoidal. Very brittle. Hardness 2½–3, specific gravity 6·276, that of argyrodite from Bolivia being 6·266. Heated before the blowpipe on charcoal at the tip of the blue cone the mineral fuses at about 2 and yields a coating of the mixed oxides of tin and germanium. This is white to grayish near the assay, tinged on the outer edges with yellow. By continued heating a globule of silver results but this is covered by a scale or coating of tin oxide. If the coating on the charcoal is scraped together and fused in the reducing flame with sodium carbonate globules of tin are formed. In the closed tube sulphur is given off and at a high temperature a slight deposit of germanium sulphide, which fuses to globules, is formed near the assay. In the open tube sulphur dioxide is given off but no sublimate is deposited.

The following method was adopted for the analysis. The mineral was oxidized by concentrated nitric acid and the excess

* Jahrb. f. Min., 1894, i, p. 98.
† Compare figure in Dana's Mineralogy, sixth edition, p. 150.

of the latter removed by evaporation. The residue after moistening with nitric acid was digested with boiling water for some time and the insoluble meta-stannic acid filtered off. This was transferred while still moist to a beaker and treated with strong ammonia into which hydrogen sulphide was conducted until the meta-stannic acid had gone into solution. A slight insoluble residue was filtered off at this point which contained about 0·10 per cent of tin and 0·40 per cent of silver. From the ammonium sulphide solution the tin was precipitated by addition of a little sulphuric acid and weighed as oxide. The filtrate from the stannic sulphide was evaporated and yielded a little germanium which had not been separated from the tin by the nitric acid treatment. In the original filtrate from the meta-stannic acid silver was precipitated by means of hydrochloric acid and weighed as chloride. The sulphur was next precipitated by barium nitrate, and after purifying by fusion with sodium carbonate weighed as barium sulphate. Before evaporating the filtrates hydrochloric acid and barium were removed by precipitation with silver nitrate and sulphuric acid. The excess of silver was finally removed by ammonium thiocyanate and the germanium obtained from the filtrate as described in a previous communication.* The results of the analysis are as follows :

		Ratio.		Theory for $Ag_8(SnGe)S_6$ where $Sn : Ge = 12 : 5$.
S	16·22	·507	5·92	16·56
Sn	6·94	·0589 ⎱ ·0842	0·98	7·18
Ge	1·82	·0253 ⎰		1·83
Ag	74·10	·686	8·00	74·43
Zn and Fe	·21			- - - -
	99·29			100·00

In this compound tin is undoubtedly isomorphous with germanium, and the two are present in about the proportion $12 : 5$. The ratio of $S : Sn + Ge : Ag$ in the analysis is very close to $6 : 1 : 8$, indicating that the formula is $Ag_8(SnGe)S_6$ or $4Ag_2S$. $(Sn . Ge)S_2$. The agreement between the theory and the analysis is satisfactory.

The only sulpho stannates thus far known to occur in nature are the rare species *stannite*, Cu_2S, FeS, SnS_2, *franckeite*, $5PbS$, Sb_2S_3, $2SnS_2$ and *plumbostannite* a mineral of doubtful composition containing Pb . Fe . Sb. and S, described by Raimondi.† Franckeite has recently been described by Stelzner‡ and in it Winkler was able to identify a small amount of ger-

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* This Journal, xlvi, p. 111, 1893.
† Zeitschr. Kryst., vi, p. 632, 1882.
‡ Jahrb. Min., 1893, II, p. 114.

manium, probably about 0·10 per cent. These authors call attention to the fact that since tin and germanium belong to the same chemical group they are isomorphous with one another and suggest the probability of finding in Bolivia a sulpho-stannate of silver isomorphous with argyrodite. The new mineral described in this article corresponds precisely to this idea. As the Freiberg argyrodite has been shown to be isometric, and the name *canfieldite* cannot therefore be applied to the germanium compound, it is proposed now to transfer the name to the new isomorphous tin compound. It is not probable that this will cause confusion as the name as at first applied was not long in use and has never been introduced into any of the text-books or systems of mineralogy, and especially as it is now transferred to a species which is very closely related, and should come next to argyrodite in a natural system of classification. It is probable that various mixtures of argyrodite Ag_8GeS_6 and the molecule Ag_8SnS_6 will be found and it would seem best to consider this latter as the canfieldite molecule, while the intermediate isomorphous mixtures would be called argyrodite or canfieldite, according as the germanium or the tin molecule predominated.

Regarding the crystallization of the argyrodite and canfieldite from Bolivia the specimens examined by the author, are apparently holohedral. The octahedron faces are equally developed and have the same luster. There is, however, on each of the dodecahedral faces of the canfieldite specimen a distinct furrow or slight depression running in the direction of the longest diagonal. This may indicate a twinning which has given rise to the apparently holohedral form, or the latter may of course have resulted from an equal development of positive and negative tetrahedrons.

Laboratory of Mineralogy and Petrography,
Sheffield Scientific School, New Haven, April, 1894.

ART. LVII.—*On the Damping of Bell-magnets and Ring-magnets by surrounding copper;* by ARTHUR KENDRICK.

THIS paper presents the results of some observations made by the writer at various times upon the damping of bell-magnets and ring-magnets in copper boxes with the view of ascertaining roughly the relations between magnetic moment, inertia moment, and size and shape of the surrounding copper.

The accompanying figures show at a glance the dimensions of the magnets and some of the boxes used. Figures 1, 3, 4 and 9 show vertical and horizontal sections, fig. 2, a horizontal