

the presence of radium in monazite sand. So the radio-activity of thorium from uranium-free minerals may be explained by the presence of radium in them.

In continuing the work on the activity of thorium we analyzed a mineral, or more properly speaking, a rock, from South America which yielded perfectly and initially inactive thorium. This rock possesses a grayish color, very similar to common slate.<sup>1</sup> It consists mostly of barium carbonate, containing a very small percentage of thoria.

Neither the barium nor the thorium in this rock shows any radio-activity. There are no  $\alpha$ -radiations given off, and barium within 140, thorium within 290 hours did not affect the photographic plate through black paper.<sup>2</sup> That our body is really thorium could be proved by the different reactions characteristic for this body: As, first, solubility of the oxalate in a hot solution of ammonium oxalate and reprecipitation of the oxalate after diluting and cooling; second, by precipitation with sodium thiosulphate, potassium iodate, fumaric acid, *m*-nitrobenzoic acid, and phenylhydrazine. The quantity of the body obtained was very small, so that we could not carry out a determination of the atomic weight. We are now occupied, however, in working with larger quantities of the rock and hope to be able soon to determine whether or not this new variety of thorium is of a simple elementary nature or capable of being resolved into the three constituents, berzelium, carolinium, and new thorium.

The important bearing these observations have on the very recent theories of radio-activity is apparent.

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## CONTRIBUTION FROM THE COMMITTEE ON UNIFORMITY IN TECHNICAL ANALYSIS, I.

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THE object of the present communication is to offer to American chemists a sketch of the reasons for the existence of the Committee on Uniformity in Technical Analysis and a statement of the policy by which it expects to be guided in seeking to remedy the present very unsatisfactory condition of analytical chemistry in at least some lines of work.

<sup>1</sup> We are indebted to Dr. Geo. C. Lee, of Philadelphia, for the material.

<sup>2</sup> Even after an exposure of 600 hours no effect upon the plate can be noted, as two subsequent experiments show.

The causes to which the committee owes its existence can best be made clear by a review of the work done by several committees in the lines of cement, copper slag and zinc ore analysis, with the coöperation of a large number of chemists throughout the country.

#### REVIEW OF PAST WORK.

In 1901, Mr. Clifford Richardson presented before the New York Section of the Society of Chemical Industry an address in which he showed the lamentable lack of agreement among different chemists in analyzing Portland cement. The result of his recommendations was the appointment of a committee of the Section to consider the subject of technical analysis, the first line of work taken up practically being that of the analysis of Portland cement and raw cement mixtures, by a subcommittee consisting of Messrs. Richardson, S. B. Newberry and H. A. Schaffer. The results of their labors have been made public in the *Journal of the Society of Chemical Industry*, 21, 12 and this Journal, 25, 1180. Discussions of and criticisms upon these reports have appeared at one time and another, notably in the *Journal of the Society of Chemical Industry*, 21, 830 and 1216, and this Journal, 26, 995; also *Cement and Engineering News*, 16, 37. Opinions differ as to the merits of the proposed analytical procedures, but the general effect of the sub-committee's work has been to greatly stimulate interest in the matter of cement analysis by the bad showing made, and to create a desire for greater uniformity in results. Owing to the wide publicity given to these reports, they will not be here discussed, though the extreme results rendered by the coöperating analysts will be reproduced farther on.

Inspired by his own experience, Mr. Thorn Smith, of Isabella Tennessee, had undertaken, independently of Mr. Richardson's committee and without knowledge of its operations, to ascertain the actual state of analysis with respect to copper slags, by enlisting the coöperation of a large number of chemists in the analysis of a sample prepared and distributed by himself. The results of this work were later placed in the hands of Mr. Richardson's general committee, and, as in the case of the cement analyses, a critical report was rendered at their request by Dr. Hillebrand, of the United States Geological Survey. This report has never

been published, though copies were placed in the hands of the chemists who had furnished analyses. The original analytical returns with comments by Mr. Thorn Smith, based on Dr. Hillebrand's report, appeared in the *Engineering and Mining Journal*, 75, 295, to which reference should be made for details. Certain data from this report will follow those relating to cements farther on.

Later, a sub-committee on zinc ore analysis was appointed, consisting of Mr. W. George Waring, of Webb City, Mo., and Mr. George C. Stone, of New York City. They distributed three samples of ore differing widely in character, and received more or less complete returns from forty-two chemists, on the basis of which the sub-committee has prepared a valuable report, which will receive attention in its proper place.

Meanwhile, for reasons which are not pertinent to this report, the central committee of the New York Section of the Society of Chemical Industry was dissolved, and the laudable aims which it sought to attain might have failed altogether of further pursuit had not the Council of the American Chemical Society directed the appointment of the present committee for the purpose of continuing the work begun by its predecessor in the other Society. The report on zinc ore analysis, above alluded to, is now in the hands of our committee, and Messrs. Waring and Stone will be continued as one of its sub-committees for the purpose of accumulating further data of an important character upon which to report at a later date.

In the first three of the following tables are presented briefly, for convenient reference, the extreme results reported by the chemists who cooperated with the former sub-committee on cement analysis and with Mr. Thorn Smith. They are followed by a detailed table of results reported by the zinc ore sub-committee and an abstract of certain features of that report. Greater space is devoted to this than to the other reports for the reason that it has not appeared in print and it is desirable that those who are engaged in the work of analysis be put in possession of the results of their fellows without further delay.

TABLE I.—EXTREME RESULTS ON (a) ORIGINAL CEMENT RAW-MIXTURE,  
(b) ORIGINAL FINISHED CEMENT.

	SiO <sub>2</sub>	Al <sub>2</sub> O <sub>3</sub> , Fe <sub>2</sub> O <sub>3</sub>	Al <sub>2</sub> O <sub>3</sub>	Fe <sub>2</sub> O <sub>3</sub>	CaO.	MgO.	SO <sub>3</sub>	Ign.
(a) { High....	15.75	8.50	6.64	2.73	41.92	2.14	....	....
(a) { Low ....	12.78	7.08	5.27	1.26	39.53	1.10	....	....
(b) { High....	21.56	11.36	8.20	3.76	64.30	3.15	1.71	3.20
(b) { Low ....	19.18	9.32	6.26	2.30	62.01	2.52	1.30	1.04

TABLE II.—EXTREME RESULTS ON SECOND SAMPLE OF (a) RAW MIXTURE,  
(b) CEMENT.

	SiO <sub>2</sub>	Al <sub>2</sub> O <sub>3</sub> , Fe <sub>2</sub> O <sub>3</sub>	Al <sub>2</sub> O <sub>3</sub>	Fe <sub>2</sub> O <sub>3</sub>	CaO.	MgO.	SO <sub>3</sub>	Ign.
(a) { High....	15.54	7.07	4.13	2.66	42.27	1.50	1.75	39.68
(a) { Low ....	12.10	4.20	2.36	1.14	40.21	0.62	1.42	35.15
(b) { High....	22.86	9.68	6.46	4.30	64.43	2.82	2.26	4.50
(b) { Low ....	20.50	8.36	4.88	2.26	62.14	0.95	1.38	0.98

It may be said with regard to the results of Table II that it was intended they should be arrived at according to a method suggested by the sub-committee on cement analysis, but they are in no way to be taken as a fair test of that method, for the reason that its provisions were adhered to by so few of the analysts. Nevertheless, notwithstanding the wide variations between extremes, a critical review of all the data showed that marked progress had been made in certain directions.

TABLE III.—EXTREMES ON COPPER SLAG BY NINETEEN ANALYSTS.

	SiO <sub>2</sub>	Fe.	Al <sub>2</sub> O <sub>3</sub>	CaO.	MgO.	Zn.	Mn.	Cu.	S.
High .....	35.15	32.20	7.16	13.53	3.21	4.25	1.53	0.46	1.98
Low .....	31.27	30.33	3.24	10.73	1.20	1.87	0.11	0.20	1.45

It may be added for these figures that they do not tell the whole truth. Only those have been included which it seemed worth while to consider in a general discussion of the causes of variation. Certain values, reported by one or two analysts, were omitted as not entitled to consideration, though included in the originally published tables.

DATA FROM UNPUBLISHED REPORT OF SUB-COMMITTEE ON ZINC ORE ANALYSIS.

TABLE IV.—ASSAYS OF ZINC ORES BY FORTY-TWO CHEMISTS.

	Sample A. <sup>1</sup>			Sample B. <sup>1</sup>			Sample C. <sup>1</sup>		
	Zn.	Method.	Fe.	Zn.	Method.	Fe.	Zn.	Method.	Fe.
1	59.06	3	2.28	17.96	3	20.63	31.47	3	11.06
2	58.64	7	2.38	17.42	7	19.99	31.97	7	10.74
	58.90	3	...	17.59	3	....	32.08	3	....
	59.73	3	...	18.21	3	....	32.50	3	....
3	57.10	3	2.96	17.70	3	20.52	28.90	3	10.40
4	57.65	3	2.61	18.81	3	20.76	32.81	3	....
5	57.83	3	2.67	18.10	3	20.92	32.13	3	10.92
6	57.52	4	2.86	38.15	4	18.04	38.77	4	11.02
7	59.13	4	...	39.22	4	....	37.95	4	....
8	58.37	4	2.30	18.90	6	18.80	31.30	5	10.60
9	58.47	4	2.80	18.65	6	19.50	31.39	5	10.90
10	57.90	1	2.10	13.00	1	19.90	30.90	1	15.00
11	58.40	4	2.40	18.40	6	20.60	31.80	5	11.00
12	57.80	7	3.26	17.80	7	21.42	31.00	7	12.51
	57.80	7	3.26	17.95	7	21.80	31.10	7	12.90
13	58.30	4	...	12.85	1	....	31.30	1	....
	58.35	4	...	16.90	6	....	31.80	5	....
	58.35	4	...	16.90	6	...	31.90	5	....
	....	...	...	17.80	8	....	32.80	5	....
	....	...	...	17.90	6	....	33.00	5	....
	....	...	...	18.20	7	....	33.20	5	....
14	58.30	4	...	17.90	6	....	33.00	5	....
15	58.30	1	...	12.87	1	....	31.60	1	....
	....	...	...	17.80	6	....	....	....	....
16	58.30	4	2.20	17.30	6	19.64	31.60	5	10.04
17	58.65	2	2.42	17.20	2	21.20	30.85	2	10.44
18	....	...	...	12.98	1	....	30.54	1	....
19	58.41	1	2.42	18.74	2	20.34	31.62	1	10.80
20	58.78	4	2.72	19.42	6	21.13	31.65	5	11.08
21	58.42	1	...	15.21		21.05	30.83	1	....
	....	...	...	16.23	7	21.92	....	....	....
22	58.35	4	2.64	16.94	6	20.40	31.25	5	10.29
23	56.03	2	2.30	15.60		19.55	30.28		10.60

<sup>1</sup> A. Blende from Joplin, Mo.

B. Oxidized ore from New Jersey, containing franklinite, willemite and zinc spinels.

C. Impure blende from Colorado.

Mr. Waring analyzed the ores and his results for the important constituents follow, those for zinc being the average by three methods, those for cadmium the mean of duplicate determinations.

	A.	B.	C.
Zn .....	58.25	18.16	31.48
Fe .....	2.38	20.36	10.77
Mn .....	....	9.37	....
Cd .....	0.34	....	0.016
Cu .....	0.08	....	6.92
Pb .....	1.82	....	13.80

	Sample A.			Sample B.			Sample C.		
	Zn.	Method	Fe.	Zn.	Method.	Fe.	Zn.	Method.	Fe.
24	59.79	4	3.23	17.60	6	20.75	30.77	5	13.03
	....		....	32.14	4	....	....		....
25	57.73	1	2.70	19.57	2	20.59	33.83	1	11.33
26	38.23	1	2.51	17.53	2	20.58	31.08	1	10.80
27	57.30	1	....	12.50	1	....	30.80	1	....
28	58.60	1	....	....		....	....		....
	58.00	1	....	....		....	....		....
29	58.50	4	2.50	13.00	1	20.80	32.40	5	8.40
30	50.80	1	2.50	12.53	1	20.05	31.40	1	11.45
	....		....	17.83	8	....	....		....
	..		....	18.11	6	....	....		..
31	57.73	7	....	18.24	7	....	32.41	7	....
	58.37	1	....	18.33	7	....	32.51	7	....
32	58.90	1	2.30	12.60	1	20.20	30.20	1	11.30
33	58.10	8	2.38	12.20	1	20.35	30.90	5	10.77
	58.25	4	....	12.73	1	....	31.28	8	....
	58.40	8	....	13.74	1	....	31.38	7	....
	58.40	4	....	17.53	2	....	....		....
	58.59	8	....	17.87	2	....	31.45	8	....
	....		....	....		....	31.51	8	....
	....		....	17.89	7	....	31.60	5	....
	....		....	17.95	6	....	....		....
	....		....	17.98	8	....	....		....
	....		....	18.09	8	....	....		....
	....		....	18.10	2	....	....		....
	....		....	18.15	8	....	....		....
	....		....	18.15	2	....	....		....
	....		....	18.24	7	....	....		....
	....		....	35.12	4	....	....		....
34	57.85	4	2.40	....		....	31.10	1	8.60
35	58.10	4	2.30	22.76	6	20.60	31.90	5	8.80
36	55.97	3	....	17.85	3	....	38.86	3	....
37	57.58	1	....	14.35	1	....	30.96	1	....
	58.47	7	....	18.21	7	....	31.53	7	....
38	58.03	4	2.77	17.99	7	20.14	31.09	7	11.47
39	59.72	3	2.38	18.22	3	19.89	32.54	3	10.74
40	57.50	4	2.40	23.30	6	20.29	30.90	5	10.71
41	57.85	3	....	....		....	....		....
42	59.12	1	....	14.73	1	....	31.16	1	....
High	59.73		3.26	39.22		21.92	38.86		15.00
Low	56.03		2.10	12.20		18.04	28.90		8.40

Of the forty-two chemists whose returns are listed above, "twenty-three are, or were, in zinc works, three in other works where zinc is frequently determined, eleven were commercial chem-

ists, most of whom make a specialty of zinc, and five were professors or instructors in colleges. The samples were sent to a number of other college men, all of whom either declined to analyze them or failed to report after repeated requests to do so."

After a brief discussion of the figures for iron, the authors say: "It is certainly not to the credit of the analysts that such enormous differences should exist in as simple a determination as iron," a conclusion which is fully in accord with those expressed by Dr. Hillebrand in his reports on the cement and copper slag analyses.

Naturally, the greater part of the report is devoted to the zinc figures. The methods used for determining zinc were numerous and are numbered in the table.

- 1.—Low's method (*Proc. Colo. Sci. Soc.*, 4, 179; this Journal, 22, 198).
- 2.—Hinman's modification of 1, using hydrochloric acid as the solvent (*School of Mines Quart.*, 14, 40; Furman's "Assaying," 4th ed., p. 207).
- 3.—Wintersteen's method, unpublished, but practically the same as Voigt's (*Ztschr. angew. Chem.*, 1889, p. 307), using citric acid for tartaric acid.
- 4.—The Joplin method, which is practically the Falberg method (*Ztschr. anal. Chem.*, 13, 379, and Waring in this Journal, 26, 20-22).
- 5.—This is 4, modified so as to remove copper by lead, or lead, copper and cadmium by aluminum or hydrogen sulphide (this Journal, 26, 23-24).
- 6.—Methods in which the iron is removed by ammonia, barium carbonate or as basic acetate, and the manganese by an oxidizing agent. The zinc usually titrated, but in some cases weighed. Copper in all cases removed (this Journal, 26, 23-24).
- 7.—Methods in which copper was separated, the iron precipitated as in 6, and the zinc by hydrogen sulphide from an acetic solution and then either weighed or titrated (Mahon: *Am. Chem. J.*, 4, 53).
- 8.—Waring's method (this Journal, 26, 26-27).

Upon tabulating the results for each sample separately by methods, the authors were able to discuss the data intelligently

and to draw certain conclusions, which will not now be reproduced, but reserved for a later report, after additional data have been accumulated with respect to method No. 8. The most superficial examination of these tables, which those interested can construct for themselves from the data of Table IV, will make it obvious that some of the methods in common use are not by any means of universal application.

## COMMENTS.

The showing of the Tables I to IV is ample demonstration that analytical chemistry, as ordinarily practiced, is anything but an exact branch of the chemical profession. Mr. Waring has furnished additional data from his own experience, to which nearly every chemist could add, showing the lack of agreement that is all too common, often leading to serious consequences, aside from the reflection cast upon the profession at large.

That this is a state of affairs not only of long standing, but long since discovered in certain lines of work, is sufficiently attested by the addresses, first of Dr. C. B. Dudley on the subjects of discrepancy in analysis, and standard methods for the analysis of iron and steel,<sup>1</sup> and secondly of Baron Hans Jüptner von Jonstorff.<sup>2</sup> Most of the causes underlying variations in results of different chemists have been very fully discussed by these gentlemen, and a perusal or reperusal of their papers and the discussions following them will be time well spent by most analysts. To repeat the substance of them here would lead too far. Suffice it to say that sources of error were pointed out besides the familiar ones of lack of uniformity in samples, poor quality of reagents, etc., or defects in the method or the chemist himself, such as the employment of different atomic weights. This last, while not a prolific source of error, may, as pointed out by Baron Jüptner, give rise at times to serious mistakes. That due to poor reagents will, in time, it is hoped, be lessened as a result of the work now being done by a committee of this Society, in coöperation with the National Bureau of Standards.

With samples of the kind represented by the analyses of Tables I to III, marked errors due to mechanical sorting of once homo-

<sup>1</sup> *Eng. Soc. Western Penna.*, September, 1892, and October, 1893; this Journal, **15**, 501 (1893).

<sup>2</sup> *J. Iron and Steel Inst.*, **49**, 80 (1896).



geneous materials must, from the very nature of those materials, be out of the question. Even with the zinc ores of Table IV the errors are of such a character as to render non-homogeneity, as well as most of the other ordinarily enumerated causes of error, quite inadequate as an explanation. There is a growing and seemingly well-grounded opinion, which has been given expression by Mr. Thorn Smith and the authors of the zinc report that our methods of teaching are largely accountable for the unsatisfactory state of affairs. There is abundant evidence in the mass of data accumulated by the several sub-committees referred to in support of this view, after making full allowance for the fact that with the best instruction not all students will make good chemists.

#### POLICY OF THE COMMITTEE.

In view of the facts set forth, this committee has adopted the following policy for the guidance of its work, a policy which is subject to change or expansion, as the need arises.

(1) To use every endeavor to impress upon chemists the necessity for such changes, either in methods of analysis or of manipulation, together with a control of the purity of reagents in use, as will make it possible to arrive at greater uniformity in the results of analyses made by different analysts.

(2) To determine whether the lack of uniformity is to be attributed to lack of proper instruction in our schools or to mere carelessness in manipulation, by inviting the coöperation of the instructors in analytical chemistry in the work, distributing among them standard material for analysis, the results of the analysis of which shall demonstrate the accuracy of the method taught by them.

(3) To test, in conjunction with the National Bureau of Standards, various methods, and determine their accuracy and suitability for general use.

It may be said in this connection that the hearty coöperation of the Bureau of Standards has been promised, contingent only on the appropriation by Congress of the funds needed to secure the help of competent chemists. Application for such an appropriation will be made at the coming session of Congress, and it is the desire of the Committee that friends of this movement use what influence they may possess to forward it. This may be

done, in part, by presenting in writing to the Director of the Bureau arguments in favor of coöperation, especially when strengthened by a clear statement of specific problems whose settlement may have commercial importance.

(4) To prepare samples of materials of different character whose exact composition shall have been determined by the most careful analyses of experts.

(5) To place such samples in the care of the National Bureau of Standards for preservation and distribution to persons desiring to test their methods of analysis or of manipulation, or to check the work of students or technical chemists employed in works.

(6) To invite the coöperation of persons interested in the analysis of any particular class of material, by the organization of sub-committees for the preparation and distribution of samples, the chairman of which shall be, for the time being, a member of the general committee and entitled to vote on the subject which his sub-committee has under consideration.

It will not be the policy of this Committee to commit the Society as a body to the endorsement of any methods as standard, but merely to recommend such as may be found satisfactory. Nor will the Committee intrude on fields of work that may be already well covered by existing organizations, such as the Society of Official Agricultural Chemists.

Suggestions as to modifications of the policy of the Committee, or criticisms of it, will be thankfully received.

W. F. HILLEBRAND, *Chairman*,  
CHAS. B. DUDLEY,  
H. N. STOKES,  
CLIFFORD RICHARDSON, *Secretary*.

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### NEW BOOKS.

THE INDUSTRIAL AND ARTISTIC TECHNOLOGY OF PAINT AND VARNISH. BY ALVAH HORTON SABIN, Chemist for Edward Smith & Co. New York: John Wiley & Sons. First edition. 1904. Octavo. vi + 372 pp. Price, \$3.00.

Prof. Sabin has brought together widely scattered notes and references to the early history of the linseed oil and varnish industry, which are not accessible to the general reader, together