Lead Content of the Hot Springs of Japan.

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The lead content of the hot springs of Japan was determined and it was found that some of the hot springs showed fairly high content of lead.

Methods of Analysis. For the determination of lead in the mineral springs, the following methods were adopted.

(a) *Dithizone-Polarographic Method.* Ammonium citrate is added to a suitable quantity (500 to 1000 ml.) of the mineral water, adjust

to *p*H 8.5 with ammonium hydroxide (5:95), and shake with successive 10 ml.-portions of the purified carbon tetrachloride solution of diphenylthiocarbazoné (dithizone). Wash the combined extracts with ammonium hydroxide (1:1000), run the carbon tetrachloride solution into a separating funnel, and shake with 6 N hydrochloric acid. Add 10 ml. of sodium chloride to the acid solution and evaporate to complete dryness. Dissolve the residue in 0.1 N potassium chloride solution and the total volume is made up to 10 ml. A part of the solution is brought to a small electrolysis vessel, freed from the air by a current of hydrogen, and then polarographically examined. Fig. 1 shows a calibration curve obtained from various heights of wave due to various amounts of lead salt in a solution which is 0.1 N with respect to potassium chloride freed from atmospheric oxygen.

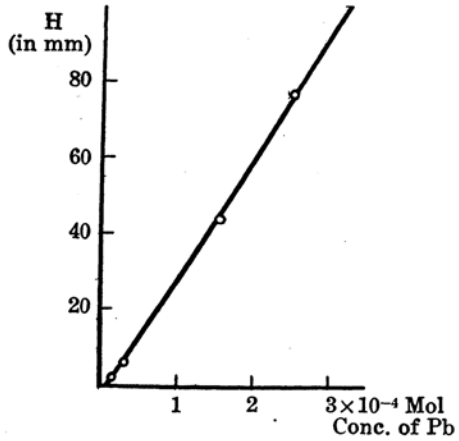

Fig. 1.

(b) *Dithizone Method.* Add 10 ml. of N ammonium citrate solution and 10 ml. of 10% potassium cyanide solution to a suitable quantity (250 ml. to 500 ml.) of the mineral water and render the solution distinctly alkaline with ammonium hydroxide (5:95). Add the purified carbon tetrachloride solution of diphenylthiocarbazone and shake in a separating funnel. Combine the carbon tetrachloride extracts and wash them with 1% potassium cyanide solution to remove excess of the reagent. Add 6 N hydrochloric acid, shake, and compare the green colour with that obtained with standard lead solution.

The efficacy of the method was tested by adding known amounts of standard lead solution to 500 ml. of water and submitting the solutions to the complete process of extraction and colorimetric determination; the results obtained are shown in Table 1.

Table 1.

Lead added (γ)	Lead found (γ)	Error (γ)
12.0	12.2	+0.2
10.0	10.0	0.0
8.0	7.4	−0.6
6.0	5.9	−0.1

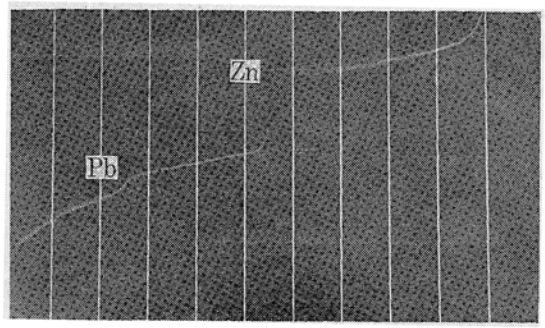

Fig. 2. The "waves" due to lead and zinc in the Monkawa hot spring. 0.1 N with respect to KCl. In the hydrogen atmosphere, sensitivity $\frac{1}{3}$, 4V accumulator. Curve starts at E.M.F. = 0.

Results. The results of the determinations of the lead content, mainly of the hot springs of Japan, are collected in Table 2.

Table 2. Lead Content of the Hot Springs of Japan.

No.	Hot Spring	Pb γ/l	% (in total residue)	Method of Analysis
1	Hon-Onsen, Arima, Hyōgo Prefecture.	62.4	0.00037	(b)
2	Katakosi-Yu, Arima, Hyōgo Prefecture.	35.2	0.00015	(b)
3	Mito, Sizuoka Prefecture.	11.4	0.00088	(b)
4	Nanasigure, Iwate Prefecture.	8.0	0.00006	(b)
5	Monkawa, Kanagawa Prefecture.	3.6 7.0	0.00001 0.00002	(b) (a)
6	Yoemon-Yu, Yunohana-zawa, Hakone, Kanagawa Prefecture.	14.0	0.00070	(a)
7	Sea Water, Yosihama.	2.4	0.000007	(b)
8	Tap Water of Tokyo.	4.0	0.0042	(b)

The radium content of the above-mentioned springs was determined by T. Nakai.(1) In the Arima hot spring which showed the highest lead content, fairly much quantity of radium was also found.(2) The average lead content of six samples was 22 γ per litre, or 0.00036% of the total residue. The presence of lead in sea water was detected by the dithizone method and the amount was estimated to be 2.4 γ per litre, but the determination by the polarographic method ended in failure.

Summary.

(1) The lead content of a number of hot springs in Japan was estimated by the dithizone method and the dithizone-polarographic method.

(2) The lead content of sea water was estimated.

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(1) *J. Chem. Soc. Japan*, **59** (1938), 1179.
(2) $65-71\times10^{-12}$ *g* Ra/l.