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A STUDY OF THE IODINE CONTENT
OF MISSOURI VEGETABLES AND SOILS

by

Charles Jackson Potter

A

THESIS

Submitted to the Faculty of the
SCHOOL OF MINES AND METALLURGY OF THE
UNIVERSITY OF MISSOURI
In partial fulfillment of the
work required for the degree of
MASTER OF SCIENCE IN CHEMICAL ENGINEERING
Rolla, Missouri
1930

Approved by W.T. Schrenks.

Professor of Chemistry

Foreword

The author wishes to express his utmost appreciation to Dr. W. T. Schrenk for the suggestion of this research and for the valuable advice and many suggestions offered during the course of the investigation.

The author also wishes to express his appreciation to Dr. H. A. Buehler and H. S. McQueen, of the Missouri Geological Survey, for their helpful suggestions.

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A STUDY OF THE IODINE CONTENT OF MISSOURI
VEGETABLES AND SOILS

Introduction

Investigations have shown that the iodine content of vegetables, water, and soils has a direct relationship to the goiter incidence of a given region. A few countries, notably New Zealand and Switzerland have made a rather complete survey. In the United States, South Carolina has made the most progress in this direction.

At the present time there are no available records of vegetable and soil analysis for iodine in Missouri. Hunze⁽¹⁾ determined the amount of iodine in waters in Missouri. The connection of his results with the author's results will be seen later.

The present investigation was carried out at the Missouri School of Mines in cooperation with the Missouri State Board of Health.

In the United States, J. F. McClendon and J. C. Hathaway⁽²⁾ made an iodine survey on a number of representative vegetables collected from various

parts of the country. With their results they divided the United States into definite regions regarding iodine distribution. In their survey Missouri was placed in

(1) School of Mines Thesis (1927)

(2) J. Am. Med. Ass'n. 82; 1668, (1924)

a region adjacent to the low iodine region.

McClendon and Hathaway arrived at the conclusion that there was an inverse ratio between iodine content and incidence of goiter in a given region, meaning that in a non-goitrous region there is a high iodine content and in a goitrous region there is a deficiency of iodine.

(3)
McClendon and Williams further proved this by showing that men coming from the low iodine regions had the greatest percentage of goiter. This was done on men drafted in the World War.

(4)
Remington in South Carolina has analyzed root and leafy vegetables and found large amounts of iodine.

(5)
Remington, Culp, and Von Kolnitz have used the potato as an index of iodine distribution with very good results. Potatoes were not used because

they contained large amounts of iodine, but because of their wide distribution. The authors show that the iodine is not a result of sea spray, but that the type of soils have a direct relationship to the iodine content. The larger quantities of iodine were found in a region of loam, granite and gneiss, while in clay and sand regions the iodine content falls off sharply. They suggest that the principal source of iodine in the disintegration of granite rocks.

(3) J. Am. Med. Ass'n. 80; 600-601, (1923)

(4) Science. 68; 590, (1928)

(5) J. Am. Chem. Soc. 51; 2942, (1929)

The Agricultural Experiment Station of Clemson College in South Carolina has analyzed a great number of soils and has found that the iodine content varies with the depth at which the soil was taken.

(6)
In New Zealand, Hercus, Benson, and Carter have shown the relation of endemic goiter to soil iodine. They definitely arrive at the conclusion that the incidence of the disease is inversely proportional to the amount of iodine in the soil, and have shown that where there is a deficiency of iodine

in the soils, there is a large amount of endemic goiter. This was first predicted by a goiter survey on men entering the World War from New Zealand. The prophylactic treatment of goiter in school children has shown that the best amount of iodine is one part of potassium iodide to two hundred thousand parts of sodium chloride, and is not enough to produce hyperthyroidism.

Hercus and Roberts⁽⁷⁾ show that loams have a property of retention of the soluble iodides, while in clays it is less, and in sands the property of retention is nil.

(6) J. of Hygiene. 34; 3 and 4 (1925)

(7) J. of Hygiene. 36; 1, (1927)

(8) Biochemische Zeitschrift, Band 139 (1923)

(9) J. Am. Med. Ass'n. 86; 1334-1338 (1926)

In Switzerland goiter presented a national problem, and the Swiss Goiter Commission was organized to study the relationship of iodine and goiter. The analyses were made by Th. von Fellenberg;⁽⁸⁾ and he showed that in a region of low iodine content there was a high incidence of goiter, and in regions of high iodine content there was little goiter. He also showed that an excess of iodine would produce

hyperthyroidism. In 1924 the Swiss Goiter Commission recognized this and prohibited the sale of salt that contained more than one part of potassium iodide in two hundred and fifty thousand parts of salt, and also prohibited the sale of the so called "goiter cures" which invariably contained excessive amounts of iodine.

In the United States Hartsock⁽⁹⁾ cites several cases of hyperthyroidism produced by the use of iodized salt in the state of Michigan. He states that in 1924, Michigan adopted a state law that all salt sold in Michigan should contain a certain amount of iodine, but the actual amount of iodine is not stated. As a result of this Hartsock condemns the use of iodized salt, which was iodized to the extent of one part of potassium iodide to five thousand parts of salt.

It is interesting to note that table salts that contain greater than one part of potassium iodide to two hundred thousand parts of salt are prohibited to be sold in New Zealand and Switzerland.

An analysis of two table salts sold in Missouri is shown in table I. It will be seen that the amount of iodine is in excess of that allowed by law in New Zealand and Switzerland. The manufacturers claim one part of KI in 5,000 parts of salt.

Table I.

Trade Name of Salt	Percent Iodine	Parts of KI in 200,000 parts of salt.
Colonial (10)	0.0118	30.8
Mortons (10)	0.0128	33.4
Mortons	0.0146	38.2

(10) Hunze, Mo. School of Mines: Thesis (1927)

All the reagents used in this work were examined for traces of iodine, and were found to be free from this element.

Iodine standards were prepared by subliming iodine from KI using sulphuric acid and potassium permanganate to liberate the iodine. This iodine was then sublimed from KI and dried in a dessicator over concentrated sulphuric acid. Weighed amounts of the dry iodine were dissolved in purified carbon tetrachloride and diluted to a known volume.

The carbon tetrachloride was purified by treating with bromine in the sunlight, washing out the excess bromine with NaOH and water, and distilling. The pure product was kept dry by adding a few grams of plaster of Paris to the solution.

As a check a $\text{Na}_2\text{S}_2\text{O}_3$ solution was standardized on a KMnO_4 solution which was standardized on a Bureau of Standards $\text{Na}_2\text{C}_2\text{O}_4$ sample. The KMnO_4 was added to a KI solution and the liberated iodine was titrated with the $\text{Na}_2\text{S}_2\text{O}_3$ solution. The Standard CCl_4 solution of iodine was then titrated with this same $\text{Na}_2\text{S}_2\text{O}_3$ and the iodine value of the CCl_4 solution calculated. Good checks were obtained.

Table II shows the strength of the solutions.

Table II.

Table of Standards

Direct Weighing gms/ml	Titration found gms/ml
.0000402	.0000404
.0001776	.0001778
.0000103	.0000103
.0000824	.0000830
.0001056	-----
.0000200	-----

Apparatus

For the preliminary drying of the vegetables an air dryer was used. This apparatus consisted of four horizontal trays, 36x36 inches, of Monel metal screen, enclosed in a wooden cabinet. Air was driven in through the bottom by the use of a small blower, the moist air leaving through small holes in the top of the cabinet.

The second drying was made in small electric ovens kept at a temperature of 78-82 degrees Centigrade.

In the preliminary ignition small heating units with variable temperature controls were used.

The final ignition was very important in that the temperature must not be allowed to go over 450°C. (11)

To secure these results an oven with a variable rheostat was used in conjunction with a Leeds and Northrup recording automatic temperature control apparatus. The thermocouple used was standardized on metals of known melting points. The temperature could be controlled within a range of 10°C. The

Maximum temperature was 450 and the minimum was 440°C. A test run was made on a blank sample and the recorder showed that the temperature did not vary between the above limits. The rheostat on the muffle was used to keep the temperature from exceeding 500°C. In case of a breakdown or excessive voltage on the instrument.

The centrifuge used was an ordinary high speed motor driven centrifuge. The micro-colorimeter was a Bausch and Lomb instrument having cups of one ml capacity.

To become familiar with the method, a series of known samples were prepared and their iodine content was determined. The summer of 1929 was spent in analyzing these and perfecting the procedure, along with the collecting samples. Table III shows some of the results that were encountered in the preliminary iodine determinations.

(11) Roe E. Remington, Personal Communication.

Table III.

Iodine added	Iodine found
.0000100	.0000103
.0000100	.0000102
.0000100	.0000097
.0000125	.0000120
.0000125	.0000118
.0000125	.0000119
.0000250	.0000235
.0000250	.0000220
.0000250	.0000219
.0000500	.0000477
.0000500	.0000492
.0000500	.0000490
.0001000	.0000920
.0001000	.0000905
.0001000	.0000896

Part A
Vegetable Analyses

In order to check the recovery of iodine from vegetables, a known amount of iodine was added to the ash of potatoes that had been previously extracted in order that there was no iodine present to affect the analysis.

In Table IV it will be seen that the iodine recovered checks the amount added within the limits of the expected error.

Dr. Roe E. Remington supplied a few samples of spinach of which he had determined the iodine content. The results of the analysis compared to his results can be seen in Table V.

In the summer of 1929 a few samples of potatoes were examined for their iodine content. The iodine content of these samples was from 600 P.P.B. to 8,000 P.P.B. of iodine. These results seemed to be a result of contamination; so all the reagents were tested for traces of iodine and none was found. It was thought that the source of contamination could have been in the drying. The air was analyzed for its iodine content and none was found. Then it was thought that the analysis might be in error. Dr. Roe E. Remington consented to analyze some of these

samples. He reported more iodine than was found by analysis in this laboratory. The direct cause for this abnormally large amount of iodine content was not established.

Table VI lists the values obtained.

Table IV.

Iodine added P.P.B.	Iodine recovered P.P.B.
219	238
100	98
100	92
50	50
109	96

Table V.

Remington	Potter
574	452
624	470
640	410

Table VI.

Vegetable	Iodine, P.P.B.
Beets	653
Potatoes	1,306
"	687
"	899
"	904
Carrots	1,771
Potatoes	2,030
Potatoes	1,838
"	1,996
"	2,397
Lettuce	8,344

Some of the samples were collected by the employees of the Missouri State Board of Health in the summer of 1929. The remainder were collected by C. J. Potter, P. H. Delano, and Dr. W. T. Schrenk in the spring and summer of 1930.

The vegetable samples were entirely potatoes. Potatoes were not selected because of their high or low iodent content, but because they were a staple food, widely distributed, and were easily obtainable.

The samples of vegetables were collected, washed, cut into fine slices, and were given a preliminary drying in the drying apparatus for 24 hours. The samples were then dried in an oven for 24 hours at 80°C. The vegetables at this point are very brittle and are pulverized in a mortar. The samples were then bottled until the chemical analysis was made.

A geological map will be found on the last page. The dots represent the place the soils and vegetables were collected from. The numbers by the dots represent the sample number.

The Analytical Method

Vegetables

The method of analysis is a modification of the method used by Remington⁽¹²⁾, and Hercus and Roberts⁽¹³⁾.

One hundred grams of the previously dried sample is weighed into a 115mm Coors evaporating dish, and heated over a small flame until the vegetable matter begins to smoulder. The heat is then withdrawn and the sample will continue to burn at low temperature, without flame. If it goes out it may be heated again until ignition starts. This is to be applied to all root and leafy vegetables which give an alkaline ash. If the sample is of a cereal grain (which gives an acid ash), it should be moistened with 100cc. of 1% sodium carbonate solution, dried and then ignited.

After the preliminary ignition, during which the sample will be completely converted into a black char, the dish is placed in a muffle and ignited at a temperature which must not exceed 450°C. until ashing is practically complete and the ash is light grey in color. It is not usually

practical to carry the ignition to complete whiteness of ash. This ignition in the muffle will require from 12 to 15 hours.

After ignition the dish is allowed to cool. The ash is light and fluffy and shows no tendency toward fusion.

Enough water to cover the ash is added and allowed to stand for fifteen minutes, with an occasional gentle stirring with a glass rod.

The liquid is decanted through a small ashless filter paper, the residue being retained in the dish. This procedure is then repeated.

The carbon residue is then burned and water added again as before.

(12) Personal communication

(13) J. of Hygiene, Vol. 36; No.1, (1927)

The filtrate is now evaporated to dryness and extracted three times with alcohol. The alcohol removes the soluble iodides and leaves the bulk of the inorganic material behind. The alcohol extract is evaporated to dryness in a platinum crucible, being careful to keep the temperature low.

The residue is now taken up with 0.36ml of water, 0.30ml of which is transferred to a small shaking out tube. A correction factor of one fifth must be made to allow for the 0.06 ml left in the platinum crucible.

To the solution in the shaking out tube a few small crystals of sodium nitrite is added and then the solution is acidified with dilute phosphoric acid (equal parts of syrupy phosphoric acid and water). The liberated iodine is then extracted with an observed volume of carbon tetrachloride and centrifuged. If the iodine liberated is below 20 P.P.B., 0.04 to 0.10 ml of carbon tetrachloride is used to extract the iodine. The amount of iodine is estimated by matching the color of the unknown with a standard sample. These standard samples are prepared by taking a known amount of a very dilute solution of KI and extracting the

iodine in the same manner as before, using the same amount of carbon tetrachloride.

But if the iodine content is greater than 20 P.P.B., 0.25 to 1.00 ml of carbon tetrachloride can be used and the color imparted to it may be matched in a micro-colorimeter, matching against a standard solution of iodine in carbon tetrachloride.

The results of the analysis are seen in Table VII.

Table VII.

Results of Vegetable Analysis

Sample No.	Iodine P.P.B., Less than 15			
8	"	"	"	"
9	"	"	"	"
10	"	"	"	"
11	"	"	"	"
12	"	"	"	"
13	"	"	"	"
14	"	"	"	"
15	"	"	"	"
16	"	"	"	"
17	"	"	"	"
18	"	"	"	"
19	"	"	"	"
20	"	"	"	"
21	20 P.P.B.			
22	P.P.B., Less than 15			
23	"	"	"	"
24	"	"	"	"
25	"	"	"	"
26	"	"	"	"
27	"	"	"	"

Table VII. Cont'd.

Results of Vegetable Analysis

Sample No.	Iodine P.P.B., Less than 15			
28	"	"	"	"
29	"	"	"	"
30	"	"	"	"
31	"	"	"	"
32	"	"	"	"
33	"	"	"	"
34	"	"	"	"
35	"	"	"	"
36	"	"	"	"
37	"	"	"	"
38	"	"	"	"
39	"	"	"	"
40	"	"	"	"
41	"	"	"	"
42	"	"	"	"
43	"	"	"	"
44	"	"	"	"
45	"	"	"	"
46	"	"	"	"
47	"	"	"	"

Table VII. Cont'd.

Results of Vegetable Analysis

Sample No.	Iodine P.P.B., Less than 15			
48	"	"	"	"
49	"	"	"	"
50	25	"		
51	"	"	"	"
52	"	"	"	"
53	"	"	"	"
54	"	"	"	"
55	"	"	"	"
56	"	"	"	"
57	25	"		
58	28	"		
59	"	"	"	"
60	"	"	"	"
61	"	"	"	"
62	"	"	"	"
63	"	"	"	"
64	"	"	"	"
65	"	"	"	"
66	"	"	"	"
67	"	"	"	"
68	24	"		

Table VII. Cont'd.

Results of Vegetable Analysis

Sample No.	Iodine P.P.B., Less than 15			
69	"	"	"	"
70	27	"		
71	"	"	"	"
72	"	"	"	"
73	"	"	"	"
74	"	"	"	"
75	"	"	"	"
76	"	"	"	"
77	"	"	"	"
78	"	"	"	"

In table VII it will be seen that the iodine content is tabulated as the minimum amount detectable accurately, which is 15 P. P. B. based on a dry, 100 gram sample. This was the least amount that would impart a definite color to the carbon tetrachloride where the volume of this substance was 0.10 ml. The author could detect 10 P. P. B. but feels that he is justified in reporting the analyses as stated above.

The low amount of iodine definitely places Missouri in a region adjacent to a low iodine belt or possibly in the low iodine belt.

In table VIII a comparison of the iodine content of vegetables of Missouri and some of the other states is shown. An average for Missouri is not justified, so no absolute number is used.

In table IX a comparison of the iodine content of waters, soils, and vegetables is shown. It is seen that there is not a definite relation between these, probably due to the fact that the waters are well waters and come from different geological systems.

Table VIII.

IODINE CONTENT OF VEGETABLES FROM GOITROUS AND
NON-GOITROUS REGIONS

Parts per billion of iodine, dry basis

	South Carolina (non-goitrous)	California (goitrous)	Oregon (goitrous)	Missouri (goitrous)
	Remington	McClendon	McClendon	Potter
Lettuce	761	--	--	--
Beets	227	8.0	--	--
Carrots	197	8.5	2.3	--
Potatoes	211	--	--	Less than 15

Table IX.

Iodine content, parts per billion

S'ple Potatoes		Soil	Water ⁽¹⁴⁾
No.			
44	Less than 15	36	0.0
36	" " "	228	0.67
43	" " "	10	1.14
54	" " "	154	1.34
51	" " "	106	1.68
77	" " "	84	7.40
57	25	149	.67
58	28	152	.67
63	Less than 15	360	.66

(14) Hunze, School of Mines Thesis (1927)

Part B
Soil Analyses

The Analytical Method

Soils

The soil is dried in an oven for 24 hours at a temperature of 80°C. 100 grams of soil are placed in a 3 inch evaporating dish and moistened with an 8% solution of sodium hydroxide. The solution is evaporated to dryness on the sand bath and then incinerated in a muffle at a temperature of 400°C. To this residue 30 ml of water is added, thoroughly macerated with a pestle, and allowed to stand for a few minutes, and then decanted through a 4 inch funnel. The residue is then extracted four more times with the same quantity of water, the filtrates combined, and allowed to evaporate to dryness on the sand bath.

The residue from this operation was then extracted four times with alcohol (recently distilled over sodium hydroxide) and filtered into a small platinum crucible. The iodides are taken up by the alcohol while the bulk of the other inorganic salts is left behind.

The alcohol extracts were carefully evaporated and incinerated below red heat.

The residue is now taken up with 0.36 ml. of water, 0.30 ml of which is transferred to a small shaking out tube. A correction of one fifth must be made to allow for the 0.06 ml of water left in the platinum crucible.

To the solution in the shaking out tube a few small crystals of sodium nitrite were added and the solution acidified with dilute phosphoric acid.

The liberated iodine is then extracted with an observed volume of carbon tetrachloride and centrifuged. (Since the iodine content of the soils is of a different order than that of vegetables, 0.25 to 1 ml of carbon tetrachloride is used to extract the liberated iodine).

The carbon tetrachloride is withdrawn from the solution by the use of a small capillary tube, and placed in one of the cups of a micro-colorimeter and compared with a standard solution of iodine dissolved in carbon tetrachloride.

The results of the analysis are seen in Table X.

Table X.

No.	Period	Formation	Iodine P.P.B.
30	Algonkian	Granite	344
32	Cambrian	Gasconade	278
33	"	Proctor	736
34	Algonkian	Granite	356
35	Cambrian	Gasconade	24
36	Tertiary	LaGrange	228
37	Cambrian	Proctor	115
39	Tertiary	LaGrange	89
41	"	"	26
42	Pleistocene	Alluvium	10
43	Tertiary	LaGrange	10
44	Pleistocene	Alluvium	36
45	Ordovician	Roubidoux	480
46	Ordovician	Jefferson City	119
47	Ordovician	Roubidoux	175
48	Cambrian	Gasconade	257
49	Ordovician	Roubidoux	74
50	Ordovician	Roubidoux	267
51	Ordovician	Jefferson City	106
52	Ordovician	Roubidoux	110
53	Ordovician	Jefferson City	240

Table X. Cont'd.

No.	Period	Formation	Iodine P.P.B.
54	Cambrian	Gasconade	154
55	Ordovician	Jefferson City	187
56	Ordovician	Roubidoux	161
57	Ordovician	Jefferson City	149
58	Ordovician	Jefferson City	152
59	Ordovician	Jefferson City	126
60	Mississippian	Burlington-Keokuk	396
61	Ordovician	Jefferson City	144
62	Ordovician	Jefferson City	150
63	Mississippian	Burlington-Keokuk	360
64	Mississippian	Burlington-Keokuk	350
65	Pennsylvania	Cherokee	293
66	Pennsylvania	Cherokee	155
67	Pennsylvania	Warrensburg-Moberly	399
68	Pennsylvania	Pleasanton	121
69	Pennsylvania	Pleasanton	153
70	Pennsylvania	Lansing	34
71	Pennsylvania	Douglas	360
72	Pennsylvania	Douglas	293
73	Pennsylvania	Lansing	286
74	Pennsylvania	Cherokee	160

Table X. Cont'd.

No.	Period	Formation	Iodine P.P.B.
75	Pennsylvania	Cherokee	132
76	Pennsylvania	Cherokee	144
77	Pennsylvania	Cherokee	84
78	Pennsylvania	Cherokee	94

Soils

A classification of the soils will be seen in Table XI in which the age of the underlying beds is used as an important factor. The oldest system is the Algonkian, which is composed of igneous rocks, chiefly granite and porphyry. The granite and porphyry consist chiefly of quartz and feldspar. The iodine content of soils overlying this system is relatively high.

In the Cambrian age, the iodine content decreased slightly. The Cambrian is composed of several formations. However, all of this age encountered were of the Gasconade formation, which consists of a comparatively thin basal sandstone, known as the Gunter member, and a thicker dolomite member. The Gunter member ranges from a fine to coarse grained, friable sandstone with well rounded and frosted grains. The dolomite member is a very cherty, crystalline dolomite.

The overlying soils of the Ordovician age show a decrease in iodine content. This system is composed of several formations, but the soils studied overlies the Roubidoux and the Jefferson City

formation. The Roubidoux which underlies the Jefferson City is composed of sandstone and dolomite. The latter is common and varies from a coarse granular to a fine argillaceous "cotton rock" or denser magnesium dolomite. Dolomite makes up the greater part of the Jefferson City, and varies from very coarse crystalline to a fine "cotton rock". The Jefferson City represents a shallow water deposition.

Soil samples were also obtained from areas underlain by the Burlington-Keokuk formations of the Mississippian age. These formations are represented by a comparatively thick series of cherty limestones. This system is entirely marine and is a result of deep water deposition. The iodine content of the soils underlain by this system increased and exceeded the iodine content of the soils underlain by the older system, the Cambrian.

The Pennsylvanian system is chiefly composed of shales, with small amounts of limestone and sandstone and beds of coal. The iodine content of the soils underlain by this system is about the same as the iodine content of soils underlain by the Ordovician.

The Tertiary and the Pliocene are composed

almost entirely of sand, gravel, and clays, and were laid down in comparatively recent times. The iodine content of soils underlain by rocks of these ages is very small.

As shown by analyses the Algonkian contains much iodine, relatively speaking. Remington⁽¹⁵⁾ and Fellenberg⁽¹⁶⁾ believed that iodine was liberated in the disintegration of granite rocks. This is possibly true, however the highest iodine content was found in soils underlain by limestones of the Mississippian age. This may be explained by the fact that life was more abundant, and conditions more favorable for growth and development of organic matter in the seas in which they were laid down, than in the seas in which the rocks of the other periods were deposited.

The Pennsylvanian rocks probably had a source of iodine similar to those of the Mississippian age. However the wide range in the amounts of iodine may be due to the varying conditions of deposition which ranged from fresh to highly saline waters.

Gautier⁽¹⁷⁾ found iodine only in the organic matter that was filtered off from water in the Mediterranean. At the surface, and at great depths he found more iodine. F.W. Clarke⁽¹⁸⁾ says living

organisms withdraw iodine from the solutions. This would tend to show the variations in the Pennsylvanian and in the Mississippian age.

The soils overlying the comparatively recent Tertiary and Pleistocene ages have very little iodine. This is expected for these deposits are of fresh water origin.

(15) J. Am. Chem. Soc. 51. 2492; (1929)

(16) Biochemische Zeitschrift, Band 139 (1926)

(17) Compt. Rend., Vol.128, (1899)

(18) U.S.G.S. Bulletin 770, 122; (1924)

Table XI.

Period	Iodine P.P.B.
Algonkian	344
<u>Algonkian</u>	<u>356</u>
Average	350
Cambrian	278
Cambrian	736
Cambrian	24
Cambrian	115
Cambrian	257
<u>Cambrian</u>	<u>154</u>
Average	261

Table XI. Cont'd.

Period	Iodine P.P.B.
Ordovician	480
Ordovician	119
Ordovician	175
Ordovician	74
Ordovician	267
Ordovician	106
Ordovician	110
Ordovician	240
Ordovician	187
Ordovician	161
Ordovician	149
Ordovician	152
Ordovician	126
Ordovician	144
<u>Ordovician</u>	<u>150</u>
Average	177

The older formation, the Roubidoux, shows an average of 213 P.P.B.; while the younger, the Jefferson City, shows an average of 153 P.P.B.

Table XI. Cont'd.

Period	Iodine P.P.B.
Mississippian	396
Mississippian	360
<u>Mississippian</u>	<u>350</u>
Average	369
Pennsylvanian	293
Pennsylvanian	155
Pennsylvanian	399
Pennsylvanian	121
Pennsylvanian	153
Pennsylvanian	34
Pennsylvanian	360
Pennsylvanian	293
Pennsylvanian	286
Pennsylvanian	169
Pennsylvanian	132
Pennsylvanian	144
Pennsylvanian	89
<u>Pennsylvanian</u>	<u>94</u>
Average	186

Table XI. Cont'd.

Period	Iodine P.P.B.
Tertiary	228
Tertiary	89
Tertiary	26
<u>Tertiary</u>	<u>10</u>
Average	88
Pleistocene	10
<u>Pleistocene</u>	<u>36</u>
Average	23

Table XI-A shows a graphical plot of the iodine content of the soils underlain by the respective ages of the rocks. The abrupt change in iodine content of the marine Mississippian deposits in relation to the other deposits is easily seen.

Table XII shows that an average iodine content of 165 P.P.B. is found in soils north of the Missouri River, in an area underlain by varying formations of the Pennsylvanian age.

Table XIII shows that an average of 218 P.P.B. of iodine is found in the soils south of the Missouri River to Rolla. These soils are underlain by rocks of the Pennsylvanian, the Mississippian and the Ordovician ages.

Table XIV shows that an average of 185 P.P.B. of iodine is found in Southeast Missouri, extending north and west to Rolla. In this region the soil samples were taken from all the systems discussed.

TABLE ELEVEN A

Curve Showing Relation of Amount of Iodine to Age of Rocks Underlying Soil.

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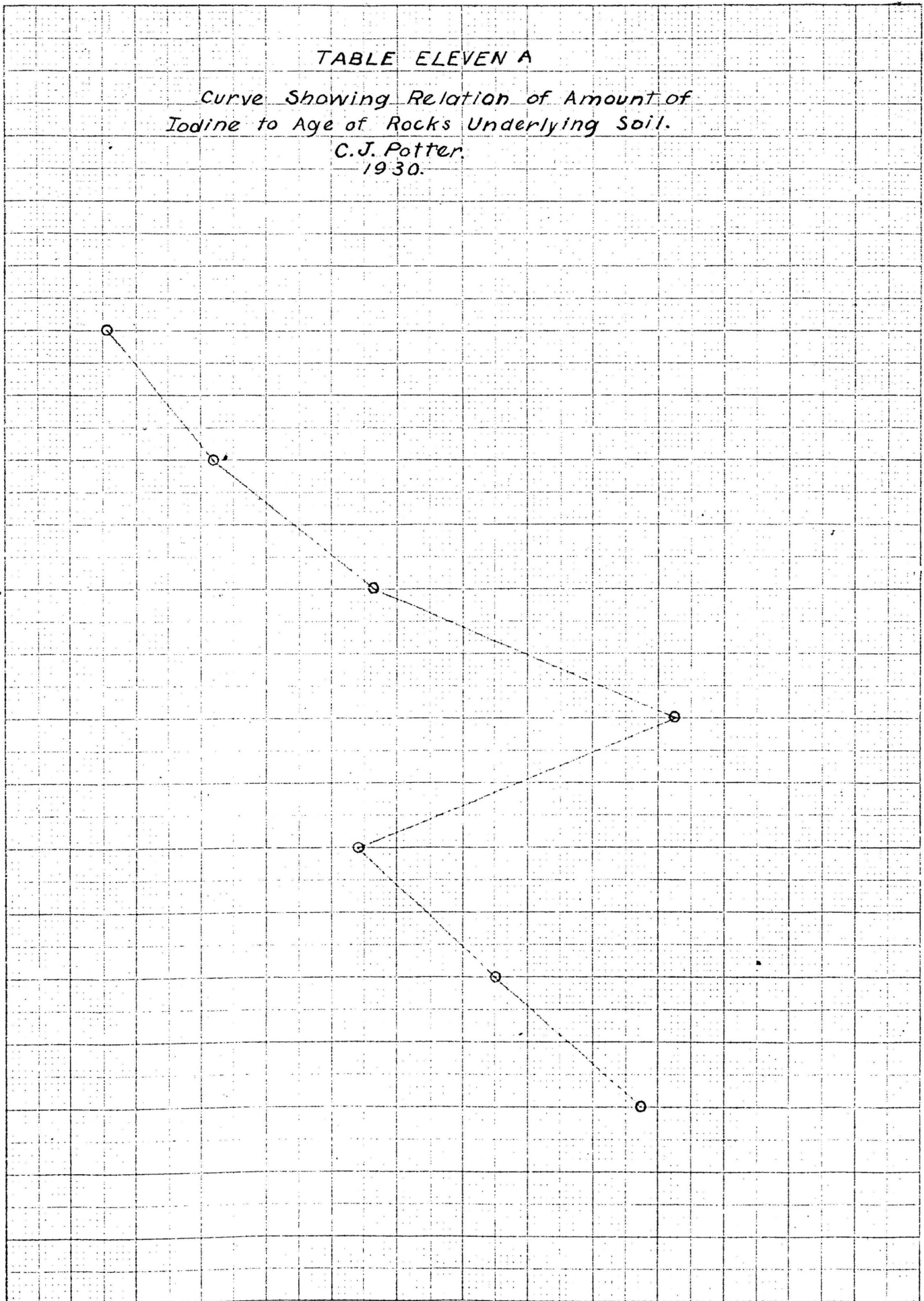


Table XII.

North of Missouri River

Iodine P.P.B.

94

84

144

132

160

286

293

360

34

Average North of Missouri River, 165 P.P.B.

Table XIII

South of Missouri River to Rolla

Iodine P.P.B.

153

121

399

155

293

350

350

150

144

396

126

152

149

161

187

Average, 218 P.P.B.

Table XIV
SOUTHEAST MISSOURI

Iodine P.P.B.

154

240

110

106

267

74

257

175

119

480

36

10

10

26

89

115

228

24

736

278

344

Average of Southeast Missouri, 185 P.P.B.

Summary

1. Samples of potatoes and soils from certain counties of Missouri have been analyzed for their iodine content.
2. The maximum amount of iodine found in any sample of potatoes was 28 P.P.B.; the most of the samples showed an iodine content of less than 15 P.P.B. of iodine.
3. The iodine content of potatoes grown in Missouri is low as compared to the iodine content of potatoes grown in South Carolina.
4. The ratio of the amount of iodine in potatoes to the amount of iodine in soils is roughly 1 to 100.
5. A greater variation was found in the iodine content in the soils than in the samples of potatoes obtained. This is probably explained by a variation in the geological system underlying the soil samples obtained.
6. Soils overlying the Algonkian and the Mississippian systems showed the greater iodine content.
7. The results of the analyses of potatoes and soils indicate that Missouri should be considered a region of low iodine content.

General Iodine Bibliography

1. Goiter and the Public Water Supply. H.M. Johnson
Jour. Am. W.W. Ass'n., 16; 205, (1926)
2. Goiter and Drinking Water. J.A. Goodfellow
Municipal Engineering, 75; 526, (1925)
3. The Prevalence of Simple Goiter and its Relationship
to Iodine Content of Water and Foods. J.F. McClendon
Jour. Am. W.W. Ass'n., 15; 222, (1926)
4. Chicago Menaced with Goiter. Anonymous
Chicago Dep't. of Health Bulletin, 17; #34
August 25, 1923.
5. Occurrence of Iodine in Nature. Th. von Fellenburg
Mitt. Leben. Hyg. 14; 161, (1923)
6. Iodine in the Treatment of Goiter. S.P. Beebe
Med. Record. 99; 996, (1921)
7. Iodine Deficiency in the Diet Supplied by the Use
of Kelp. J.W. Turrentine
J. Am. W.W. Ass'n., 16; 205, (1926)
8. Goiter and Drinking Water. G.M. Flood
Water and Water Engineering. 27; 54, (1925)
9. Relation Between Water Supply and Goiter. Mayo Tolman
Eng. News Record. 83; 516, (1919)
10. Iodine Content of the Human Thyroid. E. Zuna
Physical Abstracts. A; 338, (1919)

11. World Supply of Iodine in Relation to Goiter.
Science, 56; 269, (1922) J.F. McClendon
12. Determination of Iodine in Ferrus Iodide Pills.
Pharm. Weekblad. 59; 995, (1922) L.M. Lansberg
13. Iodine Content of Thyroid. E. Herzfeld and
R. Klinger
Jour. Am. Med. Ass'n., 79; 1005, (1922)
14. Simple Method for the Administration of Iodides
in the Food in Goitrous Regions. Herschfelder
Jour. Am. Med. Ass'n. 79; 1476, (1922)
15. Iodine in Natural Water in Relation to Goiter.
Jour. Biol. Chem., 55; 8, (1923) J.F. McClendon
16. Iodine Treatment of Water for Prevention of Goiter.
Eng. News Record. 90; 964, (1923) B.C. Little
17. Iodine Treatment of the Rochester Water Supply.
Jour. Am. W.W. Ass'n., 12; 68, (1924) B.C. Little
18. The Connection between Goiter and Low Iodine
Content of the Blood. B.C.P. Jansen
Nederland, Tijdschr, Geneeskinde., 68; 348, (1924)
19. Use of Sea Weed in the Prevention and Treatment
of Goiter. J.W. Turrentine
Endocrinology, 8; 409, (1924)
20. Use and Abuse of Iodine. D. Graham
Can. Med. Ass'n. J. 14; 821, (1924)

21. Iodine and Water Supplies. H.W. Clark
W.W. Ass'n. 65; 1-44
22. Relation between the Frequency of Goiter and the
Iodine Content of the Environment. Th.von Fellenberg
Biochem. Zeitschrift. 152; 132, (1924)
23. The Inverse Relation between Iodine and Goiter
In Utah. J.C. Hathaway
Proc. Soc. Expt'l. Biol.Med. 22; 183, (1924)
24. Effect of Administration of Iodine on Exapthalmic
Goiter. A.S. Jackson
Ann. Surg. 81; 730, (1925)
25. Use of Iodine in Exapthalmic Goiter. W.H. Brothby
Endocrinology, 8; 727, (1925)
26. Inverse Relation of Iodine in Food and Water,
and Goiter. J.F. McClendon and
Hathaway
Jour. Am. Med. Ass'n. 88; 21, 1668
27. The Determination of Traces of Iodine in Vegetables.
J.F. McClendon, Roe E. Remington
Jour. Am. Chem. Soc. 51; 394, (1929)
28. The Potato as an Index of Iodine Distribution.
Roe E. Remington, F.B. Culp,
Jour. Am. Chem. Soc. 51; 2942, (1929) H. von Kolnitz

29. Prevention of Simple Goiter. O.P. Kimball
Am.Jour.Public Health, Vol. XIII, No.2, p.81, (1923)
30. Goiter and the Public Water Supply. H.M. Johnson
Jour.Am.W.W. Ass'n. Vol.16, No. 2, p.205, (1926)