

[CONTRIBUTION FROM THE COOK COUNTY CORONER'S LABORATORY.]

THE RETENTION OF ARSENIC IN THE ORGANS.

By WM. D. McNALLY.

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The number of cases of arsenical poisoning in which most of the organs of the human body have been examined is not large. The following cases of acute and chronic poisoning, I believe, will make a welcome addition to the literature on the retention of arsenic in the human system:

De L., died Aug. 1, 1913. Nine days after death the body was exhumed and the stomach, stomach contents, liver, both kidneys, part of lung, pancreas, parts of the small and large intestines, heart, and brain were removed.

The deceased died $4\frac{1}{2}$ hours after taking an unknown quantity of some form of arsenic, and had successfully resisted all efforts of the physicians called to evacuate the stomach.

The body, with the exception of the brain, was in a fair state of preservation, the casket was dry and the earth surrounding it was also dry, so there was no chance of arsenic entering the body from external sources.

The organs were ground separately in a meat chopper, mixed thoroughly, and part of this sample used for analysis. The chopper was thoroughly cleansed before each organ was hashed. The intestines were practically empty.

The stomach walls, stomach contents, liver, intestines, lung, pancreas and heart were digested by the process of Fresenius and von Babo¹ and the arsenic estimated as the sulfide. The other samples were analyzed according to Chittenden and Donaldson's modification of Gautier's method.² The liver and stomach walls were analyzed by both methods and the results were comparable.

	Arsenic found.	Equivalent in As ₂ O ₃ .
100 g. of stomach walls.....	0.0249 g.	0.0328 g.
104 g. of stomach contents.....	0.8926 g.	1.1782 g.
100 g. of liver.....	0.0144 g.	0.0191 g.
100 g. of small intestines.....	0.0134 g.	0.0176 g.
100 g. of large intestines.....	0.0262 g.	0.0345 g.
100 g. of left kidney.....	0.0093 g.	0.0122 g.
100 g. of right kidney.....	0.0082 g.	0.0108 g.
100 g. of heart.....	0.0065 g.	0.0085 g.
100 g. of pancreas.....	0.0095 g.	0.0125 g.
100 g. of lung.....	0.0021 g.	0.0027 g.
100 g. of gall bladder.....	0.0042 g.	0.0055 g.
(10 g. of gall bladder used for sample results calculated to a 100 g. basis)		
100 g. of esophagus.....	0.0170 g.	0.0224 g.
(40 g. used for a sample, results calculated to a 100 g. basis)		
100 g. of brain.....	0.0002 g.	0.00026 g.

¹ Process of Fresenius and von Babo, "Text-Book of Legal Medicine and Toxicology," Peterson & Haines, Vol. II, p. 324, 1907 ed.

² Chittenden and Donaldson, *Am. Chem. J.*, 2, 235 (1880-1881).

The preceding table shows the amount of arsenic found in the organs examined. This, of course, represents only a portion of the total amount contained in the body.

From the above table it will be seen that per 100 g. of tissue, the stomach, large intestines and liver contained the largest amounts, respectively, in the order named. The left kidney contained more arsenic than the right kidney. The brain contained the smallest amount of any of the organs examined.

The second case which I have to report is that of E. L. B., male, age 27 years, of previous good health, who died on Sept. 26, 1914, after an illness of three weeks. From the history obtained he had been given at least two doses of arsenic, the first on Sept. 5th, and the second on Sept. 16th. He died ten days later. The first dose caused vomiting and diarrhoea, for two days, with an increasing numbness in the lower extremities. The man was not confined to his bed but was incapacitated for work. On Sept. 16th, the patient was able to walk to the office of the attending physician who was treating him for a neuritis. At this time he complained that the medicine prescribed (tonics) was not helping his condition and that the numbness was increasing. On Sept. 18th, the patient was unable to walk. On Sept. 21st, the legs and arms were tender to the touch and the reflexes (patellar and radial) were absent. On Sept. 22nd, there was a repetition of the vomiting and writhing. On Sept. 24th, the patient was constipated, vomiting had ceased. The patient appeared as if under the influence of an opiate. The voice became hoarse and husky. Complete paralysis of the lower limbs and the left arm followed by an increasing general weakness.

The patient died on Sept. 26th. The clinical diagnosis was "acute Landry's paralysis, neuritis, and gastritis."

A post-mortem examination of the principal organs of the head, neck, and trunk, failed to show gross changes to account for death. The analysis of the organs submitted 18 hrs. after death gave the data in the following table:

100 g. of tissue.	Arsenic found in g.	Equivalent in As_2O_3 per 100 g. of tissue.
Spinal cord (52.8 g.).....	0.0011	0.00275
Blood.....	0.0005	0.00066
Stomach walls.....	0.0005	0.00066
Stomach contents.....	0.0005	0.00066
Kidney.....	0.0016	0.00211
Spleen (123 g.).....	0.0013	0.00171
Liver.....	0.0013	0.00171
Urine (61.8 g.).....	0.0017	0.00363

100 g. of sample were used except in the instances indicated (the arsenic found in the cord, spleen and urine was calculated to As_2O_3 on a 100 g. basis). The kidneys weighing 439 g. were hashed as one sample. The

liver weighed 1747 g., the stomach 350 g., the stomach contents 200 g. The samples were analyzed according to the Chittenden and Donaldson's modification of Gautier's method.

From a study of the above data it will be seen that the distribution of arsenic is more nearly equal in cases of long duration than those which are more rapidly fatal. More arsenic was found, per 100 g. of tissue, in the cord than in the liver. In a number of cases of acute arsenical poisoning that I have examined, only a trace of arsenic was found in the cord. In the case reported by Scolosuboff,¹ the brain contained 8.85 mg. of arsenic, and the cord 9.33 mg. per 100 g. of tissue. Garnier² reports that the brain contained more arsenic than the liver, in two cases of patients who died of tuberculosis, while under treatment with Fowler's solution. In a third case similarly treated the chemical findings were the reverse.

Clinically, the case of E. L. B., here reported, is a typical arsenical poisoning. The symptoms may be classified under four groups:

- (1) A period of digestive disturbances, vomiting, diarrhoea followed by constipation.
- (2) A hoarse, husky voice as if suffering from a cold.
- (3) Headache, numbness in the legs, feet and arm, great tenderness on pressure of the muscles of the legs and arms.
- (4) The last period of increased muscular feebleness, complete paralysis, and death.

CHICAGO, ILL.

[CONTRIBUTION FROM THE ROCKEFELLER INSTITUTE FOR MEDICAL RESEARCH.]

THE CHEMICAL INDIVIDUALITY OF TISSUE ELEMENTS AND ITS BIOLOGICAL SIGNIFICANCE.³

By P. A. LEVENE.

Received February 1, 1917.

The principal address of this morning is to deal with the discoveries made in one of those chapters of chemistry, which is fascinating in itself and fascinating because it touches on life, on vital forces, on vitalism, if you choose to so designate them. Evidently the riddle of life still engages the attention of scientists other than biologists; and I presume that it is expected of me to lay before you the contributions made by biological chemistry towards the solution of this problem.

¹ Scolosuboff, *Bull. soc. chim.*, [2] 24, 124 (1875).

Fed a dog 5-15 mg. of sodium arsenite daily for 34 days.

Found in 100 g. of muscle.....	0.25 mg. of arsenic
Found in 100 g. of liver.....	2.71 mg. of arsenic
Found in 100 g. of brain.....	8.85 mg. of arsenic
Found in 100 g. of cord.....	9.33 mg. of arsenic

² Garnier, "These," Nancy, 1880, No. 107, p. 47.

³ An address presented at the meeting of the Chemical Section of the A. A. A. S. in New York, December, 1916.