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On the Presence of Aluminum in Blood.

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The question of the absorption of aluminum by the blood and its presence in other body tissues is one of considerable interest. A few figures have been reported for the dog, but they possess little value for the reason that the methods used were inadequate to estimate the very small amounts of aluminum found.

Several very delicate color reactions for aluminum have recently been described. After considerable effort we have been able to utilize one of these reactions, that with aurin described by Hammett and Sottery,[1] for the estimation of small amounts of aluminum in biological material containing iron. Since the amounts of iron left by the ordinary means of separation give a color very similar to that of aluminum, it must be removed more completely. The presence of iron has, however, been utilized to advantage in carrying down aluminum in the first precipitation. For this reason it is necessary to add iron when it is absent.

The method employed for blood is carried out briefly as follows: 5 cc. of blood are digested in a large Pyrex test tube over a micro burner with 2 cc. of sulfuric acid and 3 cc. of perchloric acid, until oxidation is complete. This requires less than 15 minutes.

The digestion mixture is diluted with a little distilled water and transferred quantitatively with washing to a smaller Pyrex test tube, the volume being made up to about 15 cc. One cc. of saturated ammonium acetate is now added and the solution made alkaline with conc. ammonium hydroxide. The tube is placed in a vigorously boiling water bath until the excess of ammonia is expelled. The

precipitate, which at first has a tendency to rise, will settle out on shaking. Centrifuge and decant, testing the supernatant fluid with aurin for complete precipitation of aluminum. Dissolve the precipitate in 1 cc. of 6 N hydrochloric acid and dilute with 10 cc. of water, add 1 cc. or glacial acetic acid and 5 cc. of 6 N sodium hydroxide (prepared from metallic sodium), mix and let stand 30 minutes. Throw down the iron precipitate in a centrifuge and decant into a Nessler tube graduated at 50 cc., add 2 cc. of 6 N hydrochloric acid and 1 cc. of glacial acetic acid. Dilute to about 38 cc. with water and add 5 cc. of a 1 per cent solution of the ammonium salt of aurin tricarboxylic acid. Let stand 10 minutes and add 5 cc. or a slight excess of 10 per cent ammonium carbonate in ammonium hydroxide (1 to 2). Make up to 50 cc. Compare against standards of 0.01, 0.02, 0.03, etc., mg. of aluminum containing 3 cc. of 6 N hydrochloric acid, 5 cc. of 6 N sodium hydroxide and 2 cc. of glacial acetic acid. Dilute the standards and develop the color the same as for the unknown.

Analyses have been made on the blood of 13 miscellaneous hospital cases. Repeated analyses have also been carried out on pig's blood. In all instances the amount of aluminum was less than 0.2 mg. per 100 cc. When larger quantities of blood (10 to 30 cc.) were used the results appeared to be somewhat lower. Excellent recoveries of added aluminum have been obtained.

This is a preliminary report.

[1]Hammett, L. P., and Sottery, C. T., *J. Am. Chem. Soc.*, 1925, xlvii, 142.

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Respiratory Function of the Swimbladder in Lepidosteus.*

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Many investigators have contributed evidence pointing to the probable origin of air-breathing vertebrates from certain physostomous fishes, which apparently have some organ capable of supplementing respiration in times of need. Certain Ganoids and Dipnoians have been credited with this transition of vertebrates from water to land.

* This work was done under the supervision of Dr. Frank A. Stromsten.