

The above experiments would appear to indicate that *B. tuberculosis* infection in mice deprived of vitamin A and carotene runs a more acute course than in animals receiving 0.005 mg. of carotene per day. There appears to be some evidence that the acuteness of the course of infection varies quantitatively with the amount of carotene added to the vitamin A free diet and that vitamin D is of little importance in determining the course of *B. tuberculosis* infection in adult mice.

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Kidney Secretion in Reptiles.

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In birds there is now rather conclusive evidence that tubular secretion plays a major rôle in the excretion of uric acid by the kidney.^{1, 2} Uric acid is the main nitrogenous urinary constituent of the arid-living reptiles (snakes and lizards) but no data are available as to its mode of excretion. The experiments reported here indicate that in the lizard, it is chiefly excreted by tubular secretion.

The urine/plasma ratio of uric acid has been compared with that of glucose after administration of phlorizin. Glucose is not secreted by the tubule³ and phlorizin paralyzes the reabsorptive power of the tubule for glucose. Hence, the urine/plasma ratio for glucose should be a measure of the amount of glomerular filtrate if no glucose is reabsorbed under phlorizin. This error, if present, is probably small and would not affect appreciably the conclusions drawn from the present experiments.

The iguana (*Iguana iguana Shaw*) has been used as the experimental animal. Phlorizin was injected subcutaneously in dosage of 250 mg. per kilo 2 hours before the experiment or in 2 doses of 200 mg. per kilo the afternoon before and early on the morning of the experiment. The iguanas were anesthetized with urethane (5 cc. of a 25% solution per kilo), the cloaca opened with a small incision, cannulae tied into the ureteral papillae, and urine collected for a period of 10 to 30 minutes. The abdominal cavity was then

¹ Mayrs, E. B., *J. Physiol.*, 1924, **58**, 276.

² Gibbs, O. S., *Am. J. Physiol.*, 1929, **78**, 87.

³ Marshall, E. K., *Am. J. Physiol.*, 1930, **94**, 1.

quickly opened and blood drawn from the aorta. The urine which was milky in appearance was diluted with hot water to an appropriate volume to obtain solution of all the uric acid. The plasma was precipitated with tungstic acid. Uric acid was determined by the method of Benedict⁴ and glucose by the Hagedorn-Jensen method.⁵ The glucose values given were obtained by absorption on yeast. The non-glucose reducing fraction was usually quite large,* but since correction has been made for the diffusion of non-glucose reducing substance into yeast, the results cannot be greatly in error. Neither errors in the glucose values nor errors in the uric acid data (due to the non-specificity of the method) can probably account for more than a small fraction of the differences between the concentration ratios of uric acid and glucose.

Table I gives the essential data of 5 experiments.

TABLE I.
Uric Acid and Glucose in Iguana.

Wt. Kg.	Urine cc. per hr.	Plasma, mg. %		Urine, mg. %		U/P Ratio	
		glucose	uric	glucose	uric	glucose	uric
1.21	1.20	260	20.8	980	745	3.8	35.8
1.63	2.00	55	22.0	140	1837	2.5	83.6
2.05	0.40	215	24.0	680	1200	3.2	50.0
2.50	1.51	152	15.0	740	313	4.9	20.9
2.50	1.96	276	16.5	420	1110	1.5	66.7

The average concentration ratio for glucose is 3.2 and for uric acid, 51.4. It is evident from these figures that the glomerular filtrate is much too small to account for all the uric acid excreted. Assuming the glucose ratio to be an accurate measure of the amount of glomerular filtrate,† we can calculate that only about 6% of the

⁴ Benedict, S. R., *J. Biol. Chem.*, 1922, **51**, 187.

⁵ Hagedorn, H. C., and Jensen, B. N., *Biochem. Z.*, 1923, **135**, 46.

* After these experiments were completed, it was found that phlorizin strongly reduces the ferricyanide reagent. Using absorption on yeast to determine the glucose should abolish any error from this source.

† Since these experiments were completed 2 years ago, evidence has been obtained which shows that the glucose ratio after phlorizin accurately measures the glomerular filtrate (Shannon, Jolliffe, and Smith⁶; Clarke and Smith⁷; and Marshall and Graffin⁸). It is improbable that phlorizin should cause secretion of uric acid, and in fact the large amounts excreted normally argue against this. In the dog fish Clarke and Smith⁷ observed a depression of the secretion of certain substances after phlorizin. If such an effect occurs in the iguana and bird, the proportion of total uric acid secreted would have to be increased.

⁶ Jolliffe, N., Shannon, J. A., and Smith, H. W., *Am. J. Physiol.*, 1932, **100**, 301.

⁷ Clarke, R. W., and Smith, H. W., *J. Cell. Comp. Physiol.*, 1932, **1**, 131.

⁸ Marshall, E. K., and Graffin, A. L., *J. Cell. Comp. Physiol.*, 1932, **1**, 161

uric acid is eliminated by glomerular filtration and about 94% by some other process—presumably tubular secretion.

It is interesting to compare these experiments on the reptile with similar ones on the bird, where other evidence is available for the secretion of uric acid. In Table II are given results on chickens anesthetized with urethane. Phlorizin was given in about the same dosage as for the reptile, urine was collected from cannulae in the ureters, and blood was drawn at the mid-period of urine collection.

TABLE II.
Uric Acid and Glucose in Chicken.

Wt. Kg.	Urine Flow cc. per hr.	Plasma, mg. glucose	% uric	Urine, mg. glucose	% uric	U/P Ratio glucose	uric
2.5	7.0	381	3.8	6600	604	17.3	159
	8.8	409	4.4	4370	676	10.7	154
1.6	12.0	304	2.9	3700	365	12.2	126
	8.0	302	3.1	4350	572	14.4	185
3.0	14.8	289	7.2	1355	418	4.7	58

The average of the glucose ratio is 12.0 and of the uric acid, 136.4. This means that about 9% of the uric acid is filtered and about 91% secreted, a situation quite similar to that observed in the reptile. The concentration ratio for glucose is much higher in the bird than in the reptile, which can be interpreted as greater re-absorption of water by the tubule (beginning loop of Henle in the bird). In line with this, it may be stated that in neither fish nor amphibian is the glucose ratio greater than that of the reptile, but in the mammal (with complete development of the loop of Henle) the glucose ratio can attain very much higher values than in the bird.

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Studies in Renal Denervation (IV).

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College of Medicine.*

I. *Distribution of Intra-arterially Injected Oleokoniol.* Rabbits were anesthetized with ether, a lumbar incision made, the viscera pushed to one side, and the aorta isolated and elevated proximal to the renal arteries. The aorta distal to the renal arteries was also isolated and a ligature applied. A hypodermic needle was inserted