TABLE II.—INDIVIDUAL STOOLS.

	7 hours.	2 days.	4 days.	8 days.	83 days.
Stool No. 3.					
Nitrogen (moisture-free), per cent	2.179	2.275		2.263	
Moisture, per cent	75.36	75.24		74.66	
Stool No. 4.					
Nitrogen (moisture-free), per cent	2.312	2.387	2.343		1.641
Moisture, per cent	73.28	73.14	73.44		79.18
Stool No. 5.					
Nitrogen (moisture-free), per cent	1.582	1.597	1.622	1.618	
Moisture, per cent	74.85	74.62	74.40	74.93	

TABLE III.—INDIVIDUAL STOOLS.

	Fresh.	2 days.	5 days.	7 days.
Stool No. 6.				
Nitrogen (moisture-free), per cent		1.854	1.816	1.843
Moisture, per cent	77.62	76.61	77.26	76.44
Stool No. 7.				
Nitrogen (moisture-free), per cent	1.491	1.471	1.470	1.473
Moisture, per cent	80.06	80.48	80.16	80.18
Stool N. 8.				
Nitrogen (moisture-free), per cent	1.319	1.347	1.295	1.335
Moisture, per cent	76.49	76.16	76.04	75.95

TABLE IV.—COMPOSIT STOOLS.

	Per cent. nitrogen (moisture-free basis).		
Stool No.	8 days.	43 days.	92 days.
9	1.913	1.901	1.788
10	1.863	1.740	1.848
11	2.179	2.270	...
12	2.127	2.194	2.068
13	1.730	1.736	1.663
14	1.629	1.631	1.743

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STUDIES ON WATER DRINKING.[1] III. ON THE URIC ACID ELIMINATION FOLLOWING COPIOUS WATER DRINKING BETWEEN MEALS.

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The present paper embraces a report of two metabolism studies made

[1] For I and II of this series of studies see Hawk, *University of Penn. Med. Bull.*, 18, 7 (1905); and Fowler and Hawk, *J. Exp. Med.*, 12, 388 (1910), respectively.

upon two individuals, the topic under consideration being the determination of the influence of large volumes of water taken *between* meals upon the uric acid output. The subjects were young men 24 and 29 years of age respectively. They were placed upon uniform diets containing a small amount of water and were brought into nitrogen equilibrium, after which an interval elapsed during which large volumes of water were daily added to the uniform diet, the added water being taken *between* meals. This period of high water ingestion was then followed, in each instance by a period throughout which the uniform diet and low water ration of the preliminary interval were fed. In the first experiment the three periods of the test were 3, 4, and 2 days in length respectively, whereas in the second experiment the periods were 3, 2, and 4 days in duration. The daily diet, during the first study, consisted of 2100 grams of whole milk, 120 grams of butter and 300 grams of crackers, this ration being divided into 3 equal portions and fed at the customary intervals. The ration of the second study was 1800 grams of whole milk, 75 grams of butter and 330 grams of crackers. During the interval of copious water ingestion of the first experiment, the volume of water daily ingested was 5900 cc. as against an ingestion of 400 cc. per day during the preliminary and final periods. These volumes were 5,000 cc. and 500 cc. respectively in the second experiment. In other words the water ingestion was increased $5^1/_2$ liters in the first study and 5 liters in the second study. The body weights of the subjects were about the same (60.6 kg. and 61.5 kg.). During all of Experiment II and for 3 days of Experiment I, the urine was collected in 24-hour samples. The urine specimens for the remaining days of the first experiment were daily collected in 5 sub-periods, there being four $3^1/_2$-hour periods and one ten-hour period. The $3^1/_2$-hour periods began at 8 a.m. and extended from that hour until 10 p.m., the 10-hour period extending from 10 p.m. until 8 a.m. the following day. The urine samples were preserved by thymol powder. Uric acid was determined by the Folin-Shaffer method.[1]

Copious Water Drinking and Uric Acid Output.

The data from the first experiment are given in Table I. An examination of that table shows that there was 0.319 gram of uric acid excreted upon the first day of the experiment and that this was followed on the remaining two days of the preliminary period by daily eliminations of 0.294 gram and 0.267 gram respectively. When the large volume of water was introduced into the organism, however, there was a decided lowering of the uric acid values. The data indicate that the quantitative examination of the urines for the 4 days of copious water ingestion yielded values of 0.195, 0.131, 0.150 and 0.148 gram respectively. The final period in which small amounts of water were again daily ingested was

[1] "Practical Physiological Chemistry" (Hawk), Third Edition, p. 366.

accompanied by a return to the normal uric acid level of the preliminary period. These data would seem to indicate, then, that the ingestion of large amounts of water is accompanied by a pronounced decrease in the uric acid elimination. (This question is further discussed in a later paragraph.)

TABLE I.—URIC ACID EXCRETION. EXPERIMENT I.

Day of experiment.	Number of sub-period.	Uric acid excretion. Sub-period.	Uric acid excretion. Total for day.	Urine volume. Sub-period.	Urine volume. Total for day.
		Preliminary Period (3 Days).			
		Gram.	Gram.	cc.	cc.
I			0.319		900
II			0.294		1330
	1	0.049		140	
	2	0.044		235	
III	3	0.074	0.267	260	1350
	4	0.028		360	
	5	0.072		355	
		Water Period (4 Days).			
	1	0.028		720	
	2	0.021		1750	
IV	3	0.033	0.195	1580	6720
	4	0.026		1360	
	5	0.087		1310	
	1	0.037		680	
	2	0.016		1750	
V	3	0.017	0.131	1400	6320
	4	0.040		1320	
	5	0.021		1170	
	1	0.016		730	
	2	0.062		1670	
VI	3	0.021	0.150	1200	6530
	4	0.024		1380	
	5	0.027		1550	
	1	0.019		620	
	2	0.036		1800	
VII	3	0.028	0.148	840	5530
	4	0.023		1300	
	5	0.042		970	
		Final Period (2 Days).			
	1	0.046		140	
	2	0.036		185	
VIII	3	0.034	0.212	170	1025
	4	0.033		215	
	5	0.063		315	
IX			0.279		790

A consideration of the uric acid output for the daily sub-periods of the first experiment fails to reveal any uniformity in the uric acid elimina-

tion for the different days. In some instances the maximum excretion occurred during the first $3^1/_2$-hour period, whereas on certain other days the second, third, or fourth sub-period, as the case may be, included the maximum yield. It is of interest that the largest urine flow was found to occur during the second sub-period on each day of the interval of high water ingestion. This uniformity did not hold for the preliminary or final periods. No relation was noted between the volumes of the urine fractions and their uric acid content.

TABLE II.—URIC ACID EXCRETION. EXPERIMENT II.

Day of experiment.	Urine data.		Water ingested.[1]
	Uric acid content.	Volume.	
	Preliminary Period (3 Days).		
	Gram.	cc.	cc.
1	0.282	1090	500
2	0.267	997	500
3	0.274	770	500
	Water Period (2 Days).		
4	0.279	5250	5000
5	0.258	5800	5000
	Final Period (4 Days).		
6	0.261	1275	500
7	0.283	1160	500
8	0.254	1140	500
9	0.268	885	500

When we examine the data from the second experiment, as given in Table II, we find that the conditions during the interval of high water ingestion were entirely different from those which were observed in the similar period of the first study. The daily uric acid output for the preliminary period, however, was very similar to that already discussed in connection with the data from Experiment I. This logically follows from the fact that the subjects were of practically the same body weight and were being fed a very similar ration. The values for the period range from 0.267–0.282 gram per day. The initial day of the water period was accompanied by an increase of $4^1/_2$ liters in the water ingestion. Bearing in mind the uric acid findings of the first experiment, we would expect to observe an accompanying lowering of the uric acid output. However, the data indicate that no such decrease occurred in this case, inasmuch as the daily uric acid excretion for each day of the water period was an approximate duplication of those obtained during the low water ingestion of the preliminary period. When we pass to the final period with its normal water ration, we again fail to note any considerable or significant variation in the uric acid values.

Going no deeper into the question than a comparison of the analytical

[1] Exclusive of the water content of the milk.

data obtained in the two experiments, it seems that copious water ingestion in the case of one subject caused a pronounced decrease in the daily output of uric acid, whereas in the case of the other subject similar experimental manipulation was productive of no alteration in the course of the uric acid elimination. With no other data at hand, then we would interpret the lack of uniformity observed as due to individuality. When we consider the known facts regarding the origin and excretion of uric acid, however, it is difficult to see how an increased water ingestion can be considered as a logical forerunner of a decreased uric acid excretion. To be sure, Genth[1] as far back as 1856 did obtain a lowered uric acid output after feeding a ration which embraced a comparatively high water intake. However, Genth used the Heintz method for the determination of his uric acid values, a method which is considered inaccurate. Later Schöndorf[2] using Salkowski's modification of Fokker's method secured data which indicated a slightly lowered excretion under the influence of high water ingestion.

On the other hand Laquer[3] and Schreiber[4] have each shown a slightly increased excretion of uric acid after feeding from 1–3 liters of water.

Recent tests made by us have indicated quite conclusively that the Folin-Shaffer procedure does not always yield the total uric acid output of urines which possess as low specific gravities as those obtained during the water periods of our experiments, *i. e.*, 1.003–1.010. For this reason we are not willing to interpret the data from our first experiment as indicating that copious water drinking has caused a decrease in the uric acid elimination, but are rather inclined to believe that a portion of the uric acid content of those urines of low density escaped determination by the Folin-Shaffer technic. It is possible that the factor of individuality has also exerted an influence, but we place more reliance upon the quantitative data obtained in our second experiment which show *no change* in the uric acid output under the influence of the ingestion of large volumes of water. We believe the data there set forth represent the true relations for this subject and that the urines were of such a character as to permit the securing of accurate data by means of the Folin-Shaffer procedure.[5] The values obtained for the water period of the first experiment we believe are too low and do not represent the absolute uric acid values for those days. Why the dilute urines from one subject should yield accurate data and similar urines from another subject should yield data apparently

[1] Genth, Quoted by Schöndorf, *Arch. ges. Physiol.*, **46**, 529.

[2] Schöndorf, *Arch. ges. Physiol.*, **46**, 529.

[3] Laquer: Kongress für innere Medicin, **1896**, p, 381.

[4] Schreiber, "Die Harnsäure," **1899**, p, 38.

[5] It may be, of course, that the Folin-Shaffer method also failed to determin the total uric acid content of these urines. In that event an increased excretion of uric acid must have followed copious water drinking.

inaccurate when the same procedure was used in the two instances, we are unable to say. No interfering substances could be demonstrated to be present and it is rather difficult to see just how the urines from the two experiments could differ much in general characteristics, inasmuch as the dietary of each experiment was made up of the same constituents.

Summary.

Two experiments were made to demonstrate the influence of copious water drinking *between* meals upon the uric acid output. The subjects used were two young men 24 and 29 years of age respectively. Each experiment was divided into three periods, a preliminary period during which nitrogen equilibrium was established through the feeding of a uniform diet, a water period during which this uniform diet was supplemented by the daily drinking of a large volume of water *between* meals, and lastly a final period in which the dietary regimé of the preliminary interval was in force.

In one experiment copious water drinking caused no change in the uric acid output, whereas a pronounced decrease in this excretion was observed in the case of another subject. The data indicating a decreased elimination of uric acid under the influence of copious water drinking we believe to be due to the fact that the Folin-Shaffer procedure did not, in the case of this subject, determin the total uric acid content of those urines of extremely low density, *i. e.*, 1.003–1.010. This interpretation has been substantiated by tests made in another connection.

Upon those days when the urine for the twenty-four-hour interval was collected in five sub-periods, there was apparently no relation between the urine volume for the sub-period and the uric acid content. There was likewise no uniformity in the daily course of the uric acid excretion, the maximum output occurring on different days in the first, second, third, and fourth sub-periods respectively. The maximum urine flow occurred uniformly in the second sub-period of those days on which large volumes of water were being ingested. This uniformity was not observed on the days of low water ingestion.

URBANA, ILL.

NOTE.

A Convenient Potash Bulb.—More than a year ago the writer devised a potash bulb much like the one shown in the cut, and it proved to be so convenient and efficient that it was thought worth while to describe the no less efficient and much more convenient form shown. The cut is drawn to scale from one now in use. The inner and outer tubes, A and B, are made of very thin "condenser" tubing, the tubes I and O being of ordinary thickness. The essential feature is the disks, D, which fit so loosely