which continues the journey. The difference in filtering power of a clean and uncleaned filter is thus easily explained. While with proper care such results as detailed above are easily obtainable, I would rather trust to unfiltered water than to the best filter systematically neglected. Since all by neglect accumulate organic debris, which acts as a breeding ground for germs, which can afterwards pass through in the manner outlined above ; which word of caution will not I trust deter any from using a suitable filter, but simply emphasize the fact that when one is used common sense requires that it should be kept in working order.

ON THE SOLUBILITY OF ALUMINA RESIDUES FROM BAKING POWDER IN GASTRIC JUICE.

By Lucius Pitkin, Ph. B.

During the month of December, 1886, I was called upon to make some experiments to determine the solubility of the alumina residues, left in bread or biscuit after the use of an alum baking powder, in the process of digestion. This paper is a resume of my experiments upon two of the factors in digestive action, namely, the saliva and the gastric juice. It does not pretend to give any figure as to complete digestive action ; it is, however, I think, reasonably accurate in regard to stomachic digestion, which is an important factor (probably the most important) in the whole process.

The special class of alum powders to which my experiments directly refer are those in which acid phosphate of lime is used, in connection with burnt alum, to liberate the carbonic acid of the bicarbonate of soda. It is to this class that, as I am informed, the majority of the alum powders of to-day belong ; but the experiments while made with such a powder may also throw some light on other alum powders leaving similar residues.

The proportions used by me in making the powder to be tested were as follows :

Acid sodium carbonate (bicarbonate)	29	parts.
Burnt ammonia alum	20	"
Acid calcium phosphate	20	"
Corn starch	65	"

A glance at the above is sufficient to stop any discussion as to the existence of alum, as such, in the finished bread. The real question at issue in the use of such a powder is twofold.

1st. What proportion of the alumina residue left in bread after the use of the above powder is dissolved in the process of digestion? and

2d. What will be the effect upon health of the introduction of dissolved alumina in the quantity indicated?

It is obvious that the answer to the second question is quantitatively dependent upon the result obtained in investigating the first; and that while the second query belongs to the province of the physician and will be but incidentally alluded to here, the physician himself needs an answer to the question of solubility as a basis for his opinion.

The investigation, of which we here give the results, is not presented as showing the complete action of digestion upon the alumina residues. The difficulty of procuring pancreatic and intestinal juices effectually preclude the experimental testing (under the conditions of digestion) of their solvent powers in the case before us, since on account of the small percentage of alumina present large quantities of bread must necessarily be employed.

If we consider, however, the immense flow of the gastric juice in comparison with the other secretions of the alimentary canal and its markedly acid character, we must conclude, in the absence of all evidence to the contrary, that we are dealing with by far the most important factor of digestion so far as regards our problem. The gastric juice was obtained in the usual manner from dogs by means of a gastric fistula, and after complete recovery and a preliminary fast, the dogs were fed with fragments of lean meat, the outer surface of which had been hardened in boiling water. As the gastric juice was secreted it was allowed to escape by the fistula tube, filtered and bottled. But from one-half to three-quarters of an ounce was collected at once to insure freedom from digestive products. The amount of gastric juice secreted per twenty-four hours reaches, according to the figures given in Flint's Physiology, no less than 14 lbs. per day. This large amount is no doubt due to resecretion following absorbtion, and is secreted for the most part during the ingestion and stomachic digestion of food. No figures can be obtained for the precise amount present during digestion, but assuming that 10 lbs. of the juice (of the total 14) is secreted during and immediately following the meals, and that the weight of the food is about 3 lbs. per day, we would have present in the stomach 3⅓ lbs. of the juice to each pound of food. The experiments of Dr. Beaumont in the case of Alexis St. Martin have furnished us 3½ hours as the time required for the stomachic digestion of bread. In the test then, for the solubility of the alumina residues in gastric juice, 60 grammes of biscuit were, after mastication, kept at a temperature of 37½° C. (99° F.) for 3½ hours with 200 grms. of gastric juice. The biscuits were prepared in the ordinary way, using two moderately heaped teaspoonfuls to a quart of flour, and the resulting biscuit weighed 818 grms., while the powder used weighed 13.615 grms. This amount of powder was found by analysis to contain 499.2 m.g. of alumina ($Al_2 O_3$), consequently, the 60 grammes of biscuit employed in the artificial digestion contained 36.6 m.g. of alumina, $Al_2 O_3$.

At the end of the three and one-half hours mentioned above, the mixture was filtered, thoroughly washed, and the alumina determined both in the residue and filtrate. The latter represents that portion of the alumina residue which is rendered soluble in the digestive process until such time as the food is discharged into the duodenum. The amount in solution was found to be 10.9 m.g. $Al_2 O_3$, while that remaining undissolved in the starchy residue was 23.2 milligrammes, a total of 34.1 milligrammes recovered of the 36.6 milligrammes calculated to be present. We can safely say then that under standard conditions of temperature and time, less than one-third of the alumina existing in the biscuit is dissolved in the nearest approach to stomachic digestion we can make. If alumina is judged to be harmful, then its injurious action must be predicated not for the amount of that element present in the powder, but for the amount rendered soluble and so capable of absorption and injurious effect.

In obtaining this factor of solubility of $\frac{1}{3}$ we would call attention to the fact that the investigation, if it has erred on either side, has been possibly too severe in the conditions of the experiment. All analyses tend to show that the gastric juice of the dog is stronger than that of the human being ; the degree of acidity, on which especially the solubility of the hydrate and phosphate of alumina would depend, being much higher. The total solids in the gastric juice of a dog amount to more than 20 parts per 1,000, and while we would admit that the analysis of Bidder and Schmidt giving but 6 parts per 1,000 in human gastric juice was made on an abnormal secretion, we see no reason for doubting the figure determined by Berzelius, *i.e.*, twelve (12) parts. There is reason, therefore, for supposing that human gastric juice would have given us (could it have been procured) a smaller coefficient of solubility than the figure reported.

In brief, the results obtained for the solubility of alumina residues during the process of mastication and stomachic digestion (and leaving aside the action of intestinal juices), is somewhat less than $\frac{1}{3}$ of the alumina present when canine gastric juice is used.

This represents, we think, a maximum figure. From a comparison of published analyses human gastric juice is probably about one-half as strong. If solubility is approximately proportional to strength, then our figure should be changed to $\frac{1}{5}$ or $\frac{1}{6}$ for the solubility in mouth and stomach of man.

From the impossibility of procuring human gastric juice at will, a more exact approximation is probably not now possible.

"WATER" RESULTS AND THE PUBLIC.

BY PROF. WILLIAM P. MASON.

In the *Analyst* for April, 1883, Dr. Dupré writes an excellent article on "standards" for water analysis, in which he states that the laying down of a general standard is impossible. He also adds :

"This difficulty as to standards is certainly by no means confined to water analysis, but comes up whenever a standard is laid down for a natural product liable to variation."