

III. *On the nature of the acid and saline matters usually existing in the stomachs of animals.* By WILLIAM PROUT, M. D. F. R. S.

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THAT a free, or at least an unsaturated acid usually exists in the stomachs of animals, and is in some manner connected with the important process of digestion, seems to have been the general opinion of physiologists till the time of SPALLANZANI. This illustrious philosopher concluded, from his numerous experiments, that the gastric fluids, when in a perfectly natural state, are neither acid nor alkaline. Even SPALLANZANI, however, admitted that the contents of the stomach are very generally acid; and this accords not only with my own observation, but with that, I believe, of almost every individual who has made any experiments on the subject.

With respect to the nature of this acid, very various opinions have been entertained. Some of the older chemists seem to have considered it as an acid, *sui generis*; by others it was supposed to be the phosphoric, the acetic, the lactic acid,* &c. No less various have been the opinions respecting

* After I had discovered the principal fact related in this paper, I was surprized to find how nearly SCOPOLI had come to the same conclusion. He did not indeed come to the conclusion, as far as I can ascertain, that free muriatic acid exists in the stomach, but he advanced the opinion, that the muriatic acid, in union with ammonia, found in such abundance in the stomach of ruminating animals, is secreted by that organ itself. The only account of SCOPOLI'S experiments I have seen is in JOHNSON'S Animal Chemistry, i. 183.

its origin and use ; some supposing that it is derived from the stomach itself, and is essential to the digestive process ; others, that it is derived from the food, or is a result of fermentation, &c. ; in short, there seems to be no physiological subject so imperfectly understood, or concerning which there has been such a variety of opinions.

The object of the present communication is to show, that the acid in question is the *muriatic acid*, and that the salts usually met with in the stomach, are the alkaline muriates. As to the origin and use of these principles, as well as the occasional appearance of other acids, &c. in the stomach, I reserve what I have to say on these subjects till a future opportunity, and shall merely remark at present, that the facts now adduced seem to be intimately connected, not only with the physiology and pathology of the digestive process, but with other important animal functions.

Having ascertained the circumstances above mentioned in a general manner, and by means which it would be here unnecessary to detail, an attempt was made to contrive some unexceptionable method by which their truth might not only be satisfactorily demonstrated, but at the same time that the relative quantities of the different principles might be determined : after various attempts, the following processes were adopted for these purposes.

The contents of the stomach of a rabbit, fed on its natural food, were removed immediately after death, and repeatedly digested in cold distilled water till they ceased to impart any thing to that fluid. The whole of these different portions of fluid, which always exhibited strong and decided marks of acidity, were then intimately mixed together, and after being

allowed to settle, were divided into four equal portions.

1. The first of these portions was evaporated to dryness in its natural state, and the residuum burnt in a platinum vessel ; the saline matter left was then dissolved in distilled water, and the quantity of muriatic acid present determined by nitrate of silver in the usual manner ; the proportion of muriatic acid, in union with a *fixed* alkali, was thus determined.
2. Another portion of the original fluid was super-saturated with potash, then evaporated to dryness, and burnt, and the muriatic acid contained in the saline residuum determined as before. In this manner the *total* quantity of muriatic acid present in the fluid was ascertained.
3. A third portion was exactly neutralised with a solution of potash of known strength, and the quantity required for that purpose accurately noticed. This gave the proportion of *free* acid present ; and by adding this to the quantity in union with a fixed alkali, as determined above, and subtracting the sum from the *total* quantity of muriatic acid present, the proportion of acid in union with *ammonia*, was estimated. But as a check to this result, the third neutralised portion abovementioned was evaporated to dryness, and the muriate of ammonia expelled by heat, and collected. The quantity of muriatic acid this contained was then determined as before, and was always found to represent nearly the quantity of muriate of ammonia as before estimated ; thus proving the general accuracy of the whole experiments beyond a doubt.
4. The remaining fourth portion of the original fluid was reserved for miscellaneous experiments, and particularly for the purpose of ascertaining whether it contained any other acid besides the muriatic. The experiments abovementioned

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seemed to preclude the possibility of the presence of any destructible acid ; and the only known fixed acids likely to be present were the sulphuric and phosphoric ; the muriate of barytes, however, neither alone, nor with the addition of ammonia, produced any immediate precipitate,* showing the absence of these two acids in any sensible quantity, and still farther confirming the results as before obtained.

In this manner the three following results, selected from a variety of others of a similar nature, were obtained.

	No.1	No.2	No.3
	grs.	grs.	grs.
Muriatic acid in union with a <i>fixed alkali</i> †	·12	·95	1.71
————— <i>with ammonia</i>	1.56	·76	·40
————— <i>in a free or unsaturated state</i>	1.59	2.22	2.72
Total	3.27	3.93	4.83

These results then seem to demonstrate, that free, or at least unsaturated muriatic acid in no small quantity exists in the stomach of these animals during the digestive process ; and I have ascertained, in a general manner, that the same is the case in the stomach of the hare, the horse, the calf, and the dog. I have also uniformly found free muriatic acid in great abundance in the acid fluid ejected from the human

* It may be proper to remark, that ammonia, after some time, caused a flocculent precipitate, consisting of the earthy phosphates in union with vegetable and animal matter, and that after combustion, traces of sulphuric acid, the result of that process, were very perceptible. But it is evident, from the experiment related in the text, that neither of these acids previously existed in the original fluid in a free state.

† For the sake of analogy, the chlorine, in union with the basis of the *fixed alkali*, is reduced in this table and the following to the state of muriatic acid.

stomach in severe cases of dyspepsia, as the following examples show. The original quantities of the fluids operated on, of course were various, but for the sake of comparison they are reduced, in the following table, to one pint, or 16 fluid ounces, which quantity, in three instances, (selected from many others) was found to contain of

	No.1. grs.	No.2. grs.	No.3. grs.
Muriatic acid in union with a <i>fixed alkali</i>	12·11	12·40	11·25
----- <i>with ammonia*</i>	0·0	0·0	5·39
----- <i>in a free or unsaturated state</i>	5·13	4·63	4·28
Total	17·24	17·03	20·92

* I have never in more than one instance, (No. 3, of the above table) been able to detect any sensible quantity of the muriate of ammonia in the fluids ejected from the human stomach; and upon enquiry of Sir ASTLEY COOPER, who was kind enough to furnish me with the fluid for examination, I was informed that the patient was in the habit of frequently taking ammonia as a medicine.

Dr William Prout and his discovery are described by Dr J. H. Baron in a recent article in the *British Medical Journal* (*Brit. med. J.*, 4, 600).

We are indebted to the Librarian of the Physical Sciences Library, University College, London, for the loan of the volume in which the paper was originally published so that this facsimile might be made.