phosphate of ammonia was shown again and again by dissolving it in ammonia and precipitating it from the latter solution by adding concentrated nitric acid, when the characteristic crystals of the molybdo-phosphate,as shown under the microscope, were formed. The phosphate of this precipitate was also obtained as ammonio-magnesic phosphate. When the nitric acid was allowed to act for a longer time, *e. g.*, from two to six days, at 35°C., the quantity of phosphorus liberated as phosphoric acid was increased.

Quite a different result was obtained with caseinogen. The used quantity of the latter was purified by dissolving and precipitating five times and by extracting with ether to free it from lecithin. The material so prepared did not give the slightest evidence of the presence of phosphates when the nitric-molybdate reagent was added and immediately thereafter some phenylhydrazin solution (1 per cent.). When portions of the pure caseinogen were dissolved in nitric acid of 1.2 sp. gr., and kept at 35° C., for two weeks not the slightest trace of phosphoric acid was demonstrated with the nitric-molybdate reagent and phenylhydrazin, and even after two months only the slightest possible trace of phosphoric acid was present.

It is, therefore, to be concluded that phosphorus is combined in caseinogen in a manner very different from that which obtains in true nucleoproteids and that nitric acid may be employed to distinguish nucleic acids and the typical nucleoproteids from paranucleic compounds.

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Does the stomach of the dog contain free hydrochloric acid during gastric digestion?

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In a recent contribution to the physiology of digestion from the Physiological Laboratory of the University of Vienna, Albert Müller[1] has made the announcement that the digestion of meat regularly proceeds in the stomach of healthy, normal dogs in the

[1] Albert Müller: *Archiv für die gesammte Physiologie*, 1907, cxvi, 163.

absence of *free* hydrochloric acid. He insists, further, that *free* HCl is lacking with all foodstuffs throughout the progress of gastric digestion in these animals. The total acidity is reported to reach high values in meat digestion and lower figures with other dietaries; but in each instance it is referable to *combined* acid. The ability of the dog's stomach to secrete a juice rich in *free* HCl is not questioned. In the case of this animal, however, Müller believes that the production of acid is limited by the demands of the digesting materials. As soon as the proteins present, or their cleavage products, are combined with acid, the further secretion of the latter ceases. The same behavior is said to characterize the gastric digestion of the cat; not, however, that of rabbits. Clinical experience further teaches that this description certainly does not apply to the digestive processes in the human stomach, where *free* HCl regularly occurs in a concentration of 1–2 per mille within a comparatively short period after a test meal.

These facts and ideas presented by Müller in respect to the chemical and secretory phenomena of gastric digestion in the dog were somewhat surprising to me in view of the experience gained in our laboratory,[1] on animals with gastric fistulas. In numerous experiments on two large dogs we uniformly found the acidity of the stomach contents to increase after a test meal of meat, until *free* HCl was present in not inconsiderable concentration. An illustrative protocol is reproduced here:

9.30 50 grams meat + 100 c.c. water fed.

Analysis of gastric contents; acidity expressed as HCl.

	Total acidity	Free HCl.
	%	%
10.00	0.299	0.090
10.30	0.475	0.122
11.00	0.518	0.173
11.15	0.497	0.241
11.35	0.494	0.202
11.50	0.479	0.195
12.10	0.382	0.187
12.30	Stomach empty; end of gastric digestion. Period of digestion, 3 hours.	

Müller calls attention to the difficulty of obtaining gastric contents from dogs through a stomach tube, owing to the fact that

[1] Chittenden, Mendel and Jackson: *American Journal of Physiology*, 1898, i, 193; also "Bicentennial Studies in Physiological Chemistry," Yale University, 1901, 105.

the digesting mass ordinarily forms a firm pulp unlike the semi-fluid contents of the human stomach. He therefore obtained the gastric contents by causing dogs to vomit after injections of apomorphine. Fifty trials made on 26 dogs after periods of 1, 2, 3, 4, and 6 hours with a single exception gave negative tests with Congo red paper, Günzburg's and Töpfer's reagents, although the digesting masses were always strongly acid to phenolphthalein.

In several of the more recent investigations[1] on the gastric digestion of dogs data are reported which indicate that fluid contents with little or no *free* HCl may be discharged through the pylorus. I have therefore undertaken additional experiments with the co-operation of Dr. Risley and Mr. Kleiner, to learn whether our original observations on fistula dogs are in any way unique. The dogs were given test meals of chopped meat (50–250 grams) with or without water, and samples of the gastric contents were removed at intervals through a stomach tube. By the simple device which we use for suspending the animals (and which was demonstrated) it is easy to obtain small portions for analysis. Frequently larger fluid portions (15–60 c.c.) were easily removed. They were filtered *at once* and tested qualitatively with Congo red paper, the tropaeolin 00 and dimethylaminoazobenzene reagents. Two c.c. were titrated *at once* with n/10 alkali, using Töpfer's reagent and then phenolphthalein as indicators for free HCl and total acidity.[2] Twelve test meals fed to five different animals furnished measurable quantities of *free* HCl in ten cases. Even more positive results might have been obtained if the removal of samples had been more advantageously timed. The dogs had in no case been fed since the preceding day. The accompanying summary of the essential data tells its own story.

The quantity of fluid gastric contents obtainable at any moment is never large in the dog. Nevertheless our experience scarcely justifies the assumption of a unique secretory regulation by which, as Müller assumes, acid is furnisheds ufficient only to combine with proteid material. For the cat also Cannon and Day[3] have

[1] Cf. e. g. Krehl: *Pathologische Physiologie*, 1904, 284; Lang: *Biochemische Zeitschrift*, 1906, ii, 240.

[2] Töpfer's method as modified by Einhorn: *New York Medical Journal*, 1896, xix, 603; cf. Chittenden, Mendel and Jackson: loc. cit., p. 191.

[3] Cannon and Day: *American Journal of Physiology*, 1903, ix, 402.

GASTRIC ANALYSIS.

Animal.	The test meal contained		Fluid contents removed.		Tests for free HCl were (+) positive or (—) negative with		Volume of $\frac{n}{10}$ alkali used for 2 c.c.	
Weight.	Meat.	Water.	Time.	Approximate quantity.	Tropaeolin oo.	Töpfer's reagent.	Total acidity.	Free HCl.
kgm.	gm.	gm.	hrs.	c.c.			c.c.	c.c.
A 13½	150	100	2	52	—	—	2.2	0
			4	52	+	+	2.1	0.3
do.	150	300	1	12	—	—	0.8	0
			2	13	?	?	2.4	?
			3¾	25	+	+	2.2	0.8
B 20	70	200	1	Small amount	—	—		0
do.	150	300	1	9	+	+	2.0	0.3
			2	1	+	+		
do.	150	300	1	30	—	—		
			2	47	+	+	2.7	0.7
do.	250	None	3	2	+	+	1.2	0.3
			4½	4	+	+	0.5	0.2
C 8	150	100	2½	3	+	+	1.5	0.4
			3⅚	13	?	+	2.3	0.4
do.	150	300	1	3	—	—	1.3	0
			2	5	+	+	1.9	0.3
			4½	3	+	+	1.6	0.5
D 12	100	200	1	68	—	—		
			2	29	+	+	2.6	1.2
do.	150	100	2⅓	38	?	+	3.2	0.4
			3½	8	+	+	2.0	0.6
do.	250	None	1	14	—	—	3.1	0
			3	3	?	+	1.8	0.3
			4¾	1	—	?		
E 11	150	100	1¾	36	—	—	1.6	0
			3⅓	—	—	—	2.0	0
			4¾	16	+	+	2.0	0.8

stated that free acid may be present after a meal. As a possible explanation of these discrepancies, the differences between the methods of study used by Müller and by us may be of moment. It is not unlikely that when the semi-solid gastric contents are emptied *en masse* any free HCl present in the mixture speedily combines with the excess of unchanged proteid ejected, before digestion is stopped outside of the body. In all of our experiments, on the other hand, the material, analyzed at once, represented fluid contents as they were present in the stomach. The data furnished should therefore correspond with the composition of the soluble materials ready for propulsion along the digestive tract. At any rate some caution is necessary in the interpretation of the phenomena of gastric digestion recorded by the different investigators.