or less regular waves, a condition whose occurrence in many vital functions has been especially emphasized by Petersen. 2. After denervation the excretion of the organisms by the kidney is greatly reduced and to a large extent the wave-like curve is flattened. 3. The excretion of organisms by the kidney is reduced after the injection of snake venom but their excretion is still much less from the denervated than from the normal kidney. 4. When the organisms are injected with adrenalin their excretion through the denervated kidney is increased, through the normal kidney it remains almost unaffected.

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Production of Pylorospasm and Prepyloric Ulcers in Rats.

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(Introduced by A. J. Carlson.)
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We reported that ulceration of the prostomach of rats following protein restriction was due to the action of the acid gastric juice.[1] An investigation was therefore undertaken to determine whether the gastric acidity was increased by protein restriction. To estimate the acidity, from 15 to 100 pieces of iron, steel or aluminum were given daily to 10 rats, by a method described elsewhere,[2] and the degree of erosion or the percentage of weight lost in passage through the digestive tract was noted. Tests were made for periods of from 47 to over 100 days during which chiefly the protein content of the diets was changed from time to time. Data thus obtained[3] were complicated by factors that tended to obscure evidence of changes in gastric acidity but the net impression was that ulceration of the prostomach occurred as a result of protein restriction without a marked increase in the gastric acidity of any of these rats.

A more definite and striking consequence of protein restriction in 7 of the 10 rats was the development of a gastric retention and a correspondingly increased erosion of test material, in some instances more than 10 times the normal. The retention was appar-

[1] Hoelzel, F., and Da Costa, Esther, PROC. SOC. EXP. BIOL. AND MED., 1932, **29**, 382.

[2] Hoelzel, F., *Am. J. Physiol.*, 1930, **92**, 466.

[3] Hoelzel, F., *Science*, 1932, **75**, 311.

ently due to the onset of pylorospasm. As the test material consisted mainly of pieces of iron and aluminum wire, the immediate inference might be that the pieces of metal irritated the pyloric region and spastic contractions were the consequence. But this would not explain why, *in spite of continuing to give the same kinds and amounts of metal daily,* it repeatedly proved possible to clear up growing gastric retentions by simply changing the diet from low to high protein. Moreover, pylorospasm and gastric retention were not observed to be promoted when rats were kept on diets consisting mainly of bran[1] nor when they were given larger amounts of rougher pieces of metal during longer periods in an earlier study but during which only adequate diets were used.[2] On the other hand, chemical irritation or a high gastric acidity seemed to be implicated by the observations that (1) gastric retention generally followed soon after rats were given 25% or more of alcohol and (2) a "smooth" diet of only white bread proved to be particularly effective in producing pylorospasm and gastric retention.

Related to the foregoing was the problem of explaining a seemingly curious variation in the incidence of prepyloric lesions among over 1200 rats that we examined. The lesions were round or oval craters, often multiple and occurring mainly about the lesser curvature in the antrum of the stomach. The depressed centers of the smaller craters frequently showed only moderate changes in the mucosa upon histological examination. The larger craters, however, often had bleeding centers or dark bases and grossly, as well as histologically, appeared as definite ulcers. Prepyloric craters occurred more or less independent of ulceration in the prostomach and they were not always found when gastric retention developed or vice versa. Among 175 control rats without ulcers in the prostomach of any,[1] 3 had multiple shallow prepyloric craters. Among over 1000 other rats in which we attempted to produce lesions, ulcers appeared in the prostomach of about two-thirds and there were 6 perforations, but craters in the pyloric region occurred in only about one-third and no ulcers in this region perforated. Among about 150 rats fed chiefly white bread, over 60% developed prepyloric craters, including some of the largest ulcers found in this region, and about 75% developed ulcers in the prostomach. Fifteen out of 20 rats given either kaolin, barium sulphate or agar with diets adequate in protein developed prepyloric craters but no prostomach ulcers. Thirty-three out of 102 rats fed mainly bran also showed some prepyloric crater formation but, again, without ulceration of the prostomach. The higher incidence and greater devel-

opment of prepyloric lesions on the smoother diets indicates that mechanical irritation can not very well account for them. Our opinion is that the bulky diets gave rise to craters in the pyloric region and prevented ulceration in the prostomach by shifting the acid burden in the stomach toward the pylorus. The opposite took place with starvation, as a result of which the prostomach was always most severely ulcerated. The effect of white bread was probably largely a consequence of the gastric retention which it tends to initiate. In all these cases there seemingly was an excessive exposure of the ulcerated regions to acid gastric juice and often the state of nutrition of the tissues was seriously impaired.

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Correlation Between Number of Leukocytes and Percentage of Phagocytosis.

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Interpretation of percentages obtained in phagocytic tests on patients undergoing treatment (in this instance, diathermy) is made difficult by the facts that the total leukocyte count in such patients varies and the concentration of leukocytes used in the test sensibly affects the percent of phagocytosis. To evaluate this variation it was necessary to devise a phagocytic test in which the leukocytes would be subjected to the least possible manipulation. Two cc. of heparinized salt solution (containing 1 mg. of heparin per cc. of 0.9% NaCl) are put into a test tube and about 9 cc. of blood added. In a second dry tube about 1 cc. of blood is collected and allowed to clot. The heparinized sample is centrifuged and the cells are washed once with salt solution, then divided into 2 portions. Portion A remains untreated, portion B is deleukocyted by a modification of the method of Fleming.[1] A U-tube is prepared of glass tubing with a constriction in one limb into which absorbent cotton is packed tightly. The other limb is connected to the vacuum apparatus, a little salt solution is drawn through the cotton, and finally the cell suspension B is sucked through 3 or 4 times and is thus rid of most of its leukocytes. By mixing this filtered suspension in various proportions with portion A, a series of blood samples is obtained hav-

[1] Fleming, *Brit. J. Exp. Path.*, 1926, **7**, 281.