TABLE I.
Water, base and chloride in plasma and muscle of rabbit.
(Figures in milliequivalents per kg.)

Rabbit No.	Concentration of NaCl injected	Plasma			Muscle		
		H_2O	Base	Cl	H_2O	Base	Cl
	%						
1	0.8	93.1	165.2	94.5	74.2	124.1	13.7
2		92.7	166.3	101.7	73.9	131.7	11.3
3		92.4	163.3	109.0	75.3	130.7	15.5
Average		92.7	164.9	101.7	74.5	128.8	13.5
4	25.0	93.4	181.5	132.3	75.7	158.0	18.5
5		94.0	188.1	123.2	74.7	153.5	17.8
6		92.1	183.2	133.8	74.6	156.7	17.5
7		93.1	180.7	118.7	73.7	150.8	17.6
Average		93.2	183.4	127.0	74.7	154.8	17.8

26 mM per kg. while the chloride increased only by 4 mM per kg. In the plasma the increases in base and in Cl are not very different. We may conclude, therefore, that the increase of base in the muscle of these rabbits is due to the migration of base from the plasma into the muscle cells and not merely due to increase of the base content in the intercellular fluid. Since plasma contains practically no K, the base which migrates into the muscle must be Na.

The unequal increases of base and chloride in the muscle and plasma suggest a membrane equilibrium and the problem is being studied further. For the present we wish only to conclude that the membrane of the muscle cells *in vivo* is permeable to sodium ion.

5824

Nutritional Edema. I. Effect of Level and Quality of Protein Intake on Nitrogen Balance, Plasma Proteins and Edema.

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Nutritional edema is apparently another type of edema in which the mechanism of its production is related to the low level of plasma proteins, similar to that of nephrosis and plasmapheresis. In nutritional edema, however, the lowered plasma proteins are brought

about by a deficiency in protein in diet. Denton and Kohman[1] produced edema in a large proportion of rats fed largely on carrots. This work was confirmed by Frisch, Mendel and Peters,[2] who in addition showed that the plasma proteins were low in their rats. Recently Shelburne and Egloff[3] succeeded in producing edema in a dog fed on a low protein diet. We add the following preliminary report of a study on the nitrogen balance, plasma proteins and extent of edema in 2 cases of nutritional edema under the influence of different dietary regimes.

The 2 patients, aged 11 and 20 respectively, were inmates of an orphanage in which they subsisted for a long time on a diet deficient in protein. They presented evidence of undernutrition with marked edema. There was no evidence of cardiac or renal disease. Case 1 had a total plasma protein value of 3.46% and albumin 1.43%. Case 2 had 4.01% for total proteins and 2.17% for albumin. Throughout the 21 periods of 4 days each their total caloric intake was kept at 1400, salt at 6 gm., and water at 1500 cc., while the level and character of the proteins in the diets were varied. Each diet was given for 2 to 5 periods. Diet 1 contained 23.5 gm. (Case 1) and 27.5 gm. (Case 2) of vegetable proteins, estimated intake of protein for them while in the orphanage. With this diet their nitrogen balance was barely maintained, and their plasma proteins showed a slight tendency to increase, and their edema after an initial decrease did not completely subside. With Diet 2 containing practically no protein (0.25 to 0.30 gm. nitrogen per day), there was marked negative nitrogen balance with distinct lowering of plasma proteins and return of edema. Diet 3 containing 26 gm. of animal protein was then administered, resulting in a marked gain in nitrogen, increase in plasma proteins and disappearance of edema. This was followed by Diet 4 in which there were 50 gm. of vegetable proteins. With this diet containing almost double the amount of protein of the previous diet, the extent of positive nitrogen balance was approximately the same. The level of plasma proteins showed a slight tendency to rise in Case 1, and remained about the same in Case 2. Diets 5 and 6 containing 2 gm. and 10 gm. of vegetable proteins respectively were intended to reproduce edema. The result was a marked nitrogen deficit accompanied by a moderate decrease of plasma proteins and reappearance of edema. The lat-

[1] Denton, M. C., and Kohman, E. A., *J. Biol. Chem.*, 1918, **36**, 249.

[2] Frisch, R. A., Mendel, L. B., and Peters, J. P., *J. Biol. Chem.*, 1929, **84**, 167.

[3] Shelburne, S. A., and Egloff, W. C., *Arch. Int. Med.*, 1931, **48**, 1.

ter, however, was not so pronounced as on the previous occasion.

In conclusion it may be stated that nutritional edema is definitely related to the level of plasma proteins which can be easily influenced by the level and quality of protein intake. It seems that 1 gm. of animal protein per kilo is much superior to the same amount of vegetable protein in building up plasma proteins and reducing edema, and that 2 gm. of vegetable protein seem necessary to secure the same effect as produced by 1 gm. of animal protein.

5825

Nutritional Edema. II. Effect of Alkali and Acids on Nitrogen Balance, Plasma Proteins and Edema.

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The 2 patients reported in the previous paper were studied from the standpoint of the effects of displacements of their blood acid-base balance on nitrogen balance, plasma proteins and edema. They were given known diets containing 1400 calories and enough vegetable proteins to secure nitrogen balance. The salt and water intake was kept approximately constant. Alkalosis was produced by the administration of sodium bicarbonate 12 to 20 gm. per day for one to two 4-day periods, and acidosis by 10% hydrochloric acid 30 cc. per day for 3 days or ammonium chloride 8 gm. per day for 4 or 5 days. There were altogether 3 experiments with alkali, one experiment with hydrochloric acid and one experiment with ammonium chloride with each individual. The results can be summarized as follows:

With each alkali administration, there was definite increase in edema with increase in body weight reaching a maximum within 3 or 4 days. Thereafter the edema began to subside and weight began to decrease in spite of continued alkali ingestion. With hydrochloric acid edema showed a slight diminution in Case 1 and remained unchanged in Case 2. The ingestion of ammonium chloride, however, resulted in a decrease of edema and weight in both cases.

The nitrogen balance in either case remained undisturbed with alkali or acid administration. The plasma proteins showed a slight lowering during several of the periods of alkali adminis-