and at the same time reduced urinary chlorides, both in concentration and total amount excreted. Entirely reversed effects were observed after post-pituitary extract administration. Further, when post-pituitary extract and desoxycorticosterone were injected together, the action of the former substance always appeared dominant. The increased chloride output in untreated adrenalectomized rats, and decreased output along with increased water intake and urine secretion in untreated hypophysectomized animals, may be noted. Young normal rats about 125 gms. in weight responded to desoxycorticosterone better than older animals.

To be emphasized also are the large increments in fluid exchange effected by desoxycorticosterone, and the marked increases in chloride elimination after post-pituitary injection. In the former case the changes in water intake and urine output approximated 100 per cent., and in the latter (chloride output) 100 to 500 per cent. in different series. Extraordinarily large amounts of chloride may thus be forced from the body through post-pituitary action.

The water-intake: urine-output ratios (W/U) were greatly reduced in all cases by post-pituitary extract —by 50, 55 and 70 per cent. in the 3 series. In contrast to the resultant deficits of water in pituitary-treated animals, there were apparently increases in body water in normal rats treated with desoxycorticosterone. Hematocrit readings were in keeping with these findings: in all cases tested in which desoxycorticosterone was given, the total cell volumes fell continuously over a period of 12 hours.

It appears clear from the results above, therefore, that the adrenal cortex and the post-pituitary tissues elaborate principles which specifically counteract each other in their effects on the kidney, and on salt and water balance in the body. In this connection one may recall that desoxycorticosterone has recently been found responsible for severe reactions (edema, hypertension) and some deaths in the clinic because of overdosage or cumulative action. Possible utilization in dangerous situations of the physiological antagonist to desoxycorticosterone, post-pituitary extract, should of course be kept in mind.

It may be observed that desoxycorticosterone does not exactly reproduce the effects that are brought about by cortico-adrenal extract. The action of the latter is much greater, particularly on carbohydrate levels in the body.[10] Moreover, there are surely other hormones besides those controlling body water to be found in whole cortico-adrenal extract and in post-pituitary preparations. The results herein show that the organism is intimately dependent on a balanced relationship between the adrenal and pituitary mechanisms for normal salt and water regulation in probably all body fluids and tissues.

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[10] S. W. Britton and E. L. Corey, *Am. Jour. Physiol.*, 129: 316, 1940.

NUTRITIONAL FACTORS CONCERNED IN RUSTING OF ALBINO RATS

THERE have been several recent reports in the literature concerning the achromotrichia factor and the rusting factor which offer some differences in observations. Györgyi and his coworkers[1] report that graying of black or piebald animals and, presumably, rusting of albino animals when placed on a suitable diet can be prevented by addition of pantothenic acid to that diet. Dimick and Lepp[2] report that pantothenic acid decreases graying of fur. Unna[3] reports that with 80 μgm of pantothenic acid daily only fleeting signs of fur impairment were observed. Nielsen, Oleson and Elvehjem[4] have published a procedure for the separation of a substance which is not pantothenic acid but which prevents nutritional achromotrichia. Williams[5] has found that nutritional achromotrichia could not be cured by pantothenic acid when butter fat was omitted from the diet.

We have noted the occurrence of rustiness developing in our experimental albino rats during investigations of synthetic diets. It seemed that these results were worth mentioning because, if they are confirmed, they may open another way to attack the question of the relationship of pantothenic acid to nutritional achromotrichia and also the question of the identity of the achromotrichia factor and the rustiness factor.[6] Our observations were purely incidental and the problem will not be investigated further in our laboratories.

The basal diet used contains 68 per cent. sucrose, 18 per cent. vitamin-free casein, 7 per cent. butter fat, 2 per cent. cod liver oil, 1 per cent. Wesson oil and 4 per cent. salts.

In the first experiment a supplement containing 15 μgm thiamin hydrochloride, 20 μgm riboflavin, 250 μgm nicotinic acid, and 20 μgm choline hydrochloride was fed daily six days a week. In every case rustiness was noted in 4 weeks. If 20 μgm of pyridoxine was added rustiness was noted in 4 to 7 weeks. Any sign

[1] P. Györgyi, C. E. Poling and Y. Subbarow, *Proc. Soc. Exptl. Biol. Med.*, 42: 738, 1939; *Jour. Biol. Chem.*, 132: 789, 1940; P. Györgyi and C. E. Poling, SCIENCE, 92: 202, 1940.

[2] M. K. Dimick and A. Lepp, *Jour. Nutrition*, 20: 413, 1940.

[3] K. Unna, *ibid.*, 20: 565, 1940.

[4] E. Nielsen, J. J. Oleson and C. A. Elvehjem, *Jour. Biol. Chem.*, 133: 637, 1940.

[5] R. R. Williams, SCIENCE, 92: 561, 1940.

[6] S. Ansbacher, SCIENCE, 93: 164, 1941, has shown that *p*-aminobenzoic acid is the chromotrichia factor for black or piebald rats. Whether this substance prevents rustiness in albino rats is still to be ascertained.

of dermatitis or rustiness could be cured or prevented by addition of 4 gm of potato to the daily diet.

In the second experiment 20 μgm of pantothenic acid and 20 μgm of pyridoxine were added to the supplement and the choline was increased to 20 mgm. Again rustiness was noted in 5 to 6 weeks.

In the third experiment pantothenic acid was increased to 40 μgm, keeping the rest of supplement the same as in the second experimnt. No rustiness was found.

In a fourth experiment the pantothenic acid was increased to 80 μgm, and again no rustiness developed. This experiment extended over 13 weeks with no untoward symptoms developing in that time. However, if the choline was omitted from the diet, rustiness developed in 6 weeks regardless of the high level of pantothenic acid.

The conclusions that can be drawn from these experiments are that rustiness can be produced with the albino rat provided choline or pantothenic acid is omitted from the diet and that it can be prevented if the diet is supplemented by at least 40 μgm of pantothenic acid and by 20 mgm of choline (this may be well above the actual requirement). The implication is that no matter what the factors are that prevent development of rustiness in albino rats, the liver must play an important role in their metabolism. Our observations on pantothenic acid agree with those of Györgyi and his coworkers. In a communication from Dr. Györgyi it is stated that he included 1 gram of choline per kilogram of the diet used in the experiments reported by him and his coworkers.

We wish to acknowledge our indebtedness to Dr. R. J. Williams for a generous sample of sodium pantothenate and to Merck and Company for generous samples of calcium pantothenate and pyridoxine. We also thank Dr. Paul Györgyi and Dr. R. R. Williams for their suggestions and criticisms.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

AN APPARATUS FOR PRODUCING CONSTANT GAS MIXTURES[1]

STUDIES on anoxia have often been limited because of the prohibitive cost and variation in composition of commercial gas mixtures. With these facts in mind, an apparatus has been designed by means of which constant mixtures of atmospheric air and nitrogen can be made economically.

As seen in the diagram, two wet gas meters of three-liter capacity[2] are connected by means of ladder chain G and sprocket gears H and H′. Nitrogen from a cylinder is introduced into the first meter A after passing through bottle C. Water manometer E acts as a safety valve. The nitrogen originates as compressed gas and passes through meter A, creating enough mechanical force to turn meter B at a corresponding speed. Air, drawn into meter B as it revolves, passes into bottle D, where it mixes with nitrogen from meter A. Any change in rate of flow of nitrogen through meter A causes a similar change in

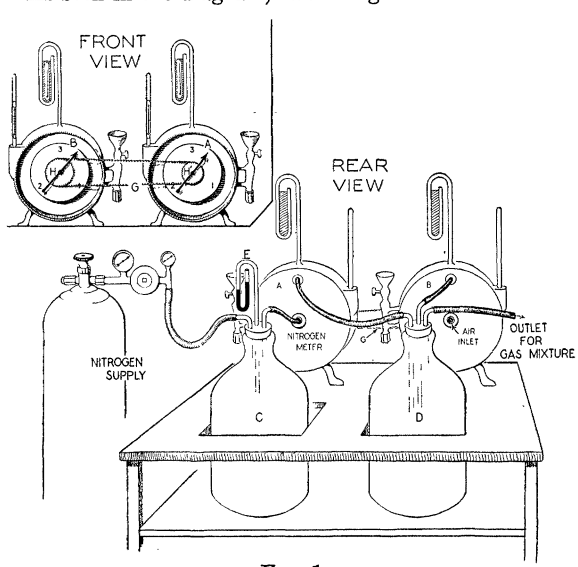

FIG. 1

TABLE 1

ANALYSIS OF GAS MIXTURES FROM THE APPARATUS (HALDANE HENDERSON METHOD)

Gear Ratio H : H′	Observed O_2, Vol. Per cent.	Observed CO_2, Vol. Per cent.	Observed N_2, Vol. Per cent.	Expected N_2, Vol. Per cent.
4 : 3	11.82	0.05	88.13	88.02
4 : 3	11.72	0.07	88.21	
1 : 1	10.33	0.01	89.66	89.51
1 : 1	10.22	0.01	89.77	
1 : 2	6.94	0.04	93.02	93.03
1 : 2	6.89	0.03	93.08	
1 : 3	5.35	0.01	94.64	94.75
1 : 3	5.38	0.03	94.60	
1 : 4	4.17	0.03	95.80	95.80
1 : 4	4.18	0.02	95.80	

[1] This study was aided by a grant made to Dr. G. W. Thorn by the Committee on Research in Endocrinology, National Research Council.

[2] American Meter Company, Model A L 18–3 (3 liters).