The above studies indicate that injections of extracts of human pregnancy urine induce marked changes in the pituitaries of immature and mature female rats, if the ovaries are present. Changes occur in both the basophiles and the eosinophiles, particularly notable was a loss of granular material. This is usually extreme in the basophiles and more or less marked in the eosinophiles. (The eosinophiles show granular loss only when active corpora lutea have been stimulated in the ovaries.) The granular cells, being depleted of granules, become chromophobes. Such loss of granules from either the eosinophiles or basophiles (or both) has been considered indicative of an active secretory state.

7330 C

Effects of Fat-Free Diet on Histological Fats in Various Organs of the Rat.

H. G. RICE AND C. M. JACKSON.

From the Department of Anatomy, University of Minnesota.

It has been shown[1] that rigid exclusion of fat from the diet of the rat induces a characteristic deficiency disorder, since the animal is apparently unable to synthesize certain fats which are necessary. The present study was undertaken to determine whether the histological fat distribution in the various organs is affected in this disorder. The organs studied include the liver, kidney, trachea, lung, skin and tela subcutanea.

Through the courtesy of Doctors Burr and Brown, 26 typical test rats that had been maintained several months on the fatless diet (No. 550B, plus vitamin supplements) were available, together with 5 rats "cured" by the subsequent addition of the necessary fats to the diet. These rats were killed by chloroform and autopsied in the usual way. The fats were studied chiefly in formalin-fixed, frozen sections stained with a solution of "oil red O" in diacetin (which presumably stains all fats and lipoids), though in some cases other methods were used. The technique is explained in detail in a separate paper dealing with the normal distribution of fats at various postnatal stages in the rat.[2] Both test rats and controls were females of the Wistar strain.

[1] Burr, G. O., and Burr, M. M., *J. Biol. Chem.*, 1929, **82**, 345; 1930, **86**, 587. Burr, G. O., and Brown, W. R., PROC. SOC. EXP. BIOL. AND MED., 1933, **30**, 1349.

[2] Rice, H. G., and Jackson, C. M., *Anat. Rec.*, in press.

For comparison, 3 types of controls were used. (1) Eleven *direct controls* were reared on the same fatless diet (550B) with the addition of the necessary vitamins and fat. This is a high carbohydrate diet, containing 84% sucrose. (2) Eight *stock diet controls* were reared on our normal colony diet (McCollum's diet I), containing 67.5% ground wheat, 15% casein, 10% whole milk powder, and 5.2% butter-fat. (3) Since the test rats were retarded in growth and somewhat emaciated, 5 *inanition controls* were held by simple underfeeding of the stock diet at a body weight corresponding to that of the test rats.

The histological appearance of the fats and lipoids in the various organs of the normal rat (on both normal stock and high carbohydrate diets) is described elsewhere.[2] In general, we find that the trachea, lung and skin, aside from individual variations, show essentially the same amount, character and distribution of fats in all the groups studied, both test rats and controls. The *tela subcutanea,* however, is definitely atrophic in the test rats and inanition controls. This is probably due to the general state of undernourishment, producing moderate emaciation in these 2 groups.

In the liver, the test rats show a variable amount of fat in both glandular and Kupffer cells. The fat appears as fine granules (liposomes), and often also as coarser droplets especially in the periphery of the hepatic lobules. In some cases the hepatic fat in the test rats does not exceed that in the stock diet controls; in others the fat is abundant and definitely increased. The liver in the "cured" group usually shows a similar increase of fats and lipoids. In the direct controls (on high carbohydrate diet) there is likewise a tendency to an increased amount of visible hepatic fat, in agreement with the observations of Jackson.[3] Also in the inanition controls there is more hepatic fat than in normal stock controls, which were fully fed on the same diet. Jackson[4] reviewed the literature showing that hepatic steatosis may occur under various dietary conditions, including overfeeding as well as inanition of different types.

The kidney is of especial interest as the site of characteristic lesions in the fat-deficiency disorder.[5] In the test rats the amount of fat in the renal cortex varies from scanty to abundant. It may occur as liposomes in the cells of the convoluted tubules and, to some extent, in the interstitial tissue. In the renal medulla the fat is simi-

[3] Jackson, C. M., *J. Nutrition,* 1930, **3**, 61.

[4] Jackson, C. M., *The Effects of Inanition and Malnutrition upon Growth and Structure,* Philadelphia, 1925.

[5] Borland, V. G., and Jackson, C. M., *Arch. Path.,* 1931, **11**, 687.

larly variable, but with a tendency to greater abundance, especially in the interstitial tissue. Liposomes of variable size may occur in the epithelium of the papillary ducts and surface of the pyramids. They are also very frequent in the epithelium of the loop of Henle, which also often contains fatty casts. Borland and Jackson[5] thought that the fat in these casts is probably excreted through the convoluted tubules. There is no evidence for a glomerular origin.

In the direct controls (on high carbohydrate diet) as well as the "cured" group the amount of renal fat is likewise usually somewhat increased in comparison with that found in the normal stock diet controls. This is in agreement with Borland and Jackson.[5] Wegelin[6] also found increased fat in the renal epithelium and interstitial tissue of animals on high carbohydrate or fatty diets. He interpreted this as evidence of renal secretion of excess fat. The inanition controls of the present series likewise show a tendency toward increased renal fat, which is a typical effect of inanition.[4]

In summary, the test rats on fatless diet show no apparent change in the amount, character and distribution of the visible (stainable) fats in the trachea, lung and skin. The decrease of fat in the tela subcutanea is probably due to the moderate emaciation of the test rats. The frequent increase of fats and lipoids in the liver and kidney may be ascribed to the effect of 2 factors—the high carbohydrate diet and the state of general undernourishment. It may, therefore, be concluded that the fatless diet apparently produces no *specific* changes in the visible fats and lipoids of the organs examined.

7331 C

Factors which Determine Renal Weight. XVII. Influence of Age.

EATON M. MACKAY AND LOIS LOCKARD MACKAY.

From the Scripps Metabolic Clinic, La Jolla, California.

We have concluded (MacKay and MacKay[1]) that in the albino rat the kidney weight has practically the same relation to body surface at all ages. In a broad sense this is true. However, a close inspection of the data presented at that time, omitting the less reliable figures obtained after 400 days of age, shows a slight but definite

6 Wegelin, C., *Berl. klin. Wchnschr.*, 1913, **50**, 2125; 2190.

1 MacKay, L. L., and MacKay, E. M., *Am. J. Physiol.*, 1927, **83**, 191.