MINNESOTA BRANCH

University of Minnesota, April 1, 1925.

196 (2719)

Spontaneous nephritis and compensatory renal hypertrophy in albino rats on diet deficient in vitamin A.

By C. M. JACKSON.

[*From the Department of Anatomy, University of Minnesota, Minneapolis, Minn.*]

An epidemic of nephritis occurred in our colony of albino rats *(Mus norvegicus albinus)*, which during the past year had been fed a modification of the McCollum-Greenman cereal mixture, as follows: oatmeal, 1500 grams; cornmeal, 1500 grams; whole wheat flour, 1500 grams; flaxseed oil meal, 500 grams; bone meal, 75 grams; sodium chloride, 25 grams; dried milk powder, 250 grams. In addition, raw liver was fed weekly, and fresh cabbage twice a week. City water was supplied *ad lib.*

For a while, the rats seemed to thrive fairly well on this diet, although growth was somewhat retarded and reproduction subnormal. The presence of nephritis was discovered last December, during the course of some experiments on compensatory renal hypertrophy. The nephritis usually appeared chronic in form, though in some cases acute and fatal. Apparently all the rats in the colony were affected. The proportion of milk powder was doubled, fresh milk was added to the mixture, and cabbage fed thrice a week, but there was no improvement.

Sixty-five of the rats above 112 grams in body weight were killed, and the weights of the kidneys were compared with Donaldson's Wistar norm for corresponding body length. In 16 cases, the kidneys were above normal (maximum +63 per cent), and in 49 cases below normal (minimum —35 per cent). In spite of this variation in total kidney weight, the two kidneys of the same rat differed but little in weight. The left kidney weight was slightly less in 43 of the 65 cases, however, the general average being 4.6 per cent below the right (total range —18 to +13 per cent).

The kidneys frequently appeared light brown in color, occasionally slightly mottled. The surface sometimes appeared smooth, but often (especially in advanced cases) irregular, with numerous small granules and depressions. The capsule was readily separable. On gross section, the fresh surface usually appeared pale and translucent, often showing yellowish radial striæ in the cortex.

In histological preparations, a peculiar interstitial nephritis was found, apparently beginning near the cortico-medullary junction, and extending variably into the cortex, often along the intralobular vessels. Local infiltrations of nononuclear cells were found in the earlier stages, with variable fibrosis and progressive degeneration of the renal tubules later. The renal (Malpighian) corpuscles appeared relatively resistant. Some of the collecting tubules were apparently obstructed, resulting in characteristic, enormous dilations, up to 1 mm. in diameter, filled with secretion, cellular detritus or pus, and lined by cuboidal or flattened epithelium. In extreme cases, the entire uriniferous tubule, excepting the glomerular region, may be distended.

Ophüls and McCoy[1] found a similar spontaneous nephritis with numerous cysts in 2 per cent of captured wild rats. They also produced a similar nephritis in white rats by subcutaneous injection of uranium nitrate, the controls remaining free from lesions. They considered this cystic renal condition characteristic of the rat, but various investigators have observed somewhat similar cystic dilations in the spontaneous nephritis of the rabbit and guinea pig.

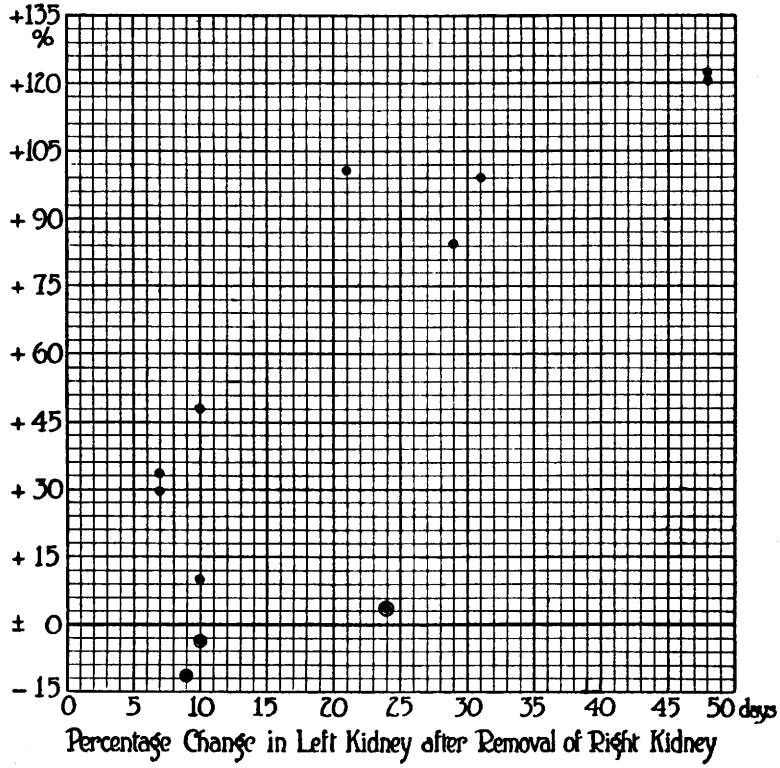
While the immediate cause of the nephritis in the present series was probably an infection, it is possible that a lowered tissue resistance, due to deficient diet, may have been a factor. The diet used appears somewhat deficient in animal protein, and especially in vitamin A. The latter deficiency was evidenced by the frequent appearance of xerophthalmia (conjunctival hemorrhage) in the affected rats. Since vitamin A deficiency is said to favor infections also of the respiratory and alimentary tracts, it may likewise lessen the resistance of the kidney. This might explain the appearance of nephritis in a rat colony in which it had not been found in previous years. It appeared also within two months in a dozen healthy young rats obtained from the

[1] Ophüls, W., and McCoy, G. W., *J. Med. Res.*, 1912, xxvi, 249.

Wistar Institute and put on the same diet, though placed in new cages and kept isolated from the old colony.

The heart and lungs usually appeared normal in the affected rats, the abdominal viscera in general atrophic and devoid of fat. The thorax seemed narrow transversely, with a marked ventral protuberance in the sternal region. Otherwise the skeleton showed no marked gross deformity. The incisor teeth, however, were abnormal, chalky white in color, usually enlarged and irregular, sometimes broken. The upper incisors were often greatly elongated and recurved, failing to articulate with the lower teeth.

In 12 male nephritic rats 8 to 9 months old, weighing 205 to 240 grams, the right kidney was removed (by lumbar incision, under ether anesthesia) and weighed. The same diet was continued, and the wounds healed promptly. In three cases, the rats died in 9 to 24 days, and the remaining left kidney (see en-



circled dots in the accompanying chart) had apparently changed but little in weight. The other 9 rats were killed after various intervals. With one exception, the remaining kidneys showed a progressive increase in weight, varying from about 30 per cent in 7 days to 120 per cent in 48 days. The body weight simultaneously decreased 10 to 38 per cent. Histological study indicated that the increase in renal weight after unilateral nephrectomy was due chiefly to increased dilation of the tubules, but partly to glandular hypertrophy. No change in weight or structure of the kidneys was apparent in 6 control (nephritic) rats kept for corresponding periods after the same operative procedure, but without nephrectomy.

197 (2720)

The relation of learning and retention to the extent of cerebral lesions in the rat.

By K. S. LASHLEY.

[*From the Department of Psychology of the University of Minnesota, Minneapolis, Minn.*]

In a preliminary study of the mass factor in neural function, lesions of various sizes were produced in the visual areas[1] of the cerebral cortex of fourteen rats. The animals were then trained in a habit of brightness discrimination, and the amount of practice required for learning, as indicated by the total number of errors made before the habit was perfected, was correlated with the locus and extent of the lesions. The destructions involved from 13 to 40 per cent of the entire cerebral cortex. The operated animals required an average of 148.4 trials for learning, with an average of 45.6 errors. The average for 60 normal animals in the same problem is 139.7 trials with 41.5 errors. The difference is not significant. All parts of the occipital third of the cerebral cortex were explored in this series, and the rate of learning is apparently unaffected by the locus of the injury. The rank-order correlation between the amount of cortex destroyed and the number of errors made in learning is 0.084. The rate for

[1] Lashley, K. S., *Am. J. Physiol.*, 1922, lix, 44.