

III.—The Effects of Diet on the Development and Structure of the Uterus. By Malcolm Campbell, M.B., Ch.B., F.R.C.S. Edin.  
(From the Physiological Department, University of Edinburgh.)  
Communicated by Professor SCHÄFER, F.R.S. (With Four Plates.)

(MS. received November 27, 1906. Read December 3, 1906.)

THE investigation was undertaken to discover what changes, if any, were produced in the development and structure of the uterus by various diets.

The animals employed in the research were rats. The uteri of 86 animals were examined, both macroscopically and microscopically. The tissue for microscopic examination was removed in all cases from, as nearly as possible, the same area, viz., the junction of the distal and middle thirds of the uterus.

Eight wild rats, in various stages of development, from the immature to the adult animal, were examined in order to form an opinion as to the structure of the uterus in animals living, presumably, under natural conditions.

The remaining animals were divided into five series, viz. :—

(a) A series of 13 animals fed from weaning, for periods of from 9 to 14 weeks, on an exclusively milk diet. In one section of this series plain milk was used; in another, Pasteurised milk; in the third, sterilised milk.

(b) A series of 27 animals fed for periods of from 21 days to 9 months on bread soaked in milk.

(c) A series of 11 animals fed for periods of from 4 to 14 weeks on a rice diet.

(d) A series of 5 animals fed for varying periods on a diet of porridge or oats.

(e) A series of 22 animals fed for periods of from 21 days to 8 months on a raw meat diet.

In the cases of the raw meat and rice diets, some animals were put on the diet as soon as weaned, others after they had reached various stages of development.

The uterus of the adult wild rat is lined by columnar epithelium. There are glands lined by epithelium which varies from low cubical to columnar in type. The mucous coat is bounded externally by a muscular coat.

In the mucous layer three varieties of cells are found :

(1) A cell with a large round or oval, relatively faintly staining nucleus. This appears to be a young connective tissue type of cell.

(2) A cell with a small, round, darkly staining nucleus, comparable to a lymphoid cell.

(3) A cell with an elongated, very darkly staining nucleus, similar to cells in fibrous tissue.

In the wild rat the large cells are most numerous (fig. 5). The cells of the other types are few in number, and are found only in that part of the mucosa near the muscular coat.

From the examination of this series of 86 animals, it is evident that in animals of the same age, and approximately of the same weight, living under similar conditions, the uteri may vary, within a limited range, in size and development. The muscular coat is relatively uniform; the mucosa shows the greatest variations. While in most cases the epithelium lining the cavity is columnar, in some it is cubical. There are also found marked variations as to the position of the nucleus, and also as to its staining capacity.

The animals fed in groups (1) and (2), on milk, and bread soaked in milk, approximate most nearly to the type of structure seen in the wild rat. The only difference is that the cells are not quite as large as in the wild rat (compare fig. 5 with fig. 6). In the other groups, fed on what we may term "abnormal diets," viz., rice, porridge or oats, or raw meat, there is found a relatively constant departure from the normal. The type of change is common to all abnormal diets; its severity varies.

The severity of the changes induced are found to be in proportion to the ages of the animals at the time when the abnormal diet was begun. The changes are most marked in the animals put on the diet at weaning, they are less marked the more mature the animals at the time of the commencement of the abnormal diet. In a fully-developed animal any abnormal diet may fail to materially change either the size or structure of the uterus.

In regard to the development of the uterus, an abnormal diet appears to arrest its growth (compare figs. 1 and 2, also figs. 3 and 4). This arrest of development is most marked in animals fed from weaning on ox-flesh, but is also very well seen in animals fed on rice or on porridge or oats.

In regard to structure, all the abnormal diets lead to a diminution of the number of the large connective tissue type of cells and a relative increase in the small cells.

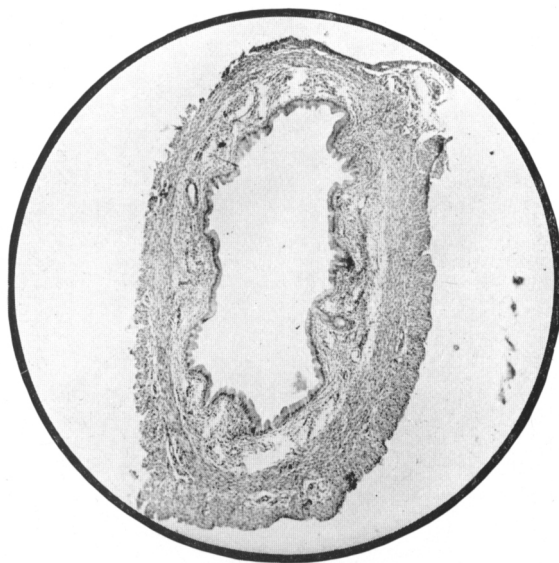


FIG. 1.—Uterus of Young Rat, æt. 10 weeks, Bread-and-Milk-fed. ( $\times 30$ .)

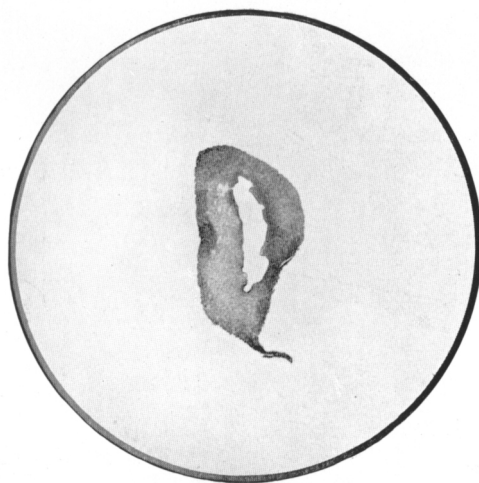


FIG. 2.—Uterus of Young Rat, æt. 10 weeks, Meat-fed. From same litter as fig. 1. ( $\times 30$ .)



FIG. 3.—Uterus of Adult Rat, Bread-and-Milk-fed. ( $\times 30$ .)

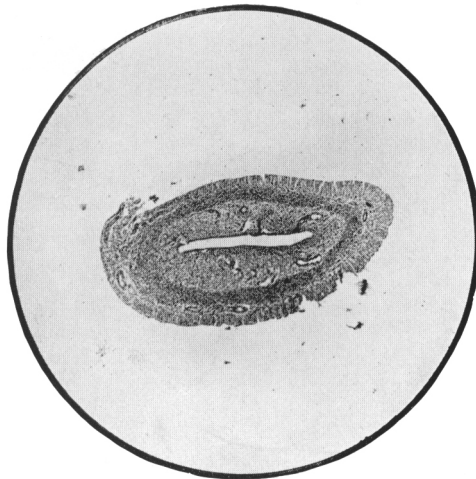


FIG. 4.—Uterus of Adult Rat, Meat-fed. ( $\times 30$ .)



FIG. 5.—From Uterus of Wild Rat, showing large cells. ( $\times 500$ .)

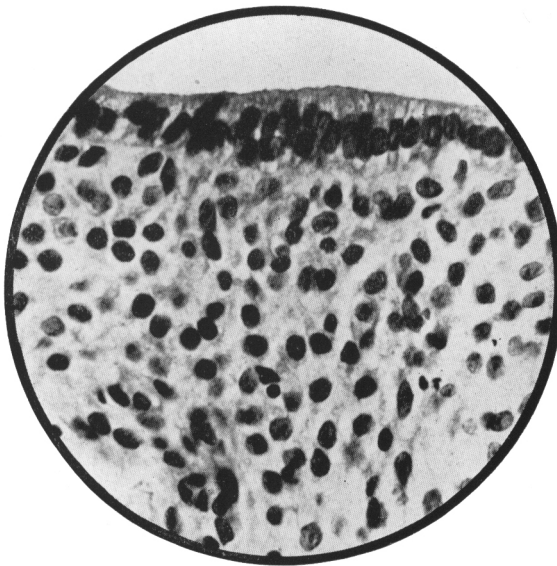


FIG. 6.—From Uterus of Bread-and-Milk-fed Rat, showing large cells. ( $\times 500$ .)

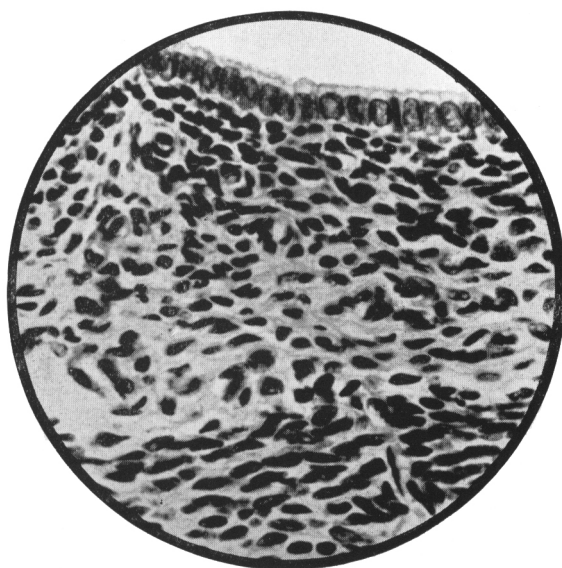


FIG. 7.—From Uterus of Meat-fed Rat, showing fibrotic change in cells of mucosa. ( $\times 500$ .)



This change, which may be described as a fibrosis (compare fig. 7 with figs. 5 and 6), was most marked in animals fed from weaning on an ox-flesh diet, for periods of from four to five months; in this group of animals none became pregnant, while controls from the same litters, fed on bread and milk, all had young.

From these observations it seems justifiable to state:

(1) The use of a non-physiological diet, *e.g.* exclusive flesh, rice, or porridge, induces, in the great majority of cases, a modification in the structure of the uterine mucous membrane. This modification consists in a diminution in the number of the large connective tissue type of cells, which appear to be important constituents in a physiologically active mucosa.

(2) The structural change is most profound in animals fed from weaning on an exclusively flesh diet. In such animals the development of the uterus is also most interfered with.

(3) The structural change in (2) is associated with sterility.\*

\* The expenses of this research were in part defrayed by a grant from the Carnegie Trust.

*(Issued separately February 11, 1907.)*