Case 3. Both roots of upper 6 left lumbar nerves cut.	Gray ramus of L. VI.	12	42
	Gray ramus of L. VII.	0	0
	Gray ramus of S. I.	0	6
	Total	12	48

Inasmuch as the preganglionic components of the efferent chains involved in the sympathetic innervation of the peripheral blood vessels and other tissues in the area of distribution of the somatic rami of the spinal nerves terminate in the ganglia of the sympathetic trunk, any fibers which join the spinal nerves through the gray rami, except those of sympathetic origin, must be regarded as fibers of spinal ganglion origin. The animals used in this study were young dogs whose gray rami contain relatively few myelinated fibers. Consequently, the myelinated fibers present were easily counted. The difference between the number of myelinated fibers in the corresponding gray rami on the normal and operated sides represents the number of myelinated posterior root fibers present. This number need not be regarded as representing the total number of fibers of spinal ganglion origin in the gray rami in question, since many posterior root fibers are unmyelinated.

The posterior root fibers which join the brachial plexus, through the gray rami arising from the stellate ganglion are components of the thoracic nerves, and probably belong to the same segments as the preganglionic components of the efferent chains with which they are associated functionally. Those which join the lumbosacral plexus, through the gray rami of the lower lumbar and sacral nerves, are components of the lower thoracic and upper lumbar nerves, and probably belong to the same segments as the preganglionic components of the efferent chains involved in the sympathetic innervation of the lower extremity.

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Heredity and Internal Secretion on Origin of Mammary Cancer in Mice.

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More than 20 years ago Loeb in preliminary investigations on the heredity of cancer in mice first applied to the analysis of this prob-

lem a method which allowed the establishment of the significance of heredity in mice on a much more secure basis than was possible by the use of the statistical methods similar to those employed in the study of the influence of heredity in human cancer. This method consisted in the breeding of separate families and strains of mice in the same breeding establishment and in the study of the cancer rate in successive generations of strains which had thus been kept under similar conditions as far as the outer environment was concerned. By this method he found in cooperation with Miss Lathrop that heredity was a factor of very great significance in the origin of cancer of mice.[1] While certain strains had a cancer rate approaching zero, other families had a rate approaching 80% or more. In successive generations these differences between different strains remained approximately constant.

However, in the further analysis of the causes of mammary cancer in mice we found that in addition to heredity, the functional activity of the sex organs played a significant part in the origin of cancer of mice. We found that the prevention of mice from breeding lowered the cancer rate definitely and that in different strains the effect of the prevention of breeding differed in intensity. However, we found castration of the mice to be of even greater significance and moreover the effect of castration was the greater, the earlier the ovaries were removed. A quantitative relation was thus established between the internal secretion of the ovary and the frequency with which cancer appeared in the breast of mice. The growth stimuli emanating from the ovary and affecting rhythmically the mammary gland acted thus in a similar quantitative manner to tar, which when applied experimentally to the skin also produced cancer the more frequently and the earlier, the earlier and oftener the tar had been used. In both cases, cancer would develop a long time after these 2 types of stimuli had ceased to act. Stimuli developing in the outer and inner environment acted therefore in a similar manner in the causation of cancer. These latter investigations were subsequently confirmed and extended by Cori.[2]

As to the mode in which heredity leads to the development of mammary cancer in mice and through which mechanism it becomes potent, nothing definite is known at the present time. In view of the fact that in addition to the hereditary factor the functional activities of the sex organs greatly influence the incidence of cancer in mice, it is conceivable that the hereditary condition itself acts through hereditarily transmitted differences in the functional activ-

[1] Loeb, Leo, *Am. Naturalist*, 1921, lv, 510.

[2] Cori, C. F., *J. Exp. Med.*, 1921, xlv, 983.

ity of the ovaries. If such a relation should exist, it should be possible to establish it by comparing the sexual periodicity in female mice belonging to strains with a very high cancer rate with the periodicity of the cycle in mice not belonging to such strains. We obtained through the kindness of Mr. M. C. Marsh of the State Institute for the Study of Malignant Diseases in Buffalo, female mice belonging to a strain in which the cancer rate exceeded 80%. In a number of these animals we studied the length of the oestrous cycle and found it to be on the average very similar to the cycle of ordinary white control mice in which, while the cancer rate had not been definitely established, it did not appear to be high. In the strain with a high cancer rate the length of the cycle was slightly greater than in the controls. The duration of the oestrous cycle in the tumor strain was likewise slightly greater than in the ordinary white mice previously studied by Allen.[3] In several of the mice in the high tumor strain cancers developed while under observation. We found that the appearance of the tumor did not greatly alter the length of the oestrous cycle. We furthermore had at our disposal through the kindness of Miss Clara J. Lynch from the Rockefeller Institute a strain of brown mice with a relatively low cancer incidence in animals kept from breeding. In these mice the sexual cycle was on the average longer than in the white mice belonging either to the ordinary strain or to the high tumor rate strain. This fact also corresponds to previous observations of Allen, who found in a strain of brown mice which he examined the length of the sexual cycle to be greater than in ordinary white mice.

On the basis of these studies of the sexual periodicity in mice, we may conclude that there is in all probability no definite relation between the length of the sexual cycle in these animals and the hereditary tendency to cancer, in the sense that mice with a higher cancer rate have a shorter sexual cycle, and we must therefore in all probability seek the point of attack of the hereditary factors not in the functional activity of the ovary but elsewhere. However, we consider these studies as preliminary and we hope to be able to continue them.

In conclusion we may point out that the fact that variable conditions in the inner environment of the animals greatly influence the incidence of cancer in addition to heredity, complicates the analysis of the genetic factors which determine the mode of hereditary transmission, and that in the study of cancer in hybrids we can not expect simple ratios under these circumstances.

[3] Allen, E., *Am. J. Anatomy*, 1922, xxx, 297.