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From the Otho S. A. Sprague Memorial Institute and the University
of Chicago.

**The incidence
and inheritability of spontaneous cancer in mice.
(Preliminary report.)¹⁾**

By

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My work on cancer is the outcome of four years of work on general problems in heredity, carried on at the University of Chicago in the Department of Zoology. During the progress of this work I accumulated a stock of some five thousand mice of known ancestry. With this stock, in which tumors had begun to appear spontaneously, I have conducted my study of cancer. I have never secured any tumor mice from outside. All have been reared from my own pedigreed stock.

This report is of the most preliminary nature and covers only a small part of one phase of the work, viz., the inheritability of cancer. All of my work is with spontaneous tumors only. All mice are allowed to die a natural death, and every mouse is autopsied as quickly as possible after death.

I have eliminated contagion as a factor in transmission of cancer as follows:

1) All materials used in the work — cages, boxes, dishes — are kept as nearly as possible sterile. Materials used for cancerous mice are not used for non-cancerous mice. The hands of all workers are sterilized before passing from tumorous to non-tumorous stocks.

2) By the following contagion tests:

House mice and other mice of non-tumorous strains are kept in the same cage with cancerous mice.

1) Presented to the American Society for Cancer Research. May 5, 1913.

When a cancerous mouse dies, non-tumorous mice are given the soiled cage in which the cancerous mouse has died, with all the debris soiled by the dead mouse.

The young of carcinomatous mothers are fed and reared by non-tumorous mothers; and the young of non-tumorous mothers are fed and reared by cancerous mothers. I have never had a case of contagion in any of these tests.

The purpose of the work is to ascertain definitely whether or not cancer is inheritable and I have used the same methods which I would use if I were testing for color, pattern, etc.

There are many difficulties in the way of definitely testing the inheritability of cancer:

1) Cancer does not appear early and the mice may be swept off by infections, accidents, etc., before they are old enough to show whether or not they would develop cancer, so that I believe any results will always show fewer cancers than are potential in the strain. Because cancer does not appear early, one must either breed before cancer appears, and for this he must carry a huge stock, since he is breeding largely in the dark with respect to the probability of cancer appearing later in any individual. Or, on the other hand, he may breed after the appearance of cancer; in this case he is likely to have feeble strains or none at all.

2) Cancer is likely to appear sporadically in any strain (not like color in a pure-bred strain). For example: there are only one or two recorded cases of cancer in house mice; yet (omitting one strain which I shall report on in this paper), I had one example in the first hundred of my autopsies on house mice, viz., desmoid sarcoma of the mammary gland in a male. This does not necessarily mean an percentage of one cancer in every hundred house mice. It may prove to be one in a thousand.

Again among my *Peromyscus Californicus* and *Novaboriensis* (the wild „Whitefoot“) I have one case in fifty, viz., Squamouscell carcinoma of the mouth, in a female.

Again I have strains, for example, the Japanese Dancing Mouse, which I have carried through from three to twenty-three generations without one case of cancer. I have four wholly different strains of these Waltzers without cancer, although many other workers have reported strains of Japanese Dancers which show frequent cancer.

Out of the mass of material gathered so far I have selected a very few cases to present in this paper.

Charts.

4 M. Gl. Carc.

♀ 1274

♂

Des. Sarc.	M. Gl. 2Sp. Cells	Sarc M. Gl. Neph.	Lung Nod.				Carc.	M. Gl.
Back & Sides ♀	2849 ♂	3053 ♂	4363 ♀	Living ♂	Living ♀	Living		

Chart No. I. — Strain 186. House mice (inbred).

Cross between female 1274 with cancer and a male who died before autopsies began. Whether or not he would have had cancer is uncertain.

Of their six young the three which have died showed (1) Desmoid Sarcoma of the mammary gland, (2) Spindle-cell Sarcoma of the mammary gland and (3) an early papillomatous lung nodule not yet cancer (This mouse died of nephritis).

Of the three living, one already has cancer of the mammary gland.

Tub. Pap. Cub. Cell
 Carc. M. Gl. Carc. Lung
 Metas. Pap.
 Lungs ♀ 158 ♂ 193
 Glds. ✕

Tub. Carc.	Lung	Pap. Carc.	Lung	Adeno-Carc.	M. Gl.	Pap. Tumor	Lung	Pap. Tumor	Lung
♂	38	♂	274	♀	293 H 9000 V	♂	741	♂	3133

✕

Alv. Sarc.	M. Gl.	Pul.	Infect.
Metas.			
Lungs ♀	529 H 9000 W	♂	553

Chart No. II. — Strain 139. Albino mice (inbred for over 25 generations).

Parents, female and male both had cancer. Every one of the young still living at the time my autopsies began, had tumors either benign or malignant.

Of their young the two which produced young, female 293 and male 274 both with cancer, had two offspring female 529 with sarcoma of the mammary gland, and male 553 who died young of pulmonary infection.

G. Par.		♀ 1478		×	♂ 452							
		Care. Lung Pap. Ade. Lungs				Sarc. Liver & Spleen		Care. M. Gl.				
								Pap. Tumor Lung (Prinn)				
G. ₁	♀	142	♀	236	♂	673	♂	1852	♀	2043	♀	2826
Uterine		Infect.	Un	certain	Sarc.	Thy.	Uncer	tain	Pleur.	Neph.	Ade.	Lung

Chart No. III. — Strain 245. Piebald grey-white strain from hybridization of purebred Japanese white-footed mouse and pure-bred albinos. (Both strains have shown cancer.)

from microscopic nodules to lungs riddled with cancer. Cases also occur of metastases in liver, kidney, spleen, glands, etc. I hope to make a fuller report of all of these results in the near future.

All mice in my laboratory are subjected to practically the same conditions (which might act as irritating causes) both external and those incident to the strain of living and of reproduction.

In the light of this fact and further, in the light of these finely graded series of tumors, the conclusions seems justified that hereditary strains determine whether or not a given irritating cause shall produce cancer in any individual.

I wish to express my sincere thanks to Dr. Gideon Wells, Director of the Spague Institute, for his assistance in diagnosis, and for his unfailing interest and support in every phase of my work.
