Little's laboratory (personal communication) showing the occurrence of 13 recently discovered spontaneous mammary gland tumors in females of the CBA line. The "functional test" that I have described above when applied to the C57 black "low-tumor" strain has already resulted in locating four females with mammary carcinoma. Twenty-one C57 females were included in this group. Five died when under 5 months of age, seven under 10 months and one at 13 months. One is alive at 10 months and three at 4 months of age. None of these showed tumor growth. The four females showed the first evidence of a mammary gland tumor when 6½, 8, 10 and 11 months of age, respectively.

In addition another female from "low-tumor" strain CBA developed a spontaneous mammary gland tumor when 13 months of age. This animal was from a group of 17 females and the only one to show a spontaneous growth. Of the remaining animals, twelve died when under 10 months of age, two at 13 months, one at 17 months and one at 18 months of age.

Conclusion: Increased functional activity of the mammary glands, under the conditions of the experiment described above, has resulted in masking any such reaction as an "extra-chromosomal influence" on the incidence of mammary tumors in mice as reported by Murray and Little. The results show that female mice, with hybrid vigor, whose mothers are derived from a strain relatively free from spontaneous mammary adenocarcinoma, have the capacity of producing such growths spontaneously, at a relatively early age, and in a high percentage of the females so far studied. The results are preliminary and are now being tested on a larger series of animals and using the exact crosses which Murray and Little have reported on.

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DELAYED KILLING OF MAIZE SEEDLINGS WITH X-RAYS

In the course of experiments with x-ray treatments of dry seeds of maize and related species, a range of dosages has been found which causes all the plants to die in the seedling stage without reducing the percentage of germination. This phenomenon has been termed "delayed killing." In the published accounts of lethal x-ray dosages applied to dry seeds little significance has been attached to the fact that seedlings may make growth before they die. A study of the seedlings that have lost—by previous x-raying of the seeds—something essential to their continued existence should throw light on the nature of the biological changes brought about by the x-rays.

Seeds of dent corn were exposed to a source of x-rays obtained from a Coolidge x-ray tube with tungsten anode operating under a constant potential of 48 kv. This provided a continuous band of radiation with maximum intensity at approximately 0.50 Å and a short wave-length limit of 0.26 Å. The x-ray dosages were measured by the use of a standard open-air ionization chamber according to the design developed at the National Bureau of Standards.[1] The ionization current was determined by means of a circuit for amplification of direct currents using the FP-54 pliotron.

The seeds (germ side up) were always placed upon a thin layer of cheesecloth which eliminated the effect of back secondary scattering. The ionization chamber could be easily placed in the equivalent position of the seeds for measurement of the dosage. In general the maximum error in the dosage measurements was less than 5 per cent. For a majority of the treatments the seeds were placed about 13 cm from the anode. The dosage then received was approximately 500 "r" units per min. for 6 milliamperes plate current at 48 kv. d. c.

The treated seeds were germinated in one of two ways. For comparing root and shoot elongation at the very early stages the seeds were placed in moist cloths or blotters in germinating chambers. For the study of delayed killing and seedling growth, the seeds were planted in sand contained in small flats placed on a clinostat in the greenhouse. With doses of less than 1,000 r units no differences were detected between treated seed and controls. Dosages from 1,000 to 20,000 r units showed increasing reduction in the rate of elongation with an occasional plant killed at the higher dosages. Treatments above 40,000 r units resulted in delayed killing, the percentage of killed plants increasing with the dosage. From 60,000 to 100,000 r units the *percentage of germination remained unimpaired but all plants died in the seedling stage.* An attempt was made to find the dosage that would inhibit germination. One lot given 1,000,000 r units germinated 39 per cent, and another lot given 2,400,000 r units failed to germinate at all. *It is estimated, therefore, that doses of approximately 2,000,000 Roentgens completely inhibit germination.*

At the time of emergence of the plumule in plants subjected to a lethal dose of 60,000 r units the rate of elongation is only slightly less than that of plants from untreated seeds. The rate decreases rapidly and elongation ceases altogether in about a week, at which time there will usually be a thick crumpled first leaf showing. After elongation has stopped the seedling remains green for about another week before dying. The stage at which the seedlings die shows that growth involving cell division has taken place and that the observed germination has not been simply cell expansion.

[1] L. S. Taylor and G. Singer, *Radiology*, 15: 637, 1930.

The plants from x-rayed seeds were grown under several widely different environments to determine whether it was possible to prolong their existence. These included various temperatures and light and dark chambers, but without exception death occurred in a similar manner under all conditions.

Something suggestive of delayed killing may be observed in old seed. In samples of maize that have been kept until they are nearly dead there will often be seeds that will sprout but die in the seedling stage. The delayed death of old seed, however, is not as clear cut as in x-rayed material and appears to differ in its nature. A few observations were made on the seedling stages of maize seeds injured by heat at 60°–65° C. In this material nothing in the nature of delayed death was found. All seeds that germinated in the sense of producing root and shoot continued to grow with no indication of "delayed killing."

Root tip material of maize seedlings from x-rayed seeds, old seeds and heat-treated seeds were examined cytologically by Dr. A. E. Longley. He found the number of dividing cells in all treated material to be much less than in controls. In the x-rayed material all mitoses were abnormal, many figures exhibiting pycnosis. The abnormality varied in degree from divisions with lagging chromosomes to those in which the chromatin was an undifferentiated amorphous mass. Dividing cells in the old material, though less numerous than in the x-rayed material, showed normal mitosis. In the heat-treated seeds there were dead areas and adjacent to these areas the cell divisions were normal.

These cytological findings are not in complete agreement with those reported in other species.

Working with *Crepis tectorum* L. Navashin[2] found chromosome aberrations in the root tips of plants from old seed that were strikingly like those in x-rayed material. In the later work Shkvarnikov and Navashin,[3] using high temperature to hasten the aging process, got similar results. The illustrations in their publication suggest that seeds of Crepis subjected to 25,000 r units show something similar to the delayed killing in maize.

Peto[4] reports an increasing mutation rate in maize with increasing age and in barley with high temperature, using chromosomal derangements as a measure of mutation.

Our failure to get abnormal mitoses with heat may be associated with the method used, but the absence of chromosomal abnormalities in the old seed examined by Longley is an outstanding difference.

From our limited cytological study it appears that in maize the primary effect of lethal dosages of x-rays is to derange the mechanism of mitosis to an extent that prevents the orderly separation of the chromosomes. Since cell division and growth continues for a time in the absence of normal mitosis it would appear that the cessation of cell division is an indirect effect of x-rays. In the absence of properly distributed chromatin, cells may divide, but the process can proceed but a short time. With aging or heat our experiments indicate that the mechanism of mitosis is unaffected and death appears to follow a more general failure of protoplasmic activity.

Aside from cytological considerations, if delayed killing proves to be peculiar to x-ray treatments, it will indicate a fundamental difference between the operation of x-rays and other lethal agencies.

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SOME PROPERTIES OF BAKED SOAPSTONES

HIGH-GRADE soapstone has been mined for centuries in China for the manufacture of carved utensils, ornaments, images of various forms, etc. According to Professor Jung Keng, of Yenching University, an expert in Chinese archeology, Chinese carvers of the Ming Dynasty (as far back as A.D. 1600, if not earlier than this) already knew that after it has been baked to certain temperature, soapstone will undergo a great change in its hardness and so they made use of this very property to prevent the particular characters and figures that they had carved on soapstone from being ground off by others.

Nowadays the uses of soapstone are many and varied and its suitability for certain uses depends closely on its physical and chemical properties. The authors present the following results of their tests on twenty-one samples of soapstone, collected from Hopeh, Shantung, Kiangsu, Chekiang and Fukien provinces, China.

I. *Volume resistivity of soapstones as a function of their baking temperatures.* By means of both the galvanometer and electrometer methods, as used by Curtis,[1] the volume of resistivity of 21 samples were measured, most of which are given in Fig. 1. It is seen that samples Nos. 1, 2, 20 and 21 are very suitable for electrical insulation at high temperatures. The rest either have been cracked into pieces at comparatively low baking temperatures or have much lower values of volume resistivity.

[2] M. Navashin, *Nature*, 131: 435, 1933.

[3] P. K. Shkvarnikov and M. S. Navashin, *Jour. de Biol.*, 4: 25–38. 1935. (Russian with English summary.)

[4] F. H. Peto, *Canadian Jour. of Research*, 9: 261–264, 1933.

[1] H. L. Curtis, "Insulating Properties of Solid Dielectrics," *Bulletin of the Bureau of Standards*, 11: 359–383, 1913.