

## 188 (2420)

Effects of sunlight on the malignancy of a transplanted tumor  
of the rabbit.

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Since the tumor upon which this report is based was first transplanted in the spring of 1921,<sup>1</sup> we have been engaged in a study of the problem of animal resistance as related to the growth and malignancy of the tumor with especial reference to factors of constitutional resistance and conditions that might cause an increase or decrease in animal resistance.

Several reports have been published dealing with some of the results of this series of investigations.<sup>2</sup> Among other things, it has been noted that although a good primary growth can be obtained in practically all rabbits by intratesticular inoculation, the ultimate malignancy of the tumor is subject to wide variations and that, from the beginning, there has been a striking tendency to the occurrence of periods of excessive malignancy during the spring and fall of each year. This focused our attention on the possible influence of meteorological conditions and led to a study of phenomena of resistance and of tumor growth from the point of view of meteorological influences. The results of these investigations contain many points of interest, but the present report will be limited to a consideration of sunlight.

The method employed involved the inoculation of a group of 5 to 10 rabbits each month. Inoculations were made by injecting 0.2 to 0.3 cc. of a cell emulsion into one testicle. The animals were then kept under observation for a period of two months, at which time the surviving animals were killed. Records were kept covering the clinical course of the disease and all animals were subjected to a careful postmortem examination which in-

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<sup>1</sup> Brown, W. H., and Pearce, L., *Proc. Soc. Exp. Biol. and Med.*, 1921, xviii, 201.

<sup>2</sup> Brown, W. H., and Pearce, L., *J. Exp. Med.*, 1923, xxxvii, 601, 631, 799, 811; *ibid.*, xxxviii, 347. *Proc. Soc. Exp. Biol. and Med.*, 1923, xx, 472. Pearce, L., and Van Allen, C. M., *Trans. Assoc. Am. Phys.*, 1923, xxxviii, 315.

cluded the weighing of organs, noting the number and distribution of metastases, and the extent and condition of the growth in all parts of the body. The data thus obtained were reduced to a form that would permit of a quantitative expression.

When the results of these investigations were analyzed with reference to monthly and yearly records of meteorological conditions, as recorded at the Central Park Observatory, New York City, it was found that the malignancy displayed by the tumor at any time appeared to be closely related to the prevailing state of the weather and to sunlight in particular, as represented by the actual hours of sunshine. Thus, a comparison of the curve of sunshine with curves showing the incidence of metastases in different groups of animals and the relative distribution of the metastases brought out the fact that malignancy increased or diminished coincident with changes in the hours of sunshine. In general, it was found that the periods of maximum and minimum sunlight, corresponding with summer and winter, were periods of relatively low malignancy while the periods of greatest malignancy occurred at times of abrupt and rapid changes in the hours of sunshine, corresponding roughly with spring and fall. Still, the exact time of the occurrence of these periods of excessive malignancy was not the same in all cases. They occurred earlier or later, as the case might be, in conformity with the actual change in sunshine rather than with the regular progression of the seasons.

In like manner, minor variations in malignancy, occurring at other times, also coincided with changes in the curve of sunshine. In other words, almost every decided fluctuation in one set of curves was reflected in the other.

It appears to be certain, therefore, that even the diffuse sunlight of the laboratory is capable of exercising a profound influence on the malignancy of the tumor, or that some factor that is capable of influencing the curve of sunshine is equally effective in determining the course of this disease.

It also appears that while the prevailing level of sunshine is a factor of some importance in this connection, the factors of foremost importance are the rate, direction, and the extent of the change that occurs at any given time.

It is possible that the effects described may be due, in part, to an action on the tumor cells, but it is more likely that the malign-

nancy of the tumor is influenced through an action on the animal organism. This conception is supported by the fact that, as reported elsewhere,<sup>3</sup> definite changes in the weight relationships of nearly all the organs of the body occurred in normal animals coincident with the changes in malignancy, and that the correlation was especially close in the case of organs that have been shown to be capable of exerting a profound influence on the malignancy of the tumor.

### 189 (2421)

#### Seasonal changes in organ weights and their relation to meteorological conditions.

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It is well known that many of the endocrine glands of normal animals undergo rhythmic changes in weight per unit of body weight which conform, in general, with seasonal conditions. Still, the cause of these changes is not clearly understood nor is it generally known that other organs and tissues such as the heart, the liver, the kidneys, the spleen, the thymus, the lymphoid tissues, and even the brain, undergo changes of a similar character.

In November, 1921, we began a series of investigations which included among other things a study of the ratio of the weights of various organs and tissues to the body weight of normal rabbits and the limits of variation that might be encountered, with especial reference to the causes of such variations. The factors studied included age, breed, length of caging, time of killing (with reference to the regular system of feeding), and meteorological conditions. All of the animals used were males, and an

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<sup>3</sup> Brown, W. H., Pearce, L., and Van Allen, C. M., Seasonal changes in organ weights and their relation to meteorological conditions, *Proc. Soc. Exp. Biol. and Med.*, 1924, **xxi**, 371.