ity; the various deviations from simple Mendelian proportions, hypostasis and latency, sterility and inbreeding. The author also treats of coupling and "repulsion" without being able to make use of the flood of light that Morgan and his pupils have thrown upon these ideas. Indeed, Johannsen at the time of writing the book was not inclined to ascribe to the chromosomes the importance in heredity that is commonly conceded to them in this country.

In his final chapter Johannsen considers certain relations of the results of heredity to man and to evolution. He thinks the fact that culture (euthenics) has no effect on the race makes it not less but the more significant; for the momentary position of the race is the summation of personal qualities. In a sense it is true that the worse the breeding the greater the need for cultivation if any sort of a crop is to be harvested. As for the bearing of the new facts of heredity on evolution Johannsen has little to say and he states that we miss today the genius of a Darwin to establish a theory of evolution in harmony with modern knowledge.

C. B. DAVENPORT

Einführung in die Tierpsychologie. Erster Band, Die Sinne der Wirbellosen. VON GUSTAV KAFKA. J. A. Barth, Leipzig. Pp. xii + 593. 8vo. 362 text illustrations.

Animal psychology, according to Kafka, takes its departure from the same body of facts that sensory physiology does, but differs from this subject in the problems it sets itself for solution. That most of these problems are still unsolved justified the author in his opinion that a good text-book on animal psychology should concern itself with the facts of animal reactions rather than with theoretic matter. The book holds consistently to this view. It contains, after a very brief introduction, an account of the rapidly accumulating material on the sense of touch, the static sense, the sense of hearing, the temperature sense, the chemical sense, the light sense, and the very questionable senses of space and of time, all in invertebrates. The volume is well illustrated and is concluded by a bibliography of over five hundred titles in a well-ordered arrangement. As an introduction to the newly discovered facts in animal reactions the volume is in every way serviceable, though from the rate at which the subject is growing the book is bound soon to fall behind the times. As a means of quickening in the student a sense of the general problems in this field of research, it is disappointing. This fault may be excused on the grounds that it is just this side of the subject that the author has intentionally avoided, but it is an open question whether this avoidance is really a virtue. While the volume from its clearness and directness of statement will be found of much use to the student of animal psychology and allied subjects, its failure to deal with the more obvious general problems of this field of science must be regarded as a real defect. Possibly this may be remedied in the companion volume on the vertebrate senses which is said to be in preparation by the same author.

G. H. PARKER

SPECIAL ARTICLES

HEREDITY AND INTERNAL SECRETION IN THE SPONTANEOUS DEVELOPMENT OF CANCER IN MICE

AFTER preliminary studies in 1901 and 1902, and subsequent observations in 1907 suggesting the significance of heredity in the spontaneous development of cancer in rats and mice, we undertook an analysis of the hereditary factors on a larger scale in 1910 in conjunction with Miss A. E. C. Lathrop in Granby, Mass.[1]

[1] Loeb, L., *Medicine*, 1900, VI., 286; *Centralbl. f. Bakteriol.*, I., Abt., Orig., 1904, XXXVII., 235; *Univ. Penn. Med. Bull.*, 1907–08, XX., 2; *Centralblatt. f. allg. Pathol.*, 1911, XXII., 993. Lathrop, A. E. C., and Loeb, L., *Proc. Soc. Exp. Biol. and Med.*, 1913, XI., 34. Loeb, L., *Lancet-Clinic*, 1913, CX., 664. Lathrop, A. E. C., and Loeb, L., *Journal Exp. Med.*, XXII., Nov., 1915, 646, and Dec., 1915, 713. The credit for the first investigations on a somewhat larger scale into the possible influence of heredity on the tumor incidence in mice belongs to E. E. Tyzzer (*Jour. Med. Research*, 1907–08, XVII., 155). The procedure

Without going into a detailed discussion of the various conclusions arrived at, it may suffice to state as one of the principal results that different strains of mice kept in the same environment, being given the same kind of food, differ very much in the frequency with which cancer occurs among them. (Carcinoma of the mammary gland in females is by far the most common kind of cancer in mice.) In some of them cancer may affect as many as 70 per cent. of the female mice, while in other strains only 2–3 per cent. are affected. In succeeding generations this percentage figure is fairly constant in different strains of mice. Equally characteristic for different strains seems to be the age at which cancer occurs; while in some strains it occurs at a relatively early age, in others it appears later in life. Such differences in the cancer age may exist even in strains in which the cancer incidence is similar.

These data are a prerequisite for further studies of factors responsible for the spontaneous development of cancer as well as for attempts to diminish or increase the cancer incidence at will. From a practical point of view such studies may ultimately lead to the discovery of means enabling us to lower the cancer rate or to prevent cancer. As a first contribution to this problem we undertook, on the basis of our previous results concerning the significance of heredity, an analysis of the influence of the ovary and especially of the corpus luteum in the spontaneous development of cancer of the mammary gland in mice. We had shown previously that a combination of a mechanical stimulus and the influence of a substance secreted by the corpus luteum at a definite period of its existence led to the production of rapidly growing tumor-like new formations with the structure of the decidua in all parts of the uterus. After a period of at first rapid and then declining growth they became later necrotic. We designated those tumor-like formations as "Deciduomata" or "Placentomata" and placed them among a category of new formations which we characterized as "transitory tumors."[2] Other investigators showed later that the corpus luteum was furthermore of significance for the periodic growth of the mammary gland, especially also during pregnancy.

These facts suggested a possible importance of the corpus luteum for the spontaneous development of cancer in mice. Accordingly, we undertook in conjunction with Miss A. E. C. Lathrop in Granby, experiments in this direction. Several lots of female mice of various ages belonging to strains rich in tumors were castrated, while other normal mice of the same strains were kept as controls. In other experiments a certain number of mice belonging to strains of known cancer incidence were prevented from breeding and thus the influence of the non-occurrence of pregnancies was tested. Under the latter condition the possible influence of a corpus luteum was not entirely abolished, but merely diminished. We wish to state briefly the results so far obtained: Castration of mice at or below the age of 6 months (corresponding to a period of life when the animals are already sexually mature) diminished the cancer incidence in a very pronounced way. The cancer rate fell from 60 per cent. to 70 per cent. in normal mice to 9 per cent. in castrated mice. Castration above the age of 6 months has so far been without any noticeable effect.

Non-breeding mice develop cancer in a somewhat smaller percentage of cases and at a somewhat higher age than normal breeding mice. The influence of prevention of breeding is therefore much less marked than the effect of castration, but considering the large number of mice we used it is not probable that the differences which we actually did observe were accidental. However, we are continuing our experiments in various directions and if accidental factors should complicate some of our results, this will become apparent during the further development of our work. We established thus two sets of factors in the etiology

used by Tyzzer (which was subsequently also used by T. A. Murray) could, however, not be depended upon to give decisive results.

[2] Loeb, L., *Centralbl. f. allg. Pathol.*, XVIII., 1907, 563, and a series of papers in the *Archiv f. Entwicklungsmechanik.*

of cancer (1) hereditary factors, and (2) chemical actions exerted by an internal secretion.

We could show that the hereditary factors are not identical with the internal secretion and do not act by changing the number of corpora lutea and their activity, but that their point of attack is somewhere else. It appears probable that with the cooperation of hereditary conditions all those internal secretions are factors in the origin of cancer which initiate or sustain continuous or periodic growth processes. In other cases mechanical stimulation of growth may take the place of chemical stimulation and again in others a combination of both may be present. Whether in addition to these factors definitely established there is still another factor (microorganisms?) present, and which relation this last-named hypothetical factor bears to the other two factors are at present unknown. But whether or not such an additional factor enters, we can be certain that the two first named sets of factors are sufficiently strong to determine to a great extent the frequency of cancer in mice.

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A NEW METHOD OF SELECTING TOMATOES FOR RESISTANCE TO THE WILT DISEASE

Perhaps the most serious disease of tomatoes in the southern states is that caused by *Fusarium lycopersici,* the one that is commonly known as the tomato wilt. The causative fungus lives in the soil and attacks the plants through the roots and later grows up through the fibrovascular bundles into the stems. In common with similar diseases of other plants, such as the wilts of cotton, watermelon, etc., the only practical method of control now known is in the use of varieties, or strains, that are resistant to the disease. By saving seed from healthy plants in a badly infected field for several seasons, strains can be obtained which show considerable resistance to the disease. This method of selecting the strains, however, has several serious drawbacks: (1) A large acreage of tomatoes is required as a large percentage of the plants which are set in the field die with the wilt. (2) Many of the plants in the field do not come in contact with the wilt fungus during the season and so do not have a chance to show whether they are resistant to the disease. (3) Resistant plants in the field are readily pollinated by the susceptible plants. (4) The time necessary to obtain a wilt-resistant strain is too long.

While studying the disease in Louisiana, an attempt has been made to improve on our common method of selecting resistant plants by selecting in the seed bed. This has been accomplished by taking advantage of the fact that soil diseases infect plants better if the soil is first sterilized and then inoculated with a pure culture of the disease organism. In ordinary unsterilized garden soil, even if it is heavily inoculated with the tomato wilt fungus, not many of the plants will show the wilt to any extent before it is time to place them in the field. The presence of bacteria and other fungi seems to have an inhibitory effect on the wilt fungus. If, however, the soil is first sterilized by heat and then heavily inoculated with the wilt fungus just before planting, the disease will develop so well that most of the susceptible plants will be killed before they are large enough to be placed in the field. By growing the plants in this manner, only plants showing resistance are placed in the field. This saves a great deal of field space and also allows a selection from an almost unlimited number of plants. This also assures the presence of the wilt fungus on the roots of every plant.

To show how this method of selection works in practise, results of some experiments may be briefly given. Having by the old method of selection obtained a strain that showed considerable resistance to the wilt disease, this was compared by the seed bed method with three standard varieties of tomatoes. The seed of each variety were planted side by side in reinoculated sterilized soil. Different cultures of the fungus from different localities were also used in order to see if they would affect the varieties differently. In the following