THE NATIONAL ACADEMY OF SCIENCES

(*Continued from page 486*)

Bread moulds and biochemical differences between sexes: DR. ALBERT F. BLAKESLEE (introduced by C. B. Davenport).

In the bread moulds (Mucors), a group of fungi with a simple but distinct type of sexual reproduction, the opposite sexes have been called (+) and (−) since, on account of their similarity in appearance, it was not possible to determine surely which was male and which female. Since in the bread moulds the sex cells are equal in size and the developing offspring are apparently nourished equally by the two sexes, these forms are especially adapted to a study of the fundamental differences between sexes. Their physiological behavior had early led to the belief that there must be a biochemical basis for sex differentiation in these and other forms.

Investigations, carried on by Miss Sophie Satina and the writer, under support of the Committee of the National Research Council for research on sex problems, show that males and females of higher and lower plants have average differences in response to biochemical tests, the female usually being the more active chemically. The test for sexes in human beings, devised by the Russian investigator Manoilov, we have found also applicable to plants and over 90 per cent. of correct identifications of sex have been obtained in different groups by use of this test.

The (+) sex of bread moulds has been found to react biochemically like females and the (−) sex like males of higher plants and animals.

An exhibit installed in the National Academy building shows cultures of sexual forms of bread moulds and some of the biochemical tests of sex in these fungi and in green plants.

Changes of structure due to a modified environment: A study of labile protoplasm in Helianthus Annus L.: ERWIN F. SMITH.

This paper details the experimental production in the common sunflower (by irritation of young meristematic tissues) of (1) ray flowers and supernumerary capitula (sessile or stalked) in the midst of tubular flowers; (2) of extensive cavities (cysts) in the stem-pith lined with a fine-celled tissue bearing numerous trichomes (hairs) like those on the surface of the plant; (3) of pith bundles, often fused into one or more long cylinders (steles) of wood and bast, produced in the center of the pith subtending the cavities and always with a reversed polarity; and (4) of roots and linear bracts produced in the floral parts.

These results were first obtained by inoculating the crowngall organism (*Bact. tumefaciens*) into young flower heads and so far this method has given the most numerous and striking examples, but the same results, exclusive of the supernumerary capitula, were obtained in a smaller number of instances from simply dislocating tiny fragments of tissue of the receptacle by means of repeated needle punctures.

The results show that cysts are independent of tumor formation, but in case of the bacterial inoculations the walls of the cysts bore numerous tumors which were either discrete or fused over long distances. These crowngalls frequently filled the cyst cavity and stretched it, often rupturing its walls to appear on the surface of the stem. My experiments were made in 1923–24, and were repeated on a larger scale in 1925 with the same results. It is the first time I have observed cysts in connection with crowngalls.

The striking structural modifications I have obtained are one more example of the potent influence of a changed environment. This, however, is active in the sunflower only on young cells. Nothing can be done with mature or semi-mature tissues.

Indications respecting the colloidal behavior of the agency of virus inducing mosaic disease of tobacco (illustrated): B. M. DUGGAR (introduced by Erwin F. Smith).

Mutations in Fusarium and their effect upon the species concept (illustrated): LEON LEONIAN (introduced by Erwin F. Smith).

Some modifications of the mononuclear white blood cell: WARREN H. LEWIS (introduced by John C. Merriam).

When simple hanging drops of blood are cultivated outside the body the mononuclear blood cells become greatly altered in appearance. Some of them ingest numbers of red blood cells and become macrophages similar to those scattered throughout the body. Others ingest only fine material, which becomes concentrated about the centriole into a central area, and becomes epithelioid cells similar to those in tuberculous lesions. Mononuclear blood cells probably undergo similar changes in the body. The tumor cell, in one variety of rat-sarcoma, is a modified mononuclear white blood cell of the epithelioid type. Puré cultures of such tumor cells, when inoculated into a rat, reproduce the tumor. Cultures from the latter behave like those from the original tumor.

The effects of X-rays upon regeneration in planarians: PROFESSOR WINTERTON C. CURTIS and JANE HICKMAN (introduced by L. J. Stejneger).

In work reported before the American Society of Zoologists at the Washington Meeting, December, 1924, (Curtis and Schulze) and before the Kansas City Meeting of the American Association for the Advancement of Science, December, 1925 (Marion F. Isely), it has been shown by the writer and his students that there exist in the parenchyma of various species of planarians formative cells that are apparently responsible for the changes observed during regeneration. Not all planarians have the great regenerative power that is possessed by species like P. maculata and P. agilis. Some, like Dendrocœlum lacteum, have relatively little capacity for

regeneration and the process takes place at a very slow rate. Comparison of the histological structure in these two extreme cases shows that P. maculata has an abundance of formative cells which are active in regeneration, while there are few such cells in D. lacteum. Other species, like Phagocata gracilis, exhibit an intermediate number of these cells. As was stated at the Kansas City meeting, we believe that by examining the parenchyma and determining the abundance of formative cells one can foretell the probable power of regeneration in a planarian; and, conversely, that knowing the power of regeneration in any species he can foretell the relative abundance of the formative cells.

In further analysis of this relation between the formative cells and regeneration, experiments are being conducted with the X-ray which have thus far been confined principally to P. agilis, but are being extended to P. velata in which similar results are being obtained. These experiments were suggested by the well-known effects of X-rays upon the tissues of higher organisms. In the treatment of cancer and in various experimental studies it has been ascertained that the X-rays give a differential killing of various tissues in the following order of susceptibility: Germ cells, lymphoid tissue, vascular endothelium, cartilage. Since, in the higher animals, *germ-cells* and *cells of an embryonic type* are, therefore, highly susceptible, it was thought that the formative cells of planarians, *which are embryonic and germinal,* might react in a similar manner. *Such appears to be the case.*

When specimens of P. agilis are cut transversely into head-, middle-, and tail-pieces of about equal bulk, and given X-ray treatment equivalent to from 2 to 16 skin units, as the term is used in medical practice, *they fail to regenerate the external features necessary for a normal individual, while internally they show what seems a complete destruction of the formative cells.* The same result is obtained whether the treatment is given at one time or as series of exposures. If given as a series of exposures, more or less normal heads are formed on all pieces, but later these heads degenerate. If given at one time, there are no "real" heads formed, although there may be some indications of eyes. Exposure without cutting results in the degeneration of the head. Cutting before treatment or within 24 hours after exposure produces entirely similar results. Histologically, the result seems to be about the same in any of the above forms of treatment. There is perhaps a better chance for the survival of some of the formative cells in worms that are treated before cutting than in specimens which are cut and then traced (microphotographs illustrating these changes will be shown as lantern slides). Studies of the exact cytological and histological changes involved in the destruction of the formative cells are being undertaken; and also of the nature of the individual that survives such treatment.

One series of experiments upon P. velata shows that the treatment likewise destroys the power of regeneration in this species. The cells in P. velata that we interpret as formative cells are smaller and more difficult to recognize as such than in P. maculata and P. agilis. Nevertheless, so far as the observations have gone, they indicate that this type of cell disappears. Further experiments upon P. velata are in progress and others upon hydra.

An experiment with radium is now in progress.

As to the possible extensions of such work, we believe that similar results may be looked for in the regenerative processes of other invertebrates, particularly the porifera, cœlenterata, and annulata. It is hoped to begin such investigations at the Marine Biological Laboratory during the coming summer. If the same principle holds for the cells of planarians as for those of the higher vertebrates, there is reason to believe that it may extend from one end of the animal kingdom to the other.

Moreover, our observations upon what we regard as the formative cells of P. velata lead us to hope that the X-ray treatment may be used as a method of technique in cases where the histology of regeneration is obscure, with the result that some one type of cell may be destroyed, and thus shown to be essentially related to the regenerative processes.

It is also possible that such technique may be utilized for the early detection of germ-cells in the development of various organisms.

Whatever may be the results of these extensions, it is believed that certain clues have been obtained to the histology of regeneration in planarians; and that a new method of technique has been indicated for the study of such problems in the lower invertebrates.

The human growth curve: DR. CHARLES B. DAVENPORT.

The development curve of human body weight is neither a straight line, as it would be were increments arithmetical, nor of the simple autocatalytic type since the locus of maximum velocity is not at the middle of the curve but there are two loci near the ends. The curve of annual increments of weight reveals that the curve of growth is composite and, indeed, consists apparently of three autocatalytic curves of which the loci of maximum intensity are, in the male, at birth, at 15 years, and probably at about 8 years. The third maximum is masked by the vigor of the other two periods of active growth which are superimposed upon the extremities of the third. An analysis of the curve of annual increments of weight into three binomial curves of very different standard deviation provides us with a full explanation of the irregularities of the development curve. The third growth cycle is not the same as Robertson's which seems to be based upon a statistical irregularity which disappears on the accumulation of additional data.

The interpretation of the three cycles of growth remains uncertain. The first and the second correspond closely with the greatest activity of the thyroid and pituitary glands, respectively, whose hormones are primarily growth stimulating. The third cycle of growth is a fundamental one underlying the others, and probably represents some more general growth stimulus exerted from the time of the fertilization of the egg to the time of growth cessation.

(To be concluded)