Clelland Morgan presented two papers on learning, and C. A. Ruckmick gave some recent improvements in galvanic technique.

Zoology Section: H. E. Jaques. The program, while utilizing only one half day, covered a range of interests almost as wide as the zoological field. Two papers were taxonomic, Robert L. King describing new protozoans of the genera *Vorticella* and *Thecacineta,* and Owen Smith illustrating some thirty species of *Tenebrionidae* known to occur in Iowa and providing a key for their identification. Records of golden and bald eagles as well as some other rather unusual birds which have been seen recently in southeastern Iowa were presented by Pete Parks, while F. L. Fitzpatrick showed that raptorial birds rather frequently possess bilateral ovaries. William T. Levine found the ovaries of frog tadpoles to degenerate when treated with x-ray. In a study of the hormone influence on the reproduction functions of parabiotic female rats Robert T. Hill reported the corpus luteum hormone stronger and more positive in action than the oestrous producing hormone, and E. W. Shrigley told of a marked difference in the susceptibility and resistance to anaphylactic shock in guinea-pigs and discussed methods of selecting. H. E. Jaques explained some methods used in conducting field contests to increase student interest in biological subjects, while Elizabeth Blagg displayed an exceptionally large earthworm and aroused a likely discussion as to the size and abundance of these creatures. Much interest was taken in Roy L. Abbott's recital of some almost human-like readjustment made by the golden digger wasp when its established routine was interfered with by the experimenter.

JOSEPH C. GILMAN,
Secretary

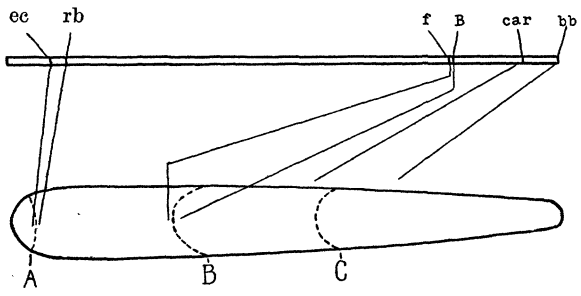
SPECIAL ARTICLES

A CYTOLOGICAL MAP OF THE X-CHROMOSOME OF DROSOPHILA MELANOGASTER

SEVERAL years ago the writer, together with Dr. H. J. Muller, pointed out that as a result of our combined genetic and cytological studies of deletions and translocations in *Drosophila melanogaster* we were forced to the conclusion that the genetic crossover maps do not give a proper concept of the morphological spacing of the genes along the chromosomes. Dobzhansky was led to the same conclusion by evidence similar to ours and his cytological maps of the second and third chromosomes have amply proved the correctness of this point of view.

Since the publication of our original papers, I have been collecting data which would permit me to plot a cytological map of the X chromosome. Dr. H. J. Muller and Dr. J. T. Patterson and their students have placed at my disposal many cases of breaks, translocations and deletions and by a cytological study of these it is now possible to give the approximate location of certain genes.

In the accompanying figure I have indicated the location of the genes involved on the genetic map and below this an outline drawing of a typical X chromosome with lines to show the position morphologically of the points which have been determined.



Beginning with the so-called left hand end of the X chromosome (left in the figure), this winter Patterson obtained a break in the X chromosome between the loci for echinus (5.5) and ruby (7.5) and this segment became attached to one of the fourth chromosomes. (See Patterson and Painter in a recent issue of this journal for genetic and cytological evidence). Morphologically this piece which carries at least 5.5 genetic units (but does not extend to 7.5) is about three times as large as a normal fourth chromosome. The estimated proportional size of this segment is indicated on the schematic X chromosome by the line A, and since echinus is carried by the translocated piece and ruby is not, these two loci must lie to the left and the right of the line A, respectively.

Recently, Mr. Wilson Stone, a student of Dr. Muller, obtained a break in the X chromosome between the loci for forked (56.6) and bar (56.8)—genetic data unpublished—and the segment from the left hand end which must thus carry at least 56.6 genetic units was translocated to a fourth chromosome. This case was studied cytologically in females carrying a normal X and the two pieces of the broken X, and also in females hyperploid for the bar-carrying piece. The piece of the X chromosome which carries bar was found to be about three fourths the size, in length and volume, of the normal X chromosome in the same cell, and the piece which was translocated to the fourth chromosome is about a fourth the volume of the normal X. On the figure the length of the bar segment is indicated by the line B. The locus for

bar must be to the right of this line, and forked as well as the 56.6 genetic units from the left end must lie to the left of the line B.

In one of the first deletions studied genetically by Muller and cytologically by the writer, there were at least 64.5 genetic units missing from the X chromosome [the locus for prune (1) but not white (1.5) was present; the locus for carnation 65.5 was lacking but bobbed (70) was present] and this deleted X was about a third of the normal X chromosome in size. At the time of these earlier studies we did not know what proportion of the deleted X was due to the left and right hand ends respectively, but in view of the recent finding that only the tip of the left hand end is involved morphologically when 5.5 genetic units are missing, it is clear that the size of the deleted X must have been due almost entirely to the right hand end segment. The size of the deleted X is shown on the figure by the line C. Since carnation (65.5) is not present in this deleted X it follows it must lie somewhere to the left of the line C but to the right of the bar locus and that bobbed, which is present, must lie to the right. From the nature of the evidence, we can not locate carnation or bobbed more accurately at present than as indicated above, but in view of the location of ruby and of bar, one might guess that carnation would lie much closer to the bar locus than the line C.

An analysis of other cases, the data for which we can not give in this brief article, fits into the cytological map as here given. Complete cytological evidence and pertinent discussion will be presented in a longer paper now about ready for press.

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THE STRUCTURE OF PROTOPLASM

INSUFFICIENT optical differentiation between the constituent parts of protoplasm has greatly hampered the advance of knowledge of protoplasmic structure. Dark-field illumination with the cardioid condenser has helped but little. The recent invention of a dark-field oil-immersion objective by Charles Spierer[1] is a very successful forward step in indirect illumination methods, especially when applied to the study of the colloidal structure of living matter. The Spierer lens reveals a structure in living protoplasm, as it does in celloidin[1] and in the cellulose walls of plant cells,[2] which is not visible with any other optical system.

The Spierer lens is a Zeiss 1/12 inch oil-immersion objective with a small platinum mirror electrolytically deposited at the center of the upper surface of the lowermost lens of the objective system. This mirror reflects all direct light, thus producing a dark-field. The scattered (colloidal) light from the object viewed is picked up by the lens around the mirror. Increased detail results because direct light is used instead of the usual bilateral illumination of the older type of ultramicroscope. The optical principles involved and a fuller description of the lens are given in other publications.[1,2]

When the hyaline protoplasm of living onion cells is viewed through the Spierer lens, it is, under favorable conditions, seen to consist of two substances, one brightly illumined, light gray in color, and very finely granular in texture, and the other, an optically empty, black background. In quiescent protoplasm these two substances are intermixed as an emulsion and then present a mottled appearance. Protoplasm under tension, as it is when formed into a thread (Fig. 1, a),

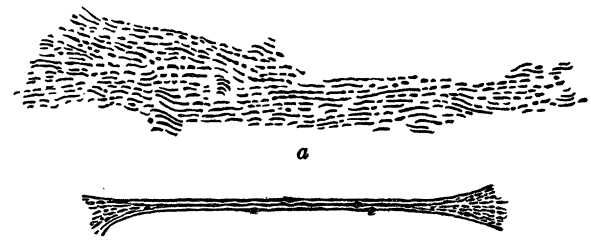

FIG. 1

or when streaming (Fig. 1, b), assumes a striated appearance, due to the parallel arrangement of long strands of the illuminated substance. These strands may be continuous (Fig. 1, a) or discontinuous (Fig. 1, b); in the latter case they are made up of rods oriented end to end. The striated structure is seen at its best in actively flowing protoplasm. Included particles occur, and appear as brilliant globules imbedded in either the gray matter or the dark intervening substance.

Without any attempt to characterize chemically or vitally the two phases which make up this dark-field structure of protoplasm, I propose calling the brightly illuminated, gray-appearing, and at times discontinuous, dispersed phase, the *phaneroplasm*, (*phaneros* = evident), and the unilluminated, black-appearing, optically empty background, or continuous phase, the *cryptoplasm* (*cryptos* = hidden). In the accompanying figure, the phaneroplasm is black and the cryptoplasm (the background) white, which reverses what is white and what is black in the actual material as seen with the Spierer lens.

Both phaneroplasm and cryptoplasm flow, though apparently not at the same rate, the phaneroplasm being more sluggish in its movement. The cryptoplasm is optically empty and can not, therefore,

1 "Un Nouvel Ultra-microscope à Éclairage Bilatéral," *Arch. Sci. Phys. et Natur.* (Genève) 8: 121, 1926.

2 "The Spierer Lens and What it Reveals in Cellulose and Protoplasm," *Jour. Phys. Chem.* 118: 35, 1931.