previous to the sixth day nor later than the eighth day following inoculation.

Virus was present in the nasal washings of swine infected by exposure on the day prior to the elevation of temperature above 40° C.; that is, on the last day of the period of incubation, and thereafter throughout the period of illness. The brain and viscera of one pig, killed after its nasal washings had contained virus of 4 consecutive days, were free of virus, while in another pig, killed after its nasal washings had contained virus for 6 consecutive days, virus was demonstrable in the lung and a mixture of spleen and liver but not in the blood, brain or other tissues tested. The nasal washings of one animal, under observation for 3 weeks, contained virus on the last day of the incubation period, on all the 6 days that the animal was ill, and on the first 4 days of convalescence.

The experiments just summarized indicate that in pseudorabies in swine the nose serves as the portal for the entrance and exit of the virus. They suggest that swine may be an important reservoir for the maintenance of pseudorabies infection because of the facts that the disease in swine is highly contagious, that it is not fatal for this species among all its hosts, and that it is of so mild and ill-defined a nature that it may escape notice, or, if it is noted, be incorrectly diagnosed. It is readily conceivable that the escape of this virus from its swine reservoir may be responsible for the sporadic and highly fatal cases of pseudorabies among cattle in the swine-raising states of the Middle West. Further evidence to support this possibility will be reported in detail later.

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CROSSOVERS IN MALE DROSOPHILA MELANOGASTER INDUCED BY HEAT*

THE long-known effect of heat in increasing the amount of crossing-over[1] in Drosophila females led the senior author some years ago to attempt to induce crossing-over in the male by use of the same agent. The undertaking failed. Perhaps others have essayed the same task without success. In view of the recent production of crossovers in the male through the agency of x-rays by Patterson and Suche[2] and by Friesen,[3] it seemed worth while to try once more the effect of heat. This time the effort has been successful.

The experiments began with a cross between wild-type flies and a multiple third-chromosome stock possessing the characters thread, scarlet, curled, stripe, sooty and claret, which we have been calling "theca," though it lacks the character rough eye contained by the stock originally called theca. The F_1 larvae from this cross were subjected, at ages ranging in different experiments from 0 to 6 days, to temperatures varying from 33° to 35° C., for periods of one to eight days. Males which survived this treatment were mated to theca females, one male and several females in each culture bottle. Non-crossover sperms from treated males would produce either wild-type or theca individuals among their offspring; crossover sperms would produce flies possessing some but not all of the mutant characters of the theca stock.

In the early experiments the flies were not classified with respect to thread or stripe. In one of these, 21 surviving F_1 males were back-crossed to theca females. One of these males gave rise, among a total progeny of 182 flies, to three crossover individuals, two of them scarlet curled sooty males, one a claret female. As a check upon the classification of these flies they were all mated back to theca individuals. The two scarlet curled sooty males gave only theca and scarlet curled sooty offspring by this cross, while the claret female yielded chiefly theca and claret classes with small numbers of crossovers in each of the delimited regions. Thus was the original classification of the crossover flies verified.

In a later series of similar experiments thread, but not stripe, was included in the classification. Of the many heat-treated cultures, one yielded 13 surviving males, three of which on being mated to theca females produced crossovers. Two of these three males produced one crossover each as follows: 1 curled sooty claret; 1 sooty claret.

The remaining one of the three is mentioned separately because it produced 32 crossover offspring, all thread scarlet, without any of the complementary class (curled sooty claret). This latter result is so unusual as to suggest contamination. No stock of thread scarlet is being maintained in this laboratory, so if contamination were the explanation it would have to come about in an indirect manner. Moreover, the conduct of the experiment seems to preclude that possibility. As in most of these experiments, the parents were transferred from bottle to bottle at frequent intervals, and the heat-treated male, after having been with one group of females for a number of days, was placed with a new group. The male which produced the 32 crossover offspring was thus introduced into two matings. Some of the crossovers appeared in two successive cultures from the first group of females, some in the first culture from the second group of females. If, therefore, contamination were the explanation of these 32 apparent crossovers, the same con-

* Contribution from the Zoological Laboratory of the University of Michigan.

1 H. H. Plough, *Jour. Exp. Zool.*, 24: 147–209, 1917.

2 *Genetics*, 19: 223–236, 1934.

3 SCIENCE, 78, 2031, 513–514, 1933.

tamination would have had to occur in two groups of females obtained virgin at different times. While we have no explanation of the failure of one complementary class to appear, we believe that contamination as by a previous uncontrolled mating of the theca females is excluded.

In the remaining experiments, somewhat more extensive and systematic than the first two series, complementary crossover classes appeared when even moderate numbers of crossover individuals were obtained. Eight out of 127 males that survived the heat treatment in this series produced crossover offspring, as shown in Table I.

Crossovers have thus been produced in each of the regions of the third chromosome marked by the genes used, except that between thread and scarlet. Questions relating to the relative frequency of crossing-over in the several regions, frequency of crossing-over in females resulting from these crossovers, the optimum age and intensity of treatment are being reserved until more data are secured.

TABLE I

Designation of male	Number of crossovers	Composition of crossover offspring
1	1	e^s ca
2	1	th st cu e^s
3	3	ca
4	12	th st
	2	cu e^s ca
5	1	th st
	1	th st cu e^s
	2	th st cu
	3	e^s ca
6	1	th st
7	1	e^s ca
8	6	th st
	5	cu e^s ca

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SUSCEPTIBILITY TO POISON IVY AND POISON OAK[1]

AN investigation of the susceptibility of 101 adult city-dwelling persons to the skin-irritating properties of poison ivy and poison oak has been made. Water-free alcoholic extracts of the dried leaves of these plants were made and diluted in varying concentration. They were tested by placing small disks of blotting paper, moistened with the extract, on the forearms of the persons examined. The patches were covered with a cellophane shield and secured by adhesive tape. They were left in place for twenty-four hours. The ivy and oak extracts were tested simultaneously one on each arm. The weakest extracts were applied first and the result examined after seven days. If no reaction, consisting of a persistent erythema and itching, was observed, the next stronger solutions were applied. The proportion of the reactions in those persons tested at each level of concentration was calculated and corrected to percentage of the total number tested by multiplying by the percentage of persons immune to the next lower level. The figures are shown in Table I. The 1:100 dilution of the original extract was arbitrarily chosen as the unit of concentration.

TABLE I

Irritant	Concentration	Power of concentration $(1+\log)$ A	Per cent. persons susceptible B	$\frac{B}{A}$
Poison oak	1	1	24	24
	3.3	1.5	36	24
	10	2	42	21
	100	3	65	22
Poison ivy	1	1	27	27
	3.3	1.5	42	28
	10	2	47	24
	100	3	60	20
	3000	4.5	75	17

It is seen from this that the number of persons susceptible to these extracts tends to vary as the logarithm of the concentration of the irritant. In other words, the proportion of the population affected increases arithmetically as the concentration of the irritant is increased geometrically, which is similar to the action of physiological stimuli in general as expressed by the Weber-Fechner law.

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[1] From the Division of Applied Immunology of the Department of Medicine, New York Post-Graduate Medical School and Hospital.

BOOKS RECEIVED

ARTHUR, JOSEPH C. *Manual of the Rusts in United States and Canada.* Pp. xv + 438. Illustrated by George B. Cummins. Purdue Research Foundation, Lafayette, Indiana.

NEAL, HERBERT V. and JAMES F. PORTER. *Vitalism and Mechanism, a Discussion.* Pp. 87. Authors.

PALMER, CLAUDE I. and CHARLES W. LEIGH. Fourth edition. *Plane and Spherical Trigonometry.* Pp. xiv + 229. Illustrated. McGraw-Hill. $1.50.

STANFORD, ERNEST E. *Economic Plants.* Pp. xxiii + 571. 376 illustrations. Appleton-Century.

WILLIS, BAILEY and ROBIN WILLIS. *Geologic Structures.* Third edition. Pp. xviii + 544. 202 figures. McGraw-Hill. $4.00.