

below 0.2 per cent. little or no effect was observable.

Higher concentrations of ether give a very different result. With 3 per cent. by volume of ether the resistance rises very rapidly to a maximum (which is about the same as when 1 per cent. is used) and then falls very rapidly. But instead of stopping when the normal is reached the resistance continues to fall rapidly until death ensues. If the concentration of ether be increased the period during which the resistance remains above the normal becomes shorter until finally it becomes impossible to detect it even when readings begin 30 seconds after placing the tissue in the anesthetic. There is a corresponding increase in the rapidity of the fall of resistance and of the onset of death.

The decrease of permeability observed in these experiments may be easily and quickly reversed by placing the tissue in sea water. Is this also the case with the increase in permeability? This was tested in the following manner: The material was allowed to remain in the anesthetic until its resistance had fallen about 100 ohms below the normal (*i. e.*, below the resistance it had before being exposed to the anesthetic). It was then replaced in sea water and readings were taken at frequent intervals; recovery would be shown by a rise in resistance.

No such rise in resistance was observed. The experiment was varied by replacing the tissue in sea water after the resistance had fallen only 50 ohms below the normal and also by choosing a concentration of ether which caused the resistance to fall very gradually. Even then there was but rarely any sign of recovery and this was of short duration and small in amount.

Similar results were obtained with chloroform, chloral hydrate and alcohol, but not at the same concentrations: the concentrations which correspond to 1 per cent. ether are approximately as follows: chloroform 0.05 per cent., chloral hydrate 0.05 per cent., alcohol 3 per cent.

Two distinct effects are observable in these experiments. One is a toxic effect evidenced

by an increase in permeability, while the other involves a decrease of permeability. A very important question is, with which of these is the anesthetic action associated? Since the distinctive mark of an anesthetic is the reversibility of its action, it is not reasonable to suppose that this action is associated with an irreversible change in permeability. Such a change is in no way peculiar to anesthetics, but is common to all toxic substances. We are, therefore, forced to the conclusion that it is the reversible change, involving a decrease of permeability, which is associated with the anesthetic action.

The fact that typical anesthetics (ether, chloroform, chloral hydrate and alcohol) decrease the permeability of the tissue to ions is profoundly significant in view of the fact that the transmission of nervous and other stimuli is believed to depend on the movement of ions within the tissues. W. J. V. OSTERHOUT

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#### PARTIAL SEX-LINKAGE IN THE PIGEON

THAT certain characters in pigeons are sex-linked is shown by the work of Staples-Browne,<sup>1</sup> Cole<sup>2</sup> and Strong.<sup>3</sup> Both Staples-Browne and Strong, however, encountered certain exceptions which I shall try to show are explicable on the assumption that there is in the female pigeon a pair of sex-chromosomes, between which crossing-over of the factors may occur.

Staples-Browne found that a white female crossed to a dark male produced all dark offspring, showing that white is recessive to dark. The reciprocal cross, viz., white male by dark female produced dark males and white females. So far, this last cross is a typical case of "criss-cross" inheritance, in which the recessive character entered the cross from the parent homozygous for the sex-differentiating factor, viz., from the male in this case.

Staples-Browne found, however, in this  $F_1$ , in addition to the white females, one dark fe-

<sup>1</sup> R. Staples-Browne, *Jour. Genetics*, June, 1912.

<sup>2</sup> L. J. Cole, *SCIENCE*, August 9, 1912.

<sup>3</sup> R. M. Strong, *Biol. Bull.*, October, 1912.

male, and Strong found three such dark females.

If in the female the sex-differentiating factor and the factor for plumage color are placed close enough together in the same chromosome to be linked, but not so close that the linkage is complete, "crossing-over" would cause the two factors which entered in the same member of the homologous pair of chromosomes to lie in different members and hence to segregate to different gametes.

If the sex-differentiating factor be  $M$ , then the formula for the male is  $MM$  and for the female  $Mm$ . Let the gene carried by the recessive white pigeon be  $w$  and the dominant form of that gene carried by the dark bird be  $W$ . The dark female would ordinarily form gametes of the types  $MW$  and  $mw$ , but would occasionally form gametes  $Mw$  and  $mW$  by crossing-over.

The gametes and their possible combinations would be as follows:

$P_1$	White ♂	$Mw-Mw$
	Dark ♀	$Mw-MW-mw-mW$
$F_1$	$Mw$	— white ♂ (exceptional)
	$Mw$	
	$Mw$	— dark ♂
	$Mw$	
	$MW$	— white ♀
	$mw$	
	$Mw$	— dark ♀ (exceptional)
	$mW$	

A measure of the linkage between the sex-differentiating factor and the factor for plumage color would be the ratio of crossovers to the total number of individuals which might show crossing-over, viz., 4:59 or 7 per cent.

It should be pointed out that "partial-sex-linkage" signifies the linkage between the sex-differentiating factor and any other factor in the sex chromosome. In the case of *Drosophila* "sex-linked" means only that the factor is carried by the sex chromosome, and as yet no evidence has been obtained bearing on the degree of linkage of the sex-differentiating factor and any of the other factors thus far found in the same chromosome.

An explanation similar to the one here adopted for the pigeon may be given to Bateson and Punnett's<sup>4</sup> results with the silky fowl where partial-sex-linkage in the pigmentation is found. Three other cases of the same sort have been reviewed by Sturtevant,<sup>5</sup> viz., pink versus black eye in canaries, *Aglia tau* and its variety *lugens*, and *Pygæra anachoreta* and *P. curta*.

Two cases of partial-sex-linkage in which the male is heterozygous for sex are reported. At least Sturtevant<sup>6</sup> so interprets the case of the dwarf guinea-pigs of Miss Sollas, and quite recently Doncaster<sup>7</sup> finds in cats that certain exceptions in the inheritance of coat-color may be due to partial-sex-linkage.

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#### EXPERIMENTS SHOWING THAT COMPLETE RELATIVITY DOES NOT EXIST IN ELECTROMAGNETIC INDUCTION

In the *Physical Review* for November, 1912, I described in detail some experiments which, taken together with earlier experiments by Faraday and others, establish the fact that complete relativity does not exist in electromagnetic induction. As a number of enquiries with reference to these experiments have been made, and as the subject of relativity is one in which great interest is taken by others as well as physicists, it seems desirable to give a brief account of the experiments in SCIENCE.

Two series of experiments were made, one without iron and the other with iron. In the first series a cylindrical condenser was mounted symmetrically in the approximately uniform magnetic field within a cylindrical electric coil coaxial with the condenser's armatures. The condenser, maintained at rest, was short-circuited, and the coil, tra-

<sup>4</sup> W. Bateson and R. C. Punnett, *Jour. Genetics*, August, 1912.

<sup>5</sup> A. H. Sturtevant, *Jour. of Exp. Zool.*, May, 1912.

<sup>6</sup> A. H. Sturtevant, *Am. Nat.*, September, 1912.

<sup>7</sup> L. Doncaster, *SCIENCE*, August 2, 1912.