To settle this question, morphology gives us little help. Although the organism of this case resembles the descriptions of the morphology as well as the photographs, of the spirillum of Obermeier, in practically all respects, it must be remembered that the spirillum of geese is strikingly similar to that of Obermeier, and yet, in the animal reactions, the anserina may be sharply differentiated from that of Obermeier, as it is not infective for monkeys.

The organism of this case, like Obermeier's, is infective for monkeys. The following differences have, however, been noted: The disease transmitted to the monkeys that were inoculated by the author seems to have been much milder than the experimental spirillum infection of those animals, as reported by various observers. Relapses in monkeys have rarely been noted; by one observer, in only one out of eight cases. Other observers seem never to have observed relapses. In the author's experience, each of three monkeys has had relapses, the first Rhesus having already had three.

Dr. Ewing has also called the author's attention to the fact that the spirochetas of this case, as seen in the blood of the inoculated monkeys, as well as in the human blood, is similar to *Spirochæte refringens.*

Such a case directs attention to the probability of mild spirochetal infections, more or less constantly occurring, in sailors or travelers coming from southern climates into the port of New York. The author also called attention to the possibility that infection may be communicated, from person to person, through the bites of ticks and bed-bugs, and through wounds.

5 (97). "**The chromosomes in relation to the determination of sex in insects**": **EDMUND B. WILSON.**

Material procured during the past summer (1905) demonstrates with great clearness that the sexes of Hemiptera show constant and characteristic differences in the chromosome groups, which are of such a nature as to leave no doubt that a definite connection of some kind between the chromosomes and the determination of sex exists in these animals. These differences are of two types. In one of these, the cells of the female possess one more chromosome than those of the male; in the other, both sexes possess the same number of chromosomes, but one of the chromosomes in the male is much smaller than the corresponding one in the female (which is in agreement with the observations of Stevens on the beetle *Tenebrio*). These types may conveniently be designated as A and B, respectively. The essential facts have been determined in three genera of each type, namely (type A), *Protenor belfragei*, *Anasa tristis*, and *Alydus pilosulus*, and (type B), *Lygæus turcicus*, *Euschistus fissilis*, and *Cœnus delius*. The chromosome groups have been examined in the dividing oögonia and ovarian follicle cells of the female and in the dividing spermatogonia and investing cells of the testis in case of the male.

Type A includes those forms in which (as has been known since Henking's paper of 1890 on *Pyrrochoris*) the spermatozoa are of two classes, one of which contains one more chromosome (the so-called "accessory" or heterotropic chromosome) than the other. In this type the somatic number of chromosomes in the female is an even one, while the somatic number in the male is one less (hence an odd number), the actual numbers being in *Protenor* and *Alydus* ♀ 14, ♂ 13, and in *Anasa* ♀ 22, ♂ 21. A study of the chromosome groups in the two sexes brings out the following additional facts: In the cells of the female all the chromosomes may be arranged two by two to form pairs, each consisting of two chromosomes of equal size, as is most obvious in the beautiful chromosome groups of *Protenor*, where the size differences of the chromosomes are very marked. In the male all the chromosomes may be thus symmetrically paired with the exception of one which is without a mate. This chromosome is the "accessory" or heterotropic one; and it is a consequence of its unpaired character that it passes into only half the spermatozoa.

In type B all the spermatozoa contain the same number of chromosomes (half the somatic number in both sexes), but they are, nevertheless, of two classes, one of which contains a large and one a small "idiochromosome." Both sexes have the same somatic number of chromosomes (14 in the three examples mentioned above), but differ as follows: In the cells of the female (oögonia and follicle cells), all the chromosomes may, as in type A, be arranged two by two in equal pairs, and a small idiochromosome is not present. In the cells of the male, all but two may be thus equally paired. These two are the unequal idiochromosomes, and during the maturation process they are so distributed that the small one passes into one half of the spermatozoa, the large one into the other half.

These facts appear to admit of but one interpretation. Since all of the chromosomes in the female (oögonia) may be symmetrically paired, there can be no doubt that synapsis in this sex gives rise to the reduced number of symmetric bivalents, and that consequently all the eggs receive the same number of chromosomes. This number (11 in *Anasa*, 7 in *Protenor* or *Alydus*), is the same as that present in those spermatozoa that contain the "accessory" chromosome. It is evident that both forms of spermatozoa are functional, and that in type A, females are produced from eggs fertilized by spermatozoa that contain the "accessory" chromosome, while males are produced from eggs fertilized by spermatozoa that lack this chromosome (the reverse of the conjecture made by McClung). Thus if n be the somatic number in the female, $n/2$ is the number in all of the matured eggs, $n/2$ the number in half of the spermatozoa (namely, those that contain the "accessory") and $n/2-1$, the number in the other half. Accordingly:

In fertilization

$$\text{Egg}\,\frac{n}{2} + \text{spermatozoön}\,\frac{n}{2} = n \text{ (female).}$$

$$\text{Egg}\,\frac{n}{2} + \text{spermatozoön}\,\frac{n}{2} - 1 = n - 1 \text{ (male).}$$

The validity of this interpretation is completely established by the case of *Protenor*, where, as was first shown by Montgomery, the "accessory" is at every period unmistakably recognizable by its great size. The spermatogonial divisions invariably show but one such large chromosome, while an equal pair of exactly similar chromosomes appear in the oögonial divisions. One of these in the female must have been derived in fertilization from the egg-nucleus, the other (obviously the "accessory") from the sperm-nucleus. It is evident, therefore, that all the matured eggs must before fertilization contain a chromosome that is the maternal mate of the "accessory" of the male, and that females are produced from eggs fertilized by spermatozoa that contain a similar group (*i. e.*, those containing the "accessory"). The presence of but one large chromosome (the "accessory") in the somatic nuclei of the male can only mean that males arise from eggs fertilized by spermatozoa that lack such a chromosome, and that the single "accessory" of the male is derived in fertilization from the egg-nucleus.

In type B all the eggs must contain a chromosome corresponding to the large idiochromosome of the male. Upon fertilization by a spermatozoön containing the large idiochromosome a female is produced, while fertilization by a spermatozoön containing the small one produces a male.

The two types distinguished above may readily be reduced to one; for if the small idiochromosome of type B be supposed to disappear, the phenomena become identical with those in type A. There can be little doubt that such has been the actual origin of the latter type, and that the "accessory" chromosome was originally a large idiochromosome, its smaller mate having vanished. The unpaired character of the "accessory" chromosome thus finds a complete explanation, and its behavior loses its apparently anomalous character.

The foregoing facts irresistibly lead to the conclusion that a causal connection of some kind exists between the chromosomes and the determination of sex; and at first thought they naturally suggest the conclusion that the diochromosomes and heterotropic chromosomes are actually sex determinants, as was conjectured by McClung in case of the "accessory" chromosome. Analysis will show, however, that great, if not insuperable, difficulties are encountered by any form of the assumption that these chromosomes are specifically male or female sex determinants. It is more probable, for reasons that will be set forth hereafter, that the difference between eggs and spermatozoa is primarily due to differences of degree or intensity, rather than of kind, in the activity of the chromosome groups in the two sexes; and we may here find a clue to a general theory of sex determination that will accord with the facts observed in Hemiptera. A significant fact that bears on this question is that in both types the two sexes differ in respect to the behavior of the idiochromosomes or "accessory" chromosomes during the synaptic and growth periods, these chromosomes assuming in the male the form of condensed chromosome nucleoli, while in the female they remain, like the other chromosomes, in a diffused condition. This indicates that during these periods these chromosomes play a more active part in the metabolism of the cell in the female than in the male. The primary factor in the differentiation of the germ cells may, therefore, be a matter of metabolism, perhaps one of growth.

6 (98). "**Experimental hepatic cirrhosis in dogs from repeated inhalations of chloroform**": **C. A. HERTER** and **WM. R. WILLIAMS.**

The difficulty of inducing pronounced interstitial hepatitis in dogs by means of poisons makes it of interest to report the well-defined results obtained as a consequence of repeated inhalations of chloroform vapor. Experiments of this character were made upon three dogs. In one experiment the animal received chloroform three times a week on eighteen occasions, each inhalation having been continued for an hour. For six subsequent inhalations the duration of the narcosis was one and a half hour. The duration of the entire experiment was about eight weeks. The liver everywhere was found to be the seat of an abundant, richly cellular, connective tissue growth between and into the lobules. The bile ducts were proliferated, and the liver cells showed much fatty and hyaline degeneration.

In two other dogs similar experiments were carried out with the exception that in each of these instances a highly satisfactory control was secured by first removing a small portion of normal liver for subsequent comparison with the damaged liver. In one of these dogs the inhalations were given eighteen times in about six weeks. The animal lived somewhat longer than five months and showed a well-marked though not extreme cirrhosis. The third dog was narcotized forty-nine times and lived about eight months. The changes in this instance were perfectly distinct, but less advanced than in either of the other animals mentioned.

The liver tissue from the first dog was subjected to an analysis which showed a distinct fall in the normal percentage of the arginin constituent of the protein molecule. Similar analyses show that the arginin yield from protein may fall rapidly after even very short exposure to toxic influences and these results, indicating early