

CHROMOSOME DIFFERENCE IN ASCARIS MEGALOCEPHALA.*

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While studying at the University of Zürich, in the winter of 1907-8, I spent some time working over a number of my old *Ascaris* slides in order to compare the peculiarities of the chromosomes with those of *Agave virginica*. The developing eggs showed the four chromosomes to consist of two sizes easily distinguishable and a number of drawings were made at the time. The work on *Agave* and other plants, however, prevented me from following the matter further. In the meantime Montgomery¹ has published a paper showing the same results as my own observations. I wish, therefore, to present this confirmatory note on his very interesting report.

I found that in the first two cleavage divisions, the chromosomes appeared as two longer and two shorter bodies. Montgomery² had previously (in 1904) concluded that the chromosomes of the polar spindles as well as of the first cleavage showed a difference in size, that the egg furnished one larger and one smaller chromosome, that the sperm cell also contained one larger and one smaller chromosome, and that the pairs can be distinguished in the first cleavage. Griggs³ has also shown that there is a difference in the shape and behavior of the two loops on the reduction spindle of the egg. (Note his figures 5, 6, 7, 9, 10 and 11, which were however, not very satisfactorily reproduced in the printed paper.)

My drawings were taken at random, and in some representing older stages the difference is not so marked. The difference is best seen shortly after the segmentation of the spirem, before the extreme contraction has taken place. The difference in length and shape is plainly shown in figures 1, 2, 3, 5 and 7. The drawings are, of course, projections and the real difference is shown to a greater or lesser extent depending on the angle from which the chromosomes are seen. Figure 1 is a spirem of the second cleavage and shows the relative positions of the two longer and the two shorter chromosomes. The spirem has just broken at one point while two other constrictions are visible.

* Contributions from the Botanical Laboratory of the Ohio State University, XLIV.

1. MONTGOMERY, JR., THOMAS H. On Morphological Difference of the Chromosomes of *Ascaris megaloccephala*. *Archiv für Zellforschung*, Bd. 2, Heft, 1, pp. 66-75. 1908.

2. MONTGOMERY, JR., T. H. Some Observations and Considerations upon the Maturation Phenomena of the Germ Cells. *Biological Bull.* 6:137.

3. GRIGGS, ROBERT F. A Reducing Division in *Ascaris*. *Ohio Nat.* 6: 519-527. 1906.

This figure shows that there has been no pairing so far of the maternal and paternal chromosomes. This would seem to indicate that definite pairing is delayed until the prophase of the reduction division where it must take place before or at the time of the formation of the spirem. The two shorter chromosomes are situated at the ends of the long ones which form a more or less parallel pair. This arrangement can still be noticed shortly after the segmentation of the spirem and is sometimes quite striking. It is shown to some extent in figures 2, 3 and 5.

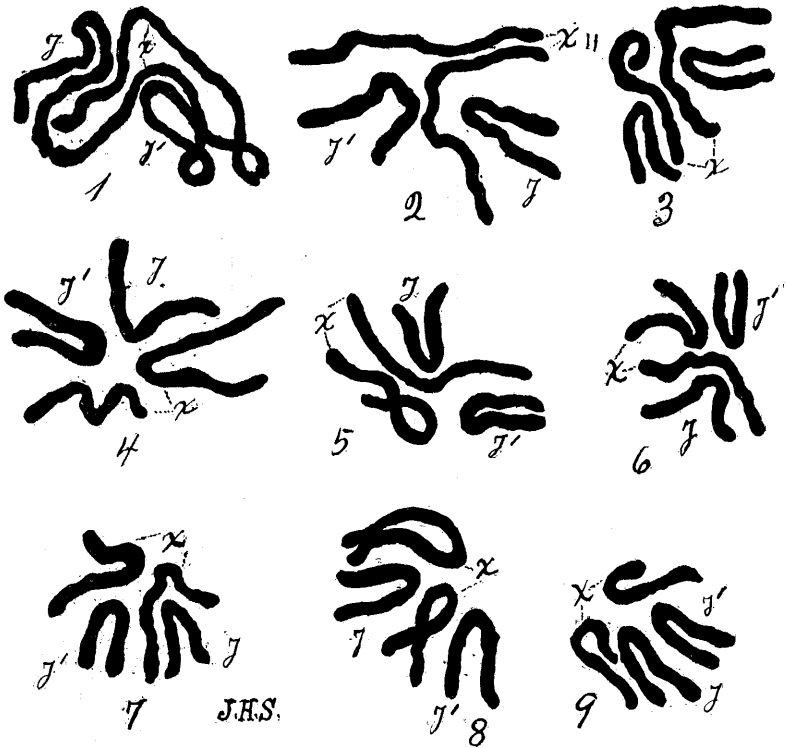
There is a rather constant difference between the pair of smaller chromosomes, one of which is now known to be a maternal and one a paternal chromosome. It would be interesting if the pedigree of these two bodies could be determined. The writer has frequently pointed out this difference in appearance between the two smaller chromosomes in *Ascaris*. It was, therefore, a pleasure to read Montgomery's statement of the same fact. It is evident that even though the difference is slight, it is distinct enough to be clearly seen by two observers entirely independent of each other and is not a matter of the imagination. I have always described (orally) the one chromosome as being more U-shaped or rounded at the head and the other as more pointed, V-shaped, or narrowed at the apex. Montgomery describes the difference as follows: "The smallest chromosome of all is very frequently hook-shaped and the other of the smaller pair often U-shaped, while the longer ones have usually two or three angles each, but none of these differences in form appear to be constant." By long-continued study one might perhaps be able to acquire the ability to distinguish these bodies just as an expert systematist can readily determine two closely related species at sight which look exactly alike to the inexperienced. Thus we are led to hope that a plant or animal may be found which will present constant and recognizable differences between the maternal and paternal chromosomes.

In my work on *Agave*⁴, a marked individuality was found in the twelve reduction chromosome loops as regards morphological character. The statement was also made that "Since these are bivalent chromosomes, it is evident that on the theory of the conjugation of maternal and paternal chromosomes, the conjugating pairs must be quite similar in shape and activity. In the microsporocytes the bivalent chromosomes have an individual shape and size easily distinguishable."

It is not necessary to assume, at the present time, that no interchange whatever of material takes place between the chromosomes even though we ascribe definite individuality to them. There might occasionally or even regularly be some

4. SCHAFFNER, JOHN H. The Reduction Division in the Microsporocytes of *Agave virginica*. Bot. Gaz. 47: 198-214. 1909.

interchange of the granular chromatin and the individual shape (probably dependent on the linin structure) still be retained. The chromatin granules appear to become diffused and spread out no less than the linin, to be massed together again at definite stages in the ontogeny.



All the figures are from accurate Abbé camera lucida drawings on the same scale. Fig. 1. Spirem of second cleavage just at the time of the separation of the chromosomes. The spirem is already broken at one point. The position of the two long and two short chromosomes is clearly marked, showing that the chromosomes are not yet paired. Figs. 2-9. Pole views of equatorial plates of first and second cleavage.

Then again it is even possible, with all of our present knowledge, that the chromatin acts as a unit organism and produces periodically a definite number of chromosomes of rather definite size and form without localizing any given quantity of the substance in any definite part. There is no need to insist that a viscid plasm must comport itself like a set of wooden blocks as some would have us believe. However, I think that most of the evidence so far presented points to a material individuality of the linin groundwork of the chromosome.