

## LETTERS TO THE EDITORS

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## Chromosomes of Monkeys and Men

CHROMOSOME numbers have been recorded in very few species of primates. All observations have been on the male, the heterozygous sex. The following are the more serious references:

OLD WORLD PRIMATES			
<i>Homo sapiens</i>	European and Negro	48	Painter <sup>1</sup> , Koller <sup>2</sup> , La Cour <sup>3</sup> , Hsu <sup>4</sup> .
	Japanese	47	Oguma <sup>5</sup> .
<i>Pan calvus</i>	Chimpanzee	c. 48	Yeager <i>et al.</i> <sup>6</sup>
<i>Macacus mulatta</i>	Rhesus macaque	48	Painter <sup>7</sup>
NEW WORLD MONKEY			
<i>Cebus</i> sp.	Capuchin monkey	54	Painter <sup>7</sup> .

Recent developments of technique, however, enable us to count the numbers and describe the forms of mammalian chromosomes with the same ease and accuracy as has long been possible for grasshoppers and newts. We have therefore examined all the species of primates available to us. The following are our counts (Figs. 1-4):

<i>Homo sapiens</i>	European, bone marrow (Fig. 1) Indian, testis	} 48
<i>Papio papio</i> , Guinea baboon, testis (Fig. 2)		
<i>Macacus nemestrina</i> , pigtailed monkey, testis (Fig. 3)	} 42	
<i>Macacus mulatta</i> , Rhesus macaque, testis (Fig. 4)		

The chromosomes of man and monkeys are generally not unlike. In the spermatogonia illustrated they are, of course, more contracted than in the pre-myelocytes of the bone marrow. With regard to the individual chromosomes we agree with Koller (who has studied meiosis), and with La Cour and Hsu, that in man X is a medium-sized chromosome and Y one of the smallest, although not individually recognizable at mitosis.

The three species of monkey are alike in two respects in which they differ from man. First, they lack the pair with median centromeres which is the largest pair in the human complement. Secondly, they have a Y chromosome which is much smaller than the human Y. It is also much smaller than any other chromosome in their own complements and is therefore at once and always recognizable at mitosis (Figs. 2-4).

Since almost the whole of the Y in man can be accounted a pairing segment exchangeable between X and Y, all three monkeys must have a much shorter length of X-Y exchangeable genes than man. The difference between man and monkey should show at meiosis, of which an account will be published later. The similarity between the monkeys, on the other hand, should be seen in their capacity for hybridization. A cross has in fact been made between *Papio sphinx* ♀ and *Macacus mulatta* ♂, and offspring have been raised in captivity.

These observations indicate that, apart from Painter's study of man, the earlier accounts based on sectioned material are not to be relied upon. They especially lead us to reject Oguma's claim of an unpaired X chromosome in the human male. The Y chromosome is obvious and characteristic in all our four species as it has been in all other mammals studied. Its absence, which would require an innovation in the centromere of the unpaired X, has never been established in any vertebrate.

Finally, our observations show, what has not so far been clear, that chromosome form and number are unstable in the primates. Both sex chromosomes and autosomes can be used to test relationships of

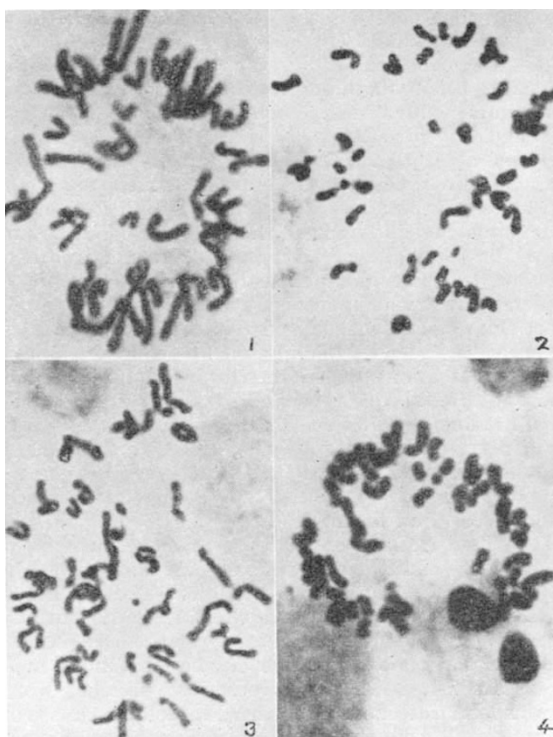


Fig. 1. Bone marrow, pre-myelocyte, man ( $\times c. 2,140$ )  
Figs. 2-4. Spermatogonium of monkeys. (Fig. 2,  $\times 1,844$ ; Figs. 3 and 4,  $\times c. 2,140$ )  
All acetic alcohol Feulgen squashes. Note: the small Y chromosome is at 5 o'clock in Fig. 2; central in Fig. 3; and at 7 o'clock in Fig. 4

descent. With this regard we should like to repeat the opinion<sup>8</sup> that the chromosomes of the great apes should be studied before these species die out altogether. In order to facilitate this we must mention that our technique is a slight modification of that described by Sachs<sup>9,10</sup>. Anyone who is able to obtain fresh monkey testis material should fix it in fresh 1:3 acetic alcohol and keep it, after twelve hours, at 0° C. Feulgen squash preparations should, however, be made as soon as possible (after twelve hours). Fixations may be sent by airmail to Dr. A. Haque, Botany Department, University of Dacca, East Pakistan.

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<sup>1</sup> Painter, T. S., *Amer. Nat.*, **59**, 664 (1925).

<sup>2</sup> Koller, P. C., *Proc. Roy. Soc. Edin.*, **57**, 194 (1937).

<sup>3</sup> La Cour, L. F., *Proc. Roy. Soc. Edin.*, **62**, 10 (1944).

<sup>4</sup> Hsu, T. C., *J. Hered.*, **63**, 4 (1952).

<sup>5</sup> Oguma, K., *J. Morph.*, **61** (1937).

<sup>6</sup> Yeager, C. H., Painter, T. S., and Yerkes, R. M., *Science*, **91**, 2351 (1940).

<sup>7</sup> Painter, T. S., *J. Exp. Zool.*, **39**, 3 (1924).

<sup>8</sup> Darlington, C. D., *Nature*, **171**, 191 (1953).

<sup>9</sup> Sachs, L., *Heredity*, **6**, 357 (1952).

<sup>10</sup> Sachs, L., *Stain Tech.*, **28**, 169 (1953).