Somatic Chromosomes of Four Common Bats of Allahabad.

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This communication deals with the structural details of chromosomes of four species of Indian bats: Pteropus giganteus giganteus Brünnich, Pipistrellus mimus Wroughton, Pipistrellus sp., and Scotophilus heathi Horsfield. Of these the karyotype of Scotophilus heathi is reported for the first time, and is strikingly different from that of its cogeneric species already studied (Pathak and Sharma 1968). A short report on the karyotype of Pteropus giganteus giganteus exists (Pathak 1965), but the illustrations are so inadequate as to fully bar their application to the description. In Pipistrellus mimus also we find certain structural features in the chromosomes which have not been noticed before (Pathak and Sharma 1969). The karyotype of Pipistrellus sp., though not firmly established, differs widely from that of its cogeneric species.

Table 1. Species of chiroptera under study

<table>
<thead>
<tr>
<th>Species</th>
<th>No. of individ. studied</th>
<th>Locality</th>
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<tr>
<td></td>
<td>Male</td>
<td>Female</td>
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<tr>
<td>Order Chiroptera</td>
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<td>Sub-order Megachiroptera</td>
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<tr>
<td>1. Pteropus giganteus giganteus</td>
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<td>Sub-order Microchiroptera</td>
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<tr>
<td>2. Pipistrellus mimus Wroughton</td>
<td>1</td>
<td>2</td>
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<tr>
<td>3. Pipistrellus sp.</td>
<td>1</td>
<td>—</td>
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<tr>
<td>4. Scotophilus heathi Horsfield</td>
<td>1</td>
<td>2</td>
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Material and methods

Table 1 lists the species of bats examined by us and the locations of their collection. The bats received an intraparetoneal injection of colcemid solution in the dose of .5 mg/kg of body weight. The animals were sacrificed one hour and a half thereafter. The bone-marrow cells were aspirated in .9% sodium citrate solution and incubated for 30 minutes at 37°C. They were further processed according to the methods of Ford and Hamerton and Rothfels and Siminovitch. The air-dried slides were stained with dilute Giemsa (1:9). A large number of well-spread metaphase plates were examined. The selected few were photographed with a Leitz Panphot. The chromosomes were classified according to Levan et al. (1964).
**Pteropus giganteus giganteus** Brünnich

Although a good number of individuals was investigated, preparations from two males and two females alone have been considered reliable. The diploid number of chromosomes has been found in all cases to be 38. To facilitate comparison we have grouped the figures in the same way as Pathak (1964), giving greater prominence to the placement of centromere and the arms ratio than to the size.

The entire chromosome complement has been arranged into 4 groups A, B, C and D (Figs. 1, 2, 3 and 4.).

Group A consists of three pairs of m chromosomes which are largest in the complement except one. All the chromosomes have almost identical length and

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**Figs. 1–2.** 1, metaphase plate of a bone marrow cell of a male *Pteropus giganteus giganteus*. 2, karyotype prepared from Fig. 1.

**Figs. 3–4.** 3, metaphase plate of a bone marrow cell of a female *Pteropus giganteus giganteus*. 4, karyotype prepared from Fig. 3.
arm ratio and so individually indistinguishable from each other, except one which generally bears a secondary constriction, often found in both members of the pair, but confined to males.

Group B consists of six pairs of m chromosomes—two pairs of medium-sized and four pairs of small elements. The first two pairs are indistinguishable from each other except for the presence of a non-staining band on one side of the centromere in both sexes in the first pair, but they can be identified as a group. The same holds for the last two pairs. Two pairs of intermediate size can sometimes be identified individually. However, they can be easily confused with the small chromosomes of the group C.

Group C consists of 5 pairs of sm chromosomes, one pair of large, two pairs of medium-sized and two pairs of small elements. The large chromosome is individually identifiable, although it can be confused with members of group A. The two medium-sized pairs, standing next in order of size, cannot be distinguished from each other. The next two pairs are small in size, the last being the smallest of the group.

Group D consists of 4 pairs of st chromosomes the first three pairs being practically of the same size and not easily distinguishable from each other. The fourth pair consists of small elements. The X-chromosome is a medium-size, sm chromosome and the Y is a t chromosome, though in photographs it appears as dot-shaped without clear short arms.

Figs. 5–6. 5, metaphase plate of a bone marrow cell of a female Pipistrellus mimus. 6, karyotype of a male Pipistrellus mimus.
**Pipistrellus mimus** Wroughton

The autosomes can be assembled in 4 groups A, B, C and D. (Figs. 5 and 6).

Group A consists of 3 large M chromosome pairs which cannot be easily distinguished individually. One member each of the 2nd and 3rd pair in the males carry a laterally attached rod like process which might or might not have resulted from an irregular process of unequal exchange. A study of meiotic pairing might furnish insight into their character, which, however, has not been carried out yet.

Group B consists of 3 large-sized m chromosomes (with median region-centromere) which also closely intergrade in size and cannot be distinguished individually although the first is somewhat larger than the rest. There is very little difference in length among the chromosomes of the groups A and B taken together.

Group C consists of 12 pairs of telocentric (T) chromosomes, which are medium-sized and small, and cannot be distinguished individually as they intergrade in size, except the first, the largest of the group. Some of these chromosomes give an indication of the presence of a knob-like second arm and so are probably t chromosomes.

Group D: In addition to the above chromosomes we have also noticed one or two pairs of microchromosomes which are present in most of the metaphase plates. They are considerably smaller in size than the last pair of telocentric chromosomes of Group C.

Sex chromosomes: X is a small-sized, metacentric chromosome and the Y is the smallest telocentric of the karyotype (except the microchromosomes).

**Pipistrellus** sp.

This is a species closely related to but quite different from *P. mimus*, the
identification of which is still being investigated. The karyotype consists of four groups of autosomes and XX/XY sex chromosomes, making up a total of eighteen pairs (Figs. 7 and 8).

Group A consists of 7 pairs of m chromosomes of which the first pair is the largest of the entire complement and can be, on most plates, individually distinguishable. The last pair of series is the smallest and hence easily identifiable. Other pairs, however, so sharply intergrade in size as to make the identification of individual elements a hazardous proceeding.

Group B consists of 4 pairs of sm chromosomes. The first two pairs are larger than the other two, and the last pair is the smallest of this series.

Group C consists of two pairs of st chromosomes. The first pair is considerably larger than the other pair, which is smaller in size than the last pair of series A and of B.

Group D consists of 3 pairs of T and t chromosomes, the first pair is telocentric (T), while the other two pairs appear to possess short arms (t).

Group E consists of one pair of dot-like chromosomes, which can be considered microchromosomes.

Sex chromosomes: The X is a medium-sized metacentric chromosome and the Y is telocentric.

*Scotophilus heathi* Horsfield

The autosomes fall into four groups, A, B, C, and D. (Figs. 9–12).

Group A consists of 3 pairs of m chromosomes, possessing median region centromere. The first two pairs are the largest chromosomes of the complement...
but the third pair is considerably smaller than the other two pairs of this series. (Fig. 10).

Group B consists of 4 pairs of sm chromosomes, two large, one medium-sized, and one small. All the four pairs are individually identifiable in some plates.

Group C consists of 3 pairs of st chromosomes. The first and second pairs have measurable short arms but cannot be identified individually. The third pair has knob-like short arm.

Group D consists of 7 pairs of telocentric (T) chromosomes which intergrade closely in size and so are individually indistinguishable from each other, except the last pair which is the smallest of the whole lot.

Discussion

Our description of the karyotype of *P. mimus* tallies with that of Pathak and Sharma (1969) except for their classification of the six large-sized chromosomes which is certainly incorrect and is not borne out by their photographs. Their photographs showed chromosomes Nos 3, 5 and 6 (their Fig. 2) to be distinctly m-type elements (with median-region centromeres) — in the terminology of Levan and Fredga (1964). So the six large-sized chromosomes must be relegated to two different groups of M and m chromosomes, as we have done in this communication. A similar failure to distinguish between 'metacentric and submetacentric' marks the classification of the chromosomes of *P. affinis*. Pathak and Sharma (1969) have not followed the system of Levan and Fredga, and their distinction between metacentric and submetacentric chromosomes is imprecise. Chromosome Nos. 3 and 4 of *P. affinis* (their Fig. 4) are classified as metacentric, although they are
distinctly submetacentric chromosomes. Chromosomes 3 and 4 of *P. mordax* (their Fig. 6) are submetacentric and not metacentric, as they described it.

The other species of *Pipistrellus* which was collected at a different locality (Allahabad city) was also identified as *P. minus* by Dr. H. Khajuria, a taxonomist of Zoological Survey of India, but its karyotype differs so radically from that of *P. minus* from the other locality, that it must be considered to be different species. In *Pipistrellus* sp. there is a considerably larger number of m and sm chromosomes than in *P. minus*, and whereas there are as many as 12 pairs of T chromosomes in *P. minus* there are only 3 such chromosomes pairs in *Pipistrellus* sp. And there is only one pair of microchromosomes in *Pipistrellus* sp. compared to two in *Pipistrellus minus*.

The chromosome complements of *S. temminicki* Wroughtoni Thomas and *S. kuhli* Leach described by Pathak and Sharma (1969) and of *S. heathi* Horsfield described here have much in common. They all consist of 17 pairs of autosomes and one pair of sex chromosomes. In *S. heathi* Horsfield we find there are 7 pairs of telocentric (T) chromosomes with terminal centromere and one pair of T chromosome with minute short arms and possessing terminal region centromere, which may at times be confused with the T chromosomes. This is what happened in the study of *S. temminicki* and *S. Kuhli* by Pathak and Sharma (1969). They described for both species 8 pairs of acrocentric chromosomes thus lumping t and T chromosomes together. In both *S. heathi* and *S. temminicki* there are only two pairs of st chromosomes. Pathak and Sharma call these 'submetacentric' but the kinetochore lies much nearer the terminal end of the chromosome than its middle point and so according to Leven and Fredga’s classification, these are st chromosomes. Similarly their assertion that the chromosome complement in *S. temminicki* includes 7 pairs of metacentric and in *S. kuhli* 6 pairs is not admissible, for with the exception of chromosome pair 2 of *S. temminicki* not one chromosome can be classified as metacentric. Thus the karyotype of the 3 species of *Scotophilus* show a noteworthy degree of uniformity of organization. As regards *Pteropus giganteus giganteus* Pathak’s photograph of the chromosomes of this bat are so unclear and indistinct as to preclude a study of the configuration types of most of the chromosomes. And in his description he lumped chromosomes of different types into metacentric and submetacentric. No description on the configuration of the Y-chromosomes was given. We have found the Y to be an sm chromosome with submedian centromere. We are also in disagreement with him regarding the size of the Y, which does not correspond in measurements to the smallest autosome as claimed by Pathak, but is considerably smaller (our Fig. 1).

Summary

1. The karyotypes of four species of bats have been described, of which two are reported for the first time.

2. A comparison of the somatic chromosomes of *Pipistrellus minus* and *Pipistrellus* sp. shows that they must be different species, in disaccordance to the view of systematists.
3. Pathak's classification of the somatic chromosomes of *Pteropus giganteus giganteus* has been revised.

4. *Scotophilus heathi* has 3 pairs of m, 4 pairs of sm and 3 pairs of st and 7 pairs of T chromosomes.

5. In all the bats studied the sex-determining mechanism is of XX/XY type.

References


