

# THE BATS OF RAJASTHAN : TAXONOMY AND ZOOGEOGRAPHY

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(With 22 Text-figures)

## INTRODUCTION

Some information on the taxonomy of the bats of Rajasthan (western India, Text Fig. 15) has been given by Wroughton (1918), Ellerman and Morrison-Scott (1951), Prakash (1963*a, b*, 1973), Agrawal (1967), Biswas and Ghosh (1968), Sinha (1973, 1975, 1976, 1977) and Agrawal and Sinha (1973), but this huge area (area 342, 274 sq. km.), which includes the bulk of the Great Indian Desert, has never been studied in detail.

In the present account, the taxonomy of bats of the 21 species occurring in Rajasthan is dealt with in detail, with descriptions and illustrations ; their zoogeography is also discussed. In a few cases, examples from Rajasthan were not available, but the species is included on the basis of other authentic records. For comparison, material from other parts of India and the neighbouring countries was also examined, as indicated under each species. Three species are new records from Rajasthan, and the range of several other species has been considerably extended. Keys are provided for easy identification. All measurements are taken in millimetres.

## *Acknowledgements*

I am grateful to Dr. M. L. Roonwal for suggestions, constant encouragement and guidance, and to the Director, Zoological Survey of India, for providing facilities. I thank also Dr. T. G. Vazirani, Officer-in-charge, for his cooperation, Dr. R. C. Sharma and Sri N. S. Rathore for their help in some of the drawings.

## KEY TO THE BATS OF RAJASTHAN

1 (6) Second finger with claw.

2 3) Size large (wing spread above 650 mm.);  
tail invisible.

... .. *Pteropus giganteus giganteus*

- 3 (2) Size small (wing spread below 600 mm.); tail visible.
- 4 (5) Five teeth in upper molar series, six in lower. *Rousettus leschenaulti*
- 5 (4) Four teeth in upper molar series, five in lower. ... .. *Cynopterus sphinx sphinx*
- 6 (1) Second finger without claw.
- 7 (8) Tail not visible. ... .. *Megaderma lyra lyra*
- 8 (7) Tail visible
- 9 (22) Tail either partly free from interfemoral membrane or perforating it.
- 10 (17) Tail partly free from interfemoral membrane
- 11 (14) Upper lip heavily wrinkled; antitragus present, small.
- 12 (18) Ears separated on the muzzle; palatal branch of premaxillae absent. ... .. *Tadarida aegyptiaca thomasi*
- 13 (12) Ears joined on muzzle; palatal branch of premaxillae present. ... .. *Tadarida plicata plicata*
- 14 (11) Upper lip not wrinkled; antitragus absent.
- 15 (16) Tail shorter than forearm. ... .. *Rhinopoma microphyllum kinneari*
- 16 (15) Tail longer than forearm. ... .. *Rhinopoma hardwickei hardwickei*
- 17 (10) Tail perforating interfemoral membrane.
- 18 (21) Forearm short, length below 66 mm; skull short, length below 22 mm.
- 19 (20) Gular sac rudimentary in male and absent in female. ... .. *Taphozous perforatus perforatus*
- 20 (19) Gular sac prominent in male, rudimentary in female. ... .. *Taphozous longimanus longimanus*
- 21 (18) Forearm long, length above 66 mm; skull long, above 22 mm. ... .. *Taphozous kachhensis kachhensis*
- 22 (9) Tail entirely covered by interfemoral membrane.
- 23 (26) Noseleaf present; tragus absent.
- 24 (25) Posterior noseleaf divided into transverse hollows; first toe with three joints; remaining toes with only two. ... .. *Rhinolophus lepidus lepidus*
- 25 (24) Posterior noseleaf divided into longitudinal hollows; all toes with two joints. ... .. *Hipposideros fulvus pallidus*
- 26 (23) Noseleaf absent; tragus present.
- 27 (28) Ears long and joined. ... .. *Barbastella leucomelas darjelingensis*
- 28 (27) Ears short and separate.
- 29 (38) Size large (wing spread 270-370 mm.); forearm length 45-64 mm.
- 30 (31) Upper cheekteeth (premolars + molars) six on each side. ... .. *Myotis blythi*
- 31 (30) Upper cheekteeth (premolars + molars) less than six on each side.
- 32 (35) Upper incisors 2-2.
- 33 (34) Outer upper incisor large, crowded inward between inner incisor and canine. ... .. *Hesperoptenus tickelli*

34 (33)	Outer upper incisor small, lying on outer side of inner incisor and separated from canine. ...	<i>Eptesicus serotinus pachyomus</i>
35 (32)	Upper incisor 1—1.	
36 (37)	Forearm length 55-64 mm. ... ..	<i>Scotophilus heathi heathi</i>
37 (36)	Forearm length 45-52 mm. ... ..	<i>Scotophilus kuhlii kuhlii</i>
38 (29)	Size small (wing spread 140-240 mm.); forearm length 26-37 mm.	
39 (40)	Forearm length 26-31 mm. ... ..	<i>Pipistrellus mimus mimus</i>
40 (39)	Forearm length 34-37 mm. ... ..	<i>Pipistrellus dormeri</i>

## TAXONOMY OF RAJASTHAN BATS

## Suborder I. MEGACHIROPTERA

## Family I. PTEROPODIDAE

## • (Text-fig. 1)

Genus (1) **Pteropus** Brisson1. **Pteropus giganteus** (Brünnich)

## (Indian Flying Fox)

*Vespertilio gigantea* Brünnich, 1782, *Dyrenes Hist.* 1, : 45. Type-loc. : Bengal.

*Diagnosis of species* : Size large (wing spread 660-890 mm.), the largest bat in Rajasthan ; noseleaf absent ; base of ear completely ringed ; tragus and antitragus absent ; inner margin of nostril projecting ; index finger with claw ; tail invisible ; inter femoral membrane not extensive ; calcar present ; hind neck, shoulders and underside of body generally paler than back. Skull large (total length 61-79 mm.) ; postorbital process long ; premaxillary without palatal branch ; parietal and occipital crests prominent ; palate continued behind last molar ; basisphenoid not excavated ; crown of molar marked with longitudinal furrow.

Dental formula :  $i \frac{2}{2}, c \frac{1}{1}, pm \frac{3}{3}, m \frac{2}{3} = 34$

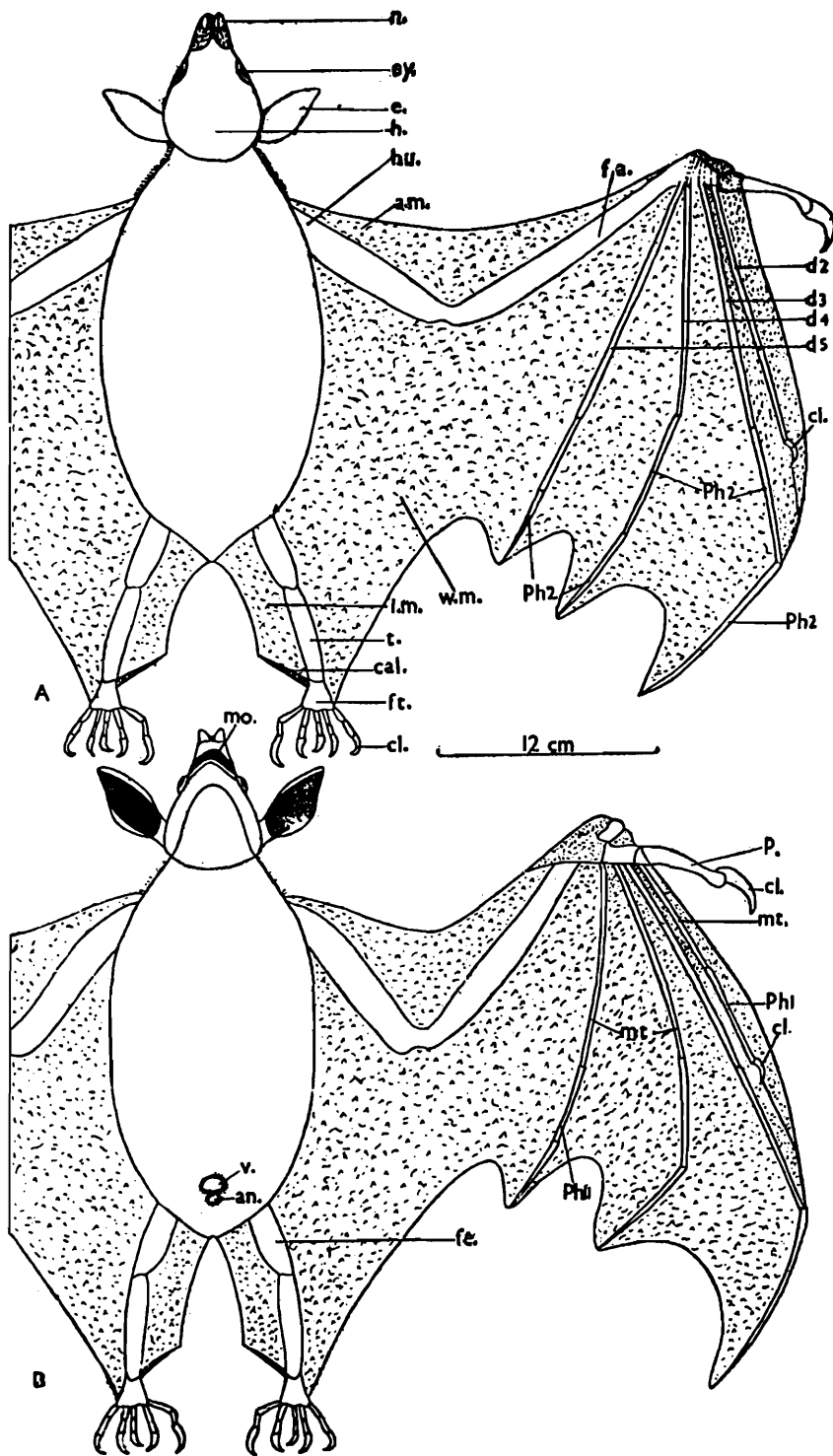
First upper premolars sometimes absent.

*Distribution of species* : Almost the whole of INDIA ; also SRI LANKA and BURMA.

*Systematic note* : Two subspecies are recognized, as follows, of which *P. g. giganteus* occurs in Rajasthan :

*P. g. giganteus* (Brünnich). —As in species (except Nepal, Assam, Manipur and Tripura).

*P. g. leucocephalus* Hodgson. —Nepal, Assam, Manipur and Tripura.



Text-fig. 1.—Family Pteropodidae : *Pteropus giganteus giganteus* (Brünnich), ♀.  
Rajasthan (Jodhpur). External body : (A) Dorsal view. (B) Ventral view.

### ***Pteropus giganteus giganteus* (Brünnich)**

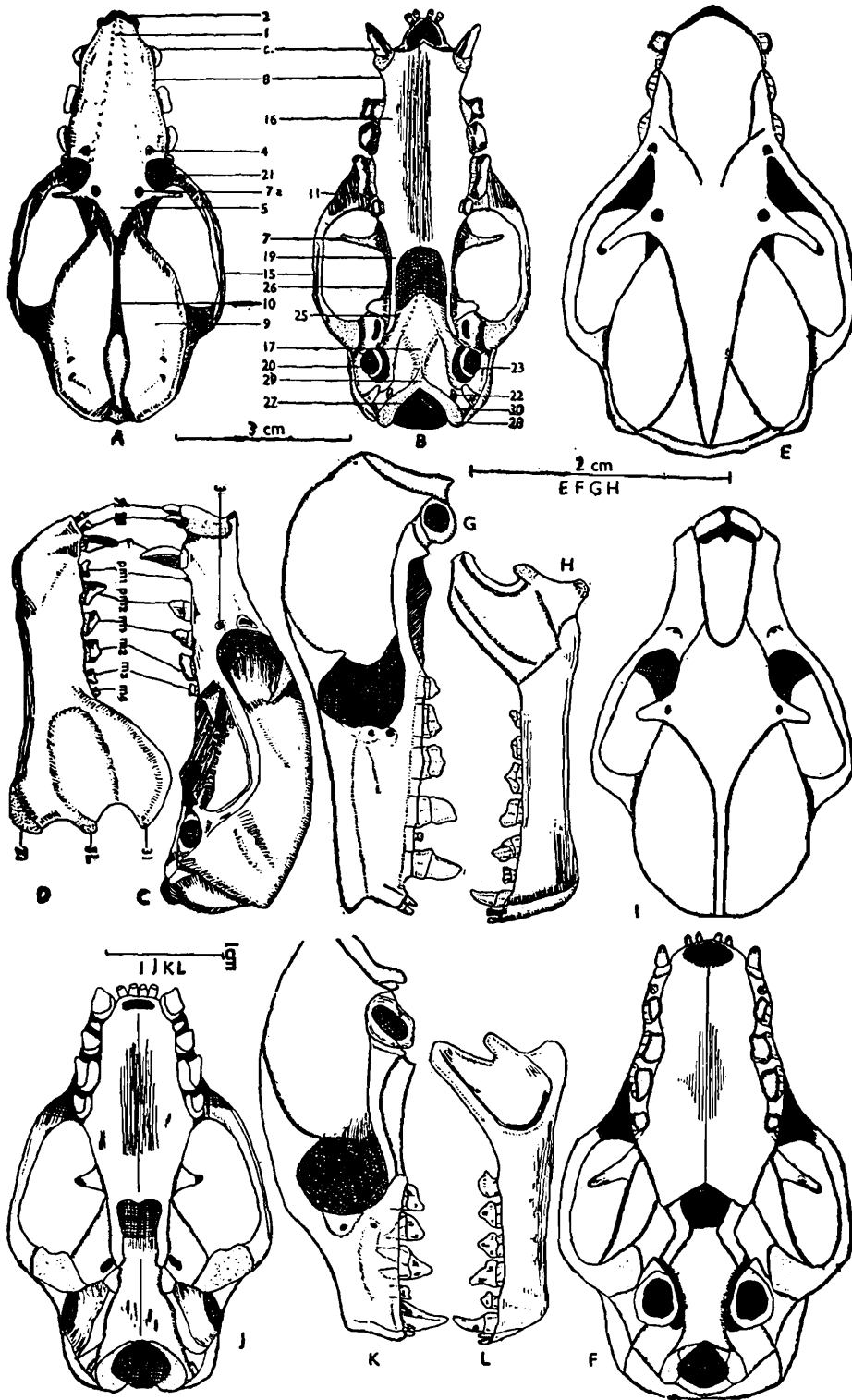
(Text-figs. 1 & 2 A, B, C, D)

*Vespertilio gigantea* Brün., 1782, as above.

*Pteropus g. giganteus* (Brün.) : Ellerman and Morrison-Scott, 1951, p. 97.

*Material examined* : Rajasthan : Jodhpur Dist. : Balsamand, 3 ♂♂ ;  
Dungarpur Dist. : Dungarpur, 4 ♂♂, 3 ♀♀ ; Banswara Dist. :  
Banswara, 2 ♂♂, 4 ♀♀ ; Udaipur Dist. : Parsad, 2 ♂♂ ; Sirohi  
Dist. : Mt. Abu, 4 ♂♂ ; Pali Dist. : Berah, 12 km. S. W. of Jawai dam,

4 ♂♂ ; Jhunjhunu Dist. : Naga village, 3 ♀♀ ; Ajmer Dist. : Nasirabad, 1 ♂ ; Jhalawar Dist. : Jhalawar, 1 ♀ . *other than Rajasthan* : INDIA : Himachal Pradesh : Kangra, 1 ♂ , 1 ♀ Madhya Pradesh : Guna, 1 ♂ ; Bhind, 2 ♂♂ ; Malwa (Agar), 1 ♂ ; Gwalior (Morar), 2 ♂♂ ; Balaghat



Text-fig. 2. (A-D): *Pteropus giganteus giganteus* (Brünnich), ♀. Rajasthan (Jodhpur). Skull : (A) Dorsal view. (B) Ventral view. (C) Lateral view. (D) Lower jaw, in lateral view ; (E-H) *Rousettus leschenaulti* (Desmarest), ♂ Rajasthan. (Jhalawar). Skull : (E) Dorsal view. (F) Ventral view. (G) Lateral view. (H) Lower jaw, in lateral view ; (I-L) *Cynopterus sphinx sphinx* (Vahl), ♂. Rajasthan (Bundi). Skull : (I) Dorsal view. (J) Ventral view. (K) Lateral view. (L) Lower jaw, in lateral view.

1 ♀. Gujarat : Himatnagar, 1 ♀ ; Rajkot, 1 ♂. Maharashtra : Satara, 1 ♀ ; Chanda, 1 ♂. Goa : 1 (unsexed). Karnataka : Dharwar, 1 ♂, 1 ♀ ; Kolar, 1 ♀. Kerala : Trivandrum Fort 1 ♀. Uttar Pradesh : Kumaun, 1 ♂ ; Lucknow, 1 ♂ ; Varanasi, 1 ♂. Andhra Pradesh : Cuddapah, 1 ♂, 1 ♀. Tamil Nadu : Salem, 1 ♂, 1 ♀. Bihar : Darbhanga, 1 ♂, 1 ♀ ; Bongaon, 1 ♂, 7 ♀ ♀ ; Amarpura 1 ♂ ; Chaibassa, 1 ♀. Orissa : Chilka Lake, 1 ♂, 4 ♀ ♀. West. Bengal : Burdwan, 2 ♀ ♀ ; Duars 1 ♂ ; Siliguri, 1 ♂. SRI LANKA : 1 ♂. BURMA : Toungoo, 1 ♀ ; Pegu, 1 ♀.

*Diagnosis of subspecies* : Differs from *P. g. leucocephalus* only in having shorter fur on back.

*Remarks* : In 26 skulls from Rajasthan and other parts of India, nine have no first upper premolars, three have the tooth only on one side, and in the remainder it is present on both sides.

Length : Head and body 215-290 ; forearm 147-180 ; ear 35-47 ; wing spread 660-890 ; tibia 66-89 ; foot and claw 45-56.

Skull : Total length 61-79 ; zygomatic width 30.5-43.5 width of braincase 23.1-26.5 ; Maxillary width ( $m^1-m^1$ ) 17.5-21 ; Length of upper tooth row ( $c-m^2$ ) 23.2-29.2 ; Length of lower tooth row ( $c-m_3$ ) 27-34 ; length of mandible 47-60.5.

*Distribution of subspecies* (Text. Figs. 16 & 20A) : RAJASTHAN : Districts of Jodhpur, Pali, Sirohi, Dungarpur, Banswara, Udaipur, Jhunjhunu, Ajmer and Jhalawar. Besides Jodhpur, all other records are new (See also Sinha, 1975). *Elsewhere* : As above.

## Genus (2) *Rousettus* Gray

### 2. *Rousettus leschenaulti* (Desmarest)

(Indian Fulvus Fruit Bat)

(Text-figs. 2E, F, G, H)

*Pteropus leschenaulti* Desmarest, 1820, *Encycl. Meth. Mammalia* 1 : 110. Type-loc. : Pondicherry, India.

*Rousettus leschenaulti* (Desm.), Ellerman and Morrison-Scott, 1951, p. 93 ; Sinha, 1969, p. 764. (syn. *Xantharphia seminuda* Gray).

*Material examined* : Rajasthan : Jhalawar Dist. : Gagaron Ka Kila, Jhalawar, 13 ♂ ♂, 22 ♀ ♀. *Other than Rajasthan* : INDIA : Maharashtra : Satara, 5 ♂ ♂, 9 ♀ ♀. Kerala : Trivandrum, 1 ♂, 1 ♀. Uttar Pradesh : Kumaun, 6 ♂ ♂, 1 ♀, 1 (unsexed). Tamil Nadu : Zakampatti, 1 ♀. Orissa : Khandagiri, 1 (unsexed). Bihar : Chaibassa, 1 ♀. Meghalaya :

Siju cave, 3 ♂♂, 1 ♀. NEPAL : Gorkha, 1 ♂. SRI LANKA : Kandy, 1 ♂. 8 ♀♀. BURMA : Pegu, 1 ♀ ; Pegan, 1 ♂, 2 ♀♀

*Diagnosis of species* : Much smaller than *Pteropus giganteus* (wing spread 480-560 mm.) ; noseleaf absent ; base of ear completely ringed ; tragus and antitragus absent ; inner margin of nostril projecting ; index finger with claw ; tail very small, 10-17 mm. long ; interfemoral membrane not extensive ; calcar present ; coloration of upper side varies from yellowish brown to dark brown and that of the underside wood brown. Skull medium-sized (total length 37-40 mm.) ; postorbital process long ; premaxillae without palatal branch ; parietal and occipital crests poorly developed ; palate continued behind last molar ; basisphenoid not excavated ; crown of molar marked with longitudinal furrow. Dental formula :  $i_{\frac{2}{2}}, c_{\frac{1}{1}}, pm_{\frac{3}{3}}, m_{\frac{2}{3}} = 34$ . First upper premolars sometimes absent.

Length : Head and body 108-135 ; forearm 71-93 ; ear 18-22 ; wing spread 480-560 ; tibia 29-43 ; foot and claw 18-22.

Skull : Total length 37-40.8 ; zygomatic width 21-24.4 ; width of braincase 15-16.5 ; Maxillary width ( $m^1-m^1$ ) 10.5-12 ; length of upper tooth row ( $c-m^2$ ) 13-15.5 ; length of lower tooth row ( $c-m_3$ ) 14.5-17.

*Distribution of species* (Text-figs. 16 & 20B) : RAJASTHAN : Previously recorded from Nasirabad (Ajmer District) by Wroughton (1918). The present record is from Jhalawar, Rajasthan (See also Sinha, in press). *Elsewhere* : Almost the whole of INDIA ; also NEPAL, SRI LANKA, BURMA, THAILAND, VIETNAM, Southern CHINA and JAVA.

### Genus (3) *Cynopterus* Cuvier

#### 3. *Cynopterus sphinx* (Vahl)

(Short-nosed Fruit Bat)

*Vespertilio sphinx* Vahl, 1797, *Skr. nat. selsk. Copenhagen*, 4 (1) : 123. Type-loc. : Tranquebar, S. India.

*Diagnosis of species* : Smaller than *Rousettus leschenaulti* (wing spread, 450-480 mm.) ; noseleaf absent ; ear base completely ringed with outer margin white ; tragus and antitragus absent ; inner margin of nostril projecting ; index finger with claw ; tail very small, 13-18 mm. long ; interfemoral membrane not extensive ; calcar present. Coloration varies from light brown to dark brown. Skull smaller than in *R. leschenaulti* (total length 31-34.5 mm.) ; postorbital process long ; premaxillae without palatal branch ; parietal crest poorly developed ;

occipital crest well developed ; palate continued behind last molar ; basisphenoid not excavated ; crown of molar marked with longitudinal furrow. Dental formula :

$$i, \frac{2}{2}, c \frac{1}{1}, pm \frac{3}{3}, m \frac{1}{2} = 30$$

*Distribution of species* : Hainan, almost the whole of INDIA ; SRI LANKA, BURMA, VIETNAM, THAILAND, Sumatra, Java, Bali, Lombok and Timor.

*Systematic note* : On the basis of forearm length, Andersen (1912) recognises three subspecies, viz., *C. s. sphinx* (Vahl) (66-73.5 mm.), *C. s. gangeticus* Andersen (73-78 mm.) and *C. s. titthaecheilus* Andersen (74.5-83 mm.). Agrawal (1972) finds no difference between *C. s. sphinx* and *C. s. gangeticus*, and I agree with him. Besides the above subspecies; Hill and Thonglongya (1972) make *angulatus* Miller a subspecies of *C. sphinx* and Paradiso (1971) describes a new subspecies, *C. s. serasani*. *C. s. major* Miller is probably also a subspecies (Chasen, 1940).

Thus, five subspecies are recognised, as follows, of which *C. s. sphinx* occurs in Rajasthan.

*C. s. sphinx* (Vahl).—As in species (except Sumatra, Java, Lombok and Timor).

*C. s. titthaecheilus* Andersen.—Java, Lombok and Timor.

*C. s. angulatus* Miller.—Thailand, Malaya and Sumatra.

*C. s. serasani* Paradiso.—Serasan (South Natuna) Island, Indonesia.

*C. s. major* Miller.—Nias Island, off Sumatra.

### ***Cynopterus sphinx sphinx* (Vahl)**

(Text-figs. 2 I, J, K, L)

*Vespertilio sphinx* Vahl, 1797, as above.

*Cynopterus sphinx sphinx* (Vahl), Ellerman and Morrison-Scott 1951, p. 98 ; Agrawal, 1972, p. 265 (syn. *Cynopterus sphinx gangeticus* Andersen).

*Material examined* : Rajasthan : Banswara Dist : Banswara, 1 ♂, 3 ♀♀ Bundi Dist. : Bundi, 4 ♂♂, 1 ♀. *Other than Rajasthan* : INDIA : W. Bengal : Madanpur, 13 ♂♂, 8 ♀♀ ; Calcutta, 3 ♂♂, 5 ♀♀ ; Darjeeling, 1 ♂, 1 ♀ ; Duars, 1 ♂. Andaman Islands : Port Blair, 1 ♂, 1 ♀. Uttar Pradesh : Lucknow, 7 ♂♂, 9 ♀♀. Bihar : Gaya, 1 ♀ ; Darbhanga, 1 ♀. Meghalaya : Cheerapunji, 1 ♀ ; Garo Hills, 1 (unsexed). Nagaland : Naga Hills, 1 ♂. Karnataka : Kanara, 1 ♂, 1 ♀. Kerala : Trivandrum, 1 ♀ ; Cochin, 2 ♂♂ Tamil Nadu : High wavy mountains, Madurai, 1 ♂, 1 ♀. Andhra Pradesh : Palkonda Hills 1 ♀ ; Malakondapenta, 1 ♀. Gujarat : Danta, 1 ♂. Maharashtra : Nagpur, 2 ♂♂, 1 ♀. SRI LANKA : Orugala, 1 ♀ ; Natichigama, 1 ♀ ; Tammammewa,



1 ♂ ; Anapura, 1 ♂. BURMA : Lower Chindwin, 1 ♀ ; Tenasserim, 3 ♀ ♀ ; Mergui Archipelago ; 2 ♂ ♂, 3 ♀ ♀ ; Toungoo, 2 ♂ ♂ ; Pagan, 2 ♀ ♀ ; Bhamo, 1 ♀ .

*Diagnosis of subspecies* : This subspecies differs from *C. s. titthaecheilus* only in being slightly smaller size.

Length : Head and body 89-109 ; forearm 64-77 ; ear 19-23 ; wing spread 450-480 ; tibia 24-32.2 ; foot with claw 15-20.3.

Skull : Total length 30.6-36.1 ; zygomatic width 18.8-22.6 ; width of braincase 13.1-14.7 ; maxillary width (*m-m*) 9.2-10.6 ; Length of upper tooth row (*c-m*<sup>1</sup>) 10.2-12.3 ; length of lower tooth row (*c-m*<sub>2</sub>) 11.1-13.4 ; length of mandible 22.8-26.7.

*Distribution of subspecies* (Text-figs. 16 & 20C) : RAJASTHAN (New records ; See also Sinha in press) : Districts of Banswara and Bundi. *Elsewhere* : As above.

## Suborder 2. MICROCHIROPTERA

### Family II. RHINOPOMATIDAE

(Text-fig. 3)

#### Genus (3) *Rhinopoma* Geoffroy

#### 4. *Rhinopoma microphyllum* (Brünnich)

(Larger Rat-tailed Bat)

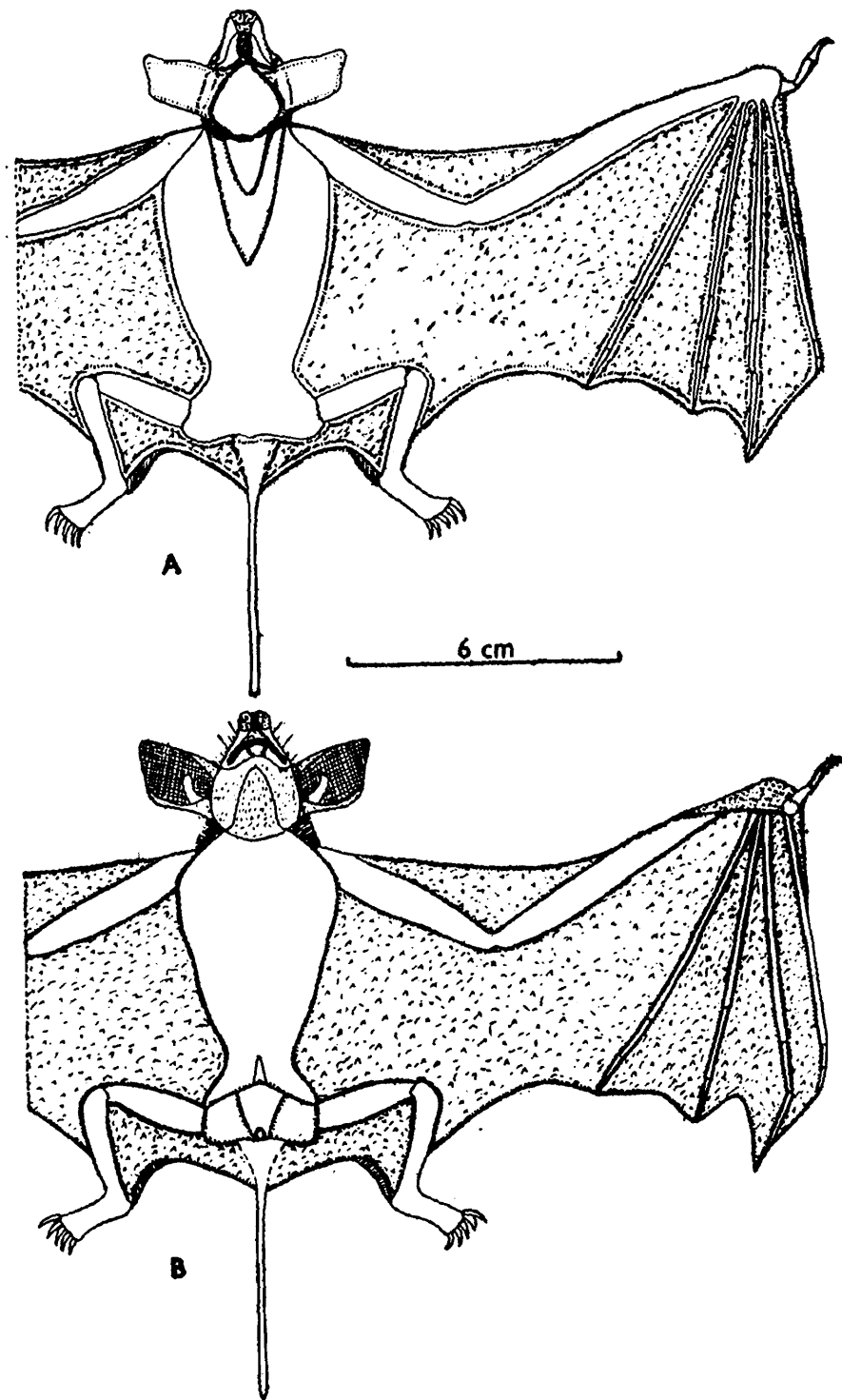
*Vespertilio microphyllum* Brünnich, 1782, *Dyrenes Hist.*, 1 : 50, pl. 6, figs. 1-4. Type-loc. : Arabia and Egypt.

*Diagnosis of species* : Size medium (wing spread 210-285 mm.) ; head with deep central cavity ; noseleaf absent but muzzle with a distinct ridge like dermal growth ; ears united ; tragus long, sickleshaped ; tail slender, partly free from interfemoral membrane and smaller than forearm ; second finger without claw, and with two bony phalanges. Skull without postorbital process ; premaxillaries bony, separate, not fusing with surrounding parts ; parietal and occipital crests prominent ; lachrymal region with prominent ridge. Palate not continued behind last molar ; basisphenoid not excavated ; crown of molar marked with transverse furrows.

Dental formula :  $i \frac{1}{2}, c \frac{1}{1}, pm \frac{1}{2}, m \frac{3}{3} = 28$

*Distribution of species* : North-west and Central INDIA ; PAKISTAN, AFGHANISTAN, IRAN, ARABIA, PALESTINE and EGYPT ; and also Sumatra.

*Systematic note*: Aellen (1959) separated *R. kinneari* Wroughton from *R. microphyllum* on the basis of longer forearm, 70-71.5 (70.7) vs. 68-70.5 (69.4), and considered it as a subspecies of the latter. Felten



Text-fig 3.—Family Rhinopomatidae: *Rhinopoma microphyllum kinneari* Wroughton, ♂. Rajasthan (Jodhpur). External body: (A) Dorsal view. (B) Ventral view.

(1962) treated specimens from Rajasthan as *R. m. microphyllum* and Prakash (1963) as *R. kinneari*. Siddiqi (1970) synonymised *kinneari* with *microphyllum*. I treat Rajasthan specimens as *kinneari* because they are slightly longer than Egypt, Pakistan and Afghanistan specimens. Schlitter and Deblase (1974) described a new subspecies, *R. m. harrisoni*

from Iran. Thus three subspecies are recognised from Indian and Palearctic regions as follows of which *R. m. kinneari* occurs in Rajasthan.

*R. m. microphyllum* (Brünnich).—As in species except Iran, and North-West and Central India.

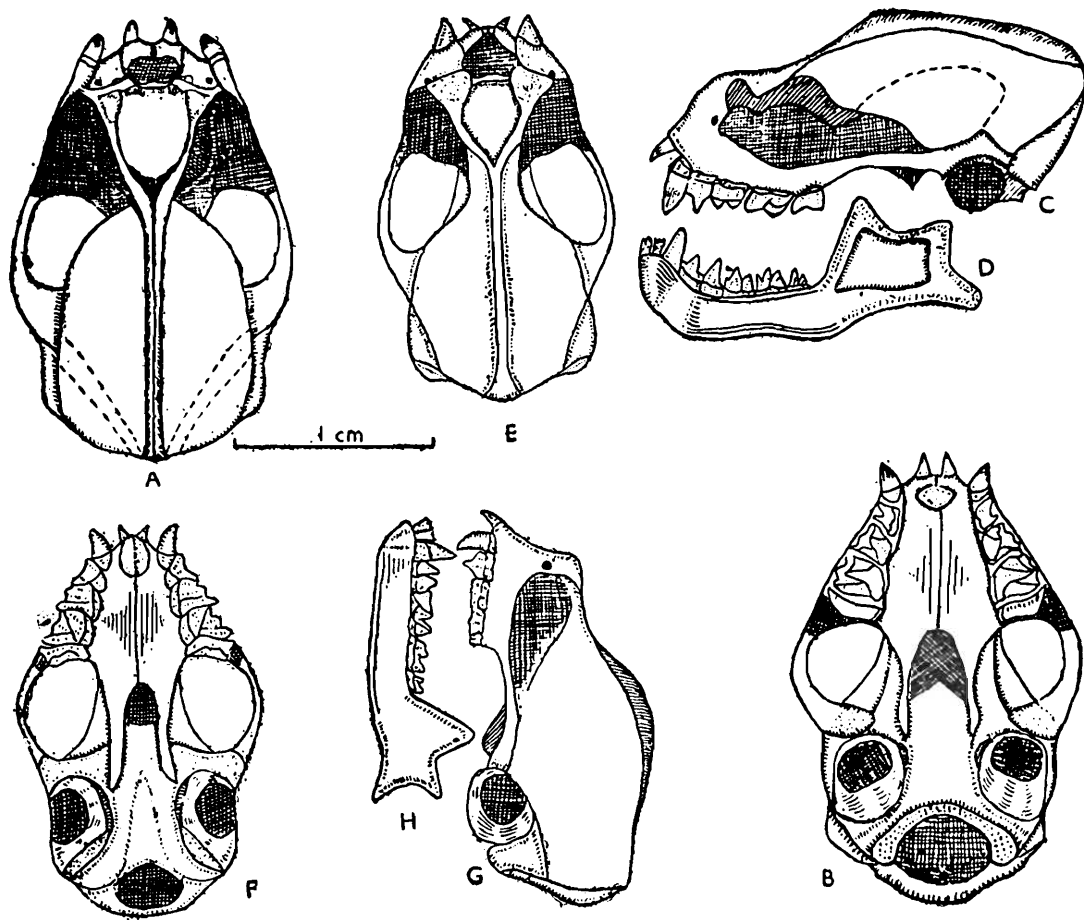
*R. m. kinneari* Wroughton.—North-West and Central India.

*R. m. harrisoni* Schlitter & DeBlase.—Iran.

### *Rhinopoma microphyllum kinneari* Wroughton

(Text-figs. 4A, B, C, D)

*Rhinopoma kinneari* Wroughton, 1912, *J. Bombay nat. Hist. Soc. Bombay*, 21 (4) : 765.  
Type-loc. : Bhuj, Kutch, Gujarat, India.



Text-fig. 4.—(A-D) *Rhinopoma microphyllum kinneari* Wroughton, ♂. Rajasthan (Jodhpur), Skull : (A) Dorsal view. (B) Ventral view. (C) Lateral view. (D) Lower jaw, in lateral view ; (E-H) *Rhinopoma hardwickei hardwickei* Gray, ♂. Rajasthan (Jodhpur). Skull : (E) Dorsal view. (F) Ventral view. (G) Lateral view. (H) Lower jaw, in Lateral view.

*Material examined* : Rajasthan : Jodhpur Dist. : Jodhpur, Mandore, Bhim-Bharak and Ransi village, 30 ♂♂, 25 ♀♀ ; Pali Dist. : From crevices of hillock on Jodhpur—Pali Road near Pali, 23 ♂♂, 22 ♀♀ ; Nagaur Dist. : Marot, Shyamgadh and Panchota, 7 ♂♂, 37 ♀♀ ; Jhunjhunu Dist. : Lohagarh, 12 ♂♂, 17 ♀♀ ; Sawai Madhopur Dist. ;

Malarna Dungar, 7 ♂♂, 12 ♀♀ ; Dungarpur Dist. : Dungarpur, 5 ♂♂, 5 ♀♀ ; Jhalawar Dist. : Jhalara-Patan fort and Gagaron Ka Kila, 19 ♂♂, 35 ♀♀ ; Bundi Dist. : Bundi, 18 ♂♂, 10 ♀♀. *Other than Rajasthan* : Gujarat : Junagadh, 4 ♂♂, 1 ♀. Maharashtra : Nagpur, 1 ♂. Uttar Pradesh : Fatehpur Sikri, 2 ♂♂, 1 ♀.

*Diagnosis of subspecies* : I have not been able to examine examples of *R. m. harrisoni* but it is slightly longer than *R. m. microphyllum*.

Length : Head and body 61-84 ; forearm 60-75 ; ear 15-20.3 ; tragus 6.2-8.5 ; tail 50-65 ; wing spread 210-285 ; tibia 22-28 ; foot with claw 16-17.

Skull : Total length 19-22.5 ; zygomatic width 12-13 ; width of braincase 8-10 ; length of maxillary width ( $m^3-m^3$ ) 9-10 ; length of upper tooth row ( $c-m^3$ ) 7.2-8.1 ; length of lower tooth row ( $c-m_3$ ) 8-9.5 ; length of mandible 14-16.

*Distribution of subspecies* (Text-figs. 16 & 20D) : RAJASTHAN : Districts of Jaisalmer, Barmer, Jodhpur, Pali, Sawai Madhopur, Nagaur, Jhunjhunu, Banswara, Jhalawar and Bundi. The present records from Nagaur, Sawai Madhopur, Pali, Banswara, Jhalawar and Bundi Districts are new. (See also Sinha, 1975). *Elsewhere* : North-West and Central INDIA, also PAKISTAN, AFGHANISTAN, ARABIA, PALESTINE and EGYPT.

## 5. *Rhinopoma hardwickei* Gray

(Lesser Rat-tailed Bat)

*Rhinopoma hardwickei* Gray, 1831, *Zool. Misc.*, p. 37. Type-loc. : India.

*Diagnosis of species* : Similar to *R. microphyllum* in shape but differs mainly in the smaller external and cranial measurements and longer tail (longer than forearm *vs.* smaller in *R. microphyllum*). Skull small, with a large globular swelling on each side above the nostrils ; otherwise similar to *R. microphyllum*. Dental formula : Same as in *R. microphyllum*.

*Distribution of species* : The Sahara, EGYPT, the SUDAN, ARABIA, IRAN, AFGHANISTAN, PAKISTAN, INDIA.

*Systematic note* : Has 4 subspecies as follows, of which *R. h. hardwickei* occurs in Rajasthan :—

*R. h. hardwickei* Gray, 1831.—India : Delhi, Uttar Pradesh, Rajasthan, Gujarat, Madhya Pradesh, Bihar, West Bengal and Karnataka.

*R. h. cystops* Thomas, 1903.—Central Egypt and the Sahara.

*R. h. arabium* Thomas, 1913.—N. W. Arabia and Palestine ; much of north Africa east to Iran.

*R. h. macinnesi* Hayman, 1937.—The Southern Sudan and Kenya.

**Rhinopoma hardwickei hardwickei** Gray

(Text-figs. 4 E, F, G, H)

*Rhinopoma hardwickei* Gray, 1831, as above.

*Material examined* : Rajasthan : Jodhpur Dist. : Jodhpur, Bhim Bharak, Salawas, and Kalyanpur, 7 ♂♂, 14 ♀♀ ; Nagaur Dist. : Solayan village, 15 km. N. E. of Kuchaman Road Railway Station, 2 ♂♂, 10 ♀♀ and 8 suckling young ; Jhunjhunu Dist. : Nangal village, 3 ♂♂, 5 ♀♀ ; Ajmer Dist. : Ajmer, 3 ♂♂, 10 ♀♀ ; Dungarpur Dist. : Dungarpur, 1 ♂ ; Jhalawar Dist. : Jhalara-Patan, 3 ♀♀ ; Bundi Dist. : Bundi, 3 ♂♂, 1 ♀. *Other than Rajasthan* : Gujarat : Palanpur and Junagadh, 10 ♂♂, 5 ♀♀ Bihar : Gaya, 1 ♂, 1 ♀.

*Diagnosis of subspecies* : Easily separable from other subspecies by its larger external and cranial dimensions.

Length : Head and body 57-70 ; forearm 58-64 ; ear 18-21 ; tragus 6-8 ; tail 60-81 ; wing spread 270-320 ; tibia 26-33 ; foot with claw 13-17.

Skull : Total length 18-20 ; zygomatic width 11-11.2 ; width of brain-case 8-9 ; maxillary width ( $m^3-m^8$ ) 7.7-8.3 ; length of upper tooth row ( $c-m^3$ ) 6.1-7 ; length of lower tooth row ( $c-m_3$ ) 6.5-7.9 ; length of mandible 12.2-14.4.

*Remarks* : Tail usually longer than forearm but in few specimens from Rajasthan it is shorter ; suckling young also has a longer tail than forearm. Examples from Rajasthan have narrower maxilla and shorter tooth rows and mandible in comparison with the example from Gujarat.

*Distribution of subspecies* (Text-figs. 16 & 20E) : RAJASTHAN : Districts of Jaisalmer, Bikaner, Jodhpur, Ajmer, Nagaur, Jhunjhunu, Dungarpur, Jhalawar and Bundi. The present records from Nagaur, Jhunjhunu, Dungarpur, Jhalawar and Bundi districts are new (See also Sinha, 1975).

*Elsewhere* : As above.

## Family III. EMBALLONURIDAE

(Text-fig. 5)

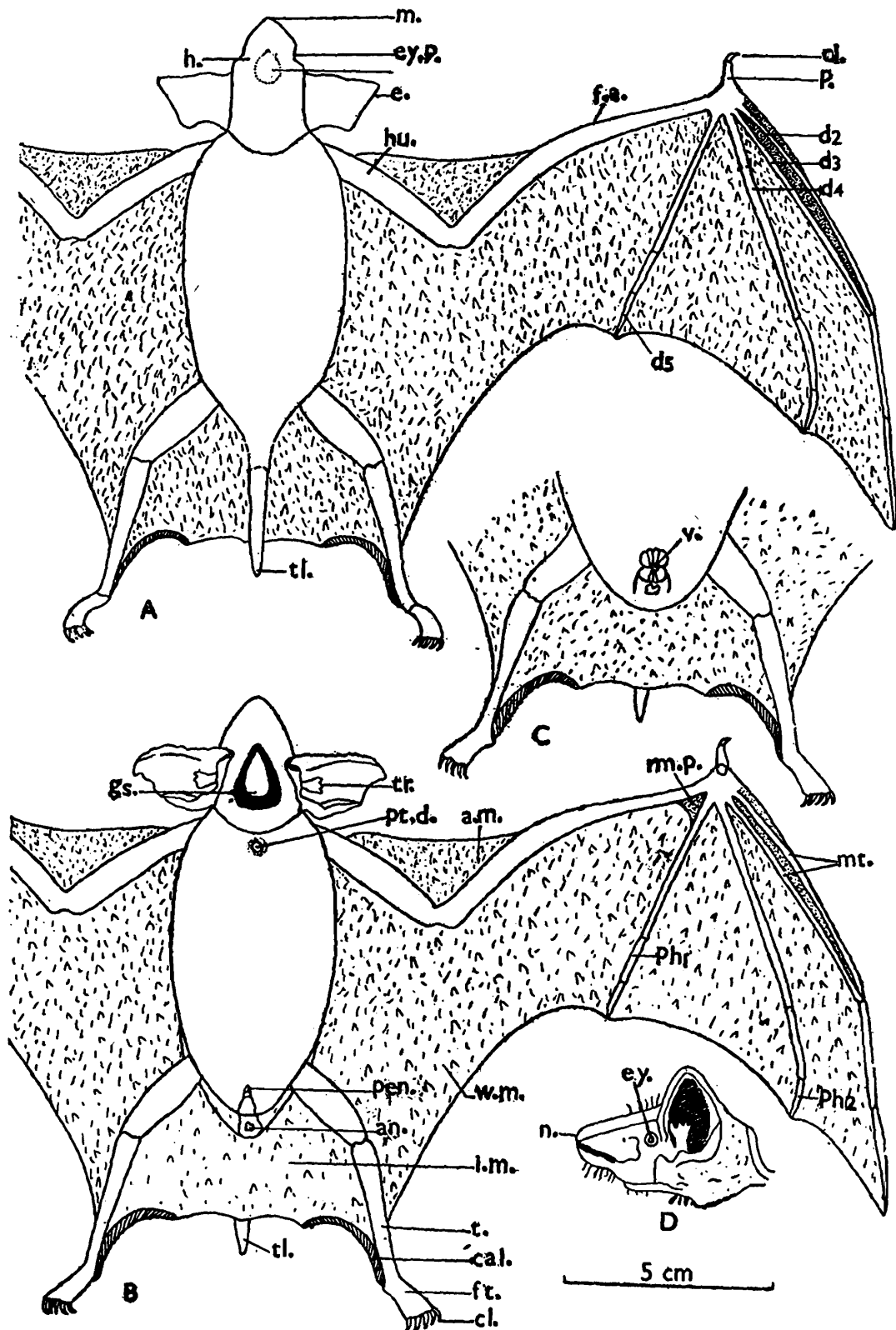
Genus (4) **Taphozous** E. Geoffroy6. **Taphozous perforatus** E. Geoffroy

(The Tomb Bat)

*Taphozous perforatus* Geoffroy, 1818, *Description de l' Egypte*, 2 : 113. Type-loc. : Egypt.

*Diagnosis of species* : Size medium (wing spread 210—280 mm.) head with deep central depression between eyes ; ears long ; tragus hammer-

shaped, distal margin not wavy ; tail perforating interfemoral membrane, its tip pointed ; calcar weak ; gular sac absent in male, rudimentary in female ; pectoral depression absent ; radio-metacarpal pouch small ; second finger has only metacarpal bone. Skull with long postorbital



Text-fig. 5.—Family Emballonuridae : *Taphozous kachhensis kachhensis* Dobson, ♂. Rajasthan (Jodhpur). External body : (A) ♂. Dorsal view. (B) ♂. Ventral view, (C) ♀., Ventral view. (D) ♂. Head, in lateral view.

process ; premaxillaries cartilaginous, free in middle and also from canine ; parietal and occipetal crests weak ; frontal depression deep ;

palate not continued behind last molar ; basisphenoid deeply excavated, divided by a thin lamina into right and left halves ; crown of molar marked with transverse furrow.

Dental formula :  $i \frac{0}{2}, c \frac{1}{1}, pm \frac{2}{2}, m \frac{3}{3} = 28$

*Distribution of species* : AFRICA and West and South ASIA : EGYPT, South to SUDAN and KENYA ; ARABIA ; West and Central INDIA.

*Systematic note* : Has two Indian and Palaearctic subspecies as follows :—

*T. p. perforatus* Geoffroy.—Egypt ; India : Rajasthan, Gujarat and Madhya Pradesh.

*T. p. haedinus* Thomas.—East Africa : the Sudan, Kenya ; South Arabia.

Besides this, *Taphozous perforatus* has probably three African subspecies viz., *T. p. sudani* Thomas, *T. p. swirae* Harrison, and *T. p. rhodesiae* Harrison.

### ***Taphozous perforatus perforatus* E. Geoffroy**

(Text-figs. 6 A, B, C, D)

*Taphozous perforatus* Geoffroy, 1818, as above.

*Material examined* : Rajasthan : Jodhpur Dist. : Jodhpur, 3 ♂♂, 6 ♀♀ ; Dungarpur Dist. : Dungarpur, 1 ♂. *Other than Rajasthan* : Gujarat : Rajkot, 2 ♂♂, 4 ♀♀.

*Diagnosis of subspecies* : Same as in the species but less darker and have average little smaller skull than *T. p. haedinus* (*vide* Thomas, 1915).

Length : Head and body 64-76 ; forearm 60-64 ; ear 17-21 ; tragus 5-6 ; wing spread 210-280 ; tibia 22-25 ; foot with claw 10-13.

Skull : Total length 18.6-19.3 ; zygomatic width 11.3-12 ; width of braincase 9.1-9.5 ; maxillary width ( $m^3$ - $m^3$ ) 7.8-8.4 ; length of upper tooth row ( $c$ - $m^3$ ) 8.1-8.6 ; length of lower tooth row ( $c$ - $m_3$ ) 9-9.5 ; length of mandible 14.6-15.5.

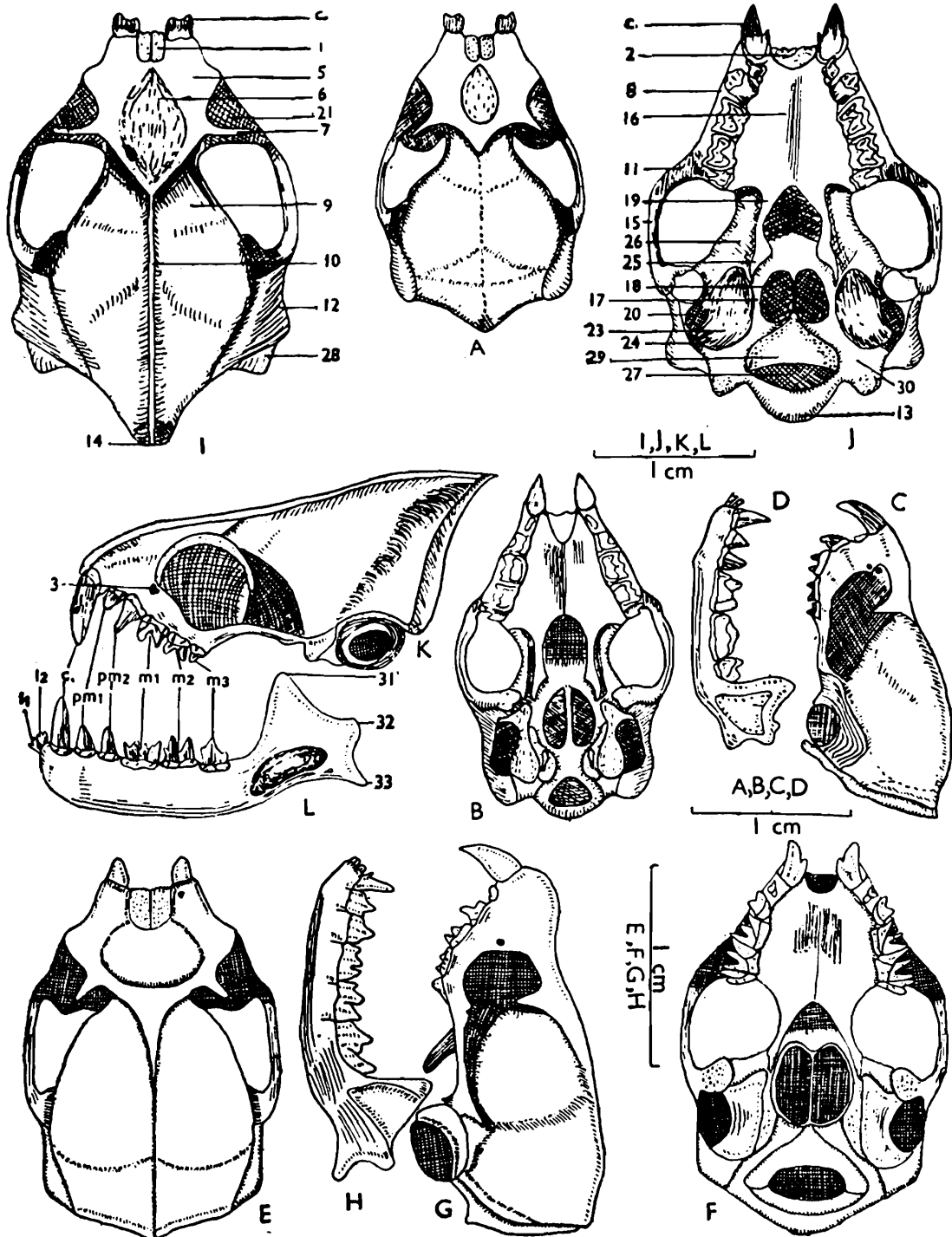
*Distribution of subspecies* (Text-figs. 17 & 20F) : RAJASTHAN : Districts of Jodhpur, Barmer and Dungarpur. The present record from Dungarpur is new (See also Sinha, 1975). *Elsewhere* : As above.

### 7. ***Taphozous longimanus* Hardwicke**

*Taphozous longimanus* Hardwicke, 1825, *Trans. Linn. Soc.*, London, 14 : 525. Typo-loc. : Calcutta, India.

*Diagnosis of species* : Size medium (wing spread 370-390 mm.) ; head with deep central depression between eyes ; ears long ; tragus hammer-

shaped, distal margin wavy ; tail perforating interfemoral membrane, its tip blunt ; calcar well developed ; gular sac deeper in male (about 10 mm. deep), rudimentary in female ; males also have a prominent pore below gular sac and above thorax ; radio-metacarpal pouch moderately developed ; second finger has only metacarpal bone ; coloration of fur varies from dark brown to black with the base of the hairs white.



Text-fig. 6.—(A-D) *Taphozous perforatus perforatus* Geoffroy, ♀ Rajasthan (Jodhpur). Skull : (A) Dorsal view. (B) Ventral view. (C) Lateral view (D) Lower jaw, in lateral view ; (E-H) *Taphozous longimanus longimanus* Hardwickei, ♀. Rajasthan (Kota). Skull : (E) Dorsal view. (F) Ventral view. (G) Lateral view. (H) Lower jaw, in lateral view. ; (I-L) *Taphozous kachhensis kachhensis* Dobson, ♂. Rajasthan (Jodhpur). Skull : (I) Dorsal view. (J) Ventral view. (K) Lateral view. (L) Lower jaw, in lateral view.



Skull larger, with the basisphenoid cavity deeper than in *Taphozous perforatus* ; otherwise the two species are similar. Dental formula as in *T. perforatus*.

*Distribution* : INDIA, SRI LANKA and further east *via* BURMA, MALAYSIA, to INDONESIA up to Flores.

*Systematic note* : Four subspecies are known as follows ; of these *T. l. longimanus* is found in Rajasthan :

*T. l. longimanus* Hardwicke—As in species (except Java, Borneo and Flores).

*T. l. kampenii* Jentink.—Java.

*T. l. albipinnis* Thomas—Borneo.

*T. l. leucopleurus* Dobson.—Flores.

### ***Taphozous longimanus longimanus* Hardwicke**

(Text-figs. 6 E, F, G, H.)

*Taphozous longimanus* Hardwicke, 1825, as above.

*Material examined* : *Rajasthan* : Ajmer Dist. : Nasirabad, 2 ♀ ♀ ; Kota Dist. : Kota, 1 ♂, 3 ♀ ♀. *Other than Rajasthan* : INDIA : Gujarat : Palanpur 5 ex. ; Bihar : Inanpur, 2 ♂ ♂ ; Chapra, 1 ♀. BURMA : Pegu, 3 ♂ ♂, 5 ♀ ♀.

*Diagnosis of subspecies* : Same as in species and ; recognised from other subspecies by slightly larger size.

Length : Head and body 75-80 ; forearm 58-62 ; ear 17-19 ; wing spread 370-390 ; tibia 22-26.5 ; foot with claw 11-13.

Skull : Total length 19-20 ; zygomatic width 12-13.4 ; width of braincase 9.7-10.5 ; maxillary width ( $m^3$ - $m^3$ ) 8.8-9.1 ; length of upper tooth row ( $c$ - $m^3$ ) 8.5-9 ; length of lower tooth row ( $c$ - $m_3$ ) 9.5-10.5 ; length of mandible 15.4-16.5.

*Remarks* : The male possesses a deep pore below the gular sac as was first noted by Sinha (1970) for Burma.

Rajasthan specimens are black above and below, but the base of fur white.

*Distribution of subspecies* (Text-figs. 17 & 20G) : RAJASTHAN : Districts of Ajmer and Kota. The record here from Ajmer and Kota Districts are new (see also Sinha, 1976). *Elsewhere* : As above.

8. *Taphozous kachhensis* Dobson

(The Kutch Sheath-tailed Bat)

*Taphozous kachhensis* Dobson, 1872, *J. Asiat. Soc. Bengal*, Calcutta. 41 (2) : 221. Type-loc. : Kutch, India.

*Diagnosis of species* : Larger than *Taphozous perforatus* (wing spread 300-420 mm.) ; head with small central depression ; ear long ; tragus short and hammer-shaped ; its distal margin wavy ; tail perforating interfemoral membrane, its tip blunt ; calcar present ; gular sac well developed in male, rudimentary in female ; pectoral depression deep ; radio-metacarpal pouch/prominent ; second finger has only metacarpal bone. Skull large ; postorbital process long ; premaxillaries cartilaginous, free in middle and also from canine ; parietal and occipital crests prominent forming at their junction behind a distinct helmet ; frontal depression shallow ; palate not continued behind last molar ; basisphenoid deeply excavated, divided by a thin bony lamina ; crown of molar marked with transverse furrow. Dental formula as in *Taphozous perforatus*.

*Distribution of species* : IRAQ ; PAKISTAN ; almost whole of INDIA ; BURMA and MALAYSIA.

*Systematic note* : Divided into three subspecies as follows of which *T. k. kachhensis* is found in Rajasthan :

*T. k. kachhensis* Dobson.—Pakistan and India.

*T. k. magnus* Wettstein.—Iraq.

*T. k. nudaster* Thomas.—Burma.

***Taphozous kachhensis kachhensis* Dobson**

(Text-figs. 6 I, J, K, L)

*Taphozous kachhensis* Dobson, 1872, as above.

*Material examined* : Rajasthan : Jodhpur Dist. : Mandore, Balsamand and Bhim Bharak, 16 ♂♂, 17 ♀♀ ; Kota Dist. : Kota, 3 ♂♂, 11 ♀♀ ; Jhalawar Dist. : Jhalara-Patan, 2 ♀♀ ; Bundi Dist. : Bundi, 4 ♂♂, 7 ♀♀ ; Tonk Dist. : Tonk, 2 ♂♂, 3 ♀♀. *Other than Rajasthan* : INDIA : Gujarat : Bhuj, 1 ♂, 3 ♀♀ ; Junagadh, 7 ♂♂, 1 ♀. Karnataka ; Vijayanagar, 1 ♀ ; Sivasamudrum, 1 ♀. Madhya Pradesh : Gwalior, 1 ♂. W. Bengal : Darjeeling Dist. : Sivok, 2 ♂♂. PAKISTAN : Kashmir, 2 ♂♂ ; Rohtas Salt Range, 1 ♂, 1 ♀.

*Diagnosis of subspecies* : Specimens of *T. k. magnus* and *T. k. nudaster* are not examined by me but according to Thomas (1915b).

*T. k. kachhensis* is slightly smaller than *T. magnus* and larger than *T. k. nudaster*.

Length : Head and body 80-104 ; forearm 68-81 ; ear 20-25 ; tragus 5-6 ; wing spread 300-420 ; tibia 27-32 ; foot with claw 14-18.

*Skull* : Total length 26-29 ; zygomatic width 16-17.8 ; width of brain case 11.5-13 ; Maxillary width ( $m^3$ - $m^3$ ) 10.4-12 ; length of upper tooth row ( $c$ - $m^3$ ) 10.6-12 ; length of lower tooth row ( $c$ - $m_3$ ) 11.7-13.3 ; length of mandible 19-21.5.

*Remarks* : Specimens from Gujarat have larger skull than those from Rajasthan.

*Distribution of subspecies* (Text-figs. 17 & 20H) : RAJASTHAN : Districts of Jodhpur, Tonk, Bundi, Kota, and Jhalawar. The present record from Tonk, Bundi, Kota and Jhalawar Districts are new (See also Sinha, 1976). *Elsewhere* : As above.

#### Family IV. MEGADERMATIDAE

( Text-fig. 7 )

#### Genus (5) *Megaderma* E. Geoffroy

#### 9. *Megaderma lyra* Geoffroy

( Indian False Vampire )

*Megaderma lyra* Geoffroy, 1810, *Ann. Mus. Hist. nat.*, Paris, **15** : 190. Type-loc. : East coast of Madras, India.

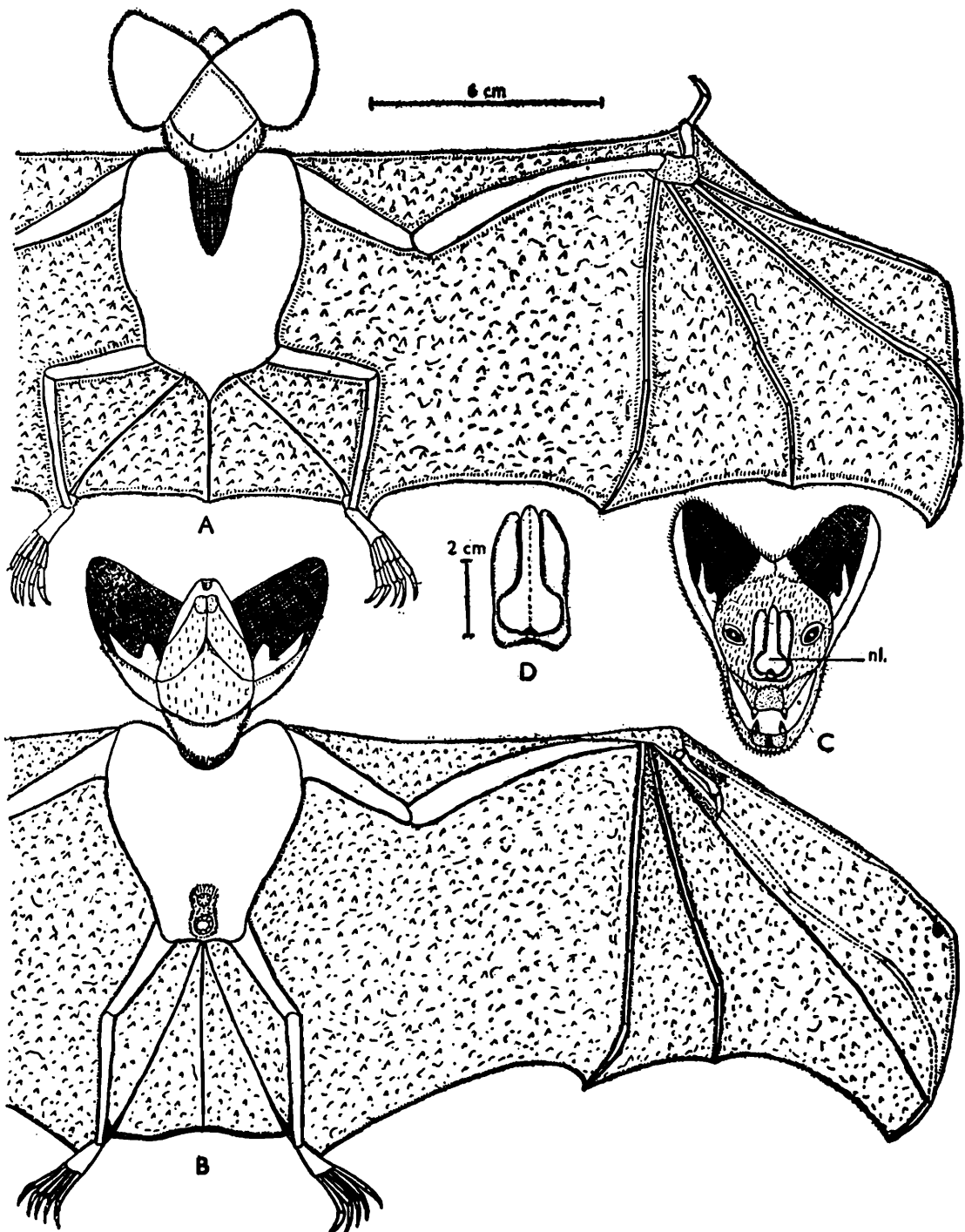
*Diagnosis of species* : Size medium ; wing spread 380-440 mm. ; noseleaf divided into anterior portion semicircular, central narrow and posterior truncated ; ears very large and united above nearly half of the inner margin ; tragus long, bifid ; antitragus absent ; tail invisible ; calcar weak and short ; second finger having only metacarpal bone. Skull with poorly developed ridge-like postorbital process ; premaxillaries absent ; parietal and occipital crests well developed ; palate not exceeding the last molar ; basisphenoid excavated and separated by bony lamina ; crown of molars marked with transverse furrows. Dental formula :  $i \frac{0}{2}, c \frac{1}{1}, pm \frac{2}{2}, m \frac{3}{3} = 28$

*Distribution of species* : INDIA, South CHINA, BURMA, SRI LANKA and MALAYASIA.

*Systematic note* : Divided into two subspecies as follows of which *M. l. lyra* is found in Rajasthan ;

*M. l. lyra* Geoffroy.—Pakistan, all India ; Burma ; Sri Lanka.

*M. l. sinensis* Andersen & Wroughton. —South China and Malayasia.



Text-fig. 7.—Family Megadermatidae: *Megaderma lyra lyra* Geoffroy, ♀ Rajasthan (Nangal, Jhunjhunu Dist.). External body: (A) Dorsal view. (B) Ventral view. (C) Frontal view of head. (D) Frontal view of noseleaf.

***Megaderma lyra lyra* Geoffroy**

( Text-figs. 9 A, B, C, D )

*Megaderma lyra* Geoffroy, 1810, as above.

*Megaderma lyra lyra* Geoff., Sinha, 1971, p. 86. (Syn.: *Euchiera lyra caurina* And. & Wr.)

*Material examined*: Rajasthan.—Jhunjhunu Dist.: Nangal village, 3 ♀♀ ; Sawai Madhopur Dist.: Ranthambhore, 3 ♂♂, 9 ♀♀ ; Kota

Dist. : Darah, 4 ♂♂, 15 ♀♀ ; Dungarpur Dist. : Dungarpur, 22 ♂♂ ; Banswara Dist. : Banswara, 6 ♂♂, 13 ♀♀ ; Jhalawar Dist. : Jhalara-Patan, 2 ♀♀. *Other than Rajasthan.* —INDIA : Gujarat : Palanpur, 1 ♂. Maharashtra : Nasik, 1 ♂, 2 ♀♀ ; Nagpur, 4 ♂♂ ; Devikop 1 ♂ ; Ratnagiri, 1 ♂ Himachal Pradesh : Kangra, 1 ♂ Madhya Pradesh : Sohagpur, 1 ♂, 2 ♀♀ ; Sagar, 1 ♂ ; Gwalior, 1 ♂ ; Hoshangabad, 1 ♂ Karnataka : Kanara, 1 ♂ ; Gersoppa, 1 ♂ ; Sagar, 1 ♂, 1 ♀ ; Bellari, 1 ♂. Kerala : Trivandrum, 2 ♂♂. Uttar Pradesh : Nishangara, 3 ♂♂, 4 ♀♀ ; Agra, 4 ♂♂, 1 ♀ ; Gazipur, 1 ♂ ; Lucknow 6 ♂♂, 3 ♀♀ ; Kumaun, 1 ♂. Andhra Pradesh : Cuddapah, 1 ♂, 1 ♀ ; Diguvametta, 1 ♂. Tamil Nadu : Salem, 1 ♂, 1 ♀ ; Coimbatore, 1 ♂. Orissa : Chilka lake, 2 ♂♂. Bihar : Harpur Osti (Vaisali Dist.), 3 ♂♂ ; Purnea, 5 ♀♀ ; Chaibassa, 1 ♀. W. Bengal : Midnapore, 4 ♂♂ ; Ranigunj, 1 ♂, 1 ♀ ; Calcutta, 1 ♂ Assam : Sylhet, 2 ♂♂ PAKISTAN : Murree, 2 ♂♂, 2 ♀♀. SRI LANKA : Udugama, 1 ♀ BURMA : N. Shan State 1 ♀ ; Toungoo, 1 ♀.

*Diagnosis of subspecies* : Differs from *M. lyra sinensis* only in having smaller skull ( total length 26-28.6 *vs.* 30-30.8 mm.).

*Remarks* : Rajasthan and Indian examples have smaller skulls than those from Burma. They also differ in the colour of the fur : dorsally slate grey (*vs.* mummy brown) ; ventrally ashy base and pale tip of hairs (*vs.* ashy with slight tinge of buff). In these respects, Burmese specimens resemble *M. lyra sinensis* (China). It is also obvious from measurements that the forearm in females is longer than males.

Length : Head and body 69—99 ; forearm 59.6-71 ; ear 32-40 ; tragus 16-19 ; wing spread 380-440 ; tibia 29-38 ; foot with claw 15-20.

Skull : Total length 26-28.5 ; zygomatic width 14-17 ; width of brain-case 11.4-12.5, Maxillary width ( $m^3$ - $m^3$ ) 9.3-10.6 ; length of upper tooth row ( $c$ - $m^3$ ) 10.5-11.3 ; length of lower tooth row ( $c$ - $m^3$ ) 11.5-12.8 ; length of mandible 18.0—20.2. Total length of Burmese specimen 29.8 mm.

*Distribution of subspecies* (Text-figs. 17 & 20 I) : RAJASTHAN : Districts of Jodhpur, Jhunjhunu, Sawai Madhopur, Kota, Dungarpur, Banswara and Jhalawar. The present records from Jhunjhunu, Sawai Madhopur, Kota, Dungarpur, Banswara and Jhalawar Districts are new (See also Sinha, 1975). *Elsewhere* : As above.

## Family V. RHINOLOPHIDAE

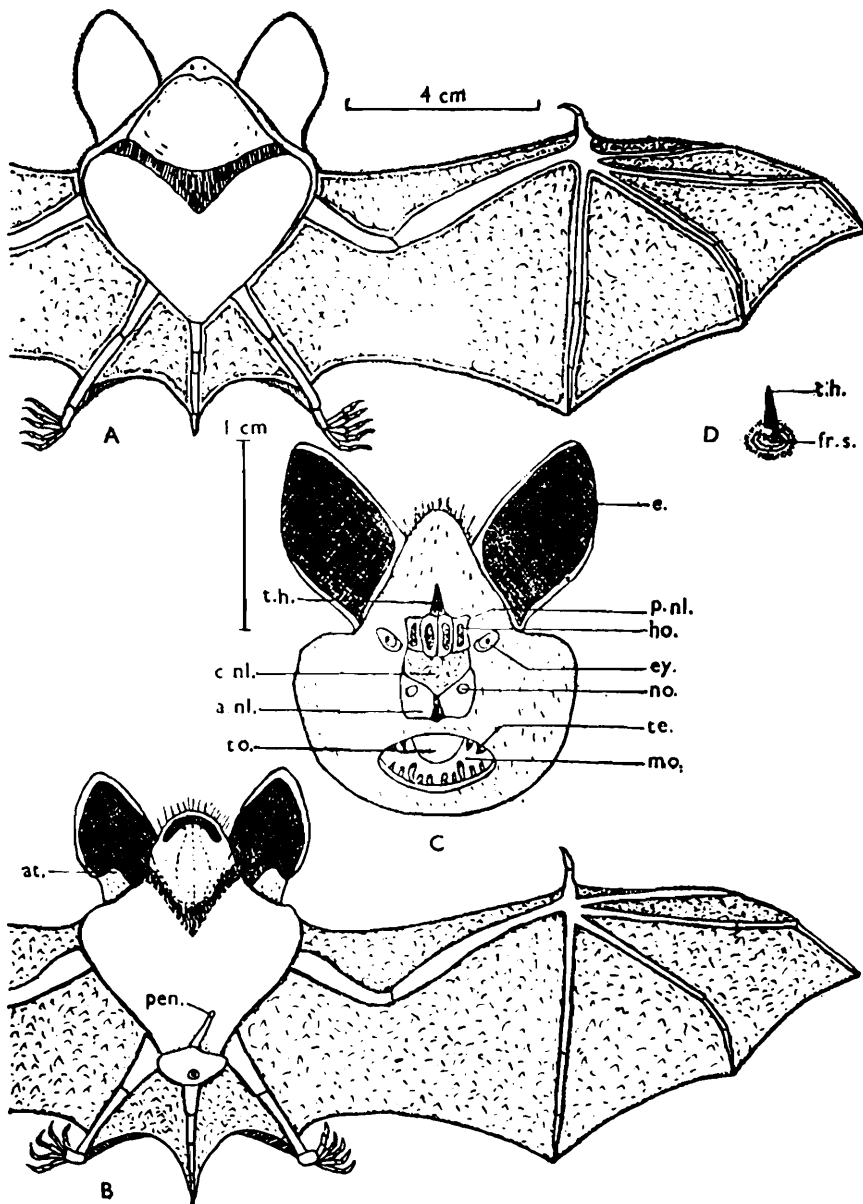
(Text-fig. 8)

Genus (6) *Rhinolophus* Lacépède10. *Rhinolophus lepidus* Blyth

(Little Indian Horseshoe Bat)

*Rhinolophus lepidus* Blyth, 1844, *J. Asiat. Soc. Bengal*, Calcutta, 13 : 486. Type-loc. : Calcutta, India.

*Diagnosis of species* : Medium-sized ; total wing spread 230-250 mm. ; noseleaf complicated and consists of an antero-horizontal portion ( the "horseshoe" ), a central process (sella) and a postero-vertical portion ;



Text-fig. 8.—Family Rhinolophidae : *Hipposideros fulvus pallidus* Andersen, ♂. Rajasthan (Jodhpur). External body : (A) Dorsal view. (B) Ventral view. (C) Head, in front view. (D) Frontal sac with tuft of hairs

ear large and pointed ; tragus absent ; antitragus present ; tail completely covered by interfemoral membrane ; calcar small ; first toe with

three joints, remaining toes with only two ; second finger having only metacarpal bone. Skull small ; without postorbital process ; premaxillae partly cartilaginous, neither touching each other nor the maxillae ; sagittal crest poorly developed ; palate not exceeding the last molar ; basisphenoid not excavated ; crown of molar marked with transverse furrows. Dental formula :  $i \frac{1}{2}, c \frac{1}{1}, pm \frac{2}{3}, m \frac{3}{3} = 32$

*Distribution of species* : AFGHANISTAN ; almost the whole of INDIA ; southern CHINA and northern BURMA.

*Systematic note* : Divided into two subspecies as follows, of which *R. l. lepidus* is found in Rajasthan.

*R. l. lepidus* Blyth.—Afghanistan ; and almost the whole of India.

*R. l. shortridgei* Andersen.—Southern China and northern Burma.

### **Rhinolophus lepidus lepidus** Blyth

( Text-figs. 9 E, F, G, H )

*Rhinolophus lepidus lepidus* Blyth, 1844, as above.

*Material examined* : *Rajasthan*.—Jodhpur Dist. : Jodhpur, 1 ♀ ; Sawai Madhopur Dist. : Ranthambhore, 1 ♂, 2 ♀ ♀ ; Bundi Dist. : Sikar Burz, 11 Km. S. E. of Bundi, 1 ♂. *Other than Rajasthan*.—Madhya Pradesh : Sohagpur, 3 ♂ ♂, 6 ♀ ♀ Orissa : Khandagiri, 1 ♂. Bihar : Singar, 7 ♂ ♂ ; Manharpur, 3 ♂ ♂, 3 ♀ ♀ ; Luia, 1 ♂. West Bengal : Salbani, 1 ♀. Meghalaya : Jaintia Hills (Syndai), 1 ♂.

*Diagnosis of subspecies* : Differs from *R. lepidus shortridgei* in having smaller hind foot and mandibles.

Length : Head and body 38-45 ; forearm 37-42 ; ear 12-18 ; wing spread 230-250 ; tibia 15-19 ; foot with claw 6-9.

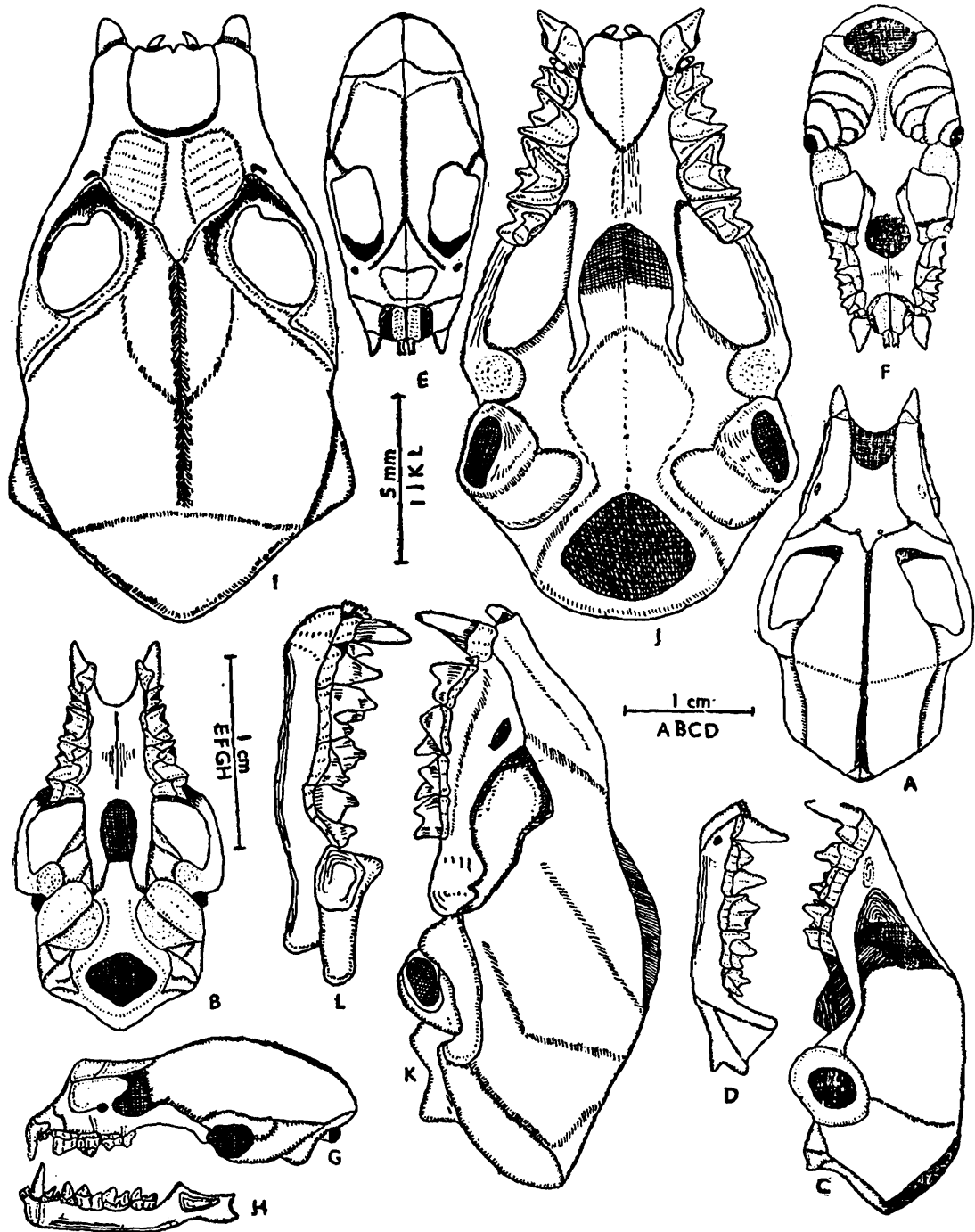
Skull : Total length 16-17.7 ; zygomatic width 7.9-8.7 ; width of brain case 6-7.4 ; maxillary width ( $m^3-m^4$ ) 6-6.1 ; length of upper tooth row ( $c-m^3$ ) 6-6.5 ; length of lower tooth row ( $c-m_3$ ) 6.4-7 ; length of mandible 9.5-11.3.

*Distribution of subspecies* (Text-figs. 17 & 20J) RAJASTHAN : Districts of Jodhpur, Bikaner, Jhunjhunu, Sawai Madhopur, and Bundi. The present records from Sawai Madhopur and Bundi Districts are new. *Elsewhere* : As above.

Genus (7) *Hipposideros* Gray11. *Hipposideros fulvus* Gray  
(Fulvus Leaf-nosed Bat)

1838. *Hipposideros fulvus* Gray, *Mag. Zool. Bot.*, 2 : 492. Type-loc. : Dharwar, S. India.

*Diagnosis of species* : Medium-sized ; total wing spread 260-270 mm. ; noseleaf present ; ear large and rounded ; tragus absent ; antitragus



Text-fig. 9.—(A-D) *Megaderma lyra lyra* Geoffroy, ♀ Rajasthan (Nangal, Jhunjhunu Dist.). Skull : (A) Dorsal view. (B) Ventral view. (C) Lateral view. (D) Lower jaw, in lateral view ; (E-H) *Rhinolophus lepidus lepidus* Blyth, ♀ Rajasthan (Jodhpur). Skull : (E) Dorsal view. (F) Ventral view. (G) Lateral view. (H) Lower jaw, in lateral view ; (I-L) *Hipposideros fulvus pallidus* Anderson, ♂ Rajasthan (Jodhpur). Skull : (I) Dorsal view. (J) Ventral view. (K) Lateral view. (L) Lower jaw, in lateral view.



reduced ; tail completely covered by interfemoral membrane ; calcar small ; all toes with two joints ; second finger having only metacarpal bone. Skull small ; without postorbital process ; premaxillaries partly cartilaginous, neither touching each other nor maxillaries ; parietal crest well developed ; palate not exceeding last molar ; basisphenoid with shallow depression ; crowns of molar marked with transverse furrow.

Dental formula :  $i \frac{1}{2}, c \frac{1}{1}, pm \frac{2}{2}, m \frac{3}{3} = 30$

*Distribution* : PAKISTAN ; almost the whole of INDIA ; SRI LANKA, BURMA (including Tenasserim), THAILAND and TAIWAN (Formosa).

*Systematic note* : Divided into two subspecies as follows, of which *H. f. pallidus* is found in Rajasthan.

*H. f. fulvus* Gray.—Parts of India (Maharashtra, Karnataka, Tamil Nadu, W Bengal, Assam) ; Sri Lanka, Burma, Thailand and Taiwan.

*H. f. pallidus* Andersen.—Pakistan ; and parts of India (Gujarat, Rajasthan, Madhya Pradesh, Bihar and Orissa ).

### **Hipposideros fulvus pallidus** Andersen

( Text-figs. 9 I, J, K, L )

*Hipposideros fulvus pallidus* Andersen, 1918, *Ann. Mag. nat. Hist.*, London, (9) 2 : 381.  
Type-loc. : Junagadh, Gujarat, India.

*Material examined* : *Rajasthan* : Jodhpur Dist. : Jodhpur, 3 ♂♂, 6 ♀♀ ; Jhalawar Dist. : Jhalara-Patan, 1 ♂ ; Ajmer Dist. : Ajmer, 2 ♀♀. *Other than Rajasthan* : INDIA : Gujarat : Junagadh, 16 ♂♂, 17 ♀♀ Bihar : Darbhanga, 1 ♂ ; Hazaribagh, 1 ♂. PAKISTAN : Rawalpindi, 2 ♂♂ ; Sind, 3 ♂♂, 3 ♀♀.

*Diagnosis of subspecies* : Differs from *H. f. fulvus* only in its paler back and creamy underparts lacking all trace of brown.

*Remarks* : Frontal sac in the form of a pore with a small tuft of black hairs, observed in male (as in *H. speoris* and *H. galeritus*, Brosset, 1962b ).

Length : Head and body 45-55 ; forearm 38-42 ; ear 22-24 ; wing spread 262-272 ; tibia 16-18 ; foot with claw 7-9.

Skull : Total length 17-17.5 ; zygomatic width 8.9-9.5 ; width of brain case 7-8.5 ; maxillary width ( $m^3$ - $m^3$ ) 6-6.5 ; length of upper tooth row ( $c$ - $m^3$ ) 6-6.7 ; length of lower tooth row ( $c$ - $m_3$ ) 6-7 ; length of mandible 11-12.

*Distribution of subspecies* (Text-figs. 17 & 20 K) : RAJASTHAN : Earlier recorded from "Rajputana" (Wroughton, 1918 ; Hill, 1963) but without

specific location. The present record from Jodhpur, Ajmer and Jalawar Districts are new. (See also Sinha, 1975). *Elsewhere* : As above.

Family VI. MOLOSSIDAE

Genus (8) **Tadarida** Rafinesque

12. **Tadarida aegyptiaca** (E. Geoffroy)

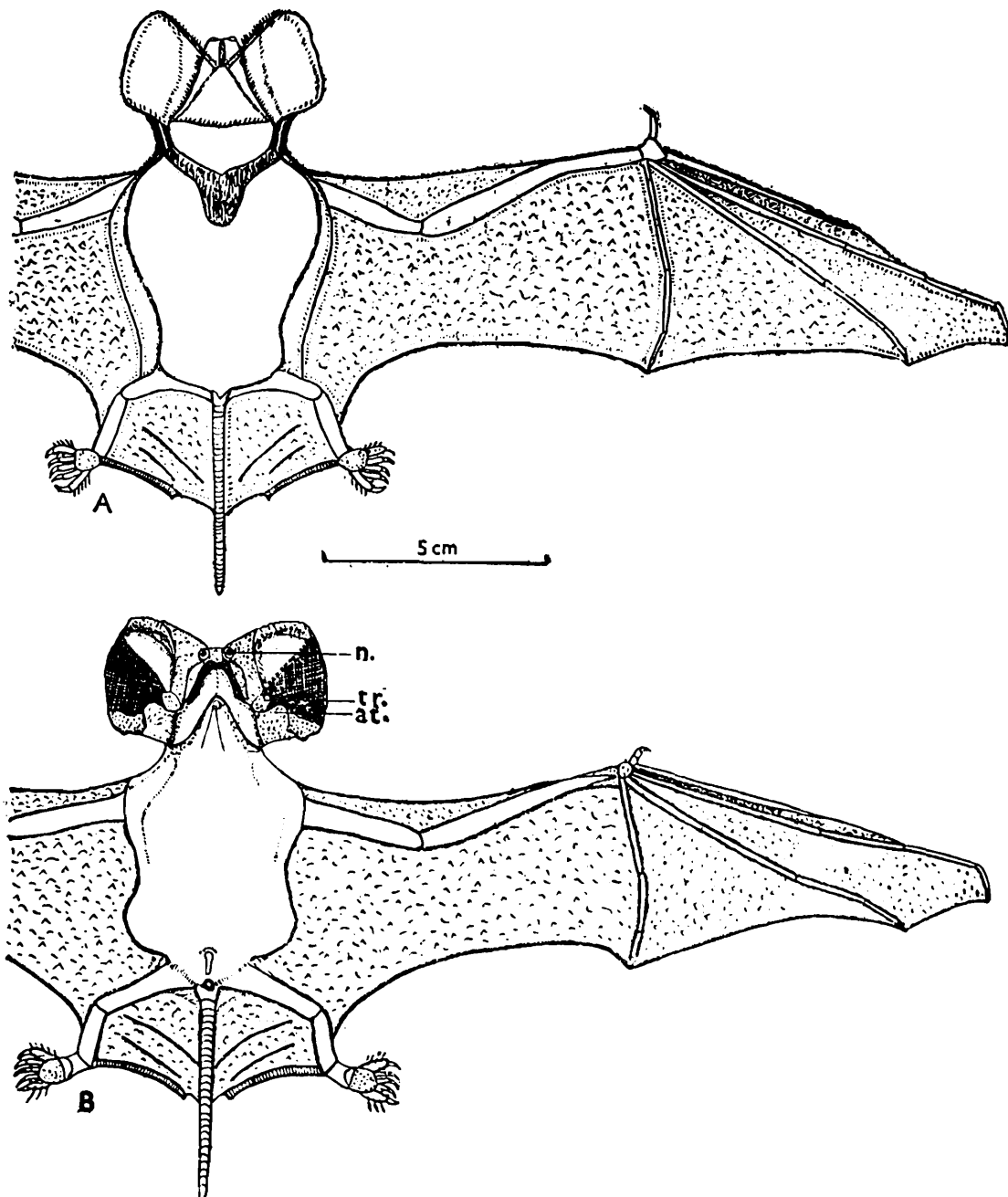
(Text-fig. 10)

(Asiatic Free-tailed Bat)

*Nyctinomus aegyptiacus* Geoffroy, *Description de l' Egypte*, 2 : 128, pl. 2. Type-loc. : Egypt.

*Tadarida aegyptiaca* Geoff., Chaturvedi, 1964, p. 432, (syn. *Tadarida tragatus* Dobson).

*Diagnosis of species* : Medium-sized ; total wing spread 300-330 ; noseleaf absent ; ear large, rounded and separated on the rostrum ;



Text-fig. 10.—Family Molossidae : *Tadarida aegyptiaca thomasi* Wroughton, ♂. Rajasthan (Jodhpur). External body : (A) Dorsal view. (B) Ventral view.

tragus broadened ; antitragus small ; upper lip heavily wrinkled ; tail projects out of the interfemoral membrane for about half its length ; calcar well developed ; second finger without claw, having only metacarpal bone. Skull without postorbital process ; anterior rim of orbit thickened and projecting outwards ; palatal branch of premaxillae absent ; parietal crest absent ; palate not exceeding last molar ; basisphenoid not excavated ; crown of molar marked with transverse furrows. Dental formula :

$$i \frac{1}{2}, c \frac{1}{1}, pm \frac{2}{2}, m \frac{3}{3} = 30$$

*Distribution of species* : AFRICA (EGYPT ; KENYA) and S. ASIA (PAKISTAN ; INDIA ; SRI LANKA).

*Systematic note* : Divided into three subspecies as follows, of which *T. a. thomasi* is found in Rajasthan :

*T. a. aegyptiaca* (E. Geoffroy).—Egypt ; Kenya.

*T. a. sindica* Wroughton.—Pakistan.

*T. a. thomasi* Wroughton.—India ; Sri Lanka.

### ***Tadarida aegyptiaca thomasi* Wroughton**

( Text-figs. 10, 11A, B, C, D )

*Tadarida thomasi* Wroughton, 1919. *J. Bombay nat. Hist. Soc.*, Bombay, 26 (4) : 732. Type-loc. : Bhuj, Kutch, India.

*Tadarida aegyptiaca thomasi* Wr., Ellerman and Morrison-Scott, 1951, p. 135 ; Sinha, 1970, p. 87 (syn. : *Tadarida gossei* Wr.).

*Material examined* : *Rajasthan* : Alwar Dist. : Alwar, 1 ♂ ; Sirohi Dist. : Mt. Abu, 1 ♀ ; Jodhpur Dist. : Jodhpur, 1 ♂ ; 3 ♀ ♀ and 2 complete skeleton ; Ajmer Dist. : Rajgad, 2 ♂ ♂, 8 ♀ ♀ ; Kota Dist. : Kota, 3 ♂ ♂, 9 ♀ ♀ ; Dungarpur Dist. : Dungarpur, 1 ♀ ; Bundi Dist. : Bundi, 1 ♂. *Other than Rajasthan*.—Maharashtra : Poona 2 ♀ ♀ . Bihar : Chota Nagpur 1 ♂ .

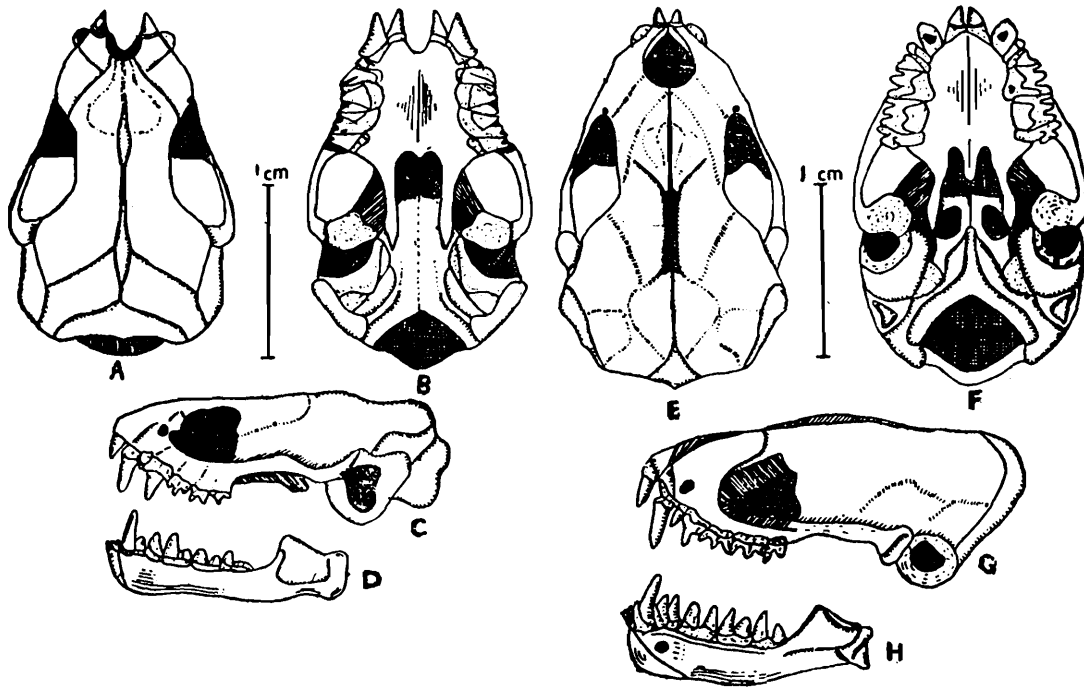
*Diagnosis of subspecies* : Differs from other subspecies in being smaller and darker (warmer, less greyish coloration).

Length : Head and body 61-64 ; forearm 46-47.5 ; ear 18-20 ; tragus 4-5 ; wing spread 300-330 ; tibia 13-14.5 ; foot with claw 7.2-9.

Skull : Total length 18.7-19.5 ; zygomatic width 11.5-12 ; width of brain case 9-10 ; maxillary width ( $m^3$ - $m^3$ ) 8-8.5 ; length of upper tooth row ( $c$ - $m^3$ ) 7-7.5 ; length of lower tooth row ( $c$ - $m_3$ ) 7.5-8 ; length of mandible 13.4-14.

*Distribution of subspecies* (Text-figs. 18 & 20 L) : RAJASTHAN : Districts of Jodhpur, Sirohi, Ajmer, Alwar, Bundi, Kota and Dungarpur. Previous

Rajasthan records were from Mt. Abu (Wroughton, 1919) and Alwar (Agrawal and Sinha, 1973). The present record from Jodhpur, Ajmer, Bundi, Kota and Dungarpur Districts are new (See also Sinha, 1975).  
*Elsewhere* : As above.



Text-fig. 11.—(A-D) *Tadarida aegyptiaca thomasi* Wroughton, ♂. Rajasthan (Jodhpur). Skull : (A) Dorsal view. (B) Ventral view. (C) Lateral view. (D) Lower jaw, in lateral view ; (E-H) *Tadarida plicata plicata* (Buchanan). ♀ Burma (Tenasserim). Skull : (E) Dorsal view. (F) Ventral view. (G) Lateral view. (H) Lower jaw, in lateral view.

### 13. *Tadarida plicata* (Buchanan) ( Wrinkled-lipped Bat )

*Vespertilio plicatus* Buchanan, 1800, *Trans. Linn. Soc. Lond.*, 5 : 261, pl. 13. Type-loc. : Bengal.

*Diagnosis* : Medium sized ; total wing spread 310-340 ; noseleaf absent ; ear large, rounded and joined on the muzzle by a narrow band of integument ; tragus small and quadrate ; antitragus small ; upper lip thick and coarsely wrinkled ; tail projecting out of the interfemoral membrane ; calcar present ; second finger without claw, having only metacarpal bone. Skull without postorbital process ; anterior rim of orbit low ; palatal branch of premaxillae present ; parietal crest low ; palate not exceeding last molar ; basisphenoid not excavated ; crown of molar marked with transverse furrows. Dental formula : Same as in *T. aegyptiaca*.

*Distribution of species* : INDIA ; SRI LANKA ; BURMA ; CHINA ; MALAYSIA ; Sumatra ; Java ; Borneo ; and PHILIPPINE Islands.

*Systematic note* : Divided into two Indian and Palaearctic subspecies as follows, of which *T. p. plicata* (Buchanan) is found in Rajasthan :

*T. p. plicata* (Buchanan).—Distribution as in species (except Sri Lanka).

*T. p. insularis* Phillips.—Sri Lanka.

Besides this *Tadarida plicata* has three more Australasian subspecies viz., *T. p. dilatata* (Horsfield), *T. p. tenuis* (Horsfield) and *T. p. luzonus* (Hollister).

### ***Tadarida plicata plicata* (Buchanan)**

(Text-figs. 11 E, F, G, H)

*Vespertilio plicatus* Buchanan, 1800, as above.

*Tadarida plicata plicata* Buch., Ellerman and Morrison-Scott, 1951, p. 135.

*Material examined* : *Rajasthan* : Sirohi Dist. : Mount Abu, 1 ♀ .  
*other than Rajasthan* : INDIA : Uttar Pradesh : Allahabad, 1 ♂ ; W. Bengal : Calcutta, 1 ♂ , 1 ♀ . BURMA : Tenasserim, 9 ♂ ♂ , 15 ♀ ♀ ; South Shan States, 5 ♀ ♀ .

*Diagnosis of subspecies* : As in species above.

Length : Head and body 60-64 ; forearm 46-49.5 ; ear 16-19 ; tragus 2-2.5 ; wing spread 310-340 ; tibia 15-18 ; foot with claw 10-12.

Skull : Total length 18-19 ; zygomatic width 10.5-11. width of brain case 8.5-9 ; maxillary width ( $m^3$ - $m^3$ ) 8-8.5 ; length of upper tooth row ( $c$ - $m^3$ ) 6.5-7 ; length of lower tooth row ( $c$ - $m_3$ ) 7-8 ; length of mandible 12-13.

*Distribution of subspecies* (Text-figs. 18 & 21 A) : RAJASTHAN : Sirohi District. *Elsewhere* : As above.

### Family VII. VESPERTILIONIDAE

(Text-fig. 12)

Genus (9) *Myotis* Kaup

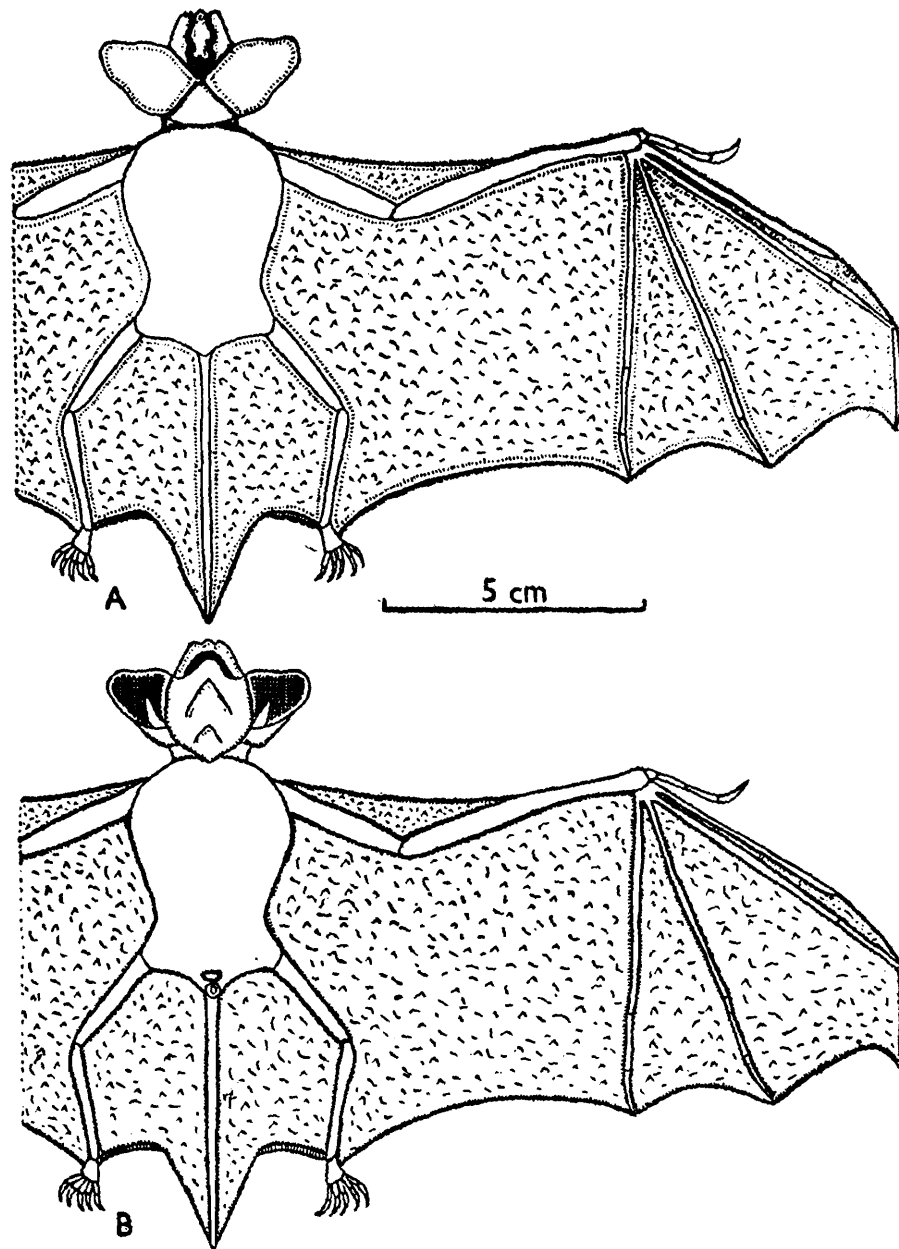
#### 14. *Myotis blythi* (Tomes)

(Blyth's Bat)

*Vespertilio blythi* Tomes, 1857, *Proc. zool. Soc. Lond.*, 1857. p. 53. Type-loc. : Nasirabad, Rajasthan.

*Diagnosis of species* : Medium-sized ; (wing spread 380) ; noseleaf absent ; ear ovoid-somewhat pointed, outer margin with a narrow

basal lobe ; tragus tapering distally ; tail covered by interfemoral membrane, tip of the tail free ; calcar reaching half way towards the tail tip ; a narrow calcarial lobe present ; second finger without claw, having only metacarpal bone. Skull without postorbital process ; premaxillaries bony and fused anteriorly ; parietal crest low, posteriorly developed ; palate narrowing abruptly behind last molar but not continue laterally ; basisphenoid not excavated ; crown of molar marked with transverse furrows. Dental formula :  $i \frac{2}{3}, c \frac{1}{1}, pm \frac{3}{3}, m \frac{3}{3} = 38$



Text-fig. 12.—Family Vespertilionidae: *Barbastella leucomelas darjelingensis* Hodgson, ♀ Himachal Pradesh (Simla). External body : (A) Dorsal view. (B) Ventral view.

*Distribution of species* : EUROPE, TURKESTAN, North-West AFRICA and ASIA.

*Systematic note* : Blanford (1891) and Thomas (1915a) regarded *Vespertilio dobsoni* Troussart (= *Vespertilio murinoides* Dobson) as an aberrant

individual of *Myotis blythi*. Ellerman and Morrison-Scott (1951) divided this species provisionally into three subspecies as follows, of which *M. blythi blythi* Tomes is found in Rajasthan.

*M. blythi blythi* Tomes.—Nasirabad (Rajasthan) to Simla, Northern India.

*M. (?) blythi dobsoni* Trouessart.—North-Western Himalayas.

*M. (?) blythi oxygnathus* Monticelli.—Europe, Turkestan, North-West Africa and South-Western Asia (excluding India).

### **Myotis blythi blythi** Tomes

*Vespertilio blythi* Tomes, 1857, as above.

*Material examined* : Known only from the type specimen (in British Museum Nat. Hist. not examined). I examined 1 ♀ from Chamba, Himachal Pradesh.

*Diagnosis of subspecies* : As for species above.

Length : Head and body 63 ; tail 54 ; ear 21.6 ; forearm 53.5 ; wing spread 380 ; tragus 10 ; tibia 25 ; foot with claw 12.

*Distribution of subspecies* (Text-figs. 18 & 21 B) : RAJASTHAN : Ajmer District. *Elsewhere* : As above.

### Genus (10) **Eptesicus** Rafinesque

#### 15. **Eptesicus serotinus** (Schreber)

( Serotine )

*Vespertilio serotinus* Schreber, 1774, *Saugeth.* 1 : 167, pl. 53. Type-loc. : France.

*Diagnosis of species* : Medium sized (wing spread 330-350 mm.) ; noseleaf absent ; muzzle thick, convex laterally ; base of ear not thickened ; tragus short, of nearly uniform breadth, rounded at the end ; tail covered by interfemoral membrane ; calcar present ; calcarial lobe small ; second finger without claw, represented by metacarpal and a small phalanx. Skull with postorbital process not distinct ; premaxillaries separate anteriorly forming palatal emargination deeper than broad ; parietal and occipital crests not prominent ; palate narrowing behind last molar ; basisphenoid not excavated ; crown of molar marked with transverse furrows ; second upper incisor small, on outside of the first incisor and separate from canine. Dental formula :

$$i \frac{2}{2}, c \frac{1}{1}, pm \frac{1}{2}, m \frac{3}{3} = 32$$

*Distribution of species* : Widespread in EUROPE, ASIA, and West AFRICA.

*Systematic note* : The following eleven subspecies have been recognised of which *E. serotinus pachyomus* Tomes is found in Rajasthan :

- E. s. serotinus* Schreber.—Europe.  
*E. s. turcomanus* Eversmann.—Asian U. S. S. R. and Iran.  
*E. s. pachyomus* Tomes.—India (Rajasthan & Kashmir).  
*E. s. shiraziensis* Dobson.—S. W. Iran.  
*E. s. andersoni* Dobson.—S. China (Yunnan, Fukien and Chekiand).  
*E. s. pallens* Miller.—China (Shensi, Chihli, Shantung) and Korea.  
*E. s. meridionalis* Dal Piaz.—Sardinia.  
*E. s. intermedius* Ognev.—Northern Caucasus.  
*E. s. brachydigitus* Mori.—Nando, Korea.  
*E. s. isabellinus* (Temminck).—North Africa.  
*E. s. pastomus* Gaisler.—Afghanista

### ***Eptesicus serotinus pachyomus* (Tomes)**

( Text-figs. 13A, B, C, D )

*Scotophilus pachyomus* Tomes, 1857, *Proc. zool. Soc. Lond.*, 1857, p. 50. Type-loc. : "Rajputana".

*Material examined* : Rajasthan. None. Other than Rajasthan : Kashmir, 2 ♂♂, 1 ♀.

*Diagnosis of subspecies* : Same as for species above ; larger than any other subspecies.

Length : 1 ♂ : Head and body 64 ; tail 46 ; forearm 52.8 ; wing spread 350 ; ear 15 ; tragus 6 ; tibia 19 ; foot with claw 13.

Skull : 1 ♂ : Total length 20 ; zygomatic width 13 ; maxillary width ( $m^8-m^8$ ) 8.3 ; cranial width 9.5 ; length of upper tooth row ( $c-m^8$ ) 7.6 ; length of lower tooth row ( $c-m_8$ ) 8.5 ; length of mandible 15.5.

*Distribution of subspecies* (Text-figs. 18 & 21 C) : RAJASTHAN : As informed by J. E. Hill (Brit. Mus.) : It seems that Boy's collected the specimen in Rajputana, probably near Nasirabad but labelled "India" ; I failed to collect it in Nasirabad. Elsewhere : As above.

### Genus (11) **Pipstrellus** Kaup

#### 16. **Pipstrellus mimus** Wroughton ( Indian Pygmy Pipistrelle )

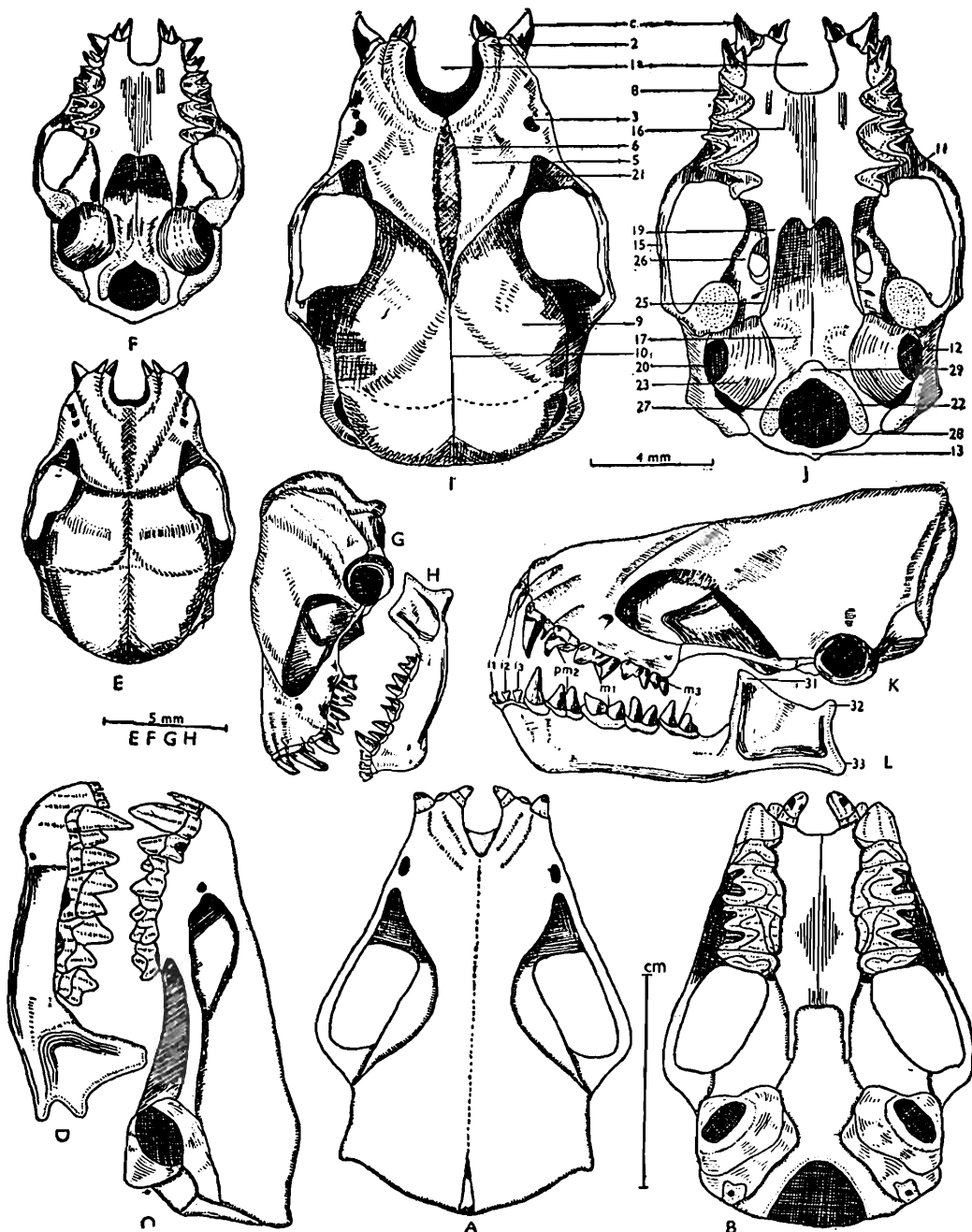
*Pipistrellus mimus* Wroughton, 1899, *J. Bombay nat. Hist. Soc.*, Bombay, 12 (4) : 722. Type-loc. : Maheshkatri, The Dangs District, Gujarat.

*Diagnosis of species* : Smallest bat in Rajasthan (wing spread 140-200 mm.) noseleaf absent ; muzzle narrow ; ear with small basal lobe ; tragus



small ; tail covered by interfemoral membrane ; calcar weak ; calcarial lobe small ; second finger without claw, having metacarpal and a small phalanx. Skull small ; postorbital process not distinct ; premaxillaries bony and free anteriorly forming U-shaped space in the middle ; parietal and occipital crests weak ; palate ends just behind last molar ; basisphenoid not excavated ; crown of the molar marked with transverse furrows ; second upper incisor subequal to first. Dental formula :

$$i \frac{2}{3}, c \frac{1}{1}, pm \frac{2}{2}, m \frac{3}{3} = 34.$$



Text-fig. 13.— (A-D) *Eptesicus serotinus pachyomus* Tomes, ♂. India (Kashmir). Skull : (A) Dorsal view. (B) Ventral view. (C) Lateral view. (D) Lower jaw, in lateral view ; E-H *Pipistrellus mimus mimus* Wroughton, ♂. Rajasthan (Jodhpur). Skull : (E) Dorsal view. (F) Ventral view. (G) Lateral view. (H) Lower jaw, in lateral view ; I-L *Pipistrellus dormeri* (Dobson), ♀ Rajasthan (Jodhpur). Skull : (I) Dorsal view. (J) Ventral view. (K) Lateral view. (L) Lower jaw, in lateral view.

*Distribution of species* : IRAQ ; PAKISTAN ; whole of INDIA ; SRI LANKA ; BURMA, and VIETNAM.

*Systematic note* : Two subspecies occur as follows of which *P. mimus mimus* is found in Rajasthan :

*P. m. mimus* Wroughton.—Distribution as in species above (except Assam).

*P. m. principulus* Thomas.—Assam (Gauhati).

### **Pipistrellus mimus mimus** Wroughton

( Text-figs. 13 E, F, G, H )

*Pipistrellus mimus* Wroughton, 1899, as above.

*Pipistrellus mimus glaucillus* Wroughton, 1912. *J. Bombay nat. Hist. Soc.*, Bombay, 21 (4) : 769. Type-loc. : Multan, Pakistan.

*Material examined* : Rajasthan : Jodhpur Dist. : Jodhpur and Salawas, 10 ♂♂, 26 ♀♀ ; Jaipur Dist. : Jaipur, 1 ♀ ; Pali Dist. : Pali, 1 ♂ ; Tonk Dist. : Tonk, 1 ♂. *Other than Rajasthan* : INDIA : Bihar : Gaya, 3 ♂♂, 8 ♀♀ ; Chaibassa, 12 ♂♂, 9 ♀♀ ; Hazaribagh, 3 ♂♂, 5 ♀♀. W. Bengal : Midnapur, 9 ♂♂, 13 ♀♀ ; Calcutta, 1 ♂, 2 ♀♀. Gujarat : Junagarh, 1 ♂, 1 ♀ ; Palanpur, 2 ♂♂. Maharashtra : Ratana-giri, 1 ♂. PAKISTAN : Chitral, 1 ♀.

*Diagnosis of subspecies* : As for species above.

Length : Head and body 31-42 ; tail 24-35 ; forearm 26-30.5 ; ear 9-11 ; tragus 3-4.5 ; wing spread 140-200 ; tibia 10-12 ; foot with claw 4.5-7.

Skull : Total length 10.8-11.5 ; zygomatic width 6.5-7.8 ; width of brain case 5.8-6.2 ; maxillary width ( $m^3$ - $m^3$ ) 4.6-5.5 ; length of upper tooth row ( $c$ - $m^3$ ) 3.6-4.2 ; length of lower tooth row ( $c$ - $m_3$ ) 4-4.9 ; length of mandible 7.2-8.6.

*Remarks* : Wroughton (1918) differentiated *P. mimus mimus* from *P. m. glaucillus* only on the colour (bistre brown *vs.* mouse-grey). My examples, from different localities of India and Pakistan, vary greatly in colour of fur (pale yellow to dark brown), but the external and skull characters do not differ significantly. I regard *P. mimus glaucillus* Wr. as a synonym of *P. mimus mimus* Wroughton.

Females collected from Jodhpur have slightly larger feet than males.

*Distribution of subspecies* ( Text-figs. 18 & 21 D ) : RAJASTHAN : Districts of Jodhpur, Nagaur, Jaipur, Tonk, Pali and Sirohi. The present records from Jaipur, Tonk and Pali Districts are new. *Elsewhere* : As above.

17. *Pipistrellus dormeri* (Dobson)

( Dormer's Bat )

( Text-figs. 13 I, J, K, L )

*Scotozous dormeri* Dobson, 1875, *Proc. zool. Soc. Lond.*, 1875, p. 373. Type-loc. : Bellari Hills, India.

*Pipistrellus dormeri dormeri* Dobs., Ellerman and Morrison-Scott, 1951, p. 102 ; Agrawal, 1972, p. 266 (syn. : *Scotozous dormeri caurinus* Thomas).

*Material examined* : *Rajasthan* : Jodhpur Dist. : Jodhpur, 5 ♂♂, 10 ♀♀ ; Bharatpur Dist. : Bharatpur, 1 ♂ ; Dungarpur Dist. : Dungarpur, 2 ♂♂, 2 ♀♀ ; Banswara Dist. : Banswara, 1 ♂, 1 ♀ *Other than Rajasthan* : INDIA : Bihar : Vaisali Dist. : Brahabatta, 1 ♂ ; Gaya Dist. : Gaya, 1 ♀ ; Singhbhum Dist. : Chaibasa, 1 ♂. Gujarat : Palanpur, 1 ♂. PAKISTAN : Shikarpur, 1 ♂, 1 ♀.

*Diagnosis of species* : Similar to *Pipistrellus mimus*, but larger (wing spread 200-240 mm.) ; muzzle broader.

Skull larger than *P. mimus* ; second upper incisors minute or in some cases absent. Dental formula :

$$i \frac{2}{3} \text{ or } \frac{1}{3}, c \frac{1}{1}, pm \frac{2}{2}, m \frac{3}{3} = 34 \text{ or } 32$$

Length : Head and body 43-54 ; tail 30-40 ; forearm 34-37 ; ear 11.5-13 ; tragus 4.5-5.2 ; wing spread 200-240 ; tibia 12-15 ; foot with claw 7-9.

Skull : Total length 13.5-14.5 ; zygomatic width 9.8-10.3 ; width of brain case 6.7-7.6 ; maxillary width ( $m^3$ - $m^3$ ) 6-7 ; length of upper tooth row ( $c$ - $m^3$ ) 5.2-5.7 ; length of lower tooth row ( $c$ - $m_3$ ) 5.8-6.2 ; length of mandible 10.5-11.5.

*Systematic note* : Thomas (1915c) recognised two subspecies, namely, *P. dormeri dormeri* and *P. dormeri caurinus*, but Agrawal (1972) finds no difference, and I agree with him.

This species has been referred by various authors to genus *Scotozous* on the basis of  $i^2$  being absent. But most of the Rajasthan and Gujarat specimens of *dormeri* have  $i^2$  present (except a few) and various recent authors e.g., Ellerman and Morrison-Scott (1951), Brosset (1962c), Prakash (1963a) and Agrawal (1967, 1972) have kept it under genus *Pipistrellus* and I accept this latter view.

*Distribution of species* ( Text-figs. 19 & 21 E ) : RAJASTHAN.—Districts of Jodhpur, Dungarpur, Banswara and Bharatpur. The present record from Dungarpur, Banswara and Bharatpur Districts are new

(See also Sinha, 1975). *Elsewhere* : Central and Western INDIA (including Bihar and West Bengal) ; also PAKISTAN and TAIWAN.

Genus (12) *Hesperoptenus* Peters

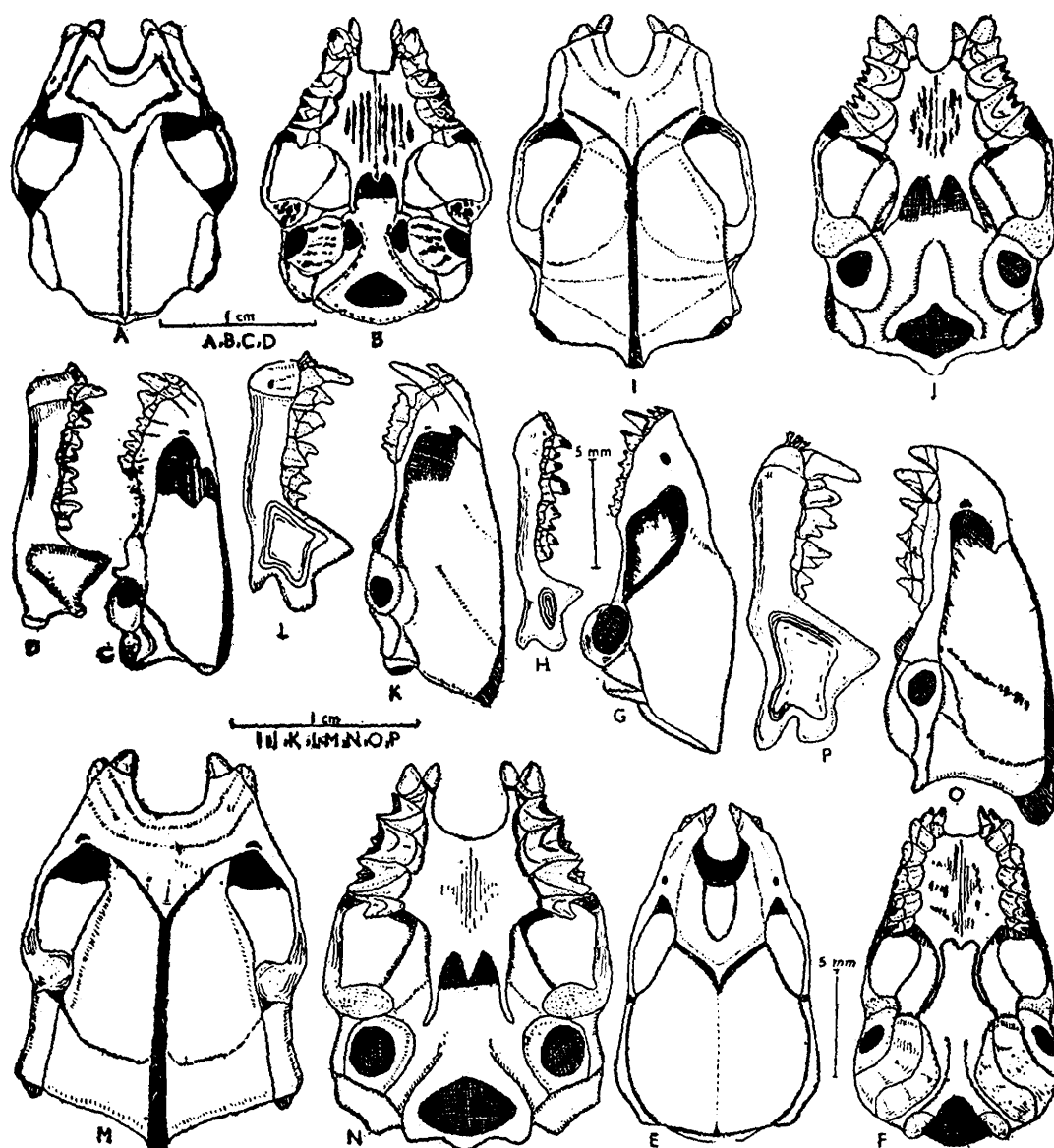
18. *Hesperoptenus tickelli* (Blyth)

(Tickell's Bat)

(Text-figs. 14 A, B, C, D)

*Nycticejus tickelli* Blyth, 1851, *J. Asiat. Soc. Bengal*, Calcutta, 20 : 157. Type-loc. :  
Chaibassa, Bihar, India.

*Hesperoptenus tickelli* Bl., Wroughton, 1918, p, 593.



Text-fig. 14.—(A-D) *Hesperoptenus tickelli* (Blyth), ♂. Madhya Pradesh (Surguja). Skull : (A) Dorsal view. (B) Ventral view. (C) Lateral view. (D) Lower jaw, in lateral view ; (E-H) *Barbastella leucomelas darjelingensis* Hodgson, ♀ Himachal Pradesh (Simla). Skull : (E) Dorsal view. (F) Ventral view (G) Lateral view. (H) Lower jaw, in lateral view ; (I-L) *Scotophilus kuhlii kuhlii* Leach, ♀ Rajasthan (Bharatpur). Skull : (I) Dorsal view. (J) Ventral view ; (K) Lateral view. (L) Lower jaw, in lateral view ; (M-P) *Scotophilus heathi heathi* Horsfield, ♂. Rajasthan (Bharatpur). Skull : (M) Dorsal view. (N) Ventral view. (O) Lateral view. (P) Lower jaw, in lateral view.

*Material examined* : Rajasthan : None. *Other than Rajasthan* : INDIA : Madhya Pradesh : Surguja, 1 ♂. Orissa : Kashipur, 2 ♂ ♂, 4 ♀ ♀. Bihar : Singhbhum District : Koira, 1 ♂. BURMA : Tenasserim, 1 ♂.

*Diagnosis of species* : Size medium ; wing spread 340 mm. ; noseleaf absent ; muzzle broad ; ear large, with posterior margin thickened at base and forming a lobe ; tragus present ; tail completely covered by interfemoral membrane ; calcar prominent ; second finger without claw, having metacarpal bone and a small phalanx, Skull broad ; postorbital process very small ; premaxillaries fused posteriorly with each other and with the maxillae ; anteriorly free and forming a U-shaped space ; sagittal and parietal crests prominent but not making a knob-like structure as in *Scotophilus* ; palate narrowing beyond the last molar and ending posteriorly in a triangular structure ; basisphenoid slightly excavated on both sides ; crown of molars marked with transverse furrows ; outer upper incisor crowded inward between inner incisor and canine. Dental formula :

$$i \frac{2}{3}, c \frac{1}{1}, pm \frac{1}{2}, m \frac{3}{3} = 32$$

Length : Head and body 60-76 ; forearm 54-58 ; ear 15-19 ; tragus 5.5-7 ; wing spread 340 ; tibia 20-25 ; foot with claw 10-12.

Skull : Total length 18.4-19.5 ; zygomatic width 14.2-15.1 ; width of brain case 9.2-10.1 ; maxillary width ( $m^3$ - $m^3$ ) 9.5-10 ; length of upper tooth row ( $c$ - $m^3$ ) 7.3-8.1 ; length of lower tooth row ( $c$ - $m_3$ ) 8.6-8.7 ; length of mandible 14.5-15.9.

*Distribution of species* (Text-figs. 19 & 21F) : RAJASTHAN : Wroughton (1918) and Ellerman and Morrison-Scott (1951) include "Rajputana" (=Rajasthan) in its range of distribution but no precise localities are mentioned. I have not been able to collect any example but as informed by J. E. Hill (Brit. Mus.), the exact locality of this species is Nasirabad (Rajasthan). *Elsewhere* : Almost the whole of INDIA (including the Andaman Islands), BURMA, SRI LANKA ; Hill and Thonglongya (1972) extend it to THAILAND.

### Genus (13) **Barbastella** Gray

#### 19. **Barbastella leucomelas** (Cretzschmar)

(Barbastelle)

*Vespertilio leucomelas* Cretzschmar, 1826, in Rüppell, *Atlas Reise nördl. Afrika. Säugeth.*, p. 73, pl. 286. Type-loc. : Israel.

*Diagnosis of species* : Medium-sized (wing spread 260-270 mm.); noseleaf absent; upper surface of rostrum concave; ears long and joined, base thickened; tragus tapering distally; tail entirely enclosed in the interfemoral membrane; calcar weak; calcarial lobe small; second finger without claw, represented by metacarpal and a small phalanx. Skull small without postorbital process; premaxillaries bony, fused with maxillae, anteriorly free but close to each other and forming a crescent space; frontal surface concave sloping anteriorly; parietal and occipital crests not prominent; palate ends just behind last molar; basisphenoid not excavated; crown of molar marked with transverse furrows; second upper incisor smaller but above the cingulum of the first. Dental formula :

$$i \frac{2}{3}, c \frac{1}{1}, pm \frac{2}{2}, m \frac{3}{3} = 34$$

*Distribution of species* : Israel; Southern most part of USSR; CHINA; JAPAN; NEPAL; and North INDIA.

*Systematic note* : Two subspecies are known as follows, of which *B. leucomelas darjelingensis* Hodgson occurs in Rajasthan :

*B. l. leucomelas* Cretzschmar.—Israel.

*B. l. darjelingensis* Hodgson.—Distribution as in species above, except Israel.

### **Barbastella leucomelas darjelingensis** Hodgson

(Text-figs. 12 14E, F, G, H)

*Plecotus darjelingensis* Hodgson, 1855, in Horsfield, *Ann. Mag. nat. Hist.*, London, 16 : 103. Type-loc. : Darjeeling, W. Bengal.

*Barbastella leucomelas darjelingensis* Hodgs., Ellerman and Morrison-Scott, 1951, p. 176.

*Material examined* : Rajasthan : None. *Other than Rajasthan*.—Jammu and Kashmir : Gilgit, 2 ♂♂, 1 ♀; Yangi Dawar, 1 ♂. Himachal Pradesh : Simla, 1 ♀. Uttar Pradesh : Mussoorie, 1 ♂, 1 ♀. W Bengal : Darjeeling, 1 ♂, 2 ♀♀. Sikkim : Lachen, 1 ♀.

*Diagnosis of subspecies* : As in species above.

Length : Head and body 50-59; tail 44-50; forearm 41-46; ear 18-19; tragus 9-10; wing spread 260-270; tibia 18-21; foot with claw 8-11.

Skull : Total length 15-15.5; zygomatic width 8-8.8. width of brain case 7.5-8; maxillary width ( $m - m^3$ ) 6-6.9; length of upper tooth row

( $c-m^s$ ) 5 ; length of lower tooth row ( $c-m_s$ ) 6 ; length of mandible 10-10.5.

*Distribution of subspecies* (Text-figs. 19 & 21 G) : RAJASTHAN : Wroughton (1918) and Ellerman and Morrison-Scott (1951) include "Rajputana" (=Rajasthan) in its range of distribution. I have not been able to collect any example but as informed by J. E. Hill (B. M.) the specimen in British Museum is probably from Nasirabad but labelled as "India". *Elsewhere* : As above.

## Genus (14) *Scotophilus* Leach

### 20. *Scotophilus kuhlii* Leach

(Lesser Yellow Bat)

*Scotophilus kuhlii* Leach, 1821, *Trans. Linn. Soc. Lond.*, **13** : 69, 71. Type-loc. : India.  
*Vespertilio temmincki* Horsfield, 1838, *Zool. Res. Java*. Type-loc. : Western Java.

*Diagnosis of species* : Medium-sized (wing spread 270-290 mm.) ; noseleaf absent ; muzzle short ; ear with a distinct basal lobe, longer than broad ; tragus long, pointed and curved inwards ; tail covered by interfemoral membrane ; calcar weak ; calcarial lobe small ; second finger without claw, having metacarpal and a small phalanx. Skull with small head-like postorbital ridge ; premaxillaries bony and free anteriorly forming deeper space than broad ; parietal and occipital crests prominent forming at their junction behind a prominent projection ; palate narrowing behind last molar and ends in the form of triangular spine ; basisphenoid not excavated ; crown of molar marked with transverse furrows. Dental formula :

$$i \frac{1}{3}, c \frac{1}{1}, pm \frac{1}{2}, m \frac{3}{3} = 30$$

*Distribution of species* : PAKISTAN ; INDIA ; BANGLA DESH ; SRI LANKA ; BURMA ; S. W. CHINA ; THAILAND ; MALAYA ; Java ; Bali ; Borneo ; and PHILIPPINES.

*Systematic note* : This species is divided into five subspecies as follows, of which *S. k. Kuhlii* (= *S. t. wroughtoni*) is found in Rajasthan.

*S. k. temmincki* Horsfield,—Malaya Peninsula ; Java ; Bali ; Borneo ; and Philippines.

*S. k. castaneus* Gray.—Malacca, Borneo, Annam and Burma (Tenasserim).

*S. k. kuhlii* Leach (= *S. t. wroughtoni* Thomas).—Pakistan, India, Sri Lanka and Burma.

*S. k. consobrinus* J. Allen.—S. W. China ; Taiwan.

*S. k. gairdueri* Kloss.—Thailand.

Siddiqi (1961, example in British Museum) recognises *S. temmincki* (*S. kuhlii*) from W. Bengal and East Pakistan (=Bengladesh) as *S. t. castaneus* (*S. k. castaneus*), but Sinha (1970) identified West Bengal (Midnapore) specimens as *S. t. wroughtoni* (*S. k. kuhlii*), is widely distributed in India, Sri Lanka and Burma.

Hill and Thonglongya (1972) have synonymised *S. temmincki* with the earlier *S. kuhli* Leach, 1822. If *S. kuhli* is accepted and since the type of *kuhli* comes from India, the Indian form would be as *kuhli kuhli* with *wroughtoni* Thomas as its synonym.

### Scotophilus kuhlii kuhlii (Thomas)

(Text-figs. 14 I, J, K, L)

*Scotophilus kuhlii* Leach, 1821, *Trans. Linn. Soc. Lond.*, 13 : 69, 71. Type-loc : India.

*Scotophilus wroughtoni* Thomas, 1897, *J. Bombay nat. Hist. Soc.*, Bombay, 11 : 275, Type-loc. : Kim, Surat District, Gujarat.

*Material examined* : Rajasthan : Bharatpur Dist. : Bharatpur 1 ♀. *Other than Rajasthan*.—INDIA : Bihar : Hazaribagh Dist. : Lohra, 1 ♂, 3 ♀♀ and 1 ♂, 2 ♀♀ (young). West Bengal : Midnapore, 3 ♂♂, 3 ♀♀ BURMA : 2 ♂♂, 2 ♀♀.

*Diagnosis of subspecies* : This subspecies is separable from others by the white undersurface.

Length : Head and body 63-66 ; forearm 45.7-51 ; ear 12-15 ; tragus 6.8 ; wing spread 270-290 ; tibia 18-20 ; foot with claw 9-11.

Skull : Total length 18-19 ; zygomatic width 12.5-13 ; width of brain case 9-9.4 ; maxillary width ( $m^8$ - $m^8$ ) 8.3-9 ; length of upper tooth row ( $c$ - $m^9$ ) 6-6.5 ; length of lower tooth row ( $c$ - $m_9$ ) 7-7.5 ; length of mandible 13.5-14.

*Distribution of subspecies* (Text-figs. 19 & 21 H) : RAJASTHAN : Bharatpur (See also Sinha, 1975). *Elsewhere* : INDIA : Gujarat, Madhya Pradesh, Uttar Pradesh; Bihar, West Bengal and Sikkim. *Extra-India* : PAKISTAN, SRI LANKA and BURMA.

### 21. Scotophilus heathi (Horsfield)

(Greater Yellow Bat)

*Nycticejus heathi* Horsfield, *Proc. zool. Soc. Lond.* 1831, p. 113. Type-loc. : Madras, India.

*Diagnosis of species* : Larger than *S. kuhlii* (wing expanse 290-370 mm.) otherwise similar. Skull similar to *S. kuhlii* but larger.



*Distribution of species* : From PAKISTAN, INDIA, SRI LANKA, BURMA and Hainan, South-East up to Celebes.

*Systematic note* : According to Tate (1942), this species is divided into four subspecies, namely *heathi* Horsfield, *belangeri* Geoffroy, *insularis* Allen and *celebensis* Sody. Siddiqi (1961) finds no difference between *S. h. heathi* and *S. h. belangeri*, and I agree.

The three known subspecies are distributed as follows, of which *S. h. heathi* is found in Rajasthan.

*S. h. heathi* Horsfield (syn. *Vespertilio belangeri* I. Geoffroy). Distribution as mentioned above in the species, except Hainan and Celebes.

*S. h. insularis* Allen.—Hainan Is.

*S. h. celebensis* Sody.—Celebes.

### **Scotophilus heathi heathi** (Horsfield)

(Text-figs. 14 M, N, O, P)

*Nycticejus heathi* Horsfield, 1831, as above.

*Scotophilus heathi heathi* (Horsf.), Siddiqi, 1961, p. 450. (syn. : *Vespertilio belangeri* Geoffroy).

*Material examined* : *Rajasthan* : Jodhpur Dist. : Jodhpur, 1 ♂, 1 ♀ ; Jhunjhunu Dist. : Nangal village, 1 ♀ ; Alwar Dist. : Perbeni village, 1 ♂ ; Bharatpur Dist. : Bharatpur, 1 ♂, 2 ♀ ♀ ; Ajmer Dist. : Rajgadh, 2 ♂ ♂, 1 ♀ ; Sawai Madhopur Dist. : Sawai Madhopur, 1 ♂ ; Dungarpur Dist. : Dungarpur and Surpur, 4 ♂ ♂, 3 ♀ ♀ ; Banswara Dist. : Banswara, 4 ♂ ♂, 10 ♀ ♀ ; Bundi Dist. : Bundi and Sikar Burz, 2 ♂ ♂, 2 ♀ ♀ . *Other than Rajasthan*. INDIA : Gujarat : Palanpur, 2 ♀ ♀ . Andhra Pradesh : Nagarjuna Sagar 1 ♂ . Bihar : Darbhanga, 1 ♂ ; Hazaribagh, 1 ♂, 3 ♀ ♀ ; Purnea, 1 ♂, 1 ♀ . Assam : 2 ♂ ♂ . BURMA : Pegu, 4 ♂ ♂, 3 ♀ ♀ .

*Diagnosis of subspecies* : As in species above. Though Tate (1942) and Ellerman and Morrison-Scott (1951) separated *S. h. insularis* and *S. h. celebensis* from *S. h. heathi* on geographical hiatus, I could not find any differences between them from the description given by the authors. However, I cannot say anything definitely about their status until topographical material of *S. h. insularis* and *S. h. celebensis* is studied.

Length : Head and body 72-82 ; forearm 55-64 ; ear 16-19 ; tragus 8-10 ; wing spread 290-370 ; tibia 21-27 ; foot with claw 10-14.

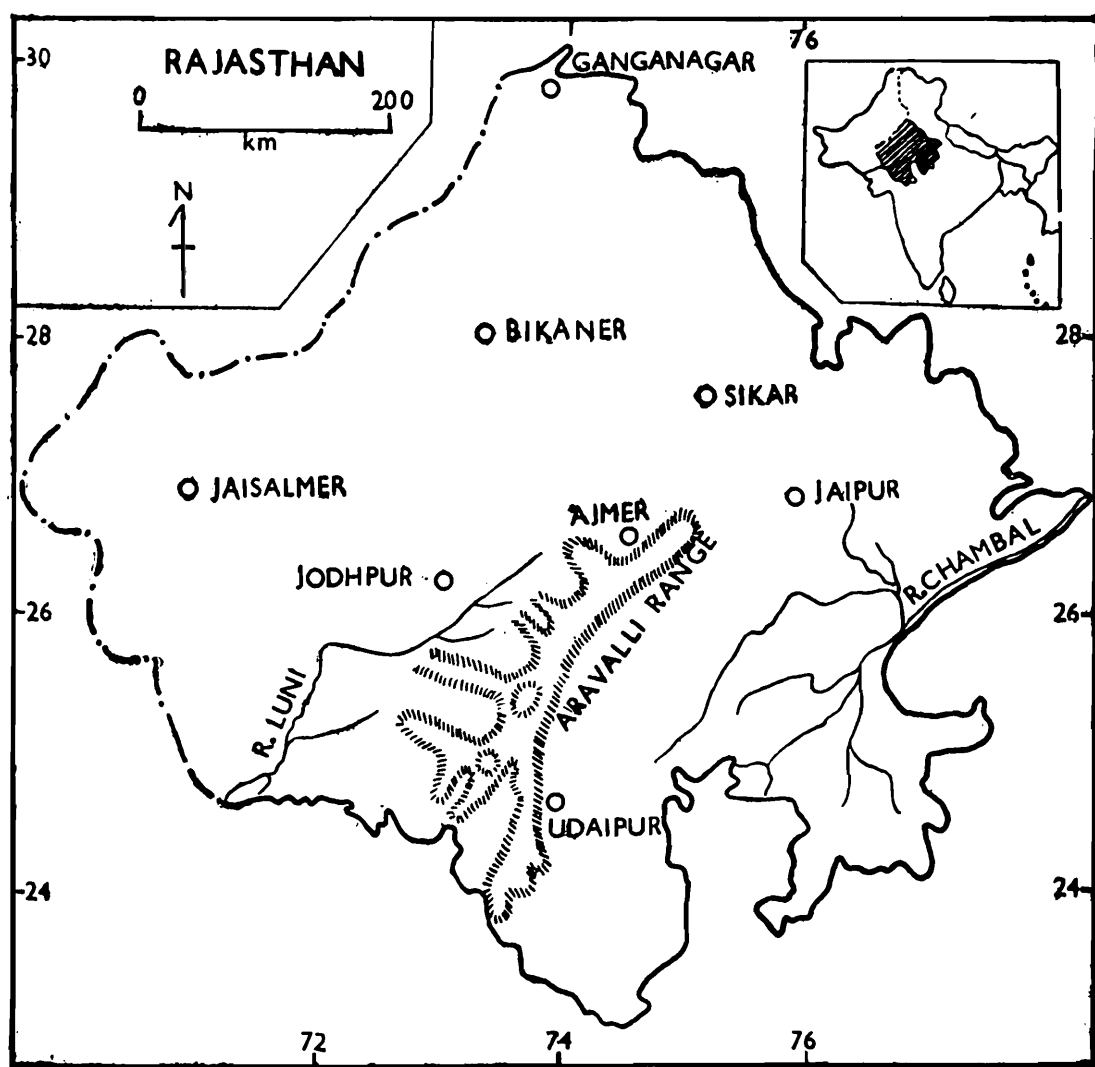
Skull : Total length 20.5-22 ; zygomatic width 15-16.8 ; width of brain case 10-11.9 ; maxillary width ( $m^3-m^8$ ) 9.2-10.5 ; length of upper tooth row ( $c-m^8$ ) 7.2-8 ; length of lower tooth row ( $c-m_3$ ) 8.4-9 ; length of mandible 15-16.2,

*Distribution of subspecies* (Text-figs. 19 & 21 I): RAJASTHAN : Districts of Jodhpur, Jhunjhunu, Alwar, Dungarpur, Banswara, Bundi, Ajmer, Sawai Madhopur and Bharatpur. The records here from Jhunjhunu, Alwar, Bharatpur, Ajmer, Sawai Madhopur, Dungarpur, Banswara and Bundi Districts are new (See also Sinha, 1975). *Elsewhere* : As above.

#### IV. ZOOGEOGRAPHY OF RAJASTHAN BATS

##### (a) General

The geographical distribution of bats is not easy to explain. Three factors govern their distribution (Allen, 1939) : (i) the means of locomotion ; (ii) the history of the land areas they inhabit ; and (iii) their individual species preferences in respect to climate, food and other conditions of life.



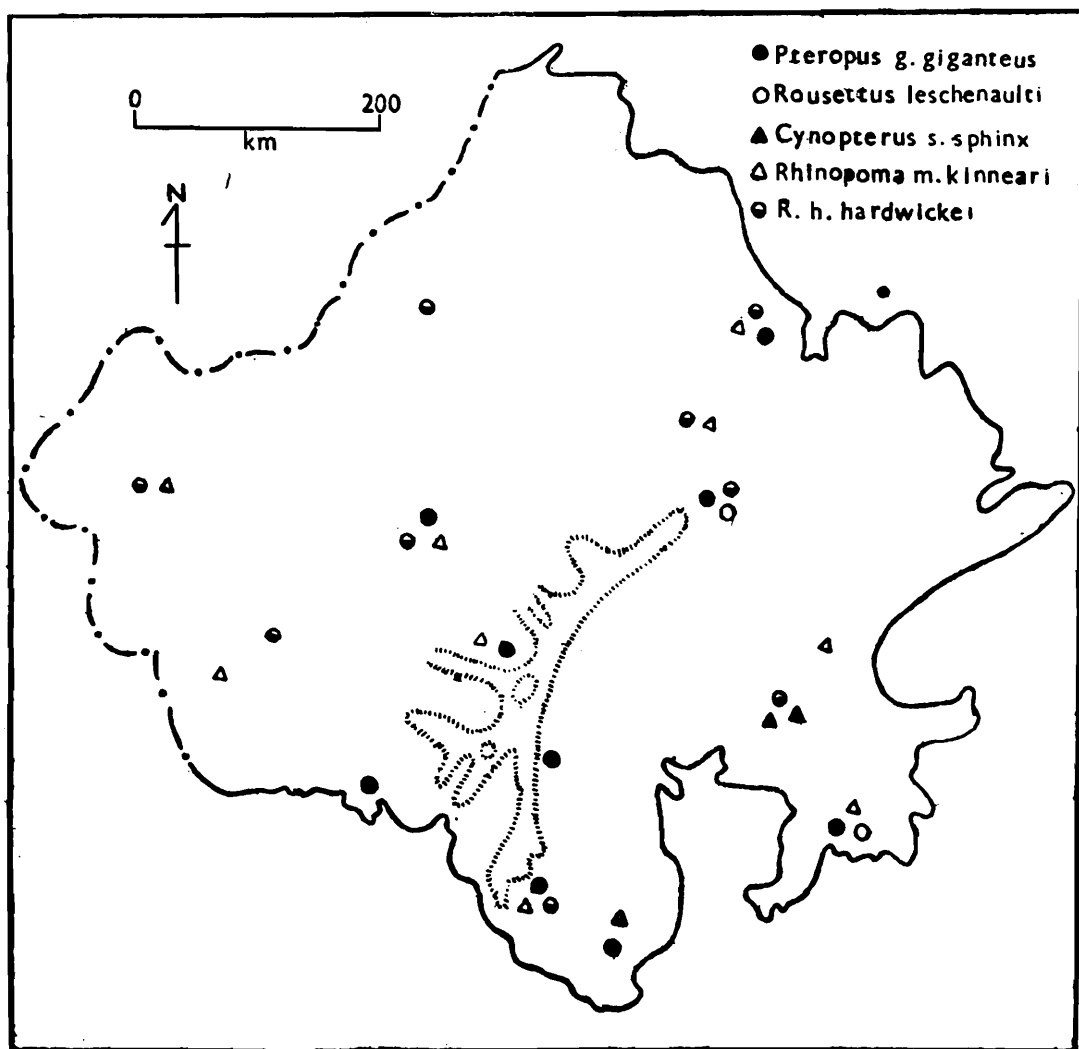
Text-fig. 15.—Map of Rajasthan (General).

Being flying animals, bats can extend their distribution more rapidly than nonflying, land-dwelling animals. And so they cover a wide range, but this is true only for the migratory species. Most bats remain confined to a particular restricted region and, in general, show no tendency to extend their bound. Thus, species inhabiting island groups tend to

remain there, and after sometime develop small characteristic differences from their main land relatives, and in this way new races or species may arise through isolation. In the case of widespread species, climatic differences of inhabited areas acting on populations may bring about slight but perceptible changes, and thus variations in fur colour, claws, etc. arise. Such changes, have been noted in many Indian species also (Andersen, 1917 ; Brosset, 1962b ; Sinha, 1973 ; etc.).

In Rajasthan, which is the westernmost State (Text-fig. 15) of India, there may be two possible factors which govern their distribution :

(i) The hot, arid, desert area of western Rajasthan is not suitable for fruit-eating bats (Megachiroptera), and no bats of this group have in fact been recorded from the region though three species, viz., *Pteropus*



Text-fig. 16.—Distribution of bat in Rajasthan.

*giganteus*, *Rousettus leschenaulti* and *Cynopterus sphinx* occur in the semi arid and wetter eastern part of Rajasthan. The arid region, however, is suitable for many insectivorous bats (Microchiroptera : species of *Taphozous*, *Rhinopoma*, *Rhinolophus*, etc.), which are actually found here. Some insectivorous species of the genus *Pipistrellus*, *Scotophilus*, *Myotis*,

etc., which prefer areas near thickly populated human habitation (towns) or woodland (near villages) have also not been recorded from the desert areas.

(ii) The Aravalli range, which cuts across Rajasthan diagonally southwest to northeast, divides the land into two unequal and climatically different halves. Its maximum height is *c.* 1722 m. above mean sea-level, and only *c.* 664 m. above the adjoining ground. It is doubtful whether these relatively low range of hills can serve as a barrier for distribution of bats. Most of the insectivorous bats and the large flying fox (*Pteropus giganteus*) which occur in the eastern part of the Aravalli hills are also found west of it.

The physiography, climate, geology, etc. of Rajasthan, a summary of which will be found in the account of Roonwal (1969) and of a number of others authors, may possibly affect the distribution of the bat fauna in this large tract, but no clear evidence of such effect has so far been brought forward.

The world bat fauna comprises 18 families, with some 168 genera. Of these, eight families are confined to the New World, seven to the Old World, and three are common to both the hemispheres. In Rajasthan, altogether seven families (four from the Old World group and three from the 'common' group) are found ; they contain 21 species (Fig. 22) which, in zoogeographical origin are partly Palaearctic (23.8%) and mainly Oriental (76.2%), as discussed below.

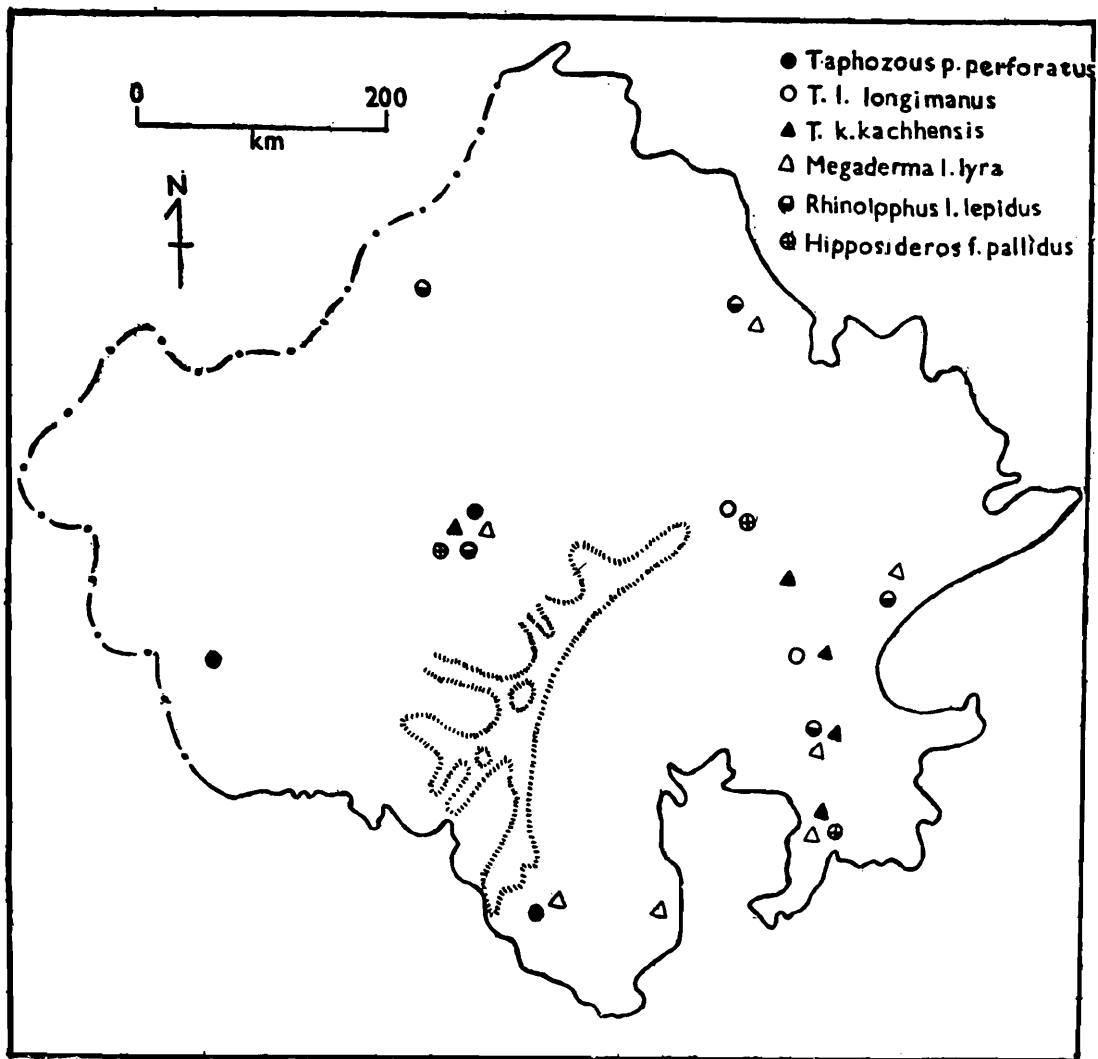
#### Family 1. PTEROPODIDAE

##### 1. Genus *Pteropus* Brission

This large genus is found in the Australian, Papuan, Oriental, Palaerctic (poor) and Malagassy regions, though most of its species are centred in Indonesia which is probably its place of origin whence it spread eastward to Australia and the Pacific Islands, north up to Japan (one species) and west as far as India. It is absent on the mainland of Africa but is present in Madagascar and a few other Indian Ocean Islands. As mentioned by Allen (1939), four species from Madagascar and Comoro Islands are related more to the Malayan fauna than to that of India and Sri Lanka. Allen was of the view that they either arrived in Madagascar as wind blown waifs from the east ; or populated this large island from Africa in early geological times and then become extinct on the African mainland. These conclusions are tentative, and the genus stands in need of revision.

The single Rajasthan species, *P. giganteus*, is widely distributed in India, Sri Lanka and Burma. In Rajasthan it occurs on both sides of the

Aravalli Hills, but not further west in the arid region. It is close to the Indo-Malayan species *P. vampyrus*.



Text-fig. 17.—Distribution of bat in Rajasthan.

## 2. Genus *Rousettus* Gray

This is a small genus of fruit bats with 9 species occurring in the Palaearctic, Ethiopian, Malagassy, Oriental, Australian and Papuan regions.

Its origin may be in the Oriental Region where it is widespread. The sole Rajasthan species, *R. leschenaulti* (absent in the western desertic portion) is widespread in India and Sri Lanka.

## 3. Genus *Cynopterus* F. Cuvier

This genus with three species is mainly Oriental in distribution which is probably its place of origin. The sole Rajasthan species, *C. sphinx*, is generally found in forested areas.

## Family 2. RHINOPOMATIDAE

## 4. Genus *Rhinopoma* Geoffroy

This is perhaps the most primitive genus among the Microchiroptera,

and contains only three species, *R. microphyllum*, *R. muscatellum* and *R. hardwickei*. It is widespread in the subtropics and the tropics (from Mauritania, across India and Burma to Sumatra). It avoids forests and is generally found in the drier areas. Both occur in Rajasthan on both sides of the Aravallis and also extend into the Indian Desert. In origin it is Saharan. *R. microphyllum* has three recognizable subspecies. Of the four present subspecies of *R. hardwickei*, three occur in Iran, Arabia, Palestine, Egypt and the Sudan and the fourth, *R. h. hardwickei*, in India, Burma and Thailand.

#### Family 3. EMBALLONURIDAE

##### 5. Genus *Taphozous* Geoffroy

This genus, with some 13 known species and numerous subspecies, is widespread : Palaearctic (2), Ethiopian (4), Oriental (4) and Australian (3). Over 54% of the species are centred in Indonesia where the genus probably originated.

Among three species of Rajasthan *T. perforatus* is African extending to India and *T. longimanus* and *T. kachhensis* are Oriental both in their modern distribution and probably also in origin. Among four subspecies of *T. longimanus*, three are found in Java, Borneo and Flores while the fourth *T. l. longimanus*, is found in India (including Rajasthan), Burma, Sri Lanka, Malayasia and Sumatra. Of three subspecies of *T. kachhensis*, two occur in India and Burma, and the third in Iraq.

#### Family 4. MEGADERMATIDAE

##### 6. Genus *Megaderma* F. Geoffroy

This genus, with two species (*M. spasma* and *M. lyra*) and numerous subspecies, is Oriental in modern distribution. *M. spasma*, the more primitive of the two, is widespread in Indo-Malaya (most of its subspecies centre there) which may be place of origin of the genus ; it does not occur in Rajasthan. *M. lyra*, the sole Rajasthan species, has two subspecies : *M. l. lyra* (all-India, Burma, Sri Lanka) and *M. l. sinensis* (Malaysia and S. China).

#### Family 5. RHINOLOPHIDAE

##### 7. Genus *Rhinolophus* Lacépède

This large genus, with some 69 species, is widespread in the following regions : Australian (8), Oriental (40), Ethiopian (19) and Palaearctic (2). Though the Australian species, *R. megaphyllus*, is the most primitive (in dentition, Andersen, 1905) the genus is, for a variety of reasons, not likely to have originated there. Andersen considered the Indo-Australian transitional tract (now broken up into numerous large and

small islands and still inhabit by many primitive forms) as its place of origin, but the genus seems to have originated in the Oriental region where its greatest concentration lies and whence it spread on the one side in the Australian and on the other to the African region.

The sole Rajasthan species, *R. lepidus*, is Oriental (India, Burma and Indo-China) in modern distribution and probably also in origin.

#### 8. Genus *Hipposideros* Gray

This large genus, with some 125 species and subspecies, is found in the following regions : Ethiopian (22), Malagassy (1), Oriental (76), Australian (23) and Papuan (3). Its place of origin is not clear but was probably Indo-Malaya where the genus is largely centred today. Hill (1963) gathered these forms into seven groups.

The sole Rajasthan species, *H. fulvus*, belongs to the *bicolor*-group (which has both Oriental and Ethiopian representatives) ; the Rajasthan species is exclusively Oriental. Of its two subspecies, *H. f. fulvus* is found in Sri Lanka, South India, West Bengal, Sikkim, Assam, Burma, Thailand and Vietnam, and *H. f. pallidus* in Central and Western India (including Rajasthan) and Pakistan (Baluchistan).

### Family 6. MOLOSSIDAE

#### 9. Genus *Tadarida* Rafinesque

This genus, with some 32 species, is widespread in the following regions : Neotropical (3), Nearctic (3), Oriental (4), Australian (9, including 2 which also occur in the Papuan region). Geologically, it first appeared in Oligocene (Blair, 1968). Its zoogeographical origin is not clear and was probably Australian. Species of the subgenus *Mormopterus* are distributed in Australia, Africa, Madagascar and South America, but are absent from India ; the South American species are related to the African, but the actual route of dispersal, which probably took place in the Tertiary times (Allen, 1939), is not clear.

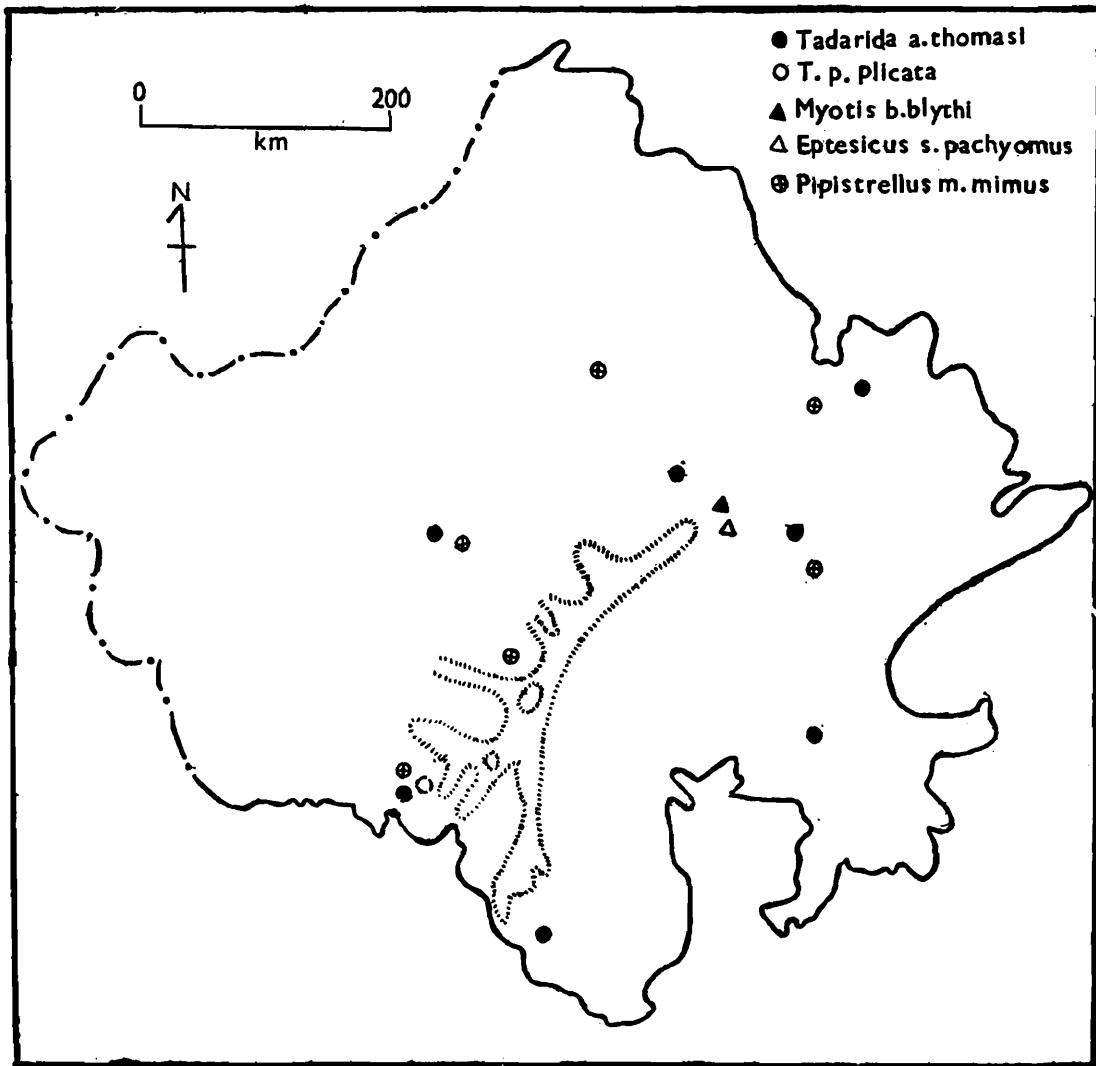
Two species, *T. aegyptiaca* and *T. plicata*, occur in Rajasthan. Of three recognised subspecies of *T. aegyptiaca*, *T. a. sindica* is found in Pakistan (Sind), *T. a. thomasi* in India (including Rajasthan) and *T. a. aegyptiaca* in Egypt. Among five subspecies of *T. plicata*, two are widely distributed in Oriental region and the rest are in Australian region.

### Family 7. VESPERTILIONIDAE

#### 10. Genus *Myotis* Kaup

This is the most primitive vespertilionid genus, and contains some

48 species. It arose early, its fossils being known from the Eocene and the Oligocene of France (Allen, 1939). In distribution it is widespread, almost cosmopolitan, and has been recorded from the following regions : Neotropical (2), Nearctic (13), Palaeartic (15), Ethiopian (8), Oriental (8) and Australian (2). The genus is cold-loving and most of its species are found in the Palearctic and the Nearctic regions. Its origin is Palaeartic (probably central Europe) from where it spread in both the hemispheres.



Text-fig. 18.—Distribution of bat in Rajasthan.

The sole Rajasthan species, *M. blythi*, is also Palearctic. Of its three subspecies, two are widespread in the Palaeartic region, while the third, *M. b. blythi* occurs in Eastern Rajasthan and Himachal Pradesh but is rare.

#### 11. Genus *Eptesicus* Rafinesque

Like the previous one, this genus, with about 30 species, is also cosmopolitan but it prefers a warm climate. It is found in the Neotropical, Nearctic, Palaeartic (rich), Ethiopian, Malagassy, Oriental and Australian regions. It is relatively recent in origin and first appeared in

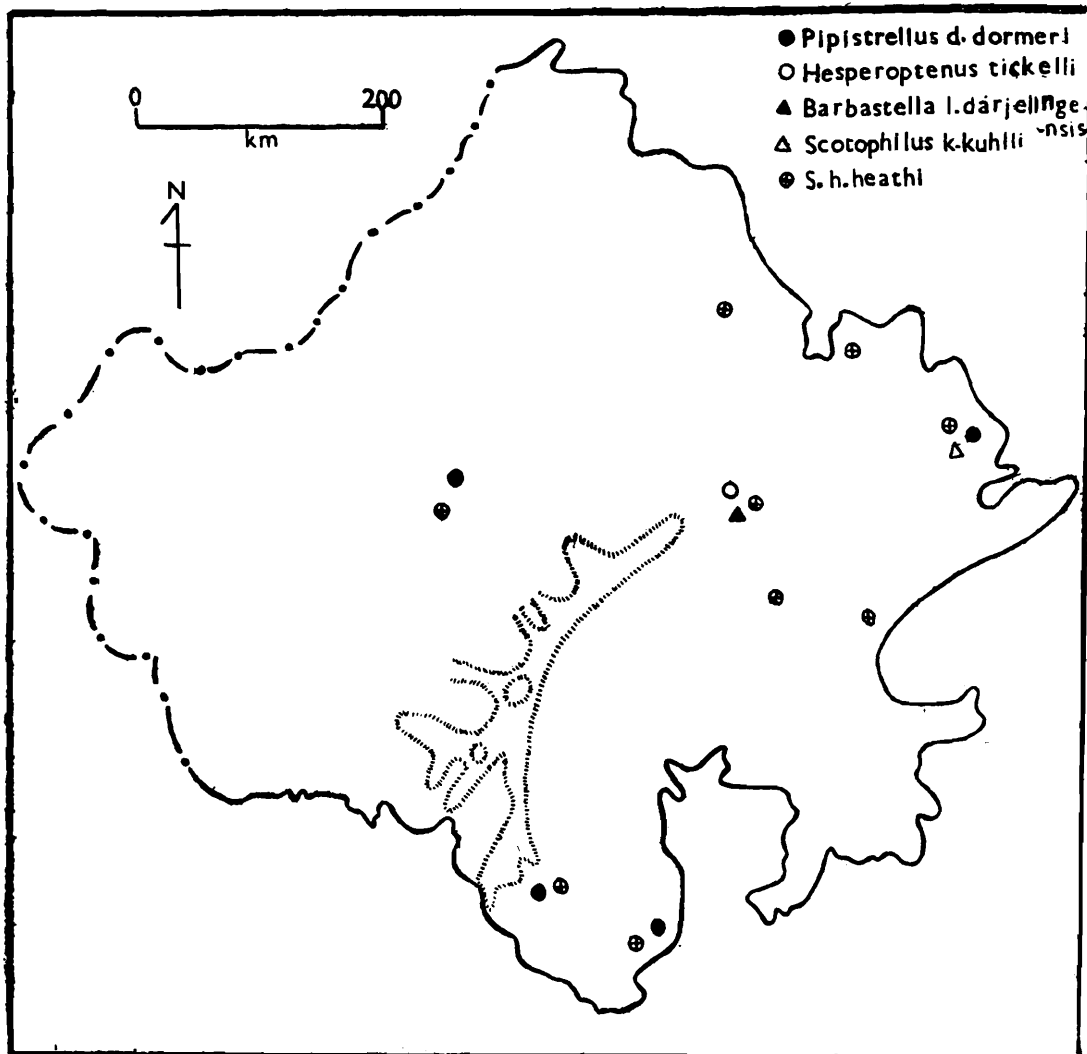


the Pleistocene (Blair, 1968). It probably arose in the Palaeartic region where it is best represented today.

The single Rajasthan species, *E. serotinus*, is mainly Palaeartic in modern distribution and probably also in origin ; of its 11 subspecies, 10 occur in the Palaeartic region (one *E.s. andersoni*, extends to the Oriental), and one, *E. s. pachyomus*, is found in northwestern India, including eastern Rajasthan.

## 12. Genus *Pipistrellus* Kaup

This genus, with some 40 species, cosmopolitan and prefers a warm climate ; it first appeared in the Pleistocene (Blair, 1968). It is found in the Nearctic, Palaeartic, Ethiopian, Malagassy, Oriental (rich) and



Text-fig.19.—Distribution of bat in Rajasthan.

Australian regions. It probably arose in the Oriental region (Indo-Malayan) where its greatest concentration today lies. The two Rajasthan species, *P. mimus* and *P. dormeri*, prefer wooded areas near thick human habitation, and both are exclusively Oriental.

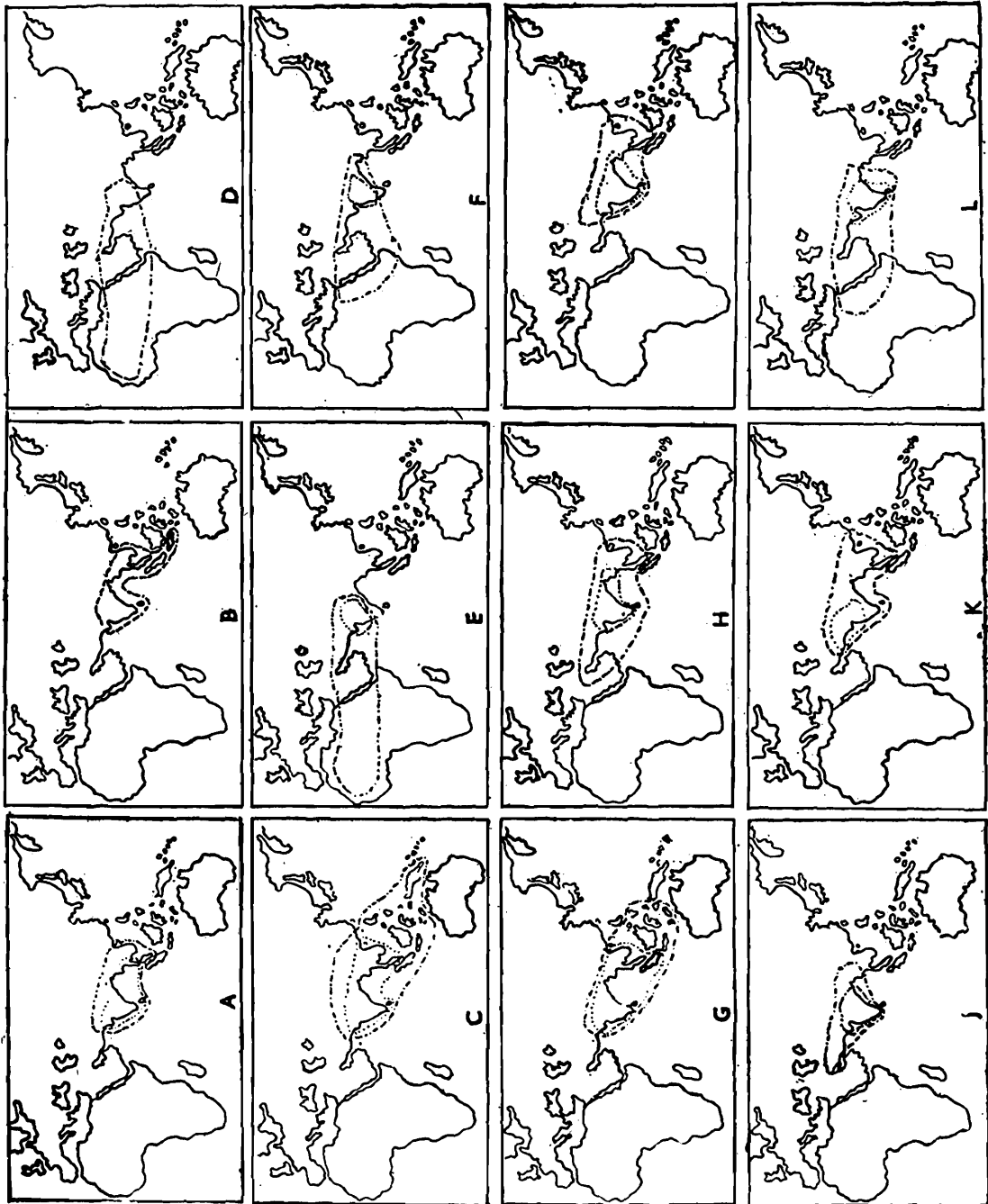
## 13. Genus *Hesperoptenus* Peters

This small genus, with four species, is today confined to the

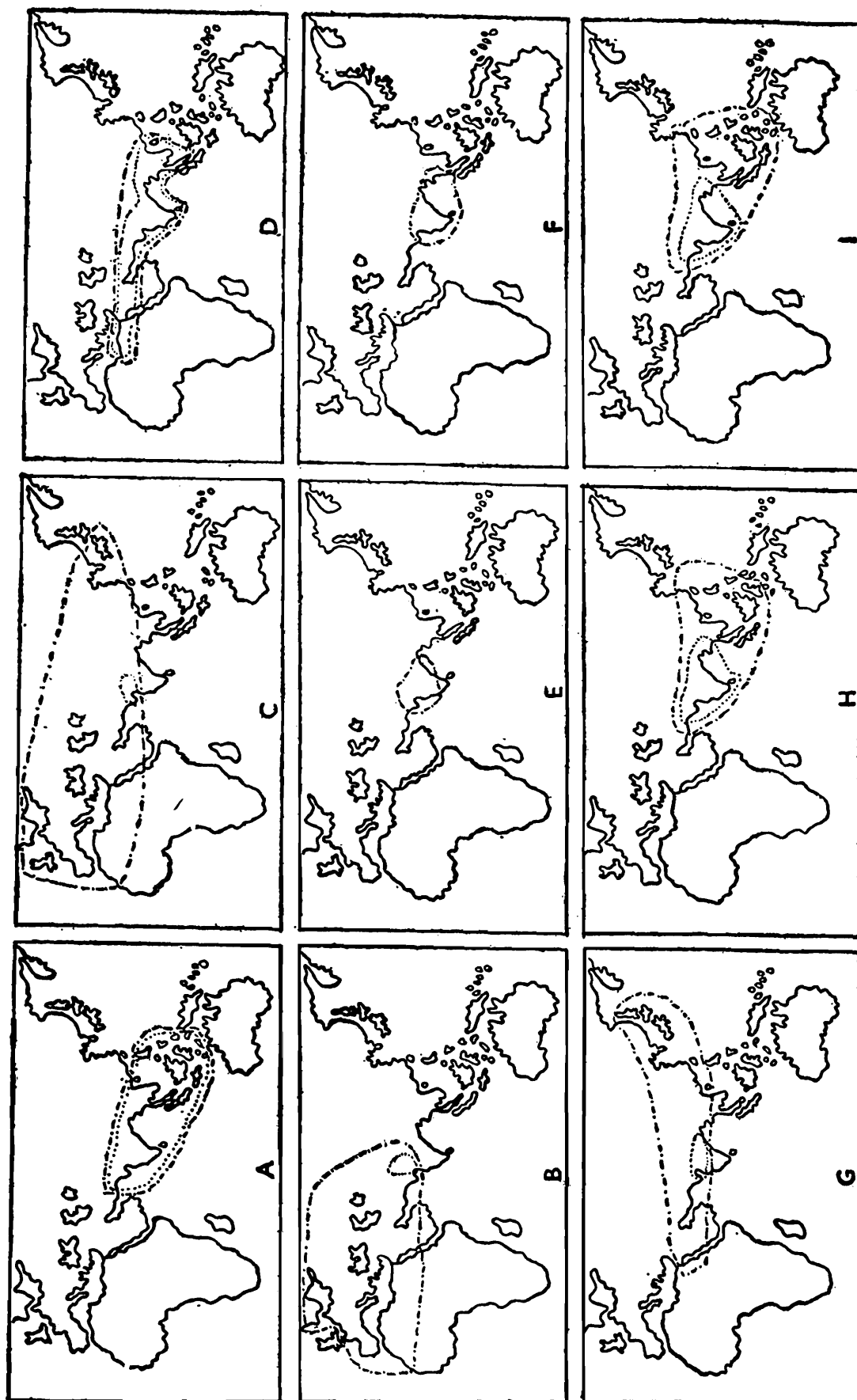
Oriental region which is probably its place of origin. The distribution is as follows :

*H. tickelli* : Eastern Rajasthan ; Peninsular India ; Burma ; Sri Lanka.

*H. blanfordi* : Southern Burma ( Tenasserim ) ; North Thailand Malay Peninsula.



Text-fig. 20. Full distribution of species (dots and dashes) and subspecies (dotted line) of bats of Rajasthan : (A) *pteropus giganteus giganteus* (Brünnich). (B) *Rousettus leschenaulti* (Desmarest). (C) *Cynopterus sphinx sphinx* (Vahl). (D) *Rhinopoma microphyllum kinneari* Wroughton. (E) *Rhinopoma hardwickei hardwickei* Gray. (F) *Taphozous perforatus perforatus* E. Geoffroy. (G) *Taphozous longimanus longimanus* Hardwicke. (H) *Taphozous kachhensis kachhensis* Dobson. (I) *Megaderma lyra lyra* Geoffroy. (J) *Rhinolophus lepidus lepidus* Blyth. (K) *Hipposideros fulvus pallidus* Andersen. (L) *Tadarida aegyptiaca thomasi* Wroughton.



Text-fig. 21. : Full distribution of species (dots and dashes) and subspecies (dotted line) of bats of Rajasthan : (A) *Tadarida plicata plicata* (Buchanan). (B) *Myotis blythi blythi* Tomes. (C) *Eptesicus serotinus pachyomus* Tomes. (D) *Pipistrellus mimus mimus* Wroughton. (E) *Pipistrellus dormeri* (Dobson). (F) *Hesperoptenus tickelli* (Blyth). (G) *Barbastella leucomelas darjelingensis* Hodgson. (H) *Scotophilus kuhlii kuhlii* Leach. (I) *Scotophilus heathi heathi* (Horsfield).

*H. tomesi* : Malay Peninsula and Borneo.

*H. doriae* : Malaya and Borneo.

#### 14. Genus *Barbastella* Gray

This Palearctic genus has two species of which one extends to the Oriental region. It probably arose in the north and migrated south to India. The sole Rajasthan species contains two subspecies : *B. l. leucomelas* is Palearctic, and *B. l. darjelingensis* Oriental (including Rajasthan).

#### 15. Genus *Scotophilus* Leach

This genus contains only three recognised species, 1 Ethiopian and 2 Oriental (of the latter, one extends east to the Celebes). It probably arose in the Oriental region. The two Rajasthan species are *S. kuhlii* (= *S. temmincki*) and *S. heathi*. Of the 4 subspecies of *S. kuhlii* (= *S. temmincki*), 3 occur in Indo-Malaya, the fourth, *S. k. kuhlii* in Pakistan, India (including eastern Rajasthan), Burma and Sri Lanka. *S. heathi* contains three subspecies, of which two occur in Hainan Island and Celebes, while the third, *S. h. heathi*, occurs in India (including Rajasthan), Burma and Sri Lanka.

### (b) Discussion

#### *Zoogeographical composition*

From the above analysis, it will be seen that the 21 Rajasthan bats are composed of two zoogeographical elements, viz., the Oriental (15 species or 76.2%) and the Palearctic (6 species or 23.8%). No species is endemic to Rajasthan. Twelve out of 21 species occur in the desert portion of Rajasthan ; among them 9 (75%) are Oriental, and 3 (25%) Palearctic. Earlier, Prakash (1963, 1973), on more restricted material (9 or 10 species), had given a higher proportion of the Palearctic element (36-40%).

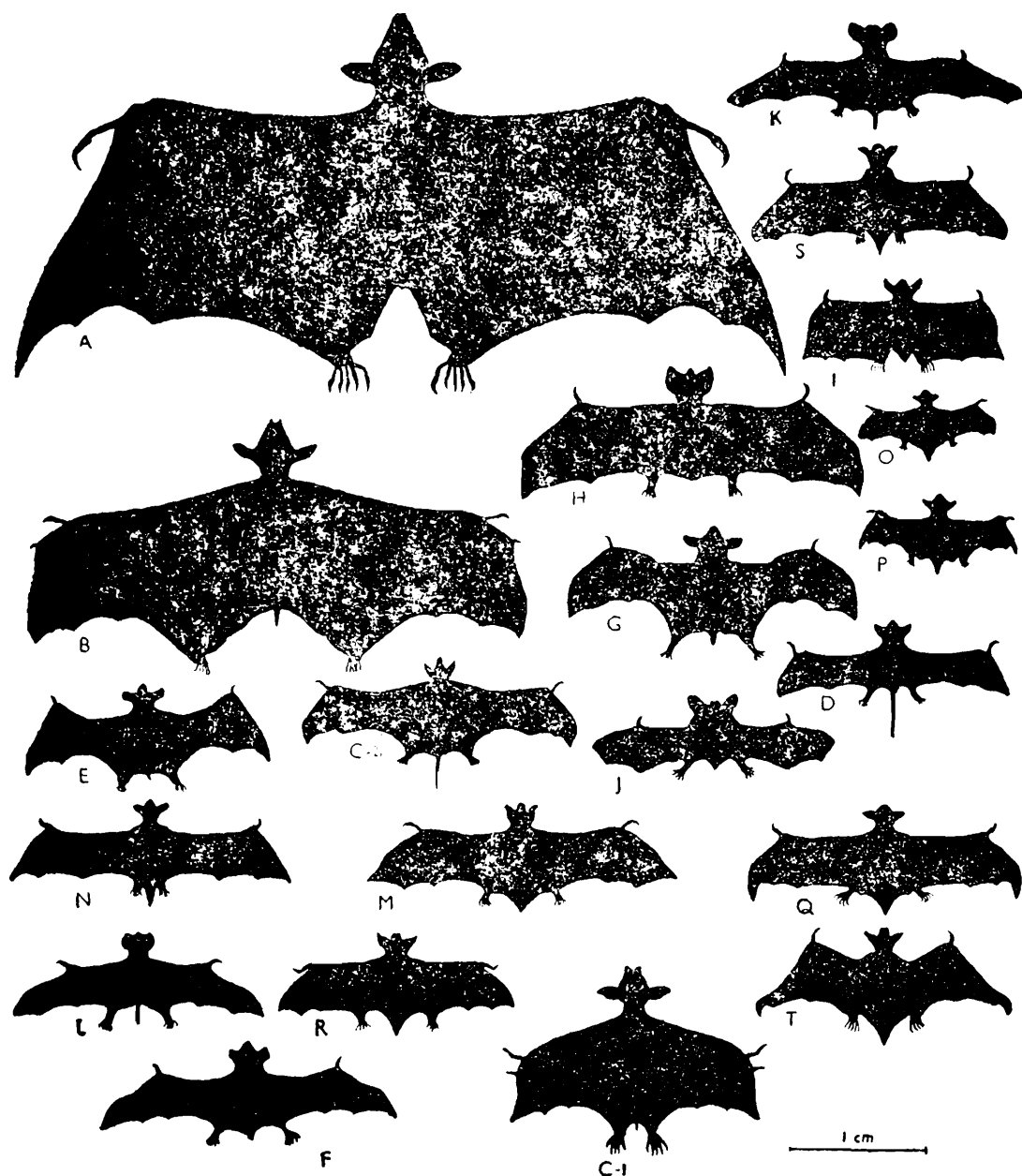
From the above analysis it may also be concluded that a number of Rajasthan genera are, chiefly Oriental and to a much lesser extent Palearctic.

### SUMMARY

1. This paper gives briefly taxonomic characters of the external body parts and skull of 21 species and subspecies of Rajasthan bats belonging to the following seven families :—Pteropodidae, Rhinopomatidae, Emballonuridae, Magadermatidae, Rhinolophidae, Molossidae and Vespertilionidae.

2. Variations in colour of fur, dentition and measurements of external parts as well as skull are discussed.

3. A synoptic key to Rajasthan bats is given.



**Text-fig. 22.**—Silhouettes of Rajasthan bats, showing size variation etc. (A) *Pteropus giganteus giganteus* (Brünnich). (B) *Rousettus leschenaulti* (Desmarest). (C<sub>1</sub>) *Cynopterus sphinx sphinx* (Vahl) (C<sub>2</sub>) *Rhinopoma microphyllum kinneari* Wroughton. (D) *Rhinopoma hardwickei hardwickei* Gray. (E) *Taphozous perforatus* E. Geoffroy. (F) *Taphozous longimanus longimanus* Hardwicke. (G) *Taphozous kachhensis kachhensis* Dobson. (H) *Megaderma lyra lyra* Geoffroy. (I) *Rhinolophus lepidus lepidus* Blyth. (J) *Hipposideros fulvus pallidus* Andersen. (K) *Tadarida aegyptiaca thomasi* Wroughton. (L) *Tadarida plicata plicata* (Buchanan). (M) *Myotis blythi blythi* Tomes. (N) *Eptesicus serotinus pachyomus* Tomes. (O) *Pipistrellus minus mimus* Wroughton. (P) *Pipistrellus dormeri* (Dobson). (Q) *Hesperoptenus tickelli* (Blyth). (R) *Barbastella leucomelas darjelingensis* Hodgson (S) *Scotophilus kuhlii kuhlii* Leach. (T) *Scotophilus heathi heathi* (Horsfield).

4. The taxonomic status of *Pipistrellus mimus glaucillus* Wroughton has been discussed and it has been synonymised with *Pipistrellus mimus mimus* Wroughton.

5. Three species *Cynopterus sphinx sphinx* (Vahl), *Taphozous longimanus longimanus* Hardwicke and *Scotophilus kuhlii kuhlii* Leach (= *Scotophilus temmincki wroughtoni* Thomas), has been recorded for the first time from Rajasthan. The range of thirteen other species in Rajasthan has been considerably extended.

6. The zoogeography of Rajasthan bats is discussed. It is concluded that the Rajasthan genera are largely Oriental and to a lesser extent Palaearctic. From the point of view of the present day distribution of species the Oriental element is 76.2% and the Palaearctic 23.8%.

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## ABBREVIATIONS USED IN FIGURES

## 1. EXTERNAL BODY-PARTS

<i>an.</i> , anus	<i>v.</i> , vagina
<i>a. nl.</i> , anterior noseleaf	<i>w. m.</i> , wing membrane
<i>a. m.</i> , ante-brachial membrane	
<i>at.</i> , anti-tragus	<i>SKULL</i>
<i>cal.</i> , calcar	<i>i1</i> , first incisor
<i>c. nl.</i> , central noseleaf	<i>i2</i> , second incisor
<i>cl.</i> , claw	<i>c.</i> , canine
<i>d2</i> , second digit	<i>pm1</i> , first premolar
<i>d3</i> , third digit	<i>pm2</i> , second premolar
<i>d4</i> , fourth digit	<i>m1-m4</i> , first to fourth molar
<i>d5</i> , fifth digit	1, nasal
<i>e.</i> , ear	1a, nasal sulcus
<i>ey.</i> , eye	2, premaxilla
<i>ey. p.</i> , eye pit	3, infraorbital canal
<i>f. a.</i> , forearm	4, lachrymal foramen
<i>fe.</i> , femur	5, frontal
<i>fr. d.</i> , frontal depression of head	6, frontal depression
<i>fr. s.</i> , frontal sac	7, postorbital process
<i>ft.</i> , foot	7a, postorbital canal
<i>g. s.</i> , gular sac	8, maxilla
<i>h.</i> , head	9, parietal
<i>ho.</i> , hollow of posterior noseleaf	10, parietal crest
<i>hu.</i> , humerus	11, Zygomatic process (of maxilla)
<i>i. m.</i> , interfemoral membrane	12, squamosal
<i>m.</i> , muzzle	13, supraoccipital
<i>mn. g.</i> , mental groove	14, supraoccipital crest
<i>mo.</i> , mouth	15, zygomatic process (complete)
<i>mt.</i> , metacarpal	16, palatine
<i>n.</i> , nose	17, basisphenoid
<i>nl.</i> , noseleaf	18, basisphenoidal pit
<i>no.</i> , nostril	19, pterygoid
<i>p.</i> , pollex	20, auditory orifice
<i>pen.</i> , penis	21, orbitosphenoid
<i>ph1.</i> , first phalanx	22, paroccipital process
<i>ph2.</i> , second phalanx	23, tympanic bulla
<i>p. nl.</i> , posterior noseleaf	24, mastoid
<i>pt. d.</i> , pectoral depression	25, hamular process (of pterygoid)
<i>rm. p.</i> , radio-metacarpal pouch	26, alisphenoid
<i>t.</i> , tibia	27, foramen magnum
<i>te.</i> , teeth	28, occipital condyle
<i>t.h.</i> , tuft of hair in frontal sac	29, basioccipital
<i>tl.</i> , tail	30, exoccipital
<i>tr.</i> , tragus	31, coronoid process of mandible
<i>to.</i> , tongue	32, condyle of mandible
	33, angular process of mandible