CHAPTER 3

CHARACTERIZATION OF SUPRACORACOIDEUS MUSCLES OF BIRDS

A characterization of the pectoralis, the most powerful adductor muscle of the wing in a number of different birds, was presented in the previous chapter. The characterization was based on the nature of the fibres, red (R), white (W) and intermediate (I) on the basis of their morphological (diameter) and biochemical properties. In all the supracoracoideus muscles examined, except that of the Hummingbird which was stained for fat, succinic dehydrogenase activity their intensity and localization in the fibres formed the basis for the characterization of the muscle. On studying the relative distribution of the fibre types in the muscle, it became possible to characterize the muscle in the various birds into six groups.

In the present study, the supracoracoideus, the principal elevator of the wing has been studied along the same lines as was done in the case of the pectoralis.

MATERIALS AND METHODS

The supracoracoideus muscles of a large number of birds (listed in Table 1) were studied. The procedure was exactly the same as was followed in the previous chapter.

RESULTS AND DISCUSSION

On the basis of the fibre diameter and the intensity of succinic dehydrogenase activity (except in the case of Hummingbird muscle which was stained with Sudan Black B for fat) of the

component fibres, the supracoracoideus muscle could be characterized under the following nine Groups:

1. Fowl type (W, I and R fibres)
2. Kite type (W and I fibres)
3. Hawk type (W, R and I fibres)
4. Owl type (R, W and I fibres)
5. Pigeon type (R, I and W fibres)
6. Egret type (R and W fibres)
7. Swift type (I and R fibres)
8. Sparrow type (R and I fibres)
9. Hummingbird type (R fibres)

The fibre types mentioned in parentheses are listed in the order of predominance in each case. The various types of the supracoracoideus muscle are shown in figures 1 to 35 and the quantitative data on the diameter and distribution of the different fibre types are given in Table 1.

Group 1.

The supracoracoideus of the Domestic Fowl and that of Guinea Fowl (Figs. 1 & 2) come under this group which contains all the three types of fibres W, I & R in the order of predominance (Table 1). The pectoralis in these birds also has the same fibre composition.

Group 2.

The muscles of the Pariah Kite and the Indian Whitebacked Vulture (Figs. 3 & 4) come under this group. The supracoracoideus muscle in these birds consists of W and I fibres instead of only I fibres as in their pectoralis.

Group 3.

The fibre composition of the muscle in the Shikra is W, R and I fibre types which is a reversal of the fibre composition of the pectoralis (I, R & W) of the same bird (Fig. 5). In the same group is included the supracoracoideus of the White-breasted Kingfisher (Halcyon smyrnensis) whose pectoralis has only R and I fibres (Fig. 6).

Group 4.

The Domestic Duck, Great Horned Owl (Bubo bubo), Spotted Owlet (Athene brama) and Crow-Pheasant (Centropus sinensis) have similar fibre composition (R, W & I) in their supracoracoideus muscles (Figs. 7 to 9). With respect to the pectoralis muscles, the Pariah Kite, Indian Whitebacked Vulture, Shikra, Great Horned Owl, Spotted Owlet and the Crow-Pheasant were all placed under one group in which I fibres predominated. All fibres appeared circular in cross section and were loosely packed, a characteristic attributed to the soaring and gliding mode of flight. Although the same characteristic is shared by the fibres of the supracoracoideus, yet the fibre composition differs.

Group 5.

The supracoracoideus muscles of this group has the fibre composition R, I and W. The following birds are a few examples (Figs. 10 to 18).

Blue Rock Pigeon (Columba livia)

Hoopoe (Upupa epops)

Redvented Bulbul (Pycnonotus cafer)

Jungle Babbler (Turdoides striatus)

Indian Robin (Saxicoloides fulicata)

Redwattled Lapwing (Vanellus indicus)

Brahminy Duck (Tadorna ferruginea)

Large Whistling Teal (Dendrocygna bicolor)

Cotton Teal (Nettapus coromandelianus)

The pectoralis in the Hoopoe, Brahminy Duck, Large Whistling Teal and Cotton Teal are similar to that in the pigeon in having R and W fibres. But in the other birds the pectoralis muscle consists of R and I fibres.

Group 6.

The fibre composition in this group is R and W eg. Cattle Egret (Bubulcus ibis), Purple Moorhen (Porphyrio porphyrio), Koel (Eudynamys scolopacea) (Figs. 19 to 21). It is interesting that the pectoralis and supracoracoideus muscles of this group have an identical fibre composition of R and W fibres.

Group 7.

The supracoracoideus of the House Swift (Apus affinis) and of other birds such as the Green Bee-eater (Merops orientalis) Crimsonbreasted Barbet (Megalaima haemacephala) and Whitebellied Drongo (Dicrurus caerulescens) having I and R fibres, fall under this group (Figs. 23 to 25). Of these, the Crimsonbreasted Barbet is the only bird that has R fibres only in its pectoralis while the other birds have R and I fibres instead.

Group 8.

In the majority of the passerine birds studied, the supracoracoideus muscle has the fibre composition R and I (Figs. 26 to 34) eg.

Roseringed Parakeet (Psittacula krameri)

Rosy Pastor (Sturnus roseus)

Common Myna (Acridotheres tristis)

Brahminy Myna (Sturnus pagodarum)

Bank Myna (Acridotheres ginginianus)

House Crow (Corvus splendens)

Jungle Crow (Corvus macrorhynchos)

Yellowheaded Wagtail (Motacilla citreola)

Tailor Bird (Orthotomus sutorius)

Purple Sunbird (Nectarinia asiatica)

House Sparrow (Passer domesticus)

Of these, the first eight birds have R & I fibres in the pectoralis also, whereas in the remaining ones, there are only R fibres.

Group 9.

The only example of the supracoracoideus muscle consisting of only the R fibres so far investigated, under this group is that of the Rubythroated Hummingbird (Archilochus colubris) (Fig. 35). Both the pectoralis and supracoracoideus having only the R fibres is a unique characteristic in the Hummingbird.

Salt (1963) studied the nature of the fibres and their distribution in the supracoracoideus muscles in a number of passerine birds by staining for fat. He distinguished dark and pale fibres corresponding to the R and I fibres of the present study. The supracoracoideus muscle of the Hummingbird was also examined

by him and his findings were confirmed in that it consists of only one type (R) fibres. This shows that unlike in other birds, both the pectoralis and supracoracoideus muscles in the Hummingbird are equally developed and powerful as an adaptation for the hovering mode of flight.

TABLE 1

DIAMETER OF THE FIBRES IN MICRONS AND THE PROPORTIONS OF THE FIBRE TYPES IN PERCENTAGE IN THE SUPRACORACOIDEUS MUSCLES OF BIRDS

Names of birds	Fibre diameter and fibre distribution		
Group 1.	(W)	(I)	(R)
Domestic Fowl (Phasianidae)	95.0(59.2)	75.0(24.5)	55.0(16.3)
Guinea Fowl (Numididae)	96.0(57.2)	80.0(23.2)	55.0(19.6)
Group 2.	(W)	(I)	
Pariah Kite, Milvus migrans (Accipitridae)	70.0(54.5)	45.0(44.5)	
Indian Whitebacked Vulture, Gyps bengalensis (Accipitridae)	74.0(52.0)	60.0(48.0)	
Group 3.	(W)	(R)	(I)
Shikra (Hawk), Accipiter badius (Accipitridae)	95.0(43.6)	60.0(37.2)	80.0(19.2)
Whitebreasted Kingfisher, Halcyon smyrnensis (Alcedinidae)	60.0(44.5)	42.5(31.8)	54.0(23.7)

Names of birds	Fibre diameter and fibre distribution		
Group 4.	(R)	(W)	(I)
Great Horned Owl, Bubo bubo (Strigidae)	55.0(39.6)	90.2(37.7)	80.0(22.7)
Spotted Owlet, Athene brama (Strigidae)	45.0(40.6)	92.0(31.4)	60.5(28.0)
Crow-Pheasant, Centropus sinensis (Cuculidae)	42.5(42.0)	72.5(38.7)	60.0(19.3)
Domestic Duck (Anatidae)	42.0(48.3)	94.0(29.3)	75.0(22.4)
Group 5.	(R)	(I)	(W)
Blue Rock Pigeon, Columba livia (Columbidae)	35.0(59.2)	52.0(28.0)	80.0(12.8)
Hoopoe, Upupa epops (Upupidae)	30.0(46.3)	41.0(29.1)	85.0(23.6)
Redvented Bulbul, Pycnonotus cafer (Pycnonotidae)	40.0(40.0)	55.0(37.5)	70.0(22.5)
Jungle Babbler, Turdoides striatus (Muscicapidae)	38.5(42,5)	60.0(34.3)	75.0(23.2)
Indian Robin, Saxicoloides fulicata (Muscicapidae)	40.0(47.0)	51,0(37.8)	62.5(15.2)
Redwattled Lapwing, Vanellus indicus (Charadridae)	35.0(50.0)	45.0(31.5)	62.5(18.5)
Brahminy Duck, Tadorna ferruginea (Anatidae)	35.0(54.0)	50.0(26.0)	70.0(20.0)

Names of birds	Fibre diameter and fibre distribution		
Large Whistling Teal, Dendrocygna bicolor (Anatidae)	40.0(46.7)	60.0(30.0)	80.0(23.3)
Cotton Teal, Nettapus coromandelianus (Anatidae)	36.2(57.7)	53.0(28.3)	78.0(14.0)
Group 6.	(R)	(W)	
Cattle Egret, Bubulcus ibis (Ardeidae)	47.0(69.8)	80.0(30.2)	
Purple Moorhen, Porphyrio porphyrio (Rallidae)	50.0(52.1)	92.5(47.9)	
Koel, Eudynamys scolopacea (Cuculidae)	55.0(61.7)	95.0(38.3)	
Group 7.	(I)	(R)	
House Swift, Apus affinis (Apodidae)	50.0(57.5)	39.0(42.5)	
Green-Bee-eater, Merops orientalis (Meropidae)	55.0(55.5)	35.0(44.5)	
Whitebellied Drongo, Dicrurus caerulescens (Dicruridae)	55.0(56.2)	42.0(43.8)	
Crimsonbreasted Barbet, Megalaima haemacephala (Capitonidae)	65.0(58.0)	45.0(42.0)	

Names of birds	Fibre diameter and fibre distribution	
Group 8.	(R)	(I)
Roseringed Parakeet, Psittacula krameri (Psittacidae)	45.0(75.2)	52.5(24.8)
Rosy Pastor, Sturnus roseus (Sturnidae)	37.0(55.5)	75.0(44.5)
Common Myna, Acridotheres tristis (Sturnidae)	50.0(52.7)	65.0(47.3)
Brahminy Myna, Sturnus pagodarum (Sturnidae)	37.5(52.6)	55.0(47.4)
Bank Myna, Acridotheres ginginianus (Sturnidae)	42.5(55.7)	47.5(44.3)
House Crow, Corvus splendens (Corvidae)	44.0(58.5)	65.0(41.2)
Jungle Crow, Corvus macrorhynchos (Corvidae)	35.0(56.5)	70.0(43.5)
Yellowheaded Wagtail, Motacilla citreola (Motacillidae)	40.0(52.9)	60.0(47.1)
Tailor Bird, Orthotomus sutorius (Muscicapidae)	45.0(65.9)	70.0(34.1)
Purple Sunbird, Nectarinia asiatica (Nectariniidae)	39.0(63.1)	58.0(36.9)
House Sparrow, Passer domesticus (Ploceidae)	42.0(63.6)	56.0(36.4)

Names of birds	Fibre diameter and fibre distribution
Group 9.	(R)
Rubythroated Hummingbird, *Archilochus colubris* (Trochilidae)	22.5(100)

* Figures in parentheses denote the respective percentage of the fibre types.

Figures 1 to 34.

Photomicrographs of the T. S. of the Supracoracoideus muscles of various birds showing the mitochondrial localization of succinic dehydrogenase activity.

Figure 35.

Photomicrograph of the T. S. of the Supracoracoideus muscle of the Rubythroated Hummingbird (Archilochus colubris) stained for fat.

W ... White fibre type

I ... Intermediate fibre type

R ... Red fibre type

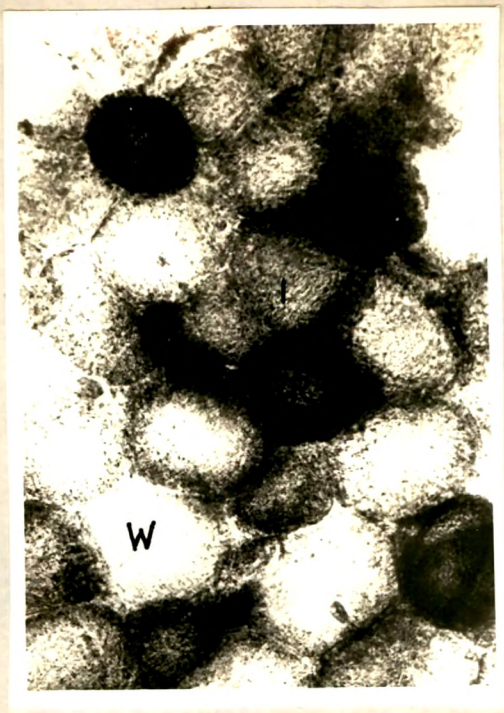

Fig. 1.
Domestic Fowl X 144.

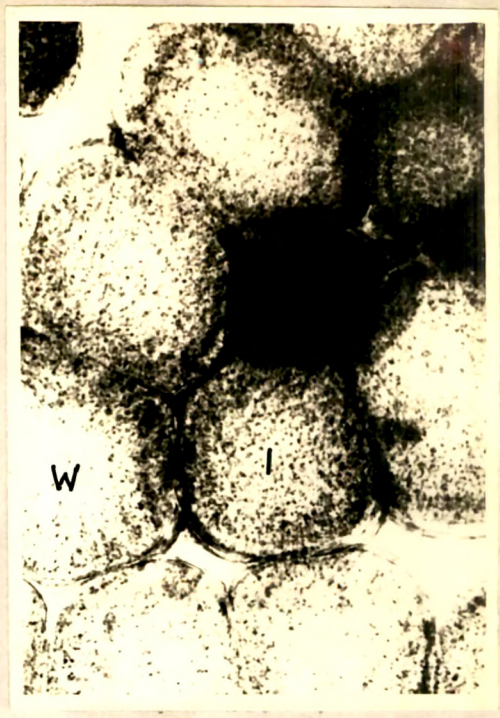

Fig. 2.
Guinea Fowl X 288.

Fig. 3.
Pariah Kite
(Milvus migrans) X 376.

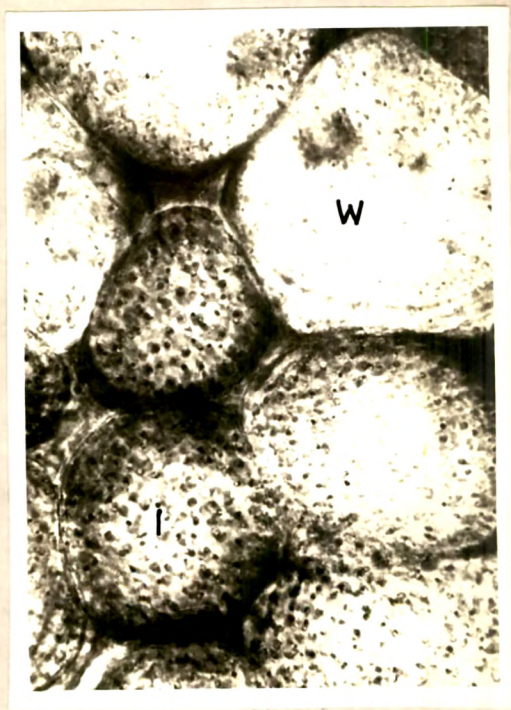

Fig. 4.
Indian Whitebacked Vulture
(Gyps bengalensis) X 376.

Fig. 5.
Shikra
(Accipiter badius) X 216.

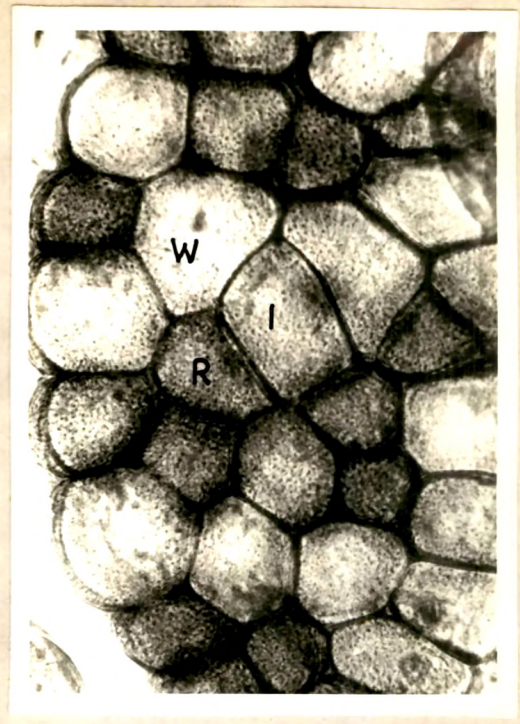

Fig. 6.
Whitebreasted Kingfisher
(Halcyon smyrnensis) X 216.

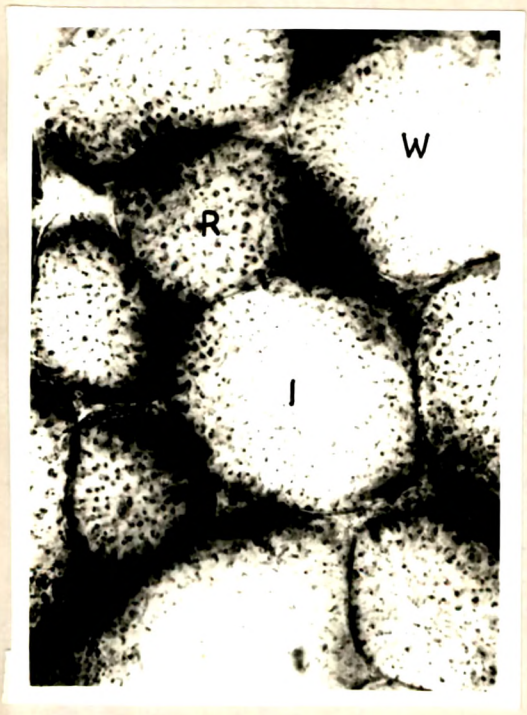

Fig. 7.
Spotted Owlet
(Athene brama) X 376.

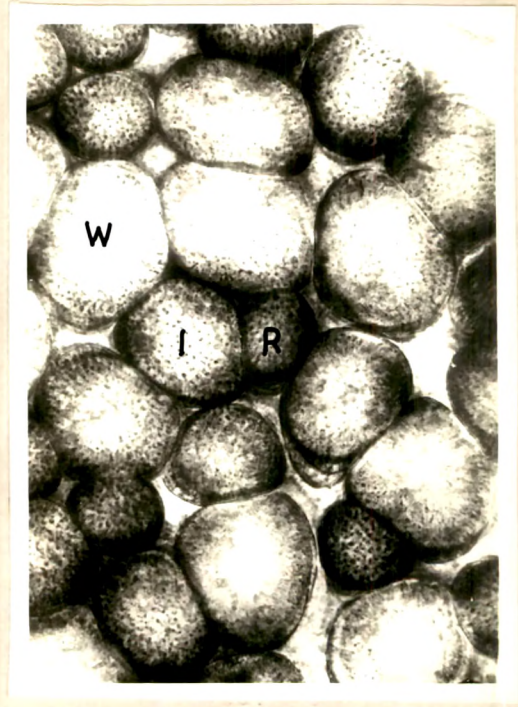

Fig. 8.
Crow-Pheasant
(Centropus sinensis) X 216.

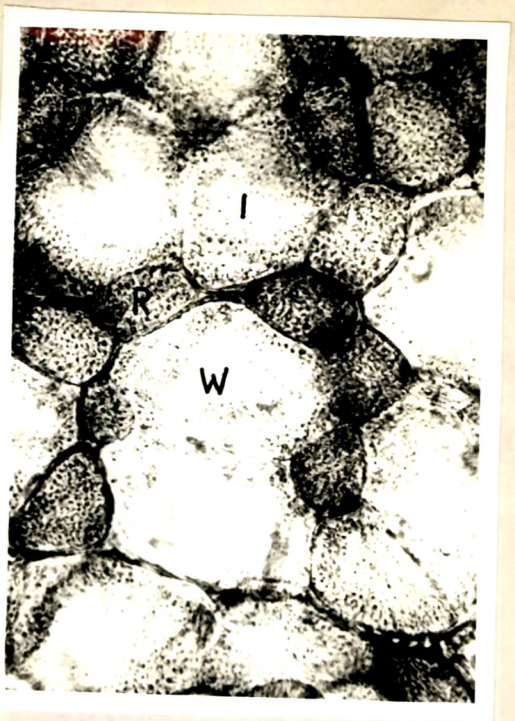

Fig. 9.
Domestic Duck X 216.

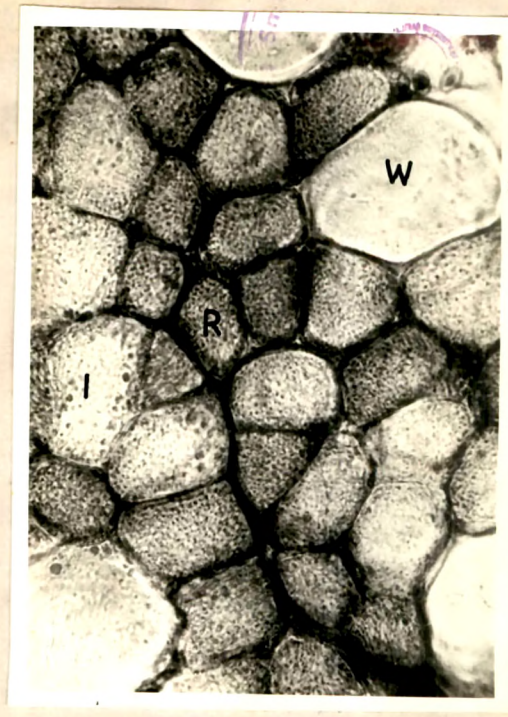

Fig. 10.
Blue Rock Pigeon
(Columba livia) X 216.

Fig. 11.
Hoopoe
(Upupa epops) X 376.

Fig. 12.
Redvented Bulbul
(Pycnonotus cafer) X 376.

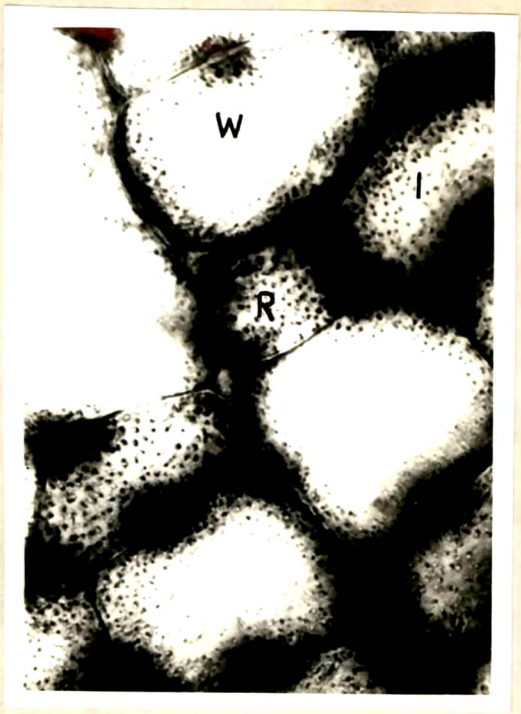

Fig. 13.
Jungle Babbler
(Turdoides striatus) X 376.

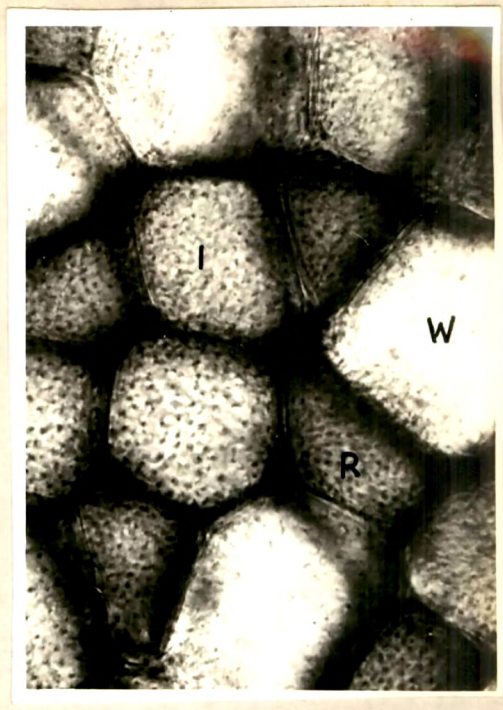

Fig. 14.
Indian Robin
(Saxicoloides fulicata) X 376.

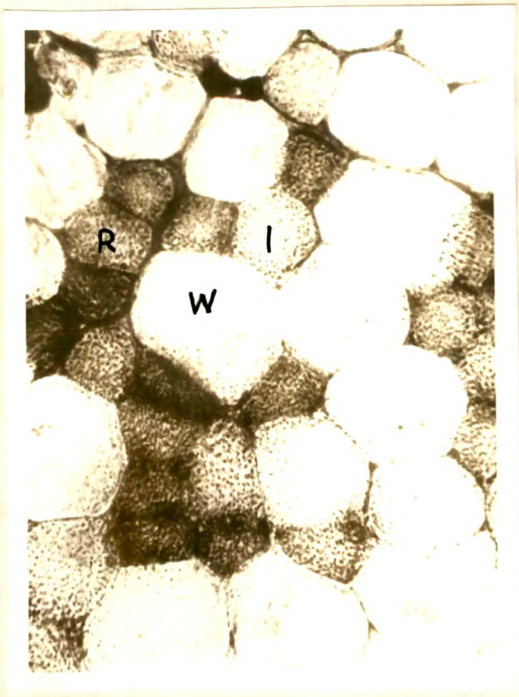

Fig. 15.
Redwattled Lapwing
(Vanellus indicus) X 216.

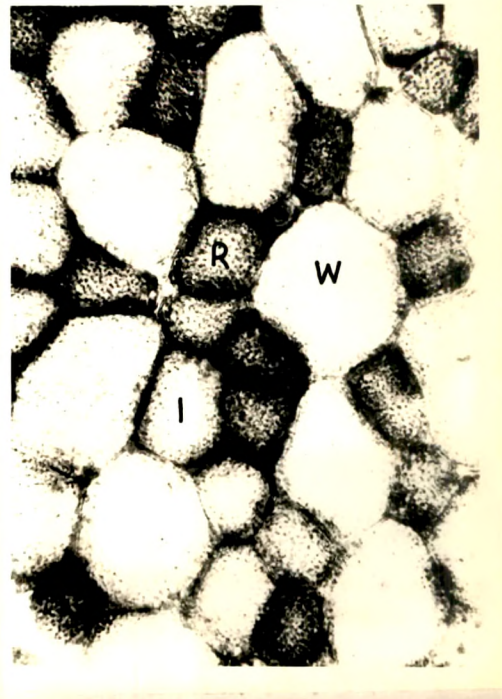

Fig. 16.
Brahminy Duck
(Tadorna ferruginea) X 216.

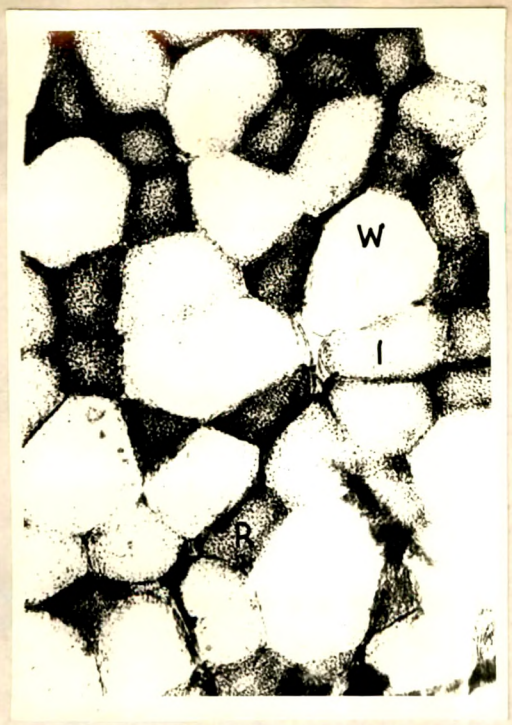

Fig. 17.
Large Whistling Teal
(Dendrocygna bicolor) X 216.

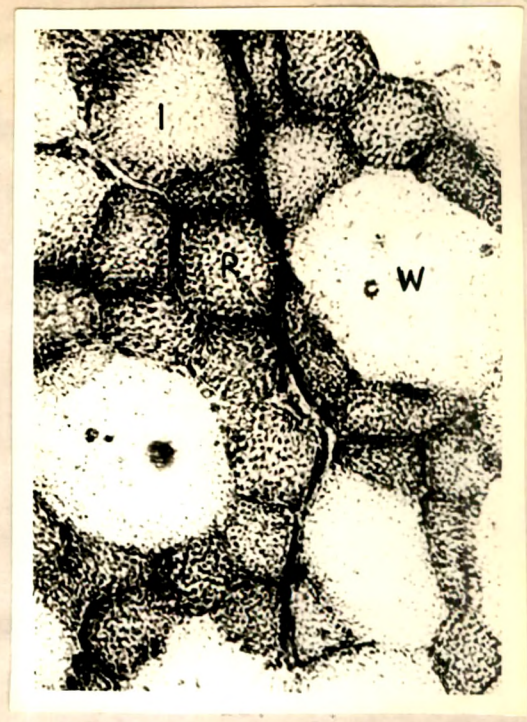

Fig. 18.
Cotton Teal
(Nettapus coramandelianus) X 288.

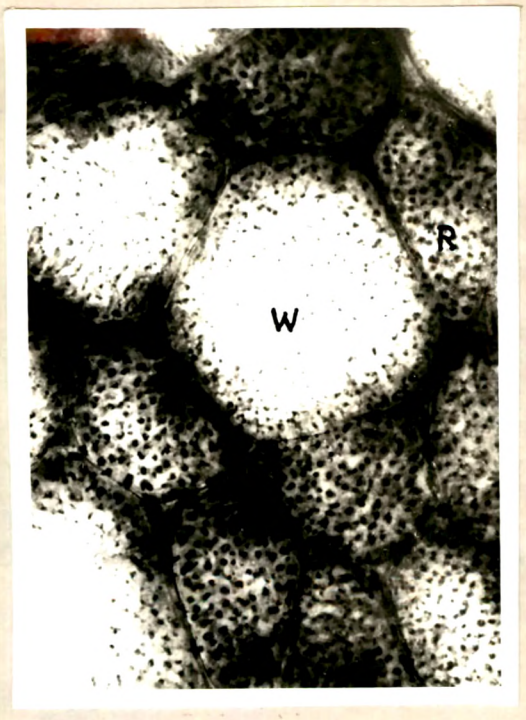

Fig. 19.
Cattle Egret
(Bubulcus ibis) X 376.

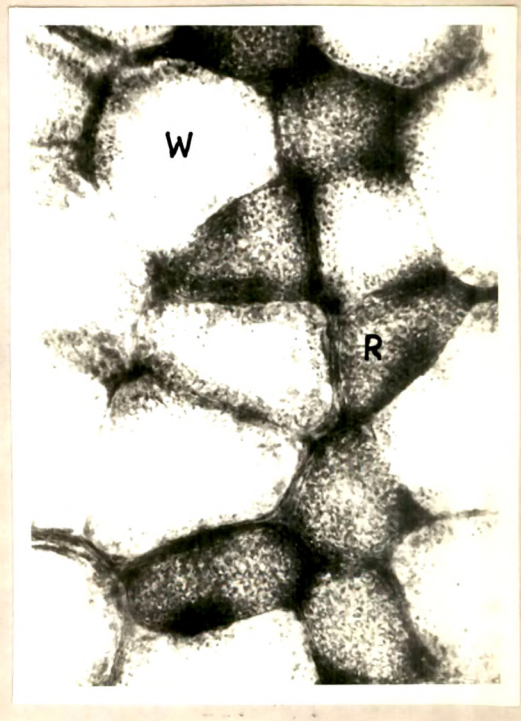

Fig. 20.
Purple Moorhen
(Porphyrio porphyrio) X 216.

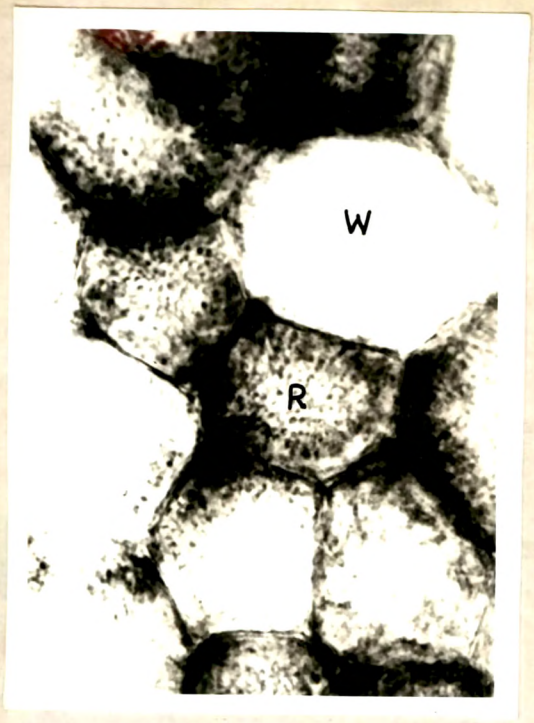

Fig. 21.
Koel
(Eudynamys scolopacea) X 376.

Fig. 22.
House Swift
(Apus affinis) X 376.

Fig. 23.
Green Bee-eater
(Merops orientalis) X 520.

Fig. 24.
Whitebellied Drongo
(Dicrurus caerulescens) X 376.

Fig. 25.
Crimsonbreasted Barbet
(Megalaima haemacephala) X 376.

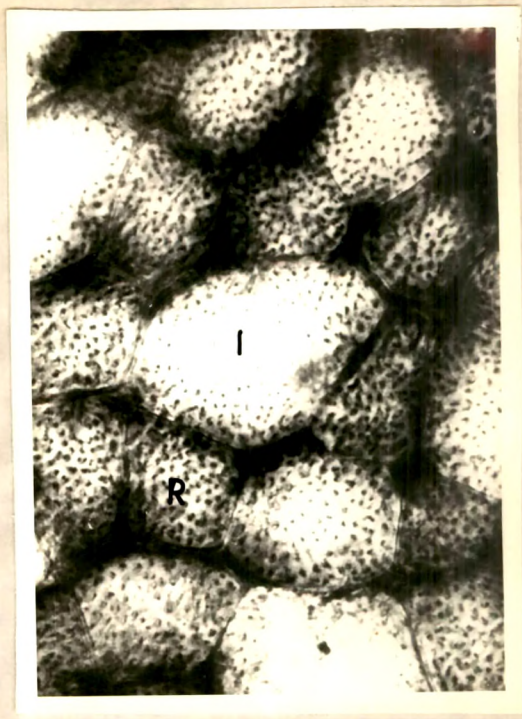

Fig. 26.
Roseringed Parakeet
(Psittacula krameri) X 376.

Fig. 27.
Rosy Pastor
(Sturnus roseus) X 336.

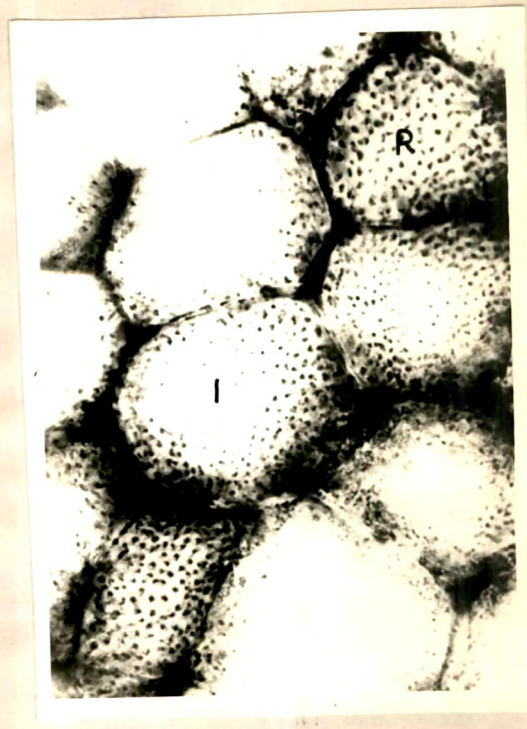

Fig. 28.
Common Myna
(Acridotheres tristis) X 376.

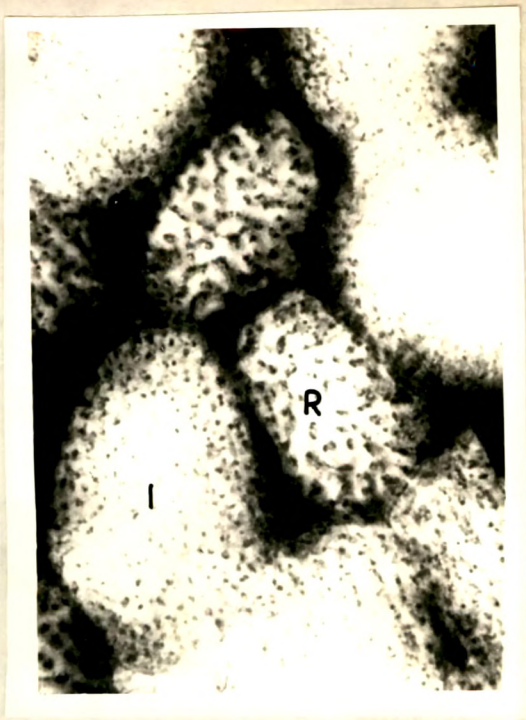

Fig. 29.
House Crow
(Corvus splendens) X 520.

Fig. 30.
Jungle Crow
(Corvus macrorhynchos) X 376.

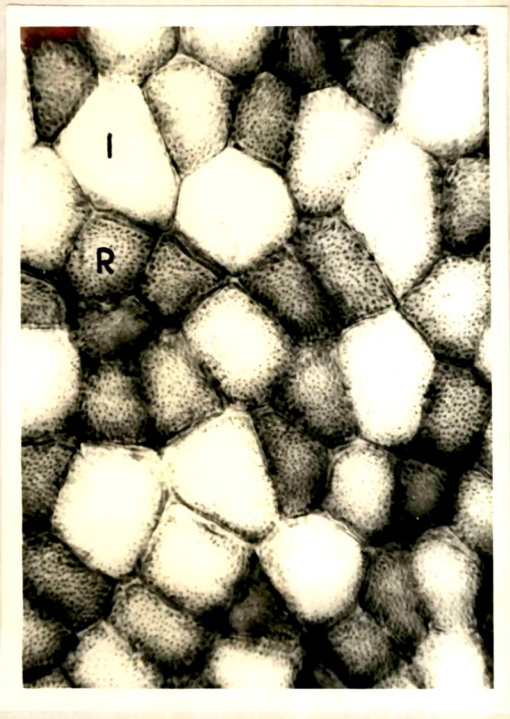

Fig. 31.
Yellowheaded Wagtail
(Motacilla citreola)

Fig. 32.
Tailor Bird
(Orthotomus sutorius) X 376.

Fig. 33.
Purple Sunbird
(Nectarinia asiatica) X 376.

Fig. 34.
House Sparrow
(Passer domesticus) X 376.

Fig. 35.
Rubythroated Hummingbird
(Archilochus colubris) X 520.