CHAPTER IV

THE EPIDERMAL STRUCTURE

The role of epidermal structures in the feeding behaviour has been mentioned by many workers in the water birds. Cracking of a hard nut by an epidermal keel of the hawfinch is described by Sims (1955) and variations in these structures have been correlated in the owlet (Strigiformes) by Dubale & Rawal (1968). The nature of the epidermal structures of the bills of falconiforms have not so far been described. Before describing these and structures/characteristics of the birds, studied here it is considered desirable to describe the epidermal structures common to all these birds.

THE BILL:

The rhamphotheca is a horny sheath, covering the bony components of the bill, and comprises of two pieces, the rhinotheca and the gnathotheca, covering the upper and the lower mandibles respectively. The rhinotheca extends all over the surface of the premaxillae forming a culmen between the fronto-nasal hinge and the anterior tip of the bill. It also extends over a part of the quadrato-jugal bar below the antorbital vacuity. The culmen is highly arched
and anteriorly, it continues as a strongly pointed and hooked nail, also called the dertrotheca. The latter extends over and more or less at right angles to the lower beak. The maxillary tomia bear the sharp edges which run posteriorly below the anorbital cavity. On its buccal surface, the rhinotheca is generally thrown into a set of a median and two lateral longitudinal ridges and extends posteriorly to form a horny palate. On either side, a sulcus i.e. a groove, is present between a median and lateral ridges. Each lateral ridge forms another groove between itself and the maxillary tomium of its side. This groove serves to house the edges of the lower beak when the bill is closed. The rhinotheca forms the lining of the palate. The palate bears a number of papillar structures which are sparcely distributed all over.

Caudal to the horny palate, the epidermal lining splits into two palatal folds which are separated from each other by the median choanal slit of the palatal fissure. The latter serves as a common opening for the internal nares into the pharynx. The palatal folds are mostly thick and bear a large number of backwardly directed horny spines. The spines on the choanal margins are generally large. The region around the choanal field is separated from the maxillary tomia by a sharp furrow on either side.
The infundibular slit is present posterior to the choanal slit. Posterior to this, the epidermal lining forms thick pharyngeal pads which bear posteriorly directed horny spines.

The gnathotheca is a horny sheath covering the lower beak and extends all over the surface of the dentaries of the two rami. The mandibular tomia become thick and blunt toward the rictal commissure. Toward its ventral surface, the gnathotheca forms a curved and an elongate gonys between the anterior tip of the lower beak and the base of the forking of the two rami. The horny covering of the lower beak extends into the buccal cavity and is thrown into a number of infoldings called the frenulum linguæ which are present near the base of the tongue. The epidermal lining of the roof and of the floor of the buccal cavity become continuous with each other at the rictal commissure. The horny spines are present at the base of the tongue. When the bill is closed, the mandibular tomia are partly covered by the maxillary tomia and the former fit into the lateral grooves formed by the lateral ridges of the rhinotheca.
Common Pariah Kite: (Plate VII, 1)

The bill is broad at the base and the upper mandible is compressed laterally. The bill tip is highly pointed and the nail extends considerably over the tip and almost at right angles to the lower mandible. The maxillary tomia are sword-edged and bear a pair of lobed elevation each on either side near the base of the bill. The nail possesses a groove along its inner ventral side. A deep cavity is formed by the edges of the maxillary tomia and the nail. This cavity houses the tip of the lower mandible. A small bulbous pad is present ventro-medially near the base of the nail. The choanal slit is long and its anterior extension is narrow. The anterior choanal field is narrow and its boundary is formed by a fimbriatous ridge. The cephalic region of the anterior choanal field bears scattered spines which are posteriorly directed. The choanal slit in this region is marked by horny ridges bearing small spines. The ridges widen toward their posterior end. A transverse row of spines separates the anterior field from the posterior choanal field. The latter is also broad and is more or less shieldlike. The posterior field is formed of a thick horny lining. Toward its posterior boundary, the field bears a row of spines which are directed posteriorly. A fimbriate ridge
forms the lateral boundary of this field. Numerous taste-pits are present in the infundibular region of the posterior field.

The edges of the gnathotheca are comparatively less sharp than those of the rhinotheca. The spadelike gonys is narrow and long.

**Shikra:** (Plate VII, 2)

The bill is relatively short and high with a lobed cutting edge on the upper beak. The culmen is steeply curved. The maxillary tomia are very sharp. The lateral fimbriate ridges are very prominent, extending right up to the posterior margin of the palate. The latter is very thick and has a median ridge demarcated from the choanal field by a shallow groove on either side. The region anterior to the choanal slit bears large spines directed caudally. The margins of the choanal slit bear a sharp ridge with small spines which are directed postero-medially. The choanal field is very broad and is divided in the middle by a transverse row of spines. The anterior field bears numerous spines. Toward its posterior boundary, the field is thick. Taste-pits are abundant between the commissural and the pharyngeal region.
PLATE VII
The gnathotheca forms a long gonys which has a spoon-shaped concavity. The mandibular tomia are relatively blunt and slightly curved turning ventrally near the tip of the beak. The taste-pits are absent and the framulum linguæ are thick.

**Kestrel**: (Plate VII, 3)

The falcon possesses a short, high, heavy and curved bill. The culmen is deeply arched. The maxillary tomia are very sharp and possess an outgrowth known as a denticle or a mandibular tooth. Ventrally, near the base of the curved nail, a thick epidermal median pad is present with its median ridge demarkated by a groove on either side. This ridge extends posteriorly upto the anterior extremity of the choanal field. The latter is very large and broad. The anterior choanal field is roughly rectangular in shape. The anterior extension of the choanal slit is very narrow and is bordered by more or less a smooth lining. Surrounding this slit are three to four rows of numerous weak spines. The transverse row of spines separating the two choanal fields is less conspicuous. The posterior choanal field is very broad and soft and shows the presence of numerous taste-pits. The posterior border of this region is formed by a single row of weak spines.
The mandibular rami are covered by thick gnathotheca. The sides of the gonys are high and the anterior end of the gonys is narrow. There is a notch on either side on the mandibular tomia wherein fits the denticle of the maxillary tomium. A median groove is present at the point of meeting of the two rami. The frenulum linguae are thin.

**Laggar Falcon: (Plate VII, 4)**

The rhinotheca closely resembles that of the Kestrel with minor variations. The denticle of the maxillary tomium is replaced by a lobed elevation. The anterior choanal field is considerably long and it bears small projections. The transverse row of spines separating the two fields is well developed. The posterior field is shield-shaped, less horny but thick. The choanal slit is very broad with high ridges on its either side. The taste-pits are numerous. The posterior field is bordered caudally by a row of weak spines which are posteriorly directed.

The mandibular tomia have a smooth lining and the corresponding notch for the lobed elevation of the maxillary tomium is not present. Toward its dorso-medial side, the gonys possesses a longitudinal groove. The gonys is long.
The following is a general account of a typical tongue with a special reference to its epidermal structures. The tongue is roughly rectangular to lanceolate. It is a highly protrusible structure formed of thick horny pads. The anterior end of the tongue is convex and the posterior end is concave. The tongue bears a shallow longitudinal groove along its dorsal side and appears as a wedge-shaped structure. The posterior margin is formed of a fimbriate lining. The tongue is broad toward the base. Towards its posterior border, it bears a row of spines of which the last one towards the lateral sides is large. These spines form the postero-lateral appendage of the tongue and are conspicuously large. A region anterior to the glottis is soft and bears a large number of taste-pits. The glottis is made up of two laryngeal pads. Each pad is triangular to rectangular in shape. The posterior margin of this pad is lined by three to four rows of horny spines which are posteriorly directed. Medially, the inner margins of these pads form a ridge on either side of the glottis. Two ridges run parallel and form a groove between them behind the glottis.

The above features are common for the epidermal structures of the tongue of all these birds. However, they
show minor variations. They are described below in individual case.

**Common Pariah Kite:**

The tongue of this animal is roughly lanceolate. Toward the posterior end, the spines are arranged in form of inverted 'V'. The postero-lateral appendage is well developed. The laryngeal pads form a triangular structure. Toward the posterior end, the pads are very thick and bear two to three rows of spines.

**Shikra:**

The tongue of this animal is more or less boat-shaped and its anterior end is slightly round, almost equal in width to the posterior end. The pads are heavy, thick and rough. The spines forming the postero-lateral appendage are very large and strong. The posterior margin of the tongue is fimbriate. The tip is bent slightly downward. The region anterior to the glottis is small and has a soft lining with a large number of taste-pits. The glottis is surrounded by two laryngeal pads. The posterior margin of this pad is lined by three to four rows of spines directed caudally. Toward the glottis, the sides of these pads are raised forming a ridge. These ridges extend posteriorly forming a
groove between them. The laryngeal pads are extremely thick in this animal.

**Kestrel:**

The anterior end of the tongue is blunt and broad. The horny palate is extremely thick. The posterior half of the tongue is also broad. A short region is present anterior to the glottis. The laryngeal region is shield-like and the hind end of the laryngeal pad is very thick and it bears spine. The groove extending posterior to the glottis is broad and shallow.

**Laggar Falcon:**

The tongue of this falcon is long with its anterior tip bent downward. The postero-lateral appendage is weak and the posterior border of the tongue bears small and weak projections. The region between the tongue and the glottis is large. The laryngeal pads are broad and the glottis is wide. The groove behind the glottis is deep and short. The posterior end of the laryngeal pad is bordered by slender spines.
FOOT:

The epidermal structures of the foot include a covering of the tarsal region and also those of the digits, including the claws. These structures have been described by a number of workers including Hess (1951) and Wallace (1964) in other birds. Van Tyne & Berger (1959) have also treated this subject at a great length. The nature of the scales and their arrangement in the tarsal region are described by Grossman et al., (1965).

In almost all the birds of prey, the claws serve as important weapons in paralysing the prey. In general, they are cant hooks with a highly pointed tip. However, their degree of curvature varies in different birds and also in different digits of the same bird.

**Common Pariah Kite:** (Plate VIII, 1)

The scales are present in form of scutes. Toward the front side of the tarsus, these scutes are arranged in a single median row. Each scute extends as a transverse band between the lateral margins of the tarsus. The bands are narrow toward the proximal part, whereas, toward the distal end these bands become broad. The hind part of the tarsus is also covered by scutes which are smaller than those of the front side. The scales are present and show
a reticulate arrangement toward the lateral sides of the tarsus. These scales are large toward the proximal end of the tarsus and become gradually small distally. They are more concentrated and thick toward the lateral portions of the roots of the digits.

**Shikra:** (Plate VIII, 2)

The scutes are more or less rectangular and are high. The median row of scutes runs completely between the lateral margins. The hind part is also scutellate. The front scutes of the first row on the lateral side of the tarsus, are rectangular and are placed vertically. The posterolateral scutes are polygonal. As in the kite, they gradually reduce in size toward the distal end of the tarsus.

**Kestrel:** (Plate VIII, 3)

There are two rows of polygonal shields situated toward the front side of the tarsus. On the distal one third portion, the shields form five transverse bands. The median row of the transverse band continues distally over the dorsal side of the third digit. Toward the lateral side, the scutes are hexagonal and exhibit a reticulate arrangement.
Laggar Falcon: (Plate VIII, 4)

The scutes are hexagonal in front forming a median row on the distal two third portion of the tarsus. On the proximal third region, there are two rows of small hexagonal shape. On the lateral side, these scutes show reticulate arrangement. The median row does not continue over the third digit. The distal end of the tarsus is covered by small, thick scutes showing reticulate arrangement.

In the kite and the Shikra toward their anterior side, all the digits are covered by a single row of scales which extend between the lateral margins of the digits. This row is succeeded on either side by one or two rows of narrow strips which are formed of scales. Towards the posterior side of digits, the pads are thick forming bumps. They bear small protuberances formed of epidermal thickenings.

In the Kestrel and the Laggar Falcon, toward its dorsal side, each digit is lined by a row of more or less oval scales. These scales do not show overlapping in the former case. They are more or less rectangular in the Laggar Falcon. In both these birds, toward the dorso-lateral side of the digits, two to three rows of scales are present showing reticulate arrangement. Toward the ventral side of the digits, the bumps are extremely well developed in the Kestrel and are lined by small denticles.
The claw of the first digit is the longest and more curved than in other digits. In female Shikra and the Kestrel, the claw of the first digit is considerably longer than the claw of the corresponding digit in other birds. These claws possess a shallow groove along their posterior side.