THE DESCRIPTION OF THE BRONZED GRACKLE AND ITS GENERAL OSTEOLOGY AND MYOLOGY

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THE DESCRIPTION OF THE BRONZED GRACKLE

AND

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INTRODUCTION.

From an economic standpoint the Bronzed Grackle possesses unusual interest to the ornithologist, therefore any information concerning this bird is of value. Since no one has, as far as could be learned, heretofore made a study of the anatomy of this bird, it has been selected as the subject of this thesis. The discussion will include, first, the description of the bird itself, and secondly, its general osteology and myology.

The Bronzed Grackle (*Quiscalus quiscula aeneus*).

This "refined crow", which is really no crow at all except in appearance, is the largest of our blackbirds, and is readily distinguished by the purplish-blue-green color of the head, neck, and upper breast and the bronze or brassy color of the entire body. The feathers of the back and belly are devoid of the iridescent bars which characterize the Purple Grackle (*Quiscalus quiscula*) found only in the Atlantic states from Massachusetts south and east of the Alleghenies. The male and female are similar, except that the latter is smaller and its feathers decidedly duller.

The bird is found in the Allegheny region and southern New England, north of Newfoundland and Great Slave Lake, west to the eastern base of the Rocky Mountains, and south to Louisiana and Texas. In fall migration it visits the southeastern states except Florida and the Atlantic Coast district south of Virginia.

A short time ago, February 14, 1929, while traveling in the East, where the snow drifts still lingered in places, I saw a flock of birds whirl into the top of a lone leafless tree. I could not identify them, but soon a sound like the scrape of a bow on a fiddle string floated on the air, and then I knew they were grackles. Their advent seemed rather early, as I had left my home in Michigan banked in snow, but then I recalled that New York was feeling the balmy air of spring at least for a few days. Be that as it may, Michigan does not see this bird until the latter part of February or early in March. They have been known to remain in a protected cedar swamp all winter, but these are only exceptions. October finds the majority departing for a warmer clime. A few may be found in November or December.

They are gregarious birds of the first order, invariably traveling in flocks and nesting in large groups. They seem to hold aloof from mankind except when their young are in danger, and then they have been known to strike their wings with great force in the face of the intruder.

Annually they have come to nest in the trees of a nearby yard. March 20 found two of these birds strutting about on the lawn. The day was perfect, for it was in the full glory of springtime. The dripping of the tiny fountain, tinkling like a bit of familiar music, and the swelling tones of the birds' voices drifted over the flowers that were clustered on the lawn. It seemed as though all Nature was in tune until the coarse voice of the grackle was heard. The iridescent plumage of the male flashed in the sun and glittered as polished steel and metallic bronze. It was mating season. Nevertheless, with all the display of color and song, the courtship was not inspiring.

The male puffed out his feathers to their fullest extent, depressed the central feathers of the tail, and sang his song of love. Though his song sounded like an iron gate creaking on rusty hinges, the grackle's mate seemed to appreciate his efforts as he poured forth his craven soul to her through a disjointed syrinx. Evidently when Nature's orchestra was tuning for the Spring Symphony, the grackle failed to adjust his vocal membranes to the proper pitch. It has been said of grackles, "They are as devoted lovers as turtle doves".

Grackles are interesting birds, ranking like the crow in intelligence. They have come into our cities, but seem more at home where the wind speaks of freedom or where the river whispers peace. The favorite nesting place is in the thick top of the evergreens. The nest is compact (Plate V) and built of coarse grasses, lined with finer grasses and a few feathers or any other soft substance. The number of eggs varies from four to six and sometimes seven. They are oval in shape and vary in color from a bluish white or greenish to a grayish brown ground color more or less blotched and streaked with brown and purple (Plate V). The young seem to be led or spirited away as quickly as possible after the eggs are hatched, and often as early as June 15 not a one is to be seen in the yard. They gradually gather into flocks and spend the time foraging about the country wherever food is most abundant. When the day is far spent and the night closes in upon them, they seek a resting place in marshes that are covered with small bushes. Here their harsh conversational chattering may be likened to a veritable bedlam.

Like the crow, grackles are more or less omnivorous. Professor Beal lists their food as 30.3% animal and 69.7% vegetable matter.

Spring finds them devouring noxious insects, but in autumn fruits and seeds attract their attention.

As ornithologists differ regarding the place of the bronzed grackle in the economic scale, the conclusions of Professors Barrows and Beal are here submitted.

Professor Barrows is of the opinion that the crow blackbird is a serious foe to the farmer whenever it occurs in large numbers, but taken all in all, the facts seem to show conclusively that the bronzed grackle is a valuable bird which does considerably more good than harm. The good done is widely distributed, but the harm is often concentrated on a few acres. Professor Beal says that these birds do a good share of the work of keeping insect life down to a proper level and are, therefore, most emphatically useful birds, but he also states that when over abundant their numbers should be reduced.

Materials.

The bronzed grackles, trapped by Professor Stack at the Bird-Banding Station on the Michigan State College campus, were the chief source of material for this study. The birds were trapped and killed in 1928; fixed in 10% formalin solution. The feathers were next plucked, the vicera and skin removed, and as much as possible of the muscle; then the specimen was immersed in a liter of boiling water to which had been added 70 grams of oakite and 140 cc. of concentrated ammonia. After the greater part of the muscle had been removed, the specimen was allowed to stand over night in a solution of pepsin and water, about 7.08 grams of pepsin to 250 cc. of distilled water. This seemed to bleach the specimen considerably. The skeleton was then placed for about two hours

on a pan in an oven heated to a temperature of 80°. The skeleton, then dry, was mounted on a cardboard and the parts labeled (Plate II). Several skeletons were thus prepared.

To get an exact outline, another plucked specimen was mounted on a cardboard. After the outline had been completed, this specimen was removed from the cardboard, the vicera taken out, and its skin carefully removed lest a muscle might be torn. Next a large dissecting tray, a pair of forceps, and three scalpels of different sizes were procured, and the task of removing the muscles began. This done, they were named as seen on the outline (Plate I). Separate plates were then made showing some of the muscles of the head and neck (Plate IA), of the trunk (Plate IB), of the upper extremity (Plate IC), of the lower extremity (Plate ID). A drawing was then made of the bronzed grackle showing the names applied to the parts of its body (Plate IV).

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PLATE V

MORPHOLOGY OF THE EXTERIOR PARTS OF BIRDS (PLATE IV).
(Greek, morpho, form; logos, discourse)

The student of ornithology must not only know the divisions of the body, i. e. head, neck, trunk, and members, but must become acquainted with the specific parts of the bird as well.

The head is well developed, the neck long and flexible, the trunk short and plump, the tail long and graceful, the body covered with feathers, the most characteristic feature of all birds.

The Head.

The head terminates in an elongated beak, consisting of an upper and lower jaw, encased in horny sheaths, and known as the upper and lower mandibles. The nostrils, two in number, are in the upper mandible. The forehead or frontal region (Latin, frons), includes all that slopes upward from the bill to a point opposite the anterior border of the eyes. The crown (Latin, corona) includes the top of the head, or the highest part, and extends from the rise of the forehead to the fall of the hindhead. The lores (Latin, lorum, a strap or space of color) extend anteriorly from the eye along the side of the head to the base of the upper mandible. It is an important area because it is, in many species, the seat of specially colored feathers. The hindhead (Latin, occiput) is the slope on the back of the head extending to the neck. The neck (Latin, cervix) is that part of the neck next to the back; it is the "hind neck" proper, or "scruff of the neck". "The nape of the neck" (Latin, nucha) is the upper portion of the neck, adjoining the hind-head. It is known as the cervical and nuchal region. The auricular (Latin, auris, auriculum, ear) is the region around the ex-

ternal opening of the ear. The position varies in different species. The malar region (Latin, mala, upper jaw) runs into the chin along the lower lateral region of the head. The jugulum is the portion of the throat lower than the gula (Latin, gulla or jugulum). The jugular portion is lowermost, disappearing in the breast, the gular uppermost, running into the chin along the under surface of the head.

The Mandibles (Latin, mandere, to chew).

The upper mandible is the upper profile of the bill, beginning where the feathers end on the forehead and extending to the tip of the upper mandible. The bill may be concave, convex, or straight. The framework of the under mandible is a compound bone called the inferior maxillary. It is V-shaped, with the point in front and the prongs running to either side of the base of the skull behind. Here they are hinged and movable. Both jaws in birds are moveable.

The Gastraeum (Greek, gaster, belly).

The gastraeum includes the breast (Latin, pectus), the belly (Latin, abdomen), and the sides of the body (Latin, pleurae). The breast begins over the clavicles where the jugulum ends. It is the swollen anterior part of the gastraeum, flatter than the abdomen.

The Abdomen (Latin, abdomen, belly) is behind the posterior edge of the sternum, bounded externally and posterially by the pubes.

The Notaeum (Greek, notos, back) begins at the ending of the neck and extends to the beginning of the tail coverts. This part of the bird is subdivided into the back (Latin, dorsum) and the rump (Latin, uropygium). Three-fourths of the notaeum we call the back, and the remaining portion the rump.

The Scapularies or Scapulars (Latin, scapula, shoulder blade).

The scapulars, or shoulder feathers, are always associated with the back. These are the feathers on the pterlae humerales (Greek, pteron, a plume; and humerales, Latin, humerus, the shoulder). The part of the notaeum they represent is called the scapulars, and the part between them the interscapulars. The flanks (Latin, ilia, or hypochondria) are the sides of the rump, the part of the body between the ribs and the thigh.

The Greater Wing Coverts (Cooperire, Latin, to cover).

The greater wing coverts are the first, outermost, and longest row of feathers reaching nearest the tips of the flight feathers.

The Median or Middle Coverts.

The next row of feathers are the middle coverts; they are shorter and less exposed.

The Lesser Coverts.

The lesser coverts are the remaining upper secondary coverts. The Alula or Ala Spuria (Latin, alula, little wing, diminutive of ala, wing; Spuria, Latin, spuria, spurious, bastard) is a small number of feathers which grow upon the second digit.

The Primaries.

The primaries or remiges (Latin, remix, remigis, an oarsman) are the flight feathers which grow upon the pinion and finger bones.

The Secondaries.

The secondaries are those remiges which are on the forearm.

The Tertiaries.

The tertiaries are the remiges upon the upper arm.

The Tail Coverts.

There are two sets of tail coverts, an over or upper and an under or lower set (Latin, tetrices, superiores tetrices, inferiores). The tail coverts are a number of very small feathers which are over and under the retrices (Latin, retrix, plural, retrices, guider) covering their bases and adding strength to the tail.

The Retrices.

The retrices are the true tail feathers and are as a rule stiff. They are always in pairs, having an equal number of feathers on the right and the left side of the tail.

The Digits.

The hand-bone consists of three bones fused in one, and these correspond to the digits or fingers of the bird. The digits of the toes consist of a number of small bones and like those of the fingers, we call them phalanges (Latin, phalanx, rank or series). They are the first, second, third, and fourth. No bird is said to possess a fifth toe.

The vent or cloacal aperture is a large transverse cleft situated on the ventral surface of the hinder end of the trunk.

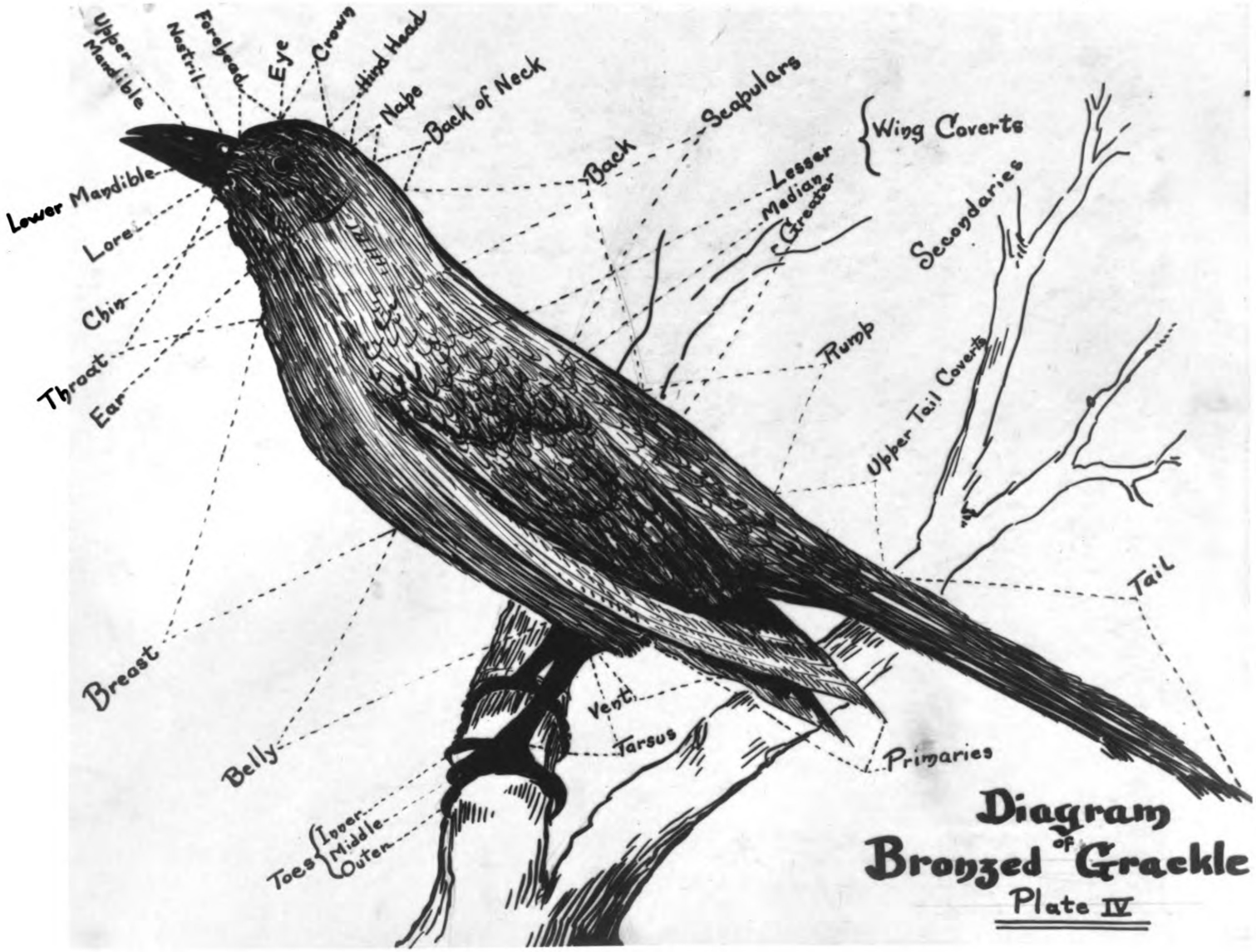


Diagram of Bronzed Grackle

Plate IV

OSTEOLOGY--THE OSSEOUS SYSTEM OR SKELETON.

Osteology is a word of Greek origin (osteon, a bone; logus, a discourse). It is therefore a scientific discussion on bone in general and bones in particular. Bone, being a derivitive of the mesoderm, represents the most highly differentiated of the connective tissues. It consists of cells and intercellular substances, the latter being hard and resistant, yet very elastic. Taken collectively the bones constitute the osseous system, known as the skeleton (Greek, skello, make dry). The primordal skeleton has its origin in the sclerotome of the somite, while the covering bones of the head originate in the dermotome of the somite. The skeleton is divided into the endoskeleton (Greek, endo, within, consisting of bones inside the body) and the exoskeleton (Greek exo, out of or those upon the surface of the body). As birds do not possess an exoskeleton, unless we consider the feathers on the greater part of the body, scales and claws on the feet, and the horny beak, we are concerned only with the internal or endoskeleton. All of these structures are of epidermal origin, formed from the stratum germinativum. There are no dermal elements of the exoskeleton of birds. The bony framework of the bird holds a prominent place in anatomical study.

Belon seems to have been the first to institute a direct comparison of the skeleton of the bird with that of man, but in this respect he only anticipated by a few years the more precise researches of Volcher Coiter, a Frisian, who in 1573 published at Nuremberg two treatises, in one of which the internal structure of birds is described, while in the other, the osteology and myology of certain forms are given.

The endoskeleton is derived chiefly from the medial wall of

the somite and constitutes a support and framework for the body and a place for attachment of the voluntary muscles. It may be divided into the bones of the axial skeleton, so named because they lie in the axis of the body, and those of the skull, back-bone, and chest, and of the appendicular skeleton, including the bones of the limbs.

The Skull of a Bird.

A bird's skull, the most birdlike structure of the whole skeleton, has been called a "poem in bone"; its architecture, "the frozen music of morphology". We marvel at its lightness, not only because its walls are so very thin, but because of the great number of its air cavities. To realize the utmost importance of lightness in this particular structure we have only to glance at the length of the neck, and ask ourselves how such a heavy head could be supported at the end of so long a neck. At the first glance the skull of a bird seems to be composed of a solid bone. It is a very good example of the fusion or ankylosing of bones, as it resembles a shell almost without a suture.

The Skull of the Bronzed Grackle.

The large rounded portion of the skull proper is a bony case, the cranium, which protects the brain (Plate 2A). The brain lies between the occipital, the ethmoidal, the sphenoidals, squamosals, the parietals, and a portion of the frontals. On either side of the skull about the center is a large cavity, the orbit, the socket for the eye. At the back of the eye case is an irregular depression, the tympanic cavity (Plate 2B). The parts of the beak, covered by a horny substance,

are the premaxillary, nasal and dentry (Plate 2A). In the base of the beak are paired apertures, the nares, (Plate 2A). The quadrate is a short stout bone in the temporal region. The palatines are two bones extending from the anterior ends of the ptergoids (Plate 2D). The Vomer is a fragile bone lying between the palatine bones and the orbits (Plate 2D). The rostrum forms the central axis of the base of the skull. The lachrymal is a small bone forming the anterior wall of each orbit, near the nasal opening and behind the nasal bone. The zygoma or jugal is a slender bone lying between the premaxillary and the quadrate. The sphenoid consists of a basisphenoid in front of the basi-occipital, the alisphenoid, a pair of bones on either side of the basisphenoid, and the presphenoidal lies above and in front of the basisphenoid. The orbitosphenoids are the bones on either side of the presphenoid. The hyoid apparatus is an arrow shaped bone in the base of the tongue. (Plate IC). The pterygoids are a pair of bones on the base of the skull. The foramen magnum is a large aperature on the posterior surface of the brain case. The occipital condyle is an elevation on the anterior margin of the foramen magnum. The lamboidal ridge is a little above the foramen magnum. (Plate 2). The squamosal is bounded by the frontal and parietal above and before. The interoibital septum (vomer) is a plate of bone separating the orbits from one another (Plate 2).

Having examined the general morphology of the skull, the structure of the principal bones are here given in detail.

Bones of the Cranium.

The Occipital Bone.

Occipital (Latin, occiput, back of head). The occipital bone is situated at the back of the base of the skull. Located on the posterior surface of the brain case, it surrounds the foramen magnum (fm) (Plate 2B) (Latin, an opening for the spinal cord as it passes to the brain). Not in this specimen but in the young bird, the foramen magnum is bounded by the supraoccipital above (Supra, Latin prefix above and occipital Latin, occiput, head.), the basioccipital below, and the exoccipital on either side. Above the supraoccipital is the lamboidal suture (Greek, Lambda, letter A, sides, form or shape). This bone, becoming the lamboidal ridge in the adult, looks smooth but under a magnifying glass has a pitted surface. This ridge separates the supraoccipital from the parietals. On the lower margin of the foramen magnum is a very small elevation, the occipital congyle (Latin, occiput, back of head, the condylus, kunckles). The cranial surface is concave conforming to the surface of the cerebrum and cerebellum.

The Parietals.

The parietals (Latin, paries, a wall) form the greater part of the sides and roof of the skull and lie between the occipital, behind the frontal, before the sumasmosal laterally. They are a pair of slightly arched bones, separated from one another by a saggital suture (Latin, saggitta, arrow and suture, to sew) and from the inter-parietal by a transverse suture. The external surface is convex and smooth, the internal surface concave and presents eminences and depressions for lodging the convultions of the brain, and numerous furrows for the rami-

fication of the arteries which supply the brain with blood.

The Frontals.

The frontals (Latin, frons, brow) (Plate 2) resemble a cockle shell and are paired in the young bird, but soon fuse together along the middle line by a frontal suture. These bones not only furnish all the anterior part of the brain case, but enter into the formation of the roof of the orbits. The frontal surface presents two convex smooth lateral areas separated by a saggital depression, anteriorally the surface is narrowed between the orbits. The cranial surface is concave conforming to the surface of the brain. The orbits are concave; pierced postero-medially by the optic foramen, they are separated from the frontal surface by the orbital rim.

Sphenoid Bone.

The Sphenoid (Greek, sphen, a wedge, eidos, form) (Plate 2) is a compound bone and consists of the main part of the bone or basisphenoid lying between the bouoccipitals and the pterygoids, a pair of alisphenoids (Greek, sphenoid, Latin prefix ala) on either side, the presphenoid (Latin prefix pre, before; sphenoid) above the basisphenoid, and the orbitosphenoids (Latin, orbita, orbit) on either side of the presphenoid. The sphenoid region is anterior to the occipital region and forms the floor of the cavity occupied by the brain. Much of the basisphenoid is concealed from view by the ptergoids and the quadrates, but its anterior end projects as a thin blunt process, the rostrum, into the space between the two orbits. A cavity in the exterior of the skull extending from the foramen magnum to the alisphenoid bone during life contained the brain.

The Premaxillae.

The premaxillae are bones forming the greater part of the beak. The free ends form the strong pointed extremity of the beak, from which three processes are given off on each side; the first is the nasal process, passing upward and backwards on the dorsal aspect of the beak; the second is a palatine process which extends along the middle of the palate to the palatine bones; and the third the maxillary process which passes backward forming the greater part of the margin of the beak, uniting with the maxillae. The maxilla is a slender rod-like bone, articulating in front with the premaxillae and behind by the jugals. A thin bone, a maxillo-palatine process scale-like in form, extends from the rod-like portion into the palate.

The Squamosal.

The squamosal bone (Latin, squama, a scale) forms a part of the cranial wall just above the tympanum and is united to the petrous or anchylosed bones. It is bounded by the frontal and parietal above and behind, by the exoccipital below, and by the alisphenoid in front. Some of these bones, as the exoccipital and the alisphenoid, do not appear in the skull of the adult, but can be seen in that of a very young bird. In the specimen before me, the squamosal has developed a spur, called the squamosal process, which extends downward over the quadrate bone to be united with the postorbital process of the frontal.

The Quadrate Bone.

The quadrate bone (Latin, quadratus, squared) is a stout, irregular four-cornered bone forming the suspensorium of the lower jaw

(Suspensory, Latin, suspensorius, a bone holding up a part); a bone by which the mandible articulates with the skull.

The head of the quadrate articulates with the squamosal in front of the tympanic cavity and the foot of the quadrate forms the free hinge of the lower jaw. The middle of its ventral surface forms a hemispherical knob with which the mandible articulates, while its dorso anterior border is drawn out into a point which extends to the inter-orbital septum.

The palatines (Latin, roof of the mouth) are cylindrical, curved, paired bones passing from the anterior ends of the pterygoids and uniting with the premaxillae by anchylosis. Their posterior ends resemble a scroll and unite with the pterygoids. The palatines diverge from the rostrum by the ends of the vomer.

The Hyoid apparatus has an arrow shaped body with a short pair of anterior cornua derived from the hyoid arch and a pair of posterior cornua, slender rods, spring from the first branchial. Plate 2C shows all the parts: (a) the basi-hyal, (b) the uro-hyal, and (c) the basibranchial. The basi-hyal is in front and the uro-hyal is behind. At the posterior end is a pair of long posterior cornua, each consisting of two pieces, the longer known as the basibranchial and the shorter cerata-branchial.

The tympanic cavity is an irregular depression bounded by the exoccipital behind and by the basitemporal beneath.

Plates showing the skull of the Bronzed Grackle

Plate SA.

Plate LP

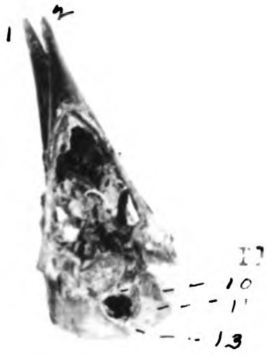


Plate SM

Plate LD

1 and 2 Maxilla and Premaxilla
3 Optic Foramen
4 Anterior Nares
5 Frontal
6 Parietal
7 Jugal
8 Vomer
9 Squamosal
10 Occipital Condyle
11 Foramen Magnum
12 Quadrate
13 Supra-occipital
14 Pterygoid
15 Basisphenoid
16 Palatine

Plate OM
Hyoid Apparatus

The Vertebral Column.

The vertebral column (Latin, verto, I turn, so called from the flexibility of the chain of vertebrae) (Plate 2 and 2J), the second division of the vertebral column, is formed by a series of bones called vertebrae. The column may be divided into the cervical vertebrae, or those of the neck; the four anterior thoracic vertebrae; the compound sacrum; the caudal vertebrae and the pygostyle, forming the posterior termination of the vertebral column.

A vertebra consists of a solid body or centrum, and neuraapophyses, an upward plate-like process on either side of the centrum, meeting in the center and forming the neural arch enclosing the neural canal through which passes the neural spine. On either side of the vertebrae are the transverse processes; these are called diapophyses (Greek, dea, across, apophyses, apo, from; phusis, growth). The oblique processes, coming from the sides of the same arches and serving to fasten them together, are called zygapophyses (Greek, zugan, yoke). Those on the anterior side are called prezygophysis, and those on the posterior surface areknown as post-zygapophysis. Each articulates with the preceding vertebra.

The first region of the vertebral column is the cervical; the cervical vertebrae are those of the neck and bear a striking resemblance to one another except the first two, the atlas and the axis vertebrae. The Atlas vertebrae without a centrum, the lower one being cupped to receive the occipital condyle, is a simple ring of bone, so called because it bears up the head as the giant Atlas was supposed to have supported the firmanent. The axis vertebra has a toothlike process

odontoid (Greek, odons, odontos, tooth) upon the anterior surface of its body about which the atlas revolves like a wheel. The last two of the cervical vertebrae bear ribs which do not unite with the sternum.

The Thoracic Vertebrae are defined as those which have ribs attached to them. Ribs are curved bones and sometimes defined as the pleuraphysial elements of the vertebrae with which they articulate one on each side. They unite with the sternum, which extends from the cervical to the pelvic region of the spine. Each thoracic rib is divided into two parts by a transverse process, a dorsal part, called the vertebral rib, resembling the last cervical rib, and the ventral part, called the sternal rib. The first dorsal is the one bearing the first rib, which is jointed, and reaches the sternum by its lower haemapophysial (Greek, half).

A notable feature of the dorsal region is its stiffness, due to the fact that the vertebrae have become ancylosed together, this being an advantage in flight. The bird's back bone bends at a point just in front of the pelvis, allowing freedom to either side. Some of the dorsals bear hypaphophyses (Greek, hypo, under) which divide into two laminae.

The Compound Sacrum.

The compound sacrum consists of several vertebrae ankylosed together and forming an attachment for the pelvis. There are the lumbar vertebrae immediately following the thoracic which have a neural spine but no hypophyses. Next follows the sacral vertebrae resembling the lumbar but having plates coming from the neural arches, these fusing with the ilia.

The Caudal Vertebrae, or terminal vertebrae, are fused together into an upturned, compressed bone, the pygostyle. It supports the tail feathers, there being one pair to each retrix-bearing vertebra; the number of tail feathers may be equal to the number of the vertebrae.

The Anterior Appendages.

The pectoral arch (Latin, pectus, the breast) Plate 2 and Plate 2F, consists of three bones, the scapula, the corocoid forming the scapular arch, and the clavicle or collar bone. These bones are often known by the name of pectoral-girdle trio. The scapula may be defined as that bony structure by which the wings are borne upon the axial skeleton. In birds, this bone is called the blade bone due to the fact of its being shaped like a sabre. In the grackle there seems to be more of a curve to this bone than in the same bone found in other birds. The head is thick and expands outward into a glenoid cavity (glc, Plate 2F) and inward to form an acromial process (Greek, akromion, point on the shoulder) for articulation with the clavicle. The scapula tapers to a point which rests close to the spine to which it is attached by muscles.

The Corocoid (Greek, koracoides; korax, a crow, and eidos, form). In the human, the corocoid process of the scapula has been likened to a crow's beak, but in the case of the bird it is not applicable. The corocoid is rather stout, straight, and somewhat cylindrical in shape. Extending from the shoulder joint to the forepart of the sternum, it expands at both ends. At the shoulder joint it meets the clavicle and scapula, forming a socket, the glenoid cavity (Greek, glene, a shallow pit or cavity) which is the socket for the humerus.

Plate II showing some of the bones of the Bronzed Grackle.....

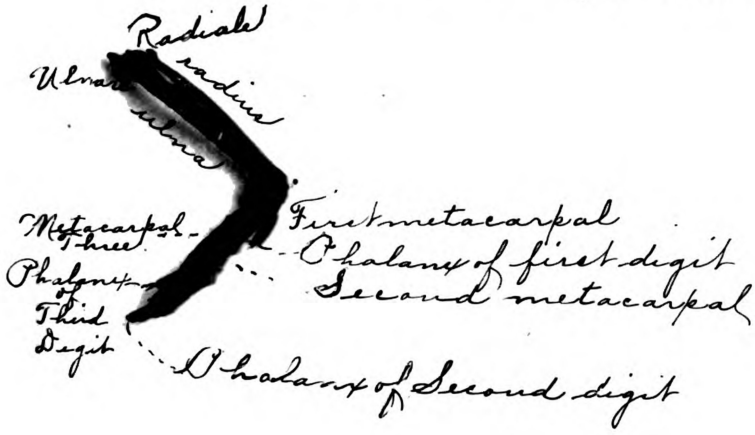
2J.....The Vertebrate

2K and 2L The Ulna

2M.....The Humerus

2N.....The Radius

2O.....The Ulna, Radius, Radiale, Ulnare, Carpals, Metacappals and Digits



The head of this bone is somewhat expanded and has a demifacet which indicates its part in the formation of the glenoid cavity. It is a very characteristic bone of birds, the writer having found it in the several skeletons examined.

The Clavicles (Latin, clavicula, a little key) or Furculum (Latin, a little fork) (Plate 2) form what is known as the clavicular arch, and are the pair of bones which unite to form the wishbone and correspond to our collar bone. In the bronzed grackle they are V-shaped, although the point of the V is not so decided. The V-shaped clavicle denotes volitorial (Latin, volitare, to fly) power of wings and the U-shaped the natatorial (Latin, swimming), therefore the bronzed grackle would be a flying bird. They lie in front of the breast across the middle line of the body; the upper ends articulate with the scapula and corocoid, in this bird but not in all birds, the clavicles being lacking in some birds. At the union of the two bones below, there is a process called the hypoclidium (Greek, hypo, under). The writer has also found this process in the chicken (Plate 1F, hpc.). Cotgrave, in his dictionary of 1660, calls it the forked craw bone of a bird which was used in sport to put over our noses. The name wishbone comes from the practice of two children each holding one prong of furcula and expressing a wish before breaking it asunder, the one carrying off the greater portion expecting the fulfillment of his wish.

The humerus (Latin for shoulder) Plate 2M, in comparison with other bones of the grackle may be considered a large strong bone somewhat of the italic f shape. It has a rounded head which articulates and fits into the socket of the glenoid cavity and two tuberosities

the larger having below it a deep cavity, the pneumatic foramen (Plate 2M, pnf) which leads to an air cavity in the shaft of the bone; the small tuberosity being continued by a small triangular ridge, the deltoid, which extends for a short distance down the shaft. The lower extremity of the bone has also a pulley-like surface or trochlea, this bearing two elevated surfaces, one on the radial tubercle and the other on the ulnar tubercle (Plate 2M). Proximal to the radial tubercle is an elevation called the radial condyle, and the ulnar bears a similar elevation, called the ulnar condyle.

Of the long bones the humerus is the most pneumatic. Having read about an experiment where the windpipe of a dead bird was tied and the humerus broken and then air forced down the humerus and the air sacks at once becoming inflated, the writer tried it with the grackle and it proved successful. "Wounded birds, having their windpipes filled with blood, have been known to breathe through a broken humerus that had pierced the skin."

The Radius, Plate ID (Latin, for staff, or rod) of the bronzed grackle is a straight slender bone (r) articulating with the humerus. It is the more slender and straighter of the two bones of the forearm. Its proximal end forms a shallow cup for the articulation of the lateral condyle (Latin condylus, prominence on a bone) of the humerus. At the other end is a knob which fits into the radial bone of the carpus, called radiale (r), (Plate 2O). Having taken a cross section of the bone, it was found to be solid, therefore not pneumatic (Greek, pneunia breath of air). The Ulna (Latin for elbow) (Plate 2O) is a much thicker bone than the radius and in this specimen slightly curved but not as much as in some other species. Its proximal end has a concave surface

the sigmoid cavity, for articulating with the humerus. The large proximal extremity of the ulna is called the olecranon (Greek, olene, ulna krancon, skull) head of the elbow (Plate 20). The small bone at the end of the Ulna is called the ulnare (u).

Plate 2K shows the sigmoid cavity, the olecranon, and the styloid of the Ulna, also the points of attachment for the secondaries. The manus includes the carpus or wrist and the hand. The carpus (Greek, karpos, wrist) consists of two short bones, the smaller the radiale, articulating with the radius, and the larger the ulnare, articulating with the ulna. It is deeply notched to receive the carpometacarpus. The hand, in the adult bird, is greatly modified, having only the second, third, and fourth digits, and the metacarpals all fused with one another and with the distal carpals to form the carpometacarpus. Articulating with the second metacarpal is a single pointed phalanx. The third metacarpal bears two phalanges, and the fourth metacarpal bears one pointed phalanx (Plate 20).

The Sternum (Greek, sterno, the breast) is a very important structure in birds, offering two leading types of sternal structure, the ratite (Latin, ratis, a raft) and the carinate (Latin, carina, a keel), raft-like or boat-like according as the bone is flat or keeled. The grackle having a keel must belong to the carinate. In all the flying birds including the grackle and robin examined by the writer, the sternum is keeled and develops from a median center of ossification as well as from lateral paired centers. The sternum gives attachment for five pairs of thoracic ribs and one pair of floating ribs.

The sternum of the grackle is concavo-convex; rectangular in shape, that is, longer than broad. The external surface of the sternum and keel are ridged in places showing the attachment of the different

Plate 2

Plate 2 G.

Plate 2 H.

Plate 2 I.

Plate 2 F showing the clavicles and coracoid.

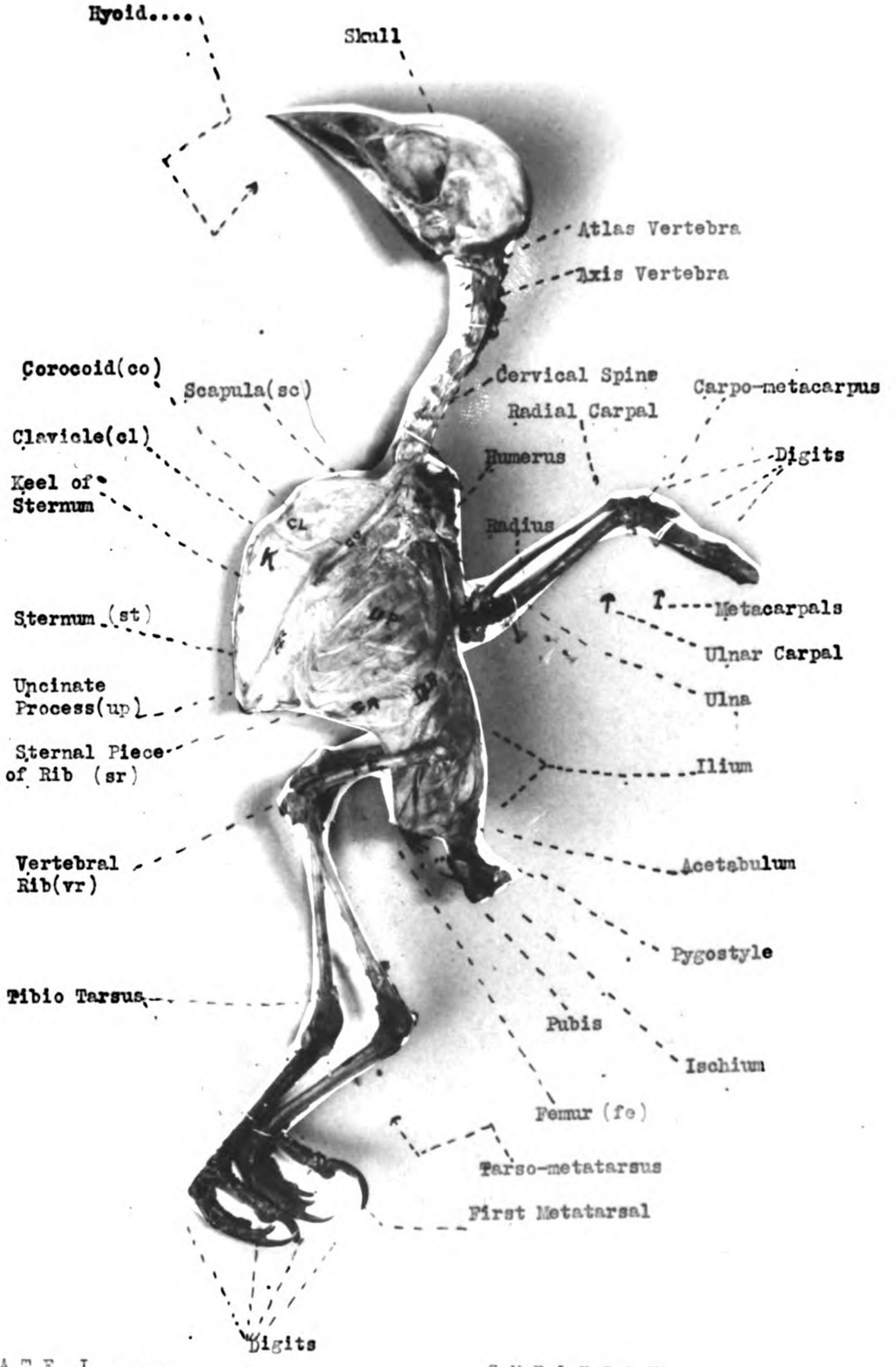
Plate 2 G showing the sternum, the keel, and the scapula.

Plate 2 H showing the ilium, the ischium, the pubis, the acetabulum, and the pygostyle

Plate 2 I showing the hind leg.

of

Bronzed Grackle.



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pectoral muscles. The writer examined very young birds, namely, the crow, the pigeon, the robin, and the grackle, also chickens and found the keel to be mere gristle. The flying power of a bird can be determined by the size of the keel, and in birds that have lost the power of flight the keel has entirely disappeared, a condition, as some orinthologists state, found in the cassowary. It is merely a secondary outgrowth from the lower side of the breast-plate to give attachment for the great muscles of flight, as, the uncinate process (Latin uncinatus, a hook). The true ribs of the grackle as many others are furnished with hooked processes to increase the stability of the thoracic side walls. Springing from the middle of the upper part of the ribs, they slope upwards and backwards. Plate 2 shows the ribs of the grackle with uncinate processes.

The pelvic limb (Plates 2 and 2i) consists of the femur, the tibiotarsus, the fibula, the tarso-metatarsus, and the four digits.

The femur is a comparatively short bone, bearing at its proximal extremity a trochanter (tr) and a round head (hd). The distal end has pulley-like condyles, two in number. On the extensor side of the knee joint is a small bone, the tibio-tarsus, having on its proximal end a cnemial process, the tibial crest (Plate 2 and 2i) for the attachment of the extensor muscle of the thigh. Its proximal articular surface has a slight hollow for the condyle of the femur and its distal end is somewhat like a pulley.

The fibula is a very slender bone attached to the outer side of the tibo-tarsus and tapers to a point at the distal end; so small does this become that we can say it fuses into the tibio-tarsus and articulates with the lateral condyle of the femur.

The tarso-meta tarsus follows the tibio-tarsus. It is a cylindrical bone bearing at its proximal end a concave surface for the condyles of the tibio-tarsus, and at its distal end, three distinct trochlea for the articulation of the toes. The first metatorsal is reduced to the distal end, which tapers to a point and is attached to the posterior surface of the tarso-metatarsus near the distal end. The digits consist of a number of small bones. Like those of the fingers, we call them phalanges (Latin, phalanx, rank or series). They are the first, second, third, and fourth. The great toe has two phalanges, the second three, the third four, and the fourth five. No bird is said to possess a fifth toe.

The pelvic girdle or pelvic arch of each side (pelus, Latin, a basin) consists of three bones, the ilium, the ischium, and the pubes (Plates 1 and 1H). All three of these bones are fused on each side to form the innominate bone (Latin, innominatus, without a name). The ilium is the largest and most dorsal part of the innominate bone, uniting with the back bone and extending backward and foreward along the whole extent of the sacrum. It unites with a number of vertebrae before and behind the hip joint, fusing or ankylosing with them and making this part of the back bone rigid. This union was found in all birds examined but not in the mammalian skeleton. The ischium (Greek, ischion, haunch bone) Plates 1 and 1H, is a thin plate-like bone composing the greater part of the side wall of the pelvic, and uniting with the ilium at only two points, the acetabulum and a point just behind it. For a greater part of their length the two bones are separated by the long narrow obturator foramen.

The pubis is a long slender bone resembling a rod and extending along the entire lower border of the ischium. Posterior to the ischium the pubis is produced into a long slender curved process, and in front of the acetabulum it bears the pre-pubis process for the attachment of origin of the ambiens.

The acetabulum (Latin, a vinegar cruet) is a rounded cavity on the outer surface of each os, innominatum, perforated by an aperture, and serves for the articulation of the leg.

The posterior caudal vertebrae are united together to form the pygostyle (Greek pygr, rump, stylos, column). It is shaped like the share of a plough in the grackle (Plates 1 and 1H). Fusing together with the true sacrum, they are known as urosacral or false bones. It is a compound bone consisting of several stunted coccygeal bones.

MUSCLES.

If muscles are defined as instruments of motion, the same is true of birds, because they exhibit a greater degree of activity than any other class of animals, either in hopping, climbing, fluttering, running, or swimming. This activity is the result of one or several muscles. Muscles constitute what is known as the flesh, each having its own function whether it be in the movement of the feathers, the wing, the tail, or even the eyelids, it matters little, it all being muscular power. It has been said that the actions of birds speak louder than words, this being brought about by the muscles aided by the skeleton and nerves. Of this triple union, the muscles constitute the greatest bulk. The skeleton gives the form, but the muscles add the grace and beauty of outline to the form.

The Cutaneous (Latin, cutis, skin, pertaining to the skin) muscles of this bird, and others examined, are well developed and form broad sheets in various parts of the body. Bundles of muscular fibres pass to the great quill feathers of the tail and wings, others to the patagium. The muscles of the neck and tail are well developed, while those of the abdomen are small; this is due to the large sternum. The diaphragm, consisting of bundles of muscular fibres, is well developed. A pecularity of the muscles of birds is the great length of their tendon of insertion; this is well exemplified in the muscles of the leg.

As the nomenclature of muscles has always been difficult, it is impossible to name all the muscles of the bronzed grackle, much less to describe them in a work of this length. Therefore the writer has arranged them according to the usual division of the body, as those of

the cutaneous system, those of the head and neck, those of the trunk, and those of the upper and lower extremity. After dissection, some of the most important were taken from each group and shown on the different plates. Plate I shows the muscles of the bronze grackle; Plate IA of the head and neck; Plate IB, of the trunk; Plate IC those of the upper extremity; and Plate ID those of the lower extremity.

Superficial Muscles of the Head and Neck (Plates I and IA).

The temporal (Latin, tempus, temple). Having removed the skin from the side of the head, a large muscle covered by a glistening fascia was found occupying the temporal fossa of the skull. It was divided into two parts--a superficial arising from the whole temporal fossa and extending to the outer surface of the lower jaw, and a deeper part, a pyramid shaped muscle having its origin in the superorbital process of the temporal fossa and ending in a stout tendon which is inserted in the quadrate, upon the raminal margin of the mandible.

The Masseter (Greek, maseter, to chew) is a large thick muscle situated in front of the submaxillary and parotid glands and covered by a shining fascia. It arises by a broad thin tendon in the zygomatic process. Passing downward and foreward and uniting with the temporal muscle, it is inserted on the lateral surface of the ramus of the mandible. Its action is to close the mouth and draw the mandibles forward. This action seems to be the result of the united contraction of its auxiliary, the temporal.

The Complexus (Latin, woven together, complicated, not simple) is a very prominent fleshy muscle having its origin in the lower cervical and upper dorsal vertebrae, and is inserted between the curved lines of the occipital bone as a thin tendinous sheet. Its

action is that of an extensor and may be an auxiliary of some of the more powerful extensors found in the back of the neck.

The Mylo Hyoidens, the mylohyoid (Greek, hyoid, U shaped, shaped like the Greek letter Upsilion and mylo, Greek, myle, mill) is a thin sheet of muscle arising on the inner side of the mandible just below the lower border of the bill. The fibres are very delicate, taking the aspect of a tendon, and are inserted in the hyoid bone and middle raphe. Its action is to lift the tongue against the roof of the mouth.

The intertransversales (Latin, between and transversales, between the transverse process of the contiguous vertebrae). These muscles are visible from the neck to the ilium, having their origin between the transverse processes of the vertebrae, and their insertion in the lateral surface and transverse process of the preceding vertebrae. Their action is to support and flex the spinal column, and offer a protection to the nerves and blood vessels as they pass out from the canal.

The rectus capitis ventrales (Latin, rectus, straight; capita, the head) has its origin in the transverse processes of the third, fourth, fifth, and sixth cervical vertebrae, and is inserted in the basilar process of the occipital bone. Its action is to flex, rotate, and assist in supporting the head.

The longus colli (Latin, long; and colli plural, colla, neck) is a fleshy muscle having its origin in the ventral surface body of the vertebrae of the lower cervical and first few thoracic vertebrae as a tendon, and extends the entire length of the neck by a series of tendnns

and is inserted in the ventral surface of the axis. Its action is to lower the head.

The Semispinales Capitis (Latin semi, half, and spinalis, spinal) has its origin in the lateral surface of the dorsal spines of the thoracic vertebrae and is inserted on the occipital crest. Its action is to elevate the head.

The Semispinales Cervicis (Latin cervicis, pertaining to the neck and spine) has its origin, as did the semispinales capitis, in the lateral surface of the dorsal spines of the thoracic vertebrae. It is inserted in the dorsal spines of all the cervical vertebrae except the first, and its action is to elevate the head.

Superficial Muscles of the Fore Limb (Plates I and IC).

The patagialis (patagium, plural patagia, a wing membrane) a muscle concerned with the folding of the patagial membrane, is found in the grackle, as well as in all birds having a keel, so called carina birds. It arises as a single muscle, which divides into two tendons--the tensor patagii longus and the tensor patagii brevis. As we are concerned with the patagiilongus, its description is here given. It arises as a tendon but takes on the aspect of a spindle-shaped muscle after leaving its origin, the cranial surface of the lateral end of the corcoid, but ends in a tendon which runs along the anterior margin of the patagium, and is inserted in the cranial surface of the carpus. Its action is to flex the elbow and tense the pre-patagium.

The deltoid (Greek, deltoides, triangular in shape) is a triangular shaped muscle, large in the grackle, a powerful flexor of the forearm, and attached for nearly its entire length to the triceps.

It has its origin as a tendon in the proximal extremity of the clavicle, and these fibres pass around the back of the shoulder joint and have their insertion in the proximal lateral half of the humerus to the deltoid tuberosity. Its action is to flex the shoulder and rotate the wing upward.

The biceps brachii (Latin bi, two, caput, head), as indicated by its name, consists of two heads. The longer arises from a tendon, the corocoid, and the shorter, from the head of the humerus. It is inserted on the radius and ulna. Its action is to extend the shoulder and flex the elbow.

The pectoralis (Latin, pectus, breast) is very large and thick, taking its origin from the entire length and the greater part of the depth of the keel of the sternum. This is well marked on the skeleton of the sternum (Plate 2).

The coracobrachialis is a spindle shaped muscle arising by tendon from the corocoid, passing upward, and again becoming tendonous as it approaches the humerus where it is inserted.

The triceps brachii (Latin tri, three, caput, head), as its name indicates, is divided into three parts, a medial, a lateral head, and a long tendon. It has its origin in the lateral neck of the scapula and humerus and its insertion as a tendon in the olecranon of the ulna. Its action is to flex the shoulder and extend the elbow. It is the great extensor of the antibrachium.

The flexor carpi ulnaris lateralis (Latin flexor, any muscle that flexes a joint; carpi, carpalis, of or pertaining to the carpus or wrist; ulnaris, pertaining to the ulna) arises from the medial

epicondyle of the humerus by a tendon, and is inserted on the medial surface of the distil extremity of the metacarpus. Its action is to supinate the manus, flex the elbow and carpus, and erect the secondaries. The flexor carpi ulnaris makes up the fleshy mass on the under side of the forearm.

The extensor of the first and second digit arises from the lateral epicondyle of the humerus. It divides on the hand into two tendons; one is inserted on the basis of the first phalanx of the first digit and the other on the phalanx of the second digit.

Extensor metacarpi radialis has its origin in the medial condyle of humerus and ends in a tendon on the metacarpal bone of the index digit at the base. It extends and adducts the carpus and flexes the forearm.

Superficial Muscles of the Hind Limb (Plates 2 and 2D).

The Sartorius (Latin, sartor, tailor) is a well developed muscle constituting the most anterior group of superficial muscles upon the outerpart of the thigh. It crosses the thigh obliquely from its origin on the lumbar dorsal spines by a tendon leading to the lateral angle of the ilium and is inserted by a tendon on the tibial crest. In the human it was supposed to be the muscle principally concerned in producing the posture assumed by the tailor in sitting cross-legged, hence its name.

The Semimembranosus (Latin, semi, half; membranosus, membranous) is a long, narrow muscle having its origin in the dorsal caudal point of the sacrum and the caudal surface of the ischium. From its origin it passes downward, and when it arrives at the muscles of the leg, it takes

the form of a tendon which, passing between the muscles of the leg, reaches the medial surface of the femur where it is inserted. It rotates the leg forward, extends the hip, and flexes the knee.

The Semitendinosus (Latin, in part composed of tendinous matter) is an accessory of the semimembranosus, lying in the same plane, and composed of coarser fibers. It has its origin in the lateral crest of the ilium and so inserted by a fascia to the middle part of the leg and to the plantar surface of the tibia. It extends the hip, flexes the knee, and rotates the leg inward.

The Gastrocnemius (Greek, gaster, stomach, keme, shank) occupies the greater part of the back of the leg, having its origin on the epicondyles of the femur and is inserted in the heel by a fascia in the metatarsus. It flexes the knee and extends the tarsus.

The Graclis (Latin, slender and graceful), as its name indicates, is a slender bone, having its origin in the caudal ventral border of the ischium and pubis, and its insertion in the proximal extremity of the tibia. It flexes and adducts the leg and thigh.

The flexor digitorium perforatis (Latin, flexor, a muscle that flexes a joint; perforati, pierced with holes; digitorium, deep) is deeper than the other flexors and is situated directly on the posterior and lateral surfaces of the tibia, where it has its origin, where it is flattened and covered with a strong fascia. Ending in a large tendon which separates and extends at the distal phalanges of the second, third, and fourth digits, it flexes the digits.

The extensor longus digitorum (Latin, extensor, a muscle which extends; longus, long; digitorium, deep) is a fleshy muscle arising from

the under edge of cnemial ridge or outer tuberosity of the tibia and the shaft of the fibula and is inserted on the second and third phalanges of the three lesser toes. It extends the toes, flexes the foot, and turns it out.

Superficial Muscles of the Upper Extremity and Trunk.

The latissimus dorsi (latissimus, Latin, the hardest; dorsi, Latin, dorsum, back) is one of the most superficial muscles of the dorsum. It is well developed in the grackle. It is divided into two parts, one part having its origin in the vertebral spines and the other a little distance farther down but on the vertebral spines. They unite and pass to the upper part of the humerus. It draws the arm (wing) downward and backward and rotates it.

The Trapezius is found beneath the latissimus dorsi and consists of a flat layer of fibers, having its origin in the supraspineus ligament and the space from the first to the sixth thoracic spines. From here the fibers pass across to the scapula where they are inserted on its dorsal border. It raises the scapula.

The gluteus maximus (Greek glautos, rump; maximus, Latin, the largest) has its origin in the superior curved line and crest of the ilium, sacrum, and coccyx and is inserted on the great trachanter of the femur. Its action is to extend and rotate the thigh.

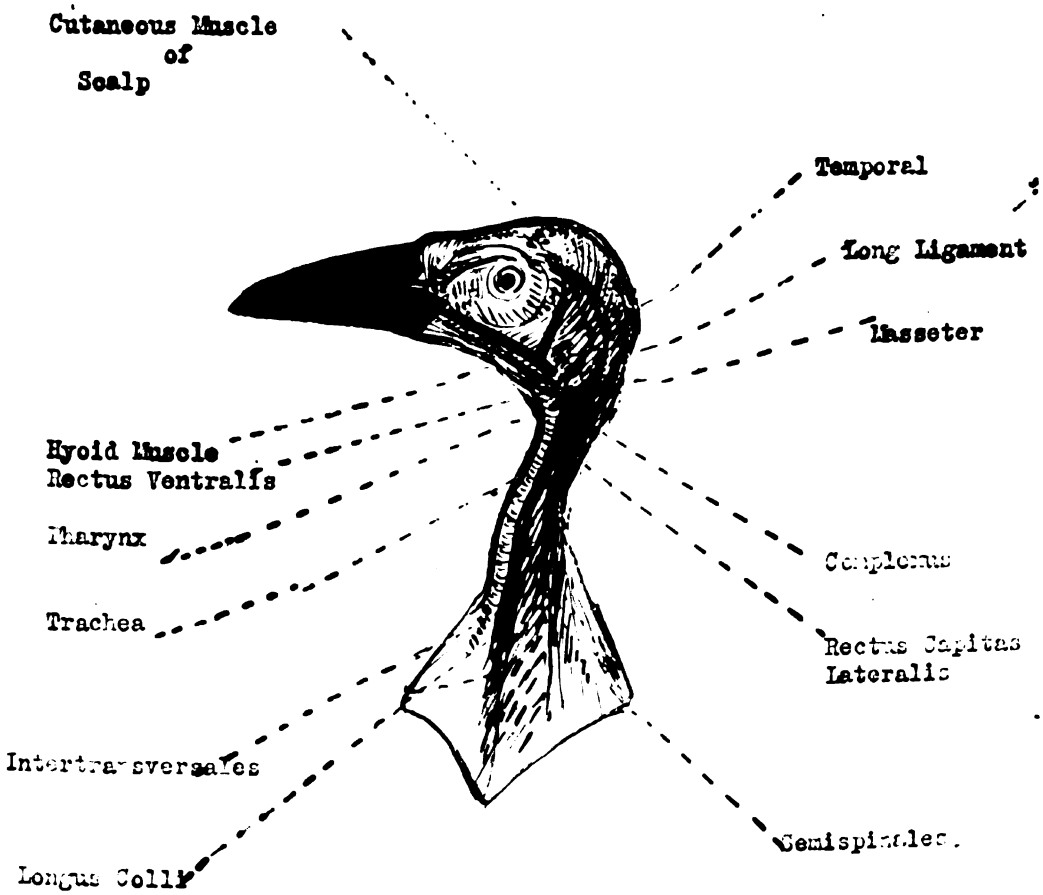
The levator coccigeus (a Greek word pertaining to the coccyx) arises on the dorsal surface of the ischium and sacrum and is inserted on the dorsal surface of the uropygium. It elevates the uropygium.

The depressor coccygeus rises from the ventral surface of the ischium and pelvic fascia and is inserted as a tendon on the ventral surface of the uropigium. Its action is to depress the uropigium.

The ischiococcygeus has its origin on the spines of the ischium and pelvic fascia and is inserted on the coccyx and median raphe. It raises the floor of the pelvis.

The pubococcygeus (Latin, pubes, hair) is the most posterior muscle of the tail, arising from the medial caudal border of the ischium and is inserted in the cloaca and coccyx. It elevates the anus.

The iliococcygeus is a fleshy muscle having two parts, both arising from the ilio-sacral ligament and inserted on the outer rectrix.



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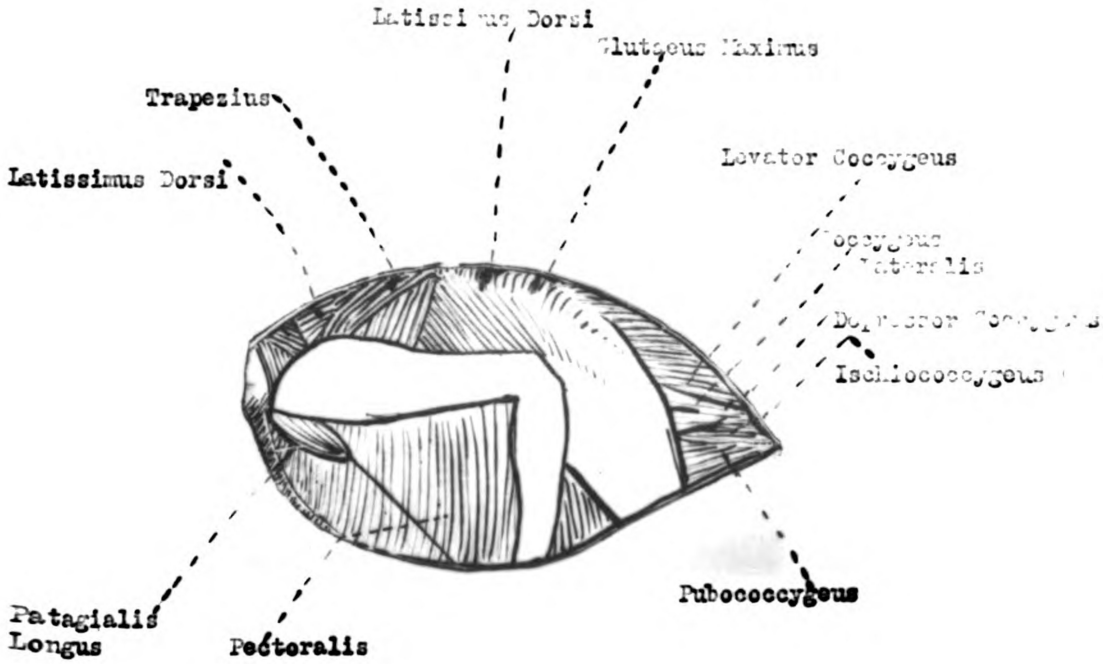

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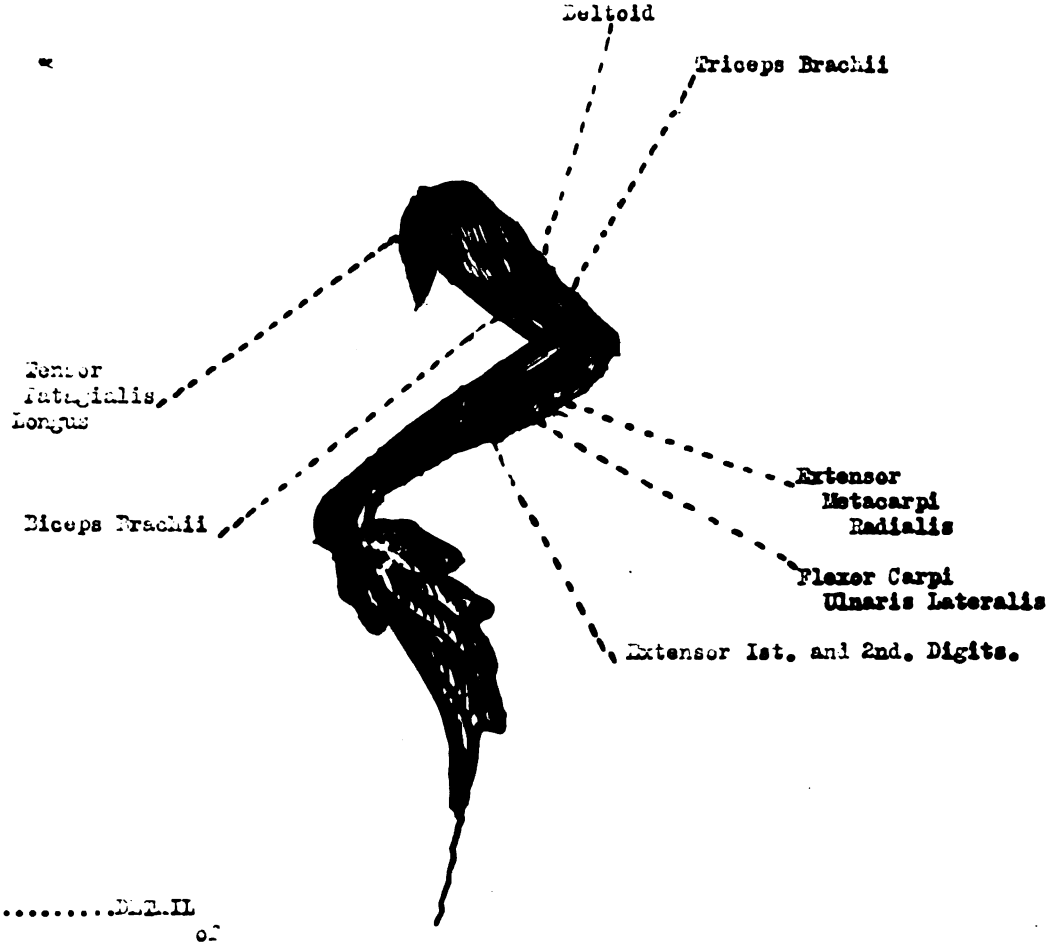
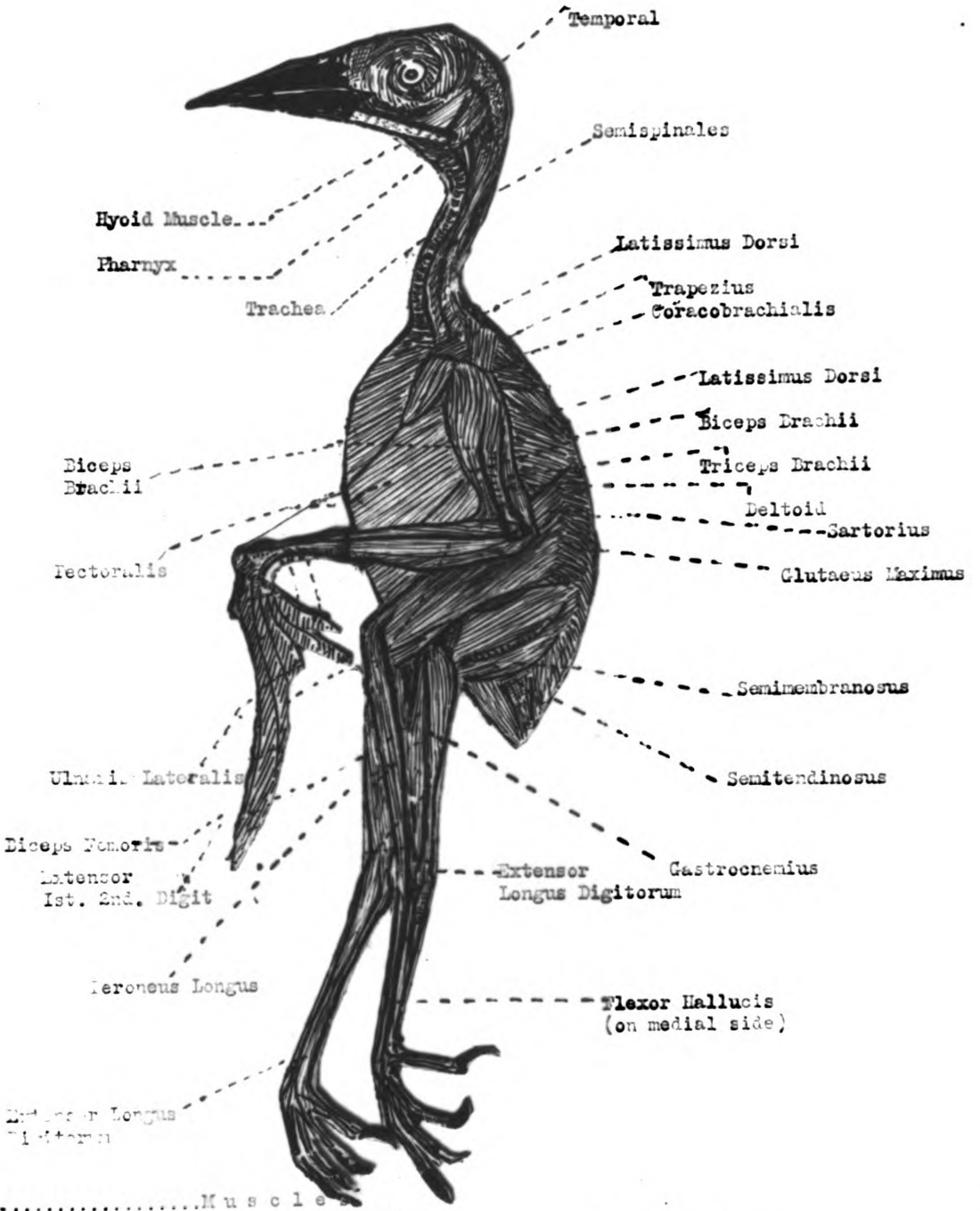


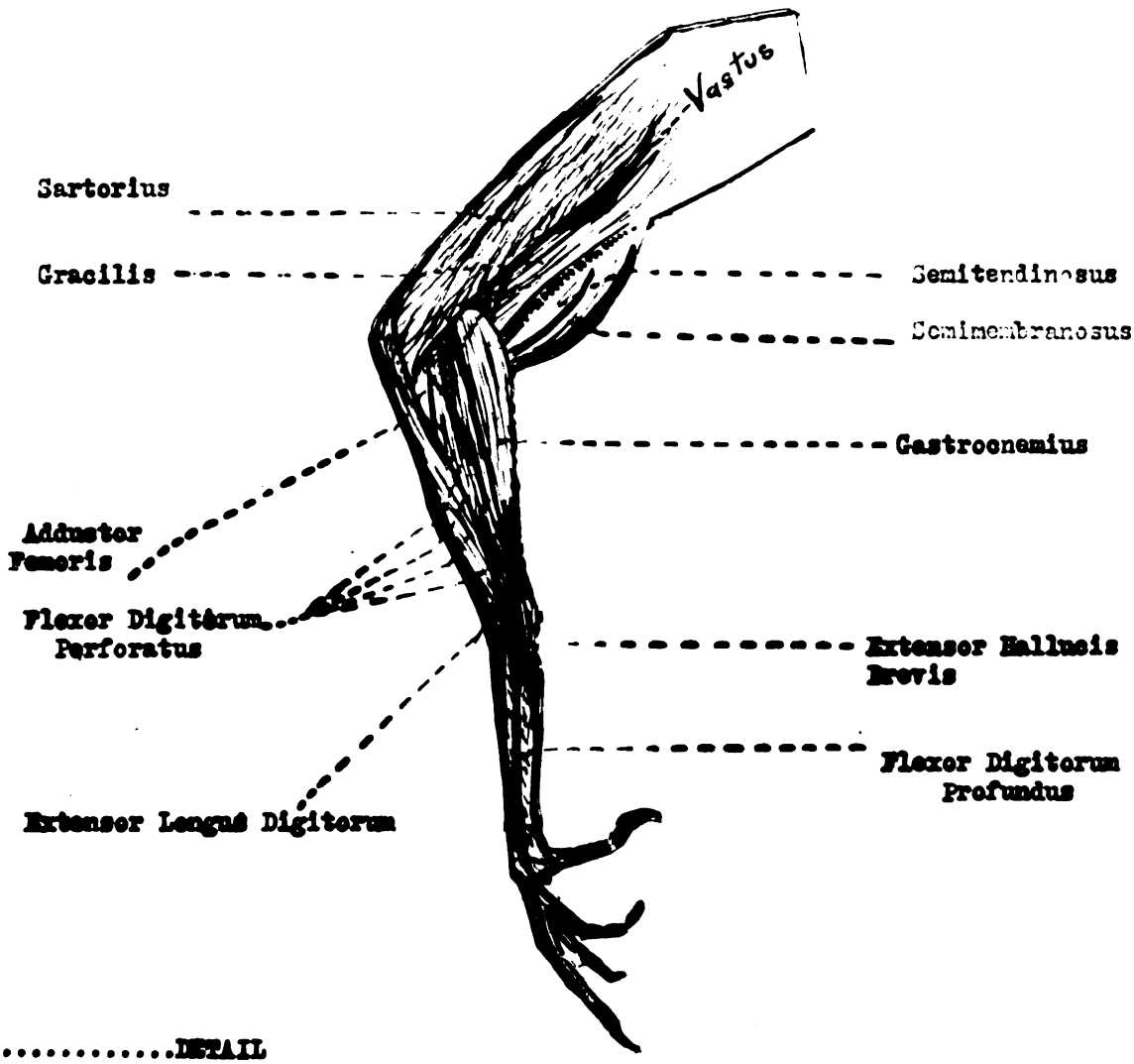
.....DELTOIL
of
BROWNED GRACKLE.....

.....PLATE IC.....



.....Muscles of BRONZED GRACKLE.....

.....PLATE II.....



.....DETAIL OF BRONZED GRACKLE.....

.....PLATE ID.....

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