ON THE ANATOMY OF THE RED BIRD OF PARADISE, WITH COMPARATIVE REMARKS ON THE CORVIDAE

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THOUGH several excellent papers have been written on the pterylography and relationships of the Birds of Paradise (Paradisaeidae), the appendicular myology has not been described. Through the kindness of Mr. Keith K. Kreag of the Detroit Zoological Park, I have been able to dissect a male Red Bird of Paradise, *Paradisaea* ("*Uranornis*") *rubra,* which died on December 1, 1954. The classification used here is that of Mayr (1941: 167–183) rather than the uncritical treatment of Iredale (1950).

Parker (1875: 339 and Plate 62) discussed and illustrated the palate of *Paradisaea minor* (*papuana*) and Stonor (1937: 476) illustrated the palate of *Manucodia.* Nitzsch (1867: 75–76 and Plate 3) illustrated the ventral feather tracts of *Paradisaea apoda* and commented on those of *Epimachus.* Forbes (1885: 335–344) described the trachea of *Seleucides ignotus, Manucodia ater,* and *Phonygammus keraudrenii gouldii.* Ogilvie-Grant (1905) discussed the display behavior of the Lesser Bird of Paradise (*Paradisaea minor*) and Pycraft (1905) described the pterylography and dermal musculature of the same species. Crandall (1937) commented on the molt and display of *P. rubra* and *Seleucides ignotus* ("*melanoleucus*"). Stonor (1936: 1177–1185) discussed the evolution of the Paradisaeidae and presented a suggested "family tree." Two years later, Stonor (1938: 417–481) illustrated the pterylosis of ten genera, including that of *P. rubra.* Beecher (1953: 287) illustrated the jaw musculature of *P. rubra.*

NOTES ON PTERYLOSIS

In speaking about *P. rubra,* Crandall (1937: 193) stated that "the expected requirement of four months for the molt of the adult male, was established. This began on May 21 and was complete by September 25." The specimen I had for study, and which died on December 1, 1954, exhibited evidence of molt in the remiges, rectrices, and the flank plumes, but not in the rest of the body tracts.

Stonor (1938: Figs. 23 and 24) illustrated the dorsal and ventral feather tracts of *P. rubra.* All that I can add is that there is an anal circlet of feathers.

There are 10 primaries and 10 secondaries. The fifth secondary is present (eutaxic). The innermost secondary is the shortest (about 45 mm.), the outermost, the longest (127 mm.). On the left wing, the outer four primaries and the fourth secondary (outermost counted as the first) possess basal sheaths, indicative of a recent molt. On the right wing, the outer three primaries and the fourth secondary have such sheaths.

A carpal covert, inserted in the proximal side of the base of the first primary, is present and is 21 mm. long in both wings. I found no evidence of a carpal remex. Pycraft (1905: 443) stated that both the carpal remex and its covert were present in *P. minor*.

I found only two obvious alula quills, both of which had recently molted. The outermost was unsheathed for a distance of 19 mm. and 22 mm. on the left and right wing, respectively. The innermost was unsheathed for 23 mm. bilaterally. The number of alula quills should be checked in non-molting specimens. It is likely that there are three quills, the innermost being very small. Miller (1915: 136) stated that "small Oscines have but three [alula quills], of which the third is small."

There are 12 rectrices and the innermost pair is raised above the level of the others. The sixth rectrix (innermost counted as the first) on the left and the fifth on the right have basal sheaths. There are 10 upper tail coverts.

All of the flank plumes possess basal sheaths.

The specimen had been eviscerated and the oil gland removed, so that I cannot say whether the oil gland is nude or tufted. Pycraft (1905: 444) stated that it is nude in *P. minor*.

OSTEOLOGY

I compared the skeleton of *P. rubra* with articulated skeletons of *Corvus brachyrhynchos* and *Cyanocitta cristata*. Table 1 presents certain of the information obtained.

The number of fused vertebrae in the synsacrum and the number of free caudal vertebrae varies in all other species I have studied,

TABLE 1

	Paradisaea rubra	*Corvus brachyrhynchos*	*Cyanocitta cristata*
Number of cervical vertebrae	14	14	14
Number of cervicodorsal ribs	2	2	2
Number of dorsal vertebrae	5	5	5
Number of true ribs	5	5	5
Number of thoracic ribs	1	1	1
Number of fused vertebrae in synsacrum	11	11	11
Number of free caudal vertebrae	6	7	6

hence it is presumed that variation would be found in the present species if sufficient material were examined.

The atlas is perforated by the odontoid process in *Corvus* and *Cyanocitta.* The configuration of the atlas is similar in *Paradisaea,* but the odontoid process of the axis does not actually perforate the atlas. A roughly U-shaped os opticus is present in all three species, as is an os humeroscapulare. The latter bone exhibits its best development in *P. rubra.* The os opticus apparently has not been described previously in the Birds of Paradise.

In *P. rubra,* the first cervicodorsal rib (articulating with cervical vertebra Number 13) is about 5 mm. long; the second cervicodorsal rib is 22 mm. long. The latter rib has a large uncinate process. Neither of the cervicodorsal ribs possess uncinate processes in *Corvus* or *Cyanocitta;* this is another character in which one expects to find some variation in a large series of skeletons. In each species, all five of the true ribs articulate with the sternum. None of the three species has uncinate processes on the thoracic rib (which articulates dorsally with the synsacrum). The sternal portion of this rib fuses with the sternal part of the fifth true rib.

The scapulo-coraco-clavicular articulation is similar in the three species and differs from the arrangement I have seen in non-passerine birds. The head of the furculum is expanded to form large anterior and posterior processes. The anterior process articulates with the head of the coracoid; near its base, the posterior process articulates with the medial surface of the acromion process of the scapula. The acromion process is very small and is fairly well hidden between the much larger heads of the coracoid and the furculum.

Though Table 2 is based on measurements of only one specimen of each species, these data reveal the much greater development of the hallux in *P. rubra.* Not only is the hallux the longest of the digits in *P. rubra,* but it is very robust, nearly equalling the bulk of the other three digits; the claw is sharply decurved. In *Corvus* and *Cyanocitta,* digit III is considerably longer than the hallux.

Pycraft (1905: 446), in speaking of *Paradisaea minor,* commented: "The hallux is of great size, much longer than the front toes. The middle and outer toes (text-fig. 30, p. 445) . . . are united at their bases, so that the foot may well be described as syndactyle." In *P. rubra,* also, the proximal phalanges of digits III and IV are united to produce a syndactylous condition.

Crandall (1937: 195) wrote of *Seleucides:* "The great grasping power of the feet and the resultant ease with which it moves about its perches, in any direction, may well be accounted for by the extraordinary

TABLE 2

LENGTH OF APPENDICULAR BONES IN MILLIMETERS

	Paradisaea rubra	*Corvus brachyrhynchos*	*Cyanocitta cristata*
Humerus	40.1	67.4	31.6
Ulna	51.4	83.2	38.4
Manus*	39.8	85.7	31.3
Femur	35.1	52.1	29.8
Tibiotarsus	62.4	92.2	50.2
Tarsometatarsus	43.7	61.9	35.2
Hallux	35.0	38.0	21.6
Digit II	27.7	35.9	20.0
Digit III	34.7	51.8	28.0
Digit IV	31.0	37.2	20.7

*Manus is carpometacarpus plus digit II.

development of the short muscles of the metatarsus." This is not true of *P. rubra* inasmuch as only two of the nine "short" muscles are present in this species and neither is unusually well developed.

The data given above also reveal that in *P. rubra* and *C. cristata* the humerus and manus are nearly equal in length, whereas in the crow there is an increase in length of the wing elements from proximal to distal.

TABLE 3

PROPORTION OF INDIVIDUAL WING ELEMENTS TO TOTAL WING-LENGTH

	Humerus	*Ulna*	*Manus*
Paradisaea rubra	30.5	39.1	30.3
Cyanocitta cristata	31.2	37.9	30.8
*Garrulus glandarius**	31.9	37.0	31.1
*Pica pica**	31.1	36.9	32.0
*Corvus corone**	29.0	35.3	35.6
*Corvus corax**	28.8	35.3	35.8
Corvus brachyrhynchos	28.5	35.2	36.2

*Data taken from Stonor, 1942: 16.

WING MUSCLES

M. pectoralis.—This muscle arises from the posterior and lateral aspects of the sternal body, from the ventral half of the carina, from the clavicle and the coracoclavicular membrane adjacent to it. Fleshy fibers, surrounded by a dense tendinous envelope, insert on the ventral surface of the deltoid crest (crista lateralis humeri). Tendinous bands (Pectoralis propatagialis longus et brevis) pass from the area of insertion to fuse, respectively, with the bellies of Mm. tensores patagialis longus et brevis. In addition, a large bundle of fleshy fibers passes dorsad to insert into the skin at the posterior margin of the pteryla ventralis (Pycraft, 1905: 444), which gives rise to the flank plumes.

M. supracoracoideus.—This powerful muscle arises from the basal (dorsal) half of the carina, from the anterior and medial portions of the body of the sternum, from the basal three-fourths of the anterior surface of the coracoid, and from the coracoclavicular membrane adjacent to the coracoid. The tendon forms on the lateral surface of the belly. Fleshy fibers insert on the stout tendon as it passes through the triosseal canal but do not extend as far as the area of insertion, which is at the junction of the humeral head and the deltoid crest. The tendon is not concealed by M. deltoideus minor. A few millimeters beyond the termination of the fleshy fibers, the tendon runs in contact with the anterior surface of the os humeroscapulare and is held in position by a strong fibrocartilaginous pulley, which is attached to the dorsal and ventral edges of this bone.

M. coracobrachialis posterior.—Typical in origin and insertion, this muscle arises by fleshy fibers from the lateral surface of the basal 20 mm. of the coracoid. It inserts by a large tendon on the capital groove surface of the internal tuberosity of the humerus.

M. latissimus dorsi.—Pars anterior is a thin band of muscle, 9 mm. wide at its origin by an aponeurosis from the spines of the last cervical and the first dorsal vertebrae. It inserts mostly by fleshy fibers on a curved area (5 mm. long) on the humerus, beginning 7 mm. distal to the area of insertion of M. supracoracoideus.

Pars posterior arises by an aponeurosis from the spines of the second, third, and fourth (anterior half only) dorsal vertebrae. After passing deep to pars anterior, the belly gives way to a thin tendon, which inserts on the posterior aspect of the humerus, 2 mm. proximal to the insertion of pars anterior and immediately anterior to the origin of the internal head of M. humerotriceps. The tendon of insertion does not pierce the fibers of origin of the latter muscle as it does in the crow (Hudson and Lanzillotti, 1955: 6).

A dermal component (M. latissimus dorsi metapatagialis) seems to be absent. Pycraft (1905: 449) stated that M. Latissimus dorsi dorso-cutaneus is well developed in *P. minor.*

M. rhomboideus superficialis.—This thin sheet arises semitendinous from the spines and the interspinous ligaments of the last two cervical and the first two dorsal (anterior half only of No. 2) vertebrae. The muscle inserts by fleshy fibers on about the anterior half (23 mm.) of the scapula and on the head of the furculum adjacent to it.

M. rhomboideus profundus.—This muscle arises by semitendinous fibers from the neural spines of the last cervical vertebra and the first four dorsal vertebrae (from about the anterior half of the spine of vertebra No. 4). It inserts on the posterior 17 mm. of the dorsomedial surface of the scapula.

M. coracobrachialis anterior.—This small, partly fibrous, muscle (8 mm. long and 1.5 mm. wide) arises by a flat tendon from the dorsal end of the coracoid. It inserts by fleshy fibers on the anterior surface of the head of the humerus, just posterior to the insertion of M. supracoracoideus. The belly does not cover any of the anterior edge of the head of the humerus.

M. tensor patagii brevis.—This muscle is separated throughout from M. tensor patagii longus, although they arise from adjacent areas on the dorsal end of the furculum. The belly is about 27 mm. in length and it extends about two-fifths the distance down the arm. The strong tendon (14 mm. long) sends fibrous bands into the belly of M. extensor metacarpi radialis, 9 mm. distal to the humeral attachment of that muscle, and then passes proximad to insert on the lateral epicondyle of the humerus, where its attachment is superficial to the tendon of origin of M. extensor metacarpi radialis. Unlike the cuckoos, there is no posterior extension of the tendon which fuses with the antibrachial fascia, nor does the main tendon fuse with the surface of M. extensor metacarpi radialis. The tendon of insertion seems to be identical to the condition described for the crow by Hudson and Lanzillotti (1955: 20; see their M. propatagialis brevis).

M. tensor patagii longus.—This is a small bundle (25 mm. in length, but only about one-fourth the bulk of the preceding muscle), which arises anterior and superior to the tensor patagii brevis. The fibrous tendon (elastic proximally, but inelastic distally) passes distad in the anterior margin of the propatagium; part of this tendon inserts on the extensor process, but most of it fuses with the fascia of the manus.

M. deltoideus major.—The structure of this muscle is similar to that found in the crow in that the two heads are separate throughout most of their extent. The larger, anterior head seems to arise solely from the very large os humeroscapulare and from the adjacent ligaments of the joint capsule. The smaller, posterior head arises primarily from the superior surface of the furculum but has a small origin from the lateral surface of the acromion process of the scapula. The anterior head inserts by fleshy fibers on nearly the entire length of the humeral shaft, beginning at the level of the deltoid crest (crista lateralis humeralis). Though the posterior head sends some fleshy fibers into the anterior head, beginning at about midlength of the humerus, essentially, the two bellies retain their independence until they reach within 8 mm. of the lateral epicondyle of the humerus, where the insertion is made by a short tendon.

M. deltoideus minor.—This is a small fleshy band, which is less than 1 mm. in width. It arises from the tip of the acromion process of the scapula near the dorsal opening of the triosseal canal. It inserts on the proximal end of the deltoid crest, 2 mm. distal to the area of insertion of the supracoracoideus.

M. proscapulohumeralis.—This is M. scapulohumeralis anterior of Hudson and Lanzillotti (1955: 11). It arises by fleshy fibers for a distance of 6 mm. from the lateral surface of the scapula posterior to the glenoid fossa. The belly is 15 mm. in length. It inserts by fleshy fibers immediately distal to the pneumatic foramen and between the areas of origin of the two heads of the humerotriceps.

M. subscapularis.—The external head of this muscle arises for a distance of 12 mm. from the lateral surface of the scapula, caudal to the glenoid fossa. The internal head arises from the medial surface of the bone for a distance of about 18 mm. The two heads are separated by the main tendon of insertion of M. serratus superficialis anterior. The two bellies fuse to insert in common on the proximal end of the internal humeral tuberosity (tuberculum mediale humeri).

M. dorsalis scapulae.—This is M. scapulohumeralis posterior of Hudson and Lanzillotti (1955: 13). This is a large muscle which arises from a little more than the posterior half (27 mm.) of the blade of the scapula. It inserts on the anconal surface, proximal end, of the bicipital crest distal to the origin of the humeral tendon of M. biceps brachii and opposite the pneumatic foramen.

M. sternocoracoideus.—This muscle is like that in the Corvidae in origin, insertion, and relationships.

M. subcoracoideus.—This muscle arises by two heads, which fuse a few millimeters before their insertion on the internal tuberosity of the humerus, adjacent to the insertion of M. subscapularis. The dorsal, shorter head arises from an area 3 mm.

wide on the medial surface of the acromion process of the scapula. The ventral, longer head arises from the posterior surface of the base of the coracoid.

M. serratus profundus.—This complex arises by four fleshy slips from the transverse processes of cervical vertebrae numbers 12 and 13 and from the lateral surface, dorsal to the uncinate processes, of the last cervicodorsal rib and the first true rib. These slips pass posterodorsally to a common fleshy insertion on the medial surface of the scapula, beginning at about the middle of the blade.

M. serratus superficialis anterior.—This muscle arises by two fleshy slips, one from the last cervicodorsal rib, the other from the first true rib. The posterior fasciculus is much larger, arising over an area 10 mm. long on the uncinate process and the body of the rib inferior to this process. The anterior slip is only about 1 mm. in width. As in the crow (Hudson and Lanzillotti, 1955: 9), the main tendon (3 mm. wide) passes between the two heads of M. subscapularis and inserts on the ventral edge of the scapula, beginning about 4 mm. caudal to the glenoid fossa. From the deep aspect of the common belly, however, an aponeurotic sheet passes inward to insert, in part, on the ventral edge of pars interna of M. subscapularis and, in part, passes dorsad medial to this belly to insert on the scapula dorsal to its origin.

M. serratus superficialis posterior.—This complex arises by three fleshy slips from the lateral surface, ventral to the uncinate processes, of true ribs numbers two, three, and four. These fasciculi fuse immediately to form a thin sheet of muscle, which inserts by fleshy fibers on the apex of the scapula and by a thin aponeurosis anteriorly as far as the tendon of the serratus superficialis anterior.

M. biceps brachii.—The biceps has a typical L-shaped tendon of origin. The longer tendon arises from the dorsal end of the coracoid; the shorter tendon, from the proximal end of the bicipital crest of the humerus. The belly, about 33 mm. long, extends nearly to the distal end of the humerus, where two tendons are formed. These insert immediately distal to the proximal articular surfaces of the radius and ulna, respectively (see Hudson and Lanzillotti, 1955: fig. 12).

M. triceps.—The scapulotriceps has a typical origin from the lateral surface of the scapula. A sesamoid is developed in the tendon where it passes around the distal end of the humerus. The tendon inserts on the dorsoproximal surface of the ulna, at the base of the coronoid process.

Both heads of the humerotriceps arise from most of the posterior surface of the shaft of the humerus. The origin of the internal head begins at the distal end of the capital groove. The origin of the external head begins on the bicipital crest, immediately distal to the articular head, and from the deep part of the pneumatic canal. The two heads fuse a short distance inferior to the insertion of M. proscapulohumeralis and insert by tendinous and fleshy fibers on the proximal end of the olecranon process of the ulna. This area of insertion is separated from the tendon of insertion of the scapulotriceps by a distance of about 3 mm.; there are no intervening fleshy fibers of insertion.

M. expansor secundariorum.—This small fleshy muscle seems to arise entirely from the humero-ulnar pulley. It inserts by fleshy fibers on the bases of four of the proximal secondaries. With respect to the origin, this seems to be the same as described for the crow by Hudson and Lanzillotti (1955: 23).

M. brachialis.—M. brachialis is fleshy throughout. It arises from the brachial impression on the distal end of the humerus and inserts (over an area 7 mm. long) in the brachial impression on the proximal end of the ulna, between the two heads of M. flexor digitorum profundus.

M. extensor metacarpi radialis.—This powerful muscle arises by fleshy fibers, surrounded by a dense tendinous envelope, from the ectepicondylar process (lateral epicondyle) of the humerus. The belly (35 mm. in length) terminates in a stout, flattened tendon, which inserts on the extensor process of metacarpal I. Just proximal to the area of insertion, fleshy fibers of M. abductor pollicis take origin from the tendon. In *P. rubra*, this is the largest muscle of the forearm.

M. extensor digitorum communis.—The common extensor arises by a tendon from the lateral supracondylar ridge of the humerus. The belly is about 33 mm. in length. The tendon of insertion bifurcates opposite the base of the pollex. The shorter tendon inserts on the base of the pollex. The longer tendon passes distad in a deep groove on the anterior edge of metacarpal II; near the distal end of that bone, the tendon runs to the dorsal surface of the metacarpal and then makes nearly a ninety degree turn to insert on the base of the proximal phalanx of digit II. The tendon of M. extensor indicis longus crosses over the tendon at its insertion.

M. supinator brevis.—This is a weakly developed muscle (belly 16 mm. long), which extends about one-third the length of the radius. It arises from the distal end of the humerus and inserts on the radius.

M. flexor metacarpi radialis.—This is M. extensor carpi ulnaris of Hudson and Lanzillotti (1955: 32). It arises by a tendon whose major attachment is to the lateral supracondylar ridge of the humerus. From this tendon, a strong fibrous band (1 mm. wide) passes posteriorly to attach to the ulna, 7 mm. from the proximal end of the olecranon process. Fleshy fibers begin about 6 mm. from the humeral origin of the tendon; the belly is 35 mm. in length. It inserts by a strong tendon on the base of metacarpal III, and not at the proximal end of the intermetacarpal space as in some birds.

M. pronator brevis.—This is M. pronator sublimus of Hudson and Lanzillotti (1955: 25). The origin of this muscle from the distal end of the humerus is typical. Fleshy fibers begin about 6 mm. distal to the humerus and extend (30 mm.) to within 15 mm. of the distal end of the radius. A tubercle marks the distal extent of insertion.

M. pronator longus.—This is M. pronator profundus of Hudson and Lanzillotti (1955: 25). The origin from the humerus is typical. The total length of the belly, which is especially heavy proximally, is 24 mm. It inserts mostly by an aponeurosis, which extends distad as far as the insertion of the pronator brevis, though the belly is only about two-thirds as long as that muscle.

M. extensor pollicis longus.—This is a small, almost rudimentary, muscle (belly 13 mm. long), which is limited to the distal third of the forearm. It arises only from the radius. It inserts only on the posteroproximal corner of the radiale; no trace of a tendon extending to the base of the carpometacarpus could be found.

M. anconeus.—The origin from the humerus is as in the corvids. The belly (28 mm. long) extends almost two-thirds the way down the ulna. The area of insertion begins just distal to the proximal articular surface of the ulna.

M. extensor indicis longus.—This is a long, thin muscle with a belly 38 mm. long. It arises from the radius only, beginning at the proximal end of that bone, proximal to the insertion of the biceps. It inserts on the base of the distal phalanx, digit II.

M. flexor metacarpi brevis.—Hudson and Lanzillotti (1955: 35) prefer to call this a "short distal head" of the extensor indicis longus. It is absent in *P. rubra*.

M. flexor digitorum sublimus.—This is a poorly developed, spindle-shaped muscle with a belly 25 mm. in length. It arises by a tendon from the entepicondylar process (medial epicondyle) of the humerus posterior to the origin of M. pronator longus. In its distal half, the belly is ensheathed by the strong fascia covering the flexor carpi ulnaris (as in the crow). Part of this fascial sheath passes around the ulnare to the carpometacarpus. At the distal end of the forearm, the tendon of the flexor digitorum sublimus passes around the anterior face of the ulnare to the carpometacarpus. At about the middle of the latter bone, the tendon forms a complete sheath around the tendon of M. flexor digitorum profundus and then inserts on the base of the proximal phalanx, digit II.

M. flexor digitorum profundus.—This muscle has two heads of origin, separated by the insertion of M. brachialis. The belly (32 mm. long) extends three-fourths the way down the forearm. The tendon inserts on the base of the distal phalanx of digit II.

M. flexor carpi ulnaris.—This large muscle (belly 32 mm. long) has a typical origin from the humerus, and its tendon passes through a well developed humero-ulnar pulley. It has a typical insertion on the proximal face of the ulnare. A small, posterior fasciculus passes from the tendon of origin to insert by fleshy fibers (proximally) and by an aponeurosis (distally) on the bases of the secondaries and extends as far as the ulnare.

M. flexor carpi ulnaris brevis.—This is M. ulnimetacarpalis ventralis of Hudson and Lanzillotti (1955: 29). The fleshy fibers (22 mm. long) begin 21 mm. distal to the proximal tip of the olecranon process. The muscle inserts on the anterior surface of the carpometacarpus at the base of the extensor process.

M. abductor pollicis.—There is a single belly (6 mm. long), which arises mostly by fleshy fibers from the tendon of insertion of M. extensor metacarpi radialis. It inserts near the base of the pollex by a tendon which sends a tendinous sheet to the tip of that digit.

M. adductor pollicis.—This is a small, fleshy muscle, which arises from the base of the carpometacarpus and which inserts on the entire posterior surface of the pollex.

M. flexor digiti III.—This is a weakly developed (belly 7 mm. long) muscle, which arises from the proximal end, posterior surface, of metacarpal III; a few fibers arise more distally and insert on the tendon. The tendon inserts near the middle of digit III. No tubercle or posterior spine is developed on this digit.

Mm. interosseous dorsalis and palmaris (volaris).—These two muscles are typical in origin and insertion. The tendons of both muscles insert on the base of the distal phalanx of digit II.

M. extensor pollicis brevis.—This muscle is absent.

M. abductor indicis.—This muscle is rudimentary. It is represented primarily by a fascial band, containing a few fleshy fasciculi, extending from the base of the pisiform process to the base of the proximal phalanx, digit II.

M. flexor pollicis.—This muscle is absent.

M. flexor metacarpi posterior.—This is M. ulnimetacarpalis dorsalis of Hudson and Lanzillotti (1955: 35). It is a very poorly developed muscle with a belly only 7 mm. long. It arises by a flat tendon from the distal end of the ulna, and it inserts on the proximal end of metacarpal III. A few fleshy fasciculi attach to the bases of several of the proximal primaries.

LEG MUSCLES

M. iliotrochantericus posticus.—This muscle arises by fleshy fibers from the entire anterior iliac fossa. It is covered superficially by the aponeurosis of origin of the iliotibialis muscle. The strong, flat (3 mm. wide) tendon inserts along a curved line on the lateral surface of the trochanter, immediately inferior to the proximal end of that process.

M. iliotrochantericus anticus.—This muscle arises semitendinous from the anterior 11 mm. of the ventrolateral edge of the ilium. This area of origin lies ventral to the origin of the iliotrochantericus posticus, anterior to that of the iliotrochantericus medius, and dorsal to that of the deep head of the sartorius. Nearly all of the muscle is visible before one reflects the iliotrochantericus posticus. The iliotrochantericus anticus inserts over a relatively wide area (3 mm. long) beginning at the lowermost part of the tendon of insertion of the ischiofemoralis muscle. The tendon passes between the external and medial heads of M. femorotibialis.

M. iliotrochantericus medius.—This is a thin strap of muscle, 7 mm. long; it is 3 mm. wide, at its origin from the ventral edge of the ilium, beginning about 1 mm. caudal to the area of origin of the iliotrochantericus anticus. It inserts by a thin tendon (1 mm. wide) on the posterolateral edge of the femur, beginning 2 mm. distal to the proximal end of that bone. The origin, belly, and insertion are concealed by the iliotrochantericus posticus. The area of insertion is anterior to that of the latter muscle and is proximal to that of the iliotrochantericus anticus.

M. iliacus.—This small muscle arises from the ventral edge of the ilium, inferior to the origin of the iliotrochantericus medius. It inserts about 2 mm. distal to the neck of the femur at the upper extent of femorotibialis internus.

M. sartorius.—This is a large thin muscle with an extensive origin and, in fact, may be considered to have two heads of origin. The anterior, more superficial, portion arises by an aponeurosis from the neural spines of the last two dorsal vertebrae and from a small area on the anterior edge of the ilium. The posterior, deeper, head is visible only after one reflects the following muscles: iliotrochantericus anticus, femorotibialis externus, and femorotibialis medius. This head arises by an aponeurosis from an area 15 mm. long on the ventral edge of the ilium, beginning at the anteriormost end of that bone and extending caudad to the area of origin of M. iliotrochantericus medius. The origin lies ventral to that of M. iliotrochantericus anticus.

The superficial and deep heads fuse along their line of contact a short distance inferior to the ilium. The anterior part of the muscle inserts by an aponeurosis primarily on the anteromedial edge of the tibial head. The posterior part of the belly inserts by fleshy fibers on the distal end of the belly and on the tendon of insertion of M. femorotibialis internus.

M. iliotibialis.—This is a thin sheet of muscle, no heavier posteriorly than anteriorly. It arises by an aponeurosis from the median dorsal ridge and the posterior iliac crest. There is a paddle-shaped aponeurotic area in the center of the distal two-thirds of the belly. Distally, it contributes to the formation of the patellar tendon and also inserts on the head of the tibia. The belly covers most of the lateral aspect of the thigh. The following muscles are visible before one reflects M. iliotibialis: the superficial part of the sartorius, most of the semitendinosus, a small part of semimembranosus, and the tendon of biceps femoris.

M. femorotibialis externus.—This muscle arises from most of the lateral surface of the femur, beginning 5 mm. distal to the proximal end of the bone, and between the areas of insertion of Mm. iliotrochantericus anticus and ischiofemoralis and distal to the insertion of Mm. iliotrochantericus posticus and medius. The anteromedial portion of the belly is fused with M. femorotibialis medius. The tendon of the externus contributes to the formation of the patellar tendon.

M. femorotibialis medius.—This muscle arises by fleshy fibers, surrounded by a dense aponeurosis, from the posteromedial surface of the femur, beginning at the level of insertion of M. iliotrochantericus medius. Fleshy fibers insert on the proximal face of the patella, and the tendon contributes to the formation of the patellar tendon.

M. femorotibialis internus.—This muscle arises from the medial surface of the femur, beginning at the level of insertion of M. iliacus and extending to the distal end of the bone. Two tendons are formed, one from the proximal fibers, the other from the distal fibers. The two tendons insert in a V-shaped pattern on the medial and anterior corner of the head of the tibiotarsus.

M. piriformis.—Pars iliofemoralis is absent.

Pars caudofemoralis is a thin strap of muscle, with a maximum width of 5 mm. It arises by a tendon from the anterolateral corner of the base of the pygostyle. It inserts by a flat tendon (1 mm. wide), on the lateral surface of the femur, beginning 11 mm. inferior to the proximal end of the bone.

M. semitendinosus.—This is a thin strap of muscle which arises semitendinous from a small area along the dorsolateral edge of the ilium, caudal to the posterior iliac crest. Posterior to the distal end of the femur, the belly is separated by a ligamentous raphe from a second fleshy belly (M. accessorius semitendinosi). The latter muscle inserts mostly by an aponeurosis along a curved line on the distal end of the femur, beginning a short distance superior to the attachment of the proximal arm of the biceps loop on the posterolateral surface of the bone. The line of insertion then passes diagonally downward and mesiad.

The raphe, which separates the semitendinosus and the accessorius, becomes a flat aponeurosis (2 mm. wide), which fuses with the proximal part of the tendon of M. semimembranosus. There also is a strong fascial connection between the semitendinosus and the pars media of M. gastrocnemius.

M. semimembranosus.—This muscle arises by semitendinous fibers from a small area on the posteroventral edge of the ischium, inferior to the origin of the ischiofemoralis and caudal to the origin of the adductor longus et brevis. It inserts by a flat aponeurosis (6.5 mm. wide) on the medial surface of the tibiotarsus, beginning about 6 mm. from the proximal end of that bone.

M. biceps femoris.—The biceps muscle arises primarily by fleshy fibers from the lateral and ventral surfaces of the entire posterior iliac crest (an area 12 mm. long). There is a very small aponeurotic origin dorsal to the acetabulum, but it does not overlap the posterior part of the iliotrochantericus posticus. The fleshy fibers give way to a strong round tendon at the level of the biceps loop. The tendon inserts 12 mm. inferior to the proximal end of the fibula.

M. ischiofemoralis.—This muscle arises by fleshy fibers from the dorsolateral surface of the ischium, dorsal to the areas of origin of Mm. adductor longus et brevis and semimembranosus. It inserts by a flat tendon (1.5 mm. wide) on the lateral surface of the femur, beginning 4 mm. from its proximal end.

M. obturator externus.—The two well developed heads of this muscle have little in common except that each has some fleshy fibers which insert on the tendon of M. obturator internus.

The dorsal head arises by fleshy fibers from the ventral edge of the ilio-ischiatic fenestra. Some of the fibers insert on the tendon of the obturator internus, but the bulk of the muscle inserts by a flat tendon (1.5 mm. wide) on the lateral surface of the femur, immediately anterior to the area of insertion of the obturator internus. Though the two tendons can be separated, there seems to be a tendency for them to fuse, and, functionally, the two muscles must act as a unit.

The ventral, shorter but more bulky, head arises by fleshy fibers from the ventral and anterior edges of the obturator foramen. A small, deep part inserts on the tendon of the obturator internus, but the main part of the muscle inserts both by fleshy and tendinous fibers (for a distance of 3 mm.) on the posterolateral edge of the femur, posterior to the insertion of the obturator internus, and beginning immediately distal to the proximal end of the trochanter.

M. obturator internus.—Triangular in shape, this muscle arises from the medial surfaces of the ischium and pubis, but apparently not from the ischiopubic membrane. None of its fibers arise from the posterolateral wall of the renal depression inside the pelvis. After emerging through the obturator foramen, the strong tendon (1.5 mm. wide) inserts on the lateral surface of the femur, beginning 1 mm. distal to the proximal end of the trochanter.

M. adductor longus et brevis.—Though there are two distinct parts to this muscle, care must be taken to make the proper separation between them in their proximal half.

Pars anticus is about three times as bulky as pars posticus. Pars anticus arises by a dense aponeurosis from the ventrolateral edge of the ischium for a distance of 10 mm., beginning at the posterior margin of the obturator foramen. The belly inserts by fleshy fibers on the posterolateral surface of the femur, beginning about 13 mm. distal to the proximal end of the trochanter (which is just inferior to the insertion of M. piriformis) and extending to the distal end of the femur. Distally, the line of insertion curves from the lateral surface of the femur to the upper end of the medial condyle, adjacent to the insertion of pars posticus. The long flexors of the digits arise just distal to this curved line of insertion of pars anticus.

Pars posticus also arises by a dense aponeurosis (about 5 mm. wide) deep to the posteriormost part of the tendon of pars anticus, and it extends about 1 mm. caudal to the origin of that muscle. Most of the belly of pars posticus lies posterior to the belly of pars anticus. Fleshy fibers extend to the distal end of the femur. The muscle inserts by a round cord of semitendinous fibers on the posterior face of the medial condyle. This insertion is shared intimately with the fibers of origin of M. gastrocnemius pars media.

M. tibialis anticus.—This muscle arises by two heads. The tibial head arises by fleshy fibers and by strong semitendinous bands (on its superficial surface) from the inner cnemial crest, the rotular crest, and the outer cnemial crest. The semitendinous bands are shared with the more superficial M. peroneus longus. The femoral head arises by a flat tendon from the anterodistal end of the lateral femoral condyle. The two heads fuse about 10 mm. inferior to the rotular crest. The belly extends to the level of the ligamentum transversum at the distal end of the tibiotarsus, where a stout tendon is formed and passes under this ligament superficial to the tendon of M. extensor digitorum longus. The tendon inserts on a tubercle 8 mm. inferior to the proximal end of the tarsometatarsus.

M. extensor digitorum longus.—This is the deepest muscle on the anterior surface of the tibiotarsus. It arises by fleshy fibers from the proximal fourth of that bone, especially from the inner cnemial crest, though the belly is 53 mm. long. Near the distal end of the tibiotarsus, the tendon passes under the ligamentum transversum, deep to the tendon of M. tibialis anticus, and then under a bony bridge. On the proximal end of the tarsometatarsus, the tendon passes under another bony bridge to a position medial to the tendon of insertion of M. tibialis anticus. The tendon trifurcates at the distal end of the tarsometatarsus to supply digits II, III, and IV, as in the crow (Hudson, 1937: 31).

M. peroneus longus.—This large muscle is similar in origin and in relative development to that found in the crow (see Hudson, 1937: 33 and Fig. 1). Two tendons are formed. The short tendon inserts on the tibial cartilage. The long tendon inserts on the tendon of M. flexor perforatus digiti III, 9 mm. distal to the proximal end of the tarsometatarsus.

M. peroneus brevis.—The short peroneal muscle arises semitendinous from the fibula and tibiotarsus, beginning at the level of the biceps insertion. Fleshy fibers extend to a fibrous loop at the distal end of the tibiotarsus. The tendon expands considerably as it approaches the area of insertion on the lateral surface of the tarsometatarsus near the base of the hypotarsus.

M. gastrocnemius.—This complex arises by three distinct heads and exhibits the same relative development as illustrated for the crow by Hudson (1937: Figs. 1 and 6).

Pars externa arises by a flat tendon (2 mm. wide) from the lateral surface of the distal end of the femur. The tendon is fused with the distal arm of the biceps loop.

Pars media arises from the femur in close relationship to the fibers of insertion of pars posticus of M. adductor longus et brevis. The belly is 22 mm. long. It passes downward lateral to the tendon of M. semimembranosus to fuse with the other two heads.

Pars interna is the largest of the three heads. It arises by fleshy fibers from the medial surface of the inner cnemial crest, from the head of the tibiotarsus, and from the fascia covering the knee. It is separated from pars media by the tendon of the semimembranosus.

The fleshy fibers of this muscle extend a little less than two-thirds the way down the tibiotarsus where they become aponeurotic. The tendon passes posteriorly around the tibial cartilage to insert on the hypotarsus and the posterolateral ridge of the tarsometatarsus in the usual manner. This tendon and the associated fascia form with the posterior sulcus of the tarsometatarsus a fibro-osseus canal which holds the flexor tendons in place.

M. plantaris.—This is a very small muscle with a belly about 12 mm. long. It arises from the posteromedial surface of the tibiotarsus immediately below the internal articular surface. The small tendon inserts on the proximomedial corner of the tibial cartilage.

M. flexor perforatus digiti II.—This spindle-shaped muscle (belly about 25 mm. long) has no origin directly from bone. It arises from the superficial tendon of origin of M. flexor hallucis longus and from the fascial bands of surrounding muscles.

There are five bony canals in the hypotarsus, two in the lateral half and three in the medial half. The deepest canal on the medial side of the process transmits the tendon of M. flexor digitorum longus. Immediately posterior to this canal is one which transmits the tendon of M. flexor perforatus digiti II. The most superficial (posterior) canal on the medial side transmits the tendons of Mm. flexores perforantes et perforati digiti II and III. The deeper canal on the lateral aspect of the hypotarsus transmits the tendon of M. flexor hallucis longus. Posterior to this is a single canal for the tendons of Mm. flexores perforati digiti III and IV.

After emerging from the hypotarsus, the tendon of M. flexor perforatus digiti II continues distad through the posterior compartment of the tarsometatarsus and through the intertrochlear space. The small tendon inserts on the medial corner of the base of the proximal phalanx, digit II, and is not perforated by the tendons of Mm. flexor perforans et perforatus digiti II or flexor digitorum longus.

M. flexor perforatus digiti III.—This muscle arises from the intercondyloid area of the femur in common with Mm. flexor hallucis longus and flexor perforatus digiti IV. The bellies of these muscles are fused proximally. The course of the tendon through the hypotarsus was given above. The long tendon of M. peroneus longus fuses with the tendon of this muscle, 5 mm. distal to the inferior surface of the hypotarsus. The tendon is perforated by both of the deep flexor tendons. The main insertion is on the medial edge, near the distal end, of the proximal phalanx of digit

III, but there is a small attachment to the lateral surface near the base of that phalanx. There is no vinculum.

M. flexor perforatus digiti IV.—This muscle shares a common origin with Mm. flexor hallucis longus and flexor perforatus digiti III. The belly extends to within 12 mm. of the distal end of the tibiotarsus, where the tendon grooves the superficial surface of the much wider tendon of M. flexor perforatus digiti III. The two tendons are enclosed in a common connective tissue sheath and retain this relationship through the hypotarsus and the upper part of the tarsometatarsus. The tendon inserts on the distal end of the proximal phalanx and on the fibrocartilaginous pad between phalanges 2 and 3. The tendon is perforated by the tendon of M. flexor digitorum longus.

M. flexor perforans et perforatus digiti II.—The belly of this muscle (22 mm. long) extends about a third the distance down the tibiotarsus. It arises from the lateral epicondyle of the femur and from associated fibrous bands located deep to the belly. It gives rise to a very thin tendon which forms, opposite the proximal phalanx of digit II, a complete fibrous sheath around the tendon of M. flexor digitorum longus. It inserts solely on the medial side of the proximal end of the second phalanx of digit II. It does not perforate the tendon of M. flexor perforatus digiti II. The relationships of the tendon in the hypotarsus were described above.

M. flexor perforans et perforatus digiti III.—This muscle has a complex origin, similar to that found in the crow (Hudson, 1937: 45), from the femur, the tibiotarsus, and the fibula. The belly is 50 mm. long. The course of the tendon in the hypotarsus was described above. The tendon inserts near the distal end of the second phalanx of digit III. Near the base of the proximal phalanx of digit III, the tendon perforates the tendon of M. flexor perforatus digiti III; it is perforated by the tendon of M. flexor digitorum longus about the middle of the second phalanx.

M. flexor digitorum longus.—This muscle has two distinct, mostly fleshy, heads. The femoral head arises from the posterior surface of the lateral epicondyle. The tibial head arises from the posterior surface of the proximal end of the tibiotarsus. The strong tendon passes through the deepest canal on the medial side of the hypotarsus. The tendon trifurcates and inserts on the bases of the distal phalanges of digits II, III, and IV.

M. flexor hallucis longus.—This large muscle arises by two heads. The superficial, or anterior, head arises by a strong tendinous band from the lateral epicondyle of the femur, distal to the attachment of the inferior arm of the biceps loop. The tendinous origin is shared by Mm. flexor perforatus digiti II and flexor perforans et perforatus digiti II. This head lies superficial to the biceps tendon.

The deep head arises by fleshy fibers and by a flat aponeurosis from the intercondylar area of the femur distal to the area of insertion of M. adductor longus et brevis pars anticus. The tendon passes through the deeper canal on the lateral side of the hypotarsus and then passes from lateral to medial across the tendon of M. flexor digitorum longus. The two tendons are not connected by a vinculum. As it passes the base of the proximal phalanx of the hallux, the tendon is completely ensheathed by the tendon of the flexor hallucis brevis. The tendon inserts on the base of the distal phalanx.

M. extensor hallucis longus.—This is a relatively well developed muscle with a belly about 30 mm. long. It arises from the anteromedial surface of the tarsometatarsus, beginning at the proximal end of that bone. The tendon passes under a fibrous loop on metatarsal I and inserts on the base of the ungual phalanx.

M. flexor hallucis brevis.—This muscle arises fleshy from the medial surface of the hypotarsus and the proximal end of the tarsometatarsus adjacent to that process. The belly is about 15 mm. long. The tendons of the flexor hallucis longus and flexor hallucis brevis pass from the posterior to the anterior surface of the tarsometatarsus through a large interval between the first and second metatarsals. At the tarsometatarsophalangeal joint, the small tendon expands into a heavy fibrous pad which completely ensheaths the tendon of the M. flexor hallucis longus and inserts on the proximal end of the first phalanx.

DISCUSSION

Pycraft (1905: 452) expressed doubt that the Birds of Paradise are closely related to the Corvidae or the Ptilonorhynchidae. Stonor (1937, 1938) demonstrated clearly that the Ptilonorhynchidae and the Paradisaeidae deserve family rank. He stated (1938: 417) that the limits of the latter family "are well defined, although their precise relationships are uncertain, and it is difficult to go further than stress their similarity to the Corvidae, for their structural features render it almost certain that the Paradiseidae originated from the same stock which appears to have given rise to the Crows, Starlings, and a few more isolated forms such as the Huia, Picathartes, and others, and of which they constitute a distinct branch."

In accordance with the modern views of many taxonomists "involving reduction of some of the present families to subfamilies and their subsequent combination into larger families," Amadon (1944: 1–3 and 17) considered the Birds of Paradise to be a subfamily (Paradisaeinae) of "an enlarged family Corvidae." In speaking of another matter, he commented that the Corvinae and the Paradisaeinae were "structurally similar subfamilies."

Much more information is needed on pterylography and other anatomical features before the extent of the above-mentioned similarity can be demonstrated. For example, Nitzsch (1867: 75) stated that all members of the Corvidae that he had examined "have the saddle of the spinal tract broad and laterally acute-angled, enclosing an elongated, fissure-like space." Stonor (1942: 4) commented that the "majority of the Corvidae" have such an apterion in the dorsal saddle. Lowe (1938: 261) elaborated on this situation by stating: "In the Corvidae the saddle-shaped expansion of the middle of the dorsal feather-tract tends to be more or less definitely and abruptly forked, with a narrow apterion or central featherless area; or, if not definitely forked, there is a long central apterion."

That there is some variation in the feather pattern in a group as large as the family Corvidae is not surprising. The striking difference in pattern, as illustrated by Lowe (1938: Pl. VI), between *Corvus frugilegus* and *C. corone*, however, is surprising and perplexing. Furthermore, neither of these patterns is like that found in the Paradisaeidae. By way of contrast, it can be said that there is a close similarity in the general feather pattern of the members of the Paradisaeidae. Stonor (1937: 484) remarked that of the species of this family that he had examined, "all agree in possessing a short saddle, situated rather more than half-way down the dorsal tract; and, furthermore, this saddle in no case shows any trace of an apterion." The differences in pterylosis which he did find were, as one would expect, associated primarily with the development of ornamental plumes.

A few remarks on the structure of the humerus also are pertinent. In a very interesting paper, Ashley (1941) analyzed the humerus of American corvids. He found that some passerine families possess two fossae at the proximal end of the humerus; this condition he considered "advanced." The Corvidae and certain other families fall into a "primitive group," in which only one pneumatic fossa is present. *P. rubra* agrees with *Corvus brachyrhynchos* and *Cyanocitta cristata* in having a single pneumatic fossa. The humeri of *P. rubra* and *C. cristata* exhibit more similarity to each other than either does to the humerus of *C. brachyrhynchos*. Insofar as the Corvidae are concerned, Ashley (1941: 194) considered the humerus of the American Crow to represent a generalized condition, that of the Blue Jay to be more specialized. Mayr and Amadon (1951: 31), however, stated: "The jays are the most primitive of the Corvidae. From them evolved first the magpies and finally *Corvus*, a genus that contains what are in many ways the most adaptable and highly evolved of all birds." Nevertheless, the pneumatic foramen in *P. rubra* is larger than that in *brachyrhynchos*, even though the humerus in *rubra* is less than two-thirds the length (and has a much smaller bulk) of that bone in the crow. Furthermore, the pneumatic canal is much deeper and more extensive in *rubra* and the external head of the humerotriceps muscle takes origin deep inside this canal. The configuration of the humerus (and reference to the recent paper by Hudson and Lanzillotti, 1955) leads me to believe that none of the humerotriceps arises inside this canal in *Corvus brachyrhynchos*.

As one might well expect, there is a great similarity between the appendicular musculature of *P. rubra* and the crow. The following wing muscles are absent in both: latissimus dorsi metapatagialis, biceps propatagialis, entepicondylo-ulnaris, extensor pollicis brevis, flexor metacarpi brevis, and flexor pollicis (the latter was "clearly observed" in only one wing of the crow by Hudson and Lanzillotti, 1955: 39).

There are, however, several differences in development of the musculature. M. abductor indicis is fairly well developed in the crow; it is rudimentary in *P. rubra*. Pars propatagialis musculi cucullaris sends a tendon to insert on the tendon of M. tensor patagii longus in the crow; I did not find such a tendon in *P. rubra*. The tendon of insertion of M. latissimus dorsi, pars posticus, does not perforate the origin of the humerotriceps, as it does in the crow, but inserts anterior to that muscle and proximal to the area of insertion of pars anticus of the latissimus dorsi. M. subcoracoideus has no origin from the dorsal end of the coracoid in *P. rubra;* it has such an origin in the crow.

In *P. rubra*, the belly of M. pronator longus is only about two-thirds the length of the belly of M. pronator brevis; these two muscles are, apparently, about equal in length in the crow. M. extensor pollicis longus shows little similarity in the two species. In *P. rubra*, this small muscle arises only from the distal third of the radius; it inserts only on the radiale. In the crow, the muscle arises from the ulna and the belly is limited to the proximal third of the forearm (Hudson and Lanzillotti, 1955: 33); it inserts on metacarpal I. M. anconeus inserts on the proximal two-thirds of the ulna in *P. rubra;* it inserts on the proximal half of that bone in the crow.

The leg muscle formula of *P. rubra*, as in the crow, is ACXY. The following muscles are absent in both birds: gluteus medius et minimus, ambiens, pars iliofemoralis of the piriformis, popliteus, extensor proprius digiti III, extensor brevis digiti IV, abductor digiti II, adductor digiti II, and adductor digiti IV. Furthermore, the tendons of Mm. flexor hallucis longus and flexor digitorum longus are not connected by a vinculum, nor is there a vinculun uniting the tendons of Mm. flexor perforatus digiti III and flexor perforans et perforatus digiti III. Hudson (1937: 75) considered M. abductor digiti IV to be rudimentary in the Eastern Kingbird (*Tyrannus tyrannus*) and the crow. I was unable to find any evidence of this muscle in my specimen of *P. rubra*. Hudson (1937: 58 and 75–76) did not state specifically whether or not M. lumbricalis is present in the crow. I did not find this muscle in the specimen of *P. rubra* which I dissected.

The muscles to be discussed next are present in both species, but they differ in several respects. In the crow, M. sartorius arises from the anterior portion of the median dorsal ridge and the neural spine of the last dorsal vertebra. In *P. rubra*, there are two distinct heads of origin. The anterior head arises from the last two dorsal vertebrae and from the anterior edge of the ilium; the deeper head arises from a long line on the ventral edge of the ilium. The latter head inserts mostly on the belly and tendon of insertion of M. femorotibialis internus.

The posterior part of M. iliotibialis is a little more extensive in *P. rubra* than it is in *Corvus* and, consequently, covers nearly all of M. biceps (see Hudson, 1937: Fig. 1).

Presumably as a result of the shape of the pelvis in *P. rubra*, M. semitendinosus arises only from the ilium and has no origin from the free caudal vertebrae. In the crow, however, this muscle arises both from the ilium and from the "transverse processes of several proximal caudal vertebrae" (Hudson, 1937: 22). I believe, also, that there is a difference in the tendon of insertion, though the written descriptions are nearly the same. In both birds, there is a strong fascial connection with pars media of the gastrocnemius. The tendon also "makes a strong connection with the tendon of the semimembranosus" in the crow. In *P. rubra*, a flat aponeurosis is formed at the distal end of the semitendinosus; this aponeurosis fuses with, and inserts with, the proximal end of the tendon of the semimembranosus.

M. obturator externus, in the crow, arises by two heads, which fuse before inserting by a single tendon. In *P. rubra*, there are not only two heads, but they retain their integrity to their respective areas of insertion, which are separated by the tendon of insertion of M. obturator internus.

In *P. rubra*, the tendon of M. flexor perforatus digiti II is not perforated either by the tendon of M. flexor perforans et perforatus digiti II or by the tendon of M. flexor digitorum longus. The tendon is perforated by both of these tendons in the crow.

Conclusions

One can readily agree with Stonor (1937: 484) who remarked: "Pterylosis is one of the most neglected branches of ornithology, and . . . the comparative pterylosis of any one family of birds has never been worked out. It is therefore difficult to know how far it can be depended on to show exact inter-relationships." Nevertheless, based on what is now known, the patterns of the dorsal feather tracts do not seem to indicate close relationship of the Corvidae with the Paradisaeidae.

So little is known about the osteology of passerine birds that it is difficult to select characters which reveal closeness of relationship. One finds little in the osteological features analyzed in this paper to indicate phylogenetic relationship, except in the broadest sense. The hypertrophy of the hallux in *P. rubra* is unusual. The development of the pneumatic canal and the relations to it of the M. humerotriceps in *P. rubra* is certainly different from the condition found in the corvids.

Because I had only one specimen of *P. rubra* for dissection, I would not want to emphasize the apparent absence of M. latissimus dorsi metapatagialis nor the fact that I found no tendon of M. cucullaris pars propatagialis extending to M. tensor patagii longus. Certain other myological features, however, probably are significant. M. abductor indicis is rudimentary in *P. rubra;* it has a fleshy belly in the corvids examined by Hudson and Lanzillotti (1955). M. extensor pollicis longus exhibits little similarity in the two groups (see page 443). M. sartorius has two distinct and separate heads in *P. rubra;* there is a single head in the crow. M. semitendinosus has no origin from the free caudal vertebrae in *P. rubra;* it has such an origin in the crow. The structure of M. obturator externus is dissimilar in these species. The tendon of M. flexor perforatus digiti II is not perforated by either of the deep flexor tendons in *P. rubra;* it is perforated by both of these tendons in the crow.

When further evidence is available to show that the Birds of Paradise do or do not belong to the corvine assemblage, it seems likely that the judgment will be made on a relatively few anatomical features, such as have been delineated here, plus, of course, ecological and other biological data.

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