THE OSTEOLOGY AND MYOLOGY OF THE FOX SQUIRREL (*SCIURUS NIGER RUFIVENTER*), THE GRAY SQUIRREL (*SCIURUS CAROLINENSIS LEUCOTIS*), AND THE RED SQUIRREL (*TAMIASCIURUS HUDSONICUS LOQUAX*)

BY

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A THESIS

Submitted to the Graduate School of Michigan State College of Agriculture and Applied Science in partial fulfilment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

Department of Zoology

1940

ACKNOWLEDGEMENTS

I am indebted to many friends for the help they have given me during this study. To Dr. H. R. Hunt, Dr. R. A. Fennell, Mr. B. T. Ostenson, Prof. J. W. Stack, and Miss Bernadette McCarthy of the Zoology Department I wish to express my gratitude for their kind and helpful suggestions. Mr. Don W. Hayne, also of the Zoology Department, contributed much time and effort to photographing the skulls and the drawings. I owe thanks to the Horticulture Department, especially to Mr. H. A. Cardinell, for allowing me to use their camera and photographic laboratory. Dr. William H. Burt, Curator of Mammals in the Museum of Zoology in Ann Arbor, kindly permitted me to examine skeletal material from the mammal collection of the Museum. Miss Katherine Orwoll and Mr. Oscar Warbach deserve much credit for the valuable suggestions they gave concerning the drawings. Miss Ruth McCormick, Mr. R. J. Matthews, and Mr. William Graf kindly supplied me with specimens of the gray squirrel. For her splendid assistance I want to thank Miss Mary Jo Armstrong, who has critically read the manuscript.

CONTENTS

LIST OF ILLUSTRATIONS

I. INTRODUCTION

The anatomy of many of the most common wild mammals has been long neglected as a subject for detailed study. No one, for example, has written very fully on the subject of the anatomy of the fox squirrel, a generalized rodent of arboreal adaptations. Peterka (1936), it is true, compared the bones and muscles of the fox squirrel with those of the Norway rat, the flying squirrel, and the prairie dog, but did not give detailed descriptions of either the bones or the muscles of any of these forms. Hoffmann and Weyenbergh (1870) briefly described the osteology and myology of the European red squirrel (Sciurus vulgaris L.). From their account, however, the latter differs in several ways from the fox squirrel.

The purpose of this paper is to give a brief description of the bones and a complete description of the muscles of the western fox squirrel, Sciurus niger rufiventer (Geoffroy), and to compare them with the bones and muscles of the Northern gray squirrel, Sciurus carolinensis leucotis (Gapper), and the Southern red squirrel, Tamiasciurus hudsonicus loquax (Bangs).

II. MATERIAL AND METHODS

The fox squirrel and red squirrel specimens used in this study were live-trapped in the neighborhood of East Lansing, Michigan. The gray squirrels were shot in Newaygo County, Michigan, about ten miles west of Howard City.

In studying the osteology the writer examined four skeletons of the fox squirrel, two of the gray squirrel, and three of the red squirrel. The specimens which had been caught alive were chloroformed. The skin, the viscera, and much of the muscular tissue were removed from each squirrel. Each specimen was then soaked in water for several hours, after which it was allowed to dry for about a day. In the final stage of the preparation of the skeletons dermestid beetles thoroughly stripped the remaining flesh from the bones.

Sixteen illustrations accompany the descriptions of the bones. The first nine of these are photographs of skulls and include three views of the skull of each of the three species studied. These photographs, one and one-half times natural size, were taken with Portrait Panchromatic film and a view camera. The remaining osteological illustrations are photographs of pen and ink drawings. All but one of the drawings (fig. 12, G) are of bones of the fox squirrel. This one exception is the draw-

ing of the gray squirrel's baculum. These drawings were prepared on illustration board and were photographed on Process film. In the lower left corner of each plate there is a size scale.

The skeletons of these three species of squirrels were carefully compared with various other rodent skeletons from the mammal collection in the Museum of Zoology in Ann Arbor. By comparing so many species'' the writer was able to determine which skeletal features are characteristic of the Sciuridae as a group and which, if any, are peculiar to the three forms considered here.

Since the writer feels it would be unnecessary to describe every bone completely, he has largely confined himself in the section on osteology to a description of those skeletal features which are characteristic of the squirrel family.

'' the following members of the Sciuridae: Cynomys ludovicianus, Spermophilus leptodactylus, Marmota monax, Citellus beecheyi, Citellus franklini, Citellus tridecemlineatus, Tamias striatus, Eutamias minimus, Eutamias townsendii, Sciurus aberti, Sciurus alleni, Sciurus deppei, Sciurus gerrardi, Sciurus griseus, Sciurus hoffmanni, Sciurus vittatus, Sciurus vulgaris, Sciurus yucatanensis, Callosciurus sp., Microsciurus napi, Tamiops sp., Tomeutes lokroides, Xerus sp., Glaucomys sabrinus, Glaucomys volans, Petaurista sp., and Pteromys volans-----the following nonsciurid rodents: Ondatra zibethica, Erethizon dorsatum, Castor canadensis, Geomys bursarius, Thomomys bottae, Rattus norvegicus, Dipodomys agilis, Sigmodon hispidus, Neotoma pennsylvanica, Myodes sp., Galea musteloides, and Capromys prehensilis.

The descriptions of the muscles are based on dissections of seven formalin-preserved specimens of the fox squirrel, three of the gray squirrel, and three of the red squirrel. These specimens were preserved in 10% formalin. Those which had been caught alive were first chloroformed. The pleural and peritoneal cavities of each were opened by cutting through the lateral wall of the abdomen and continuing the incision through the diaphragm. It was also considered advisable to remove the skin and the subcutaneous fat deposits from the axillary and inguinal regions. Next, each specimen was fastened with cord on a wooden cross, then immersed in the preservative until it had hardened in the desired shape, with its legs extended in the horizontal plane. Between successive periods of dissecting the specimens were left in water or a weak solution of alcohol.

In this paper each muscle has a number as well as a name. In the description of almost every muscle reference is made to neighboring muscles, and frequently, in such cases, there appear in parentheses the numbers of these other muscles. These numbers will be helpful for cross reference. They also serve as labels on the illustrations which accompany the myological descriptions. These illustrations are photographs, taken on Process film with a view camera, of pen and ink drawings prepared on illustration board. All of the muscle drawings were taken from the fox squirrel. In the lower left corner of each plate there is a size scale.

Although every bone or muscle in one of the species probably differs more or less in size from its homolog in the other two species treated in this paper, the writer has not attempted to describe such possible size differences. Any obvious variations among the three species as to structure of the bones and muscles or as to attachments of the muscles, however, have been noted and will be pointed out.

III. OSTEOLOGY

The next few pages are devoted to descriptions of the bones of the fox squirrel, the gray squirrel, and the red squirrel. The writer will emphasize only those skeletal features which are characteristic of the squirrel family and will deal very briefly with the other parts of the skeleton. Those who require more complete information concerning the osteology of rodents or other mammals should refer to more extensive works such as those by Flowér (1876), Beddard (1909), and Weber (1927).

In the following descriptions of the bones, wherever any bone in one of the species differs structurally from its homolog in the other two species of squirrels treated here, the differences will be mentioned.

For convenience in description, the skeleton is subdivided into three sections, which are:

The Axial Skeleton
The Visceral Skeleton
The Appendicular Skeleton

THE AXIAL SKELETON

The skull, the vertebrae, the ribs, and the sternum form the axial skeleton.

A. The Skull

Figures 1-9, inclusive, are photographs of the skulls of the three species considered in this paper. Figure 10 (A, B) includes two drawings of the lower jaw bone of the fox squirrel.

The following are the skull bones found in the fox, gray, and red squirrels.

- 1 interparietal
- 1 occipital
- 1 basisphenoid
- 1 presphenoid
- 1 ethmoid
- 2 frontals
- 2 parietals
- 2 tympanic bullae
- 3 pairs of auditory ossicles
  - 2 mallei
  - 2 inci
  - 2 stapes
- 2 squamosals
- 2 nasals
- 2 premaxillae
- 2 maxillae
- 2 lachrymals
- 2 jugals
- 2 palatines
- 1 vomer
- 3 pairs of turbinals
  - 2 ethmoturbinals
  - 2 maxilloturbinals
  - 2 nasoturbinals
- 2 dentaries

By comparing skulls of the fox squirrel, the gray squirrel, and the red squirrel with many other rodent skulls, (see footnote on page 3), the writer found that for the most part the skull bones of these squirrels are very similar in shape and position to those of other rodents. Certain features typical of the Sciuridae were noted, however. The prominent supraorbital process of the frontal bone is present in all sciurids which the writer examined. The roof of the skull between the orbits is quite wide. The temporal lines are not very prominent, nor is the nuchal crest. An interparietal is present in at least some of the Sciuridae, and probably in all, but since it usually fuses very closely with the occipital and the parietals, it is rarely visible as a distinct bone. Upon close inspection of some skulls a suggestion of the borders of the interparietal may be seen. The infraorbital foramen is relatively small and usually slit-shaped in the Sciuridae. Immediately ventral to it there is a small, stout process which the writer will refer to as the maxillary spine. The palatine fissures are fairly short. Their posterior ends either are anterior to, or coincide with the front edge of the maxillae.

The skulls of the fox squirrel, the gray squirrel, and the red squirrel are very much alike. Except for the differences in size of the skulls of these three species, the only noticeable difference is in the dental formulae. The dental formula of both the fox squirrel and the red squirrel is I 1/1, C 0/0, P 1/1, M 3/3---20, while that of the gray

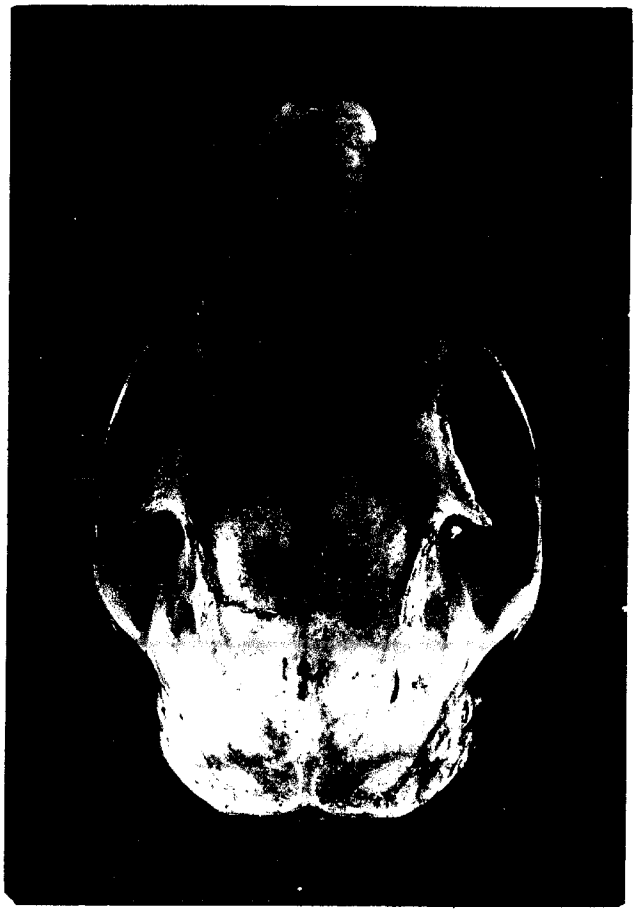

FIGURE 1.

Skull of the fox squirrel, dorsal aspect.

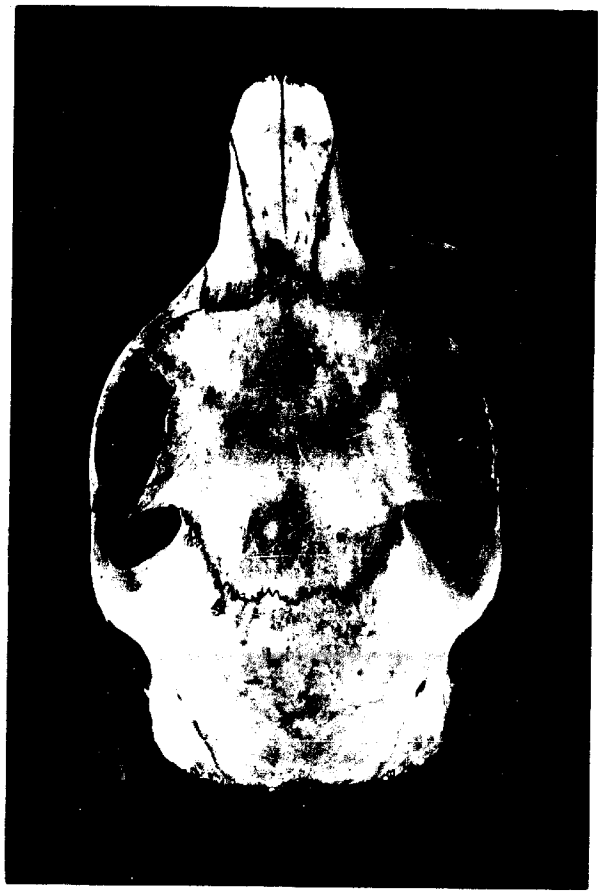

FIGURE 2.

Skull of the gray squirrel, dorsal aspect.

FIGURE 3.

Skull of the red squirrel, dorsal aspect.

FIGURE 4.

Skull of the fox squirrel, lateral aspect.

FIGURE 5.

Skull of the gray squirrel, lateral aspect.

FIGURE 6.

Skull of the red squirrel, lateral aspect.

FIGURE 7.

Skull of the fox squirrel, ventral aspect.

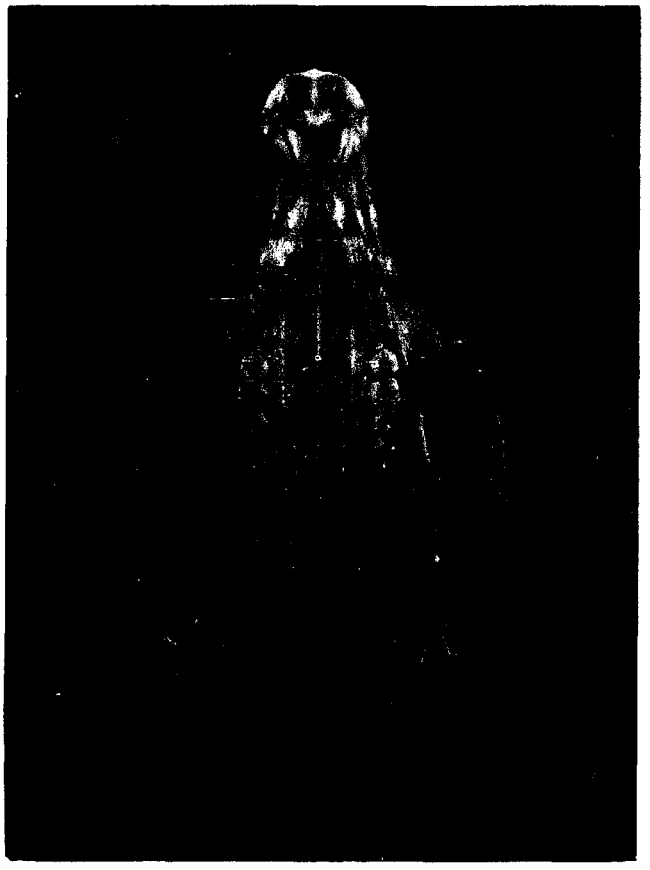

FIGURE 8.

Skull of the gray squirrel, ventral aspect.

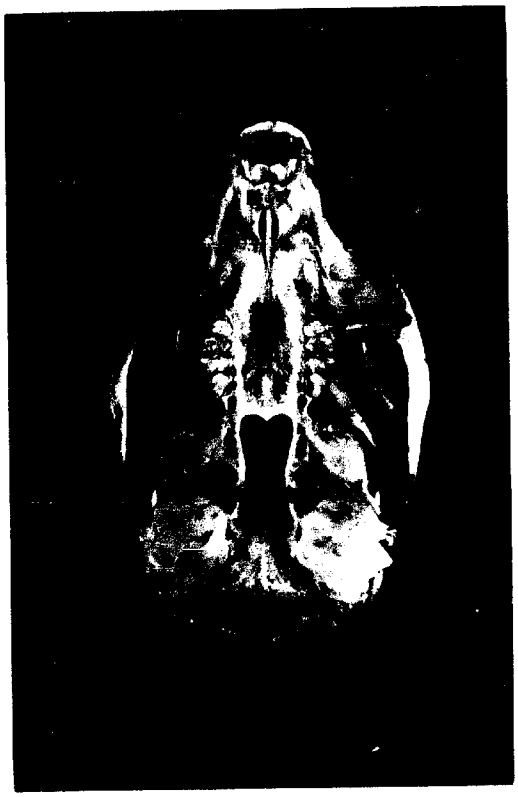

FIGURE 9.

Skull of the red squirrel, ventral aspect.

squirrel is I 1/1, C 0/0, P 2/1, M 3/3---22. The 1st premolar in the upper jaw of the gray squirrel is very small.

B. The Vertebral Column

1. The cervical vertebrae

Four of the seven cervical vertebrae are shown on figure 11 (A, B, C, D).

The atlas (fig. 11, A) of these three species of squirrels possesses no extraordinary features worthy of special mention. The odontoid process of the axis, or 2nd cervical vertebra (fig. 11, B), is peg-shaped.

The five remaining cervical vertebrae (fig. 11, C, D) resemble one another closely and do not differ appreciably from the ordinary rodent type of neck vertebrae.

2. The thoracic vertebrae

In the three species of squirrels being considered here there are thirteen thoracic vertebrae. Five of these are shown on figure 11 (E, F, G, H, J). In these squirrels only the first ten thoracic vertebrae have transverse processes. The last six have anapophyses and metapophyses. Both caudal and cranial demifacets are present on the centra of the first nine thoracic vertebrae. The remaining thoracic vertebrae have cranial demifacets, but no caudal demifacets.

FIGURE 10.

A. Left dentary of the fox squirrel, medial aspect.
B. Left dentary of the fox squirrel, lateral aspect.
C. Hyoid bone of the fox squirrel, ventral aspect.

A--incisor tooth
B--body of the dentary
C--molariform tooth
D--coronoid process
E--condyloid process
F--mandibular foramen
G--angular process
H--ramus
J--mental foramen
K--condyle
L--masseteric line
M--body of the hyoid
N--lesser cornu
O--greater cornu
P--insertion of the pterygoideus internus

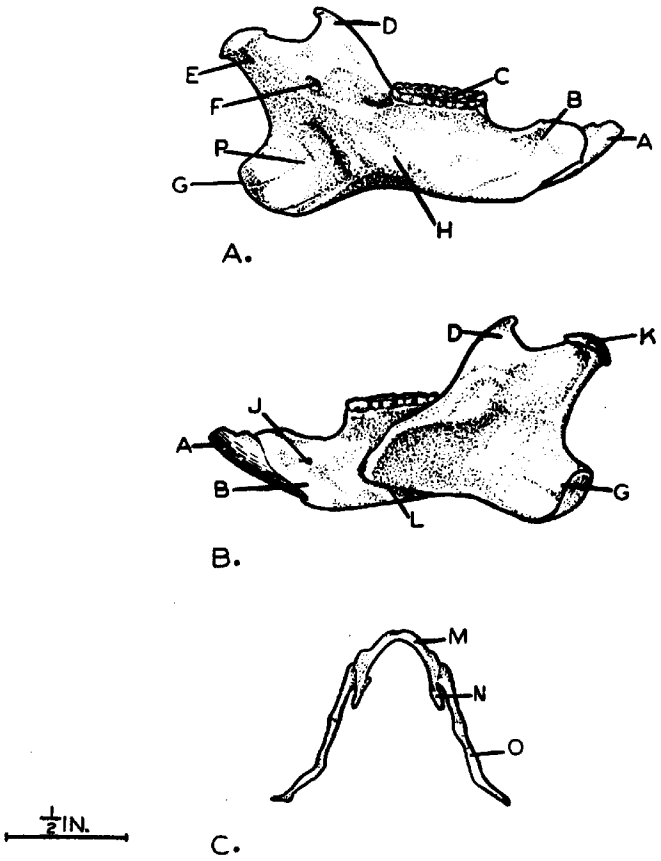

FIGURE 10.

FIGURE 11. Vertebrae Of The Fox Squirrel.

A. atlas, cranial face.
B. axis, from the left side.
C. 4th cervical, caudal face.
D. 6th cervical, cranial face.
E. 1st thoracic, cranial face.
F. 4th thoracic, from the left side.
G. 8th thoracic, from the left side.
H. 11th thoracic, from the left side.
J. 12th thoracic, from the left side.
K. 1st lumbar, from the left side.
L. 4th lumbar, from the left side.
M. 6th lumbar, from the left side.
N. sacrum, dorsal aspect.
O. 1st caudal, dorsal aspect.
P. 6th caudal, cranial face.
Q. 7th caudal, dorsal aspect.
R. 9th caudal, dorsal aspect.
S. 12th caudal, dorsal aspect.
T. 20th caudal, dorsal aspect.
U. 28th caudal, dorsal aspect.

A--spinous process
B--transverse process
C--neural canal
D--cranial articular facet
E--insertion of longi colli
F--odontoid process
G--vertebrarterial canal
H--centrum
J--caudal articular facet
K--demifacet for articulation with the head of a rib
L--prezygapophysis
M--postzygapophysis
N--anapophysis
O--metapophysis
P--sacral foramen
Q--fused sacral articular processes
R--articular process
S--chevron bone
T--cranial end
U--caudal end

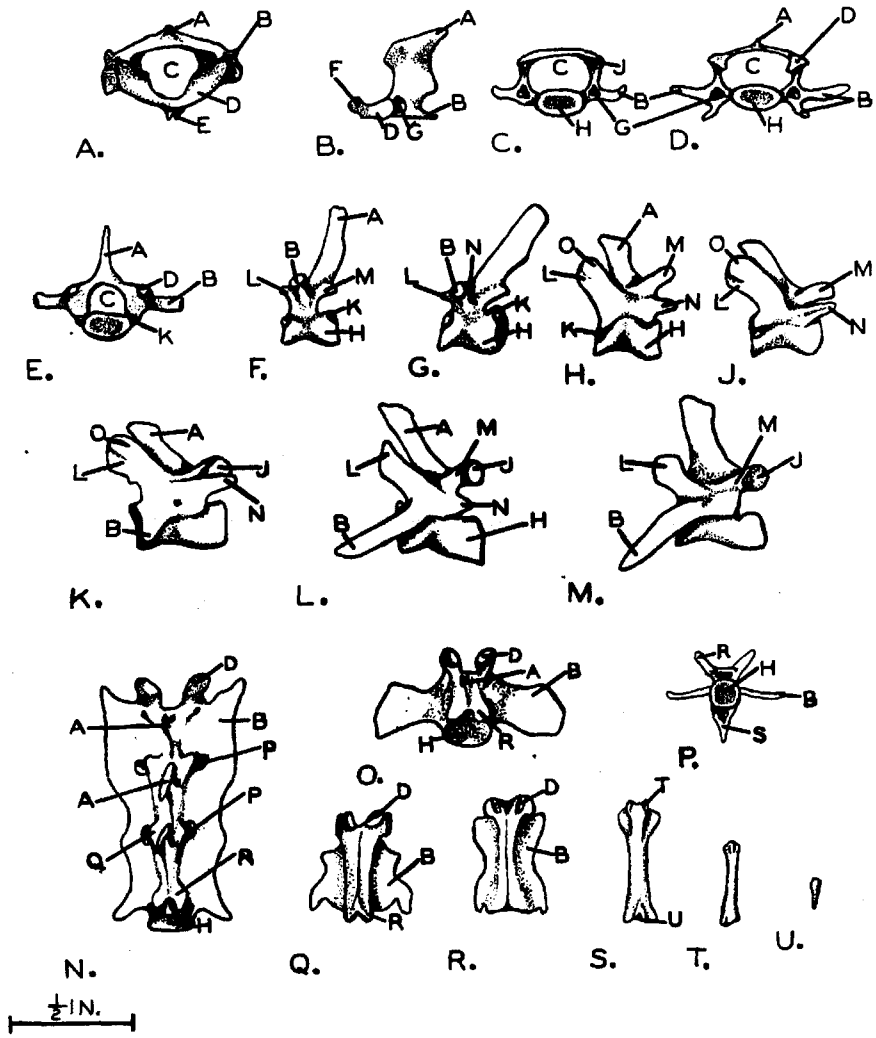

FIGURE 11.

3. The lumbar vertebrae

Three of the six lumbar vertebrae are shown on figure 11 (K, L, M). These are six strong vertebrae with prominent transverse and spinous processes. All have pronounced metapophyses and all but the last two have noticeable anapophyses.

4. The sacrum

The sacrum (fig. 11, N) is composed of the three sacral vertebrae united. The tripartite nature of the sacrum is easily observed, for in these squirrels this bone has three distinct spinous processes and three centra. The latter, it is true, are fused together, but the sutures between them are visible. On each side of the sacrum the three transverse processes are almost completely united. The two sacral foramina on each side, however, partially mark the boundaries between the individual vertebrae of which the sacrum consists. Laterally the 1st and part of the 2nd sacral transverse processes are ankylosed to the ilia.

5. The caudal vertebrae

The caudal vertebrae of these squirrels (fig. 11, O, P, Q, R, S, T, U) are not noticeably different from typical tail vertebrae of rodents. In each of four specimens of the fox squirrel the writer found twenty-eight caudal vertebrae. Of the two gray squirrels examined, one had

twenty-six caudal vertebrae, the other, twenty-seven. Two red squirrel specimens had twenty-three, the third had twenty-four.

Only the first seven or eight caudal vertebrae in these three species possess well-defined spinous, articular, and transverse processes. These are largest on the first two caudal vertebrae. The processes of each of the next five or six caudal vertebrae are smaller and less prominent than those of the preceding vertebra. Beyond the 8th caudal the vertebrae are merely thin, cylindrical bones, each of which is thinner and usually shorter than the preceding one. The terminal few vertebrae are very tiny.

The five or six bony arches found on the ventral side of the first six or seven caudal vertebrae are the chevron bones. Suggestions of chevron bones, not forming complete arches, may be seen on the ventral side of many of the remaining tail vertebrae of these squirrels, back to about the level of the 20th caudal.

C. The Ribs

Figure 12 includes drawings of four of the thirteen ribs (fig. 12, B, C, D, E). These ribs present no outstanding peculiarities of structure and do not differ in the fox squirrel, the gray squirrel, and the red squirrel. The first eight pairs are directly attached to the sternum. The next three pairs are indirectly connected to the

FIGURE 12.

A. Sternum of the fox squirrel, ventral aspect.
B. 1st rib (left) of the fox squirrel, anterior aspect.
C. 3rd rib (left) of the fox squirrel, anterior aspect.
D. 7th rib (left) of the fox squirrel, anterior aspect.
E. 12th rib (left) of the fox squirrel, anterior aspect.
F. Baculum of the fox squirrel.
G. Baculum of the gray squirrel.

A--clavicle
B--manubrium sterni
C--crista manubrii
D--2nd sternebra
E--6th sternebra
F--xiphoid process
G--capitulum
H--neck
J--tuberculum
K--costal cartilage
L--angle
M--shaft
N--distal end
O--basal (proximal) end

1-8 cartilages of ribs 1-8, inclusive

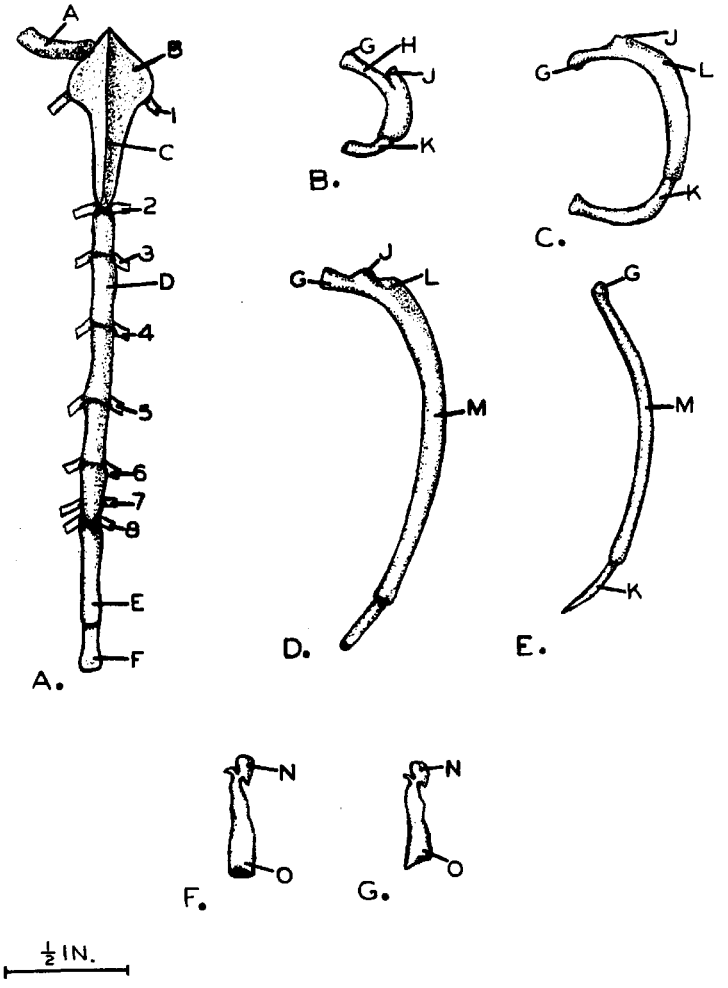

FIGURE 12.

sternum via the cartilage of the 8th rib on each side. The 12th and 13th pairs have no sternal attachment. The latter is seldom found in a cleaned skeleton, for it is very short and small and is usually lost when the skeleton is being prepared. The ribs of mammals are usually two-headed, having a terminal articular surface, the capitulum, and a subterminal articular surface, the tuberculum. This is true of the first ten pairs of ribs in the species under consideration. Each tuberculum articulates on a thoracic transverse process. The last three pairs of ribs, however, do not have tubercula, a lack corresponding to the absence of transverse processes in the last three thoracic vertebrae. The capitulum of each of the first ten ribs on either side articulates partly with the cranial demifacet of the thoracic vertebra having the same number, and partly with the caudal demifacet of the next anterior vertebra. Thus, for example, the 9th rib articulates with the cranial demifacet of the 9th, and the caudal demifacet of the 8th thoracic vertebra. Since the last four thoracic vertebrae in these three species of squirrels have no caudal demifacets but possess only cranial demifacets, the last three pairs of ribs articulate solely with the cranial demifacets of the last three thoracic vertebrae.

D. The Sternum

The sternum of these squirrels is composed of eight parts, as is fairly typical in rodents. The manubrium,

or 1st segment of the sternum, is followed caudally by a linear series of seven parts, which are the six bony sternebrae and the cartilaginous xiphoid process. By referring to figure 12 (A) one can see how the clavicle and the ribs are connected to the sternum. The sternum of the gray squirrel and that of the red squirrel are practically identical with the sternum of the fox squirrel.

THE VISCERAL SKELETON

The visceral skeleton of these squirrels consists of the hyoid bone (fig. 10, C) and the baculum, or penis-bone (fig. 12, F, G).

The hyoid (fig. 10, C) in the species considered in this paper is composed of a median bar, the body of the hyoid, from which two pairs of processes project backward. The shorter, medial pair of projections are the lesser cornua, the longer pair, the greater cornua.

Both the male fox squirrel and the male gray squirrel have a penis-bone, or baculum. These are shown on figure 12 (F, G). The baculum is not present in the red squirrel.

THE APPENDICULAR SKELETON

The bones of the appendages do not differ in the fox squirrel, the gray squirrel, and the red squirrel, except as to size. The bones of the pectoral appendage will be considered first, then those of the pelvic appendage.

A. The Pectoral Appendage

1. The pectoral girdle

a. The clavicle

In these three species of squirrels the clavicle (fig. 12, A; fig. 13, C) is well-developed. Its narrower, medial end articulates with the manubrium sterni, its wider, lateral end, with the scapula's acromion process.

b. The scapula

In addition to such ordinary structures as the spine, the glenoid fossa, the acromion process, and the coracoid process, the scapulae (fig. 13, A, B) of these squirrels possess three prominent bony ridges. The axillary ridge projects dorsad along the entire length of the axillary border. It provides attachment for several muscles, namely the infraspinatus, teres minor, teres major, subscapularis, and triceps longus. A small portion of the axillary border, known as the teres ridge, protrudes horizontally caudad beyond the medial end of the axillary ridge. The teres ridge forms much of the origin of the teres major, one of the shoulder muscles. The third of these ridges is

FIGURE 13.

A. Left scapula of the fox squirrel, dorsal surface.
B. Left scapula of the fox squirrel, costal surface.
C. Left clavicle of the fox squirrel, anterior face.

A--cranial border
B--vertebral border
C--axillary border
D--axillary ridge
E--teres ridge
F--infraspinatous fossa
G--spine
H--supraspinatous fossa
J--acromion process
K--metacromion process
L--coracoid process
M--glenoid fossa
N--subscapular ridge
O--sternal end
P--acromial end

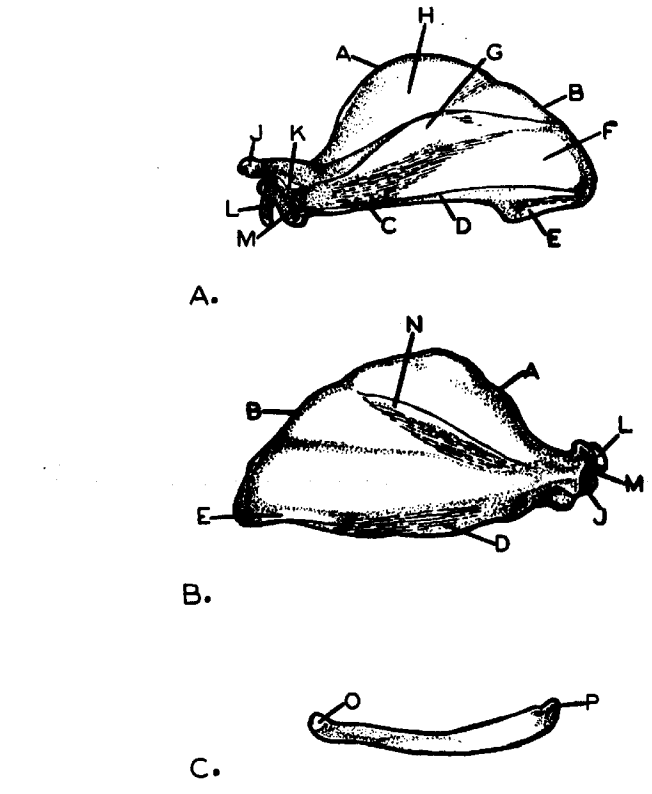

FIGURE 13.

a low vertical projection on the anterior portion of the scapula's costal surface. Since it increases the area of the subscapularis' origin, it is called the subscapular ridge. The subscapularis is a shoulder muscle found on the costal side of the scapula. These three ridges are found in all other members of the Sciuridae which the writer examined, and are apparently correlated with the comparatively strongly developed muscles of the pectoral appendage in the sciurids.

2. The humerus

The humerus (fig. 14, A, B) in these squirrels is not unusual. The deltoid ridge is not very prominent. The lateral supracondylar ridge, however, is very well-developed and provides attachment for the anconeus and some of the strong muscles of the antebrachial group of extensors. Just above the medial humeral epicondyle a short medial supracondylar canal is found.

3. The radius and the ulna

In these squirrels the radius and the ulna (fig. 14, C, D) are not fused together. Near the wrist, near the elbow, and near the middle, the radius is attached by ligaments to the ulna in such a way that a considerable degree of rotation of the wrist and hand is possible.

FIGURE 14.

A. Left humerus of the fox squirrel, anterior aspect.
B. Left humerus of the fox squirrel, posterior aspect.
C. Right radius and ulna of the fox squirrel, posteroventral aspect.
D. Right ulna of the fox squirrel, anterolateral aspect.
E. Right hand of the fox squirrel, dorsal aspect.

A--caput humeri
B--intertubercular sulcus
C--greater tuberosity
D--lesser tuberosity
E--deltoid ridge
F--lateral supracondylar ridge
G--lateral epicondyle
H--trochlea
J--coronoid fossa
K--medial epicondyle
L--medial supracondylar canal
M--olecranon fossa
N--radius
O--ulna
P--olecranon process
Q--semilunar notch
R--coronoid process
S--radial tuberosity
T--styloid process
U--ulnar accessory
V--ulnar carpal
W--scapholunate
X--radial accessory
Y--central carpal
1--1st carpal
2--2nd carpal
3--3rd carpal
4--4th carpal
M1-1st metacarpal
M2-2nd metacarpal
P1-1st phalanx
P2-2nd phalanx
P3-3rd phalanx

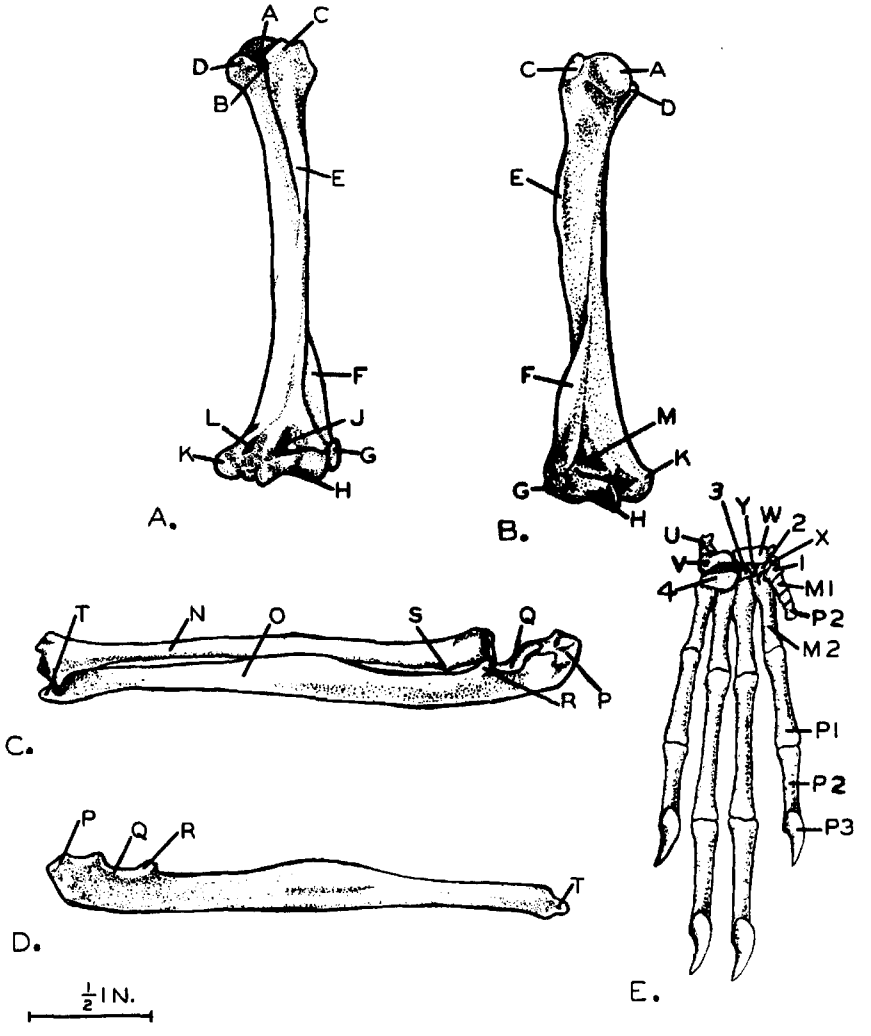
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FIGURE 14.

4. The bones of the hand

The bones in the hand of the three species of squirrels treated here include nine carpals, or wrist bones, five metacarpals, forming the palm, and fourteen phalanges, or finger bones. These bones of the hand are shown on figure 14 (E).

a. The carpals

The carpal bones of these squirrels are arranged in two transverse rows. The largest bone in the more proximal row is the scapholunate, or radial carpal. In reality it is probably composed of the radiale and the intermedium, fused together. On the radial side of the scapholunate, between the latter and the thumb, there is a very small bone called the radial accessory. Often this bone is not present in the cleaned skeleton, for it is easily lost when the skeleton is being prepared. On the ulnar side of the scapholunate is the ulnar carpal, from whose ventro-proximal edge another bone, the ulnar accessory (os pisiforme), projects backward and upward. The five remaining carpals form the more distal row. They are named in order below, from the radial side of the wrist across to the ulnar side. The most radial of these bones is the 1st carpal. Next there are three smaller bones, the 2nd carpal, the central carpal (os centrale), and the 3rd carpal. The last and largest of the bones in the distal row is the 4th carpal, probably formed by the fusion of the primitive 4th and 5th carpals, for it articulates with both the 4th and the 5th metacar-

pals. It corresponds to the os hamatum of human anatomy.

b. The metacarpals

Since the thumb, as in so many rodents, is extremely small, the 1st of the five metacarpals is considerably smaller than the other four. On the volar surface of each metacarpal there is a pair of small sesamoid bones (fig. 26), located near the metacarpo-phalangeal joint.

c. The phalanges

The thumb, as usual, has only two phalanges and, as is generally the case in rodents, is very much reduced in size. The 2nd phalanx of the thumb is encased in a short, flattened claw which to a certain extent resembles a finger-nail. Each of the other four fingers has three phalanges, the last of which is encased in a sharp, curved claw.

B. The Pelvic Appendage

1. The pelvic girdle

The pelvic girdle (fig. 15, A) consists of the right and left innominate bones. On each side one of the innominates is ankylosed to the tips of the 1st and 2nd sacral transverse processes. In the squirrels considered here the innominate bones are not much different from the usual rodent type of pelvis. The ischiadic notch and the tuber ischii, however, are quite prominent.

FIGURE 15.

A. Left innominate bone of the fox squirrel, lateral aspect

A--ilium
B--ischium, horizontal ramus
C--ischium, vertical ramus
D--pubis, horizontal ramus
E--pubis ascending ramus
F--crest of the ilium
G--superior gluteal fossa
H--inferior gluteal fossa
J--iliac spine
K--acetabulum
L--ischiadic notch
M--obturator foramen
N--tuber ischii
O--ischio-pubic angle
P--insertion of psoas minor

B. Left femur of the fox squirrel, anterior aspect.

C. Left femur of the fox squirrel, posterior aspect.

A--caput femoris
B--neck of the femur
C--greater trochanter
D--lesser trochanter
E--3rd trochanter
F--lateral epicondyle
G--lateral condyle
H--groove for articulation with the patella
J--medial condyle
K--medial epicondyle
L--trochanteric fossa
M--intercondylar fossa

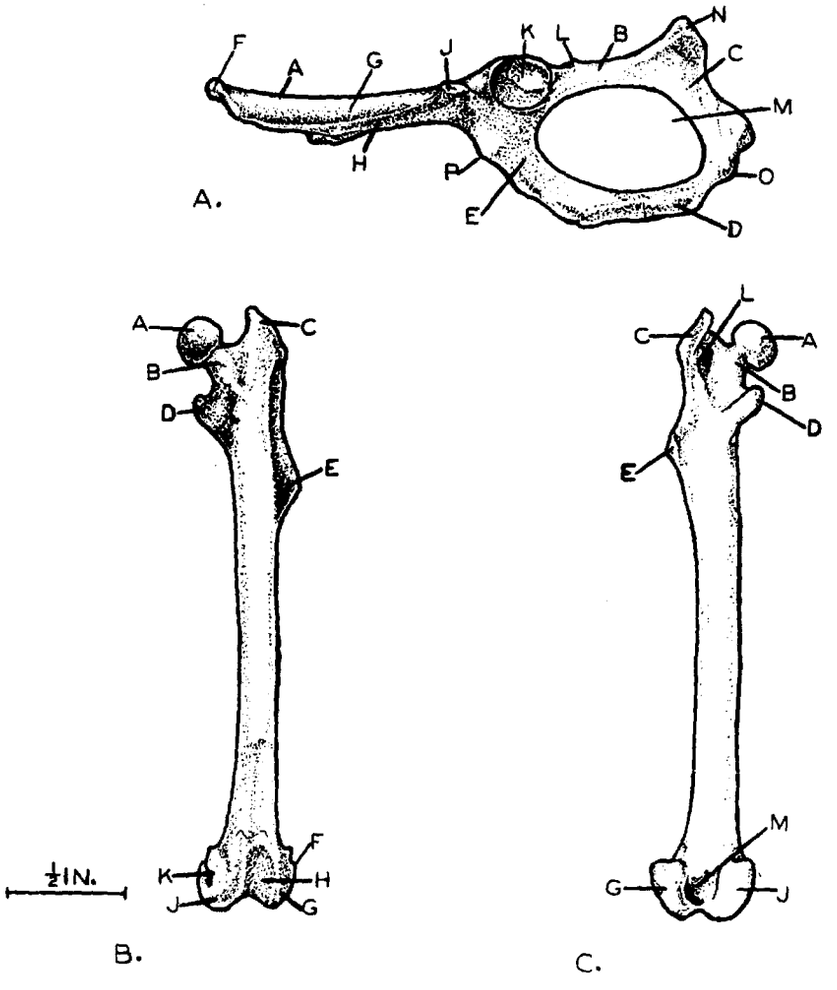

FIGURE 15.

2. The femur

The femur is shown in figure 15 (B, C). In these squirrels the femur is quite long but otherwise is very similar to that of other rodents.

3. The patella

4. The tibia and the fibula

The tibia and the fibula (fig. 16, A, B) in these squirrels are quite long. At their proximal ends they are only slightly fused together. At their lower ends the area of fusion between them is somewhat larger. These two bones do not differ noticeably from the shank bones of other generalized rodents.

5. The bones of the foot

The bones of the foot (fig. 16, C) in the three species of squirrels treated here include eight tarsals, or ankle bones, five metatarsals, forming the sole of the foot, and fourteen phalanges, or toe bones.

a. The tarsals

The largest of the tarsals in these squirrels is the os calcis (os fibulare). On the dorsal surface of the os calcis' distal end is the os talus, which, according to Flower (1876), is formed by the fusion of the intermedium and the tibiale. Distally the os talus articulates with the central tarsal and the os tibiale externum. The latter

FIGURE 16.

A. Left tibia and fibula of the fox squirrel, anterior aspect.
B. Left tibia and fibula of the fox squirrel, posterior aspect.
C. Bones of the left foot of the fox squirrel, dorsal aspect.

A--anterior crest of the tibia
B--fibula
C--lateral malleolus
D--medial malleolus
E--medial condyle
F--medial intercondylar tubercle
G--lateral intercondylar tubercle
H--lateral condyle
J--tuber calcis
K--os calcis
L--os talus
M--for articulation with the tibia
N--os tibiale externum
O--os centrale
P--1st cuneiform
Q--2nd cuneiform
R--3rd cuneiform
S--cuboid
T--peroneal groove
U--tuber metatarsi quinti
V--metatarsal
W--1st phalanx
X--2nd phalanx
Y--3rd phalanx

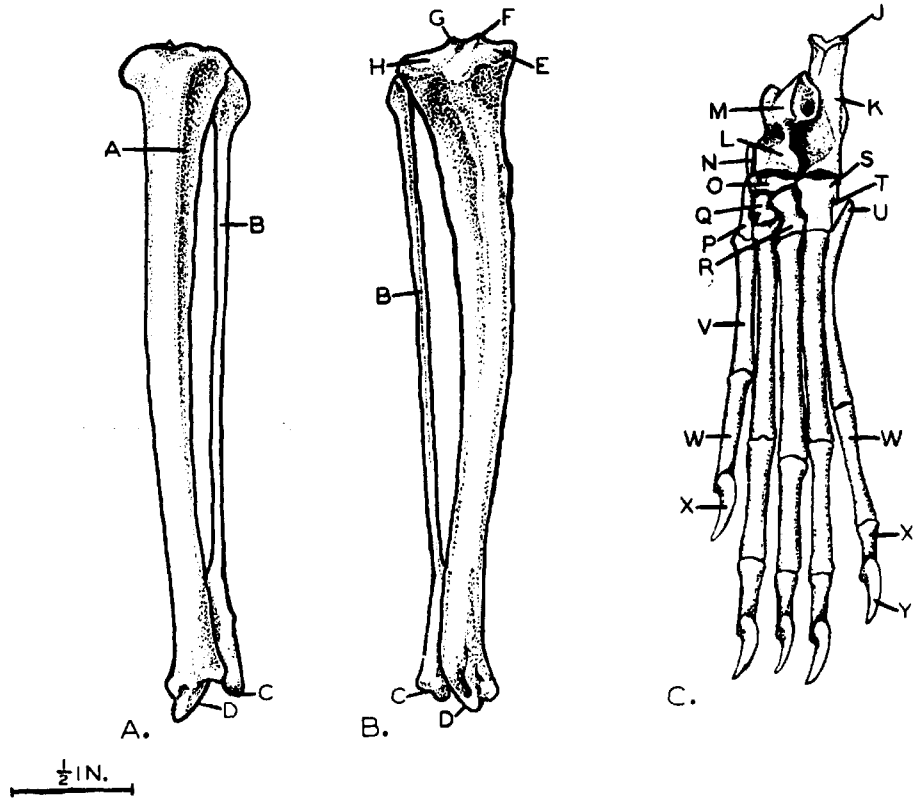

FIGURE 16.

is a small, vertical sesamoid bone lying medial to the os talus, between the os calcis and the central tarsal. Four tarsal bones form a transverse row just proximal to the metatarsals. These four, beginning with the most medial, are the following: the 1st cuneiform (1st tarsal), the 2nd cuneiform (2nd tarsal), the 3rd cuneiform (3rd tarsal), and the cuboid (4th tarsal plus the 5th tarsal). Between the three cuneiforms and the os talus is the central tarsal (os centrale, Os naviculare).

b. The metatarsals

The metatarsals, as usual, are five in number. On the plantar surface of each, near its distal end, there is a pair of small sesamoid bones (fig. 36).

c. The phalanges

The hallux, or large toe, contains two phalanges, while each of the other toes has three. Every terminal phalanx is capped by a strong claw.

IV. MYOLOGY

In the following pages all the voluntary muscles are described, except those which move the eyeball and those of the larynx. Some of these muscles are very small, some

are intimately fused with other muscles, nevertheless, all can be located without the aid of a microscope.

Wherever a muscle in one species is different from the same muscle in the other two species, the differences are mentioned. With respect to all other muscles the reader is to understand that the fox squirrel, the gray squirrel, and the red squirrel do not differ, except as to size of the muscles.

In naming and arranging the muscles the writer has largely followed the names and the arrangement used by Howell (1926) in "Anatomy of the Wood Rat", because he feels there should be some attempt to gain uniformity in the arrangements of descriptions of rodent muscles. Moreover, most of the muscles in these three species of squirrels are very similar in number and position to those of the wood rat, as described by Howell. The facial muscles, however, are not closely comparable to those of the wood rat. From a study of Hoffmann and Weyenbergh's (1870) descriptions of the facial muscles of Sciurus vulgaris it became evident that these muscles in the latter are nearly identical with the facial muscles of the three species treated here. Therefore, the writer has followed Hoffmann and Weyenbergh's nomenclature for the facial muscles.

The musculature is usually considered under four major divisions, namely:

Muscles of the Head
Muscles of the Trunk
Muscles of the Pectoral Appendage
Muscles of the Pelvic Appendage

MUSCLES OF THE HEAD

The twenty-one muscles of the head, which do not differ noticeably, as to attachments and relative extent, in the fox squirrel, the gray squirrel, and the red squirrel, are described under four headings, namely:

A. Dermal muscles of the face
B. Masticatory musculature
C. Inter-ramal musculature
D. Muscles of the tongue

A. Dermal Muscles of the Face

The ten pairs of facial muscles described in the next few pages are clearly recognizable as separate muscles, although some of them are small and obscure. In addition to these distinct muscles, however, there are some muscle fibers in the skin of the head and face which are so poorly defined that they can not be considered definite muscles.

The dermal facial muscles, inserted into the skin of the head and neck, are:

Mm. platysma
orbicularis oculi
orbicularis oris
levator alae nasi labiique superioris
depressor alae nasi
levator labii superioris proprius
levator anguli oris
depressor labii inferioris
depressor anguli oris
buccinator

1. M. platysma (fig. 18) is well-developed. It forms a thin muscular layer covering practically the whole head and neck. It arises by two heads, one from the mid-dorsal line of the cervical and anterior thoracic regions, the other from the fascia on the ventral face of the pectoralis group of muscles.

The fibers of the dorsal head run cranioventrad. Some of them are inserted into the skin of the medial, posterior, and lateral sides of the pinna, or external ear. As they pass forward to terminate in the skin of the snout, the most dorsal fibers of the dorsal head are inserted into the scalp. They cover the top of the skull and unite with fibers of the opposite platysma. The remaining fibers of the dorsal head pass cranioventrad behind the ear. They cover the lateral surface of the neck and merge with the ventral head of the platysma. Continuing craniad, terminating in the skin of the upper lip and the snout, these fibers are inserted into the skin of the side of the face.

Running between the ear and the eye are some fibers inserted into the eyelids, the pinna, and the skin between the eye and the ear. This small group of fibers is sometimes called the interscutularis, but the writer has considered it to be a part of the platysma, since it is continuous with the fibers of the latter.

The fibers of the ventral head of the platysma progress craniad, uniting medially with the opposite platysma, laterally with the dorsal head of the platysma. These fi-

bers of the ventral head are inserted into the skin of the ventral side of the head and the neck. They terminate in the margin of the lower lip.

ORIGIN: (1.), from the mid-dorsal line, beginning at the level of the 3rd or 4th thoracic vertebra, extending up onto the dorsum of the skull.

(2.), from the fascia on the ventral face of the pectoralis group of muscles.

INSERTION: into the skin of the neck and head, especially the skin of the pinna, the eyelids, the snout, and the lips.

2. M. orbicularis oculi consists of a few fibers taking a circular course around the margin of the eyelids.

3. M. orbicularis oris (fig. 17), beginning in the margin of the lower lip, passes around the angle of the mouth into the upper lip. Its fibers then diverge and lose themselves in the fibro-muscular pad of the upper lip. Thus, this muscle, unlike the preceding one, is not a complete orbicularis. In other words, it does not form a complete circle.

4. M. levator alae nasi labiique superioris (fig. 18) includes two parts. The superficial part is inserted into the skin of the lateral wall of the nostril, the deep part, into the fibro-muscular pad of the upper lip.

ORIGIN: from the maxillary fossa, under the pars major

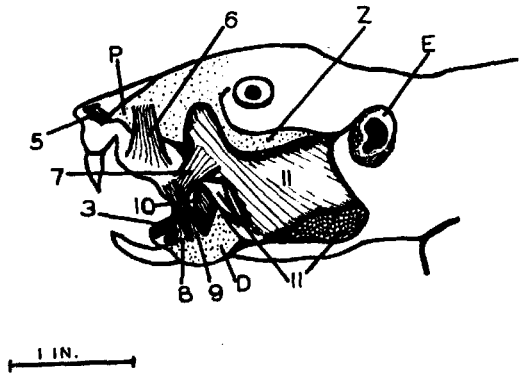

FIG. 17

FIGURE 17. Facial muscles of the fox squirrel.

3 orbicularis oris
5 depressor alae nasi
6 levator labii superioris proprius
7 levator anguli oris
8 depressor labii inferioris
9 depressor anguli oris
10 buccinator
11 masseter
D dentary
E external ear
P premaxilla
Z zygomatic arch

of the masseter (11). The muscle almost immediately divides.

INSERTION: The superficial, terete portion proceeds forward to end in a tendon which is inserted into the skin of the lateral wall of the nostril. The deep, flat part of this muscle passes cranioventrad into the fibro-muscular pad of the upper lip.

5. M. depressor alae nasi (fig. 17)

ORIGIN: This exceedingly small muscle springs from the dorsolateral edge of the anterior end of the premaxilla.

INSERTION: in the lateral wall of the nostril, deep to the levator alae nasi labiique superioris.

6. M. levator labii superioris proprius (figs. 17, 20)

ORIGIN: from the dorsolateral edge of the premaxilla, just anterior to the cranial border of the masseter (11).

The levator labii superioris propriua passes ventrad beneath and at right angles to the levator alae nasi labiique superioris.

INSERTION: in the fibro-muscular pad of the upper lip.

7. M. levator anguli oris (fig. 17)

ORIGIN: This weak, poorly defined muscle comes from the fascia which covers the masseter in the region of the maxillary spine.

INSERTION: in the skin of the angle of the mouth.

8. M. depressor labii inferioris (fig. 17)

ORIGIN: The depressor labii inferioris, a short, terete muscle, issues from the dorsum of the anterior end of the body of the dentary.

INSERTION: into the skin of the lower lip.

9. M. depressor anguli oris (fig. 17) runs from the dorsum of the body of the dentary into the skin of the angle of the mouth. It is shorter than the depressor labii inferioris and lies just behind the latter.

ORIGIN: from the dorsum of the body of the dentary, between the origins of the depressor labii inferioris and the buccinator.

INSERTION: in the skin of the angle of the mouth.

10. M. buccinator (figs. 17, 18, 19) forms the lateral wall of the oral cavity. Its cranial end protrudes from beneath the edge of the masseter. The rest of the buccinator lies under the latter.

ORIGIN: from the lateral edge of the maxilla just above the molariform teeth.

INSERTION: on the dorsum of the body of the dentary, on the lateral side of the dorsal edge of the ramus of the dentary, and in the skin of the wall of the oral cavity.

B. Masticatory Musculature

Mm. masseter	pterygoideus externus
temporalis	pterygoideus internus

11. M. masseter (figs. 17, 18, 19), a powerful muscle covering most of the side of the head, is divisible into three parts, pars superficialis, pars major, and pars profundus.

Pars superficialis

ORIGIN: (1.), from the lateral edge of the caudal 1/2 of the zygomatic arch.

(2.), from the maxillary spine by a stout, tough tendon which proceeds caudad and spreads out to form a wide, shiny aponeurosis. This aponeurosis invests most of the pars superficialis, which passes obliquely across the pars major and conceals much of the latter as well as the ventral margin of the mandible.

INSERTION: on the ventral and medial surfaces of the angular process of the dentary.

Pars major

ORIGIN: from the maxillary fossa and the ventral edge of the zygomatic arch.

The pars major is largely covered, except at its anterior end, by the pars superficialis. Its fibers run ventrad and caudoventrad.

INSERTION: on the lateral surface of the dentary along the masseteric line.

Pars profundus

ORIGIN: from the inner surface of the zygomatic arch, under the origin of the pars major. This part of the masseter is short and thin. Its fibers progress ventrad.

INSERTION: on the lateral face of the coronoid and condyloid processes of the dentary.

12. M. temporalis (figs. 18, 20, 22) is composed of a superficial portion and a deep portion.

Pars superficialis

ORIGIN: from the nuchal crest of the occipital bone and the temporal line of the parietal bone by an extensive, shiny, tough aponeurosis which overlies the deep portion of the temporalis.

The pars superficialis proceeds cranioventrad and becomes fleshy slightly behind the eye.

INSERTION: Having passed beneath the zygomatic arch and the upper portion of the masseter, the pars superficialis is inserted on the anterior edge of the tip of the coronoid process of the dentary.

Pars profundus lies deep to the pars superficialis of the temporalis and is larger than the latter. The shiny aponeurosis of the pars superficialis covers most of it. Running craniad and slightly ventrad until it reaches the temporal fossa, the pars profundus then swings directly ventrad to go beneath the zygomatic arch and the masseter.

ORIGIN: from the nuchal crest of the occipital bone, from the temporal line, from the temporal fossa, and from the post-ocular portion of the orbit. This origin is underneath the extensive aponeurosis of the pars superficialis.

INSERTION: The pars profundus passes behind the eye and medial to the zygomatic arch, is then inserted on the medial side of the coronoid process of the dentary.

13. M. pterygoideus externus (fig. 20)

ORIGIN: from the lateral pterygoid process.

INSERTION: The pterygoideus externus progresses dorsolaterad from its origin . Its insertion is on the medial face of the condyloid process of the dentary.

14. M. pterygoideus internus (fig. 20) is situated ventral to the pterygoideus externus. It is larger than the latter.

ORIGIN: from the pterygoid fossa.

INSERTION: The pterygoideus internus proceeds laterad from its origin. It is inserted on the medial side of the angular process of the dentary.

C. Inter-ramal Musculature

The four inter-ramal muscles are found beneath the platysma (1) and between the two halves of the mandible.

Mm. digastricus mylohyoideus
transmandibularis geniohyoideus

15. M. digastricus (figs. 18, 19, 20, 21) includes two bellies connected to each other by a common tendon. The anterior belly lies in the horizontal plane and passes caudad from the body of the dentary to the hyoid. The posterior belly has nearly a vertical position and extends ventrocraniad from the jugular process of the occipital bone to to the hyoid. At its lower end it is connected to the posterior end of the anterior belly as well as to the hyoid.

Anterior belly

ORIGIN: from the ventral edge of the body of the dentary.

INSERTION: The anterior belly of the digastricus runs directly caudad, medially bordering its antimere. It is inserted on the ventral surface of the body of the hyoid.

Posterior belly

ORIGIN: from the jugular process of the occipital bone.

INSERTION: The posterior belly proceeds cranioventrad to its insertion on the ventral surface of the body of the hyoid. It is inserted by a short, stout tendon, part of which continues into the anterior belly.

16. M. transmandibularis (fig. 20) is a small, unpaired muscle dorsal to the anterior bellies of the two digastrici and anterior to the mylohyoidei. Its fibers progress transversely from the medioventral edge of the body of one

dentary to the medioventral edge of the body of the other dentary.

17. M. mylohyoideus (fig. 20), found deep to the anterior belly of the digastricus, is located posterior to the transmandibularis. It continues caudomediad from its origin.

ORIGIN: from the medial surface of the dentary, posterior to the attachment of the transmandibularis.

INSERTION: on the median inter-ramal raphe, the body of the hyoid, and the proximal portion of the greater cornu of the hyoid. Along the pre-hyoid part of this insertion the two mylohyoidei are medially connected.

18. M. geniohyoideus (fig. 20), situated dorsal to the transmandibularis and the mylohyoideus, medially adjoins its antimere along the median inter-ramal raphe. It runs from the mandible to the body of the hyoid.

ORIGIN: from the medial surface of the body of the dentary.

INSERTION: on the anterior edge of the body of the hyoid.

D. Muscles of the Tongue

Mm. styloglossus
hyoglossus
genioglossus

19. M. styloglossus (fig. 20) runs ventrad and craniad from the tympanic bulla. It is crowded between the hyoglossus and the pterygoideus internus (14), behind the latter and anterior to the former. It enters the lateral edge of the caudal 1/2 of the tongue, where its fibers merge with the other lingual musculature.

ORIGIN: from the inferior surface of the tympanic bulla, just ventral to the mastoid process.

INSERTION: into the lateral edge of the caudal 1/2 of the tongue.

20. M. hyoglossus (figs. 18, 20) lies directly behind and somewhat medial to the styloglossus. It advances from the greater cornu of the hyoid into the tongue.

ORIGIN: from the body of the hyoid and the anterior edge of the greater cornu of the hyoid.

INSERTION: Progressing craniad, the hyoglossus enters the base of the tongue, where it mingles with the other lingual muscles.

21. M. genioglossus (fig. 20) is found dorsal to the anterior end of the geniohyoideus. It proceeds upward and backward from the body of the dentary into the tongue.

ORIGIN: from the medial surface of the body of the dentary, covered by the origin of the geniohyoideus.

INSERTION: The fibers of the genioglossus diverge. Some pass upward into the dorsum and tip of the tongue,

others, caudad into the base of the tongue. These fibers mix with those of the other lingual muscles.

MUSCLES OF THE BODY

The body muscles include:

A. Muscles of the Neck
B. Muscles of the Trunk

Most of the muscles of the body were found to be essentially the same, as to attachments and extent, in the fox squirrel, the gray squirrel, and the red squirrel. Several of them, however, differ somewhat. In the descriptions of the muscles where such differences occur, the differences will be pointed out. In the descriptions of all other muscles it should be understood that the attachments and extent of each are practically identical in the three forms studied here.

A. Muscles of the Neck

The muscles of the neck may be classified into three groups, as follows:

1. Superficial group
2. Suprahyoid and infrahyoid group
3. Deep lateral and subvertebral group

1. The Superficial Group includes only two muscles.

Mm. sternomastoideus cleidomastoideus

Although the clavotrapezius is not classified with this group, it will be described here, since it is so closely associated with the sternomastoideus and the cleidomastoideus.

56. M. clavotrapezius (figs. 18, 19) is a strap-shaped muscle extending craniodorsad from the sternal end of the clavicle and terminating on the nuchal crest of the occipital bone, above and slightly behind the ear. It is found on the lateral surface of the neck. Cranially it borders the sternomastoideus and caudally, the acromio-spinotrapezius. (57) and the omotransversarius (63). Much of the anterior end of the clavotrapezius is hidden by the dorsal portion of the platysma (1).

ORIGIN: from the ventral edge of the sternal 1/3 of the clavicle.

INSERTION: on the lateral 3/4 of the nuchal crest.

22. M. sternomastoideus (figs. 18, 19) lies ventrocranial and parallel to the clavotrapezius. Like the latter, it is long and strap-shaped. Except at its extreme cranial, or insertional end, it is divisible into two distinct bellies, one of which completely conceals the other.

ORIGIN: Both the superficial belly and the deep belly of the sternomastoideus spring from the cranial edge of the manubrium.

INSERTION: on the mastoid process of the tympanic bulla. The two divisions of this muscle unite at their cranial ends and have a common insertion.

23. M. cleidomastoideus (fig. 19) is located underneath the clavotrapezius, beside and dorsal to the deep belly of the sternomastoideus.

ORIGIN: from the cranial face of the sternal 1/3 of the clavicle, deep to the origin of the clavotrapezius.

INSERTION: on the mastoid process of the tympanic bulla, dorsomedial to the insertion of the sternomastoideus.

2. The Suprahyoid and Infrahyoid Group includes five small muscles. The stylohyoideus lies superior (dorsal) to the hyoid. The remaining four muscles of this group are inferior to the hyoid.

Mm.	sternohyoideus	sternothyroideus
	omohyoideus	thyrohyoideus
	stylohyoideus	

24. M. sternohyoideus (figs. 18, 19, 20, 21), the most medial and superficial of the infrahyoid muscles, covers the midventral surface of the neck. Medially it adjoins its antimere. It extends from the manubrium to the hyoid.

ORIGIN: from the dorsal (inner) surface of the manubrium.

INSERTION: on the caudal rim of the body of the hyoid.

25. M. omohyoideus (figs. 18, 19, 20, 21, 23), lateral and dorsal to the sternohyoideus, progresses cranioventrad along the lateral surface of the neck. It crosses at nearly right angles beneath the clavotrapezius, the sternomastoideus, and the cleidomastoideus.

ORIGIN: from the humeral end of the cranial border of the scapula, between the subscapularis (96) and the supraspinatus (92).

INSERTION: on the caudal edge of the body of the hyoid, lateral to the insertion of the sternohyoideus.

26. M. stylohyoideus (figs. 18, 20) runs ventrad from the lateral edge of the occipital to the lesser cornu of the hyoid. It is a very small muscle ending in a relatively long, slender tendon. Its upper end lies anterior to the cervical belly of the digastricus (15). Its lower end passes under the latter.

ORIGIN: from the occipital, just anterior to the jugular process and behind the epihyal.

INSERTION: by a slender tendon on the lateral surface of the lesser cornu of the hyoid.

27. M. sternothyroideus (figs. 20, 21) is a thin, flat muscle found directly beneath and parallel to the sternohyoideus (24).

ORIGIN: from the dorsal surface of the caudal end of the sternohyoideus.

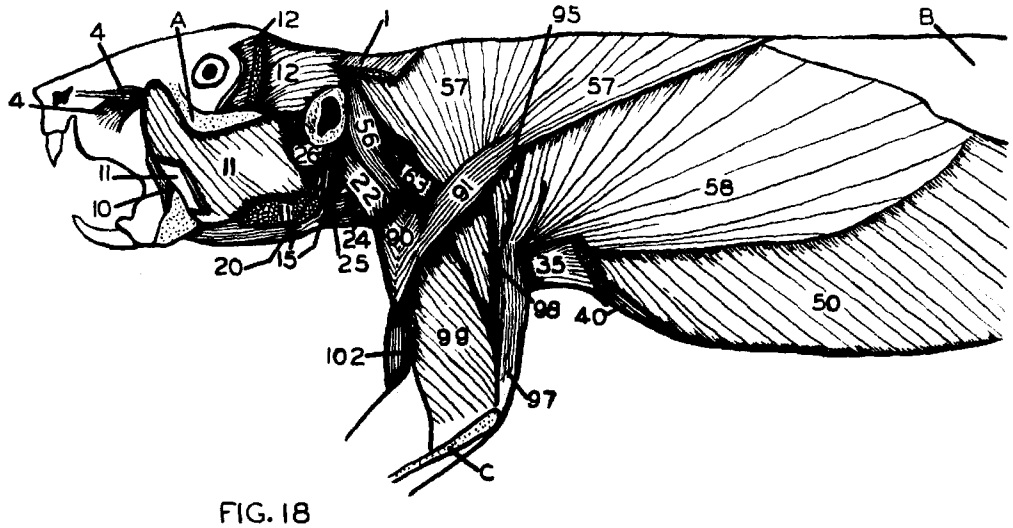

FIG. 18

1 IN.

FIGURE 18. Superficial muscles of the lateral aspect of the head, trunk, and brachium in the fox squirrel.

1 platysma
4 levator alae nasi labiique superioris
10 buccinator
11 masseter
12 temporalis
15 digastricus
20 hyoglossus
22 sternomastoideus
24 sternohyoideus
25 omohyoideus
26 stylohyoideus
35 panniculus carnosus
40 pectoralis abdominalis
50 obliquus abdominis externus
56 clavotrapezius
57 acromio-spinotrapezius
58 latissimus dorsi
63 omotransversarius
90 clavo-acromiodeltoideus
91 spinodeltoideus
95 teres major
97 epitrochlearis
98 triceps longus
99 triceps lateralis
102 biceps brachii

A zygomatic arch
B lumbodorsal fascia
C ulna

INSERTION: on the lateral surface of the thyreoid cartilage.

28. M. thyrohyoideus (figs. 20, 21), a very short, thin muscle, is situated dorsal to the cranial end of the sternohyoideus. It is anterior to and directly in line with the sternothyroideus.

ORIGIN: from the lateral surface of the cranial portion of the thyreoid cartilage.

INSERTION: on the caudal and ventral edges of the lesser cornu of the hyoid.

3. The Deep Lateral and Subvertebral Group includes six muscles found ventral and lateral to the cervical vertebrae. Most of them are very complex and it is difficult to separate all of their attachments.

Mm.	scalenus anticus	longus colli
	scalenus medius	longus capitis
	scalenus posticus	rectus capitis anterior

29. M. scalenus anticus (fig. 21) is a small muscle progressing craniad along the lateral surface of the neck, just dorsal to the longus colli (32) and partially deep to the scaleni medius and posticus. It ends underneath and dorsal to the cranial ends of the omotransversarius (63) and the spinotransversarius (62).

ORIGIN: from the cranial face of the 1st rib, opposite

the insertion of the transversus costarum (41).

INSERTION: apparently on the transverse processes of the last five or six cervical vertebrae. The limits of this insertion could not be clearly defined, because the cranial ends of all three scaleni are quite intimately joined.

30. M. scalenus medius (figs. 19, 21)

ORIGIN: In the fox squirrel and the gray squirrel the scalenus medius arises by three slips . The longest and most superficial slip issues from the outer surface of the 6th rib at a level just ventral to the 3rd original slip of the serratus magnus (43). The next slip springs from the outer surface of the 5th rib at a level immediately below the serratus magnus' 2nd original slip, and the last slip, (the shortest, deepest, and weakest), from the outer surface of the 4th rib, just below the serratus magnus' 1st original slip.

In the red squirrel the three original slips of the scalenus medius come from the outer surfaces of the 5th, 4th, and 3rd ribs, respectively. These origins are directly below the 2nd and 1st original slips of the serratus magnus and the most caudal original slip of the levator scapulae (44).

The external oblique (50) and the rectus abdominis (54) cover the original end of the scalenus medius, whose three slips advance craniad and somewhat dorsad. As they pass superficial to the levator scapulae, these slips fuse to-

gether and blend with the scalenus posticus. The combined scaleni medius and posticus continue craniad, lying along the lateral surface of the neck.

INSERTION: The scaleni medius and posticus are inserted together on the ventrolateral edges of the transverse processes of all of the cervical vertebrae. These insertional slips are not distinctly separable from one another. They are also connected to the insertions of the scalenus anticus. This united cervical portion of the scaleni medius and posticus is augmented by fibers which arise from the cranial face of the 1st rib and from the dorsolateral edges of the transverse processes of the last four cervical vertebrae.

31. M. scalenus posticus (figs. 19, 21) is the dorsal-most of the three scaleni.

ORIGIN: In the fox squirrel the more dorsal portion of this muscle's origin comes from the outer surface of the 4th rib deep to the 1st original slip of the serratus magnus (43). A smaller, more ventral portion, however, is superficial to the 1st original slip of the serratus magnus, and comes from the fascia overlying the most cranial original slip of the external oblique (50).

In the gray squirrel and the red squirrel the scalenus posticus takes origin by two slips. One of the slips springs from the 4th rib and emerges from beneath the 1st original slip of the serratus magnus. The other slip commences on the 3rd rib and emerges from below the last

original slip of the levator scapulae (44).

INSERTION: Proceeding craniad superficial to the levator scapulae, the scaleni posticus and medius combine and are inserted on the cervical transverse processes, as described in the preceding account of the scalenus medius.

32. M. longus colli is a long muscle found on the ventrolateral surface of the cervical and first few thoracic vertebrae. It is situated dorsal and lateral to the oesophagus. The longus capitis partly conceals it.

ORIGIN: from the ventral face of the centra of the first two thoracic vertebrae, medial to the caudal end of the longus capitis, also from the ventral surface of the transverse processes of the last six cervical vertebrae. One can not distinguish the cervical portion of this muscle's origin from the cervical portion of the origin of the longus capitis.

INSERTION: on the ventral face of the centra of the cervical vertebrae.

33. M. longus capitis (figs. 20, 21) is the longest and most extensive of the subvertebral cervical muscles.

ORIGIN: from the ventral face of the centra of the first six thoracic vertebrae and from the inner surfaces of the vertebral ends of the first five ribs. The slip coming from the 1st thoracic vertebra is entirely fleshy, that from the 6th is tendinous, the intervening ones, partly tendinous

and partly fleshy. Thus, there are five strong, flat tendons on the ventral aspect of the caudal end of this muscle.

As it runs craniad, the longus capitis occupies a position somewhat lateral to the longus colli, but gradually passes mediad. Meanwhile, it is strengthened by slips coming from the ventral surface of the last five cervical transverse processes. It then extends across the cranial end of the longus colli and the entire rectus capitis anterior onto the ventral face of the basioccipital.

INSERTION: on the ventral face of the basioccipital, slightly medial to the tympanic bulla.

34. M. rectus capitis anterior is a very short muscle located dorsal to the cranial end of the longus capitis. It progresses from the atlas to the ventral surface of the basioccipital.

ORIGIN: from the ventral surface of the atlas.

INSERTION: on the ventral aspect of the basioccipital, caudal and lateral to the cranial end of the longus capitis.

B. Muscles of the Trunk

The musculature of the trunk is described under six headings:

1. Muscles of the thorax
2. Muscles of the abdomen
3. Muscles of the lumbar region
4. Muscles of the back
5. Muscles of the tail
6. Perineal musculature

1. The Muscles of the Thorax are the following:

Mm.	panniculus carnosus	subclavius
	pectoralis superficialis anterior	serratus magnus
	pectoralis superficialis posterior	levator scapulae
	pectoralis profundus anterior	intercostales externi
	pectoralis profundus posterior	intercostales interni
	pectoralis abdominalis	levatores costarum
	transversus costarum	diaphragm
		transversus thoracis

35. M. panniculus carnosus (figs. 18, 19), the largest of the dermal muscles, is inserted into the skin of much of the trunk.

ORIGIN: (1.), from the entire length of the common insertional fascia of the pectorales superficialis posterior (37), profundus anterior (38), and profundus posterior (39). Therefore, the panniculus is indirectly connected to the deltoid ridge of the humerus and the coracoid process of the scapula.

(2.), from the border between the latissimus dorsi (58) and the epitrochlearis (97).

INSERTION: The panniculus carnosus passes caudad from its origin. Its fibers diverge to form a thin, muscular sheet which becomes inserted into the skin of the ventral, lateral, and dorsal surfaces of much of the trunk. Some of its fibers extend into the skin of the dorsal surface of the tail. Immediately anterior to the base of the tail there is a small, dorsal, thickened area of the panniculus fibers.

In the axilla and for a short distance caudad the panniculus carnosus is fairly thick and its borders are connect-

ed by fascia to the latissimus dorsi (58) on one side and the pectorlis abdominalis (40) on the other.

36. M. pectoralis superficialis anterior (fig. 19), found on the ventral aurface of the anterior end of the thorax, is triangular in shape. Its sternal end is wide and flat, but quite thick. Its fibers converge as they progress laterad so that the humeral end of this muscle is narrower and thicker. It is difficult to find the border between this muscle and the pectoralis superficialis posterior. The cranial border of the pectoralis superficialis anterior adjoins, and fuses with the clavodeltoideus (90).

ORIGIN: In the fox squirrel and the gray squirrel this muscle originates from the ventral surface of the sternal end of the clavicle and the ventral face of the sternum as far caudad as the level of the sternal articulation of the 5th rib.

In the red squirrel its origin is nearly the same, but the sternal attachment extends caudad only as far as the level of the sternal articulation of the 4th rib.

INSERTION: in common with the insertion of the clavodeltoideus on the medial aspect of the deltoid ridge of the humerus.

37. M. pectoralis superficialis posterior (fig. 19) is situated inferior to the pectoralis superficialis anterior. Because these two pectorales adhere very closely together,

it is difficult to discern their mutual border.

ORIGIN: In the fox squirrel and the gray squirrel this muscle springs from the ventral side of the last three sternebrae, from the anterior portion of the xiphoid process, and also from the outer surface of the chondral portions of the 6th, 7th, and 8th ribs.

In the red squirrel it arises from the ventral face of the last three sternebrae, from the anterior portion of the xiphoid process, and also from the outer surface of the chondral portions of the 5th, 6th, 7th, and 8th ribs.

The pectoralis superficialis posterior, its fibers converging, advances craniolaterad to disappear under the pectoralis superficialis anterior. It ends in a thin fascia which is continuous with the common insertional fascia of the pectorales profundi.

INSERTION: This common, wide, thin fascia receives the insertional end of the pectoralis abdominalis, then reaches insertion along the medial aspect of the deltoid ridge of the humerus and on the coracoid process of the scapula.

The panniculus carnosus takes origin from the entire length of this fascia and emerges from beneath all of the pectorales. The latissimus dorsi (58) gives off a few of its most ventral fibers to form a small slip which becomes inserted on this common fascia of the deeper pectorales.

38. M. pectoralis profundus anterior (fig. 19) is a flat, triangular muscle deep to the pectoralis superficialis anterior.

ORIGIN: In the fox squirrel and the gray squirrel it emanates from the outer edges of the chondral portions of the 3rd, 4th, and 5th ribs, as well as from the ventral surface of the 2nd, 3rd, and 4th sternebrae.

In the red squirrel this muscle comes from the outer face of the chondral portions of the 3rd and 4th ribs, and, in addition, from the ventral aspect of the 1st and 2nd sternebrae.

INSERTION: Progressing craniolaterad, its fibers converge to terminate in a thin fascia which is inserted on the coracoid process of the scapula. This fascia is continuous laterally with the fascia of the pectoralis profundus posterior , the pectoralis superficialis posterior, and the pectoralis abdominalis. From this common fascia the panniculus carnosus takes origin, and on it a small slip from the latissimus dorsi (58) is inserted.

39. M. pectoralis profundus posterior (fig. 19) is caudal to the pectoralis profundus anterior and deep to the pectoralis superficialis posterior.

ORIGIN: In the fox squirrel the pectoralis profundus posterior issues from the ventral side of the 4th and 5th sternebrae and from the outer surface of the chondral portions of the 6th and 7th ribs.

In the gray squirrel it arises from the outer aspect of the sternal end of the 6th rib and from the ventral face of the sternum for a short space cranial to and caudal

FIGURE 19. Muscles of the ventral aspect of the head, neck, and thorax in the fox squirrel.

Superficial muscles of the posteromedial side of the arm in the fox squirrel.

10 buccinator
11 masseter
15 digastricus
22 sternomastoideus
23 cleidomastoideus
24 sternohyoideus
25 omohyoideus
30 scalenus medius
31 scalenus posticus
35 panniculus carnosus
36 pectoralis superficialis anterior
37 pectoralis superficialis posterior
38 pectoralis profundus anterior
39 pectoralis profundus posterior
40 pectoralis abdominalis
42 subclavius
43 serratus magnus
50 obliquus abdominis externus
51 obliquus abdominis internus
54 rectus abdominis
56 clavotrapezius
58 latissimus dorsi
90 clavo-acromiodeltoideus
97 epitrochlearis
100 triceps medialis
102 biceps brachii
103 coracobrachialis
105 supinator longus
114 pronator teres
115 flexor carpi radialis
116 palmaris
117 flexor carpi ulnaris
119 flexor digitorum profundus

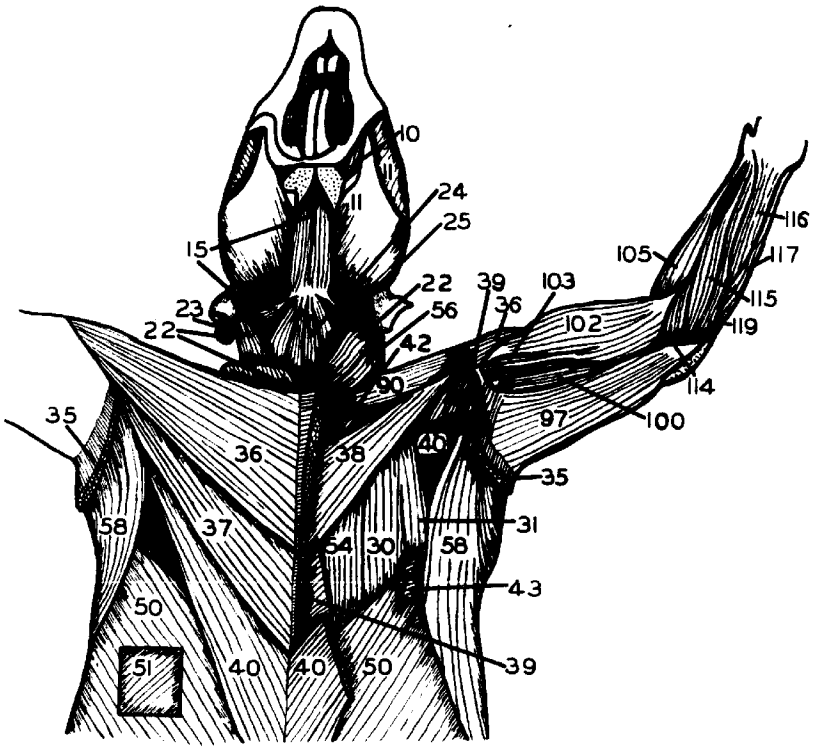
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FIG. 19

1 IN.

to the articulation of the 6th rib.

In the red squirrel it comes from the outer surface of the chondral portion of the 5th rib as well as from the ventral side of the sternum between the sternal ends of the 4th and 5th ribs.

INSERTION: by a thin fascia onto the medial aspect of the deltoid ridge of the humerus. This insertion is continuous medially with the insertion of the pectoralis profundus anterior and laterally with the insertion of the pectoralis superficialis posterior.

40. M. pectoralis abdominalis (figs. 18, 19, 20) is located caudal to the other pectorales. It extends craniolaterad from the midventral line up to its insertion on the deltoid ridge of the humerus. Its caudal border adheres to the ventrocranial edge of the anterior portion of the panniculus carnosus (35). Its cranial end passes beneath the pectoralis superficialis posterior to terminate in a thin fascia which merges with the common fascia of the three preceding pectorales.

ORIGIN: from the ventral face of the caudal portion of the xiphoid process and from the midventral line of the cranial part of the abdomen.

INSERTION: by a thin fascia which passes deep to and fuses with those of the three preceding pectorales. Thus, the pectoralis abdominalis is indirectly attached to the deltoid ridge.

41. M. transversus costarum (fig. 21) is a very small, flat muscle found beneath the pectoralis profundus anterior. Its caudal 1/2, or slightly more, consists of a wide, thin tendon. It runs obliquely craniolaterad across the rectus abdominis (54), becomes fleshy, and has a fleshy insertion on the first rib.

ORIGIN: In the fox squirrel it originates by a thin fascia from the outer surface of the chondral portions of the 3rd and 4th ribs.

In the gray squirrel and the red squirrel the thin fascia of this muscle emanates from the outer face of the chondral portions of the 3rd, 4th, and 5th ribs.

INSERTION: on the caudal border of the 1st rib, dorsal to the origin of the rectus abdominis.

42. M. subclavius (fig. 19)

ORIGIN: from the anterior face of the chondral part of the 1st rib, opposite the origin of the rectus abdominis (54).

INSERTION: This little, terete muscle goes dorso-craniolaterad to its insertion on the dorsocaudal edge of the middle 1/3 to 1/2 of the clavicle.

43. M. serratus magnus (figs. 19, 20, 21) is a fan-shaped muscle of the lateral surface of the thorax. It lies beneath the acromio-spinotrapezius (57) and the latissimus dorsi (58). The dorsal, or insertional, end, fastened to the inner surface of the vertebral border of the scapula,

forms the apex of the fan. The ventral, or original, end is serrate, for it is divided into five fleshy slips which originate from the outer faces of certain ribs.

ORIGIN: by means of five fleshy serrations from the outer surfaces of ribs 4-8, inclusive. These serrations, or slips, interdigitate with those of the external oblique (50). They are mostly deep to the origins of the scaleni medius (30) and posticus (31).

INSERTION: As they proceed craniodorsad the slips converge and unite. The muscle is inserted on the costal (inner) face of the teres ridge of the scapula, at the corner formed by the juncture of the scapula's vertebral and axillary borders. The serratus magnus and the more anterior levator scapulae are slightly joined at their dorsal ends.

44. M. levator scapulae (figs. 21, 24), cranial to the serratus magnus, runs dorsocaudad from the cervical transverse processes and the first three ribs to the vertebral border of the scapula.

ORIGIN: (1.), by three fleshy serrations from the outer surfaces of the first three ribs. In the gray squirrel and the red squirrel the last of these serrations is superficial to the deeper original slip of the scalenus posticus (31). The remainder of the levator scapulae, and the entire levator scapulae in the fox squirrel, is crossed by the scaleni medius and posticus.

(2.), from the transverse processes of the

last five cervical vertebrae. This anterior portion of the muscle's origin is a solid, fleshy mass which issues from between the scaleni and the cranial end of the longissimus dorsi (68).

INSERTION: The fibers of the levator scapulae progress mostly dorsad, the anterior ones, somewhat caudad. Converging, they reach their insertion on the costal face of the vertebral end of the scapula. The caudal edge of the levator scapulae unites at its dorsal end with the cranial border of the serratus magnus.

45. Mm. intercostales externi (figs. 20, 21) are twelve pairs of muscles, each one of which is composed of fibers passing caudoventrad from one rib to the next posterior rib. Dorsomedially these muscles extend up to the vertebrae. Ventromedially they extend only to, or slightly beyond the junctures of the osseous and chondral portions of the first eight pairs of ribs. The last five pairs of external intercostals, however, reach the ventral terminations of the last five pairs of ribs.

ORIGIN: Each external intercostal arises from the caudal border of one of the first twelve ribs.

INSERTION: Each is inserted on the cranial border of the next posterior rib. Thus, there is one intercostalis externus inserted on each rib, except the 1st.

46. Mm. intercostales interni (fig. 20) are twelve pairs of muscles lying beneath the intercostales externi. Each intercostalis internus consists of fibers which go caudodorsad, at right angles to the direction of the intercostales externi, from one rib to the next. These internal intercostal muscles extend from the vertebral to the ventral ends of the ribs. They are hidden by the external intercostals, except in the region of the chondral portions of the first eight pairs of ribs.

ORIGIN: Each internal intercostal springs from the caudal edge of one of the first twelve ribs.

INSERTION: Each is inserted on the cranial border of the next posterior rib. Thus, there is one intercostalis internus inserted on each rib, except the 1st.

47. Mm. levatores costarum are twelve pairs of small, triangular muscles which run from the transverse processes of the thoracic vertebrae to the vertebral ends of the ribs. They hide the dorsal ends of the external intercostals and are mostly dorsomedial to the angles of the ribs. Before they can be seen, it is necessary to remove the iliocostalis (67).

ORIGIN: Each levator costae comes from the transverse process of one of the first twelve thoracic vertebrae.

INSERTION: Each ends on the cranial edge of the vertebral portion of a rib. There is a levator costae for each rib, except the 1st.

48. M. diaphragm

ORIGIN: The pars sternalis emanates from the inner surface of the xiphoid process. The pars costalis comes from the inner edges of the last six pairs of ribs approximately at the level of, or slightly beyond the junctures of osseous and chondral portions. The pars lumborum arises from the ventral side of the centra of the first four lumbar vertebrae. It is likewise attached by fascia to the ventral surface of the psoases majora (129).

The diaphragm is an unpaired, dome-shaped muscle forming a transverse partition between the thoracic and abdominal divisions of the body cavity. Its cranial face is convex, its caudal face, concave. Its outer portion is fleshy, its center, tendinous. Three openings in the diaphragm serve to transmit the oesophagus, the aorta, and the inferior vena cava.

INSERTION: The fibers of the diaphragm converge inward to become inserted into the tendinous center of the muscle.

49. M. transversus thoracis is a flat muscle lying on the inner surface of the ventral part of the thoracic basket.

ORIGIN: from the lateral edge of the inner (dorsal) aspect of all six of the sternebrae.

INSERTION: The fibers of this muscle extend mostly laterad, but also somewhat craniad. They are inserted on the inner side of the chondral portions of ribs 2-8, inclusive.

2. The Muscles of the Abdomen include the following:

Mm. obliquus abdominis externus
obliquus abdominis internus
cremaster
transversalis
rectus abdominis

50. M. obliquus abdominis externus (figs. 18, 19, 20, 21, 27, 28, 29) is an extensive, flat muscle covering the lateral and ventral surfaces of the abdomen and much of the thorax. The pectorales, the latissimus dorsi (58), and the cranial end of the panniculus carnosus (35) partly cover its anterior end. Its fibers pass ventrocaudad.

ORIGIN: In the fox squirrel and the red squirrel the external oblique originates from the lumbodorsal fascia and by fleshy slips from the outer surfaces of the last ten ribs (ribs 4-13, inclusive). These short slips interdigitate with the costal attachments of the serratus magnus (43), the serratus posterior superior (64), the serratus posterior inferior (65), and the latissimus dorsi (58).

In the gray squirrel the origin of the external oblique is the same as described above, except that the muscle is attached to the last eleven ribs (ribs 3-13, inclusive).

INSERTION: In the FEMALE the external oblique is inserted along the whole length of the linea alba, by a thin fascia onto the ventral surface of the anterior part of the abdominal portion of the rectus abdominis (54), and by a short, tough fascia onto Poupart's ligament and the symphysis pubis.

In the MALE the external oblique becomes split some distance anterior to the scrotum. The more medial of its two divisions is inserted on the anterior part of the linea alba and on the ventral aspect of the cranial portion of the abdominal part of the rectus abdominis. The more lateral division of the posterior end of the male's external oblique runs caudad lateral to the scrotum. Its insertion is on Poupart's ligament and the symphysis pubis.

51. M. obliquus abdominis internus (figs. 19, 21, 27, 28) is a flat, muscular sheet found interior to the external oblique, between the latter and the transversalis. It is thinner than the external oblique and is difficult to separate from the deeper lying transversalis. Its fibers advance cranioventrad.

ORIGIN: from Poupart's ligament and the lumbodorsal fascia.

INSERTION: on the caudal face of most of the 13th rib, on the caudal face of that part of the 12th rib which projects ventrad beyond the tip of the 13th rib, on the caudal face of the portion of the 11th rib which projects ventrad beyond the tip of the 12th rib, and by a rather wide, thin fascia onto the linea alba.

The internal oblique terminates ventrally in a fascia which merges with that of the transversalis and is fastened along the linea alba. In the cranial 1/2 to 3/5 of the abdomen the combined insertional end of the internal oblique

and the transversalis passes deep to the rectus abdominis (54). In the caudal 2/5 to 1/2 of the abdomen it emerges and lies superficial to the rectus abdominis.

In the male a simple evagination of the internal oblique forms the cremaster, a muscle lining one-half of the scrotum.

52. M. cremaster (fig. 27) is found only in males. It is merely a muscular sac, an evagination of the internal oblique. It constitutes the striated muscular part of the wall of the scrotum.

53. M. transversalis (fig. 28), a thin sheet of muscle situated below the internal oblique, partially fuses with the latter. It fibers progress somewhat caudoventrad, more noticeably ventrad than caudad.

ORIGIN: from the lumbodorsal fascia, from the inner surfaces of the post-diaphragmal portions of the last four or five ribs, and from the caudal face of the ventral end of the 11th rib.

INSERTION: on the linea alba and Poupart's ligament. This muscle terminates ventrally in a fascia which combines with the ventral fascia of the internal oblique. In the cranial 1/2 to 3/5 of the abdomen the transversalis and the internal oblique pass deep to the rectus abdominis. In this region the fleshy part of the transversalis extends closer to the midline than does the fleshy part of the internal ob-

lique. In the caudal 2/5 to 1/2 of the abdomen this condition is reversed, for here the transversalis and the internal oblique emerge so as to overlie the rectus abdominis. In addition, the fleshy part of the internal oblique in this region projects nearer the midventral line than does the fleshy part of the transversalis.

54. M. rectus abdominis (figs. 19, 21) is a long, strap-shaped muscle extending all the way along the midventral surface of the thorax and abdomen. It proceeds caudad from its origin. Its anterior end is found underneath the pectorales and the transversus costarum (41), but external to the most ventral part of the scalenus medius (30). Continuing caudad, the rectus abdominis runs deep to the external oblique, then swings slightly mediad and borders its antimere throughout the length of the linea alba. At first it lies superficial to the combined insertional end of the transversalis and internal oblique. In the caudal 2/5 to 1/2 of the abdomen, however, it goes even deeper, so that the transversalis and the internal oblique cover its posterior end.

ORIGIN: from the outer face of the sternal end of the first two ribs and from the intervening lateral margin of the manubrium. At this level the sternum and the origins of the pectorales separate the rectus abdominis from its fellow.

INSERTION: on the ventral aspect of the cranial end of

the symphysis pubis and the medial end of the ascending ramus of the pubis.

3. The Lumbar Muscle is the quadratus lumborum, which is situated on the ventral surface of the lumbar transverse processes, squeezed in between the psoas major (129) and the lumbar portion of the longissimus dorsi (68).

55. M. quadratus lumborum (fig. 32) will be described with the ilio-psoas group of muscles, since it is so closely associated with them. (see page 122).

4. The Muscles of the Back are described below under two subheadings:

a. superficial, secondary muscles of the back
b. deep, intrinsic muscles of the back

a. Superficial, Secondary Muscles of the Back

These muscles all originate from the skull or from vertebrae and are inserted on some part of the pectoral appendage or fairly low on the ribs. They are subdivided into three layers.

1st layer

Mm. clavotrapezius
acromio-spinotrapezius
latissimus dorsi

56. M. clavotrapezius (figs. 18, 19) has already been described with the superficial group of neck muscles. (see page 49).

57. M. acromio-spinotrapezius (fig. 18), the most superficial of the muscles of the back, is thin, flat, and broadly triangular. Its fibers, running laterad from the mid-dorsal line of the cervical and thoracic regions, converge toward their insertion on the scapular spine. This muscle cranially borders the clavotrapezius. Caudally it overlaps the anterior end of the latissimus dorsi.

In many rodents the acromiotrapezius and the spinotrapezius are distinct from one another. This is the condition in the red squirrel, where the point of spearation comes at about the level of the 3rd thoracic vertebra. In the fox squirrel and the gray squirrel, however, the acromiotrapezius and the spinotrapezius are inseparable.

ORIGIN: from the medial portion of the nuchal crest of the occipital bone, from the ligamentum nuchae, and from the supraspinous fascia overlying the first ten thoracic vertebrae.

INSERTION: The acromiotrapezius is inserted on the cranial face of most of the scapular spine, the spinotrapezius, on the caudal face of the vertebral 1/3 of the scapular spine, medial to the origin of the spinodeltoideus (91).

56. M. clavotrapezius (figs. 18, 19) has already been described with the superficial group of neck muscles. (see page 49).

57. M. acromio-spinotrapezius (fig. 18), the most superficial of the muscles of the back, is thin, flat, and broadly triangular. Its fibers, running laterad from the mid-dorsal line of the cervical and thoracic regions, converge toward their insertion on the scapular spine. This muscle cranially borders the clavotrapezius. Caudally it overlaps the anterior end of the latissimus dorsi.

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ORIGIN: from the medial portion of the nuchal crest of the occipital bone, from the ligamentum nuchae, and from the supraspinous fascia overlying the first ten thoracic vertebrae.

INSERTION: The acromiotrapezius is inserted on the cranial face of most of the scapular spine, the spinotrapezius, on the caudal face of the vertebral 1/3 of the scapular spine, medial to the origin of the spinodeltoideus (91).

58. M. latissimus dorsi (figs. 18, 19, 20, 23, 24) is an extensive muscle of the dorsolateral surface of most of the thorax. Its most anterior fibers proceed almost directly ventrad, its most posterior fibers, almost directly craniad. Most of the latissimus dorsi is thin and flat, but, since its fibers converge toward their insertion, the muscle becomes thick and massive in the region of the axilla. The epitrochlearis (97) arises from the surface of the thickened, axillary portion of the latissimus dorsi and to a lesser extent from the surface of the adjacent teres major (95). The latissimus then disappears under, and fuses with the axillary part of the teres major. These two muscles end in a strong tendon inserted on the medial side of the upper 1/3 of the humerus.

In the axillary region the latissimus dorsi adheres to the anterior portion of the panniculus carnosus (35), a muscle which springs partially from the border between the latissimus and the epitrochlearis (97). On the inner surface of the proximal end of the upper arm a few fibers of the latissimus (not ending in the main insertion) form a small slip which unites with the insertional fascia of the pectoralis abdominalis (40).

ORIGIN: from the spinous processes of thoracic vertebrae 3-11, inclusive, from the anterior part of the lumbodorsal fascia, and by a muscle-fibrous attachment from a small part of the outer face of each of the last three ribs.

INSERTION: on the medial aspect of the upper 1/3 of the

humerus by a tendon which is common to both the teres major (95) and the latissimus dorsi.

2nd layer

Mm. rhomboideus anticus
rhomboideus posticus
occipitoscapularis
spinotransversarius
omotransversarius

59. M. rhomboideus anticus (fig. 20) is a thin muscle deep to the acromio-spinotrapezius. It extends from the ligamentum nuchae to the scapula. It is located inferomedial to the occipitoscapularis (61). Its posteromedial border closely adjoins the shorter, thicker rhomboideus posticus, but is clearly separable from the latter. As it passes caudad and slightly laterad, the rhomboideus anticus becomes narrower and thicker. It ends under the rhomboideus posticus. Having received a slip from the occipitoscapularis, it becomes inserted on the vertebral border of the scapula.

ORIGIN: from the caudal 3/4 of the ligamentum nuchae.

INSERTION: on the vertebral border of the scapula, between the insertions of the levator scapulae (44) and the rhomboideus posticus.

60. M. rhomboideus posticus (fig. 20), a short, rather thick muscle, is found between the rhomboideus anticus and the cranial border of the dorsal end of the latissimus dorsi. It is closely adherent to the posteromedial edge of the rhomboideus anticus, but can be distinctly detached from the latter. It runs caudolaterad from the vertebrae of the an-

FIGURE 20. Muscles of the lateral aspect of the head and trunk in the fox squirrel--2nd layer.

Superficial muscles of the anterolateral side of the arm in the fox squirrel.

6 levator labii superioris proprius
12 temporalis
13 pterygoideus externus
14 pterygoideus internus
15 digastricus
16 transmandibularis
17 mylohyoideus
18 geniohyoideus
19 styloglossus
20 hyoglossus
21 genioglossus
24 sternohyoideus
25 omohyoideus
26 stylohyoideus
27 sternothyroideus
28 thyrohyoideus
33 longus capitis
40 pectoralis abdominalis
43 serratus magnus
45 intercostales externi
46 intercostales interni
50 obliquus abdominis externus
58 latissimus dorsi
59 rhomboideus anticus
60 rhomboideus posticus
61 occipitoscapularis
62 spinotransversarius
63 omotransversarius
64 serratus posterior superior
65 serratus posterior inferior
66 splenius
92 supraspinatus
93 infraspinatus
94 teres minor
95 teres major
97 epitrochlearis
98 triceps longus
99 triceps lateralis
101 anconeus
102 biceps brachii
104 brachialis
105 supinator longus
106 extensor carpi radialis longus
107 extensor carpi radialis brevis
108 extensor digitorum communis
109 extensor digiti quinti
110 extensor carpi ulnaris
112 extensor metacarpi pollicis
113 extensor indicis

SC scaleni
U ulna
Z zygomatic arch

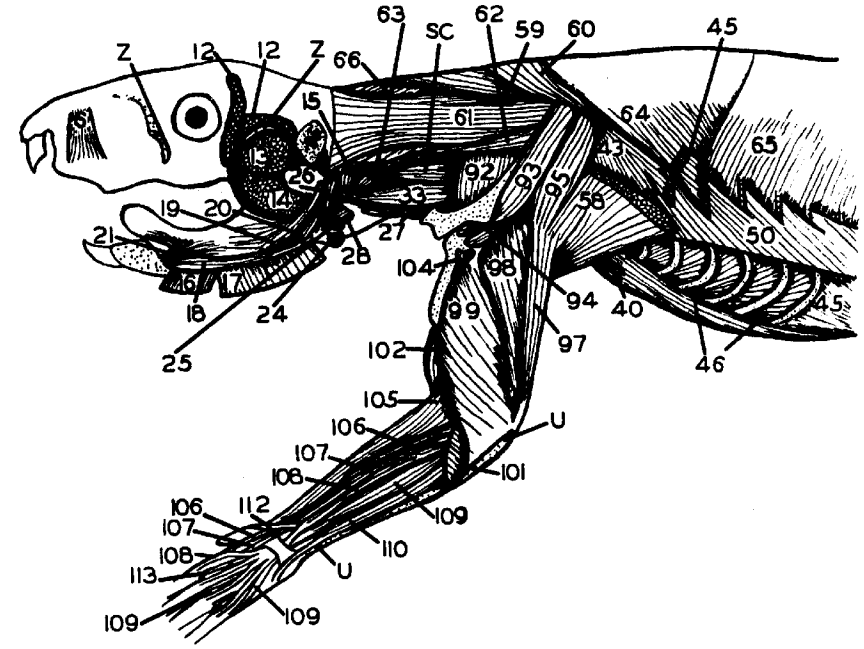
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FIG. 20

1 IN.

terior thoracic region to the vertebral rim of the scapula.

ORIGIN: from the spinous processes of the 2nd and 3rd thoracic vertebrae.

INSERTION: on the infraspinatous portion of the vertebral border of the scapula, closely associated with the insertion of the serratus magnus (43).

61. M. occipitoscapularis (rhomboideus occipitalis, rhomboideus capitis, levator scapulae, levator scapulae dorsalis), (figs. 20, 21) is a thin, flat muscle situated under the clavotrapezius (56), the cleidomastoideus (23), and the acromio-spinotrapezius (57). Ventrolaterally it borders the spinotransversarius. From its origin it progresses directly caudad onto the vertebral portion of the scapula. It splits into a wider, lateral slip and a narrower, medial slip. The latter passes beneath and medial to the scapula, then joins the rhomboideus anticus. The more lateral slip reaches insertion on the vertebral 1/5 of the scapular spine and overlaps the insertion of the spinotransversarius.

ORIGIN: from the lateral 3/4 of the nuchal crest of the occipital bone, beneath the clavotrapezius and the cleidomastoideus.

INSERTION: The medial part of the insertional end of this muscle combines with the rhomboideus anticus. The wider, lateral portion is inserted on the vertebral 1/5 of the scapular spine.

62. M. spinotransversarius (figs. 20, 21) extends from the atlas to the spine of the scapula. It is a narrow muscle whose origin is covered by the clavotrapezius (56) and the cleidomastoideus (23). Proceeding caudad and somewhat dorsad, it emerges from beneath these muscles and is located parallel and ventral to the occipitoscapularis. Before reaching insertion it becomes wider and thinner, then partly disappears under the occipitoscapularis' caudal end.

ORIGIN: from the transverse process of the atlas.

INSERTION: on the vertebral end of the scapular spine, mostly beneath the insertion of the occipitoscapularis.

Apparently, many rodents do not possess this muscle. Greene (1935), Howell (1926), Parsons (1894), and Young (1937) do not mention it. Hoffmann and Weyenbergh (1870) call it the acromiobasilaris secundus and Peterka (1936) calls it the rhomboideus profundus, but the present author prefers to call it the spinotransversarius.

63. M. omotransversarius (figs. 18, 20, 21) has also been called the atlantoscapularis, the acromiobasilaris, the levator clavículae, and the levator scapulae ventralis. It goes caudolaterad from the atlas to the metacromion process of the scapula. Most of it is hidden by the clavotrapezius (56), the acromiotrapezius (57), and the cleidomastoideus (23). Its posterior end, however, is exposed superficial to the humeral end of the scapula, between the acromiotrapezius, the clavotrapezius, and the acromiodeltoideus (90).

ORIGIN: from the transverse process of the atlas. This origin lies deep to the clavotrapezius and the cleidomastoideus, but superficial and ventral to the origin of the spinotransversarius.

INSERTION: on the metacromion process of the scapula, distal (lateral) to the insertion of the acromiotrapezius.

3rd layer

Mm. serratus posterior superior
serratus posterior inferior

64. M. serratus posterior superior (figs. 20, 21) issues from the anterior thoracic vertebrae by a wide fascia which cranially overlaps the splenius' (66) posterior end and caudally disappears under the fascia of the serratus posterior inferior. It lies mostly beneath the latissimus dorsi (58) and the serratus magnus (43). It proceeds caudoventrad, becoming fleshy at the level of the lateral edge of the iliocostalis (67).

ORIGIN: from the spinous processes and the interspinous fasciae of the first eight or nine thoracic vertebrae.

INSERTION: by eight fleshy slips, or serrations, one going to the cranial border of each of ribs 3-10, inclusive. The cranial 1/3 of the serratus posterior inferior overlaps the caudal end of the serratus posterior superior.

65. M. serratus posterior inferior (figs. 20, 21) comes from the last few thoracic vertebrae via a wide fascia which

overlaps that of the serratus posterior superior and is not easily separated from the latter. Caudally this fascia merges into the lumbodorsal fascia. The serratus posterior inferior progresses ventrad and becomes fleshy at the level of the lateral edge of the iliocostalis (67). Its cranial 1/3 overlies the caudal end of the serratus posterior superior.

ORIGIN: from the spinous processes and the interspinous fasciae of the last five or six thoracic vertebrae.

INSERTION: by five fleshy serrations, one passing to the outer surface of each of ribs 9-13, inclusive.

b. Deep, Intrinsic Muscles of the Back

These muscles are attached to vertebrae or to the skull and vertebrae. Some of them also have costal attachments. They may be subdivided, according to the plan used by Howell (1926) in his work on the wood rat, into the following four groups:

(1.) splenius
(2.) long system
(3.) transverso-spino-occipital system
(4.) deep, short system

(1.) Splenius

66. M. splenius (figs. 20, 21), a fairly wide, flat, triangular muscle of the cervical and anterior thoracic regions, is found beneath the occipitoscapularis (61), the rhomboideus anticus (59), and the rhomboideus posticus (60). Its fibers advance craniad and slightly laterad,

running from the 2nd thoracic vertebra to the nuchal crest of the occipital bone.

ORIGIN: from the ligamentum nuchae and the spinous process of the 2nd thoracic vertebra.

INSERTION: on the nuchal crest of the occipital bone and the mastoid process of the tympanic bulla.

(2.) Long system

Mm. sacrospinalis
iliocostalis
longissimus dorsi
longissimus cervicis
spinalis dorsi et cervicis

The sacrospinalis is a long muscle mass extending from the deep lateral surface of the neck back to the 10th or 11th caudal vertebra. It parallels the vertebral column, lies dorsal to the transverse processes and lateral to the spinous processes. It consists of the following muscles: the iliocostalis, the longissimus dorsi, and the extensor caudae lateralis (81).

In the lumbar region the sacrospinalis is somewhat divisible into two parts, the pars lumborum medialis coming from the sacrum, and the pars lumborum lateralis, from the inner surface of the pre-sacral portion of the ilium. The caudal continuation of the pars lumborum medialis is known as the extensor caudae lateralis (81). Partes lumborum medialis and lateralis proceed craniad and then unite at the level of the 1st lumbar vertebra to form the pars

FIGURE 21. Deep muscles of the lateral aspect of the neck and trunk in the fox squirrel.

FIGURE 22. Deepest muscles of the dorsal side of the neck and thorax in the fox squirrel.

12 temporalis
15 digastricus
24 sternohyoideus
25 omohyoideus
27 sternothyroideus
28 thyrohyoideus
29 scalenus anticus
30 scalenus medius
31 scalenus posticus
33 longus capitis
41 transversus costarum
43 serratus magnus
44 levator scapulae
45 intercostales externi
50 obliquus abdominis externus
51 obliquus abdominis internus
54 rectus abdominis
61 occipitoscapularis
62 spinotransversarius
63 omotransversarius
64 serratus posterior superior
65 serratus posterior inferior
66 splenius
67 iliocostalis
68 longissimus dorsi
70 spinalis dorsi et cervicis
71 biventer cervicis
72 complexus
73 semispinalis cervicis
75 rectus capitis posterior major
76 obliquus capitis superior
77 obliquus capitis inferior
78 rectus capitis lateralis
92 supraspinatus
93 infraspinatus
95 teres major
96 subscapularis
SC scapula

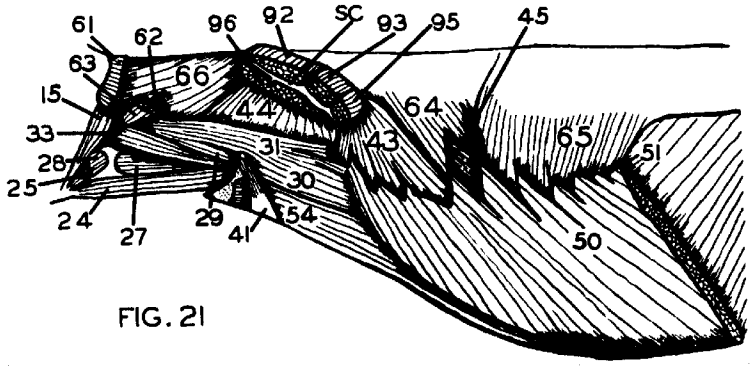
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FIG. 21

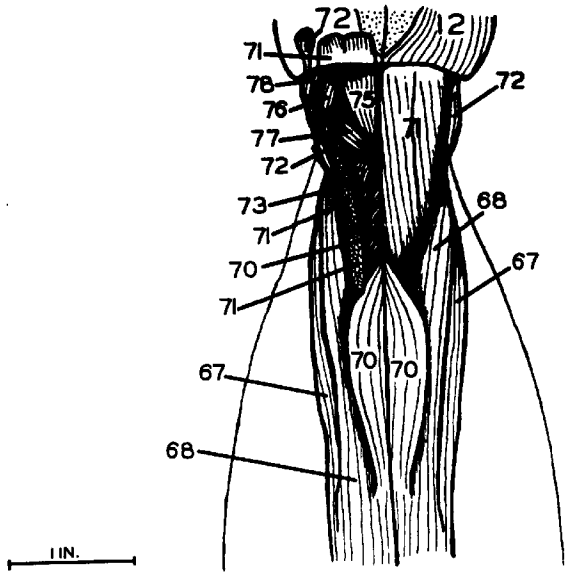
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FIG. 22

thoracis. The latter continues craniad to terminate in the cervical region. Partes lumborum medialis and lateralis and pars thoracis form the longissimus dorsi.

Arising from the lateral aspect of the pars lumborum lateralis at about the level of the 1st lumbar vertebra is a long, narrow muscle, the iliocostalis, which passes craniad lateral and parallel to the wider longissimus dorsi.

67. M. iliocostalis (fig. 22), situated ventrolateral and parallel to the longissimus dorsi, is the more lateral division of the thoracic portion of the sacrospinalis. It is a long, narrow muscle running forward from the lateral surface of the longissimus dorsi at the level of the 1st lumbar vertebra. It goes forward as far as the 4th cervical vertebra. It is located beneath the fasciae of the serrati posterior superior and inferior. Cranially it terminates between the anterior end of the longissimus dorsi and the origin of the levator scapulae (44).

ORIGIN: from the lateral surface of the pars lumborum lateralis of the longissimus dorsi at the level of the 1st lumbar vertebra.

INSERTION: on the outer border of each of the ribs at a level slightly below the angle of the rib, also on the transverse processes of the last four cervical vertebrae. The slips to the last five ribs are fleshy, the remaining slips, tendinous.

Arising from the outer edges of the last twelve ribs

are muscular bundles which augment the iliocostalis. These bundles are medial to the iliocostalis' insertional slips and ventrolateral to the angles of the ribs.

68. M. longissimus dorsi (figs. 22, 30, 32)

Partes lumborum

ORIGIN: The pars lumborum medialis originates from the dorsal surface of the sacral transverse processes, the pars lumborum lateralis, from the inner face of the pre-sacral part of the ilium.

INSERTION: As it proceeds craniad, the pars lumborum medialis becomes inserted on the anapophyses and metapophyses of the lumbar vertebrae. The pars lumborum lateralis is inserted on the lumbar transverse processes, but continues craniad to unite with the pars lumborum medialis at the level of the 1st lumbar vertebra. The iliocostalis and the pars thoracis of the longissimus dorsi are cranial prolongations from this united anterior lumbar portion of the sacrospinalis.

Pars thoracis

The pars thoracis passes craniad and, in the anterior part of the thorax, slightly ventrolaterad. It is dorsomedial to the iliocostalis and partly deep to the spinalis dorsi et cervicis (70).

INSERTION: on the anapophyses and metapophyses of the last three or four thoracic vertebrae, on the transverse processes of the thoracic and last six cervical vertebrae,

and on the outer faces of the ribs between their tubercles and angles.

69. M. longissimus cervicis is found medial to the cranial end of the longissimus dorsi, between the latter and the ventrolateral belly of the biventer cervicis (71).

ORIGIN: from the transverse processes of the first three thoracic vertebrae and from the articular processes of the last five cervical vertebrae.

INSERTION: This narrow muscle passes craniad lateral to the complexus (72) and is inserted on the transverse processes of all of the cervical vertebrae. It terminates on the wing of the atlas.

70. M. spinalis dorsi et cervicis (fig. 22)

Pars cervicis

ORIGIN: The pars cervicis arises from the spinous process of the axis and from the dorsa of the last five cervical vertebrae. It is vertical in position and deep to the biventer cervicis and the semispinalis cervicis (73).

INSERTION: The pars cervicis is inserted on the spinous processes of the first two thoracic vertebrae. It is continuous caudally with the pars dorsi.

Pars dorsi

ORIGIN: The pars dorsi originates medial to the longissimus dorsi, but since its fibers spread out in the horizontal plane, it overlies much of the thoracic part of the

latter. It springs from the spinous processes of thoracic vertebrae 1-11, inclusive.

INSERTION: The fibers of the pars dorsi are inserted into the aponeurosis which lies between the pars dorsi and the longissimus dorsi. This aponeurosis gives off three strong tendons which continue caudad to become inserted, respectively, on the metapophyses of the 13th thoracic and 1st and 2nd lumbar vertebrae.

(3.) Transverso-spino-occipital system

Mm. biventer cervicis — semispinalis cervicis
complexus — multifidus

71. M. biventer cervicis (fig. 22), divisible throughout nearly its entire length into two bellies, is located under the splenius (66) and dorsomedial to the complexus. It originates between the spinalis dorsi and the cranial end of the longissimus dorsi. It proceeds up to the occipital bone.

ORIGIN: The dorsomedial belly comes from the transverse processes of thoracic vertebrae 4-6, inclusive. The ventrolateral belly springs from the transverse processes of the first three thoracic vertebrae and from the articular processes of the last six cervical vertebrae.

INSERTION: The longer, dorsomedial belly is inserted partially on the ligamentum nuchae. Most of its insertion, however, is on the posterior face of the occipital bone by a short, wide tendon which is common to both bellies of the

biventer. Thus, the ventrolateral belly is attached to the vertical face of the occipital bone by the same tendon.

72. M. complexus (fig. 22)

This narrow, spindle-shaped muscle is located ventrolateral to the biventer cervicis. It issues from between the latter and the longissimus cervicis.

ORIGIN: from the articular processes of cervical vertebrae 2-6, inclusive.

INSERTION: The fibers of the complexus, converging as they pass craniad, reach insertion on the mastoid process of the tympanic bulla via a heavy, round tendon.

73. M. semispinalis cervicis (fig. 22) is a deep cervical muscle situated lateral to the cervical part of the spinalis dorsi et cervicis (70). The biventer cervicis hides the semispinalis cervicis.

ORIGIN: from the first three thoracic transverse processes and the dorsa of the last four cervical vertebrae.

INSERTION: on the caudal edge of the spinous process of the axis, lateral to the origin of the cervical part of the spinalis dorsi et cervicis.

74. M. multifidus (fig. 30) is a very complex set of muscles occupying a position dorsal and lateral to the vertebrae of the thoracic, lumbar, sacral, and caudal regions.

In the thoracic region (from the 1st to the 9th thor-

acic vertebra) the multifidus consists of a series of small muscle bundles. Each of these ORIGINATES from a thoracic transverse process and is INSERTED on the next anterior spinous process.

In the lumbar region (from the 9th thoracic to the sacral vertebrae) the multifidus is better developed and more prominent. Here, it forms a solid mass of muscle which fills the space between the spinous and the articular processes. Here, the bundles of which the multifidus is composed can not be separated from one another. The fibers of the multifidus in this region are attached to spinous processes, transverse processes, anapophyses, and metapophyses. The longissimus dorsi (68), lying lateral to the multifidus, can scarcely be detached from the latter in the lumbar region.

The caudal prolongation of the multifidus is the extensor caudae medialis (80), to be described later.

The writer could find no evidence of a semispinalis dorsi in any of these squirrels. If any other muscle bundles are present along the vertebral column, they are so obscure and so closely associated with the multifidus that they can not accurately be described as distinct muscles.

(4.) Deep, short system

These five muscles are the deepest of the muscles found on the dorsal side of the neck. They are attached to the atlas, the axis, and the skull.

Mm. rectus capitis posterior major
obliquus capitis superior
obliquus capitis inferior
rectus capitis lateralis
rectus capitis posterior minor

75. M. rectus capitis posterior major (fig. 22)

ORIGIN: from the ligamentum nuchae and from the lateral face of the axis' spinous process.

INSERTION: This muscle passes craniad and laterad to its insertion on the medial portion of the vertical face of the occipital bone, underneath the insertion of the biventer cervicis (71).

76. M. obliquus capitis superior (fig. 22)

ORIGIN: from the wing of the atlas, lateral to the insertion of the obliquus capitis inferior.

INSERTION: The obliquus capitis superior progresses craniomediad. It is inserted on the occipital bone lateral to the insertion of the rectus capitis posterior major.

77. M. obliquus capitis inferior (fig. 22)

ORIGIN: from the axis' spinous process, lateral to the origin of the rectus capitis posterior major.

INSERTION: The fibers of this muscle advance cranio-

laterad. They are inserted on the lateral portion of the dorsum of the atlas, medial to and partly beneath the origin of the obliquus capitis superior.

78. M. rectus capitis lateralis (fig. 22) runs beneath the obliquus capitis superior and lateral to the rectus capitis posterior minor.

ORIGIN: from the lateral border and the ventral surface of the lateral portion of the wing of the atlas.

INSERTION: Proceeding craniad, this muscle reaches insertion on the jugular process of the occipital bone.

It is quite difficult to dissociate the rectus capitis lateralis from the superimposed obliquus capitis superior.

79. M. rectus capitis posterior minor, located under the rectus capitis posterior major (75), is not easily detached from the latter. It fuses medially with its antimere.

ORIGIN: from the spinous process of the axis and from the medial part of the dorsum of the atlas.

INSERTION: on the vertical face of the occipital bone, below the insertion of the rectus capitis posterior major.

5. The Muscles of the Tail include two extensors, two abductors, and two flexors.

Mm.	extensor caudae medialis	abductor caudae internus
	extensor caudae lateralis	flexor caudae brevis
	abductor caudae externus	flexor caudae longus

80. M. extenosr caudae medialis (figs. 28, 30) is the caudal continuation of the multifidus (74). Its anterior, fleshy portion occupies the space between the articular processes and the spinous processes of the sacral and the first eleven caudal vertebrae. At about the level of the 11th caudal vertebra the muscle gives off a bundle of long tendons which proceed posteriad, mingling with the tendons from the extensor caudae lateralis.

ORIGIN: from the articular processes of the sacral and the first ten or eleven caudal vertebrae.

INSERTION: onto the spinous processes of the first eleven or twelve caudal vertebrae and by long tendons onto the dorsa of the remaining caudal vertebrae.

81. M. extensor caudae lateralis (figs. 28, 30) is the posterior prolongation of the pars lumborum medialis of the longissimus dorsi (68). It fills the space between the articular processes and the transverse processes of the sacral and the first ten or eleven caudal vertebrae. In the basal part of the tail it is laterally covered by the abductors caudae externus and internus. Its fleshy portion runs back to about the level of the 10th caudal vertebra. The remainder of the muscle consists of a bundle of long tendons which merge with the tendons from the extensor caudae medialis.

ORIGIN: from the dorsal surface of the transverse processes of the sacral and the first nine caudal vertebrae.

INSERTION: onto the articular processes of the first twelve or thirteen caudal vertebrae and by tendons onto the dorsolateral edges of the remaining caudal vertebrae.

82. M. abductor caudae externus (figs. 28, 30), a small muscle of the lateral surface of the base of the tail, progresses caudad from the inner face of the ischium to unite with the deeper, more medial abductor caudae internus. Thus, the insertions of these two muscles are not distinct from one another.

ORIGIN: from the inner (medial) surface of the caudal 1/2 of the horizontal ramus of the ischium.

INSERTION: The abductor caudae externus spreads out fanwise to become inserted in common with the abductor caudae internus on the tips of the transverse processes of the first seven caudal vertebrae.

83. M. abductor caudae internus (figs. 28, 29, 30) is a very small muscle, distinct only in its anterior portion. As it passes caudad it lies between the extensor caudae lateralis and the abductor caudae externus. It joins the latter.

ORIGIN: from the lateral edge of the transverse processes of the 2nd and 3rd sacral vertebrae.

INSERTION: on the tips of the first seven caudal transverse processes, inseparable from the insertion of the abductor caudae externus.

84. M. flexor caudae brevis (fig. 29), a small muscle on the ventral surface of the base of the tail, comes from the pubis and the sacrum. It extends caudad, lateral and ventral to the flexor caudae longus.

ORIGIN: from the dorsal (inner) surface of the ascending ramus of the pubis and from the ventral face of the first sacral transverse process.

INSERTION: into the fascia of the flexor caudae longus at about the level of the 4th caudal vertebra.

85. M. flexor caudae longus (fig. 29), situated on the ventral aspect of the sacral and the first ten or eleven caudal vertebrae, is found between the transverse processes and the chevron bones. Its fleshy portion reaches the level of the 10th or 11th caudal vertebra. The remainder of the muscle is composed of a bundle of long tendons running along the ventral side of the tail.

ORIGIN: from the ventral aspect of the centra and transverse processes of the sacral and the first ten caudal vertebrae.

INSERTION: on the chevron bones which are connected to the ventral side of most of the caudal vertebrae.

6. The Perineal Musculature comprises four small muscles. Only one of these, the sphincter ani externus, is present in both sexes. The other three are found exclusive-

ly in male specimens.

Mm. sphincter ani externus
ischiocavernosus
bulbocavernosus
compressor urethrae

86. M. sphincter ani externus (fig. 27) is a small, unpaired, orbicular muscle lying in the skin around the border of the anus. In the male it is bordered on each side by one of the bulbocavernosi.

87. M. ischiocavernosus (fig. 27) is a well-developed, paired muscle found only in the male. This short, round, thick muscle progresses ventrad and craniad from the ischium to invest much of the corpus cavernosum. It is thicker and stronger than the more medioventral bulbocavernosus.

ORIGIN: from the caudal rim of the vertical ramus, and from the inner surface of the caudal 1/3 of the horizontal ramus of the ischium.

INSERTION: into the dorsolateral surface of the proximal end of the corpus cavernosum.

88. M. bulbocavernosus (fig. 27) is another well-developed, paired muscle possessed only by males. It is located on the ventral face of the bulb of the corpus cavernosum. Its fibers pass caudad from their origin, then swing ventrad. They are augmented by more fibers coming from the ventral side of the bulb of the corpus cavernosum. The two bulbocavernosi adjoin one another, except in the region of the anus, where they diverge. Each proceeds forward on one side

of the anus. Anterior to the anus the two muscles again border one another and continue craniad, tapering to insertion on the ventral face of the corpora cavernosa.

ORIGIN: from the fascia on the dorsal surface of the rectum.

INSERTION: into the ventral surface of the corpus cavernosum.

89. M. compressor urethrae is a small, unpaired muscle present in the male only. It consists of rather poorly developed fibers which take a circular course around the wall of the urethra.

MUSCLES OF THE PECTORAL APPENDAGE

The attachments and extent of each of the muscles of the pectoral appendage were found to be practically the same in the fox squirrel, the gray squirrel, and the red squirrel. These muscles are treated under the following headings:

A. Muscles of the shoulder girdle
B. Muscles of the upper arm
C. Muscles of the forearm
D. Muscles of the hand

A. Muscles of the Shoulder Girdle

Seven muscles constitute the shoulder girdle's intrinsic musculature:

Mm.	clavo-acromiodeltoideus	teres minor
	spinodeltoideus	teres major
	supraspinatus	subscapularis
	infraspinatus	

90. M. clavo-acromiodeltoideus (figs. 18, 19) is a thick, triangular shoulder muscle distally tapering toward its apex on the anterior side of the humerus. It is composed of two parts, the clavodeltoideus and the acromiodeltoideus, which are fused together. These two portions are not distinctly separable, but the border between them is evident as a white, tendinous line. Fibers from both portions converge toward and are inserted on this common, tendinous border.

ORIGIN: The clavodeltoideus originates from the ventral edge and the caudal face of the lateral 2/3 of the clavicle, the acromiodeltoideus, from the acromion process of the scapula.

INSERTION: The clavodeltoideus is inserted on the medial aspect of the deltoid ridge of the humerus, in common with the insertion of the pectoralis superficialis anterior (36). The insertion of the acromiodeltoideus is on the lateral aspect of the deltoid ridge of the humerus. In addition, both the clavodeltoideus and the acromiodeltoideus are inserted on their common, tendinous border.

The ventral edge of the clavodeltoideus merges ventrally with the cranial boundary of the pectoralis superficialis anterior, and thus the two muscles have a common, fleshy insertion on the deltoid ridge of the humerus. The spinodeltoideus, progressing distad from its origin on the scapular spine, passes into and fuses with the acromial portion of the clavo-acromiodeltoideus.

91. M. spinodeltoideus (fig. 18)

ORIGIN: from the distal 3/5 of the scapular spine, opposite and connected to the insertion of the acromiotrapezius (57), lateral to the insertion of the spinotrapezius (57).

INSERTION: The fibers of this muscle pass distad and mingle with those of the acromial portion of the clavoacromiodeltoideus. Thus, the spinodeltoideus is indirectly inserted via the clavo-acromiodeltoideus onto the deltoid ridge of the humerus.

92. M. supraspinatus (figs. 20, 21, 23, 24) occupies the supraspinatous fossa of the scapula and is hidden beneath the omotransversarius (63) and the acromio-spinotrapezius (57).

ORIGIN: from the cranial face of the spine, the vertebral 1/2 of the cranial border, the supraspinatous portion of the vertebral border, and the supraspinatous fossa of the scapula.

INSERTION: on the dorsal edge of the greater tuberosity of the humerus by a tendon which runs under the acromion process.

93. M. infraspinatus (figs. 20, 21, 23) fills all of the infraspinatous fossa, except the small portion occupied by the teres minor. It is covered by the acromiotrapezius (57) and the spinodeltoideus.

ORIGIN: from the caudal face of the spine, the cranial face of the vertebral 3/4 of the axillary ridge, and the intervening surface of the infraspinatous fossa of the scapula.

INSERTION: on the lateral surface of the greater tuberosity of the humerus by a tendon which passes behind the metacromion process of the scapula.

94. M. teres minor (figs. 20, 23)

This tiny, sliver-shaped muscle lies caudolateral to the infraspinatus, between the latter and the origin of the triceps longus (98). It is easy to overlook the teres minor, since it lies in the infraspinatous fossa with its fibers paralleling those of the infraspinatus. Therefore, it might be mistaken for a part of the latter.

ORIGIN: from the cranial face of the humeral 1/4 of the axillary ridge of the scapula.

INSERTION: on the lateral aspect of the greater tuberosity of the humerus, slightly posterior to the insertion

of the infraspinatus.

95. M. teres major (figs. 18, 20, 21, 23, 24) is located along the axillary border of the scapula. The acromio-spinotrapezius (57), spinodeltoideus (91), latissimus dorsi (58), and triceps longus (98) conceal it almost completely. Its fibers progress distad. Having reached the region of the axilla, most of them go underneath the triceps longus and fuse with the latissimus dorsi. A few of the more dorsal fibers lose themselves in the proximal end of the epitrochlearis (97), which issues in the axillary region from the surface of both the latisaimus dorsi and the teres major.

ORIGIN: from the caudal face of the vertebral 1/3 of the axillary ridge of the scapula and from the dorsal surface of the teres ridge, which protrudes caudad from that part of the axillary ridge.

INSERTION: on the medial aspect of the upper 1/3 of the humerus, in common with the insertion of the latissimus dorsi and slightly posterior to the deltoid ridge.

96. M. subscapularis (figs. 21, 23, 24) covers nearly the whole costal (inner) surface of the scapula.

ORIGIN: from the caudal face of the middle 1/3 of the axillary ridge, from the cranial border, and from most of the costal surface of the scapula.

INSERTION: on the medial surface of the lesser tuber-

osity of the humerus by a tendon running dorsal to the scapula's coracoid process.

B. Muscles of the Upper Arm

The muscles of the upper arm are divisible into an extensor group and a flexor group.

1. The Extensor Group includes the following five muscles:

Mm. epitrochlearis
triceps longus
triceps lateralis
triceps medialis
anconeus

97. M. epitrochlearis (figs. 18, 19, 20, 23, 24), found on the posterior side of the upper arm, hides most of the triceps longus and a part of the triceps lateralis.

ORIGIN: The epitrochlearis emanates near the axilla from the surface of the latissimus dorsi (58) and the teres major. The panniculus carnosus originates partially from the border between the latissimus dorsi and the epitrochlearis.

INSERTION: on the olecranon process of the ulna and on the superficial antebrachial fascia.

98. M. triceps longus (figs. 18, 20, 23, 24)

ORIGIN: from the caudal face of the humeral 1/3 of the axillary ridge of the scapula, between the subscapularis and the teres minor.

Proceeding distad from its origin, the triceps longus emerges from beneath the spinodeltoideus (91), crosses the combined insertional end of the teres major and latissimus dorsi, and disappears below the distal ends of the triceps lateralis and the epitrochlearis. At its lower end it fuses with the triceps lateralis and the triceps medialis.

INSERTION: on the olecranon process of the ulna, in common with the insertions of the other two triceps.

99. M. triceps lateralis (figs. 18, 20, 23) covers most of the lateral side of the upper arm. Distally it is connected to the triceps longus and the triceps medialis.

ORIGIN: from the lateral surface of the humerus, just below the caput humeri and slightly distal to the insertion of the teres minor.

INSERTION: on the olecranon process of the ulna.

100. M. triceps medialis (figs. 19, 23, 24) lies along the posterior surface of the humerus under the triceps longus, the triceps lateralis, and the epitrochlearis. Since its posteromedial and posterolateral edges are higher than the middle of its belly, it is boat-shaped. Laterally the brachialis (104) and the anconeus adjoin the triceps medialis

and are practically non-detachable from the latter. Medially the triceps medialis is bordered by the coracobrachialis (103), except in the proximal portion of the upper arm where they are separated by the flat, common tendon of the teres major and latissimus dorsi.

ORIGIN: from the tip of the scapula's coracoid process, beneath the origin of the coracobrachialis, from the posterolateral side of the upper 1/2 of the humerus, and from the posteromedial surface of the entire humerus.

INSERTION: on the olecranon process of the ulna. The posterolateral edge of this muscle distally overlaps the anconeus and fuses with the triceps longus and the triceps lateralis. The posteromedial edge, however, is not attached to the two other triceps, but is inserted directly onto the olecranon process.

101. M. anconeus (figs. 20, 23)

The small, triangular anconeus is placed between the triceps medialis and the original ends of the extensor group of forearm muscles. It is partly connected to the triceps medialis .

ORIGIN: from the posterolateral side of the distal 1/2 of the humerus, including the lateral supracondylar ridge and the lateral epicondyle.

INSERTION: on the lateral face of the upper part of the ulna.

2. The Flexor Group of upper arm muscles includes the following:

Mm. biceps brachii brachialis
coracobrachialis

102. M. biceps brachii (figs. 18, 19, 20, 23, 24) is a large, spindle-shaped muscle found on the anteromedial surface of the upper arm. In these squirrels the biceps brachii was found to include two heads, the shorter and smaller of which is medial to the longer one. According to Hoffmann and Weyenbergh (1870), however, this muscle has only one head in Sciurus vulgaris.

ORIGIN: The long head springs from the supraglenoid tubercle of the scapula by a stout tendon, and the short head, from the coracoid process of the scapula by a very slight, thin tendon.

The tendon of the long head progresses distad along the intertubercular sulcus of the humerus and into a large, spindle-shaped belly, which occupies most of the anteromedial side of the upper arm. The short head is very slight. It lies superficial to the wider coracobrachialis, only partly covering the latter. In the proximal part of the upper arm the short head is fascial and hence difficult to distinguish clearly from the coracobrachialis . Distally it becomes fleshy and combines with the long head. The lower end of the biceps brachii advances into the forearm, passing between the proximal ends of the extensor and flexor groups of forearm muscles.

FIGURE 23. Deep muscles of the anterolateral side of the pectoral appendage in the fox squirrel.

FIGURE 24. Deep muscles of the posteromedial side of the pectoral appendage in the fox squirrel.

FIGURE 25. The flexor tendons and some of the muscles of the hand in the fox squirrel.

FIGURE 26. The deeper muscles of the hand in the fox squirrel.

25 omohyoideus
44 levator scapulae
58 latissimus dorsi
92 supraspinatus
93 infraspinatus
94 teres minor
95 teres major
96 subscapularis
97 epitrochlearis
98 triceps longus
99 triceps lateralis
100 triceps medialis
101 anconeus
102 biceps brachii
103 coracobrachialis
104 brachialis
105 supinator longus
106 extensor carpi radialis longus
107 extensor carpi radialis brevis
110 extensor carpi ulnaris
111 supinator brevis
112 extensor metacarpi pollicis
113 extensor indicis
114 pronator teres
115 flexor carpi radialis
117 flexor carpi ulnaris
118 flexor digitorum sublimis
119 flexor digitorum profundus
120 pronator quadratus
121 lumbricales
122 flexor pollicis
123 adductor pollicis
124 interossei
125 flexor digiti quinti
126 adductor digiti quinti
127 abductor digiti quinti
A acromion process
C coracoid process
R radius
S sesamoid bone
U ulna

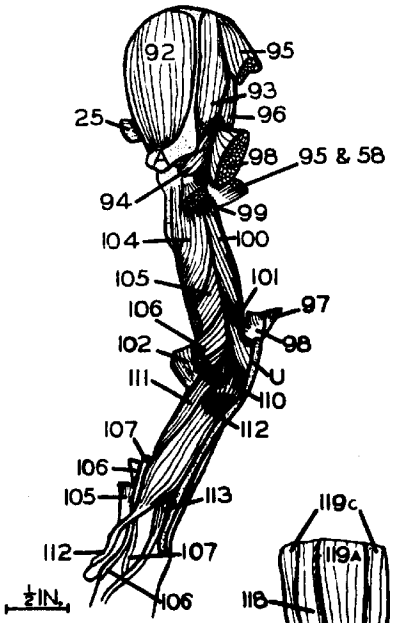

FIG. 23

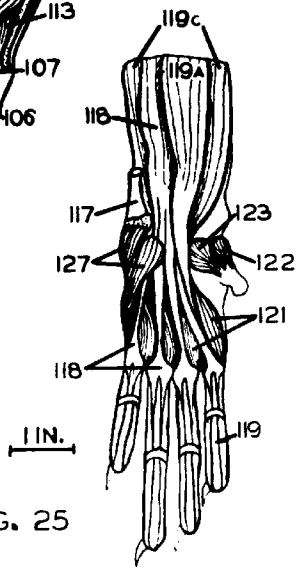

FIG. 25

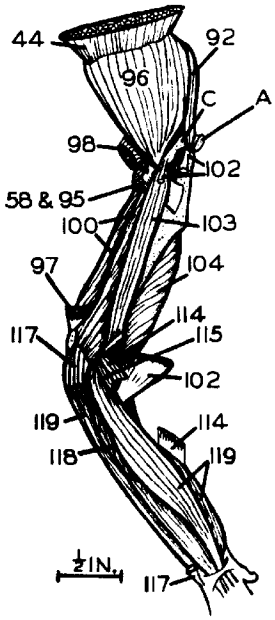

FIG. 24

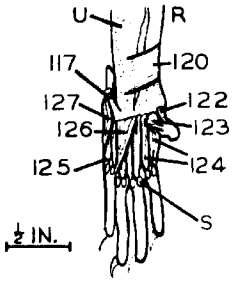

FIG. 26

INSERTION: on the radial tuberosity.

103. M. coracobrachialis (figs. 19, 24) extends along the medial side of the humerus, partly beneath and partly beside the biceps brachii. It is a long, slender muscle which the short head of the biceps partially conceals.

ORIGIN: The coracobrachialis originates from the tip of the coracoid process of the scapula, proceeds distad, and crosses the wide, common tendon of the teres major and latissimus dorsi.

INSERTION: on the medial face of the lower 1/2 of the humerus and on the bony bridge that roofs the medial supracondylar canal.

104. M. brachialis (figs. 20, 23, 24) is located under the biceps brachii and the triceps lateralis (99). Proximally it lies on the lateral side of the humerus, but distal to the deltoid ridge it swings mediad onto the anterior surface of the lower part of the humerus. Passing in front of the trochlea, it reaches insertion.

ORIGIN: from the lateral aspect of the humerus just beyond the caput humeri and from the anterior and lateral sides of the lower 1/2 of the humerus.

INSERTION: on the posterior surface of the ulna at a level just proximal to the insertion of the biceps brachii on the radius.

C. Muscles of the Forearm

The forearm muscles are divided into an extensor group and a flexor group.

1. The Extensor Group includes nine muscles:

Mm. supinator longus
extensor carpi radialis longus
extensor carpi radialis brevis
extensor digitorum communis
extensor digiti quinti
extensor carpi ulnaris
supinator brevis
extensor metacarpi pollicis
extensor indicis

105. M. supinator longus (figs. 19, 20, 23), the most medial of the extensor muscles of the forearm, emerges from beneath the triceps lateralis to continue distad along the anterior and anteromedial surfaces of the forearm.

ORIGIN: from the anterior face of the lateral supracondylar ridge of the humerus, opposite the origin of the anconeus (101).

INSERTION: on the medial surface of the lower end of the radius.

106. M. extensor carpi radialis longus (figs. 20, 23), a slender, flat muscle, borders the supinator longus on the anteromedial surface of the forearm. Its tendon, before reaching insertion, runs beneath the strong, oblique tendon of the extensor metacarpi pollicis (112).

ORIGIN: from the anterior face of the lateral supracondylar ridge of the humerus, distal to the origin of the

supinator longus.

INSERTION: on the dorsomedial edge of the proximal end of the 2nd metacarpal.

107 M. extensor carpi radialis brevis (figs. 20, 23), another long, slim forearm muscle, is situated between the extensor digitorum communis and the extensor carpi radialis longus, partly deep to the latter. Its tendon is shorter but stronger than that of the extensor carpi radialis longus, and, like the latter, passes under the tendon of the extensor metacarpi pollicis (112) before reaching insertion.

ORIGIN: from the anterior face of the lateral supracondylar ridge and from the lateral epicondyle of the humerus, distal to the origin of the extensor carpi radialis longus.

INSERTION: on the dorsomedial surface of the base of the 3rd metacarpal, underneath the tendon of the extensor indicis (113).

108. M. extensor digitorum communis (fig. 20) is found on the anterior surface of the forearm between the extensor carpi radialis brevis and the extensor digiti quinti. In the lower 1/3 of the forearm it gives off four tendons which run beneath a transverse carpal ligament, then diverge. Each of these four tendons progresses distad along the dorsomedial surface of one of the last four fingers, and is aponeurotically connected to the basal and middle

joints of its respective digit before reaching its final insertion.

ORIGIN: from the lateral epicondyle of the humerus.

INSERTION: on the bases of the 2nd phalanges of the last four fingers.

109. M. extensor digiti quinti (fig. 20) lies on the anterior side of the forearm between the extensor digitorum communis and the extensor carpi ulnaris. Its three tendons, which arise in the distal 1/4 of the forearm, pass with those of the extensor digitorum communis beneath a transverse carpal ligament. Each one proceeds distad along the dorsolateral edge of one of the last three fingers, and is aponeurotically attached to the basal and middle joints of its particular digit before reaching its final insertion.

ORIGIN: from the lateral epicondyle of the humerus.

INSERTION: on the bases of the 2nd phalanges of the last three fingers.

110. M. extensor carpi ulnaris (figs. 20, 23), the most lateral of the extensor muscles of the forearm, is seen on the anterolateral surface of the ulna. Near the wrist it becomes tendinous.

ORIGIN: from the lateral epicondyle of the humerus.

INSERTION: on the lateral edge of the base of the 5th metacarpal.

111. M. supinator brevis (fig. 23) is small and awl-shaped. The supinator longus covers it.

ORIGIN: from the lateral and anterior edges of the lateral humeral epicondyle.

INSERTION: on the anterior and anteromedial edges of the upper 1/2 of the radius.

112. M. extensor metacarpi pollicis (figs. 20, 23) is a long muscle found deep to the previously described extensor muscles of the forearm. It occupies the proximal 2/3 of the radio-ulnar groove. In the distal 1/3 of the forearm its belly ends in a tendon which advances obliquely disto-mediad across the tendons of the extensors carpi radialis longus (106) and brevis (107). After thus emerging from beneath the more superficial extensors, this tendon proceeds along the medial edge of the carpus and eventually splits to form two short, tendinous twigs.

ORIGIN: from the anterior surface of the upper 3/5 of the ulna, from the lateral surface of the upper 1/3 of the radius, and from the intervening portion of the radio-ulnar interosseous ligament.

INSERTION: (1.), on the medial side of the base of the 1st metacarpal, and (2.), on the medial face of the radial accessory carpal.

113. M. extensor indicis (figs. 20, 23) is the deepest of the extensor muscles of the forearm. It fills the distal

1/3 of the radio-ulnar groove and is partially deep to the extensor metacarpi pollicis. Its tendon passes with those of the extensors digitorum communis (108) and digiti quinti (109) under a transverse carpal ligament, then continues along the dorsolateral edge of the index finger. It is aponeurotically fastened to the basal and middle joints of the index finger before reaching its final insertion.

ORIGIN: from the anterior aspect of the lower 2/5 of the ulna, from the ulnar aspect of the lower 1/5 of the radius, and from the intervening part of the radio-ulnar interosseous ligament.

INSERTION: on the base of the 2nd phalanx of the index finger.

2. The Flexor Group is composed of seven muscles:

Mm. pronator teres
flexor carpi radialis
palmaris
flexor carpi ulnaris
flexor digitorum sublimis
flexor digitorum profundus
pronator quadratus

114. M. pronator teres (figs. 19, 24) is the most medial muscle of the flexor group of forearm muscles. It is short and proximally terete, but becomes flat distally.

ORIGIN: from the anterior edge of the medial epicondyle of the humerus.

INSERTION: by a wide, flat tendon on the anteromedial edge of the middle 1/3 of the radius.

115. M. flexor carpi radialis (figs. 19, 24) lies beside the pronator teres. As it progresses toward the wrist, it becomes tendinous in the lower 1/3 of the forearm.

ORIGIN: from the medial epicondyle of the humerus, just posterior to the origin of the pronator teres.

INSERTION: on the volar surface of the scapholunate.

116. M. palmaris (fig. 19), a superficial muscle of the posterior aspect of the forearm, partially hides the neighboring muscles, and occupies a shallow depression between the flexor carpi ulnaris and the most superficial belly of the flexor digitorum profundus. Near the wrist it spreads out into a thin fascia which merges into the palmar pad of the hand.

ORIGIN: from the fasciae which cover the neighboring muscles.

INSERTION: into the palmar pad of the hand by a wide, thin fascia.

117. M. flexor carpi ulnaris (figs. 19, 24, 25, 26) is the most lateral muscle of the superficial layer of the forearm's flexor muscles. It runs along the posterior side of the forearm. The triceps medialis (100) hides its proximal end.

ORIGIN: from the medial epicondyle of the humerus and the posterior surface of the upper 1/4 of the ulna.

INSERTION: by a short, stout tendon on the ulnar ac-

cessory (os pisiforme).

118. M. flexor digitorum sublimis (figs. 24, 25)

Reference to figures 24 and 25 indicates that the belly of the flexor digitorum sublimis is completely covered by the palmaris, the flexor carpi ulnaris, and the most superficial belly of the flexor digitorum profundus. At the distal end of the forearm the belly of the flexor digitorum sublimis gives off four tendons, which go beneath a transverse carpal ligament, proceed distad, and diverge. Each tendon supplies one of the last four fingers. Each is firmly connected to the fasciae at the level of the metacarpophalangeal joint of its particular digit, and at this same level divides. The halves of each continue distad, one lying on either side of the much larger tendon of the flexor digitorum profundus. These halves pass with the deep flexor tendon under a ligamentous arch, then terminate dorsal to the deep flexor tendon on the base of the 2nd phalanx.

ORIGIN: from the distal edge of the medial epicondyle of the humerus, between the origins of the flexor carpi radialis and the flexor carpi ulnaris.

INSERTION: on the volar surface of the bases of the 2nd phalanges of the last four fingers.

119. M. flexor digitorum profundus (figs. 19, 24, 25) consists of three distinct bellies which unite distally to

form a common tendon.

ORIGIN: The most superficial belly of the flexor digitorum profundus arises from the medial humeral epicondyle, between the origins of the flexor carpi radialis and the flexor carpi ulnaris, superficial to the origin of the flexor digitorum sublimis. This muscle completely conceals the fleshy portion of the flexor digitorum sublimis.

The smallest belly springs from the medial humeral epicondyle deep to the origin of the flexor digitorum sublimis. It progresses distad beneath the latter.

The largest, deepest belly of the flexor digitorum profundus comes from the posterior aspect of most of the radius and ulna and from the intervening portion of the interosseous ligament. It is as wide as the entire forearm, and lies deep to all the previously described flexor muscles of the forearm.

The tendons of these three bellies are located under (dorsal to) the tendons of the flexor digitorum sublimis. They advance with the latter beneath a transverse carpal ligament, then unite to form a wide tendon in the carpal region. This common tendon divides, giving off four branches which run distad. These four deep flexor tendons perforate the tendons of the flexor digitorum sublimis, and emerge from below the latter at the level of the metacarpophalangeal joints. Each supplies one of the last four fingers. In addition, there is a small twig which proceeds mediad onto the vestigial pollex, or thumb.

INSERTION: on the volar surface of the bases of the terminal phalanges. Near the distal end of the 1st phalanx of each of the last four fingers there is a ligamentous arch which serves to hold in place the flexor tendons of that digit.

120. M. pronator quadratus (fig. 26), the deepest of the muscles on the posterior side of the forearm, is small and poorly defined. It is found in the lower 1/3 of the forearm and extends transversely from the ulna to the radius. According to Hoffmann and Weyenbergh (1870), the pronator quadratus is lacking in Sciurus vulgaris.

ORIGIN: from the posterior aspect of the distal 1/4 of the ulna.

INSERTION: on the posterior side of the distal 1/4 of the radius.

D. Muscles of the Hand

Mm.	lumbricales	flexor digiti quinti
	flexor pollicis	adductor digiti quinti
	adductor pollicis	abductor digiti quinti
	interossei	

121. Mm. lumbricales (fig. 25) are four small muscles which occupy the spaces between the tendons of the flexors digitorum sublimis (118) and profundus (119).

ORIGIN: from the surfaces of the tendons of the flexor

digitorum profundus and from the surrounding fasciae.

INSERTION: on the radial surfaces of the bases of the 1st phalanges of the last four fingers.

122. M. flexor pollicis (figs. 25, 26)

ORIGIN: The flexor pollicis originates on the volar side of the scapholunate. It extends mediad onto the pollex.

INSERTION: on the sesamoids at the metacarpo-phalangeal joint of the pollex, or thumb.

123. M. adductor pollicis (figs. 25, 26) is a tiny muscle located somewhat deeper than the flexor pollicis.

ORIGIN: from the volar face of the bases of the 1st and 2nd metacarpals.

INSERTION: on the ulnar side of the 1st phalanx of the thumb.

124. Mm. interossei (fig. 26) are seven small muscles lying dorsal to the tendons of the flexor digitorum profundus and along the sides of and ventral to the last four metacarpals. There is an interosseus on each side of each of the three middle metacarpals, and one on the radial side of the 5th metacarpal.

ORIGIN: from the ventral face of the distal row of carpal bones and their ligaments.

INSERTION: Each interosseus ends on a lateral or medial sesamoid, as the case may be, at the metacarpo-phalan-

geal joint of one of the last four fingers. Thus, interosseus indicis medialis is inserted on the medial metacarpophalangeal sesamoid of the index finger, and so on.

125. M. flexor digiti quinti (fig. 26) is very similar in size, shape, and position to the interossei. It covers the ventral surface of the 5th finger and might be considered an eighth interosseus (interosseus digiti quinti lateralis).

ORIGIN: from the volar side of the lateral portion of the 4th carpal.

INSERTION: on the lateral metacarpo-phalangeal sesamoid of the 5th finger.

126. M. adductor digiti quinti (fig. 26) is an exceedingly thin muscle extending obliquely distolaterad across the four outer interossei. Narrowing distally, it ends in a relatively long, very slight tendon.

ORIGIN: from the volar aspect of the 3rd carpal and the medial portion of the 4th carpal.

INSERTION: on the radial surface of the base of the 1st phalanx of the 5th finger, between the insertions of the interosseus digiti quarti lateralis and the interosseus digiti quinti medialis.

127. M. abductor digiti quinti (figs. 25, 26)

This muscle originates by two heads from the ulnar

accessory (os pisiforme). The two heads unite to pass into a tendon which progresses out along the ventrolateral surface of the 5th finger.

ORIGIN: (1.), from the volar face of the ulnar accessory, and (2.), from the tip of the ulnar accessory, medial to the origin of the 1st head.

INSERTION: on the ulnar surface of the base of the 5th finger's 1st phalanx.

MUSCLES OF THE PELVIC APPENDAGE

The attachments and extent of each of the muscles of the pelvic appendage are practically the same in the fox squirrel, the gray squirrel, and the red squirrel. These muscles are treated under the following headings:

A. Muscles of the hip
B. Muscles of the thigh
C. Muscles of the shank
D. Muscles of the foot

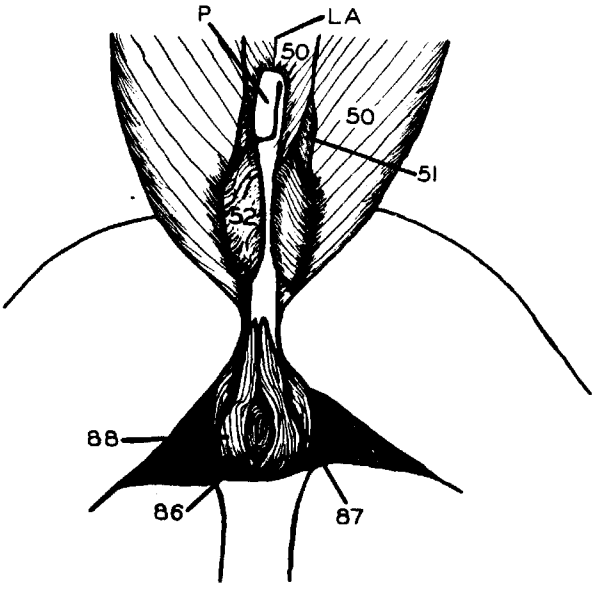

FIG. 27

FIGURE 27. The perineal muscles of the male fox squirrel.

50 obliquus abdominis externus
51 obliquus abdominis internus
52 cremaster
86 sphincter ani
87 ischiocavernosus
88 bulbocavernosus
LA linea alba
P penis

A. Muscles of the Hip

The muscles of the hip are divided into the following three groups:

1. Ilio-psoas group
2. Gluteal group
3. Obturator group

1. The Ilio-psoas Group includes three muscles, namely:

Mm. psoas minor
psoas major
iliacus

These muscles are found on the ventral surface of the lumbar vertebrae, and at their distal ends are attached to some part of the pelvic appendage. Although the quadratus lumborum is not classified with this group of muscles, it will be described here, since it is very closely associated with the psoas major.

128. M. psoas minor (fig. 32) is a long, narrow muscle lying on the ventral side of the psoas major. Its cranial portion medially adjoins the opposite psoas minor and is not completely separable from the psoas major. The caudal ends of the two psoases minora, however, diverge from the midline and are not connected to the psoases majora. At the level of the 5th lumbar vertebra the belly of the psoas minor passes into a narrow but tough tendon, which continues caudad to insertion on the ascending ramus of the pubis.

ORIGIN: from the ventral aspect of the centra of the first four lumbar vertebrae. This origin is not entirely

separable from that of the psoas major.

INSERTION: on the small psoas tubercle found on the cranial edge of the ascending ramus of the pubis.

129. M. psoas major (fig. 32) is a fairly broad muscle which hides the iliacus, the quadratus lumborum, and part of the sacrospinalis from ventral view. It is partly divisible into two bellies, the shorter one of which is located medial and caudal to the other. As they proceed caudad, these two bellies unite with one another and with the more dorsally located iliacus.

ORIGIN: from the ventral surface of the centra of the lumbar vertebrae and also from the ventral face of the anterior portion of the centrum of the 1st sacral vertebra. This origin is dorsal to, longer than, and not completely separable from that of the psoas minor.

INSERTION: on the lesser trochanter of the femur by a tendon common to both the iliacus and the psoas major.

130. M. iliacus (fig. 32) is situated dorsal to the caudal end of the psoas major, with which it fuses before reaching insertion.

ORIGIN: from the ventral rim of the pre-acetabular portion of the ilium, opposite the insertion of the quadratus lumborum and the origin of the longissimus dorsi's pars lumborum lateralis (68).

INSERTION: on the lesser trochanter of the femur by a

tendon common to both the psoas major and the iliacus.

55. M. quadratus lumborum (fig. 32), on the ventral side of the lumbar transverse processes, is a narrow muscle hidden between the sacrospinalis dorsally and the psoas major ventrally.

ORIGIN: by a slight tendon from the lateral surface of the centrum of the 10th thoracic vertebra, also by short, fleshy heads coming from the centra of the last three thoracic and the first three lumbar vertebrae.

INSERTION: The quadratus lumborum has seven strong, tendinous, insertional slips. Each of the first six of these slips is attached to the outer tip of one of the six lumbar transverse processes. The last slip is fastened to the ventral rim of the ilium at a point slightly caudal to the anterior end of the sacro-iliac articulation.

2. The Gluteal Group

The four gluteal muscles are located on the lateral side of the hip, between the abdominal muscles and the biceps femoris anticus (145). They lie mostly lateral but partly ventral to the ilium. They conceal the upper ends of the quadriceps femoris group of thigh muscles.

Mm. gluteus superficialis — gluteus medius
gluteus maximus — gluteus minimus

131. M. gluteus superficialis (figs. 28, 29, 30)

By referring to figures 28, 29, and 30 one can see that this broad muscle covers most of the lateral surface of the hip and the anterior surface of the proximal end of the thigh.

ORIGIN: from the sacral continuation of the lumbodorsal fascia, from the lateral edge of the cranial end of the ilium, from the more cranial portion of Poupart's ligament, and from the ventral rim of the ilium as far caudad as the iliac spine.

INSERTION: (1.), in the broad fascia which covers most of the anterior and lateral surfaces of the thigh, and (2.), on the greater trochanter, the 3rd trochanter, and the intervening lateral surface of the femur.

This muscle is composed of what have often been described as the sartorius and the tensor fasciae latae. The anterior portion, arising from the cranial end of the ilium, has frequently been called the sartorius and is somewhat similar to the sartorius in position. Howell (1926), however, found that in the wood rat this part of the muscle is not homologous to the sartorius, since it is innervated by a branch of the superior gluteal nerve, and not by the femoral nerve.

The posterior portion of the muscle is the same as the tensor fasciae latae and corresponds to the latter in position, attachments, and innervation. Since anterior and posterior portions are inseparable, and because this muscle

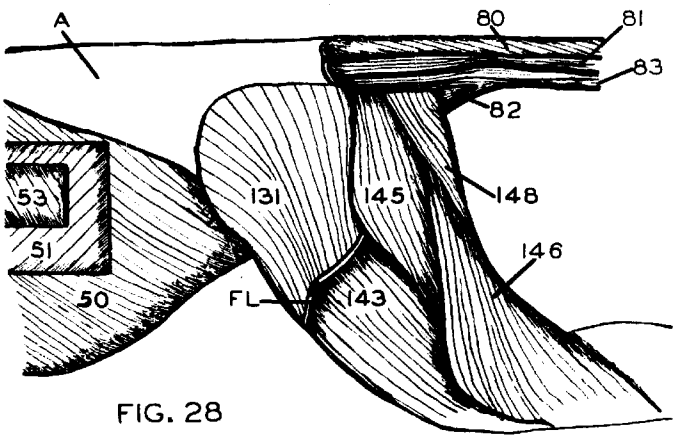

FIG. 28

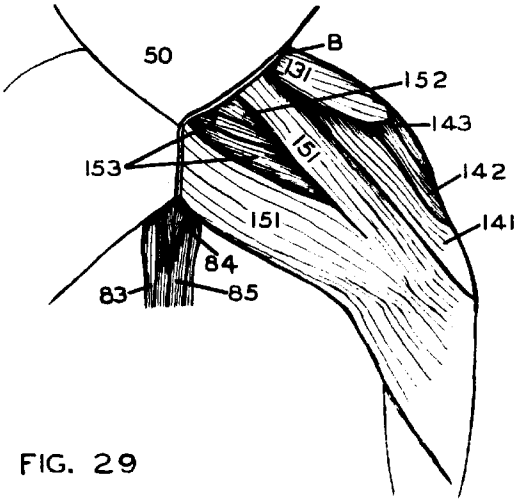

FIG. 29

1 IN.

FIGURE 28. Superficial muscles of the lateral aspect of the hip, thigh, and tail in the fox squirrel.

FIGURE 29. Superficial muscles of the medial aspect of the thigh in the fox squirrel.

50 obliquus abdominis externus
51 obliquus abdominis internus
53 transversalis
80 extensor caudae medialis
81 extensor caudae lateralis
82 abductor caudae externus
83 abductor caudae internus
84 flexor caudae brevis
85 flexor caudae longus
131 gluteus superficialis
141 vastus medialis
142 rectus femoris
143 vastus lateralis
145 biceps femoris anticus
146 biceps femoris posticus
148 semitendinosus
151 gracilis
152 pectineus
153 adductor longus
A lumbodorsal fascia
B Poupart's ligament
FL cut end of the fascia lata

has often been treated incorrectly, Howell has named it the gluteus superficialis.

In these three species of squirrels the present writer found that this muscle conforms closely, in position and innervation, to Howell's account of the gluteus superficialis in the wood rat.

132. M. gluteus maximus (fig. 30)

This muscle is found underneath the gluteus superficialis. One can only partially disconnect the gkuteus maximus from the deeper lying gluteus medius. Its fibers run caudad, paralleling and merging with those of the gluteus medius.

ORIGIN: (1.), from the sacral continuation of the lumbodorsal fascia, below the origin of the gluteus superficialis.

(2.), from the lateral edge of the cranial end of the ilium.

(3.), from the cranial end of the ventral rim of the ilium, between the gluteus minimus dorsally and the iliacus ventrally.

INSERTION: on the anterolateral, dorsal, and posterolateral edges of the greater trochanter of the femur, in common with and inseparable from the insertion of the gluteus medius.

Parsons (1894) states that this muscle fuses with the superior gluteal muscle mass, but Howell (1926), in the

case of the wood rat, found it to be distinct from the latter. In the squirrels examined during the present study the gluteus maximus was found to be distinct from the gluteus superficialis, but partially united with the gluteus medius.

133. M. gluteus medius (fig. 30), situated beneath the gluteus maximus, occupies the superior gluteal fossa of the ilium. Its fibers proceed mostly caudad, but its most posterior fibers pass laterad. Its caudal end joins the posterior end of the gluteus maximus. Their broad, short, insertional tendon caudally borders the pyriformis (139).

ORIGIN: from the sacral continuation of the lumbodorsal fascia, from the lateral edge of the cranial end of the ilium, from the superior gluteal fossa of the ilium, and from the lateral edge of a small portion of the sacrum just beyond the sacro-iliac articulation.

INSERTION: by a short, broad tendon on the dorsal rim of the greater trochanter of the femur.

134. M. gluteus minimus (fig. 31) is the deepest of the gluteal muscles. It occupies the inferior gluteal fossa of the ilium. Its anterior fibers progress caudad, its most posterior fibers, laterad. Its posterior end, lying underneath the pyriformis (139), adjoins the cranial edge of the insertional end of the obturator internus (140).

ORIGIN: from the inferior gluteal fossa of the ilium,

from the dorsum of that part of the ilium which lies caudal to the iliac spine, and from the dorsum of the ischium back nearly to the level of the ischiadic notch.

INSERTION: on the anterior and inner surfaces of the proximal end of the femur, beneath the insertions of the pyriformis (139) and the glutei maximus and medius.

3. The Obturator Group comprises six small muscles attached at one end to the ischium or pubis or both, and at the other end to the upper part of the femur. They are the deepest muscles of the hip and are covered by the glutei and the proximal ends of the thigh muscles.

Mm.	quadratus femoris	gemellus posterior
	obturator externus	pyriformis
	gemellus anterior	obturator internus

135. M. quadratus femoris (figs. 30, 31) extends from the vertical ramus of the ischium to the upper portion of the femur. It obliquely crosses part of the obturator externus and parallels the adductor brevis (155). The biceps femoris anticus (145), the biceps femoris posticus (146), the adductor longus (153), and the adductor magnus (154) conceal it.

ORIGIN: from the dorsal portion of the vertical ramus, and the caudal portion of the horizontal ramus of the ischium.

INSERTION: on the posterior surface of the greater and

lesser trochanters of the femur, also on a triangular area of the femur, the angles of which are roughly at the three trochanters.

136. M. obturator externus (fig. 31), on the outer side of the ischio-pubic part of the pelvic bone, is separated from the obturator internus by the thin, round ligament which stretches across the obturator foramen. Cranially it borders the gemellus anterior, dorsally, the gemellus posterior. The quadratus femoris obliquely crosses the obturator externus, whose fibers converge into a short, strong tendon which is closely associated with the tendons of the gemelli and the obturator internus (140).

ORIGIN: from the outer face of the vertical ramus of the ischium and from the outer face of the entire pubis, except a small portion at the cranial end where the gemellus anterior arises.

INSERTION: The fibers of the obturator externus converge as they run dorsolaterad. They pass into a tendon which is inserted in the trochanteric fossa of the femur.

137. M. gemellus anterior (fig. 31) is found anterior to the obturator externus. Its tendon is very closely associated with the tendon of the latter. The two muscles become inserted side by side.

ORIGIN: from the outer edge of the anterior end of the pubis, anterior to the origin of the obturator externus.

INSERTION: in the trochanteric fossa of the femur by a tendon common to both the gemellus anterior and the obturator externus.

138. M. gemellus posterior (figs, 30, 31), located on the dorsal rim of the ischium's horizontal ramus, borders the obturator externus on one side and the obturator internus on the other. Laterally it is covered by the quadratus femoris (135). Its tendon advances craniad to combine with the tendon of the obturator internus. This united tendon then turns laterad through the ischiadic notch to come to its insertion in the trochanteric fossa of the femur.

ORIGIN: from the dorsal aspect of the caudal part of the horizontal ramus of the ischium.

INSERTION: in the trochanteric fossa of the femur by a tendon common to both this muscle and the obturator internus.

139. M. pyriformis (fig. 30) is a small, triangular muscle extending laterad from the ventral face of the sacrum to the greater trochanter of the femur. As it proceeds laterad, this muscle borders the posterior edge of the gluteus medius (133) and passes between the latter and the caudal end of the gluteus minimus (134).

ORIGIN: from the ventral face of the 2nd and 3rd sacral transverse processes.

INSERTION: on the medial side of the femur's greater trochanter.

140. M. obturator internus, on the inner side of the ischiopubic part of the pelvic bone, is separated from the obturator externus by the thin, round ligament which stretches across the obturator foramen.

ORIGIN: from the inner surface of the vertical ramus of the ischium and from the inner surface of all of the pubis. The most cranial fibers take origin from the coxal fossa of the ilium (on the inner aspect of the posterior end of the ilium).

The fibers of the obturator internus run dorsad, then converge into a strong tendon which joins the tendon of the gemellus posterior. The common tendon of these two muscles swings laterad across the top of the ischium via the ischiadic notch.

INSERTION: in the trochanteric fossa of the femur, between the insertion of the gemellus posterior and the insertion of the gluteus minimus (134).

B. Muscles of the Thigh

The thigh muscles include extensors, flexors, and adductors.

1. The Extensor Group (Quadriceps Femoris) is composed of four muscles situated on the anterior side of the thigh. These four muscles are sometimes called the quadriceps femoris. They lift the thigh and extend the shank. They are:

Mm. vastus medialis
rectus femoris
vastus lateralis
vastus intermedius

141. M. vastus medialis (figs. 29, 32), the most medial of the muscles which form the quadriceps femoris, lies on the anteromedial surface of the thigh. Its original end is underneath the gluteus superficialis (131).

ORIGIN: from the anteromedial side of the neck of the femur and the medial aspect of the proximal 1/2 of the femur.

INSERTION: on the patella.

142. M. rectus femoris (figs. 29, 30, 32, 33) occupies the anterior side of the thigh between the vasti medialis and lateralis. Its upper end is hidden by the gluteus superficialis (131).

ORIGIN: from the iliac spine.

INSERTION: on the patella.

143. M. vastus lateralis (figs. 28, 29, 30, 32, 33) is found on the anterolateral surface of the thigh. It is the most lateral member of the quadriceps femoris group. Its proximal end is beneath the gluteus superficialis (131).

ORIGIN: from the anterior edge of the femur's greater

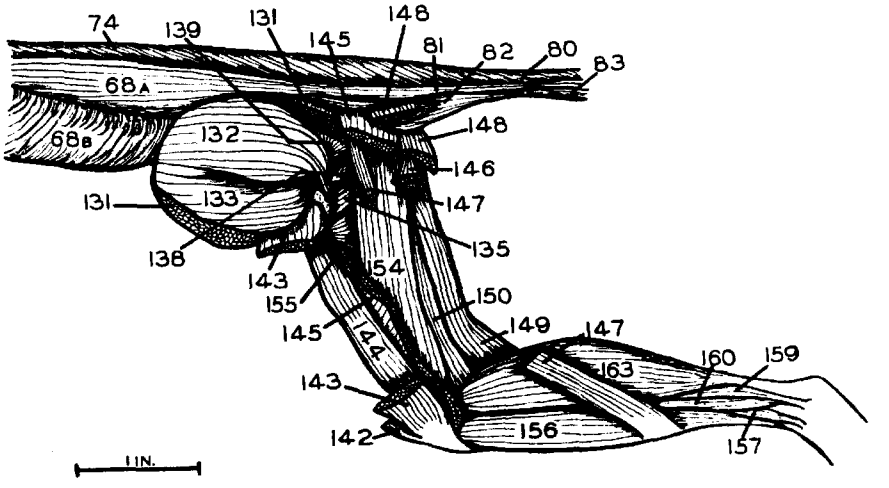

FIG. 30

FIGURE 30. Deep muscles of the lateral side of the hip and thigh in the fox squirrel.

68A longissimus dorsi--pars lumborum medialis
68B longissimus dorsi--pars lumborum lateralis

74 multifidus
80 extensor caudae medialis
81 extensor caudae lateralis
82 abductor caudae externus
83 abductor caudae internus
131 gluteus superficialis
132 gluteus maximus
133 gluteus medius
135 quadratus femoris
138 gemellus posterior
139 pyriformis
142 rectus femoris
143 vastus lateralis
144 vastus intermedius
145 biceps femoris anticus
146 biceps femoris posticus
147 tenuissimus
148 semitendinosus
149 semimembranosus posticus
150 semimembranosus anticus
154 adductor magnus
155 adductor brevis
156 tibialis anticus
157 extensor digitorum pedis longus
159 peroneus longus
160 peroneus brevis
163 gastrocnemius

trochanter, slightly inferior to the insertion of the gluteus minimus (134).

INSERTION: on the patella.

144. M. vastus intermedius (figs. 30, 32) lies on the anterior face of the femur, behind (deep to) the rectus femoris and the vasti medialis and lateralis.

ORIGIN: from the anterior surface of most of the femur.

INSERTION: on the patella.

The quadriceps femoris is inserted on the patella and the surrounding fasciae. Therefore, it is indirectly inserted via the patellar tendon onto the anterior face of the upper end of the tibia.

2. The Flexor Group includes the following six muscles found on the lateral and posterior sides of the thigh:

Mm.	biceps femoris anticus	semitendinosus
	biceps femoris posticus	semimembranosus posticus
	tenuissimus	semimembranosus anticus

145. M. biceps femoris anticus (figs. 28, 30) is situated on the lateral surface of the thigh, posterior to the gluteus superficialis (131) and the vastus lateralis, anterior to the biceps femoris posticus. Its origin is partly beneath the proximal end of the semitendinosus (148). Proceeding distad, its lower end partially disappears below the biceps femoris posticus.

ORIGIN: (1.), from the fasciae covering the anterior portion of the muscles of the tail, and (2.), from the transverse processes of the 1st and 2nd caudal vertebrae.

INSERTION: on the lateral aspect of the femur inferior to the 3rd trochanter, also on the lateral side of the upper end of the tibia.

146. M. biceps femoris posticus (figs. 28, 30) is narrow and thick at its original end, which lies under the semitendinosus. Having emerged from beneath the latter, the biceps femoris posticus continues distad. Spreading out into a wide, thin, muscular sheet, it covers the lower end of the biceps femoris anticus and ends in an extensive fascia.

ORIGIN: from the tuber ischii, deep to the origin of the semitendinosus.

INSERTION: by an extensive, thin fascia on the patella and nearly the whole anterior edge of the tibia.

147. M. tenuissimus (fig. 30) is a long, slender muscle which the two biceps conceal. As it nears its insertion, it becomes fascial.

ORIGIN: from the transverse process of the 3rd sacral vertebra, under the origin of the biceps femoris anticus.

INSERTION: on the anterior surface of the middle portion of the tibia, beneath the insertion of the biceps femoris posticus.

148. M. semitendinosus (figs. 28, 30, 32)

ORIGIN: The semitendinosus has two heads. The broader, more dorsal head issues from the fascia covering the base of the tail and from the transverse process of the 2nd caudal vertebra. The narrower, more ventral head arises from the tuber ischii. The two heads soon unite and the semitendinosus passes distad along the posterior side of the thigh onto the medial side of the tibia.

INSERTION: on the anteromedial aspect of the middle 1/3 of the tibia by an extensive fascia which the insertion of the gracilis (151) overlaps.

149. M. semimembranosus posticus (figs. 30, 32), found on the posterior surface of the thigh, is hidden by the semitendinosus, the gracilis (151), the tenuissimus, and both biceps.

ORIGIN: from the outer surface of the vertical ramus of the ischium.

INSERTION: by a wide, thin tendon on the medial epicondyle of the femur and the medial surface of the upper end of the tibia. This insertion is deep to that of the gracilis.

150. M. semimembranosus anticus (fig. 30) lies on the posteromedial side of the thigh, anterior to the semimembranosus posticus and posterior to the adductors longus (153) and magnus (154). The two biceps, the tenuissimus, and the

semitendinosus hide it from lateral view. Medially the gracilis covers it.

ORIGIN: from the tuber ischii and the outer face of the vertical ramus of the ischium.

INSERTION: on the medial epicondyle of the femur, deep to and slightly higher than the insertion of the semimembranosus posticus.

3. The Adductor Group contains five muscles located on the medial side of the thigh.

Mm.	gracilis	adductor magnus
	pectineus	adductor brevis
	adductor longus	

151. M. gracilis (figs. 29, 32) covers much of the medial surface of the thigh. A space of about half an inch separates its two heads at their original ends. These two heads, converging, unite about midway to the knee. The gracilis is thin and flat. Distally it spreads out into a wide, thin fascia which progresses onto the medial side of the shank and hides the distal ends of the semitendinosus (148) and the two semimembranosi (149 & 150).

ORIGIN: The smaller, anterior head originates from Poupart's ligament, posteromedial to the most medial part of the gluteus superficialis (131). The larger, posterior head springs from the pubic symphysis and the ventral end of the vertical ramus of the ischium.

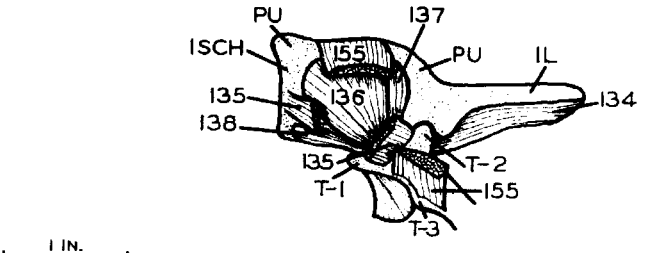

FIG. 31

FIGURE 31. Deepest muscles of the hip in the fox squirrel, ventral view.

134	gluteus minimus	IL	ilium
135	quadratus femoris	ISCH	ischium
136	obturator externus	PU	pubis
137	gemellus anterior	T-1	greater trochanter
138	gemellus posterior	T-2	lesser trochanter
155	adductor brevis	T-3	3rd trochanter

INSERTION: on the anteromedial edge of the proximal 1/2 of the tibia.

152. M. pectineus (figs. 29, 32) is a small, sliver-shaped muscle crowded between the psoas major's (129) caudal end and the adductor longus' anterior head. It lies beneath the smaller head of the gracilis.

ORIGIN: from the ventral aspect of the middle portion of the ascending pubic ramus.

INSERTION: on the posterior surface of the femur just inferior to the 3rd trochanter.

153. M. adductor longus (figs. 29, 32), beneath the gracilis on the medial side of the thigh, has two heads, the smaller and anterior of which adjoins and parallels the pectineus. The larger, longer, posterior head is found anterior to the semimembranosus anticus.

ORIGIN: The anterior head originates from the ventral edge of the ascending pubic ramus, under the origin of the gracilis and posteromedial to that of the pectineus. The posterior head comes from the ventral side of the anterior 2/3 of the horizontal ramus, as well as from the posterior end of the ascending ramus of the pubis.

INSERTION: on the medial aspect of the distal 2/3 of the femur. This insertion is inferior to the insertion of the pectineus, behind that of the vastus intermedius (144), and ahead of the insertion of the adductor magnus' posteromedial head.

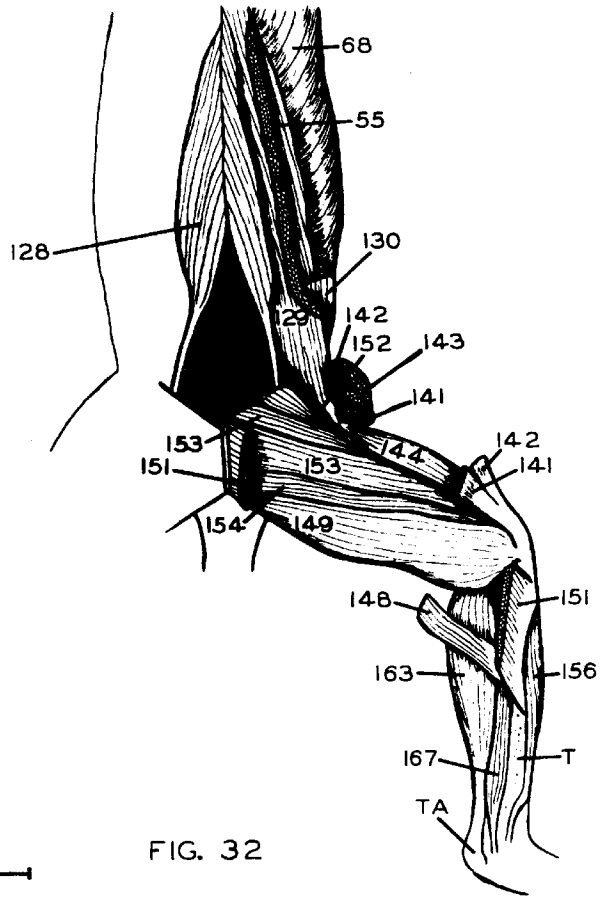

FIG. 32

FIGURE 32. The sub-lumbar muscles, the deep muscles of the medial aspect of the thigh, and the superficial muscles of the medial side of the shank in the fox squirrel.

55 quadratus lumborum
68 longissimus dorsi
128 psoas minor
129 psoas major
130 iliacus
141 vastus medialis
142 rectus femoris
143 vastus lateralis
144 vastus intermedius
148 semitendinosus
149 semimembranosus posticus
151 gracilis
152 pectineus
153 adductor longus
154 adductor magnus
156 tibialis anticus
163 gastrocnemius
167 tibialis posticus
T tibia
TA Achilles' tendon

154. M. adductor magnus (figs. 30, 32) consists of three heads, which will be described separately.

Posterolateral head

ORIGIN: The posterolateral head emanates from the lateral edge of the horizontal ramus of the ischium near its caudal end. As it proceeds distad, it lies underneath the two biceps (145 & 146) and crosses the quadratus femoris (135) and the adductor brevis.

INSERTION: on the posterolateral surface of the lower 2/3 of the femur, posterior to the insertion of the biceps femoris anticus.

Posteromedial head

ORIGIN: The posteromedial head springs from the outer edge of the caudal 1/3 of the horizontal pubic ramus. It is located posterior to the adductor longus.

INSERTION: on the posterior and medial sides of the lower end of the femur, inferior to the insertion of the adductor longus.

3rd head

ORIGIN: The third and smallest head issues by a narrow tendon from the lateral aspect of the ischio-pubic angle.

INSERTION: It passes beneath the posteromedial head to unite with the posterolateral head. Thus, it is inserted, via the posterolateral head, on the inferior 2/3 of the femur.

155. M. adductor brevis (figs. 30, 31) lies beneath the gracilis (151) and the adductor longus (153), posterior to the pectineus (152), and anterior to the quadratus femoris (135). It extends from the pubis to the 3rd trochanter of the femur.

ORIGIN: from the outer face of the horizontal ramus of the pubis, deep to the origins of the gracilis and the adductor longus.

INSERTION: on the posterior side of the 3rd trochanter.

C. Muscles of the Shank

The thirteen muscles of the shank are divided into three groups:

1. Extensor group
2. Peroneal group
3. Flexor group

1. The Extensor Group contains three muscles found on the front of the leg between the tibia and the perenei.

Mm. tibialis anticus
extensor digitorum pedis longus
extensor hallucis longus

156. M. tibialis anticus (figs. 30, 32, 33), a well-developed, fairly wide muscle, is found on the anterolateral side of the shank. Tapering distally, it becomes tendinous just above the ankle. After passing beneath a ligament

which extends from the lower end of the tibia to the lower end of the fibula, this tendon runs out along the medial surface of the ankle. It is finally inserted on the plantar surface of the 1st metatarsal.

ORIGIN: from the anterior edge and the lateral aspect of the upper 1/2 of the tibia, from the anterior edge of the upper 1/2 of the fibula, and from the intervening part of the tibio-fibular interosseous ligament.

INSERTION: on the plantar surface of the proximal end of the 1st metatarsal. The tendon may also be slightly fastened to the distal end of the 1st cuneiform, since the insertion is very close to the tarso-metatarsal articulation.

157. M. extensor digitorum pedis longus (figs. 30, 33) is a long, slender muscle hidden, except in the ankle and foot, by the tibialis anticus. It becomes tendinous at about the same level as the latter. Its tendon passes with those of the tibialis anticus and the extensor hallucis longus under a tibio-fibular ligament, then continues onto the tarsus. Having progressed beneath a second, smaller ligament extending from the os talus to the os calcis, the tendon of the extensor digitorum pedis longus divides to form four smaller tendons. These four tendons diverge. Each runs onto the dorsomedial surface of one of the last four toes.

ORIGIN: by a stout tendon coming from the lateral epicondyle of the femur and passing beneath the fasciae of the knee joint. This tendon is lightly attached to the head of

the fibula. At this level it ends in the belly of the muscle.

INSERTION: on the dorsomedial aspect of the bases of the 2nd phalanges of the last four toes. Each tendon is also aponeurotically connected to its particular digit at the metatarso-phalangeal articulation.

158. M. extensor hallucis longus (fig. 33)

This small, splinter-shaped muscle is situated behind the tibialis anticus and the extensor digitorum pedis longus, somewhat medial to the latter. Its tendon goes beneath a tibio-fibular ligament, where it lies between those of the tibialis anticus and the extensor digitorum pedis longus. Next, it swings distomediad parallel to that of the tibialis anticus, then distad onto the top of the large toe.

ORIGIN: from the anterior aspect of the upper portion of the fibula's distal 1/2.

INSERTION: on the upper side of the base of the 1st phalanx of the hallux, or big toe.

2. The Peroneal Group

Mm.	peroneus longus	peroneus digiti quinti
	peroneus brevis	peroneus digiti quarti

The peronei are slender muscles occupying the lateral edge of the shank between the gastrocnemius and the tibialis anticus.

159. M. peroneus longus (figs. 30, 33, 35), a long muscle of the lateral side of the shank, occupies the space between the gastrocnemius (163) and the tibialis anticus. Its tendon begins in the lower 1/4 of the shank and passes with the other peroneal tendons beneath the external annular ligament. It then separates from the others and comes to lie lateral to them. As it runs out along the lateral edge of the os calcis, it occupies a groove in a slight protuberance on the side of this bone. Having reached the peroneal sulcus of the cuboid bone, this tendon turns ventrad, then mediad to proceed across the plantar surface of the cuboid and the 3rd and 2nd cuneiforms. Thus it comes to its insertion on the 1st metatarsal.

ORIGIN: from the anterior and inferior edges of the head of the fibula.

INSERTION: on the plantar surface of the base of the 1st metatarsal.

160. M. peroneus brevis (figs. 30, 33) is hidden, except distally, by the peroneus longus. Its tendon goes beneath the external annular ligament. Near the distal end of the os calcis it turns abruptly laterad, crosses the tendon of the peroneus longus, and finally reaches insertion on the 5th metatarsal.

ORIGIN: from the anterolateral aspect of the distal 2/3 of the fibula.

INSERTION: on the tuberosity of the 5th metatarsal.

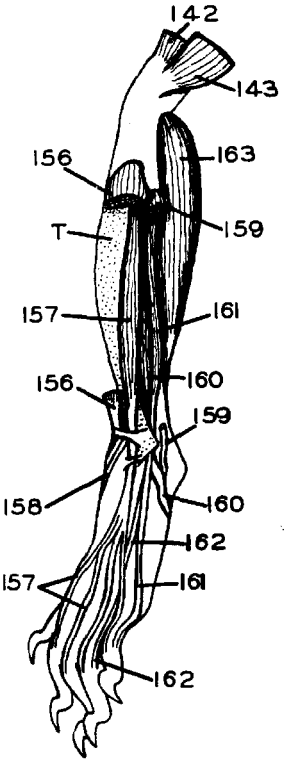

FIG. 33

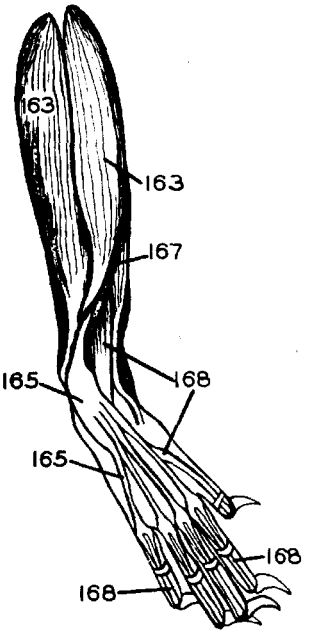

FIG. 34

1 IN.

FIGURE 33. Deep muscles of the anterior side of the shank in the fox squirrel.
FIGURE 34. Superficial muscles of the posterior side of the shank in the fox squirrel.

142 rectus femoris
143 vastus lateralis
156 tibialis anticus
157 extensor digitorum pedis longus
158 extensor hallucis longus
159 peroneus longus
160 peroneus brevis
161 peroneus digiti quinti
162 peroneus digiti quarti
163 gastrocnemius
165 plantaris
167 tibialis posticus
168 flexor digitorum pedis longus
T tibia

161. M. peroneus digiti quinti (figs. 33, 35), a very slender muscle, extends throughout the length of the shank. It is lateral to the peroneus brevis and hidden by the peroneus longus. Its tendon runs under the external annular ligament, then crosses the tendon of the peroneus brevis, and continues along the dorsolateral surface of the 5th toe. It is fastened aponeurotically to the metatarso-phalangeal joint, and ends on the base of the 2nd phalanx.

ORIGIN: from the lateral edge of the upper 1/3 of the fibula.

INSERTION: on the dorsolateral aspect of the base of the 5th toe's 2nd phalanx.

162. M. peroneus digiti quarti (figs. 33, 35) is a small muscle deep to the peroneus digiti quinti and opposite the peroneus brevis. The distal end of its belly extends with the tendons of the other peronei beneath the external annular ligament. The tendon which this belly then gives off is the deepest of the peroneal tendons. It proceeds distomediad onto the dorsolateral side of the 4th toe.

ORIGIN: from the lateral edge of the lower 2/3 of the fibula.

INSERTION: on the dorsolateral surface of the base of the 4th toe's 2nd phalanx.

3. The Flexor Group includes six muscles located on the posterior side of the shank.

Mm. gastrocnemius	popliteus
soleus	tibialis posticus
plantaris	flexor digitorum pedis longus

163. M. gastrocnemius (figs. 30, 32, 33, 34, 35), the largest of the shank muscles, includes two heads, one lateral and one medial. These two heads are closely associated with the soleus and the plantaris.

ORIGIN: The lateral head of the gastrocnemius comes from the lateral epicondyle of the femur, the medial head, from the posterior aspect of the medial femoral epicondyle and the intercondylar portion of the femur. Each head contains a samll sesamoid bone, that of the lateral head articulating with the lateral condyle of the femur, that of the medial head, with the medial condyle.

Proceeding distad along the posterior side of the shank, both heads become tendinous. The soleus arises beneath the lateral head of the gastrocnemius and soon fuses with the latter. The plantaris, whose upper end is attached to the lateral head of the gastrocnemius, becomes separate from the latter, and, lying underneath the medial head, progresses distad. The tendons of both heads of the gastrocnemius unite. The resulting, large tendon (forming the bulk of Achilles' tendon) passes below that of the plantaris and terminates on the tuber calcis.

INSERTION: on the proximal end of the tuber calcis.

164. M. soleus (fig. 35), a small muscle concealed by the gastrocnemius, extends for a short distance toward the ankle, then combines with the gastrocnemius' lateral head.

ORIGIN: by a stout tendon from the posterolateral surface of the head of the fibula.

INSERTION: into the lateral head of the gastrocnemius.

165. M. plantaris (fig. 34)

ORIGIN: The plantaris, lying mostly deep to the gastrocnemius, originates from the posterior edge of the lateral epicondyle of the femur.

Its upper end is connected to the lateral head of the gastrocnemius, but soon becomes free. Situated deep to the medial head of the gastrocnemius, the plantaris progresses toward the ankle. In the lower part of the shank its tendon emerges so as to lie superficial to that of the gastrocnemius. Continuing onto the plantar surface of the os calcis, the tendon of the plantaris flattens out, then merges into the plantar aponeurosis on the ventral aspect of the tarsus. From the plantar aponeurosis four flat tendons run distad, one on the ventral side of each of the last four toes. Each of these tendons divides at the level of the metatarso-phalangeal joint of its particular digit. The halves of each are at first located one on either side of that toe's flexor longus' tendon, but terminate dorsal to the latter.

INSERTION: on the bases of the 2nd phalanges of the

last four toes, dorsal to the tendons of the flexor digitorum pedis longus (168).

166. M. popliteus (fig. 35)

The popliteus, a short, deep, triangular muscle, stretches diagonally across the upper end of the posterior side of the shank. It lies deep to the upper portions of the gastrocnemius, the soleus, and the plantaris.

ORIGIN: by a flat, stout tendon from the distal edge of the lateral epicondyle of the femur. This tendon contains a small sesamoid bone which articulates with the lateral tibial condyle.

INSERTION: on the posteromedial edge of the upper 1/4 of the tibia.

167. M. tibialis posticus (figs. 32, 34, 35)

ORIGIN: from the posterior surface of the proximal 1/4 and the medial surface of the middle 1/2 of the tibia.

The tibialis posticus is one of the deep muscles of the posterior side of the shank. It is located somewhat anterior and medial to the flexor digitorum pedis longus and is smaller than the latter. Its upper end lies underneath the popliteus. From the lower portion of the shank the two tendons of the tibialis posticus advance along the medial side of the medial malleolus to pass under a ligament which extends from the lower end of the tibia over to the os talus.

INSERTION: The more superficial of the two tendons of

the tibialis posticus is inserted on the ventral surface of the 1st cuneiform.

The deeper tendon is somewhat longer than the more superficial one. After leaving the latter, it runs with the tendon of the flexor digitorum pedis longus below the internal annular ligament. It is inserted on the posterior edge of the os tibiale externum.

168. M. flexor digitorum pedis longus (figs. 34, 35) is found on the posterior aspect of the shank, deep to the gastrocnemius (163) and somewhat posterior and lateral to the tibialis posticus. Its thick tendon occupies a wide groove on the posterior face of the medial malleolus and passes distad between the medial malleolus and the dorsal surface of the os calcis. As it continues onto the plantar surface of the tarsus, it lies dorsal to the accessorius (170) and the plantaris (165). Having passed beneath the internal annular ligament, this tendon divides into five smaller branches, one for each toe. These branches are at first located dorsal to the tendons of the plantaris, but at the level of the metatarso-phalangeal joints, they emerge. Running along the ventral surface of one of the toes and through two ligamentous arches located on the 1st phalanx, each branch ends on the base of the terminal phalanx of its particular toe.

Proximal to the metatarso-phalangeal joints the tendons of the plantaris are ventral to those of the flexor digit-

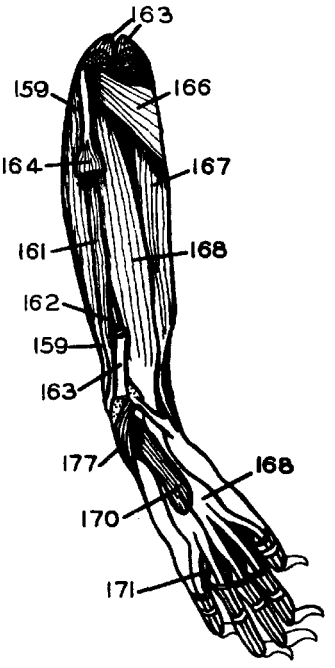

FIG. 35

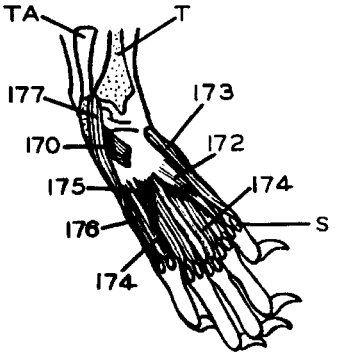

FIG. 36

FIGURE 35. Deep muscles of the posterior side of the shank in the fox squirrel.
FIGURE 36. Muscles of the foot in the fox squirrel.

159 peroneus longus
161 peroneus digiti quinti
162 peroneus digiti quarti
163 gastrocnemius
164 soleus
166 popliteus
167 tibialis posticus
168 flexor digitorum pedis longus
170 accessorius
171 lumbricales
172 adductor hallucis
173 flexor hallucis
174 interossei
175 adductor digiti quinti pedis
176 flexor digiti quinti pedis
177 abductor digiti quinti pedis

T tibia
TA Achilles' tendon
S sesamoid bone

orum pedis longus. At the level of the metatarso-phalangeal joint of its particular digit, each of the plantaris tendons divides. The halves of each then continue distad, lying at first one on either side of the flexor longus' tendon of the same toe. But gradually they swing dorsad so as to terminate dorsal to the flexor longus' tendon of that toe.

ORIGIN: from the posteromedial aspect of most of the fibula, the posterior surface of the middle 1/2 of the tibia, and the intervening part of the tibio-fibular interosseous ligament.

INSERTION: on the plantar face of the bases of the terminal phalanges. Throughout the length of its particular digit, each tendon is held in place by the surrounding fasciae.

D. Muscles of the Foot

Mm.	extensor digitorum pedis brevis	
	accessorius	interossei
	lumbricales	adductor digiti quinti pedis
	adductor hallucis	flexor digiti quinti pedis
	flexor hallucis	abductor digiti quinti pedis

There are nine muscles in the foot. Only the first of these, the extensor digitorum pedis brevis, is located on the dorsal surface of the foot. The others are ventral in position.

169. M. extensor digitorum pedis brevis is a small, flat muscle on the upper aspect of the tarsus. It lies beneath the tendons of the extensor digitorum pedis longus (157) and the extensor hallucis longus (158). Its two tendons advance out along the dorsolateral surface of the 2nd and 3rd toes to terminate on the bases of the 2nd phalanges.

ORIGIN: from the dorsal face of the os calcis and the os talus, distal to the cruro-tarsal articulation.

INSERTION: on the dorsolateral edge of the bases of the 2nd phalanges of the 2nd and 3rd toes. The two tendons of this muscle are also connected to the fasciae at the metatarso-phalangeal joints.

170. M. accessorius (figs. 35, 36)

ORIGIN: The accessorius springs from a lateral protuberance of the os calcis. The abductor digiti quinti pedis (177), however, hides its original end.

It is a very flat muscle progressing distomediad across the ventral surface of the tarsus. It emerges from beneath the abductor digiti quinti pedis to pass dorsal to the plantaris tendon (between the latter and the wide tendon of the flexor digitorum pedis longus).

INSERTION: One very slight tendon extends out from the belly of the accessorius to join the most lateral tendon of the plantaris (165), the one going to the 5th toe. The remainder of the muscle has a fleshy insertion on the dorsal face of the plantaris tendon at the level of the tarso-

metatarsal articulations. At this same level there is a small area where the wide plantaris tendon and the wide tendon of the flexor digitorum pedis longus are connected near their medial borders.

171. Mm. lumbricales (fig. 35) are four small muscles located mostly dorsal to, but somewhat beside and between the five tendons of the flexor digitorum pedis longus.

ORIGIN: from the surface of the tendons of the flexor digitorum pedis longus and from the surrounding fasciae.

INSERTION: Each lumbricalis is inserted on the medial side of the aponeurosis surrounding the metatarso-phalangeal joint of one of the last four toes.

172. M. adductor hallucis (fig. 36), a tiny, flat muscle, tapers as it proceeds distad. Its proximal end covers part of the interossei digiti secundi medialis and lateralis, while its insertional end lies between the interosseus hallucis lateralis and the interosseus digiti secundi medialis.

ORIGIN: from the plantar surface of the 1st cuneiform.

INSERTION: on the lateral aspect of the base of the 1st phalanx, and on the lateral metatarso-phalangeal sesamoid of the hallux.

173. M. flexor hallucis (fig. 36) is similar to the interossei in size, shape, and position. Therefore, it might be called interosseus hallucis medialis, since it is found be-

side the interosseus hallucis lateralis on the ventral surface of the 1st metatarsal.

ORIGIN: from the plantar face of the 1st cuneiform.

INSERTION: on the medial sesamoid bone at the metatarso-phalangeal joint of the hallux, or big toe.

174. Mm. interossei (fig. 36) are eight muscles situated between and ventral to the metatarsals. There is one interosseus on each side of each of the 2nd, 3rd, and 4th metatarsals, one on the medial side of the 5th, and one on the lateral side of the 1st.

ORIGIN: from the plantar surface of the cuboid, the plantar surface of the three cuneiforms, and the proximal ends of the metatarsals.

INSERTION: Each interosseus is inserted on the lateral or medial metatarso-phalangeal sesamoid, as the case may be, of one of the toes. Thus, interosseus digiti secundi lateralis is inserted on the lateral metatarso-phalangeal sesamoid of the 2nd toe, and so on.

175. M. adductor digiti quinti pedis (fig. 36)

ORIGIN: from the plantar aspect of the bases of the 3rd and 4th metatarsals.

This very thin muscle extends distolaterad across three of the interossei. Only its proximal 2/5 is fleshy. Its slight tendon proceeds between the interosseus digiti quinti medialis and the interosseus digiti quarti lateralis to its

INSERTION: on the medial metatarso-phalangeal sesamoid of the 5th toe.

176. M. flexor digiti quinti pedis (fig. 36) is similar to the interossei. It might be called interosseus digiti quinti lateralis, since it lies beside the interosseus digiti quinti medialis on the ventral edge of the 5th metatarsal.

ORIGIN: from the ventral surface of the base of the 5th metatarsal.

INSERTION: on the 5th toe's lateral metatarso-phalangeal sesamoid.

177. M. abductor digiti quinti pedis (figs. 35, 36) is a small muscle covering much of the ventral side of the os calcis. As it passes distad ventral to the accessorius (170), it hides the origin of the latter and that of the flexor digiti quinti pedis. It is lightly fastened by fascia to the base of the 5th metatarsal, then becomes tendinous. Its tendon runs along the lateral edge of the 5th metatarsal.

ORIGIN: from the ventral face of the tuber calcis.

INSERTION: on the lateral metatarso-phalangeal sesamoid of the 5th toe. The insertional tendon, lying lateral to the flexor digiti quinti pedis, extends throughout the length of the 5th metatarsal.

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