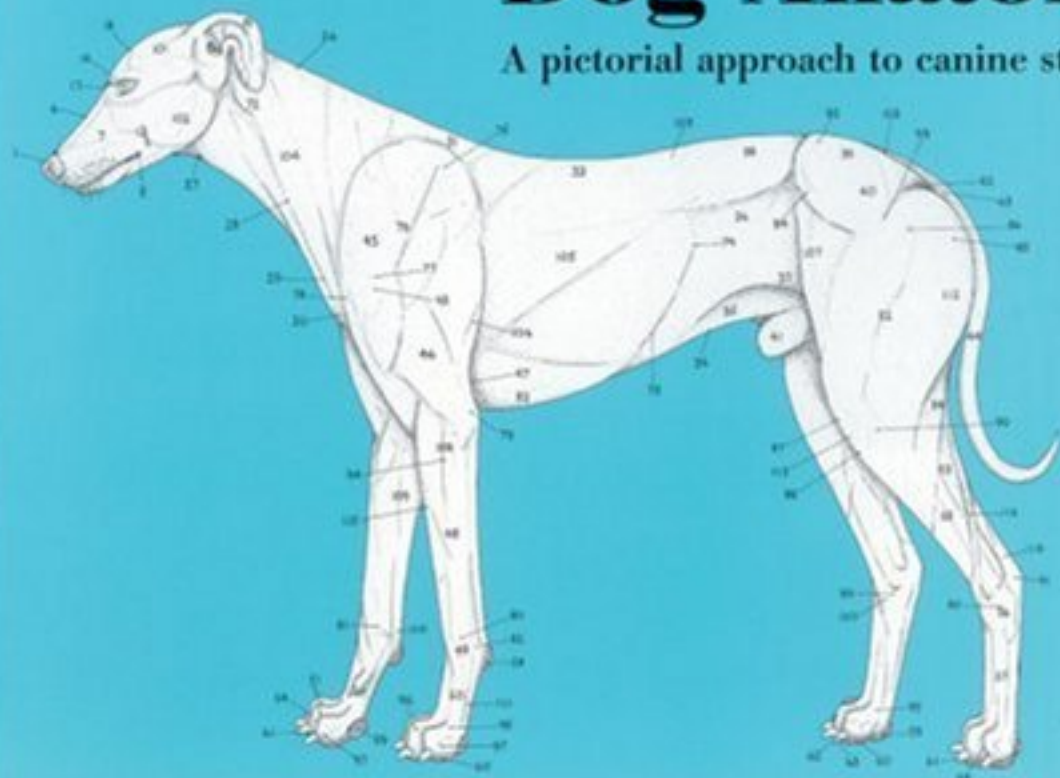


PETER C. GOODY

# Dog Anatomy

A pictorial approach to canine structure



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ment, while in warm weather the coat lies flatter reducing the thickness of the blanket and allowing heat to be dissipated more readily. Such hair movements are produced to some extent by the action of cutaneous muscle sheets in the superficial fascia but are mainly a response to reflex action in minute muscles attached to each hair root in the dermis.

Certain special facial hairs, in the form of long, stiff *tactile hairs* are important for sensory perception. These may be solitary or grouped and are found in various places on the face – on the lips, muzzle, cheeks, throat, and above the eyes – and nerve fibres wrapped around their roots record ‘touch’ information whenever the hairs are moved. Numerous other nerve endings lie in the dermal layer which means that the skin can act as a receptor organ for several different types of stimulus such as temperature, pain, touch and pressure.

#### *Surface features of head and neck*

**1** Nasal plane (pigmented hairless skin). **2** External nostril (leading into nasal vestibule surrounded by nasal cartilages). **3–5** Lips (surrounding oral fissure – mouth opening). **3** Upper lip (supporting superior labial tactile sensory hairs). **4** Lower lip. **5** Commissure of lips at angle of mouth. **6** Foreface. **7** Muzzle. **8** Prominence of chin (mentum supporting tactile sensory mental hairs). **9–12** Tactile sensory hairs of face. **9** Supraorbital sensory hairs. **10** Zygomatic sensory hairs. **11** Buccal sensory hairs. **12** Intermandibular sensory hairs. **13** Cheek (based on buccinator muscle). **14** Eyeball (situated in orbit and protected by a bony orbital rim). **15–16** Eyelids (surrounding palpebral fissure). **15** Upper eyelid supporting cilia (eyelashes). **16** Lower eyelid.

**17** Stop. **18** Forehead. **19** Pinna (visible part of external ear based on auricular cartilage). **20** Marginal cutaneous pouch of helix. **21** Tragi (prominent hairs at opening into ear canal). **22** Tongue. **23–25** Teeth of lower dental arch. **23** Incisor teeth. **24** Canine tooth (eye-tooth). **25** Lower carnassial (shearing) tooth (molar 1). **26** Crest of neck. **27** Throat. **28** Jugular groove (containing external jugular vein). **29** Jugular fossa (triangular depression at base of neck).

#### *Surface features of trunk and tail*

**30** Breast (based on pectoral muscles). **31** Withers (interscapular region). **32** Brisket (chest). **33** Back (dorsal region). **34** Umbilicus (navel – hairless scar denoting point of entry and exit of blood vessels in foetus). **35** Belly. **36** Flank. **37** Fold of flank (running onto thigh proximal to stifle joint). **38** Loins (lumbar region). **39** Croup (sacral region). **40** Rump (hindquarters). **41** Prepuce (sheath covering and protecting glans penis). **42** Ischiorectal fossa (depression lateral to root of tail and normally fat filled). **43** Root of tail (set-on of tail). **44** Tail.

#### *Surface features and regions of limbs*

**45** Shoulder. **46** Arm (brachium or upper arm). **47** Axilla (armpit). **48** Forearm (antebrachium). **49–51** Forepaw. **49** Carpus (wrist – a topographical region based on carpal bones and carpal joints). **50** Metacarpus (front pastern based on metacarpal bones). **51** Digits (toes based on phalangeal bones). **52** Thigh (upper thigh). **53** Calf (based on gastrocnemius muscle). **54** Popliteal fossa (caudal to stifle joint containing popliteal lymph node). **55** Shank (leg, crus or lower thigh). **56–57** Hindpaw. **56** Hock (tarsus or ankle – a topographical region based on tarsal bones and joints). **57** Metatarsus (rear pastern based on metatarsal bones). **58–60** Pads of paws. **58**

Carpal (stopper) pad. **59** Metacarpal pad of forepaw, metatarsal pad of hindpaw. **60** Digital pads. **61** Claw (unguis – capping ungual process of distal phalanx). **62** Wall of claw. **63** Sole of claw. **64** Interdigital space.

#### *Bony landmarks of head, neck and trunk*

**65** Zygomatic (supraorbital) process of frontal bone. **66** Orbital ligament (joining frontal bone and zygomatic arch completing orbital rim). **67** External sagittal crest. **68** External occipital protuberance (occiput). **69** Zygomatic arch (bridge of bone connecting face and cranium below eye). **70** Body of mandible (lower jaw). **71** Thyroid cartilage (forming ‘laryngeal prominence’ of voice box). **72** Wing of atlas (transverse process of 1st cervical vertebra). **73** Costal arch (fused costal cartilages of ribs 10–12 attached to costal cartilage of rib 9). **74** Rib 13 (last or floating rib normally attached by fibrous tissue with costal arch).

#### *Bony landmarks of limbs*

**75–77** Scapula (shoulder blade). **75** Dorsal (vertebral) border of scapula. **76** Spine of scapula. **77** Acromion process of scapula. **78** Point of shoulder (greater tubercle of humerus). **79** Point of elbow (olecranon process of ulna). **80** Lateral styloid process of ulna. **81** Medial styloid process of radius. **82** Accessory carpal bone. **83–85** Hip (pelvic) bone. **83** Sacral tuberosity of ilium (point of croup – cranial dorsal iliac spine). **84** Coxal tuberosity of ilium (point of haunch – cranial ventral iliac spine). **85** Ischiatic tuberosity of ischium (point of buttock or seat bone). **86** Greater trochanter of femur (point of hip). **87** Patella (‘knee cap’ – sesamoid bone in tendon of insertion of quadriceps femoris muscle). **88–89** Tibia. **88** Tuberosity of tibia (insertion for patellar tendon). **89** Medial malleolus of tibia. **90** Lateral malleolus of fibula. **91** Calcaneal tuberosity (point of hock – area

of attachment for common calcaneal tendon from calf muscles).

#### *Position of joints*

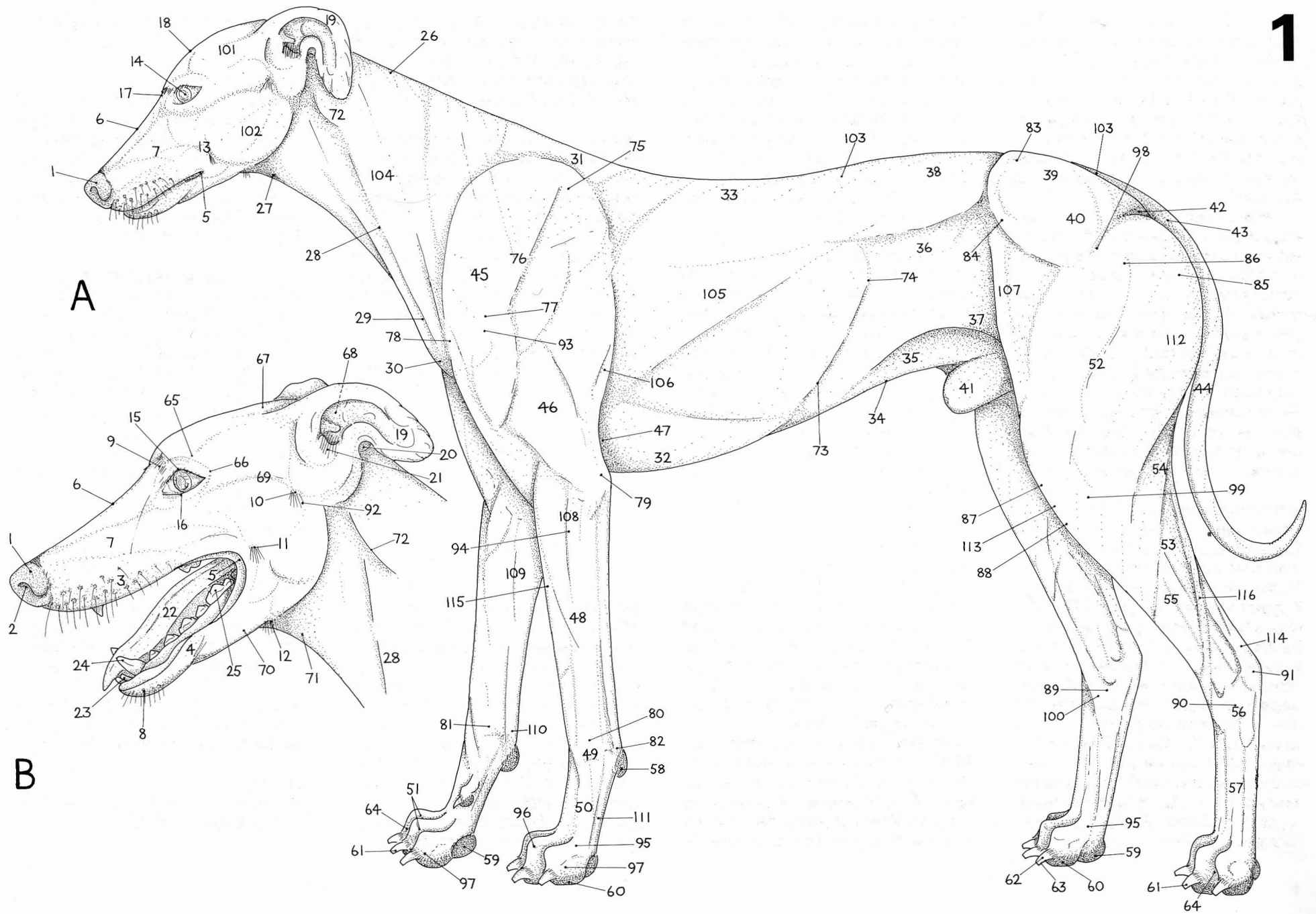
**92** Jaw (temporomandibular) joint. **93** Shoulder (scapulohumeral) joint. **94** Elbow (cubital) joint. **95** Metacarpophalangeal joints of forepaw and metatarsophalangeal joints of hindpaw. **96** Proximal interphalangeal joint. **97** Distal interphalangeal joint. **98** Hip (coxo-femoral) joint. **99** Stifle (knee) joint. **100** Talocrural (crurotarsal) joint.

#### *Muscles producing identifiable contours*

**101–102** Jaw closure muscles. **101** Temporal muscle. **102** Masseter muscle. **103** Epaxial musculature (extending whole length of neck, trunk and tail). **104** Brachiocephalic muscle (major limb protractor). **105** Latissimus dorsi muscle (major limb retractor). **106** Long head of triceps brachii muscle (forming caudal border [tricipital margin] of arm). **107** Sartorius muscle (forming cranial border of thigh). **108** Extensor muscles of carpus and digits (cranio-lateral muscle mass of forearm). **109** Flexor muscles of carpus and digits (caudomedial muscle mass of forearm). **110** Tendon of ulnar carpal flexor muscle (taut cord attached to accessory carpal bone). **111** Tendons of deep and superficial digital flexor muscles. **112** ‘Hamstring’ muscles (biceps femoris, semitendinosus and semimembranosus). **113** Patellar tendon (continuation onto tibia of quadriceps femoris tendon and containing patella). **114** Common calcaneal tendon (aggregate of tendons attached to point of hock including Achilles’ tendon from gastrocnemius and tarsal tendons from hamstrings).

#### *Blood vessels*

**115** Cephalic vein of forelimb. **116** Lateral saphenous vein of hindlimb.



# 2

## REGIONS OF THE DOG

As a slightly different approach to that adopted in fig 1, in which a selection of 'points' was indicated, these four illustrations show the body surface divided up into a number of regions which are given particular names. Nevertheless, as you may notice, many of the points of the dog are represented in this drawing as regions of the body because of their distinctness from neighbouring areas.

Some of the names used for body regions refer specifically to the major internal structures found in that particular region; eg. the femoral region based on the femur (thigh bone) and its surrounding muscles; the parotid region underlain by the parotid salivary gland, and so on. For describing positions on the body surface, and for describing the position of internal organs in relation to the surface, these named regions often prove very useful.

Skin contains a selection of **glands** situated in the dermis and emptying their secretions onto the epidermal surface through pores. *Sebaceous glands* are present throughout the skin and open into the hair follicles. The fatty semi-liquid secretion, *sebum*, solidifies when exposed to air and becomes applied to the hair root and the neighbouring epidermal surface. It helps to keep the skin soft and pliable and to 'waterproof' the body. Spread thinly over individual hairs sebum prevents them from becoming

brittle and is responsible for the glossy sheen of the coat. The *tarsal (Meibomian) glands* along the internal edge of the eyelids are modified and specialized sebaceous glands producing an oily secretion. The oily superficial layer this imparts to the tears film of the eye reduces evaporation, lubricates the lids preventing them from sticking, and forms a barrier at the lid margins preventing tear overflow onto the face.

Sweating is a method used by many animals to lower their body temperature. The evaporation of fluid (sweat) from the skin gives a considerable cooling effect. However, in dogs true *sweat glands* are only found in the pads on the paws where their watery secretion may play a role in gripping. As an alternative method of cooling dogs pant, the evaporation of water from the epithelial surfaces of the lips, tongue, mouth cavity and lungs, accomplishes a similar cooling effect to sweating. Nevertheless dogs are prone to overheating.

Several further types of gland are modifications of sweat glands. *Odoriferous* glands are quite widespread and open into hair follicles. The scent derived from their secretions is of importance in social communication between dogs. Of more restricted occurrence are the *ceruminous glands* of the ear canal producing the ear wax (*cerumen*), and the *glands of the anal sacs (paranal sinuses)*. The latter produce the foul-smelling secretion which collects in the paired anal sacs on either side of the anal canal. A duct from each anal sac opens onto the skin each side of the anus and the secretion is added to the surface of faeces as they are voided.

Anal sacs are distinct from *circumanal glands* opening separately onto the skin at and around the anus. These are modified sebaceous glands (odoriferous glands) which produce a particularly attractive secretion — at least to other dogs! Finally the *mammary glands* have a very similar structure to sweat glands and develop from the same rudiments. Five pairs of glands are a normal complement (fig 17D), although four pairs or even six pairs are not unusual, lying in the superficial fascia beneath the dermis. A conical *teat* marks the position of each gland but even these are only distinct projections in a lactating bitch and are rudimentary in a dog.

### *Topographical regions of the head*

1–5 Cranium. 1 Frontal (supraorbital region). 2 Parietal region. 3 Occipital region. 4 Temporal region. 5 Auricular region. 6–21 Face. 6–8 Nasal region. 6 Dorsal nasal region. 7 Lateral nasal region. 8 Nostril region. 9–10 Oral region. 9 Upper lip. 10 Lower lip. 11 Mental region. 12–13 Orbital region. 12 Upper eyelid. 13 Lower eyelid. 14 Zygomatic region. 15 Infraorbital region. 16 Temporomandibular (jaw) joint. 17 Masseteric region. 18 Buccal region. 19 Maxillary region. 20 Mandibular region. 21 Intermandibular region.

### *Topographical regions of the neck*

22 Dorsal neck region. 23 Lateral neck (jugular) region. 24 Parotid region. 25 Pharyngeal region. 26–27 Ventral neck region. 26 Laryngeal region. 27 Tracheal region.

### *Topographical regions of the thorax (pectoral regions)*

28 Presternal region. 29 Sternal region. 30

Scapular region. 31 Costal region. 32 Cardiac region.

### *Topographical regions of the abdomen*

33–34 Cranial abdominal (epigastric) region. 33 Hypochondriac region. 34 Xiphoid region. 35–36 Middle abdominal (mesogastric) region. 35 Lateral abdominal (iliac) region (includes paralumbar fossa). 36 Umbilical region. 37–39 Caudal abdominal (hypogastric) region. 37 Inguinal region. 38 Pubic region. 39 Preputial region.

### *Topographical regions of the back (dorsal regions)*

40 Interscapular region. 41 Thoracic vertebral region. 42 Lumbar region.

### *Topographical regions of the pelvis and tail*

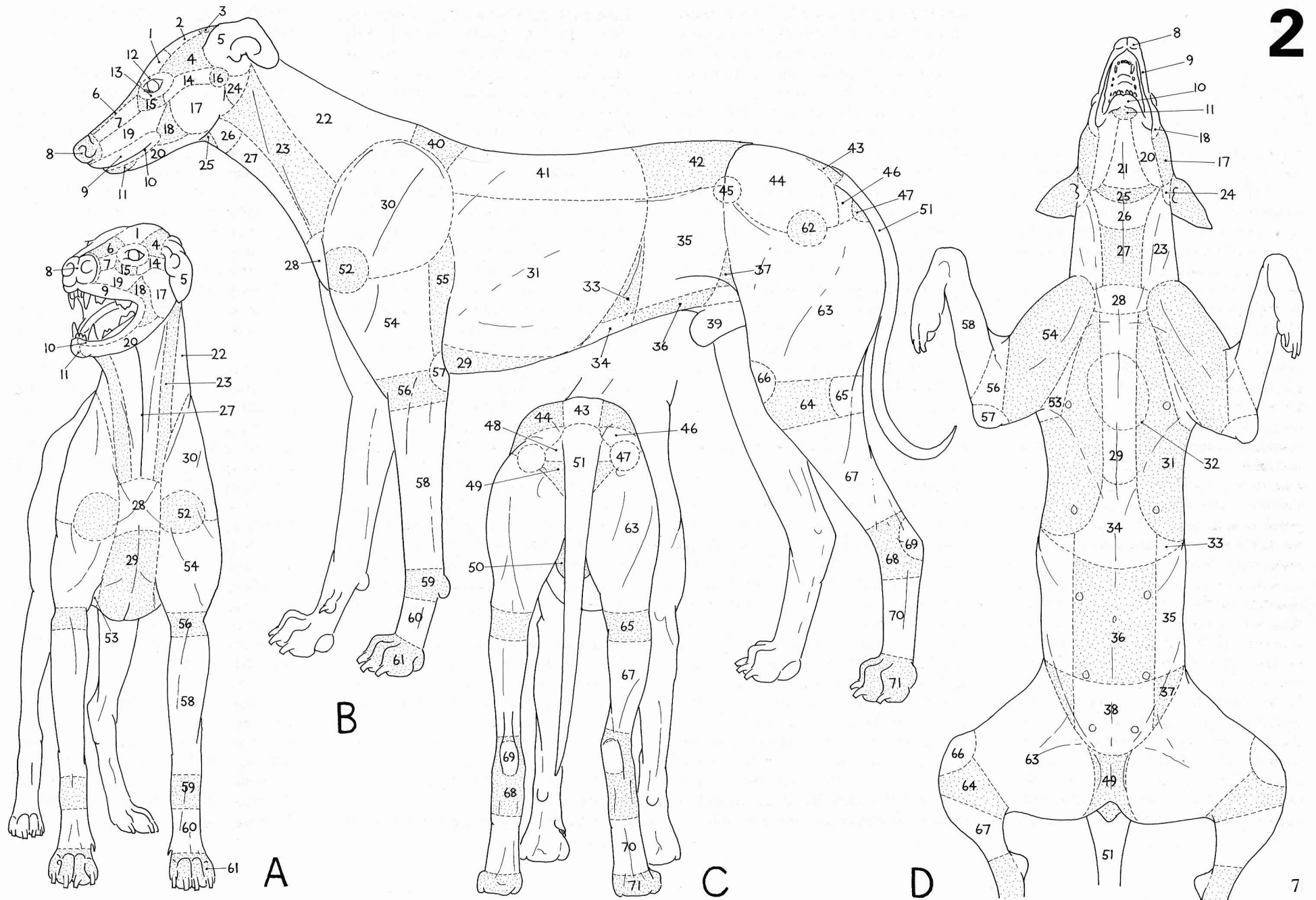
43 Sacral region. 44 Gluteal region. 45 Coxal tuberosity region. 46 Clunial region including ischiorectal fossa. 47 Ischiatic tuberosity region. 48–50 Perineal region. 48 Anal region. 49 Urogenital region. 50 Scrotal region. 51 Caudal region.

### *Topographical regions of the forelimb (thoracic limb)*

52 Shoulder joint. 53 Axillary region (includes axillary fossa). 54 Brachial region. 55 Tricipital region. 56 Cubital region. 57 Olecranon region. 58 Antebrachial region. 59 Carpal region. 60 Metacarpal region. 61 Phalangeal region (digits).

### *Topographical regions of the hindlimb (pelvic limb)*

62 Hip joint. 63 Femoral region. 64 Genual region. 65 Popliteal region. 66 Patellar region. 67 Crural region. 68 Tarsal region. 69 Calcaneal region. 70 Metatarsal region. 71 Phalangeal region.





parts: a central **diaphysis** and two extremities (**epiphyses**). Continued growth in length is ensured by the maintenance of an actively growing plate of cartilage between epiphysis and diaphysis to provide cartilage for subsequent conversion into bone. As maturity is reached the rate of bone deposition ultimately overtakes that of cartilage cell multiplication and growth, and ossification completely invades the growth plate of cartilage. Bone growth in length effectively ceases, but growth in bone diameter can continue to occur by deposition of bony tissue at the surface beneath the periosteum.

Bone once formed is not an unchanging structure, it undergoes structural rearrangement to combat the differing stresses encountered during growth. Provision is made for this change in the form of bone destroying cells sited in the periosteum. These cells can erode existing bone, dissolving its rigid matrix and making way for new bone forming cells to lay down bone in different patterns or even in different places. Thus the interior of the shaft of a long bone, for instance, receives very little stressing as it enlarges, so that bone initially deposited here is reabsorbed as the bone increases in girth by deposition at its outer, periosteal surface. This reabsorption produces a cavity at the centre of a bone which is available for housing bone marrow as we noticed earlier.

A bone's capacity to change in form according to an animal's needs is important should it be fractured. Bone in the region of the break is literally 'dissolved' and completely rebuilt to unite the broken parts. Over a period of several months the new bone is stressed

and gradually remodelled to conform to the original shape of the bone. If reset in the correct alignment following the initial fracture, the final result may well be practically indistinguishable from uninjured bone.

#### *Skull*

**1** Cranium (braincase). **2** Occiput (caudal boundary of cranium). **3** Tympanic bulla (surrounding middle ear [tympanic] cavity containing 3 auditory ossicles – incus, malleus and stapes). **4** Face (muzzle – based on nasal cavity and jaws and attached to rostral end of cranium). **5** Nasal cartilages (movably articulated with incisive bones of face and surrounding nasal vestibule). **6** Nasal cavity (containing olfactory apparatus and forming initial part of respiratory air tract). **7** Orbit (housing and protecting eyeball – continuous caudally with temporal fossa). **8** Upper jaw (supporting upper dental arch – consisting of 6 incisor teeth, 2 canine teeth, 8 premolar and 4 molar teeth). **9** Mandible (lower jaw supporting lower dental arch – consisting of 6 incisor teeth, 2 canine teeth, 8 premolar and 6 molar teeth). **10** Hyoid apparatus (suspending tongue and larynx in floor of throat). **11** Thyroid cartilage (most prominent cartilage of larynx – 'voice box').

#### *Vertebral column, ribs and sternum*

**12–15** Cervical (neck) vertebrae. **12** Atlas (cervical vertebra 1). **13** Axis (cervical vertebra 2). **14** Cervical vertebra 4. **15** Last (7th) cervical vertebra. **16–18** Thoracic (dorsal or back) vertebrae. **16** Summit of spinous process of thoracic vertebra 1. **17** Anticlinical vertebra (Thoracic vertebra 10). **18** Last (13th) thoracic vertebra. **19–20** Lumbar (loin) vertebrae. **19** Lumbar vertebra 2. **20** Summit of spinous process of last (7th) lumbar vertebra. **21** Sacrum (3 fused sacral vertebrae in pelvic

region). **22–24** Caudal (tail) vertebrae. **22** Caudal vertebra 1. **23** Caudal vertebra 6. **24** Caudal vertebra 18. **25–30** Thoracic rib-cage formed from 13 pairs of ribs. **25** Rib 1. **26** Bony part of rib 6. **27** Costal cartilage at lower end of rib 6. **28** Costal cartilage of rib 9 (last sternal [true] rib – ie. with direct attachment to sternum). **29** Costal arch (formed from fusion of costal cartilages of ribs 10–12, asternal [false] ribs – ie. without direct attachment to sternum, only indirectly through association with costal cartilage of rib 9). **30** Rib 13 (last or floating rib connected by fibrous tissue with costal arch). **31–33** Sternum ('breastbone' formed from 8 individual sternal segments [sternebrae] joined by intersternal cartilages). **31** Manubrium of sternum (sternebra 1 elongated into base of neck). **32** Sternebra 3. **33** Xiphoid cartilage of sternum (cartilaginous prolongation into belly wall of 8th [last] sternebra, xiphoid process).

#### *Joints of axial skeleton*

**34** Jaw (temporomandibular) joint. **35** Atlantooccipital joint ('yes' joint). **36** Atlantoaxial joint ('no' joint). **37** Costovertebral joint. **38** Costochondral joint. **39** Sternocostal joint.

#### *Forelimb skeleton*

**40** Scapula (shoulder blade of pectoral girdle). **41** Humerus (arm bone). **42** Radius. **43** Ulna. **44–47** Carpus ('wrist' – based on 7 carpal bones arranged in two rows). **44** Radiocarpal bone. **45** Ulnar carpal bone. **46** Accessory carpal bone. **47** Carpal bones 1–4. **48–49** Metacarpus ('palm' – based on 5 metacarpal bones). **48** Metacarpal bone 1. **49** Metacarpal bone 5. **50–53** Phalanges (3 in each digit except digit 1 ['dewclaw'] with only 2). **50** Proximal (1st) phalanx of digit 5. **51** Middle (2nd) phalanx of digit 5. **52** Distal (3rd) phalanx of digit 5. **53** Proximal palmar sesamoid bones of digit 5 (a pair at each metacarpophalangeal

joint in tendon of insertion of interosseous muscle [proximal plantar sesamoids at equivalent positions in hindpaw]).

#### *Joints of forelimb*

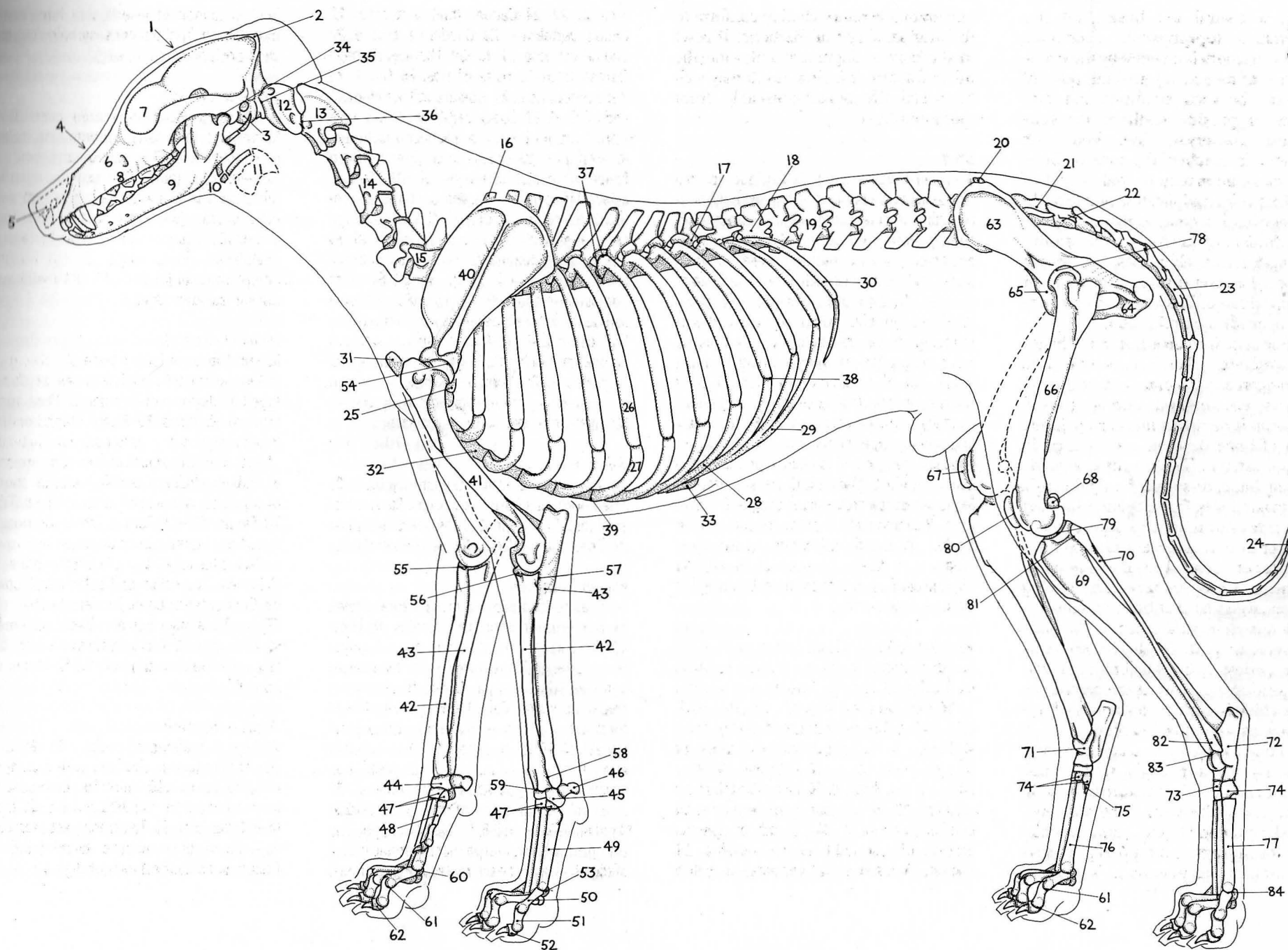
**54** Shoulder (scapulohumeral) joint. **55–57** Elbow joint (composite joint with 3 interrelated components). **55** Humeroulnar joint. **56** Humeroradial joint. **57** Proximal radioulnar joint. **58** Distal radioulnar joint. **59** Antebrachiocarpal joint (dominant component of composite carpal joint). **60** Metacarpophalangeal joint, digit 2. **61** Proximal interphalangeal joint, digit 2. **62** Distal interphalangeal joint, digit 2.

#### *Hindlimb skeleton*

**63–65** Hip bone (pelvic bone of pelvic girdle – formed from 3 separate bones which fuse together during development). **63** Ilium. **64** Ischium. **65** Pubis. **66** Femur (thigh bone). **67** Patella ('knee cap' – sesamoid bone in tendon of insertion of quadriceps femoris muscle). **68** Fabelae (stifle sesamoid bones in tendons of origin of gastrocnemius muscle). **69** Tibia. **70** Fibula. **71–74** Tarsus (ankle or hock – based on 7 tarsal bones arranged in 3 rows). **71** Talus (astragalus or tibial tarsal bone). **72** Calcaneus (os calcis or fibular tarsal bone). **73** Central tarsal bone. **74** Tarsal bones 1–4. **75–77** Metatarsus ('sole' – based on 5 metatarsal bones). **75** Metatarsal bone 1 (rudimentary). **76** Metatarsal bone 2. **77** Metatarsal bone 5.

#### *Joints of hindlimb*

**78** Hip (coxofemoral) joint. **79–81** Stifle (knee) joint (composite joint with 3 components). **79** Femorotibial joint. **80** Femoropatellar joint. **81** Proximal tibiofibular joint. **82** Distal tibiofibular joint. **83** Talocrural joint (dominant component of composite tarsal joint). **84** Metatarsophalangeal joint of digit 5.



age point at the upper ends of the forelimbs, while a lumbar bracket projects forwards from an anchorage at the sacrum above the hindlimbs. The size and strength of the backbone at any point along its length is clearly related to the stresses and strains that it bears; the greatest stress no doubt occurring at the points where it attaches to the limbs. Thus in the loins each vertebral bone carries the weight of the body in front of it together with the weight of its own body 'segment'. Passing back towards the sacrum each vertebra is accepting more total weight than the one in front of it and you can see from the drawings that the vertebrae enlarge back through the lumbar region. Likewise in the thorax, the vertebrae, and in particular their spines, are at their largest and longest over the shoulders where strains are greatest.

#### *Skull*

**1–15** Face (based on nasal cavity and jaws). **1** Nasal cartilages (movably articulated with bone of nasal cavity and surrounding nasal vestibule). **2** Nasal process of incisive bone (bordering bony nasal opening leading into nasal cavity proper). **3** Alveolar border of maxillary bone (upper jaw bearing teeth of upper dental arch). **4** Upper carnassial (shearing) tooth (premolar 4). **5** Alveolar jugae (impressions on surface of maxillary bone created by tooth roots internally). **6** Infra-orbital foramen. **7–13** Mandible (lower jaw). **7** Body of mandible. **8–11** Ramus of mandible. **8** Angular process of mandible. **9** Coronoid process of mandible (insertion of temporal muscle). **10** Masseteric fossa of mandible (insertion of masseter muscle). **11** Jaw (temporomandibular) joint (condyloid process of mandible located in mandibular

fossa of squamous temporal bone). **12** Mandibular symphysis (fibrocartilaginous intermandibular joint allowing practically no movement). **13** Alveolar border of mandible (bearing teeth of lower dental arch). **14** Lower carnassial (shearing) tooth (molar 1). **15** Mental foramen. **16–30** Cranium (braincase). **16** Zygomatic arch (bridge of bone connecting face and cranium below eye). **17** Orbit (housing and protecting eyeball). **18** Zygomatic (supraorbital) process of frontal bone. **19** Temporal line (rostral divergence of external sagittal crest). **20** External sagittal crest (in dorsal midline of cranium). **21** External occipital protuberance (occiput – most dorsocaudal portion of cranium). **22** Nuchal crest (division between dorsal and caudal surface of cranium). **23** External occipital crest. **24** Temporal fossa (origin of temporal muscle). **25** Jugular process of occipital bone. **26** Occipital condyle (both condyles form atlantooccipital joint with atlas). **27** Foramen magnum. **28** Mastoid process of temporal bone (sole representation on skull surface of petrous temporal bone). **29** Tympanic bulla (surrounding tympanic or middle ear cavity and containing 3 auditory ossicles – incus, malleus and stapes). **30** External acoustic meatus (across which eardrum is stretched in life and around which auricular cartilage is attached). **31–36** Hyoid apparatus supporting tongue and larynx. **31–34** Cranial horn of hyoid lying in pharyngeal wall. **31** Ceratohyoid bone. **32** Epihyoid bone. **33** Stylohyoid bone. **34** Tympanohyoid cartilage (articulating with tympanic bulla and mastoid process). **35** Basihyoid bone (lying transversely in floor of throat). **36** Caudal horn of hyoid (thyrohyoid bone in wall of laryngopharynx articulating with thyroid cartilage of larynx). **37–39** Laryngeal cartilages (forming larynx-voicebox). **37** Epiglottic cartilage. **38** Thyroid cartilage. **39** Cricoid cartilage.

#### *Vertebral column*

**40–52** Cervical (neck) vertebrae. **40** Dorsal arch of atlas (cervical vertebra 1 – cut through in median plane in fig D). **41** Dorsal tubercle of atlas (spinous process absent). **42** Wing of atlas (enlarged flattened transverse process). **43** Ventral arch of atlas (vertebral body absent – cut through in median plane in fig D). **44** Alar notch of atlas. **45** Spinous process of axis (cervical vertebra 2). **46** Odontoid process (dens) of axis (developmentally represents vertebral body of atlas). **47** Cranial articular surface of axis. **48** Vertebral canal in atlas. **49** Spinous process of last (7th) cervical vertebra (much reduced). **50** Transverse process of cervical vertebra 6 (enlarged and bifid). **51** Transverse foramen of cervical vertebra (consecutive foramina producing a transverse or vertebralarterial canal for passage of vertebral artery and vein). **52** Transverse (vertebralarterial) canal of axis vertebra. **53–56** Thoracic (chest or back) vertebrae. **53** Spinous process of thoracic vertebra 1. **54** Spinous process of thoracic vertebra 10 (anticlinal vertebra). **55** Spinous process of last (13th) thoracic vertebra. **56** Transverse process of thoracic vertebra 5. **57–58** Lumbar (loin) vertebrae. **57** Spinous process of last (7th) lumbar vertebra. **58** Transverse process of lumbar vertebra 5. **59–62** Sacrum (3 fused sacral vertebrae). **59** Median sacral crest (3 fused spinous processes of sacral vertebrae). **60** Sacral wing (enlarged 1st sacral transverse process). **61** Lateral sacral crest (fused sacral transverse processes 2 and 3). **62** Auricular surface of sacral wing (for formation of sacroiliac joint). **63** Caudal (tail) vertebrae. **64–67** Additional vertebral processes. **64** Cranial articular process of vertebra. **65** Caudal articular process of vertebra. **66** Accessory process of vertebra (present only on caudal thoracic and lumbar vertebrae). **67** Mamillary process of vertebra (present on thoracic and lumbar

vertebrae). **68–70** Intervertebral foramina (for passage of spinal nerves, arteries and veins). **68** Intervertebral foramen 1 (lateral vertebral foramen of atlas). **69** Intervertebral foramen 2 (between atlas and axis – for passage of cervical nerve 2). **70** Intervertebral foramina 8 (last cervical), 17 (9th thoracic) and 25 (4th lumbar).

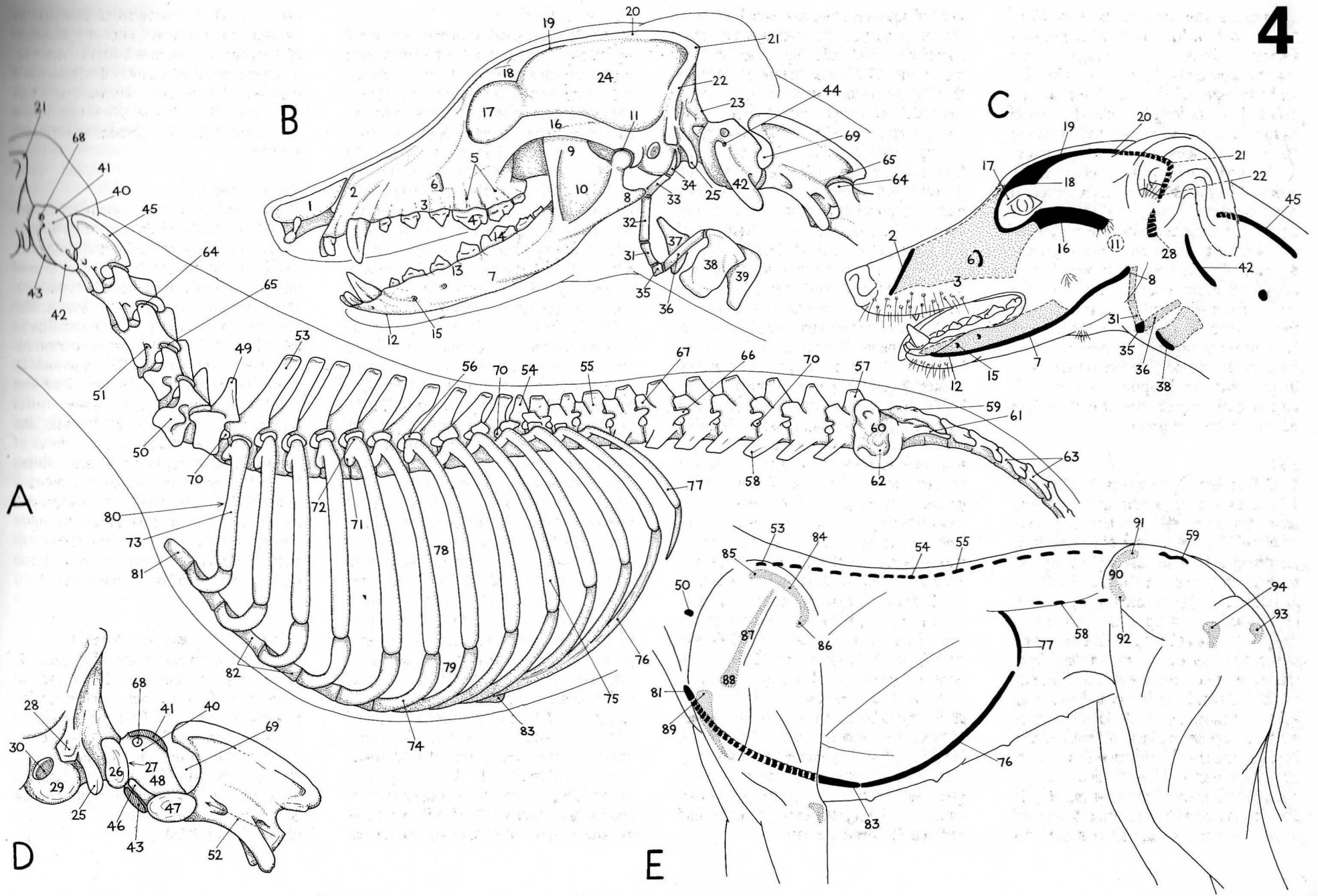
#### *Ribs and sternum*

**71** Rib head (capitulum) of rib 5. **72** Rib tubercle of rib 5. **73** Shaft (bony body) of rib 1. **74** Costal cartilage of rib 6 (articulating with intersternbral cartilage). **75** Rib 9 (last sternal [true] rib – i.e. with direct sternal attachment). **76** Costal arch (fused costal cartilages of ribs 10–12 with fibrous connection to costal cartilage of rib 9). **77** Rib 13 (last or floating rib united with costal arch by fibrous tissue). **78** Intercostal space 6 (between bony ribs 6 and 7). **79** Interchondral space 6 (between costal cartilages of ribs 6 and 7). **80** Thoracic inlet (bounded by sternal manubrium, first pair of ribs and costal cartilages and thoracic vertebra 1). **81** Manubrium of sternum (sternebra 1 elongated into base of neck). **82** Sternebrae 2 and 3 (sternal segments joined by intersternbral cartilage 2). **83** Xiphoid cartilage of sternum (cartilaginous prolongation of last [8th] sternebra, xiphoid process, into belly wall).

#### *Landmarks of appendicular skeleton*

**84** Dorsal (vertebral) border of scapula. **85** Cranial angle of scapula. **86** Caudal angle of scapula. **87** Scapular spine. **88** Acromion process of scapula. **89** Greater tuberosity of humerus (point of shoulder). **90** Iliac crest. **91** Sacral tuberosity of ilium (point of croup). **92** Coxal tuberosity of ilium (point of haunch). **93** Ischiatic tuberosity (point of buttock). **94** Greater trochanter of femur. (D After Taylor, 1955)







often accompanied by a brachygnathic, receding lower jaw. Dogs with shortened faces as I'm sure you know may also have problems breathing through their noses and/or difficulties with the bite of their jaws.

The dorsal profiles of the cranium and face are in approximately parallel planes, the nasofrontal suture marking the boundary on the dorsal surface between the two. The step down from the cranium to the facial level is the nasofrontal angle or **stop**. In brachycephalic breeds the shortened, broadened face is coupled with a deepened stop and eyes that are directed more forwards. Cranial and facial regions in all breeds are joined on either side by a bar of bone, the **zygomatic arch**, which forms the outer boundary of an orbitotemporal fossa containing the eyeball and jaw muscle. The orbit therefore lies at the cranio-facial boundary although normally considered a part of the face.

#### *Bony basis of face and jaws*

**1–4** Nasal cartilages. **1** Internasal septum (cartilaginous septum). **2** Dorsolateral nasal cartilage. **3** Ventrolateral nasal cartilage. **4** Accessory nasal cartilage. **5** Nasal process of incisive bone (bordering nasal opening leading into bony part of nasal cavity). **6** Nasal bone. **7** Maxillary bone. **8** Dorsal nasal concha (nasoturbinate bone – supporting nasal mucous membrane). **9** Ventral nasal concha (maxilloturbinate bone – supporting nasal mucous membrane). **10** Nasal meatuses (air passageways through nasal cavity). **11** Nasopharyngeal meatus (airway leading back to internal nostrils). **12** Internal nostril (choana – leading into nasopharynx). **13** Cribriform plate of ethmoid bone (separating cranial from nasal cavities). **14** Ethmoidal labyrinth

(ethmoturbinate bones – attached to cribriform plate and supporting nasal mucous membrane). **15** Maxillary recess (lateral diverticulum from nasal cavity). **16–17** Frontal sinus. **16** Lateral part of frontal sinus (large empty space in frontal bone). **17** Medial part of frontal sinus (containing extensions from ethmoidal labyrinth). **18** Hard palate (from palatine processes of incisive, maxillary and palatine bones). **19–28** Mandible (lower jaw). **19** Body of mandible. **20** Angular process of mandible. **21** Ramus of mandible. **22** Coronoid process of mandible (insertion of temporal muscle). **23** Masseteric fossa of mandible (insertion of masseter muscle). **24** Condylod (articular) process of mandible (transverse to articulate with mandibular fossa of temporal bone in jaw joint). **25** Mandibular notch (separating coronoid and condylod processes of mandible). **26** Mandibular fossa (smooth articular area for mandibular condyle in formation of jaw joint). **27** Retroarticular process (caudal boundary of mandibular fossa). **28** Mandibular symphysis (fibrocartilaginous intermandibular joint). **29** Alveolar borders of maxillary bone and mandible (tooth-bearing areas of upper and lower jaws).

#### *Cranium and ears*

**30** Orbit (housing and protecting eyeball). **31** Zygomatic arch (bridge of bone connecting face and cranium below eye). **32** Zygomatic (supraorbital) process of frontal bone. **33** Temporal line (rostral divergence of external sagittal crest). **34** External sagittal crest (in dorsal midline of cranium). **35** External occipital protuberance (most dorsocaudal portion of cranium). **36** Nuchal crest (division between dorsal and caudal surface of cranium). **37** Parietal bone. **38** Frontal bone. **39** Temporal fossa (origin of temporal muscle). **40** Occipital bone. **41** Occipital condyle (both condyles form atlantooccipital joint with atlas). **42**

Jugular process of occipital bone. **43** Foramen magnum (passage of spinal cord). **44** Cranial cavity (containing brain). **45** Bony cerebellar tentorium (separating cerebral from cerebellar hemispheres). **46** Hamulus of pterygoid bone. **47** Basisphenoid bone. **48–52** Temporal bone. **48** Petrous component of temporal bone (pyramid – housing membranous labyrinth of inner ear). **49** Tympanic bulla (surrounding tympanic [middle ear] cavity containing three auditory ossicles – incus, malleus and stapes). **50** External acoustic meatus (across which eardrum stretched in life). **51** Squamous part of temporal bone. **52** Mastoid process of temporal bone (sole representation on skull surface of petrous temporal bone). **53–67** Auricular cartilage. **53** Scapha (helix). **54** Apex. **55** Medial border of helix. **56** Spine of helix. **57** Lateral crus of helix. **58** Medial crus of helix. **59** Lateral border of helix. **60** Antitragus. **61** Lateral process of antitragus. **62** Exterior opening of vertical part of ear canal. **63** Concha. **64** Tragus. **65** Pretragic notch. **66** Intertragic notch. **67** Anthelix.

#### *Skull foramina for nerve and blood vessel passage*

**68** Orbital fissure (rostral lacerate foramen – passage of oculomotor, trochlear and abducent nerves and ophthalmic branch of trigeminal nerve). **69** Foramen lacerum (middle lacerate foramen/internal carotid foramen – passage of internal carotid artery). **70** Jugular foramen (caudal lacerate foramen – passage of glossopharyngeal, vagus and accessory nerves and internal jugular vein). **71** Optic canal (passage of optic nerve). **72** Round foramen (passage of maxillary branch of trigeminal nerve – position indicated by broken circle in fig A in medial wall of alar canal). **73** Oval foramen (passage of mandibular branch of trigeminal nerve). **74** Hypo-

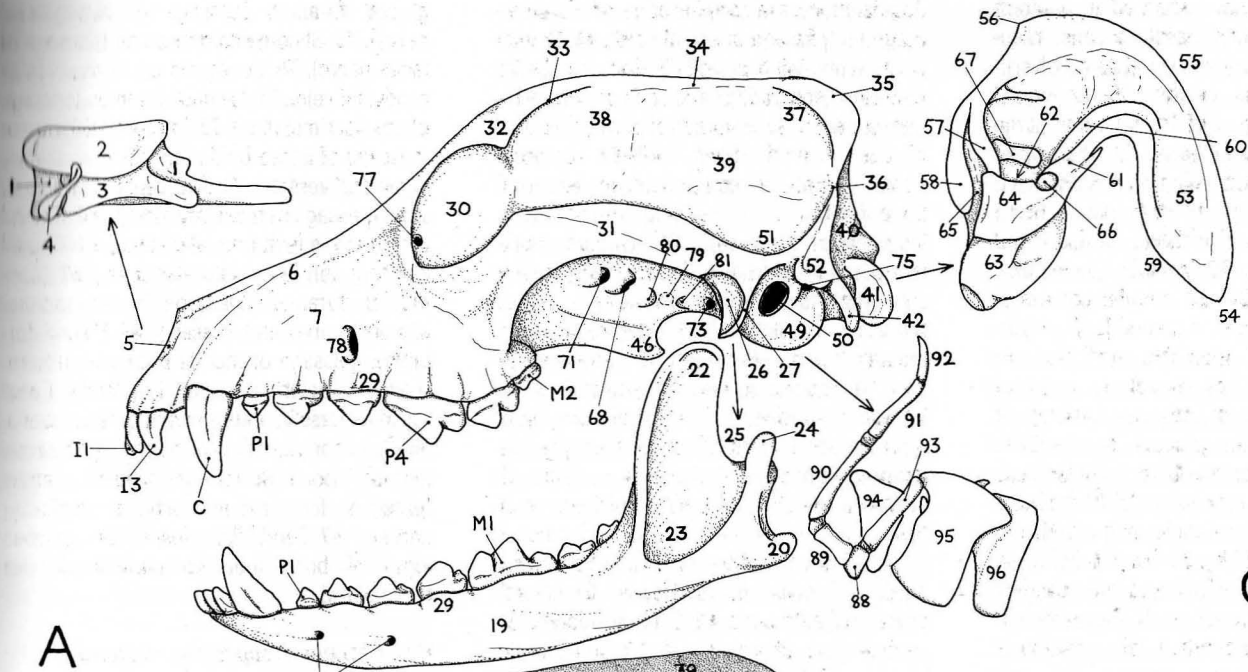
glossal foramen (passage of hypoglossal nerve). **75** Stylomastoid foramen (passage of facial nerve). **76** Condylod canal passage of condylod vein). **77** Lacrimal foramen (passage of nasolacrimal duct). **78** Infraorbital foramen (passage of infraorbital branches of maxillary nerve and vessels). **79** Alar canal of sphenoid wing (passage of maxillary artery). **80** Rostral alar foramen (exit from alar canal). **81** Caudal alar foramen (entry into alar canal). **82** Mandibular foramen (passage of mandibular alveolar nerve and vessels). **83** Mental foramina (passage of mental branches of mandibular alveolar nerve and vessels). **84** Canal for transverse venous sinus in occipital bone. **85** Canal for trigeminal nerve through petrous temporal bone. **86** Internal acoustic meatus (passage for vestibulocochlear [auditory] nerve). **87** Cerebellar fossa of petrous temporal bone (housing paraflocculus of cerebellum).

#### *Hyoid apparatus supporting tongue and larynx, and laryngeal cartilages*

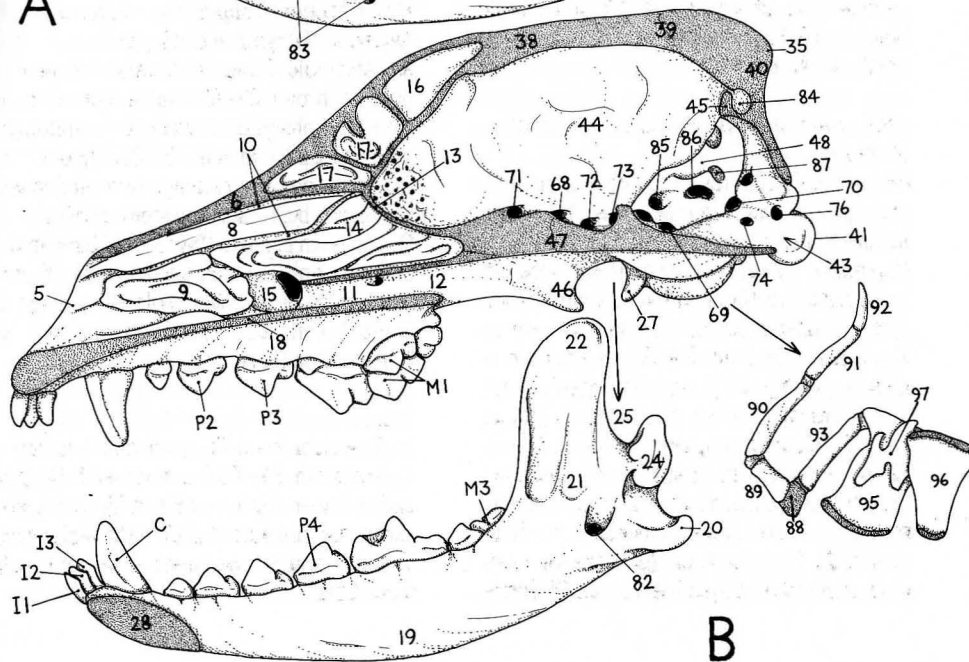
**88** Basihyoid bone (transverse element in floor of throat). **89–92** Cranial horn of hyoid (lying in pharyngeal wall). **89** Ceratohyoid bone. **90** Epihyoid bone. **91** Stylohyoid bone. **92** Tympanohyoid cartilage (articulating with tympanic bulla and mastoid process). **93** Caudal horn of hyoid (thyrohyoid bone in wall of laryngopharynx articulating with thyroid cartilage of larynx). **94** Epiglottic cartilage. **95** Thyroid cartilage. **96** Cricoid cartilage. **97** Arytenoid cartilage.

#### *Teeth*

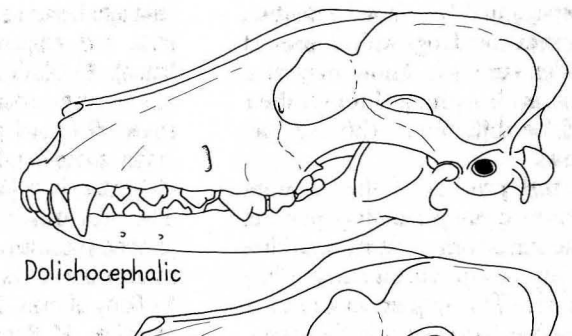
**I1–I3** Incisor teeth (3 upper and 3 lower). **C** Canine teeth. **P1–P4** Premolar teeth (4 upper and 4 lower teeth – with 'milk' precursors except for premolar 1). **M1–M3** Molar teeth (2 upper and 3 lower teeth – without 'milk' precursors).



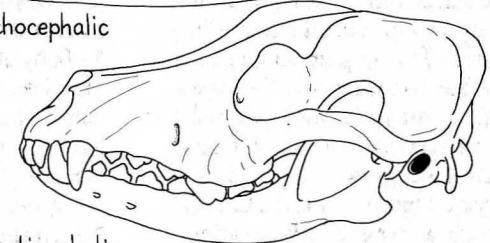
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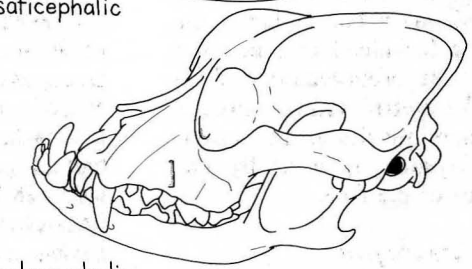
B



Dolichocephalic

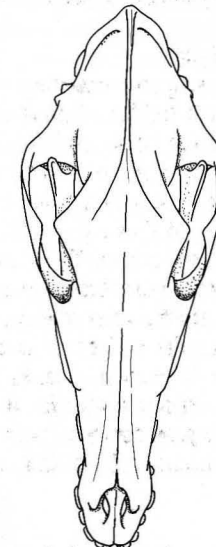


Mesaticephalic

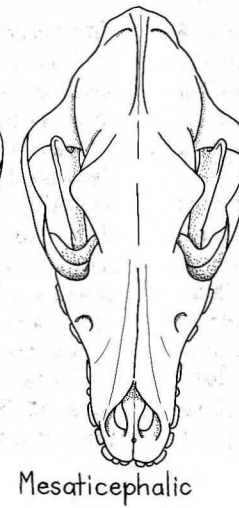


Brachycephalic

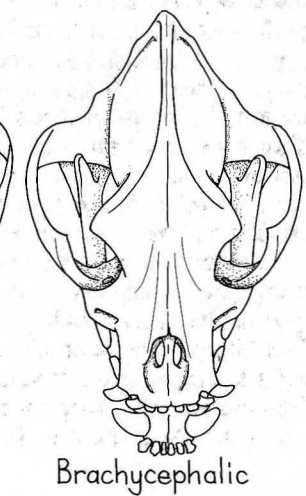
D



Dolichocephalic



Mesaticephalic



Brachycephalic

pressing down onto the pad.

The **phalangeal joints**, *proximal and distal interphalangeal* in each digit, are closely comparable in forepaw and hindpaw and again are functional if not strictly anatomical hinges, flexing and extending. The angles at these digital joints in a normal standing position are quite marked: the proximal interphalangeal joint has a ventral angle of about 135°, the dorsal angle of the distal interphalangeal joint is about 90°. The digits are therefore not splayed out flat on the ground as many skeletal drawings and museum preparations would have us believe.

#### *Topographical regions of forelimb*

1 Scapular region (shoulder). 2 Shoulder joint region. 3 Brachial region (arm or upper arm). 4 Tricipital region (caudal border of arm based on tricipital muscle). 5 Cubital region (elbow). 6 Olecranon region. 7 Antebrachial region (forearm). 8 Carpal region (wrist). 9 Metacarpal region (fore pastern). 10 Phalangeal region (digits or toes designated by roman numerals – I = dewclaw or 1st digit).

#### *Forelimb skeleton*

11–22 Scapula (shoulder blade – pectoral girdle). 11 Spine of scapula. 12 Supraspinous fossa of scapula. 13 Infraspinous fossa of scapula. 14 Acromion process of scapula. 15 Dorsal (vertebral) border of scapula. 16 Caudal angle of scapula. 17 Caudal border of scapula. 18 Infraglenoid tubercle. 19 Cranial angle of scapula. 20 Cranial border of scapula. 21 Scapular notch at level of neck of scapula (constricted region separating off articular angle in which lies glenoid cavity for humeral head). 22 Supraglenoid tubercle of scapula. 23–34 Humerus (arm bone). 23 Head of humerus (larger than glenoid cavity of

scapula). 24 Neck of humerus (only distinct caudally). 25 Greater tubercle of humerus (point of shoulder). 26 Crest of greater tubercle of humerus. 27 Tricipital line of humerus. 28 Deltoid tuberosity of humerus. 29 Brachial (musculospiral) groove of humeral shaft (begins on caudal surface of humeral neck and ends on cranial surface of shaft). 30–31 Condyle of humerus. 30 Capitulum of humeral condyle (articulating with head of radius). 31 Trochlea of humeral condyle (larger than capitulum and pulley-shaped, articulating with trochlear notch of ulna). 32 Supratrochlear foramen of humerus. 33 Medial (flexor) epicondyle of humerus. 34 Lateral (extensor) epicondyle of humerus. 35–44 Forearm bones. 35–39 Radius. 35 Head of radius (articulating with capitulum of humerus and radial notch of ulna). 36 Neck of radius. 37 Lateral tuberosity of radius. 38 Body (shaft) of radius. 39 Medial styloid process of radius. 40–43 Ulna. 40 Olecranon process of ulna (point of elbow). 41 Trochlear (semilunar) notch of ulna. 42 Body (shaft) of ulna. 43 Lateral styloid process of ulna (articulating with ulnar carpal and accessory carpal bones). 44 Antebrachial interosseous space between radius and ulna. 45–56 Forepaw bones. 45–48 Carpal bones. 45 Radial carpal bone (scaphoid). 46 Ulnar carpal bone (triquetrum). 47 Accessory carpal bone (pisiform). 48 Carpal bones 1–4 (trapezium, trapezoid, capitate and hamate). 49–51 Metacarpal bones. 49 Metacarpal bone 1. 50 Metacarpal bone 2. 51 Lateral surface of base of metacarpal bone 5. 52–56 Digital bones. 52 Proximal (1st) phalanx of digit 2. 53 Middle (2nd) phalanx of digit 2. 54 Distal (3rd) phalanx of digit 2. 55 Ungual process of 3rd phalanx. 56 Proximal sesamoid bones of metacarpophalangeal joint of digit 5 (pair of sesamoids associated with each metacarpophalangeal joint).

#### *Joints of forelimb*

57 Shoulder joint. 58–59 Elbow joint. 58 Humeroulnar component of elbow joint. 59 Humeroradial component of elbow joint. 60 Antebrachiocarpal joint (main component of carpal joint). 61 Metacarpophalangeal joint of digit 2. 62 Proximal interphalangeal joint of digit 5. 63 Distal interphalangeal joint of digit 5.

#### *Topographical regions of pelvis and hindlimb*

64 Gluteal region (rump). 65 Coxal tuberosity region (haunch). 66 Clunial region (including ischiorectal fossa). 67 Ischiatic tuberosity region (buttock). 68 Hip joint region. 69 Femoral region (thigh or upper thigh). 70 Genual region (stifle). 71 Patellar region. 72 Popliteal region. 73 Crural region (leg, shank or lower thigh). 74 Tarsal region (ankle or hock). 75 Calcaneal region. 76 Metatarsal region (rear pastern).

#### *Hindlimb skeleton*

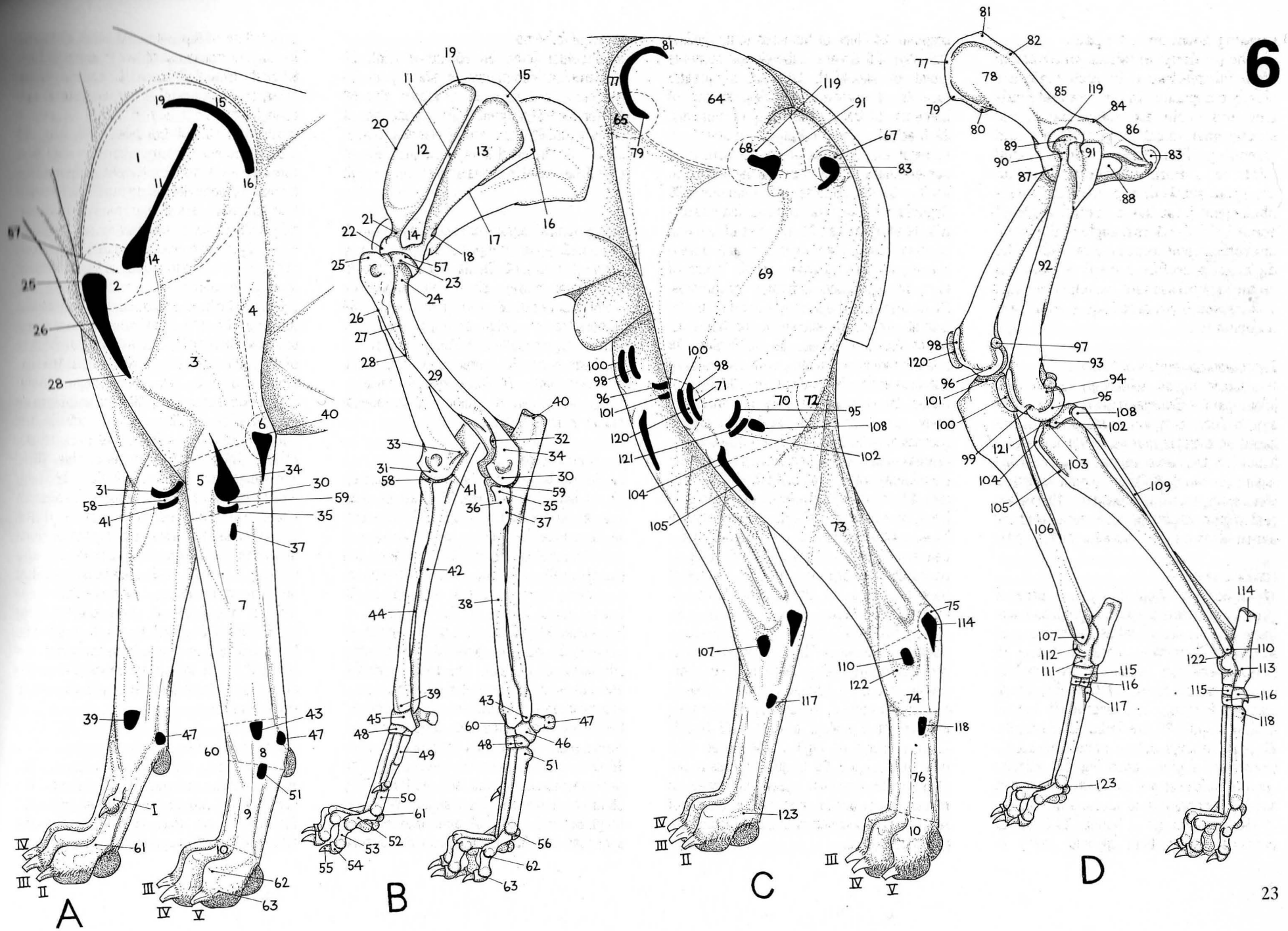
77–88 Hip bone (pelvic bone of pelvic girdle). 77–84 Ilium of hip bone. 77 Crest of ilium (cranial border of ilium). 78 Wing of ilium. 79 Coxal tuberosity of ilium (point of haunch – cranial ventral iliac spine). 80 Caudal ventral iliac spine. 81 Sacral tuberosity of ilium (point of croup – cranial dorsal iliac spine). 82 Caudal dorsal iliac spine. 83–86 Ischium of hip bone. 83 Ischiatic tuberosity (point of buttock). 84 Ischiatic spine. 85 Greater ischiatic notch of hip bone. 86 Lesser ischiatic notch of hip bone (converted into lesser ischiatic foramen by sacrotuberous ligament). 87 Pecten of pubic bone (attachment area for cranial pubic ligament and prepubic tendon). 88 Obturator foramen (blocked in by obturator membrane in life and perforated by obturator nerve and vessels). 89–99 Femur (thigh bone). 89 Head of femur (nearly hemispherical and fitting into deep cup-shaped

acetabulum of hip bone). 90 Neck of femur. 91 Greater trochanter of femur (point of hip). 92 Body (shaft) of femur. 93 Lateral supracondylar tuberosity of femur. 94 Lateral epicondyle of femur supporting a sesamoid fabella. 95 Lateral condyle of femur. 96 Medial condyle of femur (smaller and less convex than lateral). 97 Fabella supported on medial epicondyle of femur. 98 Femoral trochlea with lateral and medial trochlear ridges. 99 Extensor fossa of femur (origin of long digital extensor muscle). 100 Patella ('knee cap' – sesamoid bone in tendon of insertion of quadriceps femoris muscle and occupying trochlea of femoral condyle [patellar groove]). 101–110 Crural bones (bones of leg or shank). 101–107 Tibia. 101 Medial condyle of tibia. 102 Lateral condyle of tibia. 103 Extensor groove of tibia (for passage of long digital extensor tendon). 104 Tibial tuberosity (insertion of patellar tendon). 105 Cranial border of tibia (tibial crest). 106 Body (shaft) of tibia. 107 Medial malleolus of tibia. 108–110 Fibula. 108 Head of fibula. 109 Body (shaft) of fibula. 110 Lateral malleolus of fibula. 111–118 Hindpaw bones. 111–116 Tarsal bones. 111 Talus (astragalus or tibial tarsal bone). 112 Trochlea of talus (artulatory surface with tibia). 113 Calcaneus (os calcis or fibular tarsal bone). 114 Calcaneal tuberosity (point of hock). 115 Central tarsal bone (navicular). 116 Tarsal bones 1–4 (medial, intermediate and lateral cuneiform and cuboid). 117–118 Metatarsal bones. 117 Metatarsal bone 1. 118 Metatarsal bone 5 (lateral surface, base).

#### *Joints of hindlimb*

119 Hip joint. 120–121 Stifle joint. 120 Femoropatellar component of stifle joint. 121 Femorotibial component of stifle joint. 122 Crurotarsal joint (main component of tarsal joint). 123 Metatarsophalangeal joint, digit 2.





synovial joints but still help to connect bones and to prevent dislocation. The backbone, for instance, has a variety of ligaments, a particularly important one being the **supraspinous ligament** joining the tips of spinous processes together and reducing the possibility of excessive separation of vertebral bodies. In the neck it is modified as the **nuchal ligament** containing an extra component of elastic tissue. Passing forwards from the summit of the first thoracic spine to the spine of the axis this assists in head support and, due to its elastic nature, helps to raise the head and neck on the thorax reducing the muscular effort needed.

A further important ligament, the **sacrospinous ligament**, lies in the pelvic wall (E). It is a stout band of fibrous tissue running from the ischiatic tuberosity (point of the buttock) to the sacrum and caudal vertebra 1, and provides attachment for some of the muscles of the rump and thigh. Below it blood vessels and nerves to the pelvic wall and hindlimb pass in and out of the pelvis over the surface of the pelvic bone through the greater and lesser ischiatic foramina. It will also therefore prevent compression of these vessels and nerves by surrounding muscle contractions.

#### *Joints and ligaments of skull*

**1** Orbital ligament (completing orbital rim caudally joining zygomatic process of frontal bone with frontal process of zygomatic bone of zygomatic arch). **2** Jaw (temporomandibular) joint (synovial, hinge, containing an intra-articular cartilage subdividing joint cavity into upper and lower compartments). **3** Lateral ligament of temporomandibular joint. **4** Temporohyoid joint (fibrous, limited degree

of movement). **5** Mandibular symphysis (fibrocartilaginous intermandibular joint, little if any movement).

#### *Joints and ligaments of vertebral column*

**6** Intervertebral discs (fibrocartilaginous, very restricted movement at individual discs although sum total throughout column is quite considerable). **7** Zygapophyseal joints between cranial and caudal articular processes (synovial, some angular movement, restrict rotation between vertebrae). **8** Intertransverse ligaments (only distinct in lumbar region). **9** Interspinous ligaments. **10** Supraspinous ligament (uniting summits of spinous processes in trunk). **11** Nuchal ligament (continuation of supraspinous ligament in neck attaching cranially to spine of axis). **12** Lumbosacral joint (intervertebral joint between lumbar vertebra 7 and sacrum). **13** Atlantooccipital joint (synovial, hinge in action, flexion and extension of head on neck – 'yes' joint). **14** Lateral atlantooccipital ligament. **15** Atlantoaxial joint (synovial, rotation of head on neck – 'no' joint). **16** Dorsal atlantoaxial ligament or membrane.

#### *Joints and ligaments of ribcage*

**17–18** Costovertebral joint. **17** Rib head (capitular) articulation with vertebral body (synovial, hinge in action). **18** Rib tubercle articulation with transverse process (synovial, hinge in action). **19** Ligament of rib head. **20** Ligament of rib tubercle (costotransverse ligament). **21** Sternocostal joint (synovial, hinge in action). **22** Dorsal sternal ligaments. **23** Ventral sternal ligaments (merging with sternal membrane). **24** Costochondral joints (fibrous, little appreciable movement).

#### *Joints and ligaments of forelimb*

**25** Shoulder joint (synovial, ball-and-socket although movement restricted primarily to a

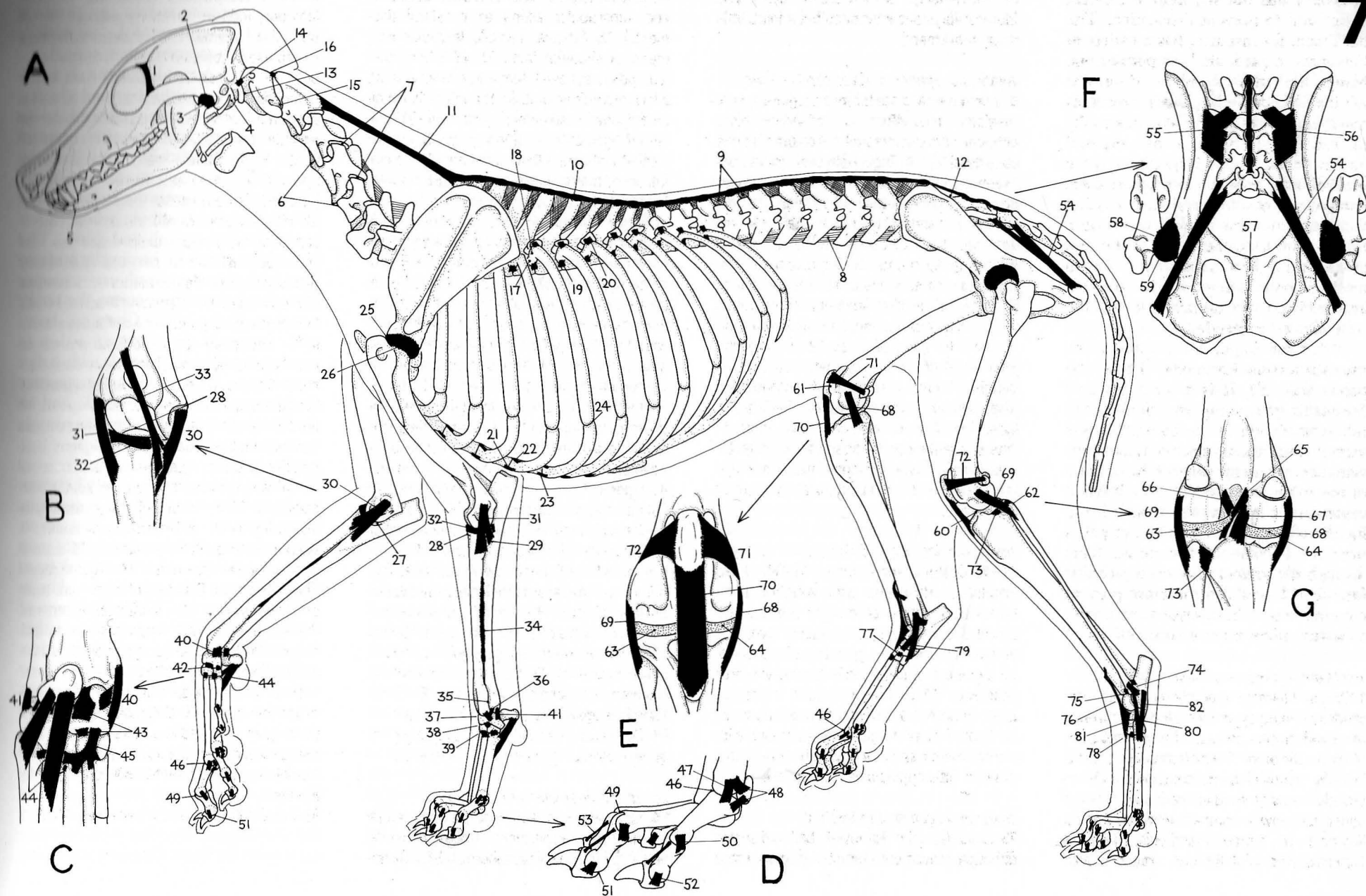
hinge action by muscles such as supraspinatus and subscapular acting as collateral ligaments). **26** Articular capsule (capsular ligament) of shoulder joint. **27–29** Elbow joint (composite synovial, hinge in overall action). **27** Humeroulnar joint. **28** Humeroradial joint. **29** Proximal radioulnar joint. **30–31** Collateral ligaments of elbow joint. **30** Medial (radial) collateral elbow ligament. **31** Lateral (ulnar) collateral elbow ligament. **32** Annular ligament of radial head. **33** Oblique ligament of elbow joint. **34** Antebrachial interosseous ligament. **35** Distal radioulnar joint (synovial, contributing to forearm rotation). **36** Radioulnar ligament. **37–39** Carpal joints (composite, synovial, several plane joints although a hinge in overall action). **37** Antebrachio-carpal joint (carpal component at which most movement occurs). **38** Intercarpal joints. **39** Carpometacarpal joints. **40–41** Collateral ligaments of carpus. **40** Medial (radial) collateral carpal ligaments. **41** Lateral (ulnar) collateral carpal ligaments. **42** Dorsal intercarpal ligaments. **43** Palmar intercarpal ligaments. **44** Ligaments of accessory carpal bone. **45** Palmar carpal fibrocartilage. **46** Metacarpophalangeal joints of forepaw/metatarsophalangeal joints of hindpaw (synovial, hinge in action). **47** Medial and lateral collateral ligaments of metacarpophalangeal/metatarsophalangeal joints. **48** Medial and lateral collateral ligaments of proximal sesamoid bones. **49** Proximal interphalangeal joint (synovial, hinge in action). **50** Collateral ligaments of proximal interphalangeal joints. **51** Distal interphalangeal joint (synovial, hinge in action). **52** Collateral ligaments of distal interphalangeal joint. **53** Dorsal elastic ligaments.

#### *Joints and ligaments of hindlimb*

**54** Sacrotuberous ligament (joining lateral sacral crest and transverse process of caudal vertebra 1 with ischiatic tuberosity). **55** Sacro-

iliac joint (combined synovial and fibrocartilaginous, little or no movement). **56** Dorsal sacroiliac ligament. **57** Pelvic symphysis (combination of pubic and ischiatic symphyses – fibrocartilaginous, little if any movement). **58** Hip joint (synovial, ball-and-socket with wide potential range of movement). **59** Articular capsule (capsular ligament) of hip joint. **60–62** Stifle (knee) joint (complex synovial, hinge in action). **60** Femorotibial joint. **61** Femoropatellar joint. **62** Proximal tibiofibular joint. **63–64** Intraarticular fibrocartilages (semilunar meniscal cartilages) of stifle joint. **63** Lateral meniscus. **64** Medial meniscus. **65** Meniscofemoral ligament (femoral ligament of lateral meniscus). **66–67** Intraarticular ligaments (cruciate ligaments) of stifle joint (joining tibia and femur in interior of stifle joint). **66** Cranial (lateral) cruciate ligament. **67** Caudal (medial) cruciate ligament. **68–69** Collateral ligaments of stifle joint. **68** Medial (tibial) collateral stifle ligament. **69** Lateral (fibular) collateral stifle ligament. **70** Patellar ligament (continuation of tendon of quadriceps femoris muscle onto tibial tuberosity). **71–72** Femoropatellar ligaments (collateral ligaments of femoropatellar joint). **71** Medial femoropatellar ligament. **72** Lateral femoropatellar ligament. **73** Ligaments of fibular head. **74** Distal tibiofibular joint (synovial, immobile). **75** Tibiofibular ligaments. **76–78** Tarsal joint (composite synovial, hinge). **76** Talocrural joint (synovial saddle-shaped joint at which most tarsal movement occurs). **77** Intertarsal joints. **78** Tarsometatarsal joints. **79–80** Collateral ligaments of tarsal joint. **79** Medial collateral tarsal ligament. **80** Lateral collateral tarsal ligament. **81** Dorsal tarsal ligaments. **82** Long plantar ligament.

(E, F & G After Evans & Christensen, 1979)





especially thick and well formed, they may provide attachment areas for muscles themselves, just like skeletal bones. The thoracolumbar and gluteal fascia, both shown in this drawing, can be included in this category, the former providing attachments for muscles of the abdominal wall. In the flanks and belly, however, deep fascia is not so well developed as it is on the limbs and is not as easily separated from underlying muscles. The relatively poor development of deep trunk fascia presumably allows for the degree of expansion required from this area. Nevertheless it must be borne in mind that the abdominal wall in particular is supporting the weight of the guts through its muscles. In this action it receives assistance from its deep fascia.

#### *Bony landmarks*

1 Spine of scapula. 2 Olecranon process of ulna (point of elbow). 3 Accessory carpal bone. 4 Sacral tuberosity of ilium. 5 Calcaneal tuberosity (point of hock).

#### *Muscles*

6 Superficial sphincter muscle of neck (located in superficial fascia of neck). 7 Platysma muscle. 8 Cutaneous muscle of trunk (located in superficial fascia of trunk). 9 Preputial muscle of sheath. 10 Deep sphincter muscle of neck and head (intermediate part). 11 Frontal muscle. 12 Orbicularis oculi muscle of eyelids (sphincter of palpebral fissure). 13 Orbicularis oris muscle of lips (sphincter of mouth). 14 Levator muscle of nostril wing and upper lip. 15 Rostral auricular muscles. 16 Brachiocephalic muscle. 17 Trapezius muscle. 18 Deltoid muscle. 19 Lateral head of triceps muscle. 20 Biceps femoris muscle. 21 Common calcaneal tendon.

#### *Fascial layers*

22 Superficial fascia of rump and tail. 23 Superficial fascia of shoulder and arm. 24 Deep fascia of forearm (antebrachial fascia forming a close fitting sleeve around forearm muscles). 25 Deep fascia of carpus (producing flexor and extensor retinacula). 26 Deep fascia of thigh (lateral femoral fascia – providing attachment for biceps femoris muscle and having its own tensor muscle). 27 Deep fascia of shank (crural fascia – closely investing muscles of crus). 28 Deep fascia of tarsus (producing flexor and extensor retinacula of tarsus).

#### *Blood vessels and lymph nodes*

29 Facial vein. 30 Linguofacial vein. 31 Maxillary vein. 32 External jugular vein. 33 Dorsal common digital veins. 34 Accessory cephalic vein. 35 Cephalic vein. 36 Axillo-brachial vein. 37 Omobrachial vein. 38 Lateral saphenous vein. 39 Medial saphenous vein. 40 Mandibular lymph nodes.

#### *Cutaneous branches of cranial nerves*

41–51 Trigeminal nerve (cranial nerve 5). 41–43 Ophthalmic branch of trigeminal nerve (smallest of 3 trigeminal subdivisions – sensory nerve of orbit, skin of dorsum of muzzle and some of mucous membrane of nasal cavity and paranasal sinuses). 41 Frontal (supra-orbital) nerve. 42 Infratrochlear nerve (from nasociliary branch of ophthalmic). 43 External nasal nerve (from ethmoidal branch of ophthalmic). 44–46 Maxillary branch of trigeminal nerve (largest of 3 trigeminal subdivisions – sensory nerve of cheek, side of nose, muzzle, maxillary recess, palate, teeth and gums of upper jaw). 44 Zygomatico-temporal nerve. 45 Zygomaticofacial nerve. 46 Infraorbital nerve. 47–51 Mandibular branch of trigeminal nerve (mixed motor and sensory nerve – sensory components to

pinna, cheek, lower lip, teeth and gums of lower jaw). 47–48 Auriculotemporal nerve. 47 Rostral auricular nerve (from auriculotemporal). 48 Transverse facial nerve (from auriculotemporal). 49 Buccal nerve. 50 Mental nerves. 51 Mylohyoid nerve.

#### *Cutaneous branches from dorsal rami of spinal nerves*

52 Cutaneous branches of dorsal rami of cervical nerves 2–7. 53 Cutaneous branches of dorsal rami of thoracic nerves 2–13. 54 Cutaneous branches of dorsal rami of lumbar nerves 1–6 (cranial clunial nerves). 55 Cutaneous branches of dorsal rami of sacral nerves 1–3 (middle clunial nerves). 56 Cutaneous branches of dorsal rami of caudal nerves 1–5.

#### *Cutaneous branches from ventral rami of cervical nerves*

57–58 Ventral ramus of cervical nerve 2. 57 Great auricular nerve. 58 Transverse cervical nerve. 59 Lateral cutaneous branches of ventral rami of cervical nerves 3–6 (supra-clavicular nerves). 60 Lateral thoracic nerve (from ventral rami of cervical nerve 8 and thoracic nerve 1).

#### *Cutaneous branches from ventral rami of thoracic nerves (intercostal nerves)*

61 Lateral cutaneous branch of intercostal nerve 2 (intercostobrachial nerve). 62 Lateral cutaneous branch of intercostal nerve 3 (intercostobrachial nerve). 63 Lateral cutaneous branches of intercostal nerves 4–12. 64 Lateral cutaneous branch of costoabdominal nerve (thoracic nerve 13). 65 Ventral cutaneous branches of intercostal nerves 3–10.

#### *Cutaneous branches from ventral rami of lumbar nerves*

66 Lateral cutaneous branches of ventral rami

of lumbar nerves 1–3 (cranial iliohypogastric, caudal iliohypogastric and ilioinguinal nerves). 67 Genitofemoral nerve (from ventral ramus of lumbar nerve 4). 68 Lateral cutaneous femoral nerve (bulk of ventral ramus of lumbar nerve 4).

#### *Cutaneous branches from ventral rami of sacral and caudal nerves*

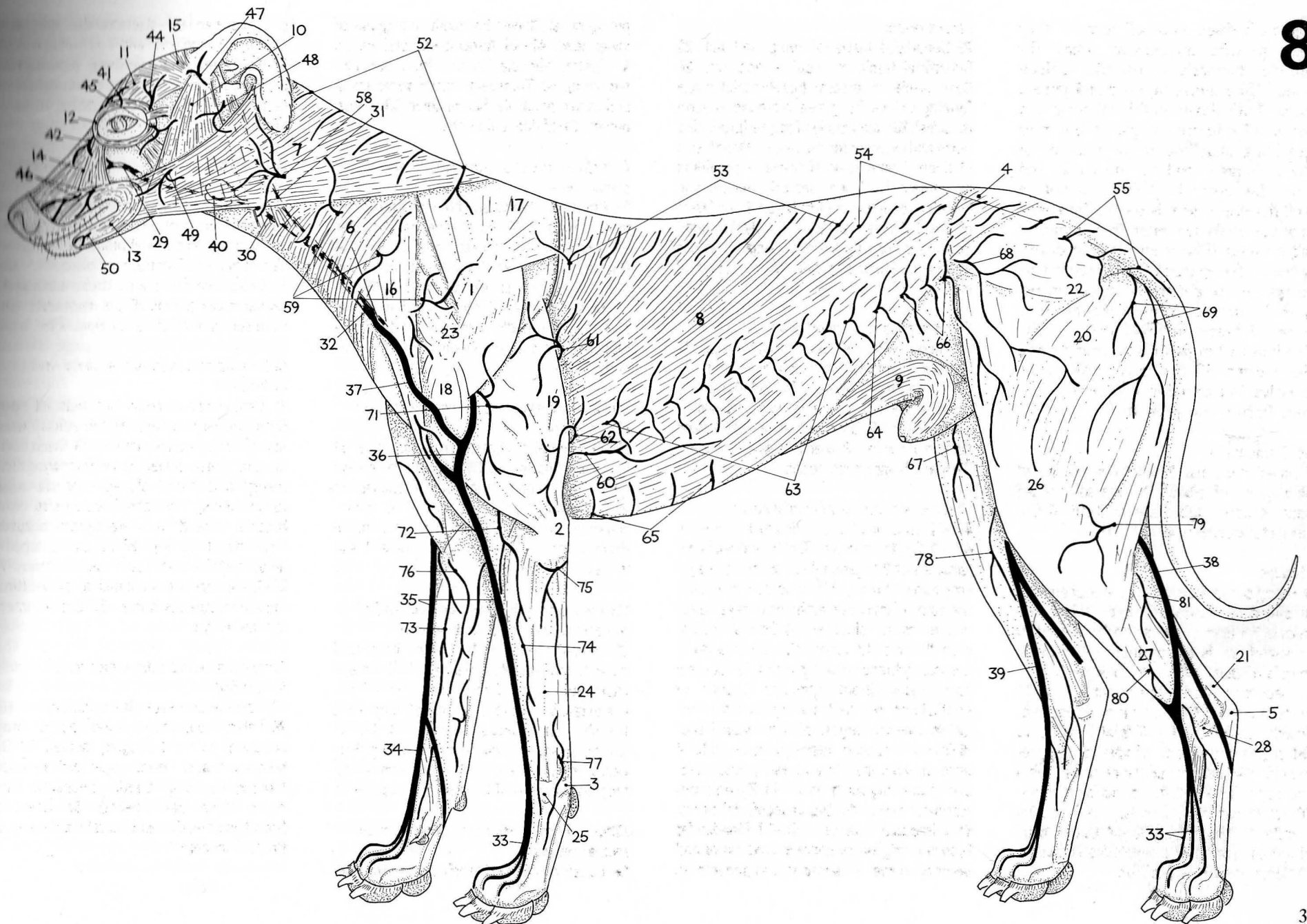
69 Caudal cutaneous femoral nerve (from ventral rami of sacral nerves 1 and 2 and giving origin to perineal branches and caudal clunial nerves). (Ventral rami of sacral nerves 1–3 also give rise to a pudendal nerve and a caudal scrotal nerve). 70 Cutaneous branches from ventral rami of caudal nerves 1–5.

#### *Cutaneous nerves from brachial plexus to forelimb*

71 Cranial lateral cutaneous brachial nerve (from axillary nerve). 72 Superficial radial nerve (from radial nerve). 73 Cranial cutaneous antebrachial nerve (branches from medial and lateral elements of superficial radial nerve). 74 Lateral cutaneous antebrachial nerve (from lateral branch of superficial radial nerve). 75 Caudal cutaneous antebrachial nerve (from ulnar nerve). 76 Medial cutaneous antebrachial nerve (from musculocutaneous nerve). 77 Dorsal branch of ulnar nerve.

#### *Cutaneous nerves from lumbosacral plexus to hindlimb*

78 Saphenous nerve (from femoral nerve). 79 Lateral cutaneous sural nerve (from common peroneal [fibular] nerve). 80 Cutaneous branch from superficial peroneal [fibular] nerve. 81 Caudal cutaneous sural nerve (from tibial nerve). 82 Cutaneous branches of medial and lateral plantar nerves (from tibial nerve).





ment the triceps contracts concentrically, the muscle shortening to extend the elbow. Stabilization (fixation) of many other joints depends upon the cooperation between antagonistic muscle groups to a greater extent; i.e. equal isometric contraction in both groups effectively cancelling out any tendency for either to produce joint movement.

#### *Bones and ligaments*

**1** Zygomatic (supraorbital) process of frontal bone. **2** Nasal bone. **3** Zygomatic arch (bridge of bone connecting face and cranium below eye). **4** Spine of scapula. **5** Caudal angle of scapula. **6** Medial (flexor) epicondyle of humerus. **7** Lateral (extensor) epicondyle of humerus. **8** Body (shaft) of radius. **9** Styloid process of radius. **10** Olecranon process of ulna (point of elbow). **11** Styloid process of ulna. **12** Accessory carpal bone. **13** Crest of ilium. **14** Position of patella (in tendon of quadriceps femoris muscle). **15** Body (shaft) of tibia. **16** Medial malleolus of tibia. **17** Lateral malleolus of fibula. **18** Calcaneal tuberosity (point of hock). **19** Rib 5. **20** Rib 13 (last or floating rib).

#### *Muscles of head*

**21** Platysma muscle. **22–37** Facial musculature (muscles of facial expression). **22** Intermediate sphincter muscle of head and neck. **23** Frontal muscle. **24** Orbicularis oculi muscle of eyelids (sphincter muscle of palpebral fissure). **25** Orbicularis oris muscle of lips (sphincter muscle of mouth). **26** Levator muscle of medial (inner) angle of eye. **27** Retractor muscle of lateral (outer) angle of eye. **28** Levator muscle of upper lip. **29** Levator nasolabialis muscle (levator muscle of nostril wing and upper lip). **30** Zygomatic muscle (retractor muscle of angle of mouth). **31** Pal-

pebral part of sphincter muscle of head (malar muscle). **32–33** Buccinator muscle (forming basis of cheek). **32** Buccal part of buccinator muscle. **33** Molar part of buccinator muscle. **34** Zygomaticoauricular muscle. **35** Parotidoauricular muscle. **36** Interscutular muscle. **37** Scutuloauricular muscle. **38–40** Jaw muscles. **38** Temporal muscle (passing from temporal fossa of cranium onto coronoid process of mandible). **39** Masseter muscle (passing from zygomatic arch onto masseteric fossa of mandible). **40** Digastric muscle (passing from jugular process of occiput onto body of mandible). **41** Geniohyoid muscle (passing from mandible close to symphysis back to basihyoid bone).

#### *Muscles of neck, trunk and tail*

**42** Sternohyoid muscle. **43** Sternoccephalic muscle. **44** External abdominal oblique muscle (originating from ribs and from thoracolumbar fascia). **45** Tendon of insertion (aponeurosis) of external abdominal oblique muscle (meeting fellow of opposite side in midventral fibrous linea alba). **46** Tail depressor muscles (ventral sacrocaudals). **47** Tail levator muscles (dorsal sacrocaudals). **48** Lateral flexor muscles of tail (intertransverse caudals). **49** Coccygeus muscle (component of pelvic diaphragm extending between ischiatic spine and caudal vertebrae and forming medial boundary of ischiorectal fossa).

#### *Muscles of forelimb*

**50–52** Brachiocephalic muscle (important limb protractor muscle). **50** Cleidobrachial part of brachiocephalic muscle. **51** Cleidocervical part of brachiocephalic muscle. **52** Clavicular tendon (fibrous intersection representing remains of clavicle situated in brachiocephalic muscle). **53–54** Trapezius muscle. **53** Cervical part of trapezius muscle. **54** Thoracic part of trapezius muscle. **55**

Omotransverse muscle. **56** Latissimus dorsi muscle (important limb retractor muscle). **57** Deep pectoral muscle (adductor muscle of arm and subsidiary limb retractor). **58–59** Deltoid muscle. **58** Scapular part of deltoid muscle. **59** Acromial part of deltoid muscle. **60** Supraspinous muscle. **61** Infraspinous muscle. **62** Teres major muscle. **63** Biceps brachii muscle (shoulder extensor and elbow flexor muscle). **64** Brachial muscle (elbow flexor muscle inserting into forearm with biceps). **65–67** Triceps muscle (elbow extensor muscle and main support of forelimb in normal standing posture). **65** Long head of triceps muscle (arising from caudal border of scapula and forming caudal margin of arm). **66** Lateral head of triceps muscle. **67** Medial head of triceps muscle. **68** Pronator muscle of forearm. **69–72** Flexor muscles of carpus and digits. **69** Radial carpal flexor muscle. **70** Ulnar carpal flexor muscle (forming caudal contour of forearm). **71** Superficial digital flexor muscle and tendon. **72** Radial head of deep digital flexor muscle. **73–77** Extensor muscles of carpus and digits. **73** Radial carpal extensor muscle (forming cranial contour of forearm). **74** Common digital extensor muscle and tendon. **75** Lateral digital extensor muscle and tendon. **76** Ulnar carpal extensor muscle (lateral ulnar muscle). **77** Oblique carpal extensor muscle and tendon (abductor muscle of digit 1).

#### *Muscles of hindlimb*

**78–80** Rump muscles. **78** Superficial gluteal muscle. **79** Middle gluteal muscle. **80** Tensor muscle of lateral femoral fascia. **81–82** Sartorius muscle (forming cranial margin of thigh). **81** Cranial part of sartorius muscle. **82** Caudal part of sartorius muscle. **83–85** 'Hamstring' muscles (extensor muscles of hip joint and important limb retractor muscles). **83** Biceps femoris muscle. **84** Semitendinosus

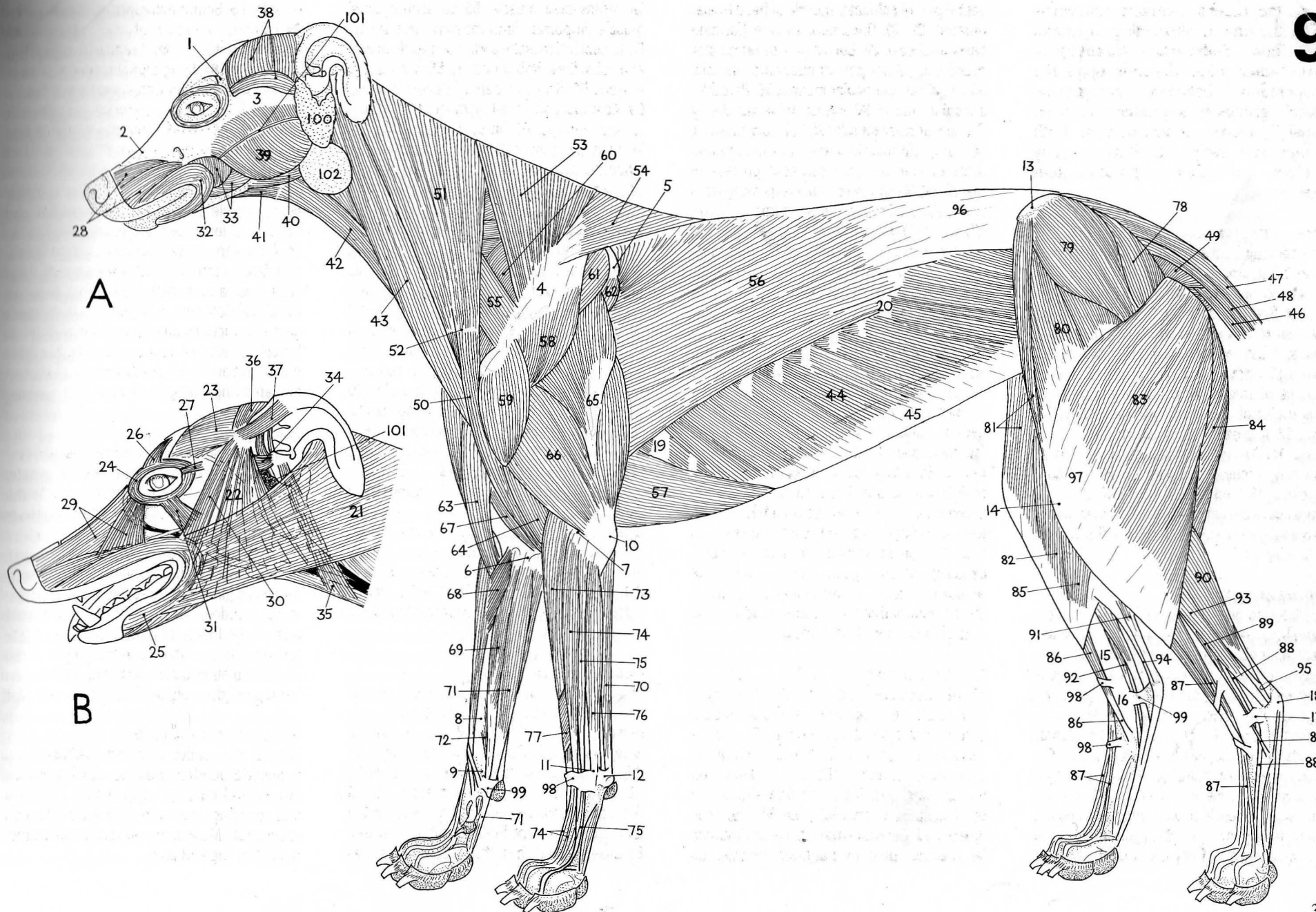
muscle. **85** Semimembranosus muscle. **86–89** Extensor muscles of digits and flexor muscles of tarsus. **86** Cranial tibial muscle and tendon. **87** Long digital extensor muscle and tendon. **88** Lateral digital extensor muscle and tendon. **89** Long peroneal muscle and tendon. **90–93** Flexor muscles of digits and extensor muscles of tarsus. **90** Lateral head of gastrocnemius muscle. **91** Medial head of gastrocnemius muscle. **92–93** Deep digital flexor muscle of hindlimb. **92** Medial digital flexor muscle. **93** Lateral digital flexor muscle. **94** Accessory (tarsal) tendon of 'hamstring' and gracilis muscle (thickened band of deep crural fascia extending down onto point of hock). **95** Common calcaneal tendon (aggregate of structures attaching to point of hock, including Achilles' tendon, superficial digital flexor tendon, and accessory or tarsal tendon of 'hamstring' and gracilis muscles).

#### *Fascial layers*

**96** Thoracolumbar fascia (deep fascial layer enclosing epaxial muscles and providing attachment for latissimus dorsi and lateral abdominal muscles). **97** Lateral femoral fascia (deep fascial layer enclosing extensor muscles of stifle joint and providing one area of attachment for biceps femoris muscle). **98** Extensor retinacula (loops of deep fascia holding extensor tendons in position at carpus and tarsus). **99** Flexor retinacula (holding flexor tendons in position at carpus and tarsus and completing carpal and tarsal canals for passage of deep digital flexor tendons).

#### *Salivary glands and ducts*

**100** Parotid salivary gland (diffuse and wrapped around concha of auricular cartilage). **101** Parotid duct (crossing masseter muscle and opening into oral vestibule through cheek). **102** Mandibular salivary gland (caudo-medial to angle of jaw).



ball-and-socket nature. Probably the main shoulder extensor, and protractor of the forelimb, is the **brachiocephalic muscle**. More minor extensors include the **supraspinatus** and **subscapular muscles**. These two muscles, however, are very important shoulder stabilizers with their strong tendons of insertion lying close to the shoulder joint itself and playing the part of lateral and medial 'ligaments' which restrict adduction and abduction confining the joint to a single plane of movement. The counterpart to the brachiocephalic on the rear of the shoulder is the **latissimus dorsi**. Although it will flex the shoulder to a certain extent its major action is to pull the whole limb backwards in relation to the trunk (retraction). Additional shoulder flexors include the **teres muscles**, the **deltoid** and the **infraspinatus**. However, this last muscle is best viewed as a further ligament muscle which stabilizes the shoulder joint.

Abduction and adduction at the shoulder joint refer to inward and outward movement of the humerus in relation to the scapula. The deltoid and infraspinatus muscles could abduct the humerus, the subscapular could adduct it. However, both movements appear to be of negligible occurrence so that synchronized contraction within these three muscles effectively cancels out either action stabilizing the joint. Any apparent abducting/adducting movements at the shoulder are most likely to be movements of the whole limb on its muscular attachments to the trunk. Finally, rotation of the humerus relative to the scapula might be brought about by the subscapular, infraspinatus and teres

minor muscles. However, rotation does not seem to occur these three muscles presumably cooperating to prevent it.

#### *Bones and joints of forelimb*

**1** Dorsal (vertebral) border of scapula. **2** Caudal angle of scapula. **3** Spine of scapula. **4** Acromion process of scapula. **5** Greater tubercle of humerus (point of shoulder). **6** Deltoid tuberosity of humerus. **7** Humeral condyle. **8** Medial (flexor) epicondyle of humerus. **9** Lateral (extensor) epicondyle of humerus. **10** Olecranon process of ulna (point of elbow). **11** Body (shaft) of ulna. **12** Lateral styloid process of ulna. **13** Body (shaft) of radius. **14** Medial styloid process of radius. **15** Radial carpal bone. **16** Ulnar carpal bone. **17** Accessory carpal bone. **18** Metacarpal bone 2. **19** Metacarpal bone 5, base. **20** Phalanges of digit 4. **21** Position of shoulder joint. **22** Elbow joint. **23** Antebrachio-carpal joint. **24** Metacarpophalangeal joint, digit 5. **25** Proximal interphalangeal joint, digit 4.

#### *Muscles of forelimb*

**26** Sternoccephalic muscle. **27** Sternohyoid muscle. **28** Sternothyroid muscle. **29** Cervical part of trapezius muscle. **30** Thoracic part of trapezius muscle. **31** Omotransverse muscle. **32** Latissimus dorsi muscle (important limb retractor muscle). **33-34** Ventral serrate muscle (symsarcotic muscle suspending trunk from upper end of forelimb). **33** Cervical part of ventral serrate muscle. **34** Thoracic part of ventral serrate muscle. **35** Thoracic part of rhomboid muscle. **36** Cervical part of rhomboid muscle. **37-39** Brachiocephalic muscle (main limb protractor muscle). **37** Cleido-brachial part of brachiocephalic muscle. **38** Cleidocervical part of brachiocephalic muscle. **39** Clavicular tendon in brachiocephalic muscle. **40-41** Pectoral muscles (adductor muscles of forelimb). **40** Superficial pectoral muscle.

**41** Deep pectoral muscle. **42** Infraspinatus muscle. **43** Supraspinatus muscle. **44** Teres major muscle. **45** Scapular part of deltoid muscle. **46** Acromial part of deltoid muscle. **47** Biceps brachii muscle. **48** Brachial muscle. **49** Long head of triceps muscle. **50** Lateral head of triceps muscle. **51** Medial head of triceps muscle. **52** Anconeal muscle. **53** Pronator muscle of forearm. **54** Radial carpal flexor muscle. **55** Ulnar carpal flexor muscle. **56** Superficial digital flexor muscle of forelimb. **57** Superficial digital flexor tendon. **58** Deep digital flexor muscle of forelimb. **59** Deep digital flexor tendon. **60** Radial carpal extensor muscle. **61** Radial carpal extensor tendon. **62** Common digital extensor muscle. **63** Common digital extensor tendons. **64** Lateral digital extensor muscle. **65** Lateral digital extensor tendon. **66** Ulnar carpal extensor muscle (lateral ulnar muscle). **67** Oblique carpal extensor muscle and tendon. **68** Supinator muscle of forearm. **69** Abductor muscle of digit 5. **70** Interosseous muscle of digit 5. **71** Extensor retinaculum. **72** Flexor retinaculum. **73** Palmar annular ligaments.

#### *Bones and joints of hindlimb*

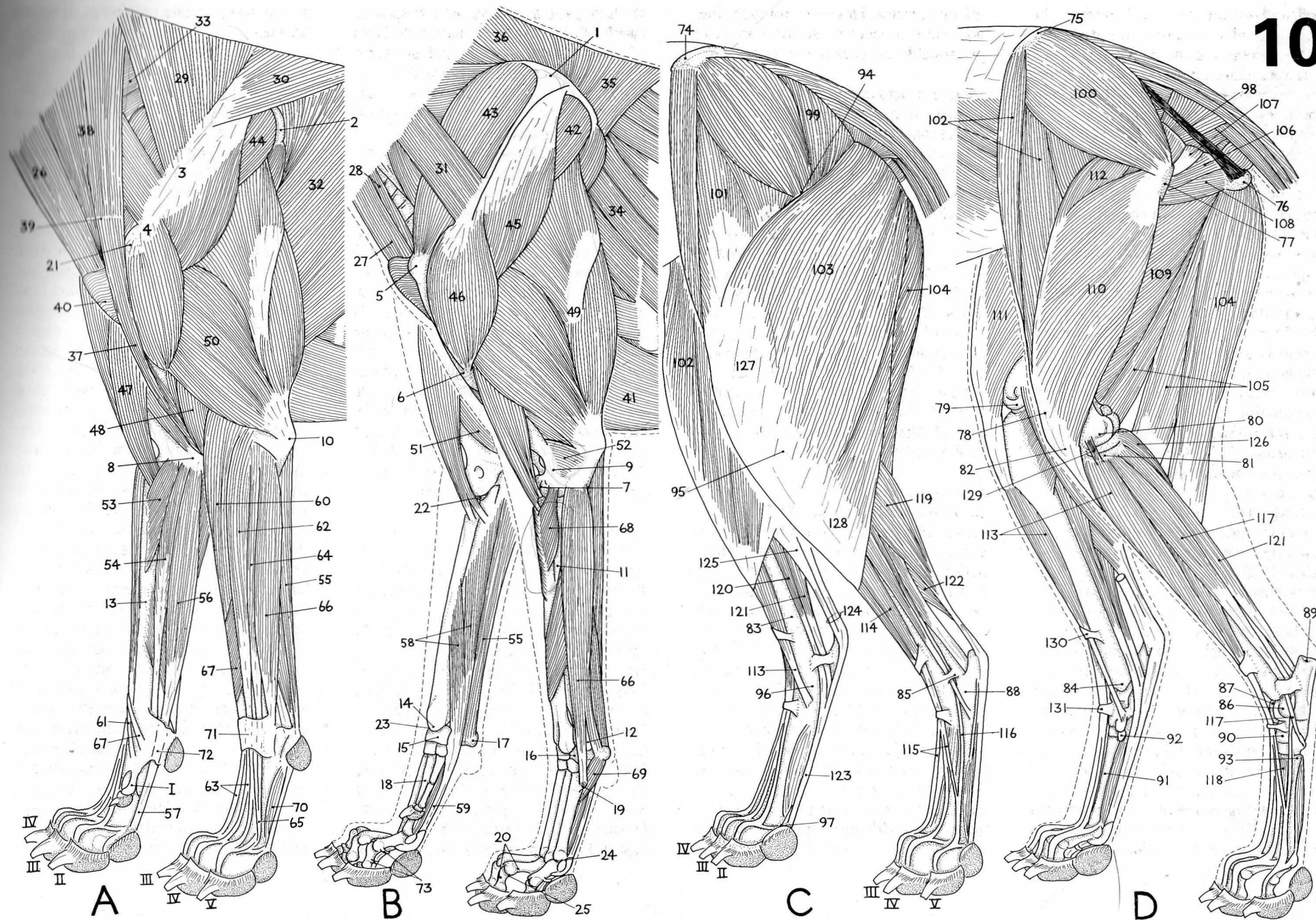
**74** Crest of ilium. **75** Sacral tuberosity of ilium. **76** Ischiatic tuberosity (point of buttock). **77** Greater trochanter of femur. **78** Position of patella (in tendon of quadriceps femoris muscle). **79** Medial condyle of femur. **80** Lateral condyle of femur. **81** Lateral condyle of tibia. **82** Tibial crest (cranial border of tibia). **83** Body (shaft) of tibia. **84** Medial malleolus of tibia. **85** Lateral malleolus of fibula. **86** Talus. **87** Trochlea of talus. **88** Calcaneus. **89** Calcaneal tuberosity (point of hock). **90** Central tarsal bone. **91** Metatarsal bone 2. **92** Metatarsal bone 1. **93** Base of metatarsal bone 5. **94** Position of hip joint. **95** Stifle joint. **96** Crurotarsal joint. **97** Metatarsophalangeal joint, digit 2. **98** Sacrotuberous ligament (joining

sacrum and 1st caudal vertebra with ischiatic tuberosity).

#### *Muscles of hindlimb*

**99** Superficial gluteal muscle. **100** Middle gluteal muscle. **101** Tensor muscle of lateral femoral fascia. **102** Sartorius muscle (cranial and caudal parts). **103-105** 'Hamstring' muscles (extensor muscles of hip joint and main retractors of hindlimb). **103** Biceps femoris muscle. **104** Semitendinosus muscle. **105** Semimembranosus muscle. **106** Gemelli muscles. **107** Tendon of internal obturator muscle. **108** Quadratus femoris muscle. **109** Adductor muscles. **110-112** Quadriceps femoris muscle (major stifle extensor muscle inserting through patella and patellar tendon onto tibial tuberosity). **110** Lateral vastus muscle. **111** Medial vastus muscle. **112** Rectus femoris muscle. **113** Cranial tibial muscle and tendon. **114** Long digital extensor muscle. **115** Long digital extensor tendon. **116** Lateral digital extensor muscle and tendon. **117** Long peroneal muscle and tendon. **118** Short digital extensor muscle. **119** Lateral head of gastrocnemius muscle. **120** Deep digital flexor muscle of hindlimb (medial component). **121** Deep digital flexor muscle of hindlimb (lateral component). **122** Superficial digital flexor muscle of hindlimb. **123** Superficial digital flexor tendon. **124** Common calcaneal tendon (aggregate of structures attaching to point of hock including Achilles' tendon, superficial digital flexor tendon, accessory or tarsal tendon of 'hamstring' and gracilis muscles). **125** Accessory (tarsal) tendon (from tendinous components of biceps femoris, semitendinosus and gracilis muscles). **126** Popliteal muscle. **127** Lateral femoral fascia. **128** Crural fascia. **129** Lateral collateral stifle ligament. **130** Proximal extensor retinaculum. **131** Distal extensor retinaculum. **I-V** Digits (Digit 1 of forepaw = dewclaw).





ments might have is difficult to determine. The first digit (dewclaw) has its own adductor, flexor and abductor muscles (G): the fifth digit has its own abductor and flexor muscles (G). Of these five small muscles only the **abductor of the fifth digit** seems to have real importance in posture and movement since it is attached onto the underside of the accessory carpal bone. Onto the upper surface of the accessory carpal bone the ulnar carpal flexor muscle attaches. When the muscles acting at the carpus were considered this ulnar carpal flexor was pointed out as being one of the major supports for the carpal joint; ie. preventing its over-extension and consequent collapse. Were the accessory carpal bone not firmly attached in position it could easily be displaced. A firm anchorage is assured by several ligaments running from it to the other carpal bones and to the fourth and fifth metacarpals (see fig 7), but is also aided by active contraction in the abductor of the fifth digit pulling on it in the opposite direction to the ulnar carpal flexor muscle. However, this in itself might present a problem should the accessory carpal bone be damaged (fractured possibly). Muscles pulling on the bone from above and below will mean that unless weight can be removed from the paw for some considerable time it will be difficult for a fractured accessory carpal bone to heal.

#### *Bones and joints of forepaw*

1 Antebrachium (based on radius and ulna). 2 Carpus (topographical region based on seven carpal bones). 3 Radial carpal bone. 4 Ulnar carpal bone. 5 Accessory carpal bone. 6 Carpal bone 1. 7 Carpal bone 2. 8

Carpal bone 3. 9 Carpal bone 4. 10 Metacarpus (topographical region based on metacarpal bones). 11 Metacarpal bone 1. 12 Metacarpal bone 5. 13 Carpal (stopper) pad. 14 Metacarpal pad of forepaw (metatarsal pad of hindpaw). 15 Digital pad. 16 'Dewclaw' (1st digit of forepaw - remaining digits labelled II-V). 17 Claw (unguis). 18 Styloid process of radius. 19 Radial groove for passage of oblique carpal extensor tendon. 20 Radial groove for passage of radial carpal extensor tendon. 21 Radial groove for passage of common digital extensor tendon. 22 Styloid process of ulna. 23 Intermetacarpal spaces. 24 Proximal (1st) phalanx of digit 4. 25 Middle (2nd) phalanx of digit 4. 26 Distal (3rd or terminal) phalanx of digit 4. 27 Ungual crest of distal phalanx of digit 3. 28 Ungual process of distal phalanx of digit 3. 29-30 Sesamoid bones of metacarpophalangeal/metatarsophalangeal joints. 29 Palmar/plantar sesamoid bones of digit 3 (in tendons of insertion of interosseous muscles). 30 Dorsal sesamoid bone of digit 3. 31-33 Composite carpal joint. 31 Antebrachiocarpal joint (joint at which major carpal movement occurs). 32 Inter-carpal joints. 33 Carpometacarpal joints. 34 Metacarpophalangeal joint of digit 4 of forelimb and metatarsophalangeal joint of digit 4 of hindlimb. 35 Proximal interphalangeal joint of digit 3. 36 Distal interphalangeal joint of digit 3. 37 Dorsal elastic ligaments. 38 Extensor retinaculum. 39 Digital annular ligaments (proximal, middle and distal). 40 Palmar carpal fibrocartilage (covering rear of carpus and serving as origin for most of special muscles of digits 1, 2 and 5). 41 Collateral ligaments of proximal and distal interphalangeal joints and metacarpophalangeal joint.

#### *Muscles and tendon sheaths of forepaw*

42-51 Carpal and digital extensor muscles. 42 Radial carpal extensor muscle. 43 Radial

carpal extensor tendon surrounded by a synovial sheath at carpus. 44 Oblique carpal extensor muscle. 45 Oblique carpal extensor tendon surrounded by a synovial sheath at carpus. 46 Common digital extensor muscle. 47 Common digital extensor tendon surrounded by a synovial sheath at carpus. 48 Lateral digital extensor muscle. 49 Lateral digital extensor tendon surrounded by a synovial sheath at carpus. 50 Ulnar carpal extensor (lateral ulnar) muscle. 51 Ulnar carpal extensor tendon. 52 Extensions from interosseous muscles onto common extensor tendon branches. 53-60 Carpal and digital flexor muscles. 53 Superficial digital flexor muscle. 54 Superficial digital flexor tendons. 55 Deep digital flexor muscle. 56 Deep digital flexor tendon surrounded by a synovial sheath in carpal canal. 57 Digital synovial sheath around superficial and deep digital flexor tendons. 58 Ulnar carpal flexor muscle. 59 Ulnar carpal flexor tendon. 60 Radial carpal flexor tendon.

#### *Intrinsic muscles of forepaw*

61 Short flexor muscle of dewclaw. 62 Short abductor muscle of dewclaw. 63 Adductor muscle of dewclaw. 64 Adductor muscle of digit 2. 65 Adductor muscle of digit 5. 66 Flexor muscle of digit 5. 67 Abductor muscle of digit 5. 68 Interosseous muscles. 69 Tendons of interosseous muscles.

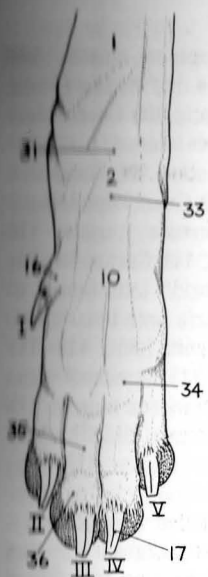
#### *Bones and joints of hindpaw*

70 Shank (crus or leg - based on tibia and fibula). 71 Tarsus (hock a topographical region based on seven tarsal bones). 72 Talus (astragalus or tibial tarsal bone). 73 Trochlea of talus. 74 Calcaneus (fibular tarsal bone). 75 Calcaneal tuberosity (point of hock). 76 Sustentaculum tali. 77 Central tarsal bone. 78 Tarsal bone 1. 79 Tarsal bone 2. 80 Tarsal bone 3. 81 Tarsal bone 4. 82 Groove on tarsal

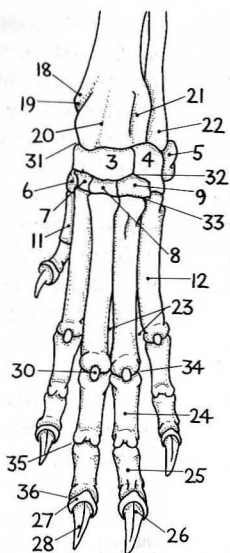
bone 4 for passage of long fibular tendon. 83 Metatarsus (topographical region based on metatarsal bones). 84 Remains of metatarsal bone 1. 85 Metatarsal bone 2. 86 Metatarsal bone 5. 87 Medial malleolus of tibia. 88 Lateral malleolus of fibula. 89 Lateral malleolar groove for passage of lateral digital extensor tendon. 90 Extensor tubercle on ungual crest of distal phalanx of digit 4. 91-93 Composite tarsal joint. 91 Crurotarsal joint (joint at which main movement at hock occurs). 92 Intertarsal joints. 93 Tarsometatarsal joints. 94 Articular capsule of tarsal joint. 95 Proximal extensor retinaculum. 96 Distal extensor retinaculum. 97 Flexor retinaculum.

#### *Muscles and tendon sheaths of hindpaw*

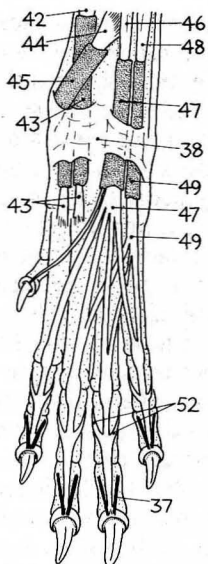
98-104 Tarsal flexors and digital extensors. 98 Cranial tibial muscle. 99 Cranial tibial tendon surrounded by a synovial sheath at tarsus. 100 Long digital extensor muscle. 101 Long digital extensor tendon surrounded by a synovial sheath at tarsus. 102 Lateral digital extensor tendon surrounded by a synovial sheath at tarsus. 103 Long peroneal tendon surrounded by a synovial sheath at tarsus. 104 Short digital extensor muscle. 105-108 Tarsal extensors and digital flexors. 105 Lateral component of deep digital flexor tendon surrounded by a synovial sheath at tarsus. 106 Medial component of deep digital flexor tendon surrounded by a synovial sheath in tarsal canal. 107 Superficial digital flexor tendons. 108 Common calcaneal tendon (aggregate of structures attaching to point of hock including Achilles' tendon, superficial digital flexor tendon, accessory or tarsal tendon of 'hamstring' and gracilis muscles). 109 Calcaneal bursa (between superficial flexor tendon and calcaneal tuberosity). (C, F, J, & M after Bourdelle & Bressou, 1953; N after Evans & Christensen, 1979)



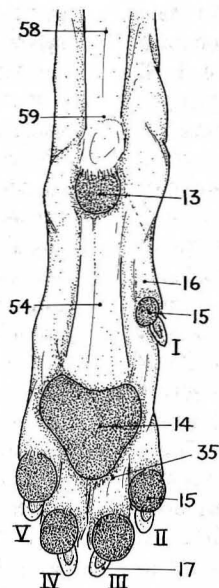
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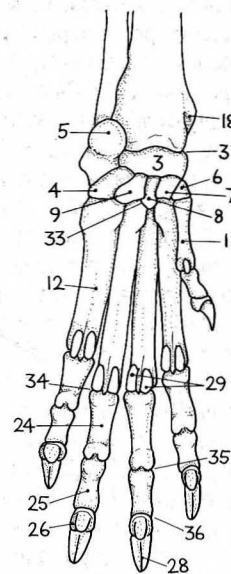
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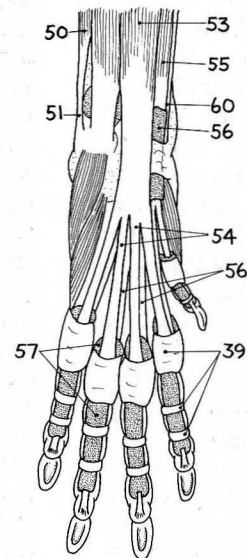
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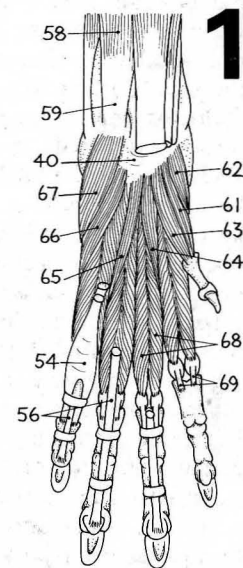
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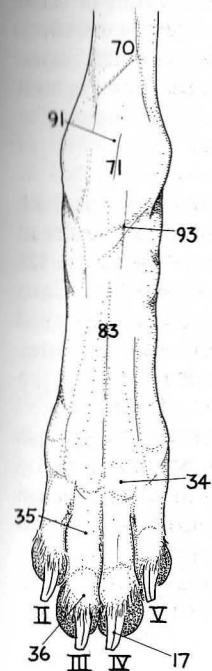
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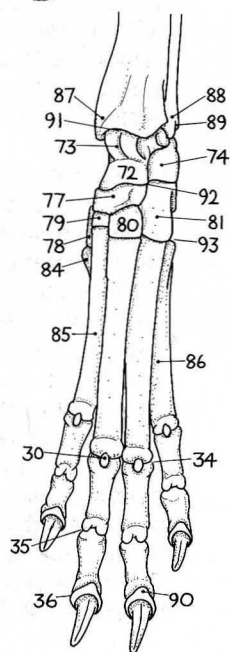
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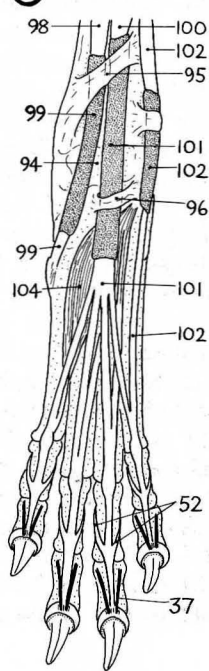
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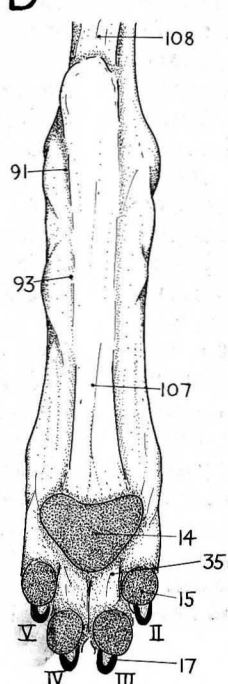
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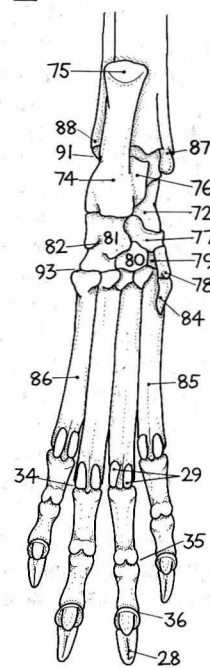
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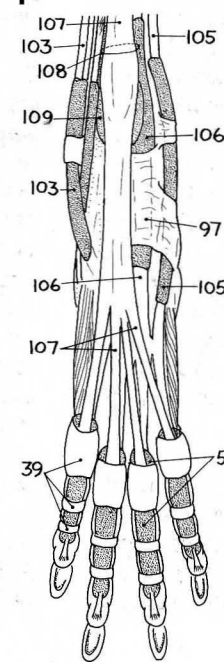
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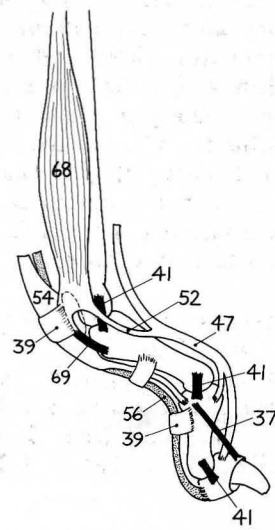
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# 12

## DEEP MUSCLES OF THE DOG - 1

These two drawings follow on from fig 9 and show further stages in the dissection and display of the axial musculature in the neck, trunk and tail – and the branchiomic musculature in the head and throat. In **A** a number of extrinsic forelimb muscles have been removed exposing musculature of the neck and thorax while in **B** the left shoulder and arm have been removed and are placed as an inset sketch at bottom left. This removal would have been effected by cutting through the remaining extrinsic muscles attaching the forelimb to the trunk – superficial and deep pectorals, rhomboid and ventral serrate (their cut surfaces are shown by heavily stippled areas in **B**). As a result of this procedure muscles in the chest wall and at the base of the neck are now exposed, in particular the scalenes passing onto the first few ribs, and the large fan-shaped ventral serrate muscle, both of which lie in neck and thorax in the medial wall of the axilla. Removal of various muscles in the rump and thigh has exposed practically the entire extent of the abdominal wall muscles and the sacrotuberous ligament and muscles in the pelvic wall.

### Bones, joints and ligaments

**1** Zygomatic (supraorbital) process of frontal bone. **2** Zygomatic arch. **3** Orbit (housing and protecting eyeball). **4** Infraorbital foramen

(passage of infraorbital branches of maxillary nerve and vessels). **5** Body of mandible. **6** Temporomandibular (jaw) joint. **7** External acoustic meatus (across which eardrum is stretched in life). **8** Lateral sacral crest. **9** Rib **1** (marking lateral boundary of thoracic inlet). **10** Rib **5**. **11** Rib **13** (last or floating rib). **12** Dorsal (vertebral) border of scapula. **13** Caudal angle of scapula. **14** Cranial border of scapula. **15** Spine of scapula. **16** Acromion process of scapula. **17** Supraspinous fossa of scapula. **18** Scapular notch. **19** Supraglenoid tubercle of scapula. **20** Greater tubercle of humerus (point of shoulder). **21** Deltoid tuberosity of humerus. **22** Humeral condyle. **23** Olecranon process of ulna (point of elbow). **24** Shoulder joint. **25** Elbow joint. **26** Crest of ilium. **27** Coxal tuberosity of ilium (point of haunch). **28** Sacral tuberosity of ilium (point of croup). **29** Ischiatic tuberosity (point of buttock). **30** Lesser ischiatic notch. **31** Greater trochanter of femur. **32** Body (shaft) of femur. **33** Lateral condyle of femur. **34** Fabella (stifle sesamoid in tendon of origin of lateral gastrocnemius muscle). **35** Position of patella (in tendon of quadriceps femoris muscle). **36** Hip joint. **37** Stifle joint (femorotibial component). **38** Tibial tuberosity (insertion of patellar tendon). **39** Body (shaft) of tibia. **40** Medial malleolus of tibia. **41** Lateral malleolus of fibula. **42** Tarsus (ankle or hock). **43** Calcaneal bone (with calcaneal tuberosity forming point of hock).

### Muscles of head

**44** Orbicularis oculi muscle. **45** Levator muscle of upper lip. **46** Buccal part of buccinator muscle. **47** Molar part of buccinator muscle. **48** Superficial part of masseter muscle. **49** Deep part of masseter muscle. **50** Temporal muscle. **51** Digastric muscle. **52** Stylohyoid muscle. **53** Mylohyoid muscle. **54** Thyrohyoid muscle. **55** Cricothyroid muscle. **56** Crico-

pharyngeal muscle. **57** Thyropharyngeal muscle. **58** Styloglossal muscle of tongue. **59** Sternohyoid muscle. **60** Sternothyroid muscle.

### Muscles of neck, trunk and tail

**61** Thoracic part of iliocostal muscle. **62** Longissimus muscle (covered by thoracolumbar fascia). **63** Cervical intertransverse muscles. **64** Longus capitis muscle. **65** Splenius muscle. **66** Lateral tail flexors (caudal intertransverse muscles). **67** Tail depressors (ventral sacrocaudal muscles). **68** Tail levators (dorsal sacrocaudal muscles). **69** Scalene muscle. **70** Sternoccephalic muscle with sternomastoid and sternocapital parts. **71** Cranial dorsal serrate muscle. **72** Caudal dorsal serrate muscle. **73** Cervical part of ventral serrate muscle. **74** Thoracic part of ventral serrate muscle. **75** External intercostal muscles. **76** Rectus thoracis muscle. **77** Rectus abdominis muscle. **78** Aponeurosis of origin of rectus abdominis muscle. **79** External abdominal oblique muscle. **80** Aponeurotic tendon of external abdominal oblique muscle (forming outer layer of rectus sheath). **81** Coccygeus muscle. **82** Levator ani muscle (in combination with coccygeus muscle forming pelvic diaphragm). **83** External anal sphincter muscle.

### Muscles of forelimb

**84** Capital part of rhomboid muscle. **85** Cervical part of rhomboid muscle. **86** Thoracic part of rhomboid muscle. **87** Omotransverse muscle. **88** Superficial pectoral muscle. **89** Deep pectoral muscle. **90** Scapular part of deltoid muscle. **91** Acromial part of deltoid muscle. **92** Supraspinatus muscle. **93** Infraspinatus muscle. **94** Teres minor muscle. **95** Teres major muscle. **96** Biceps brachii muscle. **97** Brachial muscle. **98** Long head of triceps muscle. **99** Lateral head of triceps muscle. **100** Anconeal muscle.

### Muscles of hindlimb

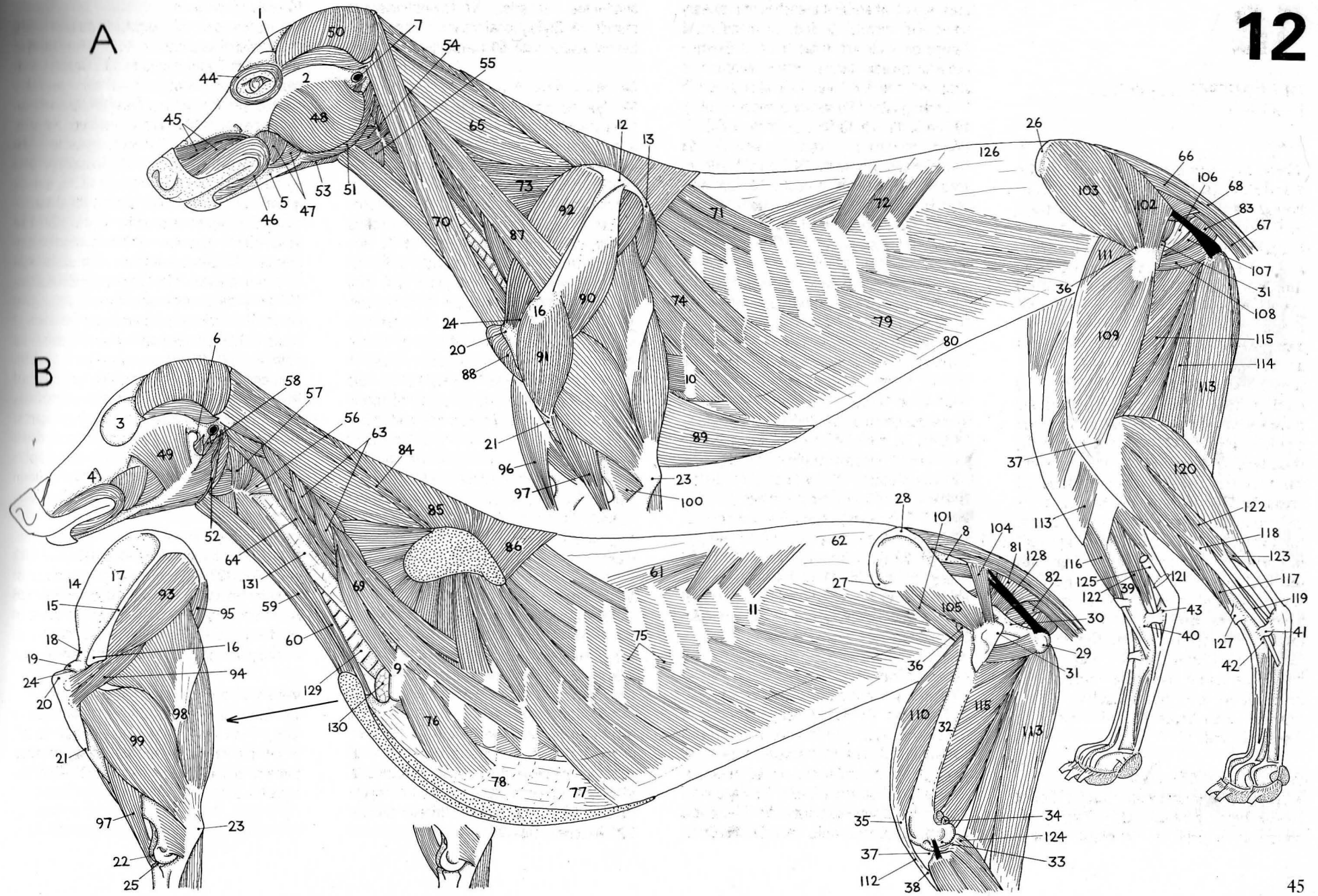
**101** Iliacus part of iliopsoas muscle. **102** Superficial gluteal muscle. **103** Middle gluteal muscle. **104** Piriform muscle. **105** Deep gluteal muscle. **106** Tendon of internal obturator muscle. **107** Gemelli muscles. **108** Quadratus femoris muscle. **109–112** Quadriceps femoris muscle. **109** Vastus lateralis muscle. **110** Vastus medialis muscle. **111** Rectus femoris muscle. **112** Patellar tendon (attachment of quadriceps femoris muscle onto tibial tuberosity, crossing front of stifle joint). **113–114** 'Hamstring' muscles. **113** Semitendinosus muscle. **114** Semimembranosus muscle. **115** Adductor muscle. **116** Cranial tibial muscle. **117** Long digital extensor muscle. **118** Long peroneal muscle. **119** Lateral digital extensor tendon. **120** Lateral head of gastrocnemius muscle. **121** Common calcaneal tendon (aggregate of tendons attaching to point of hock, including Achilles' tendon, superficial digital flexor tendon, and accessory or tarsal tendon of hamstring and gracilis muscles). **122** Deep digital flexor muscle. **123** Superficial digital flexor muscle. **124** Popliteal muscle. **125** Accessory or tarsal tendon.

### Fascia and ligaments

**126** Thoracolumbar fascia (deep fascia of back and loin). **127** Extensor retinacula (loops of deep fascia holding tendons in position). **128** Sacrotuberous ligament (uniting sacrum and caudal vertebra **1** with ischiatic tuberosity and forming lateral boundary of ischiorectal fossa).

### Internal viscera

**129** Trachea (windpipe). **130** Cranial (apical) lobe of left lung (occupying pleural pocket of left pleural cavity and projecting through thoracic inlet into base of neck). **131** Oesophagus (gullet).





The cubital fossa has its equivalent depression in the hindlimb – the **popliteal fossa** – a depression caudal to the stifle joint; ie. on its flexor surface (see fig 16). The divergent hamstrings, semitendinosus medially and biceps femoris laterally, and the gastrocnemius muscle below form the boundaries of the fossa. The fossa is deep and its floor is formed from the popliteal surface of the femur, the stifle joint capsule, and the deep fascial covering on the popliteus muscle. Embedded in fat within the fossa is the prominent *popliteal lymph node*, a structure which is normally palpable. The lateral saphenous vein enters the fossa from the lower leg, and the popliteal artery and vein and the tibial and common fibular nerve traverse the fossa more deeply.

#### *Surface features and topographical regions*

**1** Nasal plane (pigmented hairless skin). **2** External nostril (leading into nasal vestibule, movable part of nose surrounded by nasal cartilages). **3** Philtrum. **4** Muzzle. **5** Lips. **6** Commissure of lips at angle of mouth. **7** Chin (mentum). **8** Tongue. **9** Cheek (based on buccinator muscle). **10** Foreface. **11** Stop. **12** Forehead. **13** Pinna of external ear (based on auricular cartilage). **14** Throat. **15** Jugular groove (containing external jugular vein). **16** Jugular fossa (triangular depression at base of neck communicating internally with axilla). **17** Dorsal neck region. **18** Lateral neck region. **19** Tracheal region. **20** Median pectoral groove. **21** Presternal region (breast based on superficial pectoral muscles). **22** Sternal region (brisket based on deep pectoral muscles). **23** Axillary region (includes axilla or axillary fossa – the armpit). **24** Scapular region (shoulder). **25** Shoulder joint region. **26** Brachial region (brachium, arm or upper

arm). **27** Cubital region (including cubital fossa). **28** Antebrachial region (forearm). **29** Carpal region (carpus or wrist based on carpal bones and joints). **30** Metacarpal region (front pastern). **31** Phalangeal region (digits or toes). **32** Claws (capping ungual processes of distal phalanges). **33** Digital pad (beneath distal interphalangeal joint). **34** 'Dewclaw' (1st digit of forepaw – remaining digits are designated by roman numerals II–V). **35** Interdigital space.

#### *Bones of skull*

**36** Bony nasal opening (piriform aperture leading into bony part of nasal cavity bounded by nasal processes of incisive bones). **37** Nasal bone. **38** Infraorbital foramen (passage of infraorbital branches of maxillary artery and nerve). **39–42** Mandible (lower jaw). **39** Body of mandible. **40** Angular process of mandible. **41** Ramus of mandible. **42** Mental foramen (passage of mental branches of mandibular alveolar nerve and vessels). **43** Mandibular symphysis (fibrocartilaginous intermandibular joint allowing little if any movement). **44** Jaw (temporomandibular joint). **45** Zygomatic arch (bridge of bone connecting face and cranium below eye). **46** Orbit (housing and protecting eyeball). **47** Zygomatic (supraorbital) process of frontal bone.

#### *Vertebral column, ribs and sternum*

**48** Cervical vertebra 7. **49** Transverse process of cervical vertebra 6. **50** Rib 1 (short and fairly straight). **51** Costal cartilage of rib 1 (articulating with manubrium of sternum). **52** Manubrium of sternum (sternebra 1 elongated into base of neck). **53** 2nd sternebra (sternum formed from 8 sternebrae joined by intersternbral cartilages which tend to ossify in aged dogs). **54** Thoracic inlet (more or less oval opening bounded by sternal manubrium, first pair of ribs and thoracic vertebra 1).

#### *Forelimb skeleton and joints*

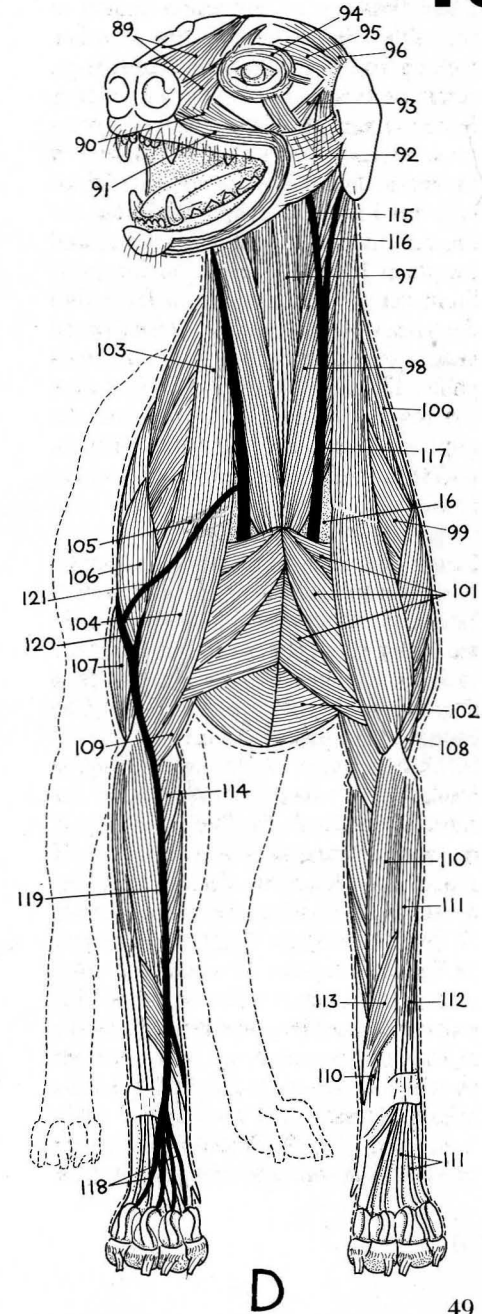
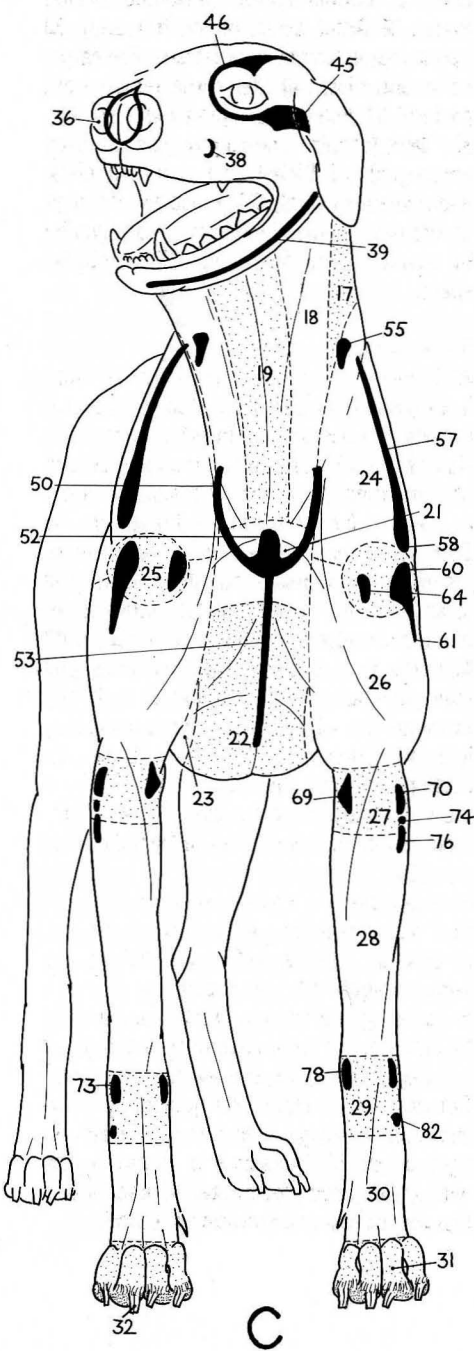
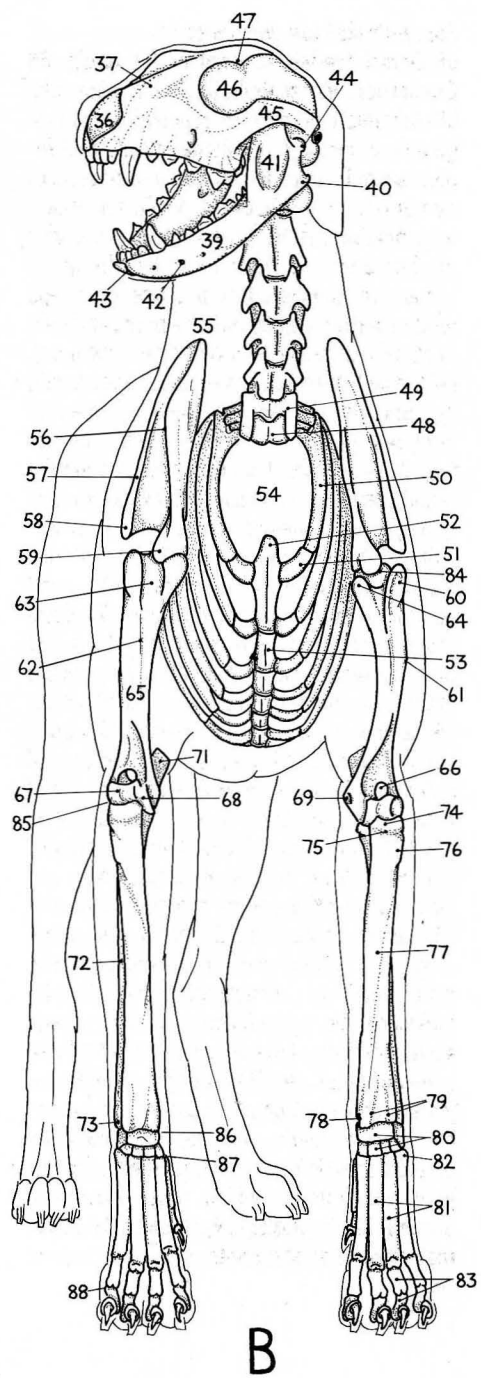
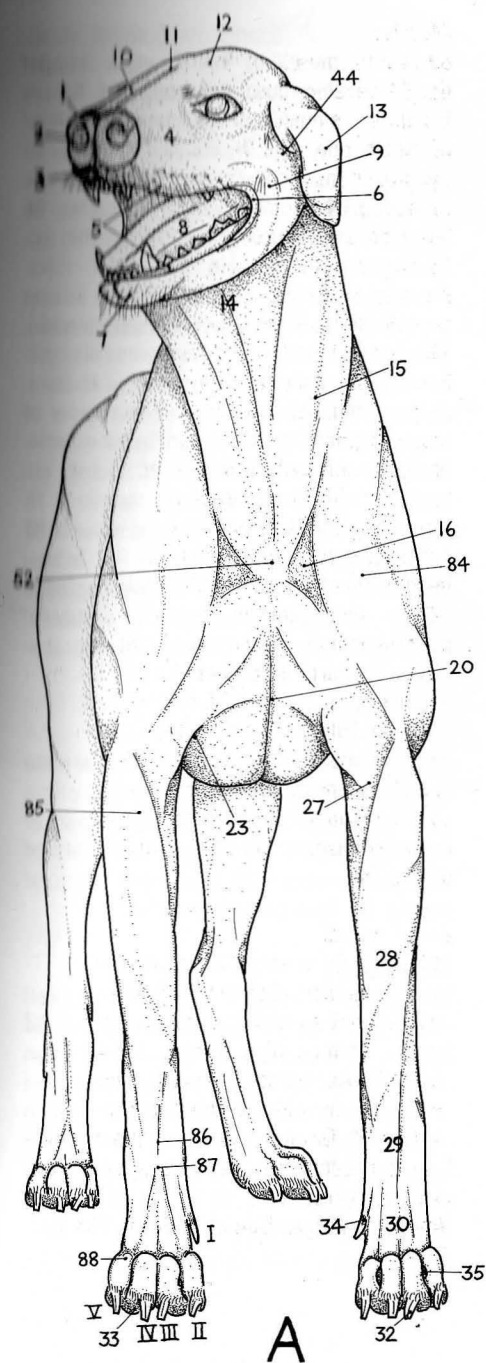
**55** Dorsal (vertebral) border of scapula. **56** Cranial border of scapula. **57** Spine of scapula. **58** Acromion process of scapula. **59** Supraglenoid tuberosity of scapula (attachment for biceps brachii muscle). **60** Greater tubercle of humerus (point of shoulder). **61** Deltoid tuberosity of humerus. **62** Crest of greater tubercle of humerus. **63** Intertubercular (bicipital) groove of humerus (for passage of biceps tendon surrounded by bicipital bursa and held in place by a transverse humeral retinaculum). **64** Lesser tubercle of humerus. **65** Body (shaft) of humerus. **66** Supratrochlear foramen of humerus. **67** Capitulum of humeral condyle (small lateral part of condyle articulating with radial head). **68** Trochlea of humeral condyle (pulley-shaped medial part of condyle articulating with trochlear notch of ulna). **69** Medial (flexor) epicondyle of humerus. **70** Lateral (extensor) epicondyle of humerus. **71** Olecranon process of ulna (point of elbow). **72** Body (shaft) of ulna. **73** Lateral styloid process of ulna. **74** Head of radius. **75** Neck of radius. **76** Lateral tuberosity of radius. **77** Body (shaft) of radius. **78** Medial styloid process of radius. **79** Grooves on surface of distal end of radius for passage of extensor tendons (medial groove for oblique carpal extensor: middle groove for radial carpal extensor: lateral groove for common digital extensor). **80** Carpal bones (radial carpal and ulnar carpal in proximal row, carpal bones 1–4 in distal row). **81** Metacarpal bones (5 with metacarpal bone 1 reduced in size). **82** Lateral surface of base of metatarsal bone 5. **83** Phalanges of digits. **84** Shoulder joint. **85** Elbow joint (composite synovial joint – 3 parts contained in a single joint capsule). **86** Antebrachiocarpal joint (main component of carpal joint and joint at which most movement occurs). **87** Carpometacarpal joints. **88** Proximal interphalangeal joints.

#### *Muscles*

**89** Levator muscle of nostril wing and upper lip. **90** Levator muscle of upper lip. **91** Orbicularis oris muscle of lips (sphincter muscle of mouth opening). **92** Platysma muscle. **93** Zygomatic muscle (retractor muscle of angle of mouth). **94** Orbicularis oculi muscle of eyelids (sphincter muscle of palpebral fissure). **95** Frontal muscle. **96** Rostral auricular muscles. **97** Sternohyoid muscle. **98** Sternoccephalic muscle. **99** Omotransverse muscle. **100** Cervical part of trapezius muscle. **101** Superficial pectoral muscles. **102** Deep pectoral muscle. **103** Cleidocervical part of brachiocephalic muscle. **104** Cleidobrachial part of brachiocephalic muscle. **105** Clavicular tendon within brachiocephalic muscle (representing fibrous remnants of clavicle). **106** Acromial part of deltoid muscle. **107** Lateral head of triceps muscle. **108** Brachial muscle (elbow joint extensor occupying brachial [musculospiral] groove of humerus). **109** Biceps brachii muscle (shoulder joint extensor and elbow joint flexor inserting onto both radius and ulna in forearm). **110** Radial carpal extensor muscle and tendon. **111** Common digital extensor muscle and tendon. **112** Lateral digital extensor muscle. **113** Oblique carpal extensor muscle. **114** Pronator muscle of forearm.

#### *Blood vessels*

**115** Linguofacial vein. **116** Maxillary vein. **117** External jugular vein (entering jugular fossa at base of neck *en route* for thoracic inlet). **118** Dorsal common digital veins. **119** Cephalic vein. **120** Axillobrachial vein (connection of cephalic vein with brachial/axillary vein in axilla). **121** Omobrachial vein (minor superficial connection between cephalic vein and external jugular vein).  
(After Ellenberger, Dittrich & Baum, 1956)



# 14

## DEEP MUSCLES OF THE DOG AND BITCH – 2

In this second pair of deep muscle drawings exposure of the musculature of the head, neck, trunk and tail is continued from fig 12B. In the head the remaining facial musculature has been removed exposing the branchiomeric (modified visceral) muscle of the jaws, tongue and pharynx. Removal of the ventral and dorsal serrate muscles and thoracolumbar fascia, all in position in A, exposes the three main components of the epaxial musculature – iliocostal and longissimus components in the back and loins, and the spinal and semispinal parts of the transversospinal component in the back and neck. Additional removal of the splenius from the neck exposes the cervical longissimus and the biventer and complexus parts of the capital semispinal muscle.

The external abdominal oblique muscle has been removed from the caudal end of the chest and flank exposing the rectus abdominis muscle as it runs forwards on the underside of the belly onto the chest, and the internal abdominal oblique lying in the flank and belly. Removal of rump and thigh musculature has also exposed the iliopsoas muscle emerging from the abdomen behind the caudalmost extent of the internal abdominal oblique muscle.

In B the internal abdominal oblique muscle has been removed exposing the

transverse abdominal in the flank and practically the entire length of the rectus abdominis in the belly. In the chest removal of the scalene, rectus abdominis and external intercostal muscles exposes the ribs, costal cartilages and internal intercostal muscles. Consequently in the trunk overall, only the innermost layers of the body wall muscles (internal intercostals in the thorax between the ribs, transverse abdominal in the abdomen) are left in place on the surface of the serous membranes lining the body cavities.

In the pelvic wall complete removal of the rump and thigh muscles and the femur exposes the hip bone and sacrotuberous ligament. Medial to this ligament the 'pelvic diaphragm' is displayed composed of the coccygeus and levator ani muscles. This diaphragm originating from the hip bone and inserting onto caudal vertebrae and blending caudally with the external anal sphincter, separates off an ischiorectal fossa laterally between it and the sacrotuberous ligament.

### *Bones, joints and ligaments*

1 Body of mandible. 2 Angular process of mandible. 3 Coronoid process of mandible (removed in B). 4 Temporomandibular (jaw) joint. 5 External occipital protuberance (occiput – most dorsocaudal portion of cranium). 6 Nuchal crest (division between dorsal and caudal surface of cranium). 7 Zygomatic arch (sawn through and removed). 8 Temporal fossa (origin of temporal muscle). 9 External acoustic meatus (across which eardrum stretched in life). 10 Basihyoid bone. 11 Thyroid cartilage of larynx. 12 Lateral sacral crest (fused 2nd and 3rd sacral transverse processes). 13 Rib 1. 14 Rib 13 (last or floating

rib). 15 Costochondral junction between bony ribs and costal cartilages. 16 Costal arch (fused costal cartilages of ribs 10–12 [asternal ribs], linked by fibrous tissue with costal cartilage of rib 9, last sternal rib). 17 Manubrium of sternum (sternebra 1 enlarged into base of neck). 18 Wing of ilium. 19 Crest of ilium. 20 Coxal tuberosity of ilium (point of haunch). 21 Sacral tuberosity of ilium (point of croup). 22 Greater ischiatic notch of hip bone. 23 Lesser ischiatic notch of hip bone. 24 Ischiatic tuberosity (point of buttock). 25 Ischiatic spine. 26 Pubic pecten of hip bone. 27 Obturator foramen. 28 Acetabulum of hip joint. 29 Hip (coxo-femoral) joint. 30 Greater trochanter of femur. 31 Sacrotuberous ligament (joining lateral sacral crest and 1st caudal transverse process with ischiatic tuberosity).

### *Muscles of head*

32 Temporal muscle. 33 Medial pterygoid muscle. 34 Geniohyoid muscle. 35 Mylohyoid muscle. 36 Thyrohyoid muscle. 37 Jugulo-hyoid muscle. 38 Cricothyroid muscle. 39 Cricopharyngeal muscle. 40 Thyropharyngeal muscle. 41 Hyopharyngeal muscle. 42 Ceratopharyngeal muscle. 43 Styloglossal muscle. 44 Hyoglossal muscle.

### *Muscles of neck, trunk and tail*

45 Sternothyroid muscle. 46 Lumbar part of iliocostal muscle. 47 Thoracic part of iliocostal muscle. 48 Lumbar part of longissimus muscle. 49 Thoracic part of longissimus muscle. 50 Cervical part of longissimus muscle. 51 Capital part of longissimus muscle. 52 Thoracic part of spinal muscle. 53 Cervical part of spinal muscle. 54 Thoracic part of semispinal muscle. 55 Capital part of semispinal muscle (biventer). 56 Capital part of semispinal muscle (complexus). 57 Cervical intertransverse muscles. 58 Longus capitis muscle. 59 Longus colli muscle. 60 Splenius muscle. 61 Scalene

muscle. 62 Tail depressors (ventral sacro-caudal muscles). 63 Tail levators (dorsal sacrocaudal muscles). 64 Lateral tail flexors (caudal intertransverse muscles). 65 Ventral serrate muscle (remains of). 66 Cranial dorsal serrate muscle. 67 Caudal dorsal serrate muscle. 68 External intercostal muscles. 69 Internal intercostal muscles. 70 Internal abdominal oblique muscle. 71 Tendon (aponeurosis) of internal abdominal oblique muscle (contributing to external layer of rectus sheath). 72 Inguinal ligament. 73 Transverse abdominal muscle. 74 Tendon of transverse abdominal muscle (contributing to external layer of rectus sheath). 75 Rectus abdominis muscle. 76 Tendinous intersections in rectus abdominis muscle. 77 Prepubic tendon. 78 Coccygeus muscle. 79 Levator ani muscle. 80 External anal sphincter muscle. 81 Ischio-cavernosus muscle. 82 Bulbospongiosus muscle. 83 Constrictor muscle of vestibule. 84 Constrictor muscle of vulva. 85 Thoracolumbar fascia.

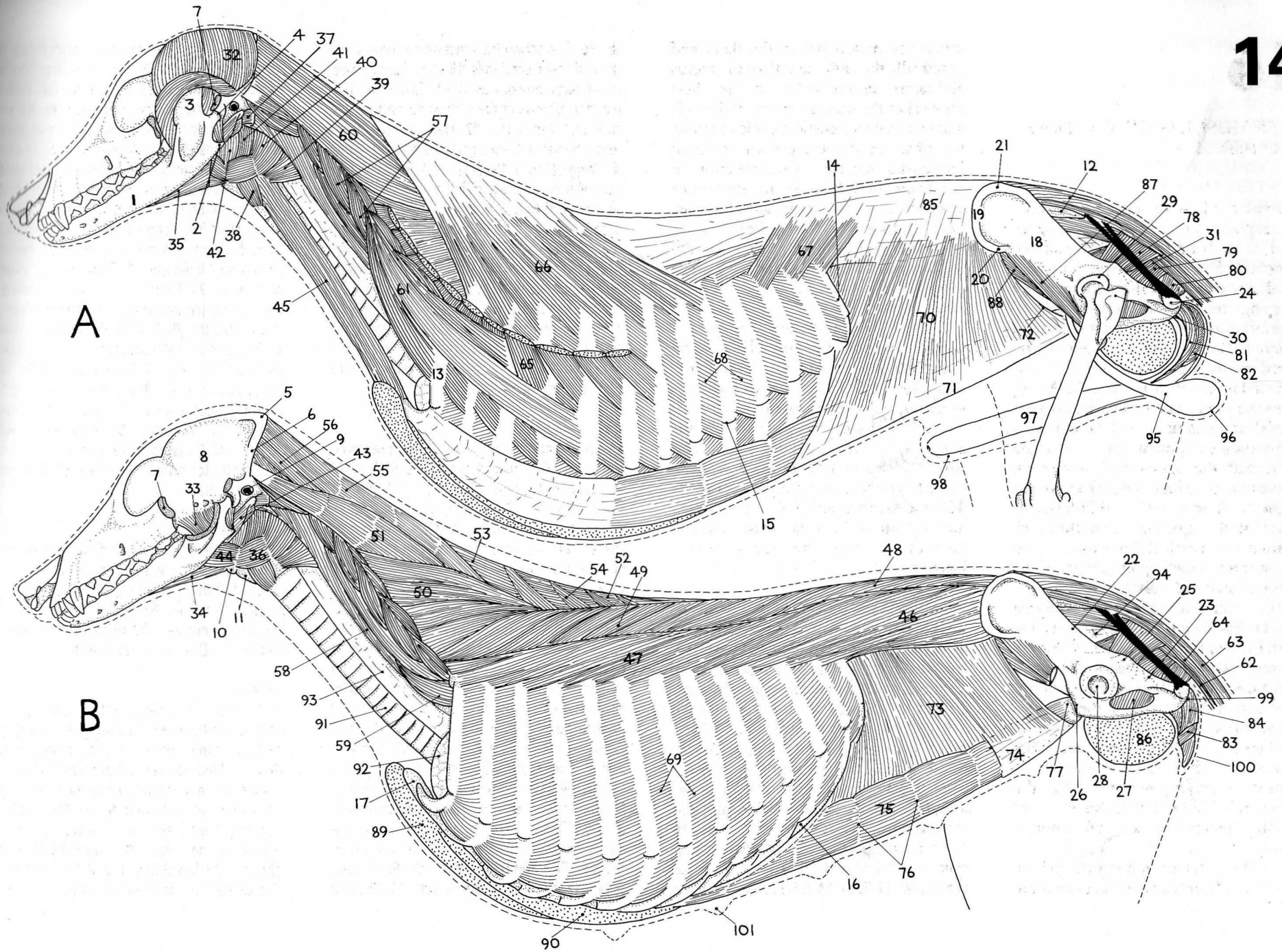
### *Limb muscles*

86 Symphyseal tendon (midline fibrous plate attached to pelvic symphysis providing origin for medial thigh muscles). 87 Iliacus part of iliopsoas muscle. 88 Psoas major part of iliopsoas muscle. 89 Superficial pectoral muscle. 90 Deep pectoral muscle.

### *Viscera*

91 Trachea (windpipe). 92 Cranial (apical) lobe of left lung. 93 Oesophagus (gullet). 94 Rectum (continuation of descending colon within pelvis). 95 Vaginal process (extension of parietal abdominal peritoneum through inguinal canal containing testis). 96 Scrotum (sparsely haired skin sac containing vaginal processes and testes). 97 Penis. 98 Prepuce (sheath). 99 Vestibule. 100 Vulva. 101 Position of teats of mammary glands.





and bodies of tail vertebrae back to six or seven. The levator ani also has a significant attachment to/association with the external anal sphincter muscle around the anal canal effectively sealing off the pelvic cavity caudally beneath the perineum. It seems fairly obvious that these muscles will cooperate with tail depressors to pull the tail down against the anus and external genitalia, and between the hindlegs. However, during defaecation these pelvic diaphragm muscles are important in squeezing the rectum and anal canal to void the faeces. At such a time the tail is raised to avoid becoming soiled, hence these diaphragm muscles, acting at the same time as tail levators, produce the pronounced kink in the tail at about the sixth or seventh vertebra which is often apparent in the defaecating dog.

Also of importance during the straining accompanying voiding is the role played by these same pelvic diaphragm muscles in stopping pelvic organs from being pushed backwards. Straining results from raising pressure within the abdomen which in turn raises pressure inside the pelvis (the two cavities being continuous). Increased intrapelvic pressure compresses the rectum and forces faeces through the anal canal. The coccygeus and levator ani muscles help to prevent the intestine from herniating through the pelvic wall lateral to the anus into the ischiorectal fossa.

#### *Surface features and topographical regions*

1 Upper eyelid (supporting cilia). 2 Foreface (dorsal nasal region). 3 Muzzle (lateral nasal region). 4 Stop. 5 Forehead. 6 Temporal region. 7 Frontal (supraorbital) region. 8 Parietal region. 9 Occipital region (occiput).

10 Auricular region (pinna of external ear). 11 Neck. 12 Crest of neck. 13 Dorsal neck region. 14 Interscapular region (withers). 15 Thoracic vertebral region (back). 16 Lumbar region (loins). 17 Sacral region (croup). 18 Clunial region (includes ischiorectal fossa). 19 Root of tail. 20 Caudal region (tail). 21 Scapular region (shoulder). 22 Costal region (chest or thorax). 23 Lateral abdominal region (flank). 24 Coxal tuberosity region (haunch). 25 Gluteal region (rump). 26 Ischiorectal fossa (depression between root of tail and sacrotuberous ligament lateral to anus). 27 Hip joint region. 28 Ischiatic tuberosity region (buttock).

#### *Bones of skull*

29 Zygomatic (supraorbital) process of frontal bone. 30 External sagittal crest (in dorsal midline of cranium). 31 External occipital protuberance (occiput – most dorsocaudal part of cranium). 32 Nuchal crest (division between dorsal and caudal surface of cranium). 33 Zygomatic arch (bridge of bone connecting face and cranium below eye). 34 Orbit (housing and protecting eyeball). 35 Temporal fossa (origin of temporal muscle). 36 Coronoid process of mandible (insertion of temporal muscle). 37 Mastoid process of temporal bone. 38 Auricular cartilage (basis of pinna of external ear). 39 Scutiform cartilage. 40 Nasal cartilages (surrounding nasal vestibule).

#### *Vertebral column, ribs and sternum*

41–46 Cervical (neck) vertebrae. 41 Dorsal arch of atlas vertebra (C1). 42 Wing of atlas vertebra (enlarged flattened transverse process). 43 Transverse foramen of atlas vertebra (passage of vertebral artery). 44 Spinous process of axis vertebra (C2). 45 Transverse processes of cervical vertebrae. 46 7th (last) cervical vertebra. 47–49 Thoracic

(chest or back) vertebrae. 47 Spinous process of 1st thoracic vertebra. 48 Spinous process of anticlinal vertebra (T10). 49 Spinous process of last thoracic vertebra (T13). 50–51 Lumbar (loin) vertebrae. 50 Transverse process of lumbar vertebrae. 51 Spinous process of lumbar vertebra 7. 52–54 Sacrum (3 fused sacral vertebrae) and caudal vertebrae. 52 Median sacral crest (fused spinous processes of sacral vertebrae). 53 Wing of sacrum (enlarged 1st sacral transverse process). 54 Lateral sacral crest (fused 2nd and 3rd sacral transverse processes). 55 Transverse processes of caudal vertebrae. 56 Cranial articular process of vertebra. 57 Caudal articular process of vertebra. 58 Accessory process of vertebra (on caudal thoracic and lumbar vertebrae). 59 Mammillary process of vertebra (on thoracic and lumbar vertebrae). 60 Intervertebral foramen 1 (lateral vertebral foramen of atlas). 61 Intervertebral foramen 2 (between atlas and axis). 62 Dorsal sacral foramina (passage of dorsal rami of sacral spinal nerves). 63 Lumbosacral junction. 64 Rib 1. Rib 65 13 (floating rib).

#### *Limb skeleton*

66 Dorsal (vertebral) border of scapula. 67 Cranial angle of scapula. 68 Caudal angle of scapula. 69 Spine of scapula. 70 Crest of ilium. 71 Sacral tuberosity of ilium (point of croup). 72 Ischiatic tuberosity (point of buttock). 73 Ischiatic spine. 74 Greater ischiatic notch. 75 Lesser ischiatic notch. 76 Ischiatic arch. 77 Sacroiliac joint. 78 Hip joint. 79 Greater trochanter of femur.

#### *Axial muscles*

80 Levator muscle of nostril wing and upper lip. 81 Frontal muscle. 82 Interscutular muscle. 83 Rostral auricular muscles. 84 Caudal auricular muscles. 85 Temporal muscle. 86 Splenius muscle. 87 Lumbar part

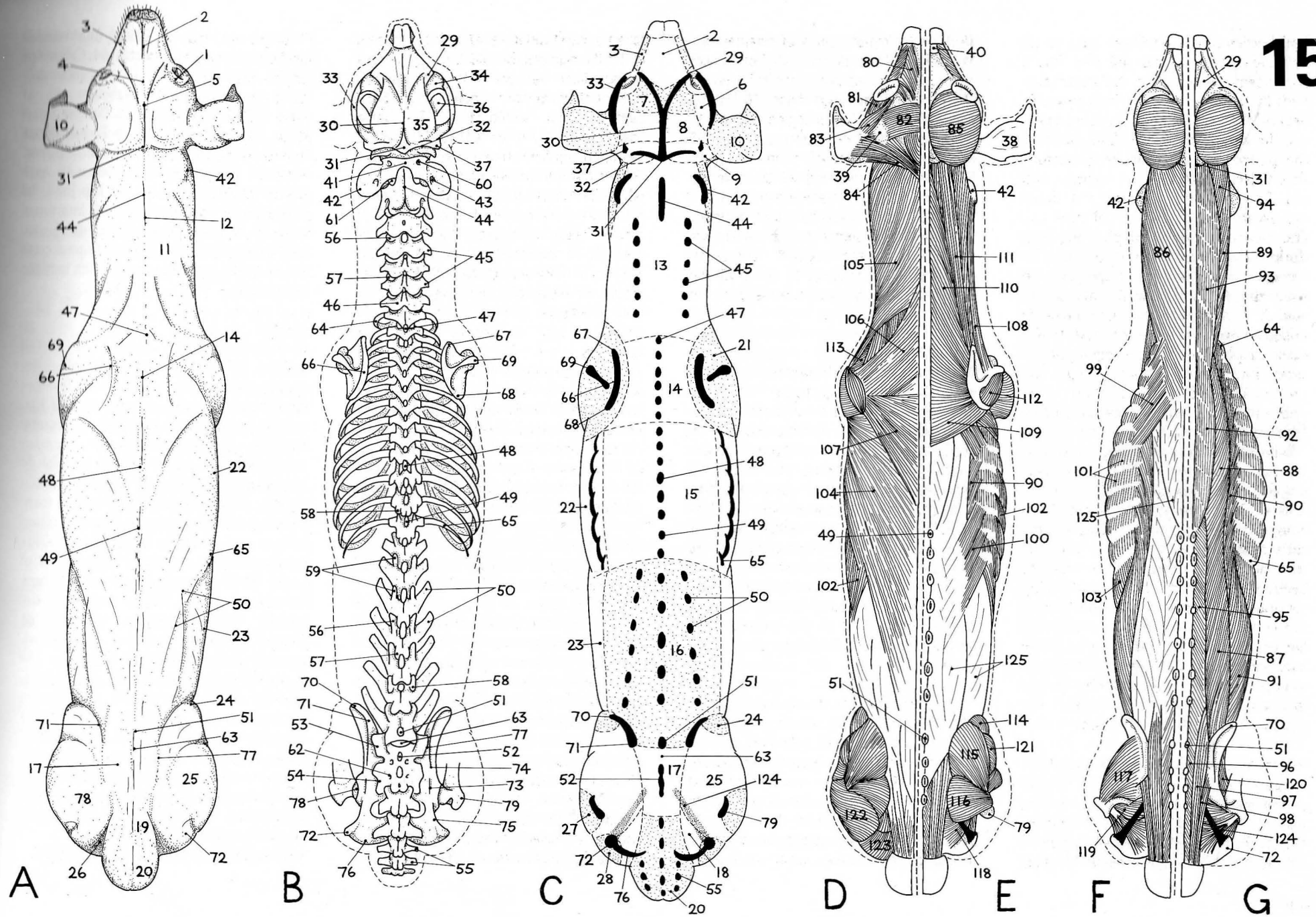
of longissimus muscle. 88 Thoracic part of longissimus muscle. 89 Cervical part of longissimus muscle. 90 Thoracic part of iliocostal muscle. 91 Lumbar part of iliocostal muscle. 92 Spinal and semispinal muscle. 93–94 Capital part of semispinal muscle. 93 Complexus muscle. 94 Biventer muscle. 95 Multifidus components of transversospinal muscle. 96 Long tail levators (dorsal medial sacrocaudal muscles). 97 Short tail levators (dorsal lateral sacrocaudal muscles). 98 Lateral tail flexors (caudal intertransverse muscles). 99 Cranial dorsal serrate muscle. 100 Caudal dorsal serrate muscle. 101 External intercostal muscle. 102 External abdominal oblique muscle. 103 Internal abdominal oblique muscle.

#### *Appendicular muscles*

104 Latissimus dorsi muscle. 105 Cleidocervical part of brachiocephalic muscle. 106 Cervical part of trapezius muscle. 107 Thoracic part of trapezius muscle. 108 Omotransverse muscle. 109 Thoracic part of rhomboid muscle. 110 Cervical part of rhomboid muscle. 111 Capital part of rhomboid muscle. 112 Infraspinatus muscle. 113 Supraspinatus muscle. 114 Sartorius muscle. 115 Middle gluteal muscle. 116 Superficial gluteal muscle. 117 Deep gluteal muscle. 118 Internal obturator muscle. 119 Gemelli muscles. 120 Iliopsoas muscle. 121 Tensor muscle of lateral femoral fascia. 122–123 'Hamstring' muscles. 122 Biceps femoris muscle. 123 Semitendinosus muscle.

#### *Ligaments and fascia*

124 Sacrotuberous ligament (uniting lateral sacral crest and 1st caudal transverse process with ischiatic tuberosity). 125 Thoracolumbar fascia (dense layer of deep fascia covering epaxial muscles of loins). (After Ellenberger, Dittich & Baum, 1956)





# 16

## SURFACE FEATURES, SUPERFICIAL MUSCLES AND SKELETON OF THE DOG FROM BEHIND

The four illustrations here of the body from the rear show the surface (A), the superficial muscles once the skin has been removed (D), the skeleton (B) and a surface view (C) on which the topographical subdivisions of the body surface are indicated as are the major palpable bony features.

The **ischiorectal fossae** are depressions situated on either side between the root of the tail and the rump muscles roofed over by perineal fascia underlying the skin of the perineum. The lateral wall of a fossa consists of rump muscles, sacrotuberous ligament and ischiatic tuberosity, and the internal obturator muscle on the dorsal surface of the ischium: the medial wall consists of muscles of the pelvic diaphragm (levator ani and coccygeus), external anal sphincter and retractor penis/constrictor vulvae muscles. Ventrally and cranially the fossa is closed off by a merging of fascia on the pelvic diaphragm and internal obturator muscles. From this description I hope you can appreciate that each fossa is a deep wedge-shaped depression lateral to the anus and anal canal and to the terminal end of the urogenital tract in the pelvis. They are normally padded out with fat and loose connective tissue and in older

dogs may be the site of hernia of viscera from the pelvic cavity.

The **hamstring muscles** (*biceps femoris*, *semimembranosus* and *semitendinosus*) form the large muscle mass at the rear of the thigh, extending down from the sacrotuberous ligament and ischiatic tuberosity. Unlike the hamstrings in yourself, those of a dog do not terminate in well-defined tendons behind its stifle joint (your own knee joint where you may feel them in yourself quite easily). In a dog they continue down into the lower part of the leg to pass on either side of the calf muscles (gastrocnemius muscles) and attach onto the tibia. Further up in the thigh they have additional attachments onto the femur, patella and patellar tendon, and, as we have already seen, their action on the stifle joint will be both considerable and complex. Extra tendinous cords from the hamstrings (*accessory* or *tarsal tendons*), and also from the gracilis muscle, extend down the rear of the leg where they are closely associated with the tendon from the calf muscles attaching with it on the calcaneal tuberosity. The compound **common calcaneal tendon** attaching to the point of the hock therefore contains: firstly the Achilles' tendon, the tendon of the gastrocnemius muscle beginning midway down the back of the leg; secondly the superficial digital flexor tendon winding around the medial side of Achilles' tendon to spread and cap the point of the hock before continuing down on the underside of the paw to the digits; and thirdly the accessory tendons from the hamstrings and gracilis muscles.

### Surface features and topographical regions

1 Sacral region (croup). 2 Root of tail. 3 Caudal region (tail). 4 Gluteal region (rump). 5 Ischiatic tuberosity region (buttock). 6 Clunial region. 7 Ischiorectal fossa. 8 Anal part of perineal region. 9 Urogenital part of perineal region. 10 Root of penis (diverging fibrous structures attached to ischiatic arch). 11 Femoral region (thigh). 12 Popliteal region. 13 Popliteal fossa (at rear of stifle joint). 14 Crural region (crus, shank or lower thigh). 15 Calf. 16 Tarsal region (tarsus, hock or ankle). 17 Calcaneal region. 18 Metatarsal region. 19 Phalangeal region. 20 Metatarsal pad. 21 Digital pad. 22 Scrotum (scrotal region).

### Bones, joints and ligaments

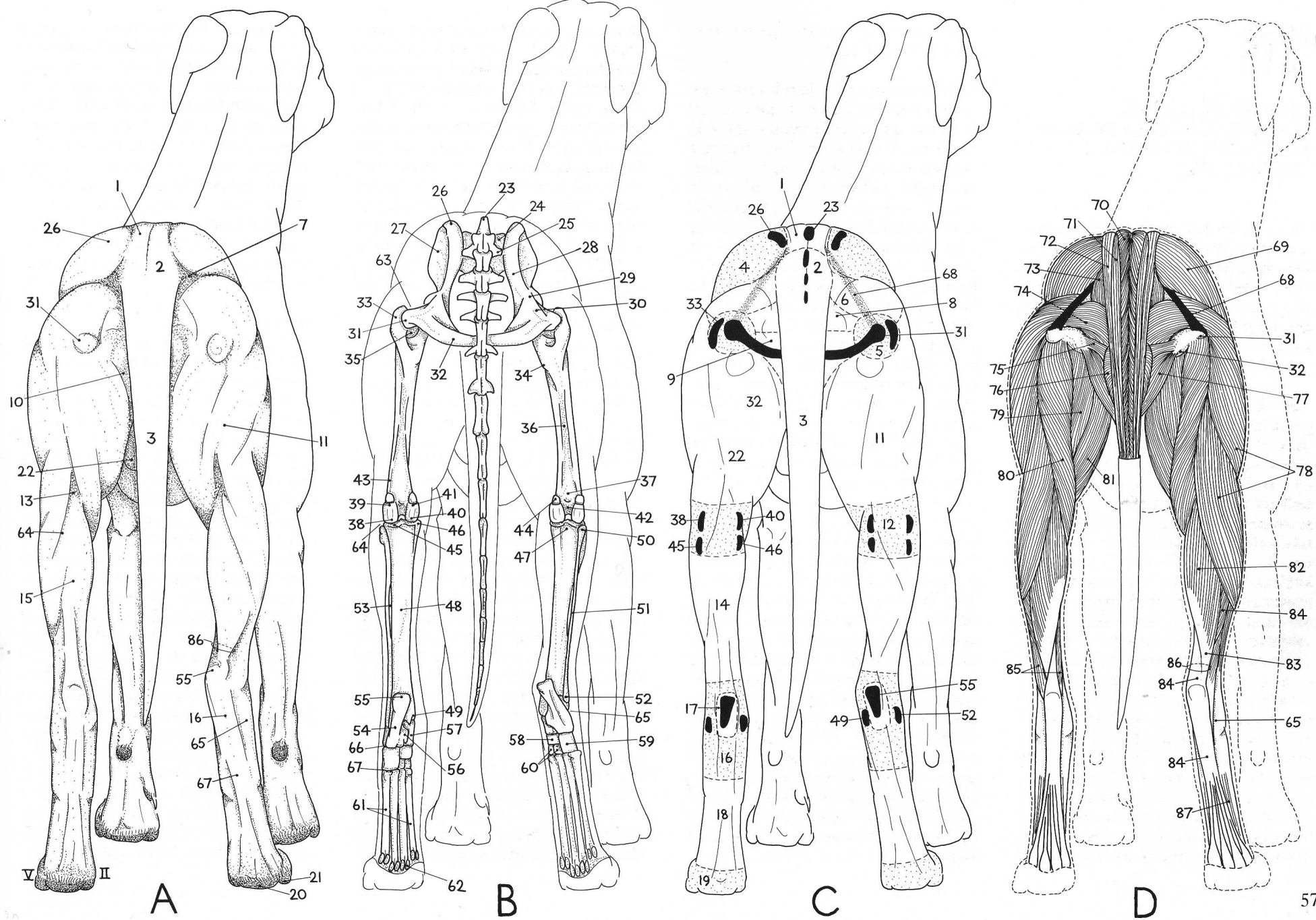
23 Median sacral crest (fused sacral spinous processes). 24 Sacral wing (enlarged 1st sacral transverse process). 25 Transverse process of 1st caudal (tail) vertebra. 26 Sacral tuberosity of ilium (point of croup). 27 Wing of ilium. 28 Greater ischiatic notch. 29 Ischiatic spine of hip bone. 30 Lesser ischiatic notch. 31 Ischiatic tuberosity (point of buttock). 32 Ischiatic arch of pelvic girdle (extending transversely between ischiatic tuberosities). 33 Greater trochanter of femur. 34 Lesser trochanter of femur. 35 Trochanteric fossa of femur. 36 Rough surface of femur bounded by medial and lateral lips. 37 Popliteal surface of femur. 38 Lateral condyle of femur. 39 Lateral epicondyle of femur. 40 Medial condyle of femur. 41 Medial epicondyle of femur. 42 Intercondyloid fossa of femur. 43 Lateral supracondyloid tuberosity of femur. 44 Fabelae (stifle sesamoids situated in tendons of origin of gastrocnemius muscle). 45 Lateral condyle of tibia. 46 Medial condyle of tibia. 47 Popliteal notch of tibia. 48 Body (shaft) of tibia. 49 Medial malleolus of tibia. 50 Head of fibula. 51 Body (shaft) of fibula. 52 Lateral

malleolus of fibula. 53 Crural interosseous space between tibia and fibula. 54 Calcaneus (fibular tarsal bone). 55 Calcaneal tuberosity (point of hock). 56 Sustentaculum tali. 57 Talus (tibial tarsal bone). 58 Central tarsal bone. 59 Tarsal bone 4. 60 Tarsal bones 1-3. 61 Metatarsal bones. 62 Proximal plantar sesamoid bones (pair associated with each metatarsophalangeal joint). 63 Hip joint. 64 Stifle joint. 65 Crurotarsal joint. 66 Intertarsal joint. 67 Tarsometatarsal joints. 68 Sacrotuberous ligament (uniting lateral sacral crest and 1st caudal transverse process with ischiatic tuberosity).

### Muscles

69 Superficial gluteal muscle. 70-72 Tail muscles. 70 Long tail levators (dorsal medial sacrocaudal muscles). 71 Short tail levators (dorsal lateral sacrocaudal muscles). 72 Lateral tail flexors (dorsal intertransverse caudal muscles). 73 Coccygeus muscle (forming pelvic diaphragm with levator ani muscle). 74 Internal obturator muscle. 75 Ischiourethral muscle. 76 Bulbospongiosus muscle (continuation of urethral muscle around urethral bulb in root of penis). 77 Ischiocavernosus muscle (covering cavernous body in root of penis). 78-80 'Hamstring' muscles. 78 Biceps femoris muscle. 79 Semimembranosus muscle. 80 Semitendinosus muscle. 81 Gracilis muscle. 82 Lateral head of gastrocnemius muscle. 83 Achilles' tendon. 84 Superficial digital flexor muscle and tendons. 85 Deep digital flexor muscle. 86 Common calcaneal tendon (aggregate of structures attaching to point of hock, including Achilles' tendon, superficial digital flexor tendon, and accessory or tarsal tendon of hamstring and gracilis muscles). 87 Interosseous muscles (4 components forming bulk of musculature on plantar surface of metatarsus).

(After Ellenberger, Dittrich & Baum, 1956)





# 17

## SURFACE FEATURES, SUBCUTANEOUS STRUCTURES AND SKELETON OF THE BITCH FROM BELOW

The four accompanying drawings are of a bitch lying on her back. As in previous drawings this sequence shows the surface of the body (A), the skeleton (B) and then subcutaneous structures (D). An additional surface view (C) is shown on which the specifically palpable bony features of the trunk are indicated along with the topographical subdivisions. Such a view is especially useful in attempting to visualize internal structures in relation to surface 'landmarks'.

The surface view shows the typical complement of ten **teats** – two pairs of thoracic, two pairs of abdominal and an inguinal pair. Teats, although not absent in the male dog, are rudimentary and not normally visible through the coat. Teats and their underlying **mammary glands** develop in the young animal along the *milk-line*, a line on either side of the trunk more or less parallel to the midline extending from pectoral to inguinal regions. The glands themselves appear to be highly modified sweat glands of the skin! Since they provide nourishment to a litter of pups they will only be prominent at certain times of a bitch's life – when she is pregnant (also if she is undergoing a pseudo-pregnancy) and throughout the subsequent nursing period. Shrivelling of

the milk-producing glandular tissue takes place over a period of a month or two after the pups have been weaned.

Each teat is a short, practically hairless cone of skin which thickens towards its base where a fine covering of hair may be present. Opening onto the surface of a teat are up to a dozen or more small holes each one terminating a teat canal. These canals are the narrowed ends of large spaces inside the gland which receive and temporarily store the milk. Storage of a sufficient amount of milk depends to a considerable extent on the smooth muscle sphincters surrounding teat canals. Reflex relaxation of these sphincters will allow milk to flow when suckling begins. Mammary glands are richly supplied with both blood vessels and lymphatics, the drainage of the latter being of particular interest since it is the pathway taken by malignant cells should they disseminate from mammary tumours particularly in old bitches.

### *Surface features and topographical regions*

**1** Nostril region (nasal plane). **2** Oral (mouth) region. **3** Hard palate in roof of mouth. **4** Mental (chin) region. **5** Buccal region (cheek based on buccinator muscle). **6** Masseteric region. **7** Mandibular region (lower jaw). **8** Intermandibular region. **9** Auricular region (pinna of external ear). **10** Outer opening of external ear canal. **11** Lateral neck (jugular) region. **12** Jugular groove. **13** Jugular fossa. **14** Parotid region. **15** Pharyngeal region (throat). **16** Laryngeal region. **17** Tracheal region. **18** Presternal region (breast). **19** Sternal region (brisket). **20** Median pectoral groove. **21** Costal region (thorax, chest or rib region). **22** Cardiac region. **23** Axillary region (including axillary fossa [armpit] between

muscles of shoulder and upper arm and muscles of chest wall). **24** Belly. **25–26** Cranial abdominal (epigastric) region. **25** Hypochondriac regions left and right (internal extent of hypochondriac region indicated by dome of diaphragm). **26** Xiphoid region. **27–28** Middle abdominal (mesogastric) region. **27** Lateral abdominal (iliac) regions right and left (flanks). **28** Umbilical region. **29** Fold of flank. **30** Umbilicus (navel). **31–32** Caudal abdominal (hypogastric) region. **31** Inguinal regions right and left. **32** Pubic region. **33** Fold of groin. **34** Teats of mammary glands (cranial and caudal thoracic, cranial and caudal abdominal, inguinal). **35** Urogenital part of perineal region. **36** Vulva (external genitalia, pudendum). **37** Caudal region (tail). **38** Brachial region (arm). **39** Femoral region (thigh). **40** Femoral triangle (bordered by sartorius, pectineus and abdominal muscles).

### *Bones, joints and ligaments*

**41** Body of mandible (lower jaw). **42** Angular process of mandible. **43** Upper jaw (supporting teeth of upper dental arch). **44** Internal nostrils (choanae – leading into nasopharynx). **45** Zygomatic arch (bridge of bone connecting face and cranium below eye). **46** Tympanic bulla (surrounding tympanic [middle ear] cavity containing ear ossicles). **47–49** Hyoid apparatus (supporting tongue and larynx). **47** Basi-hyoid bone. **48** Cranial horn of hyoid. **49** Thyrohyoid bone (caudal horn of hyoid). **50** Thyroid cartilage of larynx. **51** Wing of atlas (C1) vertebra (enlarged transverse process). **52** Enlarged bifid transverse process of cervical vertebra 6. **53** Transverse process of lumbar vertebra 5. **54** Wing of sacrum (enlarged 1st sacral transverse process). **55** Pelvic (ventral) surface of sacrum. **56** Pelvic sacral foramina. **57** Transverse processes of caudal vertebrae. **58** Rib 1. **59** Rib 13 (last or floating rib). **60** Costal arch (fused costal cartilages of ribs 10–

12 attached to costal cartilage of rib 9 last sternal rib – ie. with direct sternal attachment). **61** Costochondral junction between bony rib and costal cartilage. **62–64** Sternum (breastbone). **62** Manubrium of sternum (1st sternebra elongated into base of neck). **63** Sternebrae (sternal segments joined by intersternbral cartilages). **64** Xiphoid cartilage of sternum (last sternebra enlarged into belly wall). **65** Scapula (shoulder blade). **66** Greater tubercle of humerus (point of shoulder). **67** Ilium of hip bone. **68** Coxal tuberosity of ilium (point of haunch). **69** Pubis of hip bone. **70** Pubic pecten. **71** Ischium of hip bone. **72** Ischiatic arch of pelvic girdle. **73** Ischiatic tuberosity (point of buttock). **74** Obturator foramen. **75** Pelvic symphysis (combination of pubic and ischiatic symphyses-fibrocartilaginous). **76** Head of femur. **77** Jaw (temporo-mandibular) joint. **78** Lumbosacral joint. **79** Sacroiliac joint. **80** Shoulder joint. **81** Hip (coxofemoral) joint.

### *Muscles*

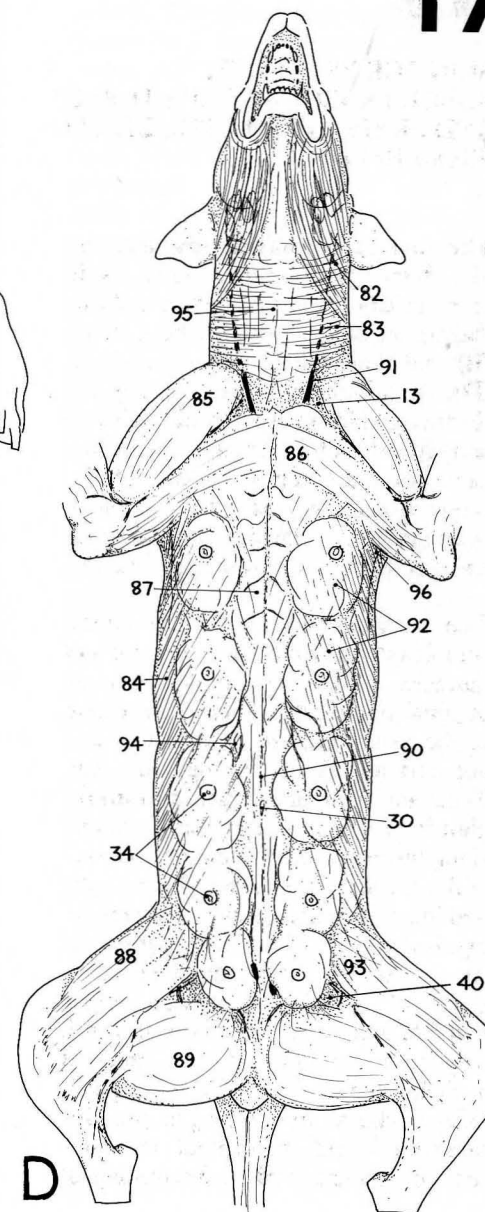
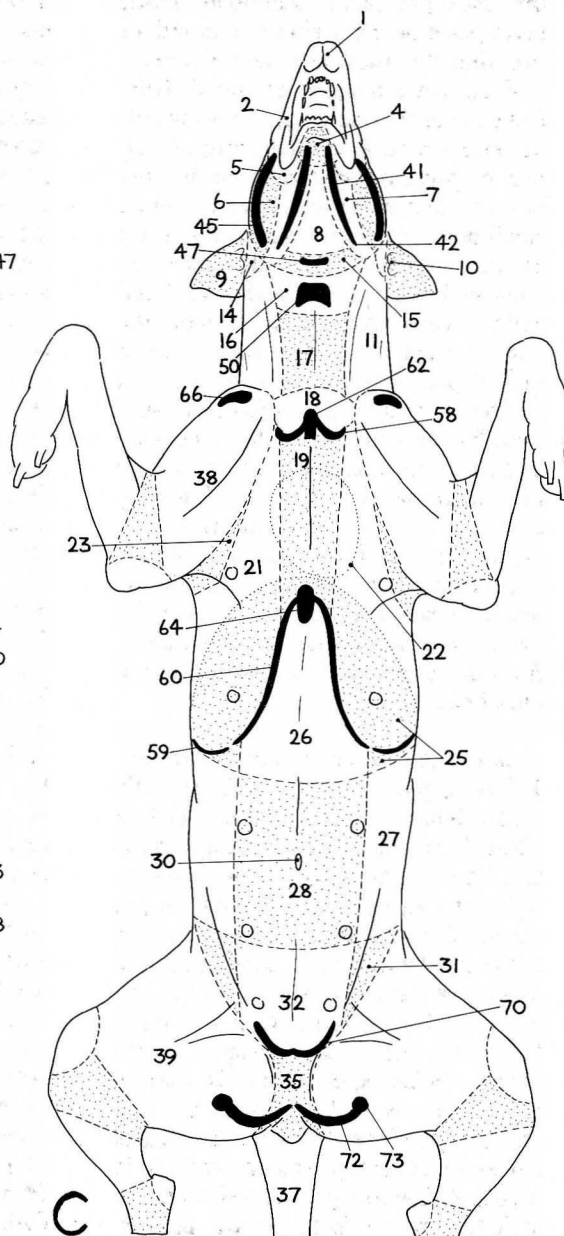
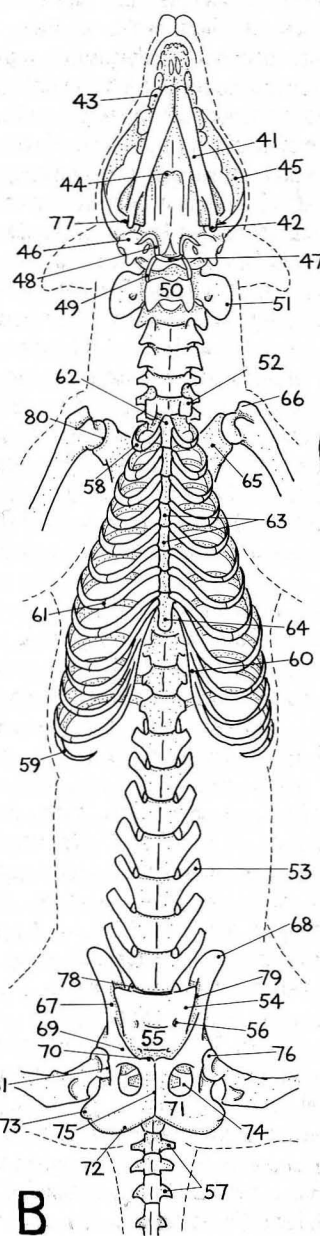
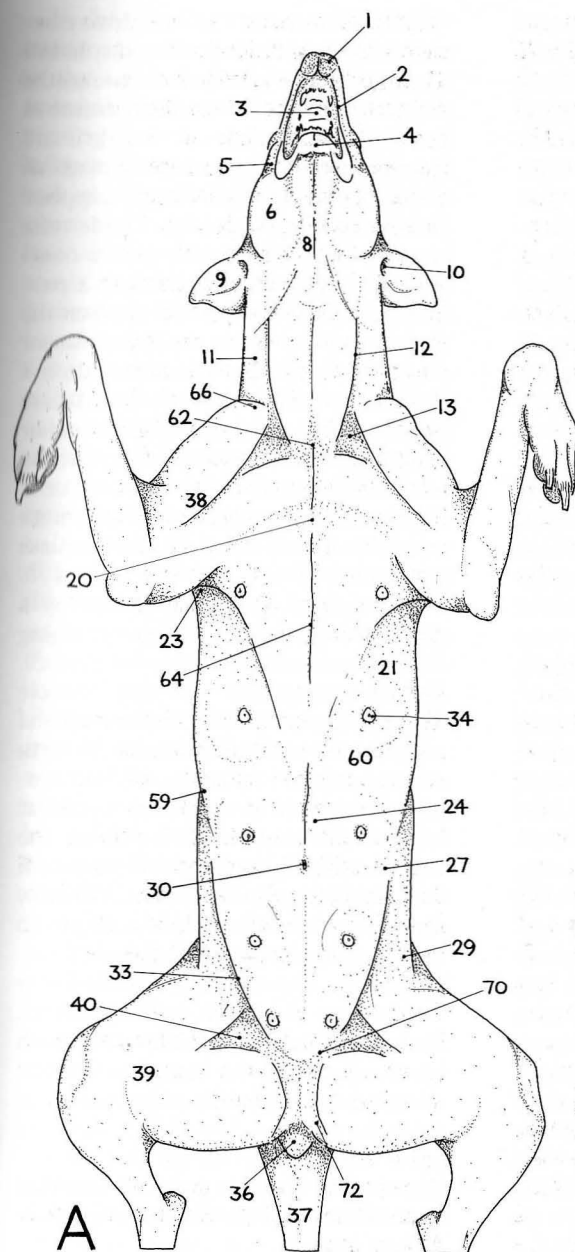
**82** Platysma muscle. **83** Sphincter muscle of neck (poorly developed scattering of transversely arranged strands). **84** Cutaneous muscle of trunk. **85** Cleidobrachial part of brachiocephalic muscle. **86** Superficial pectoral muscle. **87** Deep pectoral muscle. **88** Sartorius muscle. **89** Gracilis muscle. **90** Linea alba (fibrous union of lateral abdominal muscles in midventral line of abdomen).

### *Blood vessels and glands*

**91** External jugular vein. **92** Mammary glands (cranial and caudal thoracic, cranial and caudal abdominal and inguinal).

### *Fascial layers*

**93** Superficial fascia of thigh. **94** Superficial fascia of trunk. **95** Superficial fascia of neck. **96** Axillary fascia.



parent. The rectus abdominis muscle extends from attachments on the ribcage as far forwards as the first rib, back to an attachment on the leading edges of the pubic bones where it merges with a mass of fibrous tissue, the cranial pubic ligament. As the drawing indicates, it has several fibrous inter-sections in it which suggest that it is a compound structure made up from several smaller segments. Its functions are allied to those of the lateral abdominal muscles considered elsewhere, and there is a very close structural relationship between them. The lateral muscles must pass over the surface of the rectus to reach their attachments on the fibrous tissue of the **linea alba** (white line) in the midline of the underside of the belly. The external and internal oblique muscles pass over its outer (ventral) surface, while the transverse muscle passes over its internal (dorsal) surface (except at the caudal end of the abdomen). Each rectus muscle therefore lies sandwiched between the sheet-like tendons (aponeuroses) of lateral abdominal muscles which form a sheath. On contraction the rectus muscles can move within this sheath.

The midventral fibrous union of the lateral abdominal muscles, the white line, extends from the xiphoid process of the sternum to the prepubic tendon at the pubic symphysis. The **navel (umbilicus)** shown on the skin surface by a whorl of hair and located in the umbilical region, is an area of scar tissue which marks the remains of the point of entry of blood vessels from the developing foetus to the placenta of the mother and *vice versa*. Obviously the scar tissue forms after the umbilical cord is severed,

the vessels shrivel and the umbilicus closes at the birth of a pup. The simple structure of the fibrous linea alba, and the fact that it is not crossed by blood vessels or nerves, makes it a favourable site for surgical incision into the abdomen. However, bearing in mind its capacity for and speed of healing, it cannot compare with that of muscle.

#### *Surface features and topographical regions*

**1** Mental region (chin). **2** Oral region (mouth). **3** Mandibular region (lower jaw). **4** Intermandibular region (between mandibular bodies). **5** Buccal region (cheek based on buccinator muscle). **6** Masseteric region. **7** Hard palate (in roof of mouth crossed by ridges of cornified buccal mucosa). **8** Auricular region (pinna – visible part of external ear). **9** Parotid region. **10** Pharyngeal region (throat). **11** Laryngeal region. **12** Tracheal region. **13** Lateral neck (jugular) region. **14** Jugular fossa. **15** Pre-sternal region (breast). **16** Sternal region (brisket). **17** Median pectoral groove. **18** Axillary region (armpit between muscles of shoulder and upper arm, and muscles of chest wall). **19** Chest (costal or rib region). **20** Right hypochondriac region. **21** Xiphoid region. **22** Right lateral abdominal region (flank). **23** Fold of flank (extending onto thigh proximal to stifle joint). **24** Umbilicus (navel in umbilical region). **25** Inguinal region (fold of groin between thigh and abdominal wall). **26** Pubic region. **27** Sheath (prepuce covering glans penis). **28** Preputial orifice (leading into preputial cavity). **29** Penis (composed of root, body and glans extending from pelvic outlet forwards between thighs onto underside of belly wall – cut through in figs **D** and **E**). **30** Scrotum (skin sac containing testes and vaginal processes). **31** Scrotal raphe (surface representation of internal subdivision). **32** Root of tail. **33** Thigh (femoral region). **34**

Femoral triangle. **35** Arm (brachial region).

#### *Bones, joints and ligaments*

**36** Auricular cartilage (basis of pinna of external ear). **37** Body of mandible (lower jaw). **38** Zygomatic arch. **39** Basihyoid bone of hyoid apparatus. **40** Thyroid cartilage of larynx (forming laryngeal prominence of voice box). **41** Manubrium of sternum (1st sternebra elongated into base of neck). **42** Xiphoid cartilage of sternum (last sternebra enlarged into belly wall). **43** Rib 1. **44** Costal arch (fused costal cartilages of ribs 10–12 [asternal ribs] attached by fibrous tissue to costal cartilage of rib 9). **45** Rib 13 (last or floating rib). **46** Pubic pecten (supporting a cranial pubic ligament). **47** Ischiatic tuberosity (point of buttock). **48** Ischiatic arch. **49** Os penis (penile bone representing ossified cavernous bodies extending through glans penis).

#### *Muscles and fascia*

**50** Platysma muscle. **51** Sphincter muscle of neck. **52** Cutaneous muscle of trunk. **53** Preputial muscle. **54** Mylohyoid muscle. **55** Geniohyoid muscle. **56** Digastric muscle. **57** Masseter muscle. **58** Styloglossal muscle. **59** Hyoglossal muscle. **60** Sternohyoid muscle. **61** Sternothyroid muscle. **62** Thyrohyoid muscle. **63** Cricothyroid muscle. **64** Sternocervical muscle. **65** Scalene muscle. **66** External intercostal muscles. **67** Internal intercostal muscles. **68** Linea alba (white line – fibrous union of left and right sides of belly wall extending from sternum to pubic symphysis). **69** External abdominal oblique muscle. **70** Tendon (aponeurosis) of external abdominal oblique muscle (contributing to external layer of rectus sheath). **71** Internal abdominal oblique muscle. **72** Tendon (aponeurosis) of internal abdominal oblique muscle (contributing to both internal and external layers of rectus sheath). **73** Transverse ab-

dominal muscle. **74** Tendon (aponeurosis) of transverse abdominal muscle (contribution to external layer of rectus sheath). **75** Rectus abdominis muscle. **76** Tendinous inscriptions in rectus abdominis muscle. **77** Aponeurotic tendon of origin of rectus abdominis muscle. **78** Prepubic tendon. **79** Rectus sheath (from tendons of insertion of lateral abdominal muscles). **80** Inguinal canal (through abdominal wall muscles). **81** External inguinal ring (subcutaneous exit from inguinal canal). **82** Internal inguinal ring (abdominal entry into inguinal canal). **83–85** Brachiocephalic muscle. **83** Cleidobrachial part of brachiocephalic muscle. **84** Cleidocervical part of brachiocephalic muscle. **85** Clavicular tendon within brachiocephalic muscle. **86** Superficial pectoral muscle. **87** Deep pectoral muscle. **88** Latissimus dorsi muscle. **89** Teres major muscle. **90** Biceps brachii muscle. **91** Retractor penis muscle (arising from caudal vertebrae and external anal sphincter and travelling along underside of root and body of penis to attach in region of preputial fornix). **92** Cranial and caudal parts of sartorius muscle. **93** Gracilis muscle. **94** Pectineus muscle. **95** Semimembranosus muscle of 'hamstring' group. **96** Adductor muscle. **97** Superficial fascia of thigh. **98** Superficial fascia of trunk. **99** Superficial axillary fascia. **100** Superficial fascia of neck.

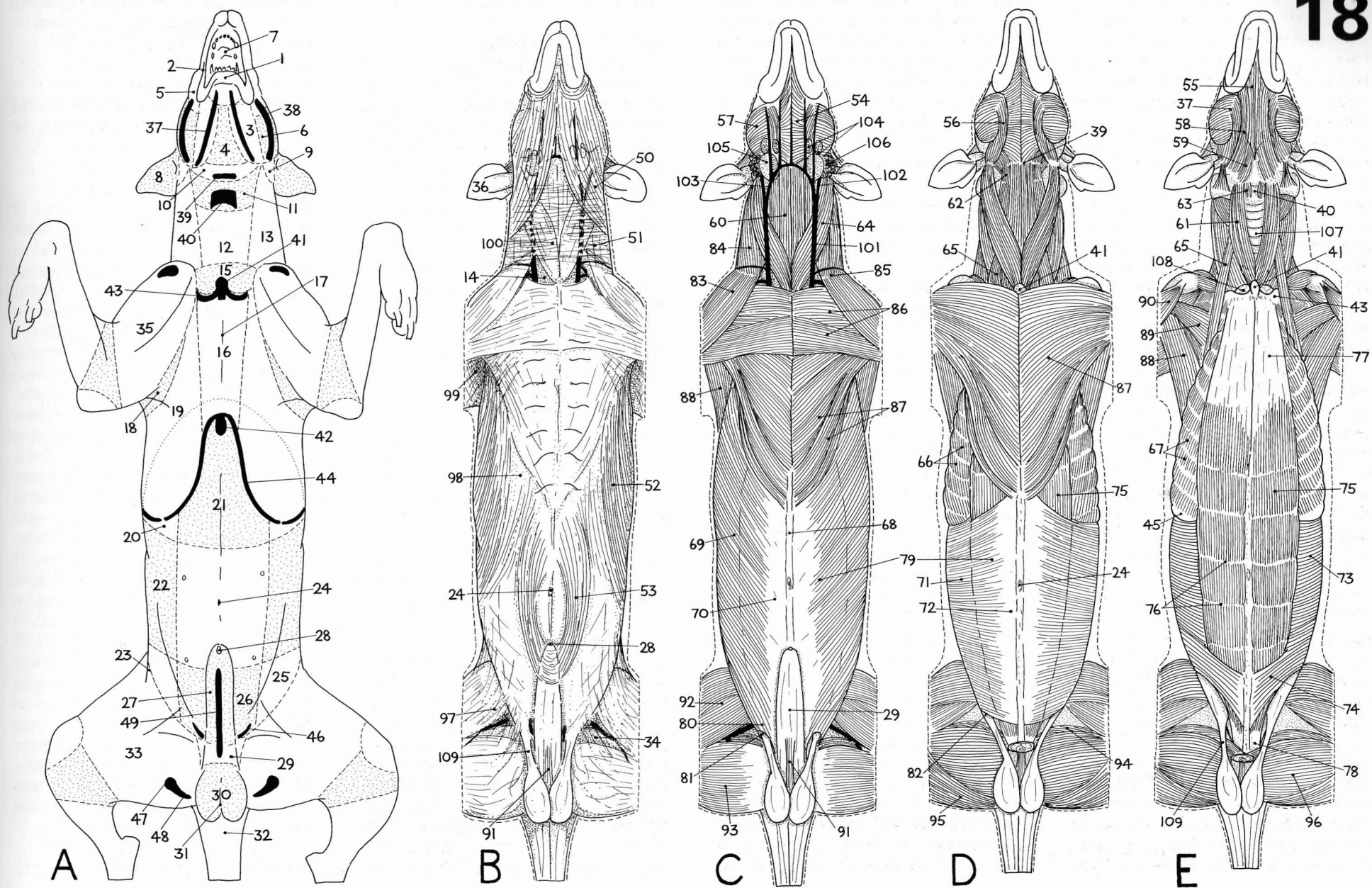
#### *Blood vessels and lymph nodes*

**101** External jugular vein. **102** Maxillary vein. **103** Linguofacial vein. **104** Mandibular lymph nodes.

#### *Glands, viscera and peritoneum*

**105** Mandibular salivary gland. **106** Parotid salivary gland. **107** Trachea (windpipe). **108** Apex of cranial lobe of right lung. **109** Vaginal process (pocket of abdominal peritoneum extending through inguinal canal into scrotum).







# 19

## BIOMECHANICS OF THE MUSCULOSKELETAL SYSTEM OF THE DOG

The body of a dog is clearly an integrated system, it cannot be subdivided into separate units independent in their form and function. The preceding drawings have therefore tried to depict the close functional relationship that exists between the muscular and skeletal systems. The text accompanying the drawings has also tried to emphasize their integrated roles in posture and movement. Many of the muscles figured and mentioned in the earlier part of the book are included in the diagrams here but in a somewhat diagrammatic and stylized pattern. Each muscle is depicted simply by lines running along its 'functional axis' between its origin and insertion. In such a format the action of a muscle at any particular joint can be quite readily visualized.

The extrinsic musculature of the limbs is shown in drawings A and D; the intrinsic limb musculature in drawings B and E. The epaxial components of the axial trunk muscles are shown in drawing C, and the hypaxial components in both drawings A and C.

### Epaxial muscles

1–2 Iliocostal muscle. 1 Lumbar part of iliocostal muscle (*m iliocostalis lumborum*). 2 Thoracic part of iliocostal muscle (*m iliocostalis thoracis*). 3–6 Longissimus muscle. 3 Lumbar part of longissimus muscle (*m*

*longissimus lumborum*). 4 Thoracic part of longissimus muscle (*m longissimus thoracis*). 5 Cervical part of longissimus muscle (*m longissimus cervicis*). 6 Capital part of longissimus muscle (*m longissimus capitis*). 7–9 Semispinal muscle. 7 Thoracic part of semispinal muscle (*m semispinalis thoracis*). 8–9 Capital part of semispinal muscle (*m semispinalis capitis*). 8 Biventer muscle (*m biventer cervicis*). 9 Complexus muscle (*m complexus*). 10 Tail levator muscles (*m sacrocaudalis dorsalis lateralis* and *m sacrocaudalis dorsalis medialis*).

### Subvertebral hypaxial muscles

11 Psoas minor muscle (*m psoas minor*). 12 Quadratus lumborum muscle (*m quadratus lumborum*). 13 Longus colli muscle (*m longus colli*). 14 Longus capitis muscle (*m longus capitis*). 15 Tail depressor muscles (*m sacrocaudalis ventralis lateralis* and *m sacrocaudalis ventralis medialis*).

### Hypaxial muscles

16 Sternohyoid muscle (*m sternohyoideus*). 17 Sternothyroid muscle (*m sternothyroideus*). 18 Thyrohyoid muscle (*m thyrohyoideus*). 19–20 Sternoccephalic muscle (*m sternoccephalicus*). 19 Sternoccephalic component of sternoccephalic muscle (*m sternoccephalicus pars occipitalis*). 20 Sternomastoid component of sternoccephalic muscle (*m sternoccephalicus pars mastoidea*). 21 Scalene muscle (*m scalenus*). 22 External intercostal muscles (*mm intercostales externi*). 23 External abdominal oblique muscle (*m obliquus externus abdominis*). 24 Internal abdominal oblique muscle (*m obliquus internus abdominis*). 25 Transverse abdominal muscle (*m transversus abdominis*). 26 Rectus abdominis muscle (*m rectus abdominis*). 27–28 Muscles of pelvic diaphragm. 27 Coccygeal muscle (*m coccygeus*). 28 Levator ani muscle (*m levator ani*).

### Extrinsic muscles of forelimb

29–30 Trapezius muscle (*m trapezius*). 29 Thoracic part of trapezius (*m trapezius pars thoracica*). 30 Cervical part of trapezius (*m trapezius pars cervicalis*). 31 Omotransverse muscle (*m omotransversarius*). 32–33 Rhomboid muscle (*m rhomboideus*). 32 Thoracic part of rhomboid muscle (*m rhomboideus thoracis*). 33 Cervical part of rhomboid muscle (*m rhomboideus cervicis*). 34–35 Ventral serrate muscle (*m serratus ventralis*). 34 Thoracic part of ventral serrate muscle (*m serratus ventralis thoracis*). 35 Cervical part of ventral serrate muscle (*m serratus ventralis cervicis*). 36–38 Brachiocephalic muscle (*m brachiocephalicus*). 36 Brachial part of brachiocephalic muscle (*m cleidobrachialis*). 37 Cervical part of brachiocephalic muscle (*m cleidocephalicus pars cervicalis*). 38 Mastoid part of brachiocephalic muscle (*m cleidocephalicus pars mastoidea*). 39 Latissimus dorsi muscle (*m latissimus dorsi*). 40–41 Pectoral muscles (*mm pectorales*). 40 Superficial pectoral muscle (*m pectoralis superficialis*). 41 Deep pectoral muscle (*m pectoralis profundus*).

### Intrinsic muscles of forelimb

42 Supraspinous muscle (*m supraspinatus*). 43 Infraspinous muscle (*m infraspinatus*). 44 Deltoid muscle (*m deltoideus*). 45 Teres major muscle (*m teres major*). 46 Biceps brachii muscle (*m biceps brachii*). 47 Brachial muscle (*m brachialis*). 48 Triceps brachii muscle (*m triceps brachii*). 49 Radial carpal extensor muscle (*m extensor carpi radialis*). 50 Common digital extensor muscle (*m extensor digitorum communis*). 51 Ulnar carpal extensor (*m extensor carpi ulnaris* or *m ulnaris lateralis*). 52 Superficial digital flexor muscle of forelimb (*m flexor digitorum superficialis*). 53 Ulnar

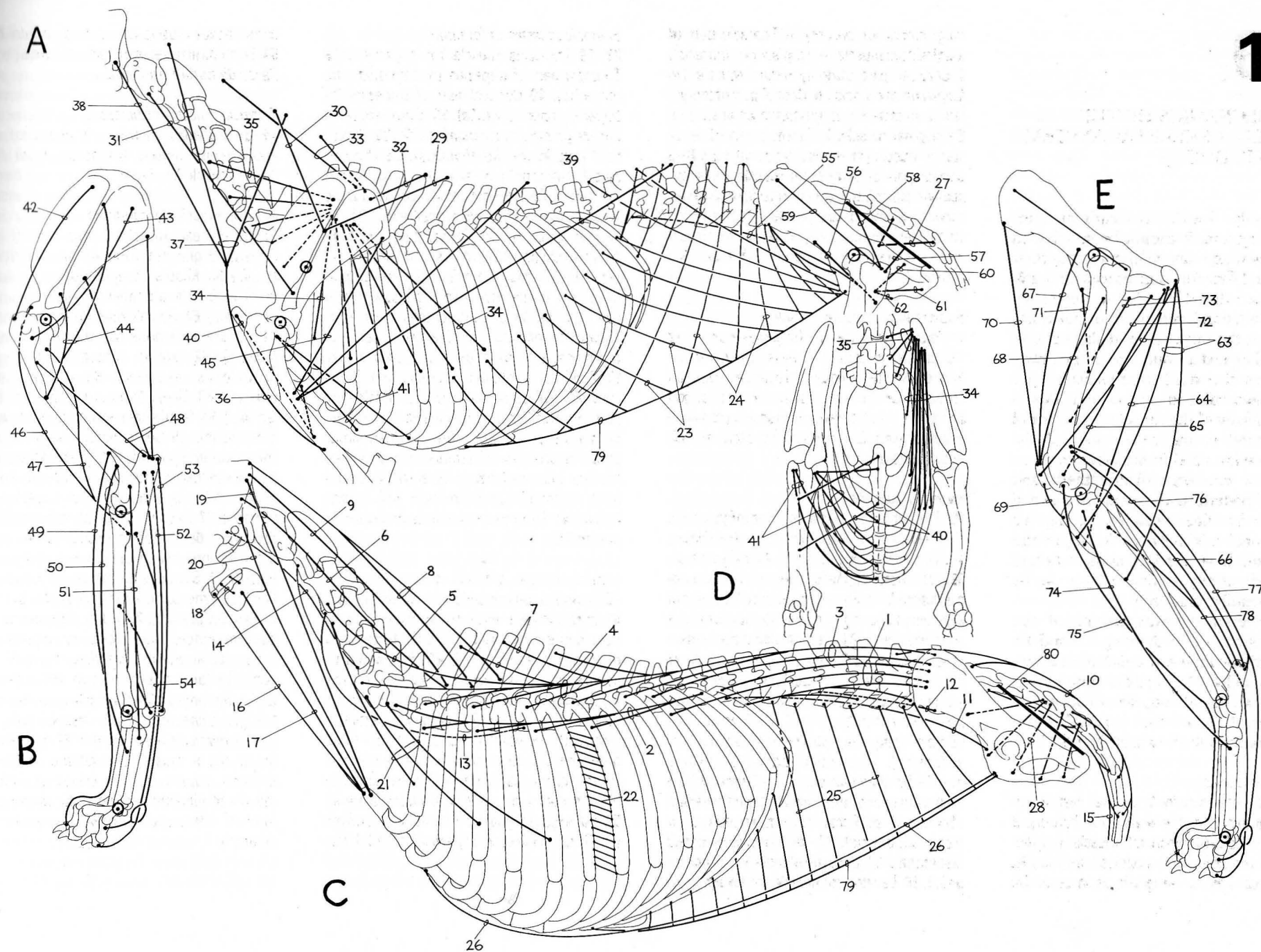
carpal flexor muscle (*m flexor carpi ulnaris*). 54 Deep digital flexor muscle of forelimb (*m flexor digitorum profundus*).

### Extrinsic muscles of hindlimb

55–56 Iliopsoas muscle (*m iliopsoas*). 55 Psoas major muscle (*m psoas major*). 56 Iliacus muscle (*m iliacus*).

### Intrinsic muscles of hindlimb

57–59 Gluteal muscles (*mm glutei*). 57 Superficial gluteal muscle (*m gluteus superficialis*). 58 Middle gluteal muscle (*m gluteus medius*). 59 Deep gluteal muscle (*m gluteus profundus*). 60 Gemelli muscles (*mm gemelli*). 61 Quadratus femoris muscle (*m quadratus femoris*). 62 External obturator muscle (*m obturatorius externus*). 63–66 'Hamstring muscles'. 63 Biceps femoris muscle (*m biceps femoris*). 64 Semitendinosus muscle (*m semitendinosus*). 65 Semimembranosus muscle (*m semimembranosus*). 66 Tarsal (accessory) tendons of 'hamstring' muscles. 67–68 Quadriceps femoris muscle (*m quadriceps femoris*). 67 Rectus femoris muscle (*m rectus femoris*). 68 Vastus muscles (*mm vasti medialis, intermedius et lateralis*). 69 Patellar tendon. 70 Sartorius muscle (*m sartorius*). 71 Pectineus muscle (*m pectineus*). 72 Gracilis muscle (*m gracilis*). 73 Adductor muscles (*m adductor longus* and *m adductor magnus*). 74 Cranial tibial muscle (*m tibialis cranialis*). 75 Long digital extensor muscle (*m extensor digitorum longus*). 76 Gastrocnemius muscles (*m gastrocnemius caput mediale* and *m gastrocnemius caput laterale*). 77 Superficial digital flexor muscle of hindlimb (*m flexor digitorum superficialis*). 78 Deep digital flexor muscle of hindlimb (*m flexor digitorum profundus*). 79 Linea alba. 80 Sacrotuberous ligament.



pelvic roof into the rectal wall and anal canal where it blends with the external anal sphincter muscle before continuing to the external genitalia. Together with the coccygeus and levator ani muscles of the pelvic diaphragm, and tail musculature (sacrocaudal muscles), these anal diaphragm muscles contribute to defaecatory movements. The tail is raised by the dorsal sacrocaudal muscles, and the position of the anus is stabilized by the anal part of the retractor penis/clitoridis muscle assisted by the fibrous union of the external anal sphincter with the underside of tail vertebrae 3 and 4. The rectum and anal canal are shortened by rectococcygeal contraction, assisted by raising of the tail which pulls on the rectococcygeus, and squeezed by pelvic diaphragm muscles, assisted by raising of the tail which pulls on these same muscles. The anus is opened on relaxation of the anal sphincter muscles. These defaecatory movements occur practically simultaneously during normal voiding and are accompanied by widespread muscular actions within the trunk which are associated with straining — raising the pressure in the abdomen and pelvis, and with the adoption of the crouched, defaecatory posture.

The anal canal has numerous lubricative mucous glands to assist in faecal passage and also has two large **anal sacs (paranal sinuses)**, one on either side of its opening, sandwiched between internal and external sphincters. These sacs open into the anal canal laterally and contain the foul-smelling secretion from anal glands which is added to the faeces when passed. It may be lubricative assisting defaecation, although its

'scent' presumably had an importance in behaviour patterns such as territorial marking in ancestral dogs, but under domestication it seems to serve little apparent purpose. Indeed, quite often it proves to be a considerable nuisance should the drainage ducts of the sacs become blocked permitting the sacs to swell with accumulated secretion. This will irritate the dog and lead to discomfort. An afflicted dog will try to alleviate its discomfort by chasing its tail or more commonly by squatting and dragging its bottom along the ground.

#### *Surface features and topographical regions*

1 Dorsal neck region. 2 Lateral neck (jugular) region. 3 Jugular fossa. 4 Ventral neck (tracheal) region. 5 Presternal region (breast based on superficial pectoral muscles). 6 Sternal region (brisket based on deep pectoral muscles). 7 Scapular region (shoulder). 8 Costal (rib or chest) region. 9 Cardiac region. 10 Axilla (armpit between muscles of shoulder and upper arm, and muscles of chest wall). 11 Left hypochondriac region. 12 Xiphoid region. 13 Left lateral abdominal region (flank). 14 Fold of flank (extending back from belly onto thigh proximal to stifle joint). 15 Umbilical region. 16 Belly. 17 Left inguinal region. 18 Pubic region. 19 Interscapular region (withers). 20 Thoracic vertebral region (back or dorsal region). 21 Lumbar region (loins). 22 Sacral region (croup). 23 Root of tail. 24 Caudal region (tail). 25 Gluteal region (rump). 26 Coxal tuberosity region (haunch). 27 Clunial region. 28 Ischiorectal fossa. 29 Ischiatic tuberosity region (buttock). 30 Shoulder joint region. 31 Brachial region (arm). 32 Cubital region (elbow). 33 Tricipital margin of arm (based on long head of triceps muscle). 34 Olecranon region. 35 Hip joint region. 36 Femoral region (thigh). 37 Cranial margin of

thigh (based on sartorius muscle).

#### *Bones, joints and ligaments*

38 Transverse process of cervical vertebra 6. 39 Spinous process of thoracic vertebra 1. 40 Spinous process of lumbar vertebra 1. 41 Spinous process of lumbar vertebra 6. 42 Transverse processes of lumbar vertebrae. 43 Median sacral crest (fused spinous processes of sacral vertebrae). 44 Lateral sacral crest (fused 2nd and 3rd sacral transverse processes). 45 Manubrium of sternum (1st sternebra elongated into base of neck). 46 Rib 1 (bordering thoracic inlet). 47 Rib 6 (denoting approximate caudal extent of heart in chest). 48 Rib 13 (last or floating rib). 49 Costal arch (fused costal cartilages of ribs 10–12 attached to costal cartilage of rib 9 last sternal rib). 50 Dorsal (vertebral) border of scapula. 51 Cranial angle of scapula. 52 Caudal angle of scapula. 53 Spine of scapula. 54 Acromion process of scapula. 55 Greater tuberosity of humerus (point of shoulder). 56 Olecranon process of ulna (point of elbow). 57 Crest of ilium (cranial border of ilium). 58 Coxal tuberosity of ilium (point of haunch). 59 Sacral tuberosity of ilium (point of croup). 60 Ischiatic tuberosity (point of buttock). 61 Ischiatic spine of hip bone. 62 Greater ischiatic notch of hip bone. 63 Lesser ischiatic notch of hip bone. 64 Pubic pecten. 65 Iliopubic eminence. 66 Obturator foramen. 67 Pelvic symphysis. 68 Acetabular fossa of hip bone. 69 Acetabular notch of acetabular fossa.

#### *Muscles*

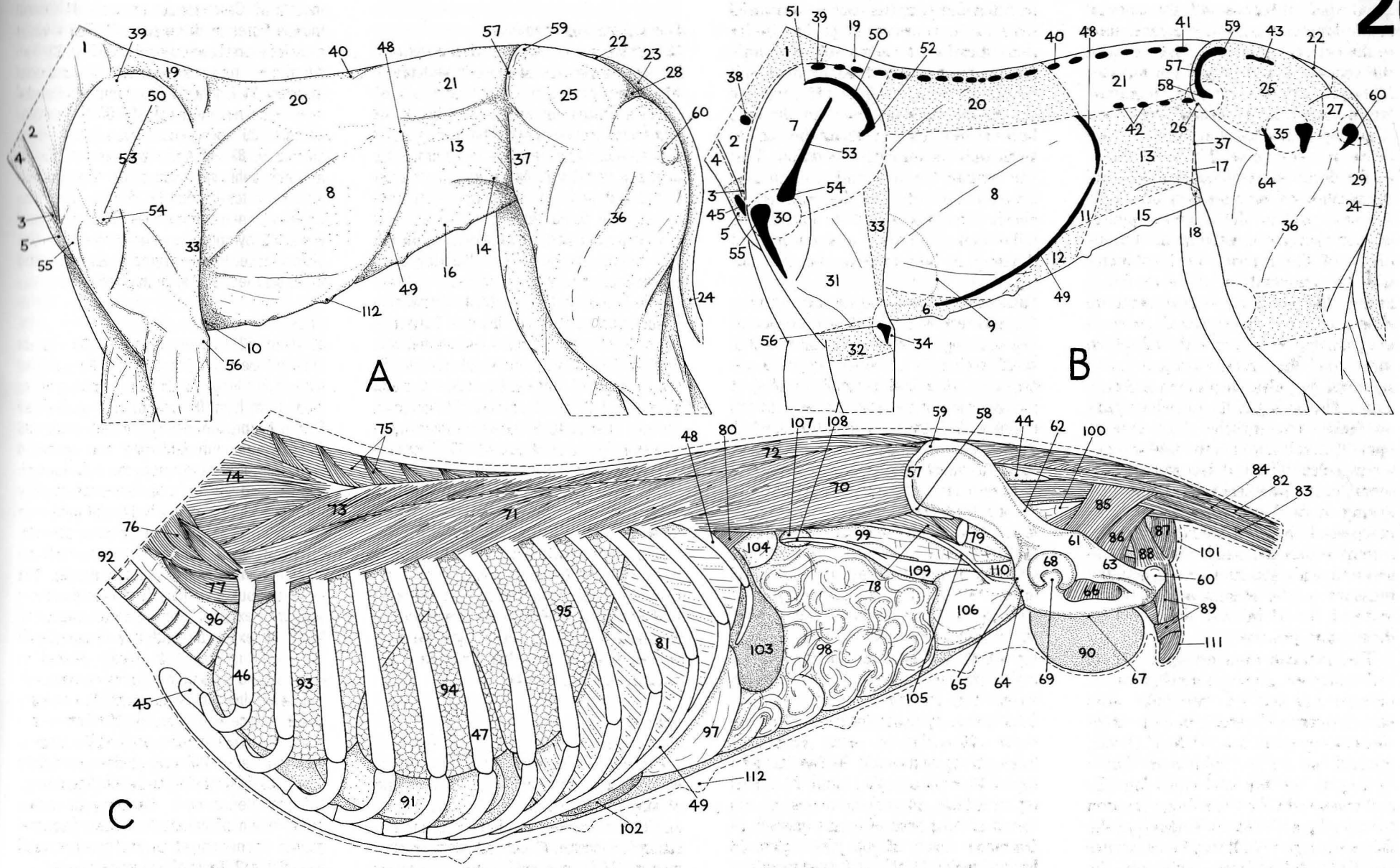
70 Lumbar part of iliocostal muscle. 71 Thoracic part of iliocostal muscle. 72 Lumbar part of longissimus muscle. 73 Thoracic part of longissimus muscle. 74 Cervical part of longissimus muscle. 75 Thoracic spinal and semispinal muscle. 76 Cervical intertransverse muscle. 77 Longus colli muscle. 78 Psoas

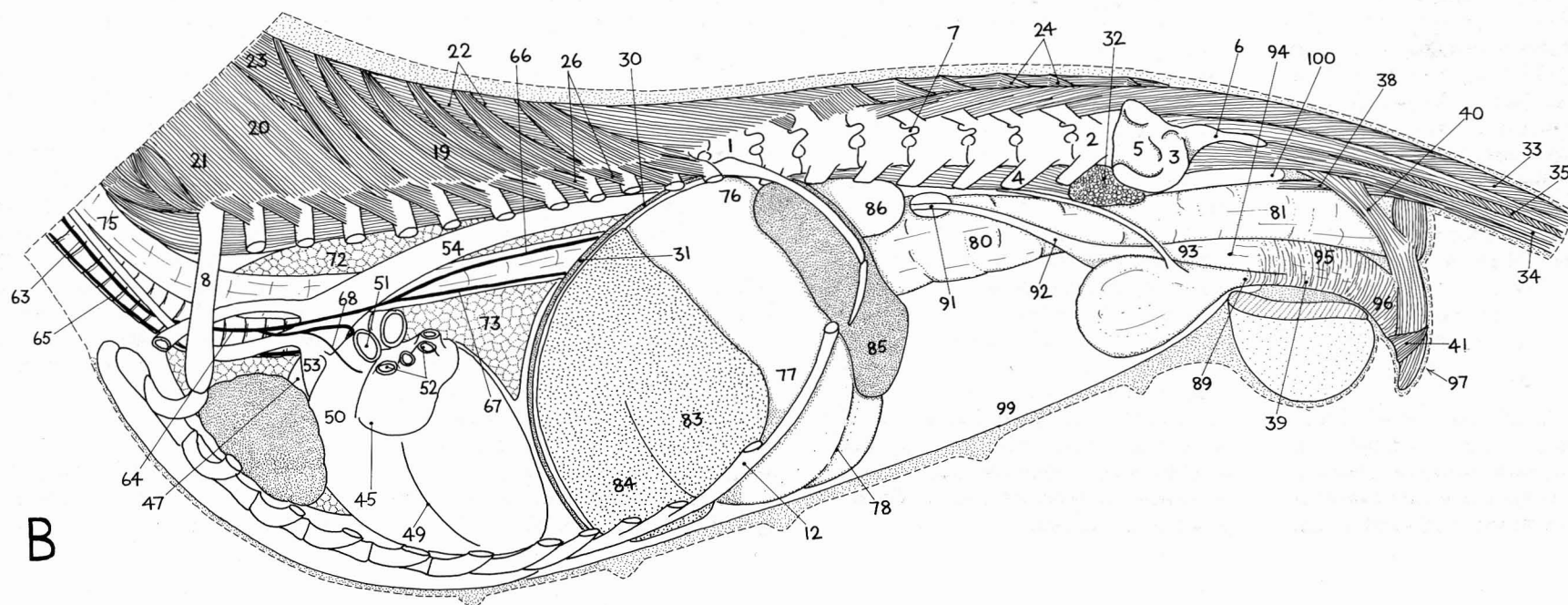
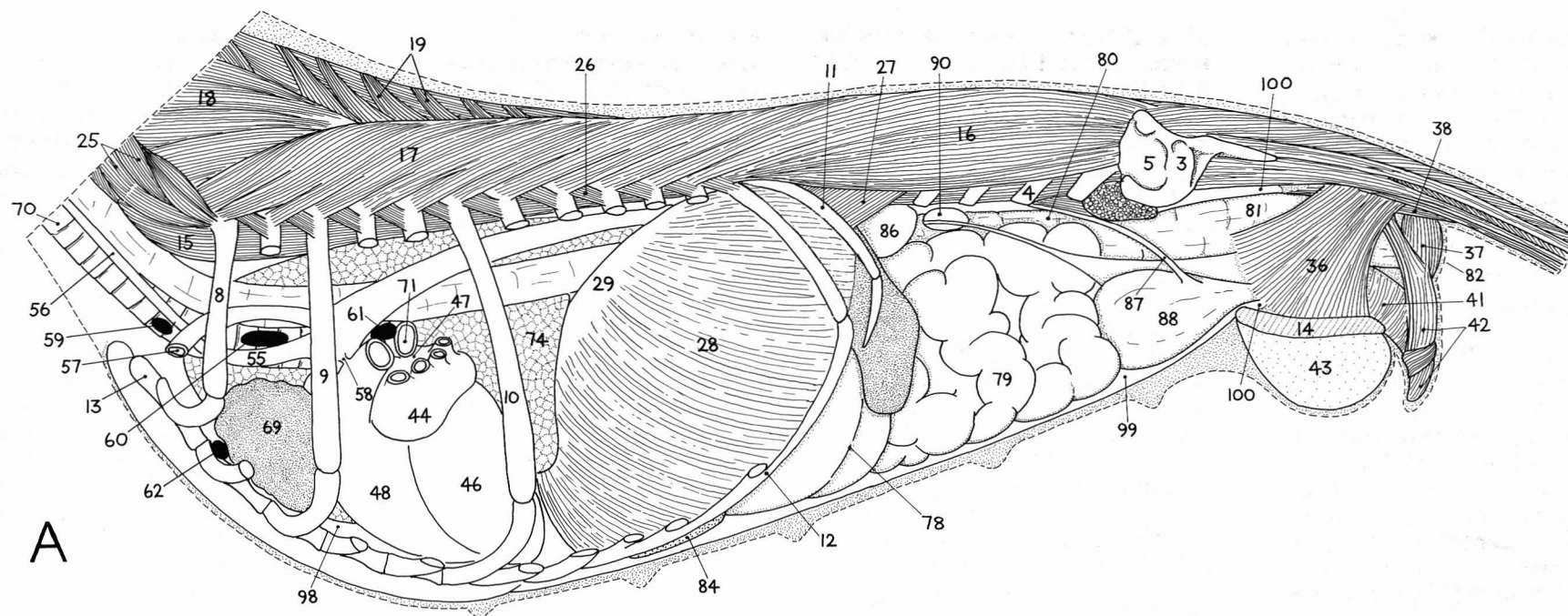
major muscle. 79 Tendon of psoas minor muscle. 80 Costal retractor muscle. 81 Costal muscle fibres of diaphragm. 82 Tail levator muscles (dorsal sacrocaudal muscles). 83 Tail depressor muscles (ventral sacrocaudal muscles). 84 Lateral tail flexor muscles (caudal intertransverse muscles). 85–86 Pelvic diaphragm. 85 Coccygeus muscle. 86 Levator ani muscle. 87–88 Anal diaphragm. 87 External anal sphincter muscle. 88 Anal part of retractor clitoridis muscle. 89 Urogenital diaphragm (constrictor muscles of vestibule and vulva). 90 Symphyseal tendon (midline fibrous plate attached to pelvic symphysis and serving for attachment of medial thigh muscles).

#### *Viscera*

91 Heart. 92 Trachea (windpipe). 93 Cranial (apical) lobe of left lung. 94 Middle (cardiac) lobe of left lung. 95 Caudal (diaphragmatic) lobe of left lung. 96 Oesophagus (gullet). 97 Stomach (predominantly on left side). 98 Greater omentum (enlarged and modified dorsal mesogastrium associated with stomach but covering much of intestinal mass laterally and ventrally and extensively infiltrated with fat). 99 Descending colon (passing caudally in contact with left flank). 100 Rectum (direct continuation of colon through pelvis). 101 Anus (surrounded by involuntary internal and voluntary external anal sphincter muscles). 102 Liver (exposed slightly beyond costal arch in xiphoid region). 103 Spleen (related to stomach and supported in greater omentum). 104 Left kidney. 105 Left ureter. 106 Urinary bladder (receiving ureters). 107 Left ovary (anchored in sublumbar position by a suspensory ligament). 108 Left uterine (Fallopian) tube (closely related to and encircling ovary). 109 Left uterine horn. 110 Body of uterus (from fusion of horns). 111 Vulva (external genitalia, consisting of vulvar cleft surrounded by labia). 112 Teats of mammary glands.







walls are subjected to during copulation and parturition, and allow for the expansion in diameter necessitated during both activities. On either side the vagina is related to the levator ani muscles of the pelvic diaphragm and the ureters cross its lateral surface on their way from kidneys to bladder.

The **vestibule** is the common passageway for genital and urinary systems – a urogenital sinus. Its structure is very similar to the vagina; i.e. muscular and dilatable with a stratified, squamous epithelium. It continues back through the pelvis to the vulva, the external opening at the surface of the body. The **vulva** is the only part of the tract which can really be considered as external genitalia and constitutes an opening or *vulval cleft* lying some way below the anus and bounded on either side by thickened lips (*labia*). The area of the body surface surrounding the vulval cleft, the urogenital region (*pudendum*), is part of the perineum which also includes the anus. At the lower boundary of the cleft the lips join to form a pointed projection hanging down below the level of the ischiatic arch. Labia are soft and pliable, containing fat, elastic tissue, smooth muscle and numerous sebaceous glands. During oestrus (heat) they become enlarged and more prominent. They are in fact the female equivalent of the male scrotum developing from the same areas of the embryo.

#### *Bones*

1 13th (last) thoracic vertebra. 2 7th (last) lumbar vertebra. 3 Sacrum (3 fused sacral vertebrae). 4 Lumbar transverse process. 5 Wing of sacrum (enlarged 1st sacral transverse process). 6 Lateral sacral crest (fused 2nd and

3rd sacral transverse processes). 7 Lumbar accessory process. 8 Rib 1. 9 Rib 3. 10 Rib 6. 11 Rib 13 (last or floating rib). 12 Costal arch (fused costal cartilages of ribs 10–12 attached to costal cartilage of rib 9 [last sternal or true rib]). 13 Manubrium of sternum (1st sternebra elongated into base of neck). 14 Pelvic symphysis (cut through in median plane).

#### *Muscles*

15 Longus colli muscle. 16–18 Longissimus muscle. 16 Lumbar part of longissimus muscle. 17 Thoracic part of longissimus muscle. 18 Cervical part of longissimus muscle. 19–21 Semispinal muscle. 19 Thoracic part of semispinal muscle. 20–21 Capital parts of semispinal muscle. 20 Biventer muscle. 21 Complexus muscle. 22–23 Spinal muscle. 22 Thoracic part of spinal muscle. 23 Cervical part of spinal muscle. 24 Multifidus muscle. 25 Cervical intertransverse muscles. 26 Rib levator muscles. 27 Costal retractor muscle. 28–31 Diaphragm. 28 Costal muscle fibres of diaphragm. 29 Central tendinous area of diaphragm. 30 Aortic hiatus of diaphragm (passage of aorta from thorax into abdomen). 31 Oesophageal hiatus of diaphragm (passage of oesophagus into stomach). 32 Sublumbar muscles (cut surface). 33–35 Tail muscles. 33 Tail levators (dorsal sacrocaudal muscles). 34 Tail depressors (ventral sacrocaudal muscles). 35 Lateral tail flexors (caudal intertransverse muscles). 36 Levator ani muscle (major component of pelvic diaphragm). 37 External anal sphincter muscle. 38 Rectococcygeal muscle. 39 Urethral muscle. 40 Anal part of retractor clitoridis muscle (coccygeoanal muscle). 41 Constrictor muscle of vestibule. 42 Constrictor muscle of vulva. 43 Symphyseal tendon (midline fibrous plate attached to pelvic symphysis and providing attachment for adductors and gracilis, the medial thigh muscles).

#### *Heart and blood vessels*

44–48 Heart exposed on removal of left lung. 44 Left atrium of heart. 45 Auricular appendage of left atrium of heart. 46 Left ventricle of heart. 47 Right atrium of heart. 48 Right ventricle of heart. 49 Interventricular groove (denoting position of interventricular septum internally). 50 Pulmonary trunk (leading from right ventricle and dividing into right and left pulmonary arteries). 51 Left pulmonary artery. 52 Pulmonary veins (entering left atrium of heart from lungs). 53 Aortic arch (leading off from left ventricle of heart). 54 Thoracic aorta (continuing aortic arch back through thorax). 55 Brachiocephalic trunk (origin of blood vessels to head and right forelimb). 56 Left common carotid artery. 57 Left subclavian artery (to left forelimb – arising directly from aortic arch). 58 Ligamentum arteriosum (occluded ligamentous representation of a patent foetal communication between aorta and pulmonary trunk, ductus arteriosus, which bypassed lungs in foetal life. Occlusion occurs at birth when lungs expand at first breath).

#### *Lymph nodes*

59 Caudal deep cervical lymph node (only member of deep cervical nodes consistently present). 60 Cranial mediastinal lymph node (one of up to 6 nodes). 61 Middle tracheobronchial lymph node (large node at tracheal bifurcation). 62 Sternal lymph node.

#### *Autonomic nerves*

63 Left vagosympathetic trunk (association of cervical sympathetic trunk and vagus nerve in neck). 64 Left vagus nerve. 65 Left recurrent nerve (hooked around aortic arch prior to ascent of neck on trachea). 66 Dorsal vagal trunk (joins dorsal vagal trunk of right side on oesophagus). 67 Ventral vagal trunk (joins ventral vagal trunk of right side on oesophagus). 68 Cardiovagal nerve.

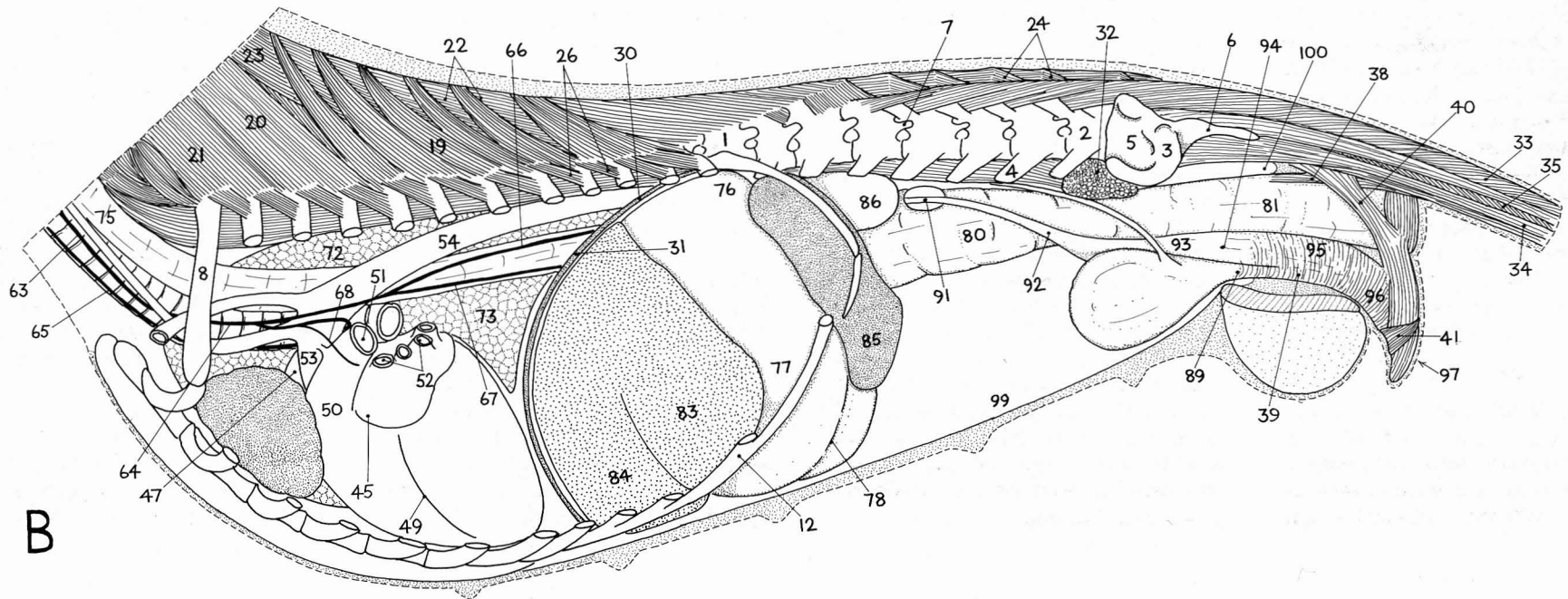
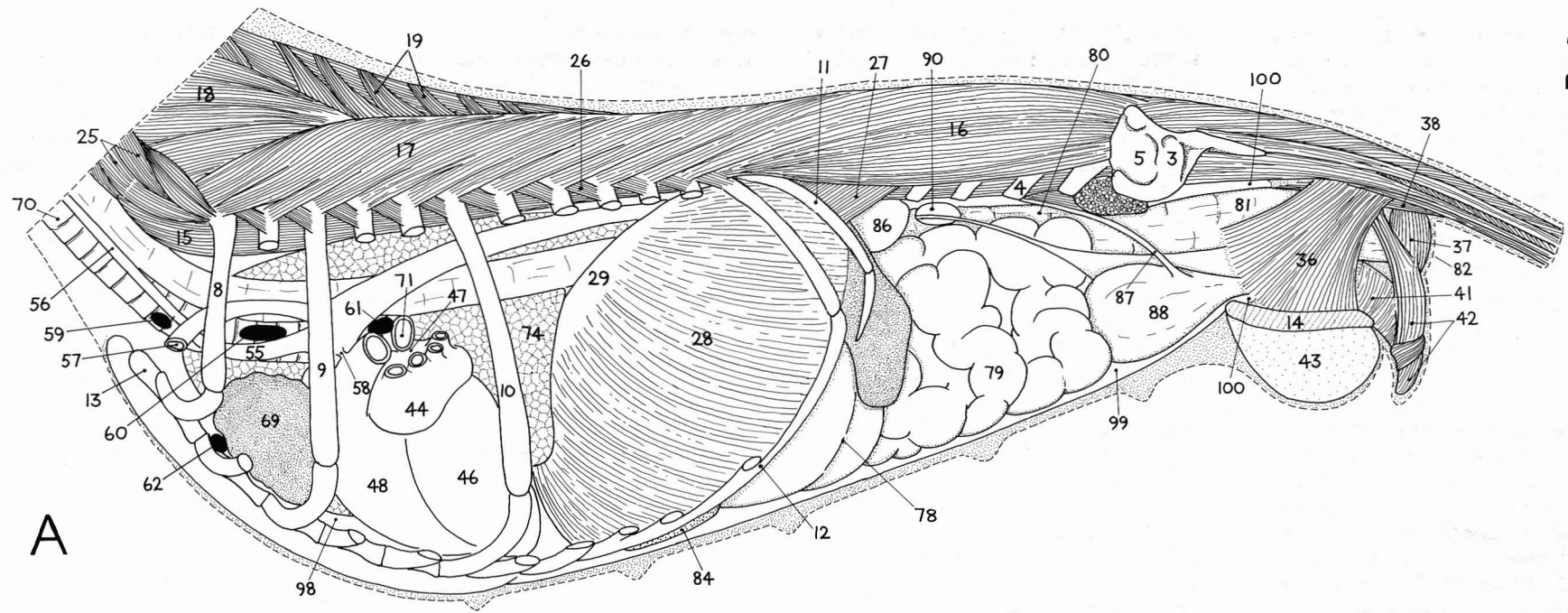
#### *Internal organs*

69 Thymus gland (shown here as the size it might be in a juvenile – in later life regresses considerably although always present). 70 Trachea (windpipe). 71 Left principal bronchus (from tracheal bifurcation). 72 Cranial (apical) lobe of right lung. 73 Caudal (diaphragmatic) lobe of right lung. 74 Intermediate (accessory) lobe of right lung. 75 Oesophagus (gullet). 76–78 Stomach (predominantly on left side of body). 76 Fundus of stomach (bulging dorsally). 77 Body of stomach (orientated transversely). 78 Greater curvature of stomach (facing caudoventrally). 79 Small intestine (numerous coils of jejunum and ileum occupying much of abdominal cavity and removed in B). 80 Descending colon (passing caudally against left flank). 81 Rectum (continuation of colon through pelvis). 82 Anus (surrounded by internal and external anal sphincter muscles). 83–84 Liver (moulded on rear face of diaphragm). 83 Left lateral lobe of liver. 84 Left medial lobe of liver. 85 Spleen (related to stomach and supported in greater omentum). 86 Left kidney. 87 Left ureter. 88 Urinary bladder (receiving ureters from kidneys). 89 Urethra (continuation of neck of bladder). 90 Left ovary. 91 Left uterine (Fallopian) tube (closely related to ovary). 92 Left uterine horn. 93 Body of uterus (formed from fusion of uterine horns). 94 Position of cervix of uterus (sphincteric neck terminating uterine body). 95 Vagina (continuing cervix into pelvic cavity). 96 Vestibule (urogenital sinus, direct caudal continuation of vagina, entry of urethra marking vaginovestibular junction). 97 Vulva (external genitalia – consisting of vulvar cleft surrounded by labia).

#### *Body cavities*

98 Thoracic cavity. 99 Abdominal cavity. 100 Pelvic cavity (in continuity with abdominal cavity through pelvic inlet).





of the duct — sperm at this stage are *still* in effect non-motile.

Beyond the point of entry of the sperm ducts the **urethra** is a common passage for both sperm and urine, but the flows obviously occur at different times. It continues through the pelvis and penis opening at the tip of the glans. As you may see from the drawing (B) the point of entry of sperm ducts into urethra is surrounded by the **prostate gland**. The ejaculate (semen) is a combination of sperm from the testes and fluid from the prostate emptied into the urethra through numerous minute openings. It is somewhat difficult to suggest what prostatic fluid actually does although it has been suggested that it provides an energy source for the sperm because it contains some simple sugars. It might also alter the composition of the fluid in which the sperm is carried. In the epididymis fluid becomes increasingly acid because sperm concentration leads to a build up of carbon dioxide produced by their respiratory activity. Prostatic secretion may neutralize this acidity producing the required 'environment' in which sperm can develop to the full their capacity for independent mobility. A further possible function for prostatic fluid will be mentioned later when the mechanics of copulation are considered.

#### *Bones, joints and ligaments*

**1** Transverse process of thoracic vertebra **4**. **2** 13th (last) thoracic vertebra. **3** Transverse process of lumbar vertebra **4**. **4** 7th (last) lumbar vertebra. **5** Median sacral crest (fused sacral spinous processes). **6** Wing of sacrum (enlarged 1st sacral transverse process). **7** Lateral sacral crest (fused 2nd and 3rd sacral transverse processes). **8** Caudal vertebra **1**.

**9** Accessory processes on caudal thoracic and lumbar vertebrae. **10** Mammillary processes on thoracic and lumbar vertebrae. **11** Inter-vertebral foramen (for passage of spinal nerves and vessels). **12** Supraspinous ligament. **13** Nuchal ligament. **14** Rib **1**. **15** Rib **3**. **16** Rib **6**. **17** Rib **13** (last or floating rib). **18** Costal arch (fused costal cartilages of ribs 10-12 [asternal or false ribs] associated with costal cartilage of rib **9** [last sternal or true rib]). **19** Manubrium of sternum (1st sternebra elongated into base of neck). **20** Wing of ilium of hip bone. **21** Crest of ilium. **22** Coxal tuberosity of ilium (point of haunch). **23** Sacral tuberosity of ilium (point of croup). **24** Ischium of hip bone. **25** Ischiatic spine. **26** Greater ischiatic notch. **27** Lesser ischiatic notch. **28** Ischiatic tuberosity (point of buttock). **29** Pubis of hip bone. **30** Pubic pecten. **31** Obturator foramen. **32** Acetabular fossa of hip bone. **33** Pelvic symphysis.

#### *Muscles*

**34** Symphyseal tendon (fibrous midline plate attached to pelvic symphysis and serving for origin of medial thigh muscles). **35** Sub-lumbar muscles. **36** Longus colli muscle. **37**—**41** Transversospinal muscles. **37** Lumbar part of multifidus muscle. **38** Thoracic part of multifidus muscle. **39** Rib levator muscles. **40** Rotator muscles. **41** Interspinal muscles. **42**—**44** Diaphragm. **42** Costal muscle fibres of diaphragm. **43** Central tendinous area of diaphragm. **44** Caval foramen of diaphragm (passage of caudal vena cava). **45** Tail depressors (ventral sacrocaudal muscles). **46** Tail levators (dorsal sacrocaudal muscles). **47** Lateral tail flexors (caudal intertransverse muscles). **48** Diagrammatic representation of position of inguinal canal. **49**—**50** Pelvic diaphragm. **49** Coccygeus muscle. **50** Levator ani muscle. **51**—**54** Urogenital diaphragm. **51** Urethral muscle (around pelvic urethra). **52**

Bulbospongiosus muscle (covering surface of penile bulb). **53** Retractor penis muscle. **54** Ischiocavernosus muscle (on root of penis attached to ischiatic arch). **55**—**57** Anal diaphragm. **55** External anal sphincter muscle. **56** Rectococcygeal muscle. **57** Anal part of retractor penis muscle.

#### *Heart and blood vessels*

**58**—**59** Heart. **58** Right atrium of heart. **59** Right ventricle of heart. **60** Coronary groove of heart. **61** Caudal vena cava (returning blood from rear end of body to heart). **62** Cranial vena cava (returning blood from front end of body to heart). **63** External jugular vein. **64** Internal thoracic (mammary) vein. **65** Subclavian vein (draining blood from forelimb). **66** Costocervical vertebral trunk. **67** Azygos vein.

#### *Autonomic nerves*

**68** Vagosympathetic trunk (association of vagus nerve and cervical sympathetic trunk). **69** Vagus nerve. **70** Dorsal vagal trunk. **71** Ventral vagal trunk. **72** Recurrent nerve. **73** Subclavian loop of sympathetic trunk (sub-division of trunk around subclavian artery). **74** Cervicothoracic (stellate) sympathetic ganglion (fused last cervical and first three thoracic sympathetic trunk ganglia). **75** Sympathetic trunk. **76** Vertebral nerve (transverse nerve — combined grey communicating rami to cervical nerves).

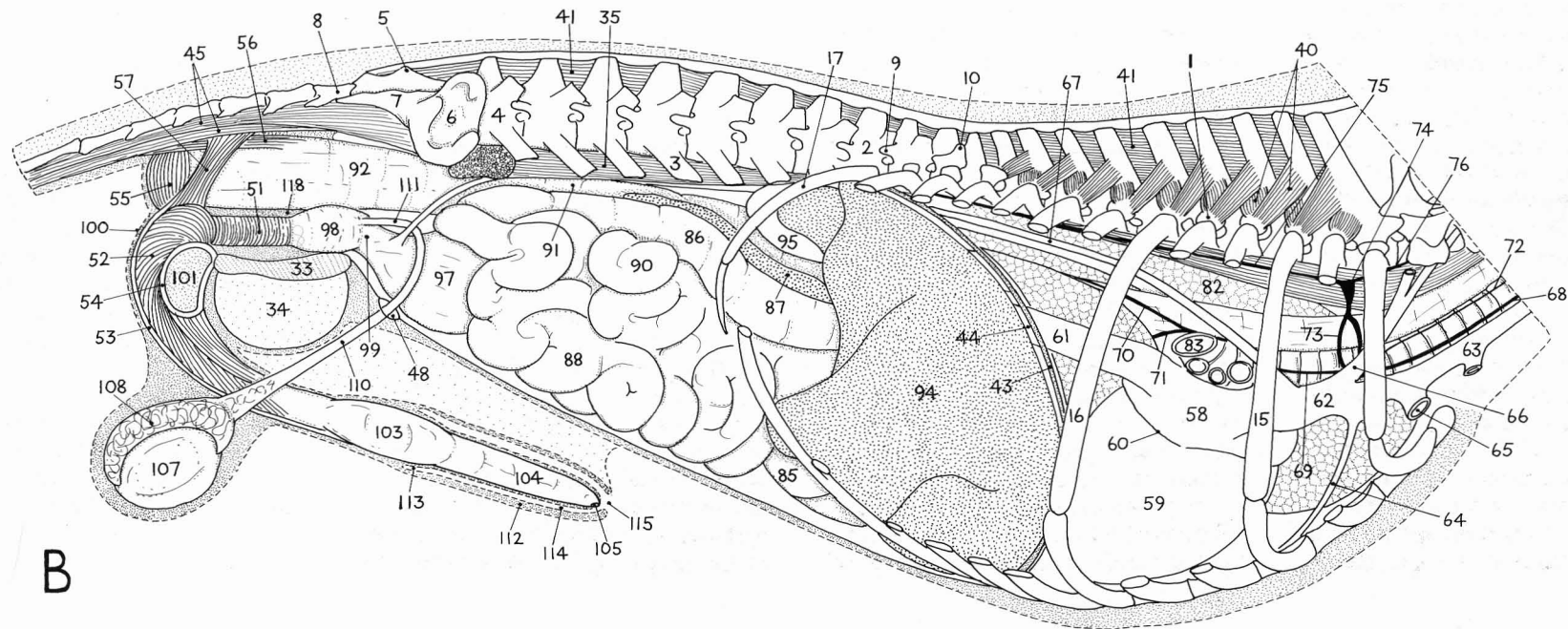
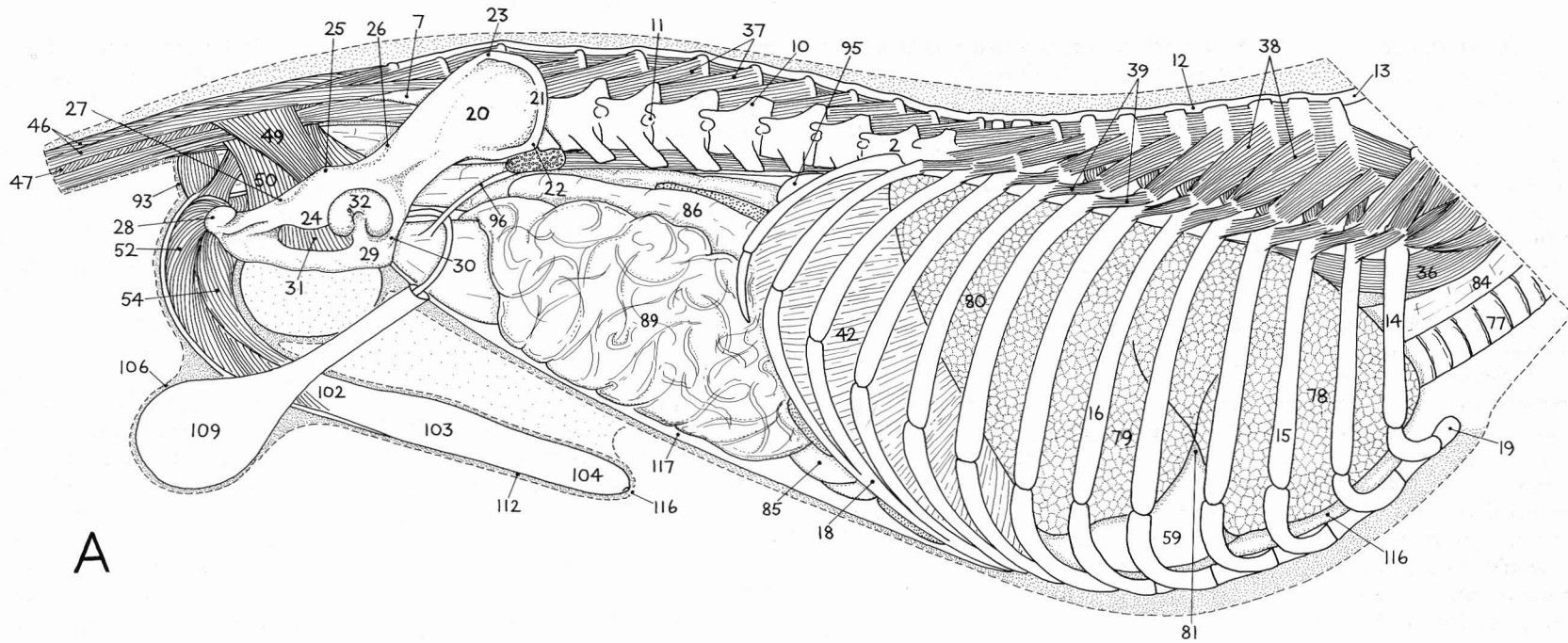
#### *Internal organs*

**77** Trachea (windpipe). **78**—**81** Right lung. **78** Cranial (apical) lobe of right lung. **79** Middle (cardiac) lobe of right lung. **80** Caudal (diaphragmatic) lobe of right lung. **81** Cardiac notch in ventral border of right lung. **82** Left lung (partly visible). **83** Principal bronchus of right side (arising from tracheal bifurcation). **84** Oesophagus (gullet). **85** Stomach (only

just visible on right side). **86** Descending duodenum (passing back against right flank). **87** Pancreas. **88** Small intestine (coils of jejunum and ileum in abdominal floor). **89** Greater omentum (enlarged and modified dorsal mesogastrium). **90** Caecum (in centre of right flank). **91** Descending colon. **92** Rectum (continuing colon through pelvis). **93** Anus. **94** Liver. **95** Right kidney. **96** Right ureter. **97** Urinary bladder (receiving ureters from kidneys). **98** Prostate gland (surrounding pelvic urethra at pelvic inlet). **99** Urethra (continuation of neck of bladder). **100** Penile (urethral) bulb (at root of penis). **101** Right crus of penis (attached to ischiatic arch medial to ischiatic tuberosity — cut through after removal of hip bone). **102** Body of penis (commences at merging of penile crura). **103**—**104** Glans penis. **103** Bulbus glandis (expansion of erectile tissue at base of glans penis). **104** Pars longa glandis (bulk of glans penis containing os penis). **105** External urethral orifice (at free end of glans penis). **106** Scrotum (containing testes). **107** Testis. **108** Epididymis (appendage of testis containing epididymal duct in which sperm is stored and concentrated). **109** Vaginal process of parietal peritoneum. **110** Spermatic cord (composed of testicular blood vessels and vas deferens located within vaginal process). **111** Vas deferens (conveying sperm away from testis). **112** Sheath (prepuce). **113** Preputial fornix (at which sheath reflects onto glans penis). **114** Preputial cavity (around glans penis). **115** Preputial orifice (at tip of penis and leading into preputial cavity).

#### *Body cavities*

**116** Thoracic cavity (separated from abdominal cavity by diaphragm). **117** Abdominal cavity. **118** Pelvic cavity (in continuity with abdominal cavity through pelvic inlet).





circular in section as is the pelvic inlet. However, since the ilia of the pelvic girdle slope strongly down and back from their sacral articulations, the pubic brim lies ventral to the sacrocaudal boundary and the inlet is set at an oblique angle to the long axis of the body. Since the pelvic roof is longer than the floor the pelvic outlet although still oblique is more upright than the inlet. However, the longitudinal axis of the pelvic canal remains more or less horizontal.

As you can see from **D**, compared with the abdomen *the pelvic cavity is small, and considerably smaller than the surface contour of the pelvic region would suggest*. The cavity is reduced further in size by the pelvic diaphragm whose muscles close off the caudolateral part of the pelvic cavity (where the walls are lacking in musculoskeletal support) from the perineum and ischioanal fossae caudally and laterally.

The outer contour of the **peritoneal cavity** (disposition of parietal peritoneum) is shown in **D** by the broken line. Abdominal and peritoneal cavities are coincident in surface projection but in the pelvis the peritoneal cavity is considerably less in size than the pelvic cavity since much of the caudal and lateral parts of the pelvic cavity are 'excluded' by the pelvic diaphragm. Even within the restricted pelvic cavity the terminal parts of the digestive and urogenital tracts are still not peritoneal structures but are retroperitoneal in position, embedded in loose connective tissue. The extent of this retroperitoneal component is indicated by the close stippling in **D**. The peritoneal cavity

actually terminates caudally as a series of blind-ending pockets between pelvic viscera particularly clearly illustrated in the pelvis diagrams (figs 29C & 29F).

The parietal peritoneum of the abdomen is also extended on either side caudally as the **vaginal processes** projecting through the inguinal canals into the scrotum. The cavities of the processes remain in communication with the peritoneal cavity in the abdomen throughout life and represent persistent 'flaws' in the abdominal wall always presenting the potential for herniation of abdominal contents. An additional site at which herniation is not uncommon is the umbilicus (navel).

#### *Surface features and topographical regions*

**1** Scapular region (shoulder). **2** Position of shoulder joint. **3** Brachial region (arm). **4** Olecranon region. **5** Tricipital margin of arm (based on long head of triceps muscle). **6** Interscapular region (withers). **7** Thoracic vertebral region (back). **8** Lumbar region (loins). **9** Lateral boundary of iliocostal muscle (ventral extent of epaxial musculature). **10** Gluteal region (rump). **11** Coxal tuberosity region (point of haunch). **12** Hip joint region. **13** Clunial region (including ischioanal fossa). **14** Root of tail. **15** Femoral region (thigh). **16** Cranial margin of thigh (based on sartorius muscle). **17** Presternal region (breast). **18** Sternal region (brisket). **19** Costal region (thorax, chest or rib region). **20** Cardiac region. **21** Axilla (armpit between muscles of arm and shoulder and muscles of chest wall). **22** Hypochondriac region. **23** Xiphoid region. **24** Lateral abdominal region (flank). **25** Fold of flank. **26** Umbilical region (belly). **27** Inguinal region. **28** Pubic region. **29** Preputial region (prepuce [sheath] surrounding glans penis). **30** Anus. **31** Penile (urethral) bulb (in

root of penis). **32** Scrotum.

#### *Bones, joints and ligaments*

**33** Median sacral crest. **34** 1st thoracic spinous process. **35** 1st lumbar spinous process. **36** Lumbar transverse processes. **37** Sternum (breastbone). **38** Manubrium of sternum (1st sternebra elongated into base of neck). **39** Rib 1 (bordering thoracic inlet). **40** Rib 3. **41** Rib 6. **42** Rib 13 (last or floating rib). **43** Costal arch (fused costal cartilages of ribs 10–12 attached to costal cartilage of rib 9). **44** Dorsal (vertebral) border of scapula. **45** Cranial angle of scapula. **46** Caudal angle of scapula. **47** Spine of scapula. **48** Acromion process of scapula. **49** Greater tuberosity of humerus (point of shoulder). **50** Olecranon process of ulna (point of elbow). **51** Crest of ilium. **52** Coxal tuberosity of ilium (point of haunch). **53** Sacral tuberosity of ilium (point of croup). **54** Pubic pecten. **55** Ischiatic tuberosity (point of buttock). **56** Greater trochanter of femur. **57** Sacrotuberous ligament.

#### *Surface projections of body cavities*

**58** Surface projection of outer boundary of thoracic cavity – endothoracic fascia lining thoracic cavity (unbroken line incorporating 1st rib [39], sternum [37], costal arch [43] and last rib [42]). **59** Contour of diaphragm in median plane of body. **60** Surface projection of outer boundary of abdominal cavity – transversalis fascia lining abdominal cavity (unbroken line incorporating diaphragm [59]). **61** Surface projection of outer boundary of pelvic cavity – pelvic fascia lining pelvic cavity (unbroken line continuous with outer abdominal boundary at pelvic inlet). **62** Thoracic inlet (bordered by 1st ribs, thoracic vertebra 1 and sternal manubrium). **63** Pelvic inlet (more or less rounded opening at an oblique angle to long axis of body and bordered above by sacral promontory, below by cranial borders

of pubic bones and on either side by arcuate lines on ilia – boundary indicated by dotted line). **64** Pelvic outlet (roughly triangular opening bordered above by caudal vertebra 3, below by ischiatic arch and ischiatic tuberosities and on either side by sacrotuberous ligaments).

#### *Surface projection of coelomic cavities*

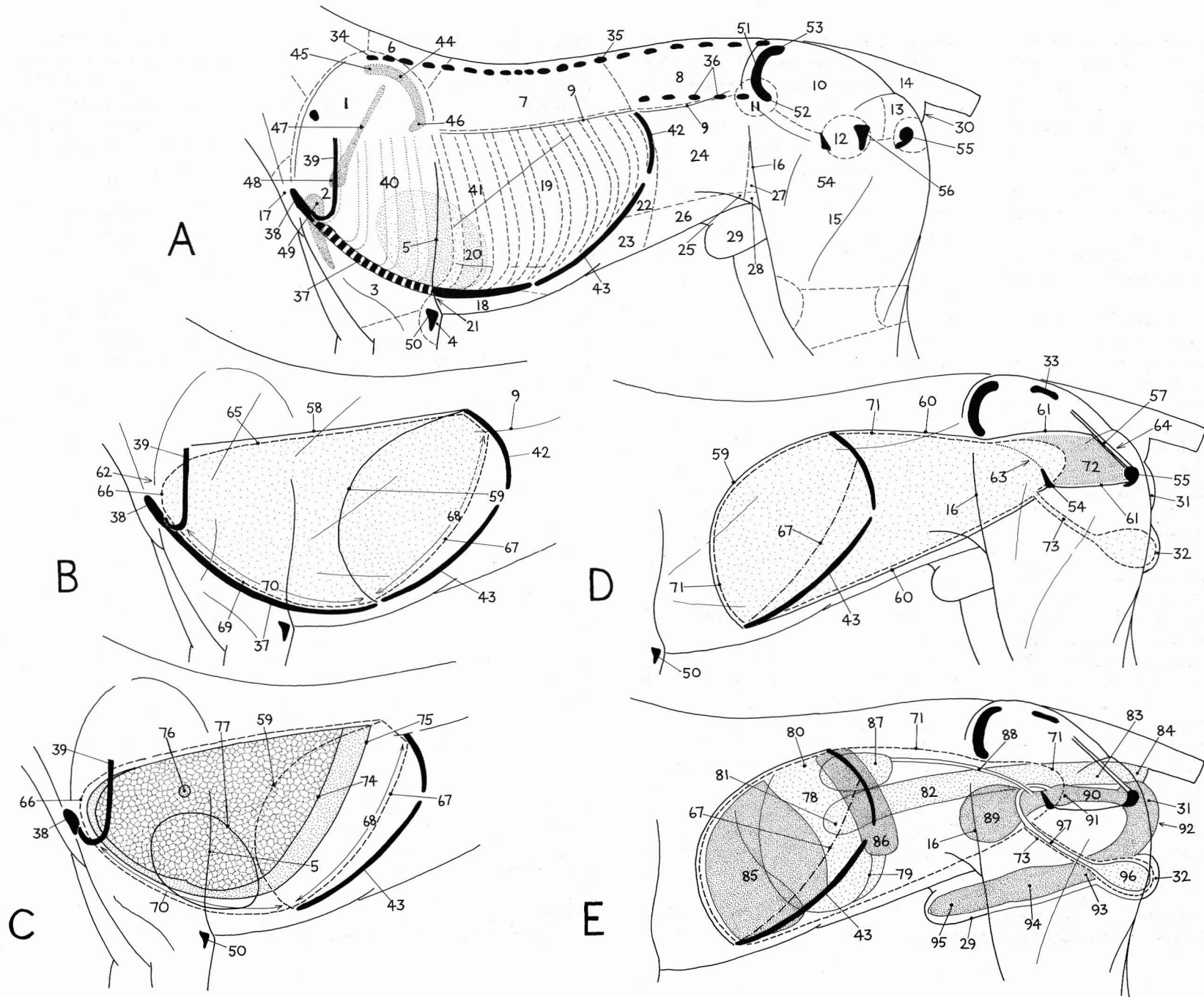
**65** Surface projection of outer boundary of left pleural cavity (parietal [costal] pleura – indicated by broken line). **66** Pleural pocket of left pleural cavity. **67** Costodiaphragmatic line of pleural reflection. **68** Position of costodiaphragmatic recess of left pleural cavity. **69** Costomediastinal line of pleural reflection. **70** Position of costomediastinal recess of left pleural cavity. **71** Surface projection of outer boundary of peritoneal cavity in abdomen and pelvis (parietal peritoneum – indicated by broken line). **72** Retroperitoneal component of pelvic cavity (indicated by dense stipple). **73** Vaginal process from peritoneal cavity in abdomen (projecting through inguinal canal).

#### *Surface projections of thoracic viscera*

**74** Surface projection of left lung at maximal expiration. **75** Surface projection of left lung at maximal inspiration. **76** Position of tracheal bifurcation. **77** Heart.

#### *Surface projections of abdominal and pelvic viscera*

**78** Stomach. **79** Greater curvature of stomach. **80** Fundus of stomach. **81** Transverse colon. **82** Descending colon. **83** Rectum (continuing colon through pelvic cavity). **84** Anal canal. **85** Liver. **86** Spleen. **87** Left kidney. **88** Left ureter. **89** Urinary bladder. **90** Pelvic urethra. **91** Prostate gland. **92** Root of penis. **93** Body of penis. **94–95** Glans of penis. **94** Bulbus glandis. **95** Pars longa glandis. **96** Left testis. **97** Left vas deferens.



# 24

## SURFACE PROJECTIONS OF THORACIC, ABDOMINAL AND PELVIC VISCERA OF THE BITCH FROM THE RIGHT SIDE

As a complement to the five preceding drawings of a dog from the left side, these five outline sketches are of a bitch from the right side. The significant difference in the chest is that on the right (D) the ventral border of the lung is indented with a **cardiac notch** through which the heart gains greater contact with the chest wall at the lower ends of intercostal spaces 4 or 5. The cavity of the heart in this area is the right ventricle.

In E the lung is again considered but from the point of view of auscultation — listening to the sounds emanating from a lung. You might think that lung sounds could be heard from any point at which a lung is in contact with the chest wall. Not so, however, since for instance caudally, lung tissue in the region of the basal border of the lung has little depth where it occupies the costodiaphragmatic recess. Dorsally also, the upper limit of a lung is some distance in from the body surface covered by the epaxial muscles (iliocostal and longissimus). Consequently there is a roughly triangular minimum area of constant contact between lung and chest wall mapped by three construction lines:

Cranial boundary — the tricipital margin of the upper arm extending more or less vertically from point of elbow to caudal angle of scapula, roughly cor-

responding to rib 5.

Dorsal boundary — the ventral limit of the epaxial muscle mass from rib 5 caudally to intercostal space 11, corresponding to a line from the caudal angle of the scapula to the coxal tuberosity of the pelvic bone.

Caudoverventral boundary — an oblique line from the upper end of the penultimate intercostal space (at the ventral border of the epaxial musculature) to the point of the elbow at the lower end of intercostal space 6, crossing the middle of rib 8.

### *Surface features and topographical regions*

1 Scapular region (shoulder). 2 Shoulder joint region. 3 Brachial region (arm). 4 Olecranon region. 5 Tricipital margin of arm (based on long head of triceps muscle and in a normal standing position approximately at the level of rib 5). 6 Interscapular region (withers). 7 Thoracic vertebral region (back). 8 Lumbar region (loins). 9 Lateral boundary of iliocostal muscle (ventral extent of epaxial musculature). 10 Gluteal region (rump). 11 Coxal tuberosity region (haunch). 12 Hip joint region. 13 Clunial region (including ischioanal fossa). 14 Root of tail. 15 Femoral region (thigh). 16 Cranial margin of thigh (based on sartorius muscle). 17 Pre-sternal region (breast). 18 Sternal region (brisket). 19 Costal region (thorax, chest or rib region). 20 Cardiac region. 21 Axilla (armpit between muscles of arm and shoulder and muscles of chest wall). 22 Hypochondriac region. 23 Xiphoid region. 24 Lateral abdominal region (flank). 25 Fold of flank. 26 Umbilical region. 27 Inguinal region. 28 Pubic region. 29 Anus.

### *Bones, joints and ligaments*

30 Median sacral crest. 31 1st thoracic spinous process. 32 1st lumbar spinous

process. 33 Lumbar transverse processes. 34 Sternum (breastbone). 35 Manubrium of sternum (sternebra 1 elongated into base of neck). 36 Rib 1 bordering thoracic inlet. 37 Rib 13 (last or floating rib). 38 Costal arch (fused costal cartilages of ribs 10–12 attached to costal cartilage of rib 9). 39 Dorsal (vertebral) border of scapula. 40 Cranial angle of scapula. 41 Caudal angle of scapula. 42 Spine of scapula. 43 Acromion process of scapula. 44 Greater tuberosity of humerus (point of shoulder). 45 Olecranon process of ulna (point of elbow). 46 Crest of ilium. 47 Coxal tuberosity of ilium (point of haunch). 48 Sacral tuberosity of ilium (point of croup). 49 Pubic pecten. 50 Ischiatic tuberosity (point of buttock). 51 Greater trochanter of femur.

### *Surface projections of body cavities*

52 Surface projection of outer boundary of thoracic cavity — endothoracic fascia lining thoracic cavity (unbroken line incorporating 1st rib [36], sternum [34], costal arch [38] and last rib [37]). 53 Contour of diaphragm in median plane of body. 54 Surface projection of outer boundary of abdominal and pelvic cavities — transversalis and pelvic fascia lining abdominal and pelvic cavities (unbroken line incorporating diaphragm [53]). 55 Thoracic inlet (bordered by 1st ribs, thoracic vertebra 1 and sternal manubrium). 56 Pelvic inlet (more or less rounded opening bordered above by sacral promontory, below by cranial borders of pubic bones and on either side by arcuate lines on ilia). 57 Pelvic outlet (roughly triangular opening bordered above by caudal vertebra 3, below by ischiatic arch and ischiatic tuberosities and on either side by sacrotuberous ligaments).

### *Surface projections of coelomic cavities*

58 Surface projection of outer boundary of right pleural cavity (parietal [costal] pleura —

broken line). 59 Pleural pocket of right pleural cavity. 60 Costodiaphragmatic line of pleural reflection. 61 Position of costodiaphragmatic recess of right pleural cavity. 62 Costomediastinal line of pleural reflection. 63 Position of costomediastinal recess of right pleural cavity. 64 Surface projection of outer boundary of peritoneal cavity in abdomen and pelvis (parietal peritoneum — broken line). 65 Retroperitoneal component of pelvic cavity (dense stipple).

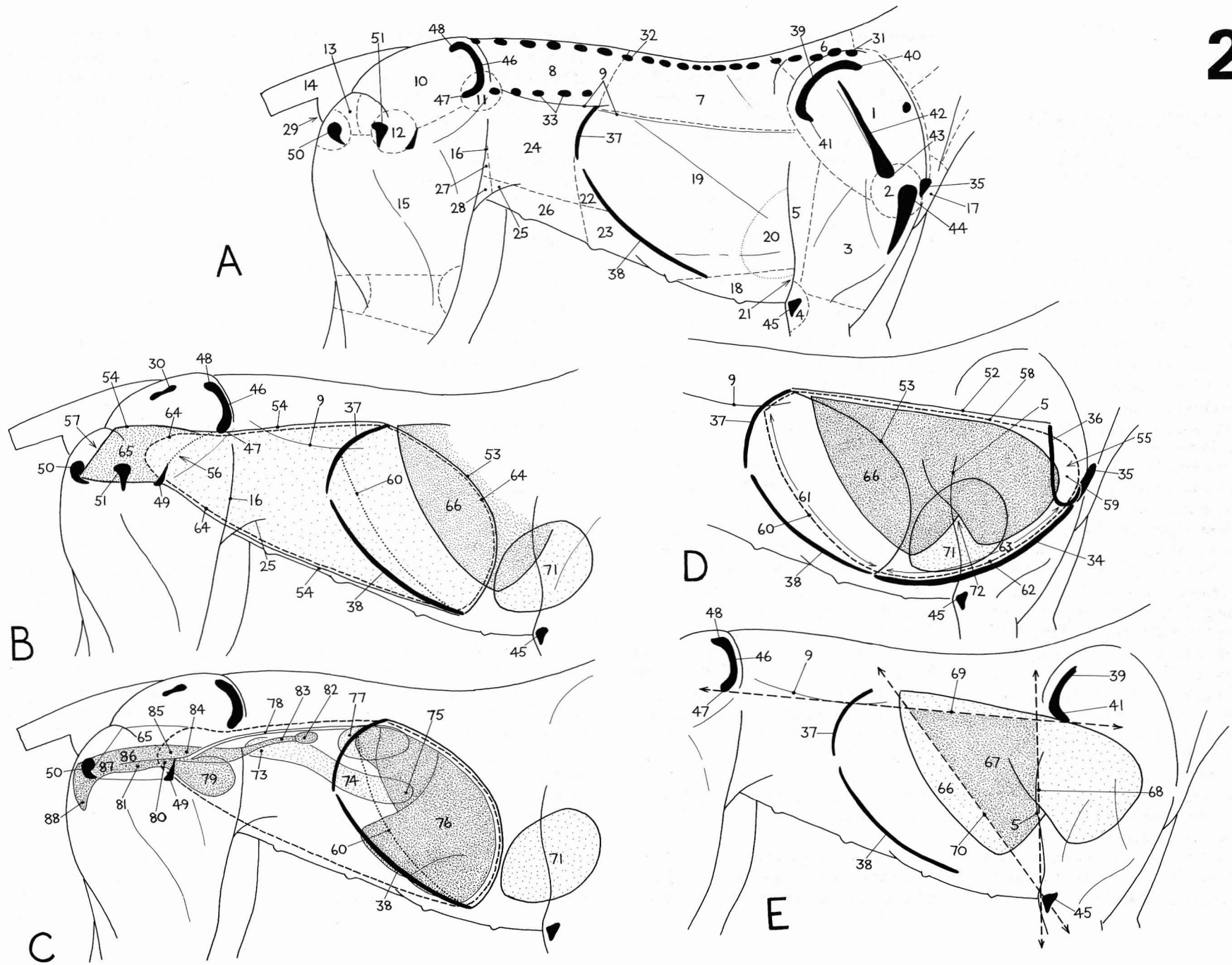
### *Surface projections of thoracic viscera*

66 Surface projection of right lung at maximal expiration (dense stipple). 67 Area of auscultation of lung. 68–70 Borders of auscultatory area. 68 Cranial border (tricipital margin in standing animal, from caudal angle of scapula to point of elbow roughly corresponding to rib 5). 69 Dorsal border (lower border of epaxial musculature from rib 5 caudally to intercostal space 11 approximately on a line from caudal angle of scapula to coxal tuberosity roughly paralleling vertebral column). 70 Caudoverventral (basal) border (from point of elbow at lower end of intercostal space 6 to upper end of intercostal space 11 and crossing middle of rib 8). 71 Heart. 72 Cardiac notch in ventral border of right lung.

### *Surface projections of abdominal and pelvic viscera*

73 Duodenal loop. 74 Ascending duodenum. 75 Duodenojejunal flexure. 76 Liver. 77 Right kidney. 78 Right ureter. 79 Urinary bladder. 80 Neck of bladder. 81 Urethra. 82 Right ovary. 83 Right uterine horn. 84 Uterine body. 85 Position of uterine cervix. 86 Vagina. 87 Vestibule. 88 Vulva.





the fat that is normally present filling the spaces between muscles in the socket and displaces it forwards around the eyeball. The movement of fat pushes on the stem of the T which moves the third eyelid across the cornea. In a starved, emaciated dog, orbital fat has often been used up so its eyeball becomes sunken and its third eyelid is allowed to protrude permanently across its eyeball.

#### *Surface features*

**1** Nasal plane. **2** External nostril (leading into nasal vestibule surrounded by nasal cartilages). **3–7** Lips (surrounding mouth opening – oral fissure). **3** Upper lip (supporting superior labial sensory hairs). **4** Lower lip. **5** Philtrum. **6** Wing of nostril. **7** Commissure of lips (at angle of mouth). **8** Prominence of chin (mentum – supporting mental sensory hairs). **9** Sensory hairs of face (supraorbital, zygomatic, buccal, intermandibular). **10** Foreface. **11** Stop. **12** Forehead. **13** Cheek (based on buccinator muscle). **14** Eyeball (situated in orbit and protected by bony orbital rim – outline of eyeball indicated by broken line in orbit in fig C). **15–17** Eyelids (surrounding palpebral fissure). **15** Upper eyelid (supporting cilia – eyelashes). **16** Lower eyelid. **17** Third eyelid (nictitating membrane). **18** Position of lacrimal puncta in eyelids. **19** Lacrimal caruncle. **20** Medial angle of eye. **21** Lateral angle of eye. **22** Iris (visible through cornea). **23** Sclera (white of eye). **24** Pinna of ear (visible part of external ear). **25** Helix (scapha of auricular cartilage). **26** Cranial margin of helix with spine. **27** Marginal cutaneous pouch of pinna. **28** Tragi (prominent hairs at opening of ear canal). **29** External opening of ear canal (facing dorsally). **30** Anthelix. **31** Pretragic notch. **32** Intertragic notch. **33** Tragus of conchal part of auricular cartilage. **34–37** Tongue. **34** Apex

of tongue. **35** Body of tongue. **36** Root of tongue. **37** Circumvallate taste buds of tongue. **38** Lingual frenulum. **39** Palatoglossal fold. **40** Palatine tonsil (in tonsillar fossa). **41** Epiglottis (based on epiglottic cartilage). **42** Soft palate. **43** Palatine ridges of hard palate. **44** Sublingual papilla (opening of mandibular and sublingual salivary gland ducts). **45** Sublingual fold of mucosa (on course of salivary gland ducts). **46** Gums (gingivae). **47** Carnassial (shearing) teeth (upper premolar 4 and lower molar 1). **48** Jugular groove. **49** Neck. **50** Throat.

#### *Bones*

**51** Facial region of skull (based on nasal cavity and jaws). **52** Nasal bone. **53** Nasal process of incisive bone (bordering entry into bony part of nasal cavity). **54** Maxillary bone (forming much of lateral surface of muzzle). **55** Infraorbital foramen. **56** Alveolar border of maxillary bone (bearing teeth of upper dental arch). **57–63** Mandible (lower jaw). **57** Body of mandible. **58** Angular process of mandible. **59** Masseteric fossa of mandibular ramus (insertion of masseter muscle). **60** Coronoid process of mandible (insertion of temporal muscle). **61** Alveolar border of mandible (bearing teeth of lower dental arch). **62** Mandibular symphysis. **63** Mental foramina. **64** Cranial region of skull (braincase). **65** Orbit (housing and protecting eyeball). **66** Bony orbital rim (from frontal, maxillary and zygomatic bones). **67** Zygomatic process of frontal bone. **68** Zygomatic arch (bridge of bone connecting face and cranium below eye). **69** Orbital ligament (completing orbital rim). **70** Temporal line of frontal bone (rostral divergence of external sagittal crest). **71** External sagittal crest (in dorsal midline of cranium). **72** External occipital protuberance (occiput). **73** Nuchal crest (dividing caudal from lateral surface of cranium). **74** Mastoid process of

temporal bone (sole representation on skull surface of petrous temporal bone). **75** Temporomandibular joint (position shown by broken circle in fig A). **76–78** Hyoid apparatus (support for tongue and larynx in floor of throat). **76** Cranial horn of hyoid (in wall of pharynx – composed of tympanohyoid cartilage, epihyoid, stylohyoid and ceratohyoid bones). **77** Basihyoid bone (transverse bar of bone located in musculature of tongue root and linking horns of left and right sides). **78** Thyrohyoid bone (caudal horn of hyoid in wall of laryngopharynx linking basihyoid with thyroid cartilage of larynx). **79–81** Laryngeal cartilages. **79** Epiglottic cartilage. **80** Thyroid cartilage (most prominent with ventral border forming laryngeal prominence of 'voice box'). **81** Cricoid cartilage. **83** Dorsal arch of atlas. **84** Lateral vertebral foramen of atlas (intervertebral foramen 1 for passage of 1st cervical spinal nerve and vertebral artery). **85** Wing of atlas. **86** Spinous process of axis. **87** Transverse foramina of transverse canal (passage of vertebral blood vessels). **88** Atlantooccipital joint. **89** Atlantoaxial joint.

#### *Nasal and auricular cartilages*

**90–93** Nasal cartilages (surrounding vestibule and supporting mobile part of nose). **90** Nasal septum. **91** Dorsolateral nasal cartilage. **92** Ventrolateral nasal cartilage. **93** Accessory nasal cartilage. **94–98** Auricular cartilage (surrounding ear canal and supporting pinna of ear). **94** Scapha of auricular cartilage (outer leaf-like portion). **95** Antitragus of caudal border of helix. **96** Medial crus of helix. **97** Lateral crus of helix. **98** Concha of auricular cartilage (basal rolled tubular portion). **99** Position of external acoustic meatus (at base of concha facing laterally across which eardrum stretched in life – shown in broken line in fig C). **100** Scutiform cartilage (lying on temporal muscle rostral to ear).

#### *Muscles*

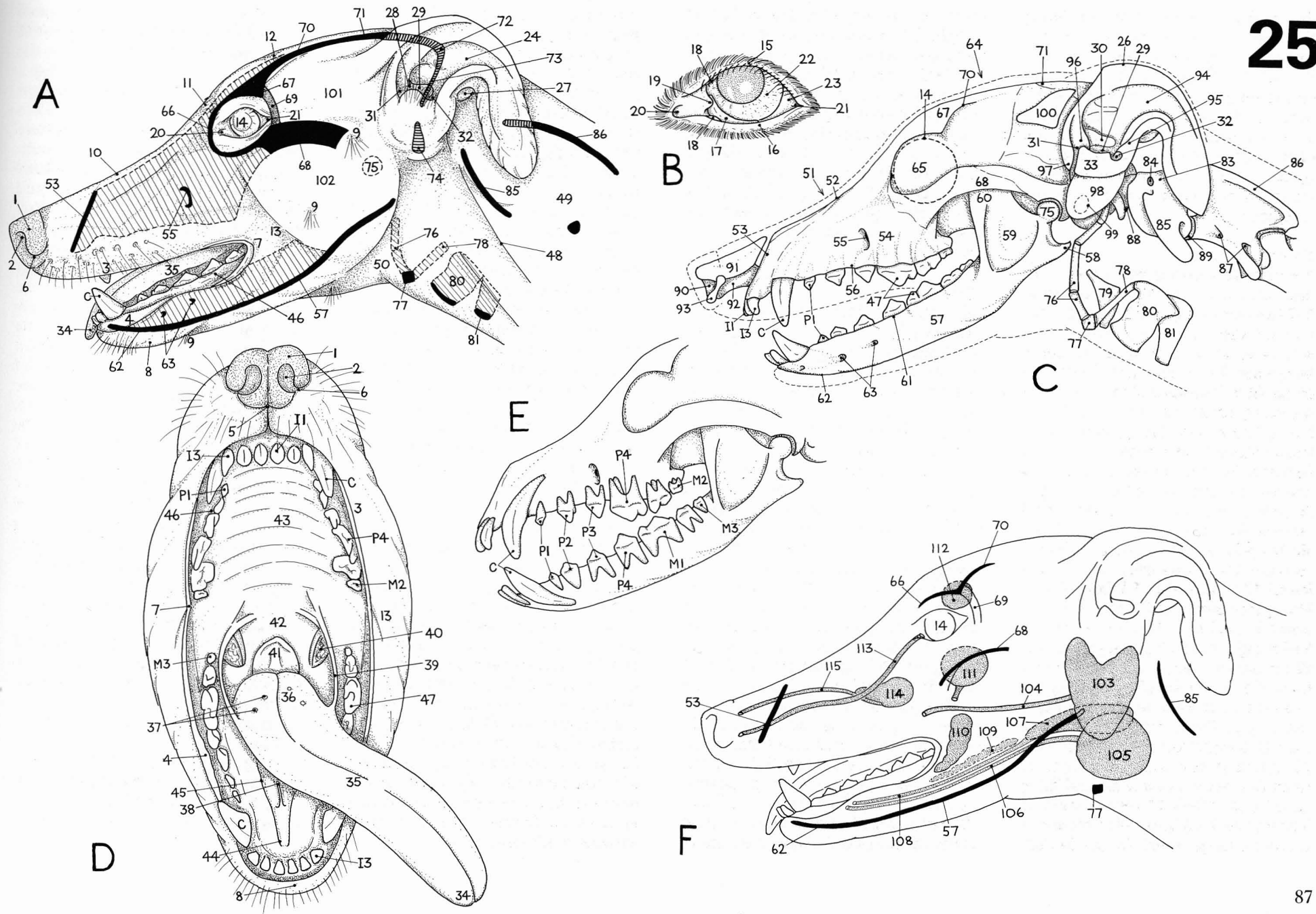
**101–102** Jaw closure muscles. **101** Temporal muscle. **102** Masseter muscle.

#### *Glandular structures of head in surface projection*

**103** Parotid salivary gland (surrounding concha of auricular cartilage). **104** Parotid salivary gland duct (opening into oral vestibule through cheek opposite upper premolar 4). **105** Mandibular salivary gland. **106** Mandibular salivary gland duct (opening at rostral end of floor of oral cavity proper on sublingual caruncle to side of lingual frenulum). **107** Sublingual salivary gland, monostomatic part. **108** Sublingual salivary gland duct (accompanies duct of mandibular gland). **109** Sublingual gland, polystomatic part (diffuse lobules alongside mandibular duct opening separately in floor of mouth). **110–111** Buccal salivary glands. **110** Ventral buccal glands (intermingled with fibres of buccinator and orbicularis oris muscles in cheek). **111** Zygomatic gland (consolidation of dorsal buccal glands in base of orbit below eyeball emptying into oral vestibule caudal to parotid duct). **112** Lacrimal gland (beneath supraorbital process of frontal bone and emptying into conjunctival sac). **113** Nasolacrimal duct (leading from lacrimal ducts from lacrimal puncta at medial angle of eye – runs through wall of nasal cavity to empty into nasal vestibule below alar fold). **114** Lateral nasal gland (located in wall of maxillary recess). **115** Duct of lateral nasal gland (opening in nasal vestibule above alar fold).

#### *Teeth*

**I1–I3** Incisor teeth 1–3. **C** Canine tooth. **P1–P4** Premolar teeth 1–4. **M1–M3** Molar teeth (1–2 upper and 1–3 lower).  
(D after Taylor, 1955)





with a forcible attempt to breathe out by abdominal tension is the basis of straining activities. Air cannot escape through the glottis and is retained in the trachea and lungs raising intrathoracic pressure. In turn this raises pressure in the abdomen and pelvis necessary for evacuative procedures. Sudden opening of the glottis after such a pressure rise is also the basis of coughing. Once swallowing has occurred the various pharyngeal structures return to their original positions, the glottis opens, and breathing movements can recommence.

Although the trachea can be felt through the skin in the ventral midline of the neck, it is still covered by a layer of muscles of the undersurface of the neck (sternohyoid and sternothyroid) running forwards from sternum and first costal cartilage to the hyoid apparatus and larynx in the throat just behind and between the angles of the lower jaws. They form a continuation of the strap muscles of the abdomen and thorax and in turn are continued forwards in the floor of the mouth beneath the tongue by geniohyoid muscles extending from hyoid to chin. These muscles associated with the hyoid arch and larynx will assist in moving it backwards and forwards in the throat during the swallowing movements which have been outlined above.

#### *Bones of skull*

**1** Nasal cartilage (surrounding nasal vestibule). **2** Bony nasal aperture (leading into bony part of nasal cavity). **3** Nasal bone. **4** Infra-orbital foramen (passage of infraorbital vessels and nerves). **5** Zygomatic arch (bar of bone linking cranium and face below eye). **6** Alveolar border of maxillary bone (upper jaw – supporting teeth of upper dental arch). **7** Hard

palate. **8–10** Nasal conchae (turbinate bones – supporting nasal mucous membrane). **8** Dorsal nasal concha (nasoturbinate). **9** Ventral nasal concha (maxilloturbinate). **10** Alar fold of ventral nasal concha. **11–12** Ethmoid bone. **11** Cribriform plate of ethmoid bone (separating nasal from cranial cavities). **12** Ethmoidal labyrinth (ethmoidal conchae – attached to cribriform plate and supporting olfactory mucous membrane). **13–17** Lower jaw (mandible). **13** Body of mandible. **14** Ramus of mandible. **15** Angular process of mandible. **16** Mandibular symphysis. **17** Alveolar border of mandible (supporting teeth of lower dental arch). **18** Frontal bone. **19** Zygomatic process of frontal bone. **20** Parietal bone. **21** Occipital bone. **22** External occipital protuberance. **23** Nuchal crest. **24** Canal for transverse venous sinus (in occipital bone). **25** Cerebellar tentorium. **26** Sphenoid bone in braincase floor. **27** Pituitary (hypophyseal) fossa (in braincase floor). **28** Cranial cavity (shown in surface projection in E). **29** Foramen magnum. **30–32** Cranial horn of hyoid (situated in pharyngeal wall). **30** Epihyoid bone. **31** Stylohyoid bone. **32** Ceratohyoid bone. **33** Basihyoid bone. **34** Caudal horn of hyoid (thyrohyoid bone).

#### *Laryngeal and tracheal cartilages*

**35** Epiglottic cartilage (forming basis of epiglottis). **36** Thyroid cartilage. **37** Cricoid cartilage. **38** Arytenoid cartilage. **39** Tracheal cartilage (one of approximately 35 ring-shaped cartilages, incomplete dorsally).

#### *Vertebral bones*

**40** Dorsal arch of atlas vertebra (C1). **41** Ventral arch of atlas. **42** Spinous process of axis vertebra (C2). **43** Vertebral body of axis. **44** Odontoid process (dens) of axis (projecting forwards into vertebral canal of atlas). **45** Vertebral (spinal) canal (for housing spinal cord – shown in surface projection in E).

#### *Nasal cavity and paranasal sinuses*

**46** External nostril (leading into nasal vestibule). **47** Nasal vestibule (surrounded by nasal cartilages). **48** Internasal septum (dividing nasal cavity into left and right nasal fossae). **49** Nasal cavity (shown in surface projection in A & C). **50–53** Air passages (meatuses) through nasal cavity. **50** Dorsal nasal meatus. **51** Middle nasal meatus. **52** Ventral nasal meatus. **53** Nasopharyngeal meatus (airway leading back to internal nostrils). **54** Internal nostrils (leading into nasopharynx). **55** Maxillary recess (lateral diverticulum from nasal cavity shown in surface projection in A, B & C). **56** Nasal opening into maxillary recess. **57** Frontal sinus (shown in surface projection in A, B & C). **58** Lateral part of frontal sinus (large empty space in frontal bone). **59** Medial part of frontal sinus (containing extensions from ethmoidal labyrinth).

#### *Muscles*

**60** Mylohyoid muscle. **61** Geniohyoid muscle. **62** Sternohyoid muscle. **63** Genioglossal muscle. **64** Intrinsic musculature of tongue. **65** Longus colli muscle. **66** Ventral rectus capitis muscle. **67** Dorsal rectus capitis muscle. **68–69** Semispinal muscle of head. **68** Biventer muscle. **69** Complexus muscle. **70** Dorsal cricoarytenoid muscle (glottic opening muscle).

#### *Oral cavity, pharynx and larynx*

**71** Oral fissure (mouth opening between lips). **72** Oral cavity (in surface projection in E). **73** Oral vestibule (between lips and cheeks and dental arches and gums). **74** Oral cavity proper. **75–78** Tongue. **75** Apex of tongue. **76** Body of tongue. **77** Root of tongue. **78** Lyssa (rod-like body in free end of tongue). **79** Soft palate (attached to caudal border of hard palate). **80** Palatine veil (soft palate beyond pterygoid hamuli). **81** Position of palatoglossal fold of mucous membrane (between tongue and soft

palate and denoting termination of oral cavity caudally). **82** Palatine rugae (transverse ridges of cornified mucosa of hard palate). **83–85** Pharynx (pharyngeal cavity shown in surface projection in E). **83** Nasopharynx (pharynx above soft palate continuing nasopharyngeal meatus of nasal cavity). **84** Oropharynx (pharynx below soft palate continuing oral cavity). **85** Laryngopharynx (common pharynx – confluence of nasopharynx and oropharynx). **86** Palatopharyngeal arch (mucosal fold in lateral pharyngeal wall marking caudal boundary of nasopharynx – arches on either side surround intrapharyngeal opening). **87** Middle ear (tympanic) cavity (contained within tympanic bulla and housing three auditory ossicles shown in surface projection in C). **88** Pharyngotympanic (auditory or Eustachian) tube (linking middle ear cavity with nasopharynx) and pharyngeal opening. **89** Palatine tonsil (in tonsillar fossa). **90** Epiglottis (based on epiglottic cartilage and projecting from pharyngeal floor marking caudal boundary of oropharynx). **91** Aryepiglottic fold (bordering laryngeal vestibule). **92** Laryngeal vestibule. **93** Laryngeal cavity. **94** Trachea (windpipe). **95** Vocal fold (mucous membrane bordering glottis – opening from laryngeal vestibule into larynx proper). **96** Vestibular fold (false vocal fold). **97** Entry into laryngeal ventricle. **98** Oesophagus (gullet).

#### *Central nervous system*

**99** Cerebral hemisphere of forebrain. **100** Olfactory lobe of forebrain. **101** Corpus callosum (connecting cerebral hemispheres – cut in median plane). **102** Fornix (fibre tract associated with hippocampus). **103** Intermediate mass of thalamus (cut in median plane). **104** Optic chiasma (confluence of right and left optic nerves). **105** Pituitary body (hypophysis). **106** Pineal body. **107** Midbrain. **108** Cerebellum of hindbrain. **109** Pons (cut in median plane). **110** Medulla oblongata. **111** Spinal cord.



of its wall is thrown into numerous longitudinal folds. The lumen is opened up either by urine or the ejaculate being moved along it by muscle activity. In urination movement is predominantly due to bladder contraction, but in ejaculation sperm is moved along by the surrounding urethral muscle, assisted by rhythmic contraction in the bulbospongiosus muscle around the penile bulb.

The large **prostate gland** completely surrounds the pelvic urethra and neck of the bladder at the pelvic inlet, but obviously the degree of bladder distension will effect its position somewhat. A full bladder drags the prostate gland forwards into the abdomen; an empty bladder allows the prostate to lie just inside the pelvic cavity. The sperm ducts pass through the prostate on their way into the pelvic urethra. Because of its position and relationships to urethra, bladder, sperm ducts and rectum (clearly shown in fig 29C), I'm sure you can appreciate how enlargement of the prostate gland in an old dog (not an uncommon happening) may interfere with both urination and particularly defaecation.

#### *Surface features and topographical regions*

**1** Tracheal region. **2** Presternal region (breast). **3** Sternal region (brisket). **4** Costal (rib) region. **5** Cardiac region. **6** Axillary region (armpit). **7–8** Cranial abdominal (epigastric) region. **7** Right hypochondriac region. **8** Xiphoid region. **9–10** Middle abdominal (hypogastric) region. **9** Right lateral abdominal (iliac) region (flank). **10** Umbilical region. **11** Fold of flank. **12** Umbilicus (navel). **13–14** Caudal abdominal (hypogastric) region. **13** Right inguinal region. **14** Pubic region. **15** Fold

of groin. **16** Urogenital (pudendal) region (vulva). **17** Root of tail. **18** Brachial region (arm). **19** Femoral region (thigh). **20** Femoral triangle. **21** Teats of mammary glands.

#### *Bones, joints and ligaments*

**22** Rib 1. **23** Rib 13 (last or floating rib). **24** Costal arch (fused costal cartilages of ribs 10–12 attached to costal cartilage of rib 9 [last sternal rib]). **25** Sternum (formed from fusion of eight sternbrae – intersternbral cartilages becoming infiltrated with bone). **26** Manubrium of sternum (first sternbra projecting forwards into base of neck). **27** Xiphoid process of sternum (last sternbra extending back into belly wall). **28** Pubic brim (pubic pectens of left and right sides). **29** Ischiatic tuberosity (point of buttock). **30** Ischiatic arch. **31** Pelvic symphysis. **32** Hip joint. **33** Obturator foramen.

#### *Muscles*

**34** Internal intercostal muscles (beneath parietal pleura). **35–40** Diaphragm (musculo-tendinous partition between thorax and abdomen). **35** Costal muscle fibres of diaphragm. **36** Crura of diaphragm (arising from lumbar vertebrae). **37** Central tendinous area of diaphragm. **38–40** Diaphragmatic hiatuses (openings for passage of structures between thorax and abdomen). **38** Caval foramen of diaphragm (passage of caudal vena cava). **39** Oesophageal hiatus of diaphragm (passage of oesophagus). **40** Aortic hiatus of diaphragm (passage of aorta). **41** Costal retractor muscle. **42** Quadratus lumborum muscle. **43** Psoas minor muscle. **44–45** Iliopsoas muscle. **44** Psoas major part of iliopsoas muscle. **45** Iliacus part of iliopsoas muscle. **46** Cranial and caudal parts of sartorius muscle. **47** Pectineus muscle. **48** Adductor muscles. **49** Gracilis muscle. **50** Symphyseal tendon (uniting adductor and gracilis muscles of left and right

sides and attaching to pelvic symphysis). **51** Semitendinosus muscle of hamstring group. **52** Quadratus femoris muscle. **53** External obturator muscle.

#### *Heart and blood vessels*

**54–57** Heart. **54** Right ventricle. **55** Left ventricle. **56** Auricular appendage of right atrium. **57** Auricular appendage of left atrium. **58** Aorta (leading from left ventricle). **59** Thoracic aorta. **60** Abdominal aorta. **61** Renal artery to kidney. **62** Left external iliac artery (to hind-limb). **63** Brachiocephalic artery (origin of blood vessels to head, neck and right fore-limb). **64** Left common carotid artery (to head). **65** Right subclavian artery. **66** Left subclavian artery. **67** Cranial vena cava (returning blood from front end of body). **68** Right brachiocephalic vein. **69** External jugular vein. **70** Left subclavian vein. **71** Caudal vena cava (returning blood from hind end of body). **72** Renal vein. **73** Pulmonary trunk. **74** Left pulmonary artery.

#### *Internal organs*

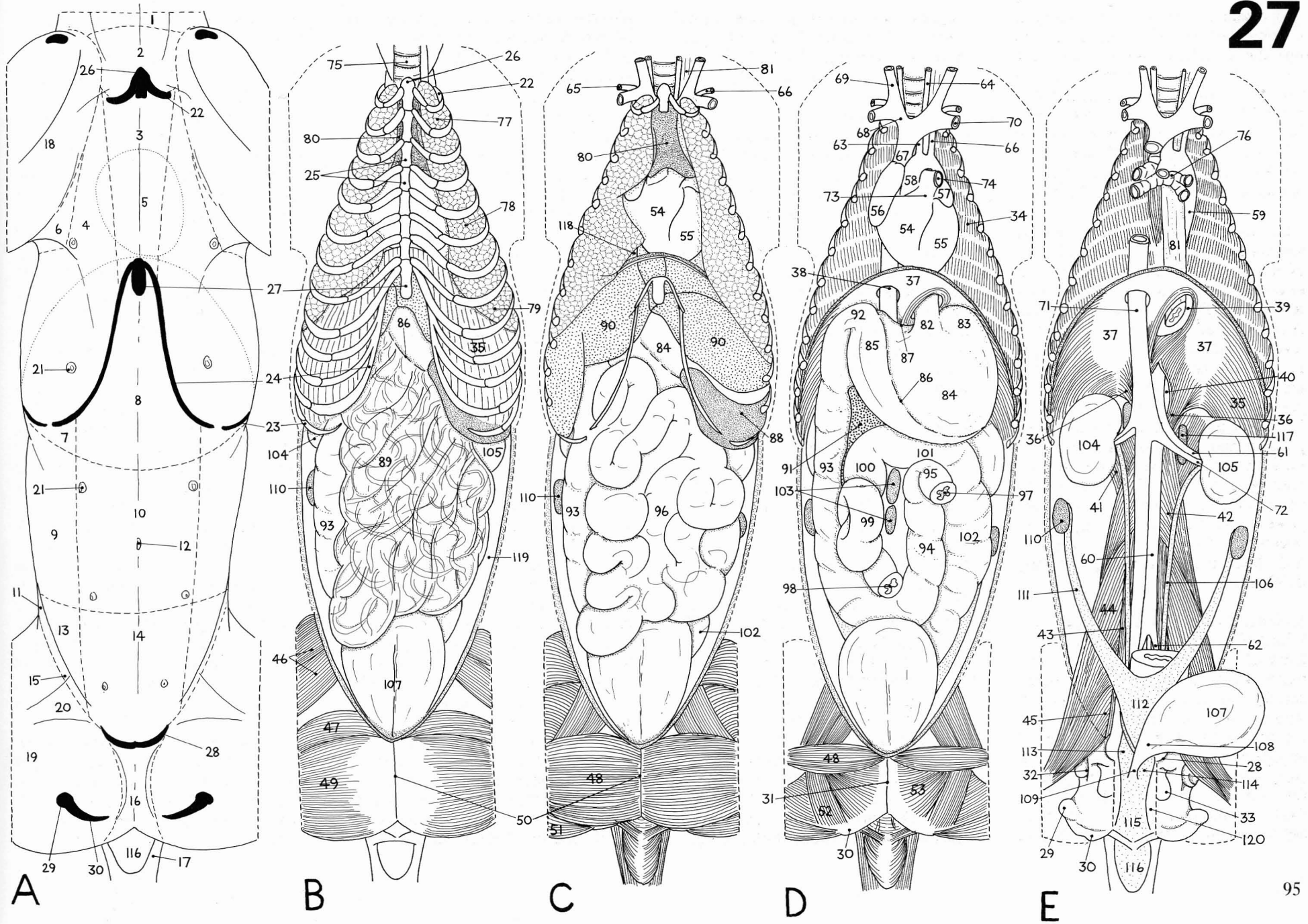
**75** Trachea (windpipe). **76** Tracheal bifurcation (division into left and right principal bronchi). **77** Cranial (apical) lobe of left lung. **78** Middle (cardiac) lobe of left lung. **79** Caudal (diaphragmatic) lobe of left lung. **80** Thymus gland (at its largest in young dog and atrophying with age although never disappearing completely). **81** Oesophagus (gullet). **82–87** Stomach (more or less transversely orientated with bulk on left side). **82** Cardia of stomach (entry from oesophagus). **83** Fundus of stomach. **84** Body of stomach. **85** Pylorus of stomach (exit into duodenum). **86** Greater curvature of stomach (transversely positioned with greater omentum attached to it). **87** Lesser curvature of stomach. **88** Spleen (associated with greater curvature of stomach and costal arch of left side). **89** Greater omentum (en-

larged and modified dorsal mesogastrium extensively infiltrated with fat). **90** Liver (moulded on rear surface of diaphragm). **91** Pancreas. **92–97** Small intestine. **92–95** Duodenum (U-shaped loop in abdominal roof). **92** Cranial duodenal flexure. **93** Descending duodenum (against upper part of right flank). **94** Ascending duodenum. **95** Duodenojejunal flexure. **96** Coils of small intestine. **97** Jejunum (cut through just beyond duodenojejunal flexure). **98** Ileum (cut through just before ileocolic junction). **99** Caecum (blind-ending corkscrew-shaped projection from the colon on right side at ileocolic junction). **100–102** Large intestine (colon – a sigmoid shaped structure in 3 parts). **100** Ascending colon (against right flank). **101** Transverse colon. **102** Descending colon (passing back against upper part of left flank). **103** Jejunal lymph nodes. **104** Right kidney. **105** Left kidney (further caudally in abdomen than right). **106** Left ureter (leaving hilus of left kidney). **107** Urinary bladder (receiving ureters from kidneys and temporarily storing urine). **108** Neck of bladder. **109** Urethra (continuation into pelvis of neck of bladder). **110** Right ovary. **111** Right uterine horn. **112** Uterine body (from fusion of uterine horns in midline). **113** Position of uterine cervix. **114** Vagina (continuing uterine cervix into pelvis). **115** Vestibule (urogenital sinus, direct caudal continuation of vagina, entry of urethra marking vaginovestibular junction). **116** Vulva (external genitalia of vulvar cleft surrounded by labia). **117** Left adrenal gland.

#### *Body Cavities*

**118** Thoracic cavity. **119** Abdominal cavity (containing abdominal part of peritoneal cavity). **120** Pelvic cavity (containing pelvic part of peritoneal cavity opened by removal of midventral sections of pubic and ischiatic bones).





# 28

## SURFACE PROJECTIONS OF THORACIC, ABDOMINAL AND PELVIC VISCERA OF THE BITCH FROM BELOW

The selection of sketches on this page are outline drawings of the body surface on which have been superimposed the outline of various internal structures to indicate the position they might occupy in relation to the surface. This procedure has already been used from left and right lateral views (figs 23 & 24).

As a starting point **A** shows the body surface on which are indicated the palpable bony points of reference and topographical subdivisions of the trunk. The thorax drawings (**B**, **C** & **D**) show initially a projection of the bony limits of the **thoracic cavity** (solid line). However, the more restricted internal longitudinal extent of the cavity is again indicated by a line showing the most cranial extent of the dome of the diaphragm. The outer limits of left and right **pleural cavities** are shown by the broken lines. From **B** it might be assumed that the pleural cavities come close together in the midline of the thorax where they are separated by the narrow connective tissue partition the **mediastinum**. This is in fact the situation in the ventral thorax internal to the sternum where right and left pleural cavities are only separated by a mediastinum composed of a thin sheet of endothoracic fascia supporting the pleura. Because of its thinness the ventral

mediastinum is a potentially fragile structure which might rupture. Further dorsally in the chest, however, the mediastinum is a substantial partition containing the heart, great vessels, trachea and oesophagus and occupying up to one third of the volume inside the thoracic cavity. In **D** the heart is shown in position in the cardiac mediastinum and you can see how the pleural cavities here will be much restricted in size.

Consideration of the thorax is completed in **C** on which approximate positions of the lungs and heart are shown. Surface projections of the lungs and heart again indicate that the lungs are smaller than would be expected. The long axis of the heart is at an angle to the long axis of the body with up to two thirds of the heart being to the left of the median plane.

In **E** the outer boundary of the abdominal and pelvic cavities is shown in the solid line with the outer limit of the peritoneal cavity contained within in a broken line. The retroperitoneal part of the pelvis shown by the heavy stippling is again clearly apparent, the peritoneal cavity not extending very far back through the pelvic inlet so that pelvic viscera are in the main retroperitoneal in position.

In drawings **F** and **G** the approximate positions in surface projection of the principal abdominal and pelvic organs are shown.

### *Surface features and topographical regions*

**1** Tracheal region. **2** Lateral neck (jugular) region. **3** Jugular fossa. **4** Presternal (breast) region. **5** Sternal region (brisket). **6** Costal (rib) region. **7** Cardiac region. **8** Axillary region (armpit). **9–10** Cranial abdominal (epigastric)

region. **9** Right hypochondriac region. **10** Xiphoid region. **11–12** Middle abdominal (mesogastric) region. **11** Right lateral abdominal (iliac) region (flank). **12** Umbilical region. **13** Umbilicus (navel). **14** Fold of flank. **15–16** Caudal abdominal (hypogastric) region. **15** Right inguinal region. **16** Pubic region. **17** Fold of groin. **18** Urogenital (pudendal) region. **19** Brachial region (arm). **20** Femoral region (thigh). **21** Femoral triangle.

### *Bones*

**22** Rib 1 (at thoracic inlet). **23** Rib 13 (last or floating rib). **24** Costal arch (fused costal cartilages of ribs 10–12 attached to costal cartilage of rib 9 [last sternal rib]). **25** Manubrium of sternum (first sternebra projecting forwards into base of neck). **26** Xiphoid process of sternum (last sternebra extending back into belly wall). **27** Pubic brim (formed from pubic pectens of left and right sides). **28** Ischiatic tuberosity (point of buttock). **29** Ischiatic arch. **30** Greater tubercle of humerus (point of shoulder).

### *Surface projections of body cavities*

**31** Surface projection of outer boundary of thoracic cavity – endothoracic fascia lining thoracic cavity (unbroken line including 1st rib [22], costal arch [24] and last rib [23]). **32** Contour of diaphragm at its most cranial extent. **33** Surface projection of outer boundary of abdominal and pelvic cavities (unbroken line including diaphragm [32]). **34** Thoracic inlet (bordered by 1st ribs, thoracic vertebra 1 and sternal manubrium). **35** Pelvic inlet (more or less rounded opening at an oblique angle to long axis of body and bordered above by sacral promontory, below by cranial borders of pubic bones and on either side by arcuate lines on ilia). **36** Pelvic outlet (roughly triangular opening bordered above by caudal vertebra 3, below by ischiatic arch and ischiatic

tuberosities and on either side by sacrotuberous ligaments).

### *Surface projections of coelomic cavities*

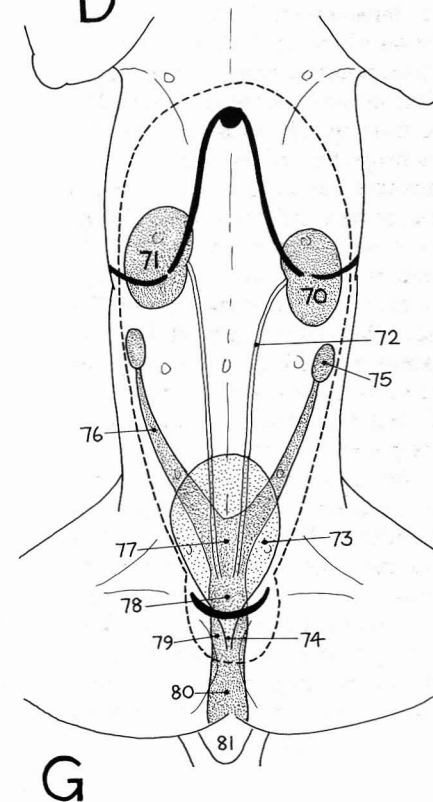
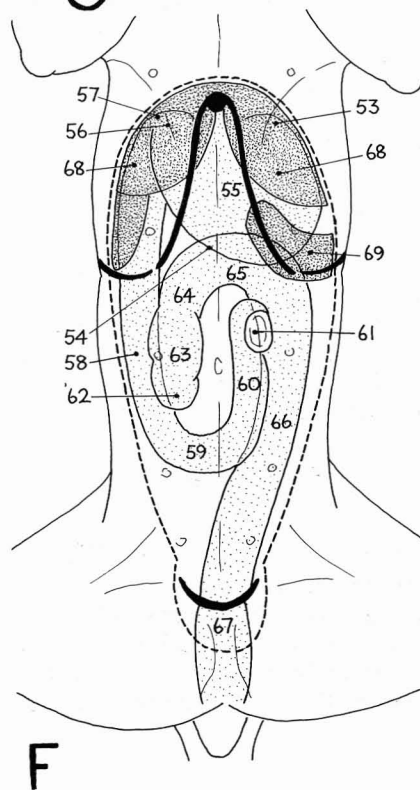
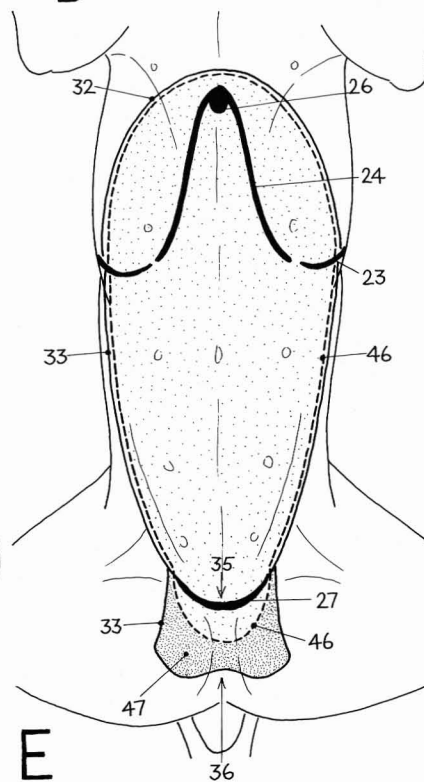
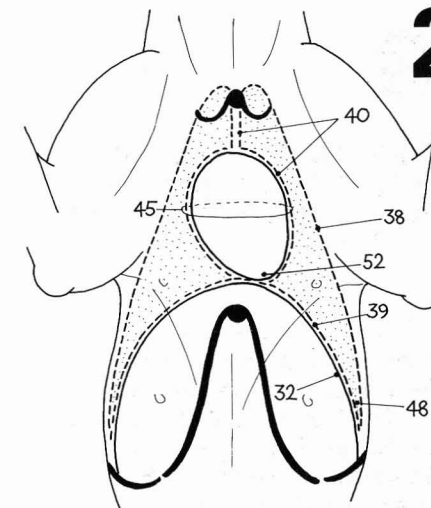
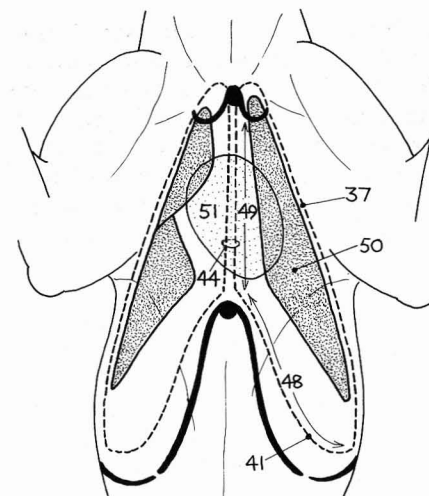
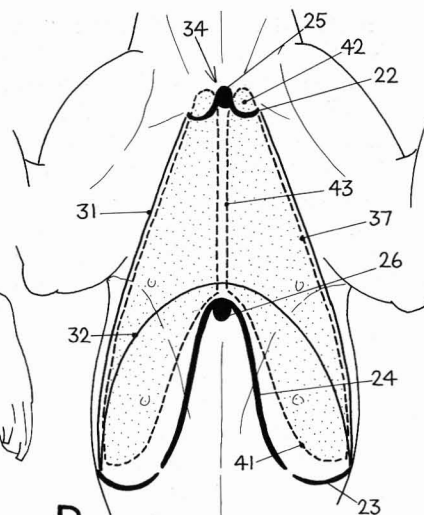
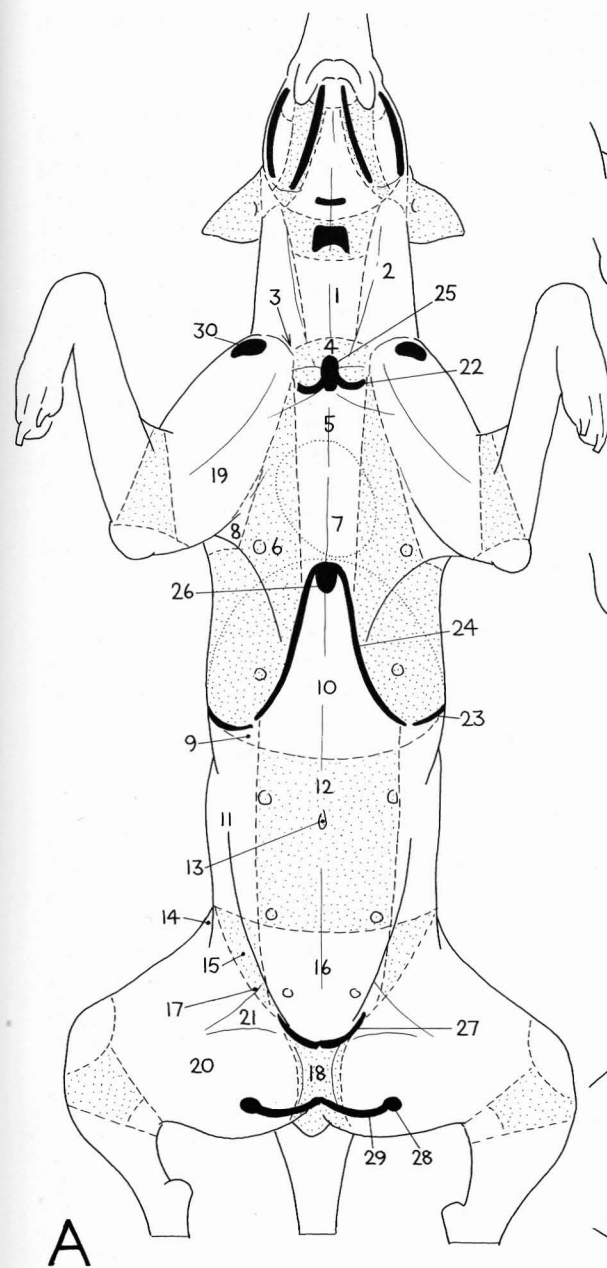
**37** Surface projection of outer boundaries of left and right pleural cavities – parietal pleura (broken line). **38** Costal pleura. **39** Diaphragmatic pleura. **40** Mediastinal pleura. **41** Costodiaphragmatic line of pleural reflection. **42** Pleural pocket of left pleural cavity. **43** Costomediastinal line of pleural reflection. **44–45** Mediastinum. **44** Ventral mediastinum. **45** Cardiac mediastinum. **46** Surface projection of outer boundary of peritoneal cavity in abdomen and pelvis – parietal peritoneum (broken line). **47** Retroperitoneal component of pelvic cavity. **48–49** Areas available in pleural cavities for lung expansion. **48** Costodiaphragmatic recess. **49** Costomediastinal recess.

### *Surface projections of thoracic viscera*

**50** Surface projection of lungs at maximal expiration. **51** Surface projection of heart. **52** Apex of heart.

### *Surface projections of abdominal and pelvic viscera*

**53** Fundus of stomach. **54** Greater curvature of stomach. **55** Body of stomach. **56** Pylorus of stomach. **57** Cranial duodenal flexure. **58** Descending duodenum. **59** Duodenal loop. **60** Ascending duodenum. **61** Duodenojejunal flexure. **62** Ileocolic junction. **63** Caecum. **64** Ascending colon. **65** Transverse colon. **66** Descending colon. **67** Rectum. **68** Liver. **69** Spleen. **70** Left kidney. **71** Right kidney. **72** Left ureter. **73** Urinary bladder. **74** Urethra. **75** Left ovary. **76** Right uterine horn. **77** Uterine body. **78** Uterine cervix. **79** Vagina. **80** Vestibule. **81** Vulva.





before the tie fully forms. It would seem that the formation of a tie is not necessarily an essential component of successful copulation. Nevertheless a tie seems to be a normal component of copulation and may last for some considerable time, up to 30 minutes, during which the dog may continue to ejaculate. It has been suggested that the ejaculate which is passed during the tie consists mainly of prostatic gland secretion and this aids in flushing the sperm loaded initial ejaculate further into the bitch.

#### *Surface features and topographical regions*

**1** Caudal region (tail). **2** Gluteal region (rump). **3** Femoral region (thigh). **4** Ischiatic tuberosity region. **5–8** Perineal region. **5** Anal region. **6** Urogenital region. **7** Pudendal region. **8** Scrotal region (scrotum containing testes). **9** Scrotal raphe (surface representation of internal scrotal division). **10** Ischiorectal fossa (clunial region). **11** Anus. **12** Circumanal skin. **13** Urethral (penile) bulb (expansion of spongy body in penile root between diverging crura). **14** Vulvar cleft. **15** Labia (vulval lips). **16** Inguinal mammary gland.

#### *Bones*

**17** Lumbar vertebra 3. **18** Wing of sacrum. **19** Lateral sacral crest. **20** Ischiatic tuberosity of hip bone (point of buttock). **21** Ischiatic arch of pelvic girdle (origin for ischiocavernosus and ischiourethral muscles and fibrous cavernous bodies of penis). **22** Pelvic symphysis (cut through in median plane).

#### *Muscles*

**23** Symphyseal tendon (fibrous plate in median plane attached to pelvic symphysis providing attachment for medial thigh muscles). **24** Superficial gluteal muscle. **25** Gracilis muscle. **26–28** Hamstring muscles.

**26** Biceps femoris muscle. **27** Semitendinosus muscle. **28** Semimembranosus muscle. **29** Tail depressors (ventral sacrocaudal muscles). **30** Lateral tail flexors (caudal intertransverse muscles). **31** Tail levators (dorsal sacrocaudal muscles). **32** Internal obturator muscle. **33–34** Pelvic diaphragm. **33** Coccygeus muscle. **34** Levator ani muscle. **35–36** Anal diaphragm. **35** Rectococcygeus muscle. **36** External anal sphincter muscle. **37–41** Urogenital diaphragm. **37** Bulbospongiosus muscle (modified urethral muscle around penile bulb). **38** Constrictor muscle of vestibule (female equivalent of urethral and bulbospongiosus). **39** Constrictor muscle of vulva (labial muscle as for vestibular constrictor). **40** Retractor penis muscle (anal part extends from caudal vertebrae and inserts into rectum and external anal sphincter before passing along underside of penis to preputial fornix). **41** Anal part of retractor penis/clitoridis muscle. **42** Ischiocavernosus muscle (originating from ischiatic arch covering cavernous body in penile root). **43** Ischiourethral muscle. **44** Sacrotuberous ligament (joining ischiatic tuberosity with sacrum and caudal vertebra 1).

#### *Body cavities and peritoneum*

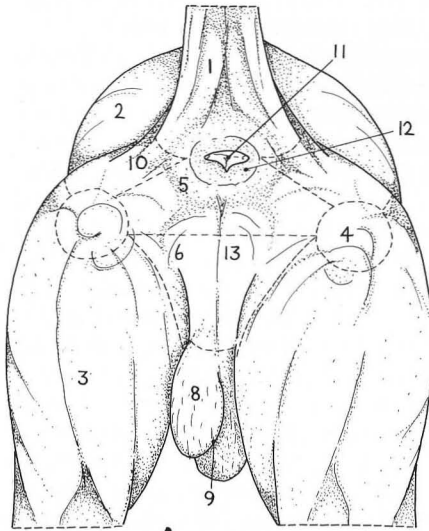
**45–46** Peritoneum (fluid secreting layer lining abdominal and pelvic cavities). **45** Parietal peritoneum (lining walls of abdominal and pelvic cavities, enclosing peritoneal cavity). **46** Visceral peritoneum (covering abdominal and pelvic viscera). **47** Abdominal part of peritoneal cavity. **48** Pelvic part of peritoneal cavity. **49–52** Pelvic peritoneal excavations. **49** Pubovesical pouch. **50** Vesicogenital pouch. **51** Rectogenital pouch. **52** Pararectal fossa. **53** Retroperitoneal part of pelvic cavity (perineum). **54** Transverse fascia (lining abdominal wall limiting abdominal cavity). **55** Vaginal process (extension of peritoneal cavity

through inguinal canal). **56** Spermatic fascia (enveloping vaginal process – continuation of transverse fascia through inguinal canal). **57–59** Vaginal tunic (extension of parietal peritoneum enclosing cavity of vaginal process). **57** Proper (visceral) vaginal tunic (broken line – covering testis and epididymis). **58** Common (parietal) vaginal tunic (broken line – lining scrotal cavity). **59** Cavity of vaginal process. **60** Vaginal ring (brim of parietal peritoneum surrounding entry into vaginal sac at internal opening of inguinal canal).

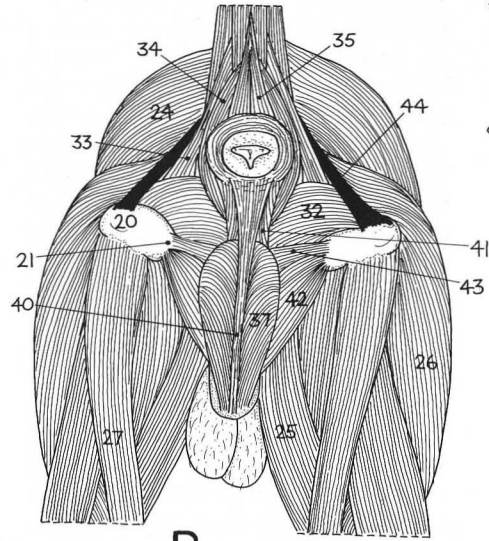
#### *Internal organs*

**61** Rectum (continuation of descending colon through pelvis). **62** Left ureter. **63** Urinary bladder (receiving ureters from kidneys and temporarily storing urine). **64** Urethra (continuation of bladder neck). **65** Pelvic urethra of dog (urogenital sinus – equivalent to vestibule of bitch). **66** Penile urethra of dog (without counterpart in bitch – extends from pelvic outlet to free end of penis). **67** External urethral opening (in floor of vestibule in bitch at vaginovestibular junction and at free end of penis in dog). **68** Testis (spermatozoa produced continuously). **69–71** Epididymis (testicular appendage containing long coiled epididymal duct). **69** Head of epididymis (receiving sperm from testis). **70** Body of epididymis (storing and concentrating sperm). **71** Tail of epididymis (giving origin to vas deferens). **72** Spermatic cord (aggregate of blood vessels and nerves to testis and vas deferens). **73** Spermatic (testicular) artery vein and nerve (passing to/from vessels in abdominal roof). **74** Vas deferens (conveying sperm to pelvic urethra). **75** Prostate gland (accessory sex gland surrounding pelvic urethra at entry of vasa deferentia in pelvic inlet). **76** Cavernous body of penis (pair of fibrous erectile bodies extending through penis from attachments bilaterally on ischiatic arch).

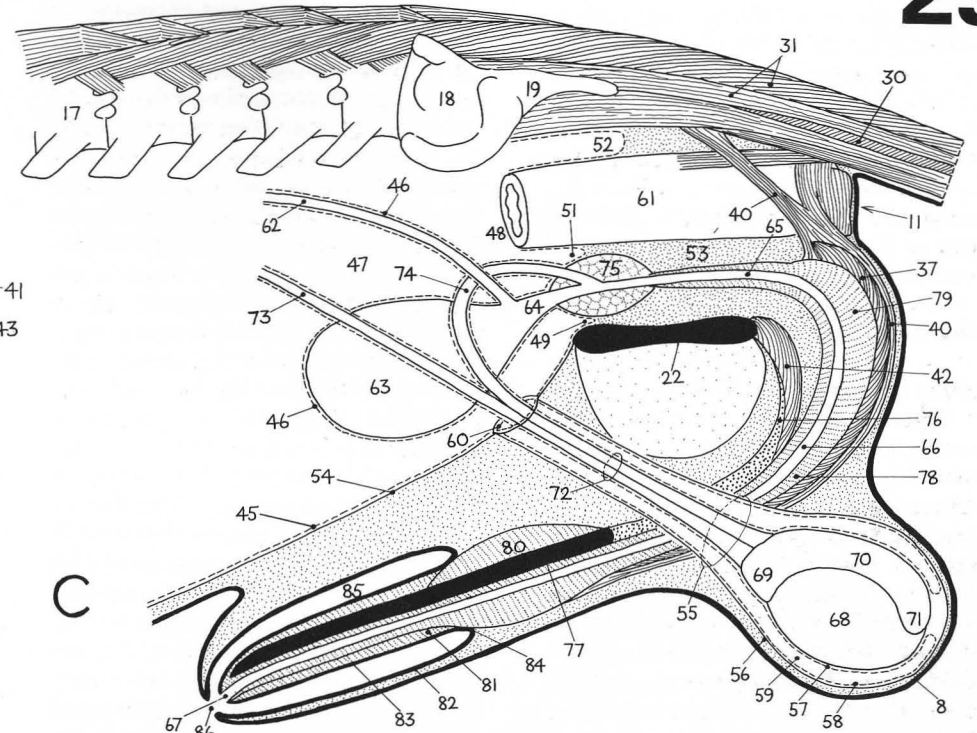
**77** Os penis (ossification of both cavernous bodies in glans penis). **78** Spongy body of penis (erectile tissue surrounding penile urethra – continuation of urethral spongy tissue around pelvic urethra). **79** Urethral (penile) bulb (expansion of spongy erectile tissue in penile root between diverging penile crura). **80–81** Glans penis (expansion from spongy erectile body along length of os penis). **80** Bulb of the glans (expansion of spongy erectile body at base of glans). **81** Long part of the glans (elongated expansion of spongy erectile body). **82–83** Prepuce (sheath – enclosing glans). **82** Parietal (middle) layer of sheath. **83** Visceral (inner) layer of sheath (sensory covering of glans penis continuous with urethral epithelium at external urethral opening). **84** Preputial fornix (reflection of middle layer of sheath onto glans surface as inner layer). **85** Preputial cavity (only present in non-erect state of penis, during erection sheath is rolled back along penile body). **86** Preputial opening (leading into preputial cavity). **87** Left ovary (suspended by mesentery from left flank). **88** Ovarian bursa (enclosed by mesentery supporting ovary and uterine tube and into which ova are shed from ovary). **89** Left uterine (Fallopian) tube encircling ovary. **90** Infundibulum of uterine tube (inflated, flared opening leading off from ovarian bursa). **91** Left uterine horn (long and narrow). **92** Uterine body (short from fusion of left and right horns). **93** Uterine cervix (neck, terminating body). **94** Cervical canal (constricted passage through cervix). **95** Round ligament of uterus (assisting in anchorage of uterine horn). **96** Vagina (continuing cervix into pelvis). **97** Vestibule (direct continuation of vagina, urethral entry marks vaginovestibular boundary). **98** Clitoris (female equivalent of male penis lying in vulval floor).  
(C & F After Evans & Christensen, 1979).



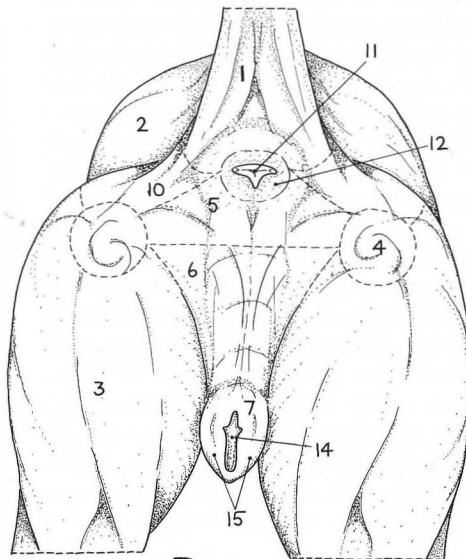
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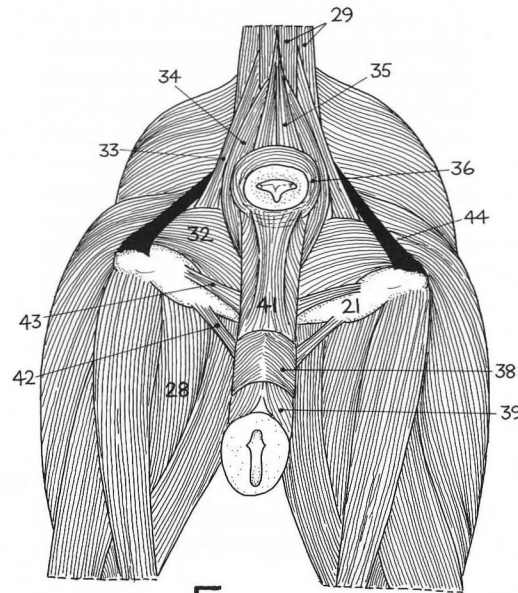
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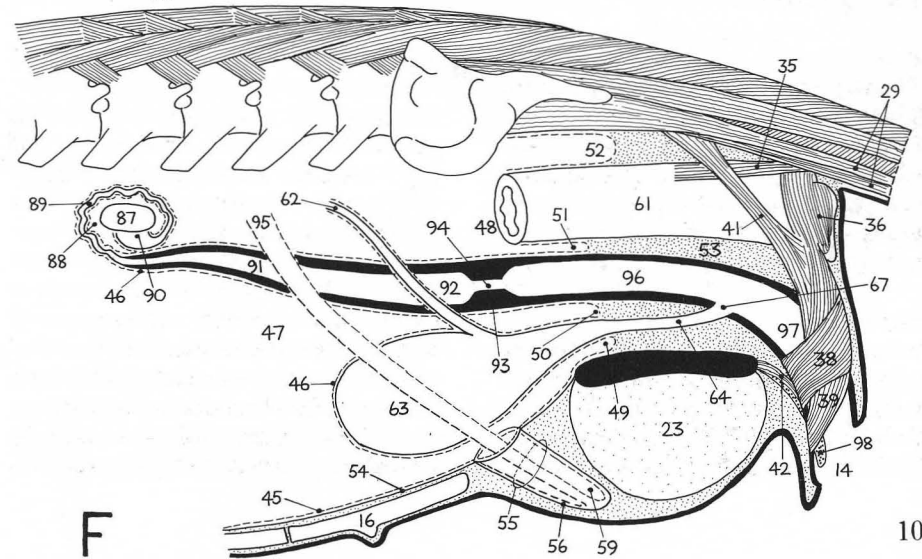
C



D



E



F

The forelimbs receive blood from the **subclavian arteries** (right from the brachiocephalic trunk: left as the second branch from the aortic arch), each continuing across the axilla as the **axillary artery** and into the arm as the **brachial artery**. In the forearm it is continued as the **median artery** and into the palmar surface of the paw where it is distributed as the **palmar common digital arteries** and finally **palmar proper digital arteries**. Forelimb distribution is in a number of branches arising from this main trunk *en route* through the limb.

The hindlimbs receive blood from the **external iliac arteries** (right and left) from the abdominal aorta. An external iliac leaves the abdominal cavity to continue in the thigh as the **femoral artery**. Behind the stifle joint it is continued as the **popliteal artery**, in the shank as the **cranial tibial artery** and into the dorsum of the paw as the **dorsal pedal artery**. It penetrates through to the plantar surface of the paw as the **perforating metatarsal artery** and is distributed to the digits as the **plantar metatarsal arteries** and finally as the **plantar proper digital arteries**. Hindlimb distribution is in a number of branches from the main trunk *en route* through the limb.

The thorax receives blood to its walls primarily through **intercostal arteries** (right and left): dorsal intercostals from the thoracic aorta and ventral intercostals from the subclavian via the **internal thoracic arteries** (right and left). The dorsal intercostals also supply the spinal cord. Blood to thoracic viscera is in the **bronchoesophageal arteries** from the thoracic aorta to the lungs and bronchi, and in the **coronary arteries** (right and

left) to the heart from the aorta close to its origin from the left ventricle.

The abdomen receives blood to its walls dorsally through **phrenicoabdominal arteries** (right and left), a series of **lumbar arteries** (right and left) and **deep circumflex iliac arteries** (right and left) all arising from the abdominal aorta: ventrally from **epigastric arteries** (right and left) arising cranially from internal thoracic arteries and caudally from external iliac arteries via **deep femoral arteries** (right and left). The lumbar arteries also supply the spinal cord. Blood to abdominal viscera is from three unpaired branches from the abdominal aorta — **coeliac artery**, **cranial mesenteric artery** and **caudal mesenteric artery**, and from paired aortic branches — **renal arteries** (right and left) and **gonadal arteries** (right and left).

The pelvis receives blood from the **internal iliac arteries** (right and left) arising from the abdominal aorta caudal to the external iliacs. An internal iliac gives rise to a **caudal gluteal artery** supplying the pelvic wall and rump and terminating in the tail and thigh, and an **internal pudendal artery** supplying the pelvic viscera and external genitalia.

#### *Arterial supply to head, neck, forelimb and thorax*

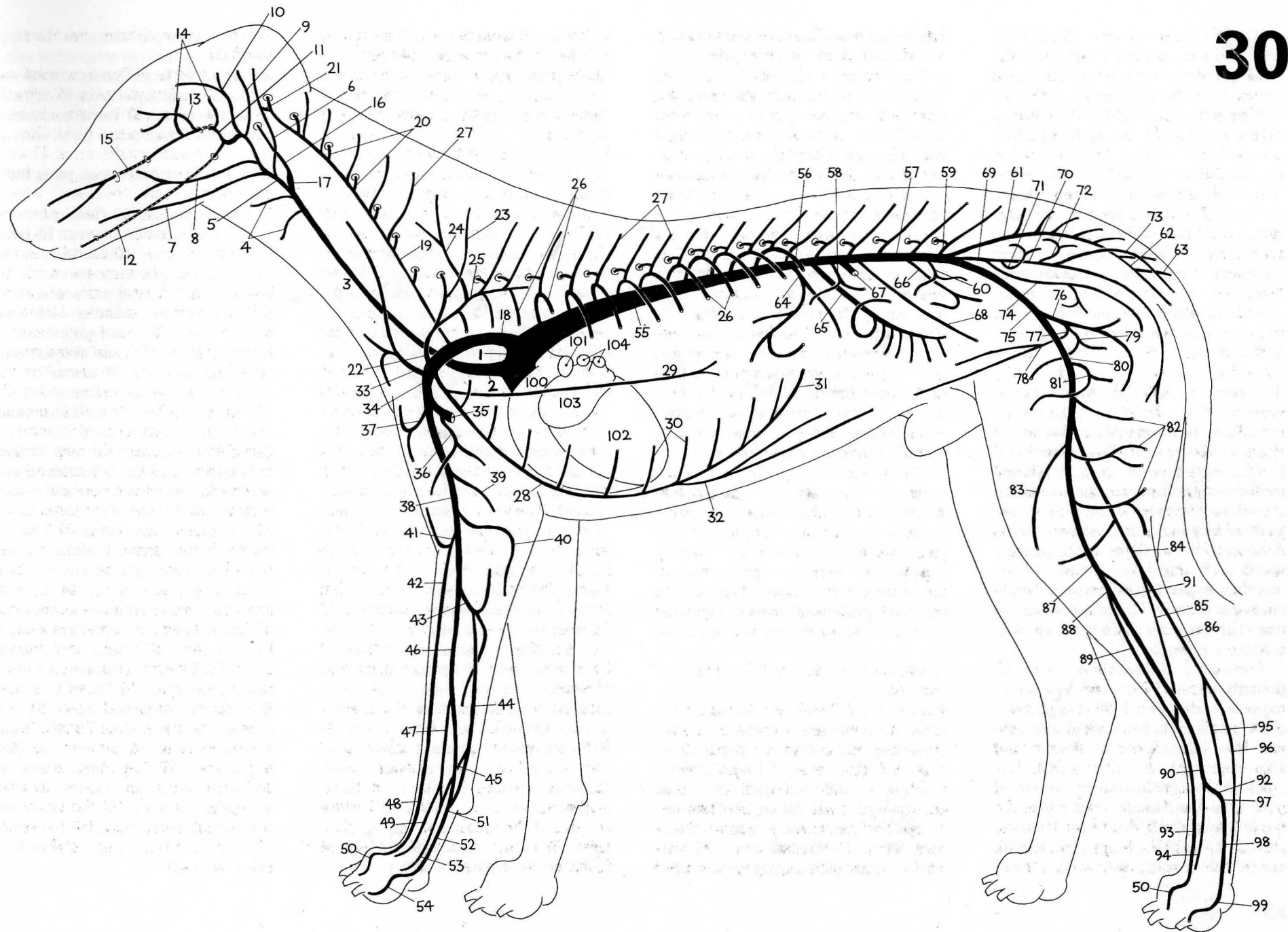
**1** Aortic arch. **2** Brachiocephalic trunk. **3** Left common carotid artery. **4** Cranial thyroid and cranial laryngeal arteries. **5** External carotid artery. **6** Occipital artery. **7** Lingual artery. **8** Facial artery with sublingual and dorsal (superior) and ventral (inferior) labial branches. **9** Caudal auricular artery. **10** Superficial temporal artery. **11** Maxillary artery. **12** Mandibular alveolar artery (supplying lower dental

arch and with terminal mental branches). **13** External ophthalmic artery. **14** Rostral and caudal deep temporal arteries. **15** Infraorbital artery (supplying upper dental arch and with terminal dorsal and lateral nasal arteries). **16** Internal carotid artery. **17** Carotid sinus. **18** Left subclavian artery. **19** Vertebral artery. **20** Spinal arteries. **21** Anastomotic branch between vertebral and occipital arteries. **22** Costocervical artery. **23** Dorsal scapular artery. **24** Deep cervical artery. **25** Thoracic vertebral artery. **26** Dorsal intercostal arteries. **27** Dorsal branches to epaxial muscles. **28** Internal thoracic (mammary) artery. **29** Pericardiophrenic artery. **30** Ventral intercostal arteries. **31** Musculophrenic artery. **32** Cranial epigastric artery with superficial and deep branches. **33** Superficial cervical artery with deltoid and ascending branches. **34** Axillary artery (direct continuation of subclavian artery). **35** Subscapular artery (cut through after scapular removal consequently circumflex scapular and thoracodorsal branches to chest wall removed). **36** Caudal circumflex humeral artery. **37** Cranial circumflex humeral artery. **38** Brachial artery (direct continuation of axillary artery). **39** Deep brachial artery. **40** Colateral ulnar artery. **41** Superficial brachial artery. **42** Cranial superficial antebrachial artery (medial and lateral branches). **43** Common interosseous artery with ulnar and recurrent ulnar branches into forearm. **44** Caudal interosseous artery (main continuation of common interosseous). **45** Caudal interosseous artery, dorsal branch. **46** Median artery (direct continuation of brachial artery). **47** Radial artery with dorsal and palmar carpal branches. **48** Dorsal common digital arteries. **49** Dorsal metacarpal arteries. **50** Dorsal proper digital arteries. **51** Superficial palmar arterial arch. **52** Palmar common digital arteries. **53** Palmar metacarpal arteries. **54** Palmar proper digital arteries.

#### *Arterial supply to abdomen, pelvis and hindlimbs*

**55** Thoracic aorta. **56** Dorsal costoabdominal artery. **57** Abdominal aorta. **58** Phrenicoabdominal artery. **59** Lumbar arteries. **60** Deep circumflex iliac artery. **61** Median sacral artery. **62** Median caudal artery. **63** Caudal arteries. **64** Coeliac artery with gastric, hepatic, pancreaticoduodenal and splenic branches. **65** Cranial mesenteric artery with caudal pancreaticoduodenal, ileocolic and numerous intestinal branches. **66** Caudal mesenteric artery with left colic artery and cranial rectal branches. **67** Left renal artery. **68** Left gonadal (testicular/ovarian) artery. **69** Left internal iliac artery. **70** Caudal gluteal artery. **71** Iliolumbar artery. **72** Cranial gluteal artery. **73** Lateral caudal artery. **74** Internal pudendal artery with urogenital and penile branches. **75** Left external iliac artery. **76** Deep femoral artery. **77** Pudendoepigastric artery. **78** Caudal epigastric artery with deep and superficial branches. **79** External pudendal artery with medial circumflex femoral and obturator branches. **80** Femoral artery (direct continuation of external iliac artery). **81** Lateral circumflex femoral artery. **82** Proximal, middle and distal caudal femoral arteries. **83** Descending genicular artery. **84** Saphenous artery. **85** Cranial branch of saphenous artery. **86** Caudal branch of saphenous artery. **87** Popliteal artery. **88** Cranial tibial artery. **89** Superficial branch of cranial tibial artery. **90** Dorsal pedal artery. **91** Caudal tibial artery. **92** Perforating metatarsal artery. **93** Dorsal common digital arteries. **94** Dorsal metatarsal arteries. **95** Lateral plantar artery. **96** Medial plantar artery. **97** Deep plantar arterial arch. **98** Plantar metatarsal arteries. **99** Plantar proper digital arteries. **100** Pulmonary trunk. **101** Left pulmonary artery. **102** Left ventricle of heart. **103** Left atrium of heart. **104** Pulmonary veins.





# 31

## BLOOD VESSELS OF THE DOG - VEINS

This second blood vessel schema shows the major systemic veins from the right side. As with the arterial diagram by no means all of the veins have been included since the drawing would have become too complex, and when vessels are symmetrically disposed right and left sides, only the right side has been included.

The arrangement and distribution of veins is more variable than that of arteries. This is presumably explained because mechanical as well as inherited genetic factors play a role in the formation of blood pathways in the developing animal. Preferred channels are 'selected' by these factors out of a diffuse vascular network in the early embryo. Since the speed of flow in veins is considerably less than in arteries, mechanical influences will be lessened and the possibility that different pathways will be 'chosen' is thereby increased. The end result is that veins are less regular in arrangement than arteries and they also tend to be more numerous. They often communicate freely with each other and, although generally running with arteries, an accompanying vein may be paired, one on either side of the artery.

Despite some notable exceptions the overall distribution of venous channels parallels arteries to a considerable extent. Thus many arteries and veins

run together serving comparable parts of the body and consequently having the same names. However there are a number of exceptions such as the **hepatic portal vein** draining the guts which has no arterial counterpart running with it. It has been drawn in the schema in isolation in the abdomen since it terminates in the sinusoidal networks of the liver. Subsequent drainage from the liver passes into the caudal vena cava through the hepatic veins which are shown as cut stumps in the drawing. In the limbs also we have already seen that the system of deep veins accompanying arteries is supplemented by a superficial, subcutaneous venous circuit. The **cephalic** venous network in the forelimb drains into the axillary vein and external jugular vein; the **saphenous** venous network in the hindlimb drains into the femoral vein.

In the head we see considerable differences between arterial and venous distribution. Drainage from the face and musculature outside the cranium is into tributaries eventually draining into the external jugular vein running down the neck superficially. Drainage from the brain inside the cranium is into a separate system of **venous sinuses** located in the dural layer of the meninges. These pursue a different course to the main arterial supply to the brain in the internal carotid artery. Some of this head drainage is channelled back into the vertebral canal as large **internal vertebral venous plexuses** accompanying the spinal cord. These venous plexuses also receive blood from the epaxial musculature and drain into vertebral, intercostal and lumbar

vessels. As we shall see later these plexuses play a significant role in 'cushioning' of the spinal cord.

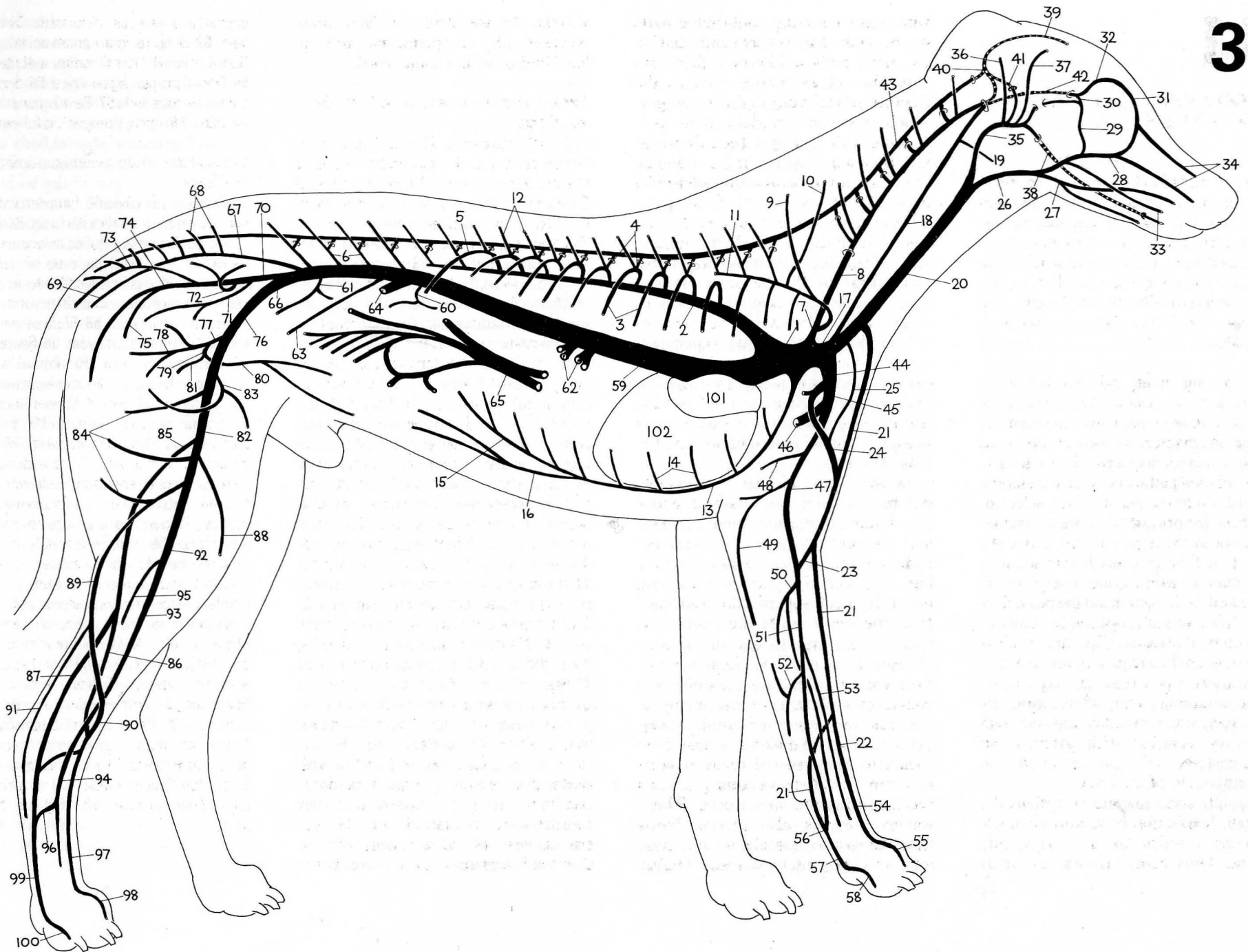
### *Venous return from head, neck, forelimbs and thorax*

1 Cranial vena cava. 2 Azygos vein. 3 Dorsal intercostal veins. 4 Intervertebral veins. 5 Costoabdominal vein. 6 Lumbar veins. 7 Costocervical vein. 8 Vertebral vein. 9 Dorsal scapular vein. 10 Deep cervical vein. 11 Thoracic vertebral vein. 12 Venous branches from epaxial muscles. 13 Internal thoracic (mammary) vein. 14 Ventral intercostal veins. 15 Musculophrenic vein. 16 Cranial epigastric vein with superficial and deep branches. 17 Brachiocephalic vein. 18 Internal jugular vein. 19 Thyroid vein. 20 External jugular vein. 21 Cephalic vein. 22 Accessory cephalic vein. 23 Median cubital vein. 24 Axillobrachial vein (receiving a lateral thoracic vein from chest wall). 25 Omobrachial vein. 26 Linguofacial vein. 27 Lingual vein with sublingual branch. 28 Facial vein. 29 Deep facial vein. 30 Connection between deep facial vein and external ophthalmic vein. 31 Angular vein of eye (connection between facial vein and external ophthalmic vein). 32 External ophthalmic vein. 33 Maxillary (superior) labial vein. 34 Dorsal and lateral nasal veins. 35 Maxillary vein. 36 Caudal auricular vein. 37 Superficial temporal vein. 38 Mandibular alveolar vein (draining lower dental arch). 39 Dorsal sagittal sinus. 40 Sigmoid sinus. 41 Temporal sinus. 42 Cavernous sinus continued caudally as ventral petrosal sinus. 43 Ventral internal vertebral venous plexus. 44 Subclavian vein. 45 Axillary vein. 46 Subscapular vein (cut through after scapular removal receiving thoracodorsal vein from chest wall and caudal circumflex humeral vein). 47 Brachial vein. 48 Deep brachial vein. 49 Collateral ulnar vein. 50 Common interosseous vein with cranial and

caudal interosseous tributaries. 51 Median vein. 52 Deep (palmar) antebrachial vein. 53 Radial vein. 54 Dorsal common digital veins. 55 Dorsal proper digital veins. 56 Superficial palmar venous arch. 57 Palmar common digital veins. 58 Palmar proper digital vein.

### *Venous return from abdomen, pelvis and hindlimbs*

59 Caudal vena cava. 60 Phrenicoabdominal vein. 61 Deep circumflex iliac vein. 62 Hepatic veins. 63 Gonadal (testicular/ovarian) vein. 64 Renal vein. 65 Hepatic portal vein with gastroduodenal, pancreaticoduodenal, splenic, cranial mesenteric, intestinal, and caudal mesenteric tributaries. 66 Right common iliac vein. 67 Median sacral vein. 68 Sacral veins. 69 Median caudal vein. 70 Internal iliac vein. 71 Urogenital vein. 72 Cranial gluteal vein. 73 Lateral caudal vein. 74 Caudal gluteal vein. 75 Internal pudendal vein. 76 Right external iliac vein. 77 Deep femoral vein. 78 Medial circumflex femoral vein. 79 Pudendoepigastriac vein. 80 Caudal epigastric vein with superficial and deep branches. 81 External pudendal vein. 82 Femoral vein. 83 Lateral circumflex femoral vein. 84 Proximal, middle and caudal femoral veins. 85 Medial saphenous vein. 86 Cranial branch of medial saphenous vein. 87 Caudal branch of medial saphenous vein. 88 Descending genicular vein. 89 Lateral saphenous vein. 90 Cranial branch of lateral saphenous vein. 91 Caudal branches of lateral saphenous vein. 92 Popliteal vein. 93 Cranial tibial vein. 94 Dorsal pedal vein. 95 Caudal tibial vein. 96 Perforating metatarsal vein. 97 Dorsal common digital veins. 98 Dorsal proper digital veins. 99 Plantar common digital veins. 100 Plantar proper digital veins. 101 Right atrium of heart. 102 Right ventricle of heart.





the latter into the venous system at the union of the left subclavian vein and the cranial vena cava on the left side. The **right tracheal trunk** containing lymph from the right side of the head and neck, empties into the venous system with lymph from the right forelimb as the right lymphatic duct, in the angle between the right external jugular vein and the right subclavian vein.

#### *Lymph nodes*

**1** Parotid lymph node – small node under parotid salivary gland (drainage area = skin and subcutaneous tissues of upper part of head, eyelids and external ear; jaw joint, jaw muscles and parotid salivary gland).

**2** Mandibular lymph nodes – 2 or 3 palpable nodes up to 2 cm long at angle of jaw (drainage area = skin and subcutaneous tissues of lower part of head, lips and cheeks; mucosa of floor of mouth, tongue, jaw joint, jaw muscles and salivary glands).

**3** Medial retropharyngeal lymph node – large node up to 5 cm long, deeply placed on pharynx below atlas wing (drainage area = all deep structures of head and cranial end of neck including oral, nasal and pharyngeal cavities, tongue, salivary glands, tonsils, larynx, oesophagus, orbits, deep parts of ear, muscles of head and neck. Also receives lymph from parotid and mandibular lymph nodes).

**4** Superficial cervical lymph nodes – 2 nodes up to 3 cm long, cranial to shoulder and palpable if enlarged (drainage area = skin and subcutaneous tissues of caudal part of head and ear, of neck, shoulder, back and forelimb; deep structures of forelimb, shoulder and cranial part of ventral thoracic wall).

**5** Deep cervical lymph nodes – cranial, middle and caudal, but small and variable in number – caudal deep cervical is only one constantly

present on trachea cranial to thoracic inlet (drainage area = deep structures of neck including bones, muscles, larynx, trachea, thyroid gland and oesophagus; deep drainage from shoulder and upper arm into caudal member of series).

**6** Cranial mediastinal lymph nodes – may be as many as 6 and up to 3 cm long in cranial mediastinum on trachea (drainage area = bones and muscles of dorsal parts of neck, thorax and abdomen; trachea, oesophagus, thymus gland, heart, pericardium, aorta and parietal pleura dorsally. Also receives lymph from sternal, intercostal and tracheobronchial lymph nodes).

**7** Sternal lymph node – up to 2 cm long and inside chest at lower end of intercostal space 2 (drainage area = ventral parts of thoracic wall including ribs, sternum, intercostal muscles, thoracic muscles, diaphragm and parietal pleura; also from thymus gland and pericardium. NB. May participate with axillary node in draining thoracic and cranial abdominal mammary glands. It also receives lymph from parietal peritoneum of abdomen which passes in lymphatic vessels penetrating periphery of diaphragm to run forwards beneath transverse thoracic muscles).

**8** Intercostal lymph node – small and often absent, inside chest at upper end of intercostal space 5 or 6 (drainage area = bones and muscles of thoracic roof, upper parts of ribs, thoracic muscles and parietal pleura).

**9** Tracheobronchial lymph nodes, left right and middle – large, in relation to tracheal bifurcation and principal bronchi (drainage area = lungs, bronchi, trachea, oesophagus, heart, aorta, mediastinum and diaphragm. Also receives lymph from pulmonary lymph nodes when present).

**10** Pulmonary lymph nodes – small, inconstant at lung hilus (drainage area = lungs and bronchi).

**11** Axillary lymph node – in axilla related to rib 2, palpable when enlarged (drainage area = skin and subcutaneous tissues of thoracic wall including thoracic and cranial abdominal mammary glands; deep structures of forelimb and neck. Also receives lymph from accessory axillary lymph node when present).

**12** Accessory axillary lymph node – caudal to axillary in region of rib 3, inconstant (drainage area = same as for axillary).

**13** Hepatic lymph nodes, left and right – flanking hepatic portal vein close to porta (drainage area = lesser curvature of stomach, duodenum, pancreas and liver).

**14** Splenic lymph nodes – several on splenic vessels at hilus (drainage area = oesophagus, fundus, body and greater curvature of stomach, pancreas, liver, spleen, greater omentum and diaphragm).

**15** Gastric lymph nodes – in lesser omentum close to pylorus, inconstant (drainage area = oesophagus, stomach, liver and diaphragm).

**16** Pancreaticoduodenal lymph node – on cranial duodenal flexure related to pancreas, inconstant (drainage area = pancreas, duodenum and greater omentum).

**17** Jejunal lymph nodes – 2 large nodes may be up to 20 cm long in a large dog in root of mesentery (drainage area = ileum, jejunum and pancreas).

**18** Colic lymph nodes – several small nodes in mesocolon (drainage area = ileum, caecum, ascending and transverse colon).

**19** Caudal mesenteric lymph nodes – several small nodes on colon close to pelvic inlet (drainage area = descending colon).

**20** Lumbar aortic lymph nodes – 12 or more small nodes in sublumbar fat flanking aorta (drainage area = bones and muscles of abdominal roof including parietal peritoneum; ureters and abdominal parts of urogenital system including ovary, uterus and testis).

**21** Renal lymph node – cranialmost member

of lumbar aortic series near renal vessels (drainage area = kidney and adrenal gland).

**22** Medial iliac lymph node – up to 4 cm long in abdominal roof at pelvic inlet (drainage area = bones and muscles of dorsal half of abdomen and pelvis and thigh; abdominal and pelvic genitalia including uterus, vagina and prostate gland; caudal parts of digestive and urinary systems including urethra, bladder, colon and rectum. Also receives lymph from superficial inguinal, hypogastric and popliteal nodes).

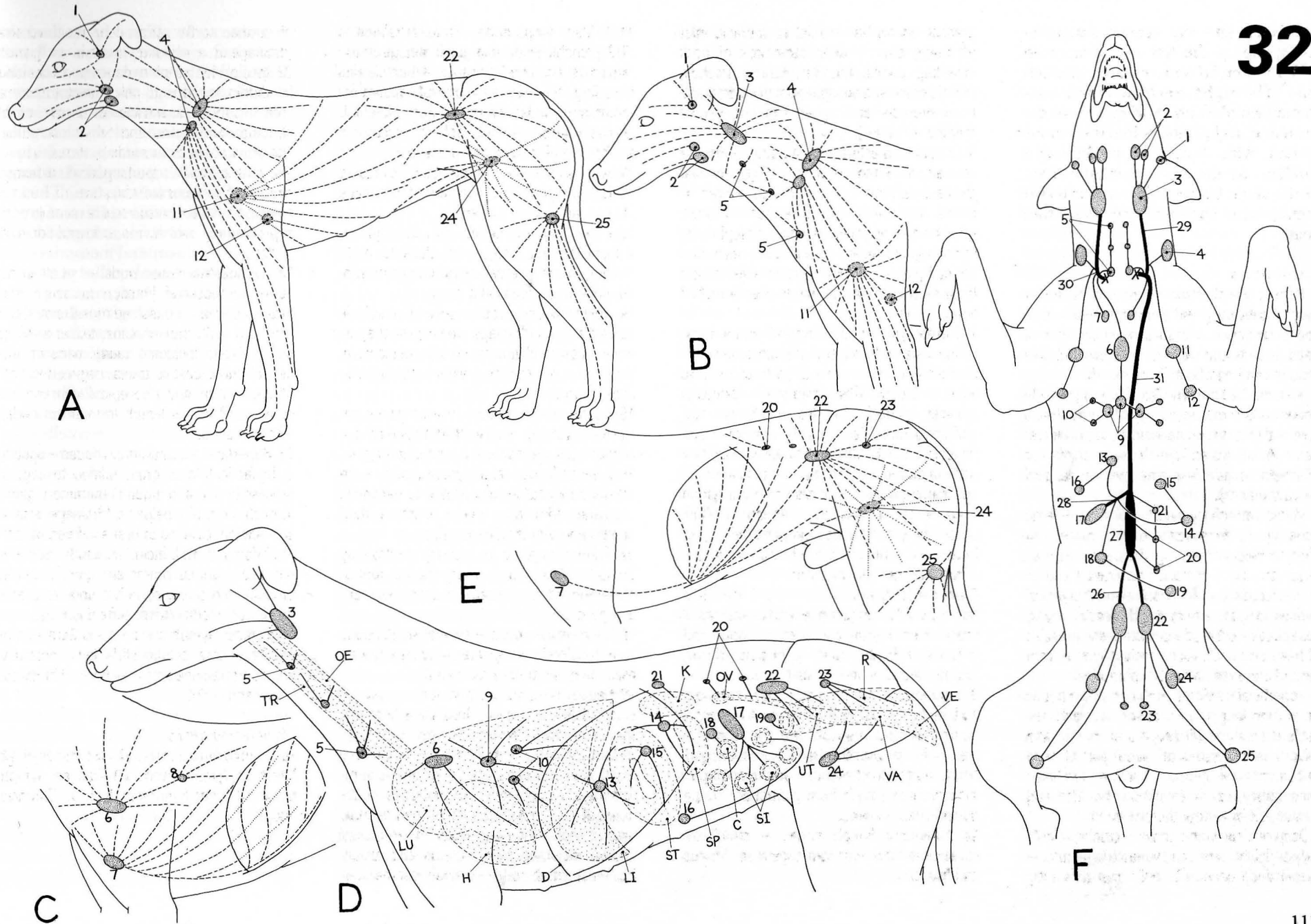
**23** Hypogastric lymph node – small in fat below lumbosacral junction in pelvic roof (drainage area = bones and muscles of pelvic roof and wall, part of loins, tail and thigh; pelvic viscera including caudal parts of urogenital and digestive tracts, vagina and vestibule, urethra, and also epididymis and vas deferens. Receives lymph from sacral nodes when present).

**24** Superficial inguinal lymph nodes – usually 2, in fat in fold of groin related to vaginal process in dog and inguinal mammary gland in bitch, normally palpable (drainage area = skin and subcutaneous tissues of ventral half of abdominal wall, including caudal abdominal and inguinal mammary glands, penis, prepuce and scrotum; pelvic floor and perineum, tail, medial thigh, stifle and crus).

**25** Popliteal lymph node – up to 2 cm long in popliteal fossa behind stifle joint, normally palpable (drainage area = all parts of hindlimb below stifle joint).

#### *Major lymph trunks*

**26** Lumbar lymph trunk. **27** Cisterna chyli. **28** Intestinal lymph trunk. **29** Tracheal lymph trunk. **30** Right lymphatic duct. **31** Thoracic duct.



largest of the cranial nerves are indicated on the diagram. Six of the cranial nerves have a very restricted distribution and are not considered in our drawing: the olfactory (cranial nerve 1), optic (cranial nerve 2) and auditory (cranial nerve 8) supply the nose, eye and ear respectively, the organs of special sensation; the oculomotor (cranial nerve 3), trochlear (cranial nerve 4) and abducent (cranial nerve 6) supply the muscles that move the eyeball in its socket.

Of the remaining six nerves the **trigeminal nerve** (cranial nerve 5) has the most extensive distribution in the head. It is responsible for conveying sensation from the skin of the head and the mucosa of the mouth cavity, and motor impulses to the jaw muscles. A number of its ramifications are shown in the schema. The **facial nerve** (cranial nerve 7) is also an extensively distributed nerve since it is responsible for conveying motor innervation to the muscles of facial expression. Some of its ramifications are shown in the schema. The **hypoglossal nerve** (cranial nerve 12), also shown, innervates tongue muscles.

Certain of the cranial nerves also supply structures in the neck. The connection (*cervical loop*) between the hypoglossal nerve and cervical nerve 1 is shown in the diagram. Fibres from the loop pass to strap muscles on the underside of the throat and neck. The **accessory nerve** (cranial nerve 11) is also shown on the diagram extending back in the neck, communicating with the ventral rami of cervical nerves, and innervating certain muscles of the lateral surface of the neck and shoulder. The two remaining cranial nerves, glossopharyngeal (cranial nerve 9) and vagus

(cranial nerve 10) are not included in the drawing. The vagus, widely distributing autonomic fibres to the viscera, is shown in fig 35B.

*Dorsal rami of spinal nerves with cutaneous branches and muscular branches to epaxial muscles*

1 Dorsal ramus of cervical nerve 1 (suboccipital nerve). 2 Dorsal ramus of cervical nerve 2 (greater occipital nerve). 3 Dorsal ramus of cervical nerve 7 (NB dorsal ramus of last cervical nerve [C8] always small and often absent). 4 Dorsal rami of thoracic nerves 1 and 13. 5 Dorsal rami of lumbar nerves 1 and 7 (cutaneous branches are cranial clunial nerves). 6 Dorsal rami of sacral nerves 1 and 3 (cutaneous branches are middle clunial nerves.) 7 Dorsal rami of caudal nerves 1–5 (interconnected to form a dorsal caudal plexus [trunk]).

*Ventral rami of spinal nerves*

8 Ventral ramus of cervical nerve 1. 9 Ventral ramus of last cervical nerve (C8). 10 Cervical loop (ansa hypoglossi – connecting ventral ramus of cervical nerve 1 with hypoglossal nerve [cranial nerve 12]). 11 Cervical plexus (interconnections between ventral rami of cervical nerves). 12 Great auricular nerve (from ventral ramus of cervical nerve 2). 13 Transverse cervical nerve (from ventral ramus of cervical nerve 2). 14 Supraclavicular nerves (from ventral rami of cervical nerves 3–5). 15 Phrenic nerve (from ventral rami of cervical nerves 5–7). 16–36 Nerves arising from brachial plexus – ventral rami of C6–T1. 16 Subclavian nerve (nerve to brachiocephalic muscle from ventral ramus of cervical nerve 6). 17 Suprascapular nerve (from ventral rami of cervical nerves 6–7). 18 Musculocutaneous nerve (from ventral rami of cervical nerves 7–8). 19 Medial cutaneous antebrachial nerve

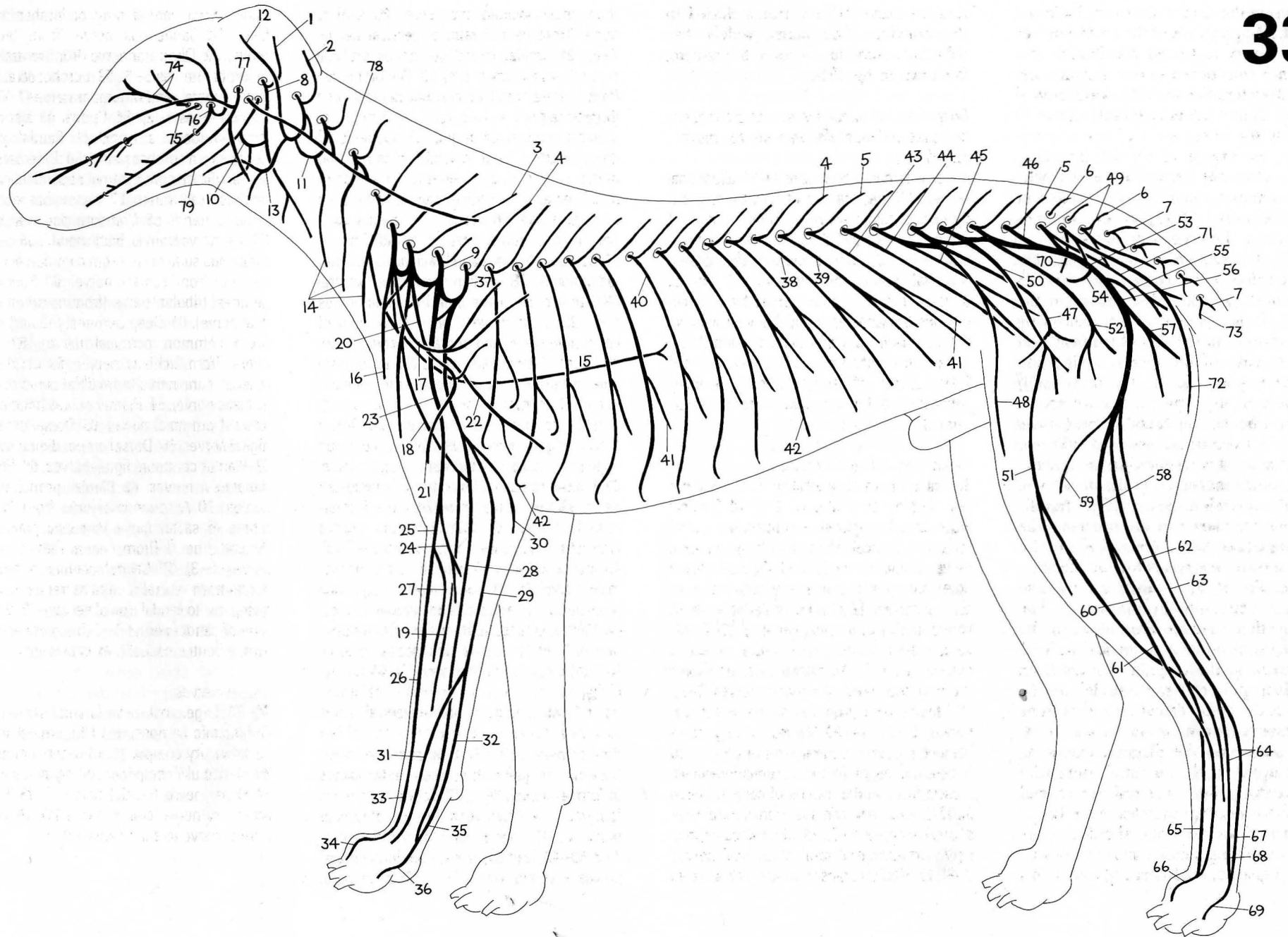
(from musculocutaneous nerve). 20 Axillary nerve (from ventral rami of cervical nerves 7–8). 21 Cranial lateral cutaneous brachial nerve (from axillary nerve). 22 Pectoral nerve (from ventral rami of cervical nerve 8 and thoracic nerve 1 and incorporated with lateral thoracic nerve at its origin). 23 Radial nerve (from ventral rami of cervical nerves 7–8 and thoracic nerve 1). 24 Deep (motor) branch of radial nerve. 25 Superficial (cutaneous) branch of radial nerve. 26 Lateral and medial components of superficial branch of radial nerve. 27 Lateral cutaneous antebrachial nerve (from radial nerve). 28 Median nerve (from ventral rami of cervical nerve 8 and thoracic nerves 1–2). 29 Ulnar nerve (from ventral rami of cervical nerve 8 and thoracic nerves 1–2). 30 Caudal cutaneous antebrachial nerve (from ulnar nerve). 31 Dorsal carpal branch of ulnar nerve. 32 Palmar branch of ulnar nerve. 33 Dorsal common digital nerves. 34 Dorsal proper digital nerves. 35 Palmar common digital nerves. 36 Palmar proper digital nerves. 37 Ventral ramus of 1st thoracic (intercostal) nerve. 38 Ventral ramus of 12th thoracic (intercostal) nerve. 39 Costoabdominal nerve (ventral ramus of last thoracic nerve – T13). 40 Intercostal nerve 7 (ventral ramus of thoracic nerve 7). 41 Distal lateral cutaneous branches of intercostal and lumbar nerves. 42 Ventral cutaneous branches of intercostal nerves 3–10. 43 Cranial iliohypogastric nerve (ventral ramus of lumbar nerve 1). 44 Caudal iliohypogastric nerve (ventral ramus of lumbar nerve 2). 45 Ilioinguinal nerve (ventral ramus of lumbar nerve 3). 46 Ventral ramus of last lumbar nerve (L7). 47 Genitofemoral nerve (external spermatic nerve from ventral ramus of lumbar nerves 3–4). 48 Lateral cutaneous femoral nerve (from ventral ramus of lumbar nerve 4). 49 Ventral rami of sacral nerves 1–3. 50–69 Nerves arising from lumbosacral plexus – ventral rami of L3–S3. 50 Femoral

nerve (from ventral rami of lumbar nerves 5–6). 51 Saphenous nerve (from femoral nerve). 52 Obturator nerve (from ventral rami of lumbar nerves 5–6). 53 Lumbosacral trunk (from ventral rami of lumbar nerves 6–7 and sacral nerves 1–2). 54 Cranial gluteal nerve (from lumbosacral trunk). 55 Caudal gluteal nerve (from lumbosacral trunk). 56 Ischiatic nerve (direct continuation outside pelvis of lumbosacral trunk). 57 Motor branches of ischiatic nerve. 58 Common peroneal nerve (fibular nerve from ischiatic nerve). 59 Lateral cutaneous sural nerve (from common peroneal nerve or from ischiatic nerve). 60 Superficial peroneal (fibular) nerve (from common peroneal nerve). 61 Deep peroneal (fibular) nerve (from common peroneal nerve). 62 Tibial nerve (from ischiatic nerve). 63 Caudal cutaneous sural nerve (from tibial nerve or from ischiatic nerve). 64 Plantar nerves (medial and lateral from tibial nerve). 65 Dorsal common digital nerves. 66 Dorsal proper digital nerves. 67 Plantar common digital nerves. 68 Plantar metatarsal nerves. 69 Plantar proper digital nerves. 70 Autonomic branch from ventral ramus of sacral nerve to pelvic plexus. 71 Pudendal nerve (from ventral rami of sacral nerves 1–3). 72 Caudal cutaneous femoral nerve (from ventral rami of sacral nerves 1–2 giving rise to caudal clunial nerves). 73 Ventral rami of caudal nerves 1–5 (interconnected to form a ventral caudal plexus or trunk).

*Cranial nerves*

74–76 Trigeminal nerve (cranial nerve 5). 74 Ophthalmic component of trigeminal nerve. 75 Maxillary component of trigeminal nerve. 76 Mandibular component of trigeminal nerve. 77 Facial nerve (cranial nerve 7). 78 Spinal accessory nerve (cranial nerve 11). 79 Hypoglossal nerve (cranial nerve 12).





# 34

## MOTOR INNERVATION OF THE SKELETAL MUSCLES OF THE DOG

The groups of body muscles innervated by specific nerves are indicated on these drawings in various different types of shading. If you remember when muscles were considered earlier the emphasis was firmly placed on groups of muscles acting together to produce actions at specific joints. The drawing here through the medium of its shading, shows how the motor nerve innervation to muscles is organized in terms of these same muscle groups. In practical terms what this means is that should damage occur to a particular nerve then specific groups of muscles will be affected. Temporary or even permanent paralysis of muscles (loss of voluntary movement) might well be a symptom of such nerve damage.

Muscle groups produce specific actions at particular joints so that disruption of nerve supply and the consequent muscle paralysis will produce alterations in the action of these joints. Certain actions may be lost by a joint; other actions may be accentuated at that joint because of the loss of antagonistic muscle activity.

Should you examine the drawing, and in particular the forelimb, you might

notice that the radial nerve is very important because of the muscle groups that it innervates; viz. the extensor muscles of the elbow (triceps group), carpal and digital joints. A paralysis involving the radial nerve leads to a dog being unable to perform the actions of elbow, carpal and digital extension. Loss of the capacity to extend its carpal and digital joints will accentuate the action of the opposing flexors of these joints, and a dog so afflicted might well stand and move 'knuckled over'; i.e. placing and dragging the dorsum of its paw along the ground. Loss of the capacity to extend its elbow, on the other hand, is a far more serious situation for a dog to cope with since it means that the elbow joint cannot be fixed in position (stabilized) to support weight. Weight placed on the limb will automatically flex the elbow and collapse the limb. The dog would limp along very badly on three legs only.

### *Muscles innervated by cranial nerves*

**1–3** Muscles innervated by trigeminal nerve (cranial nerve 5). **1** Masseter muscle. **2** Temporal muscle. **3** Digastric muscle. **4–7** Muscles innervated by facial nerve (cranial nerve 7). **4** Levator muscle of upper lip. **5** Orbicularis oris muscle. **6** Buccinator muscle. **7** Orbicularis oculi muscle. **8–9** Muscles innervated by vagus nerve (cranial nerve 10). **8** Pharyngeal muscles. **9** Cricothyroid muscle. **10–13** Muscles innervated by spinal accessory nerve (cranial nerve 11). **10** Sternoccephalic muscle. **11** Brachiocephalic muscle (cleidocervical part). **12** Omotransverse muscle. **13** Trapezius

muscle (cervical and thoracic parts). **14** Geniohyoid muscle innervated by hypoglossal nerve (cranial nerve 12).

### *Muscles innervated by nerves arising from brachial plexus*

**15** Ventral serrate muscle (thoracic part) innervated by long thoracic nerve. **16** Latissimus dorsi muscle innervated by dorsal thoracic nerve. **17–18** Muscles innervated by pectoral nerves. **17** Superficial pectoral muscle. **18** Deep pectoral muscle. **19–20** Muscles innervated by suprascapular nerve. **19** Supraspinatus muscle. **20** Infraspinatus muscle. **21–24** Muscles innervated by axillary nerve. **21** Deltoid muscle. **22** Teres major muscle. **23** Teres minor muscle. **24** Brachiocephalic muscle (cleidobrachial part). **25–26** Muscles innervated by musculocutaneous nerve. **25** Biceps brachii muscle. **26** Brachial muscle. **27–32** Muscles innervated by radial nerve. **27** Triceps brachii muscle. **28** Radial carpal extensor muscle. **29** Common and lateral digital extensor muscles. **30** Ulnar carpal extensor muscle (lateral ulnar). **31** Oblique carpal extensor muscle. **32** Supinator muscle. **33–36** Muscles innervated by median nerve. **33** Pronator teres muscle. **34** Radial carpal flexor muscle. **35** Superficial digital flexor muscle. **36** Deep digital flexor muscle (all three heads). **37–38** Muscles innervated by ulnar nerve. **37** Ulnar carpal flexor muscle. **38** Deep digital flexor muscle (bar radial head).

### *Muscles innervated by dorsal rami of spinal nerves*

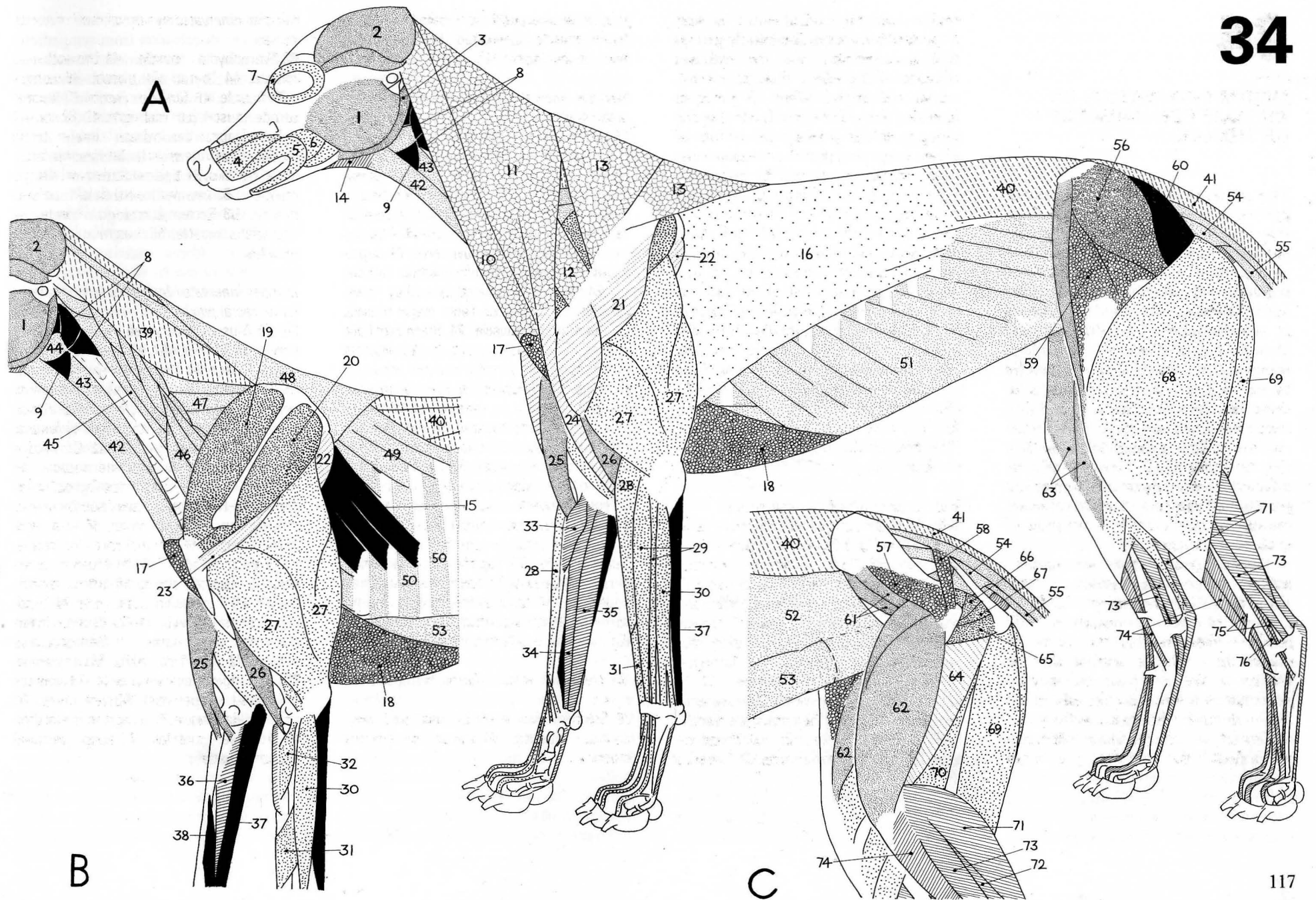
**39** Splenius muscle. **40** Iliocostal and longissimus muscles. **41** Dorsal sacrocaudal muscles.

### *Muscles innervated by ventral rami of spinal nerves*

**42** Sternohyoid muscle. **43** Sternothyroid muscle. **44** Thyrohyoid muscle. **45** Longus colli muscle. **46** Scalene muscle. **47** Ventral serrate muscle (cervical part). **48** Rhomboid muscle (capital, cervical and thoracic parts). **49** Dorsal serrate muscle. **50** External intercostal muscles. **51** External abdominal oblique muscle. **52** Internal abdominal oblique muscle. **53** Rectus abdominis muscle. **54** Coccygeus muscle. **55** Ventral sacrocaudal muscles.

### *Muscles innervated by nerves arising from lumbosacral plexus*

**56–59** Muscles innervated by cranial gluteal nerve. **56** Middle gluteal muscle. **57** Deep gluteal muscle. **58** Piriform muscle. **59** Tensor muscle of lateral femoral fascia. **60** Superficial gluteal muscle innervated by caudal gluteal nerve. **61–63** Muscles innervated by femoral nerve. **61** Iliopsoas muscle. **62** Quadriceps femoris muscle. **63** Sartorius muscle. **64** Adductor muscles innervated by obturator nerve. **65–67** Muscles innervated by rotator nerves from ischiatic nerve. **65** Quadratus femoris muscle. **66** Internal obturator muscle. **67** Gemelli muscles. **68–70** Muscles innervated by ischiatic nerve. **68** Biceps femoris muscle. **69** Semitendinosus muscle. **70** Semimembranosus muscle. **71–73** Muscles innervated by tibial nerve. **71** Gastrocnemius muscle. **72** Superficial digital flexor muscle. **73** Deep digital flexor muscle. **74–76** Muscles innervated by peroneal (fibular) nerve. **74** Cranial tibial muscle. **75** Long and lateral digital extensor muscles. **76** Long peroneal (fibular) muscle.





trol include such things as respiration, blood pressure regulation, gut activity, glandular secretion, bladder emptying, and so on.

Although not included in the drawing the **adrenal glands** are of importance in any consideration of the autonomic nervous system. They are shown in fig 27E in the abdominal roof between the kidneys, related to the aorta and caudal vena cava. Their importance lies in the role they play in reinforcing the effects of sympathetic activity. The central core of an adrenal gland, the **adrenal medulla**, is formed in embryonic development from the same cellular rudiments that produce the peripheral sympathetic ganglia and postganglionic sympathetic nerves. What this means is that the adrenal medulla will function as a giant postganglionic sympathetic fibre passing adrenal hormone (*adrenaline* and *noradrenaline*) into the bloodstream for widespread distribution. The effects produced are superimposed on the more local effects produced by sympathetic postganglionic nerves. You may surmise from this that the adrenal medulla must also receive preganglionic fibres from the sympathetic trunk in visceral nerves. These actually originate from the more caudal thoracic segments of the sympathetic trunk as part of the splanchnic nerves.

#### *Ventral rami of spinal nerves*

1 Cervical nerve 1. 2 Cervical nerve 8. 3 Thoracic nerve 1. 4 Lumbar nerve 4. 5 Sacral nerve 1.

#### *Sympathetic nervous system*

6–11 Visceral (communicating) rami of spinal nerves. 6–9 Grey visceral rami (postganglionic

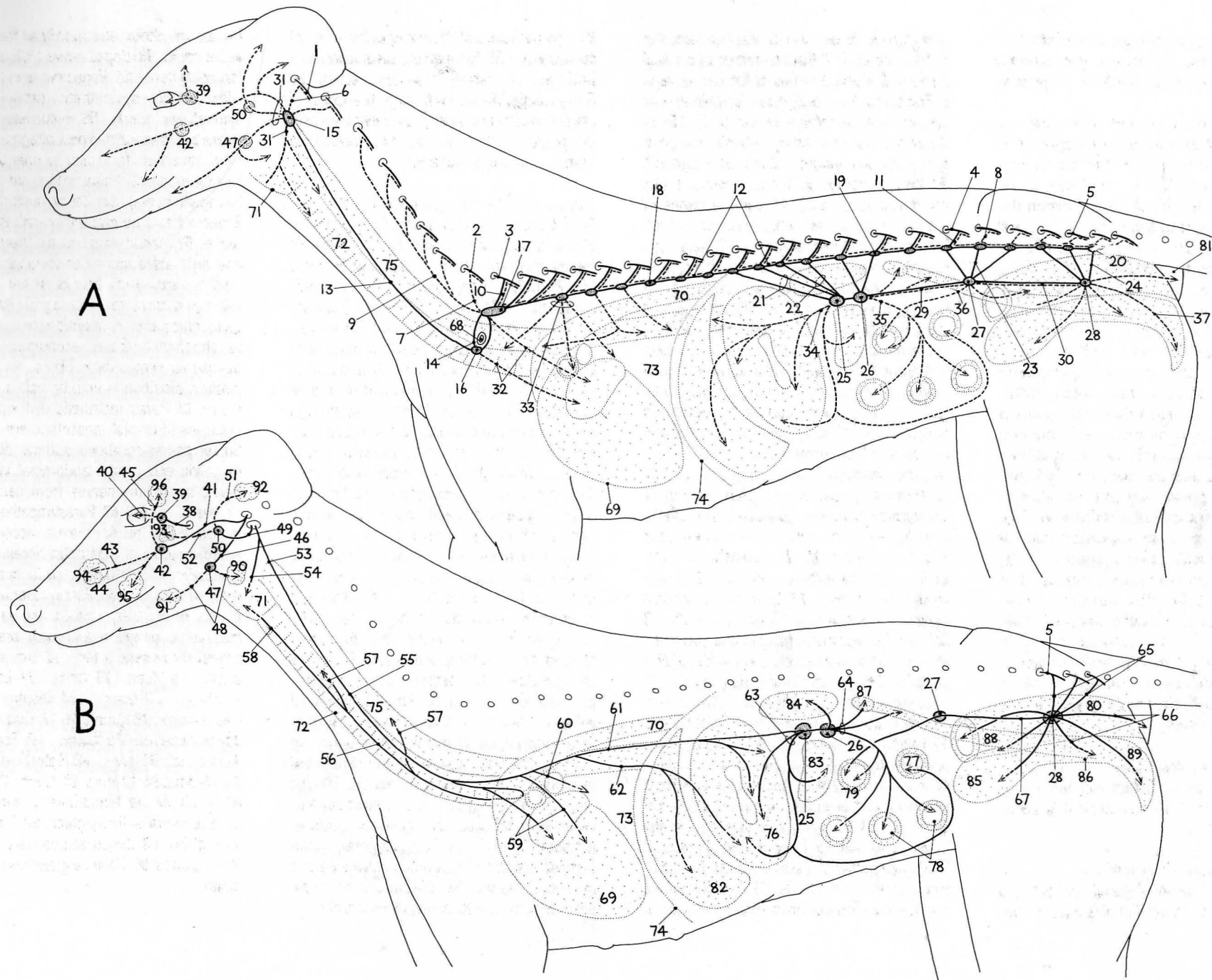
sympathetic fibres only). 6 Visceral ramus of cervical nerve 1. 7 Visceral ramus of cervical nerve 8. 8 Visceral ramus of lumbar nerve 5. 9 Transverse (vertebral) nerve (combined grey visceral rami of cervical nerves 3–7). 10–11 White visceral rami (preganglionic and postganglionic sympathetic fibres intermingled). 10 Visceral ramus of thoracic nerve 1 (1st white visceral ramus). 11 Visceral ramus of lumbar nerve 4 (last white visceral ramus). 12–14 Sympathetic trunk. 12 Sympathetic trunk in thorax, abdomen and pelvis (trunk in pelvis becomes irregular and trunks of left and right sides may join). 13 Sympathetic trunk in neck (runs with vagus nerve as vago-sympathetic trunk). 14 Subclavian loop (subdivision of sympathetic trunk around subclavian artery). 15–20 Sympathetic trunk ganglia. 15 Cranial cervical sympathetic ganglion. 16 Middle cervical sympathetic ganglion. 17 Cervicothoracic (stellate) sympathetic ganglion (fused ganglia of C8–T3). 18 Thoracic sympathetic ganglion. 19 Lumbar sympathetic ganglion. 20 Sacral sympathetic ganglion (ganglia in pelvis become irregular and may combine). 21–24 Splanchnic nerves. 21 Greater splanchnic nerve. 22 Lesser splanchnic nerve. 23 Lumbar splanchnic nerves. 24 Sacral splanchnic nerves. 25–30 Collateral sympathetic ganglia and plexuses. 25–26 Coeliacomesenteric plexus. 25 Coeliac ganglion. 26 Cranial mesenteric ganglion. 27 Caudal mesenteric ganglion. 28 Pelvic plexus. 29 Intermesenteric (abdominal aortic) plexus. 30 Hypogastric nerve. 31–37 Postganglionic sympathetic distribution to viscera. 31 Postganglionic sympathetic distribution to viscera in head and cranial end of neck with carotid artery. 32–33 Postganglionic sympathetic distribution to viscera in neck and thorax. 32 Cardiosympathetic nerves. 33 Broncho-sympathetic nerves. 34–36 Postganglionic sympathetic distribution to abdominal viscera.

34 Sympathetic distribution with branches of coeliac artery. 35 Sympathetic distribution with branches of cranial mesenteric artery. 36 Sympathetic distribution with branches of caudal mesenteric artery. 37 Postganglionic sympathetic distribution to pelvic viscera with branches of urogenital artery.

#### *Parasympathetic nervous system*

38–52 Cranial parasympathetic outflow to glandular structures in head. 38 Preganglionic parasympathetic fibres in oculomotor nerve (3). 39 Ciliary ganglion. 40 Postganglionic parasympathetic fibres to ciliary and pupillary muscles in short ciliary and nasociliary nerves. 41 Preganglionic parasympathetic fibres originating in facial nerve (7) but distributed in branches of maxillary component of trigeminal nerve (5) – vectored from facial through nerve of pterygoid canal. 42 Pterygopalatine ganglion. 43 Postganglionic parasympathetic fibres to nasal glands in caudal nasal nerve. 44 Postganglionic parasympathetic fibres to palatine glands in major and minor palatine nerves. 45 Postganglionic parasympathetic fibres to lacrimal gland in lacrimal nerve. 46 Preganglionic parasympathetic fibres originating in facial nerve (7) and distributed in mandibular component of trigeminal nerve (5) – vectored from facial through chorda tympani nerve and lingual nerve. 47 Mandibular ganglion. 48 Postganglionic parasympathetic fibres to mandibular and sublingual salivary glands in lingual nerve. 49 Preganglionic parasympathetic fibres originating in glossopharyngeal nerve (9) but distributed in branches of trigeminal nerve (5). 50 Otic ganglion. 51 Postganglionic parasympathetic fibres to parotid salivary gland in auriculotemporal nerve. 52 Postganglionic parasympathetic fibres to zygomatic salivary gland in buccal nerve. 53–64 Cranial parasympathetic outflow distributing to viscera of neck,

thorax and abdomen caudally as far as transverse colon. 53 Vagus nerve (10). 54 Cranial laryngeal nerve. 55 Vagus nerve in neck (runs with cervical sympathetic trunk as vago-sympathetic trunk). 56 Recurrent laryngeal nerve. 57 Tracheal and oesophageal branches from recurrent laryngeal nerve. 58 Caudal laryngeal nerve (termination of recurrent laryngeal nerve). 59 Cardiovascular nerve. 60 Bronchial and pulmonary branches of vagal nerve. 61 Dorsal vagal trunk (trunks of left and right sides join close to diaphragm). 62 Ventral vagal trunk (trunks of left and right sides join close to diaphragm). 63–64 Preganglionic parasympathetic vagal distribution to abdominal viscera accompanying postganglionic sympathetic fibres. 63 Parasympathetic distribution with branches of coeliac artery. 64 Parasympathetic distribution with branches of cranial mesenteric artery. 65–67 Sacral parasympathetic outflow distributing to pelvic and caudal abdominal viscera. 65 Pelvic splanchnic nerves from sacral spinal nerves 1–3. 66–67 Parasympathetic distribution from pelvic plexus accompanying postganglionic sympathetic fibres. 66 Parasympathetic distribution with branches of urogenital artery. 67 Parasympathetic distribution through hypogastric nerves, caudal mesenteric ganglion and with branches of caudal mesenteric artery. 68 Left subclavian artery. 69 Heart. 70 Aorta. 71 Larynx. 72 Trachea. 73 Lung. 74 Diaphragm. 75 Oesophagus. 76 Stomach. 77 Duodenum. 78 Jejunum/Ileum. 79 Colon. 80 Rectum. 81 Anal canal. 82 Liver. 83 Spleen. 84 Kidney. 85 Bladder. 86 Urethra. 87 Ovary. 88 Uterus. 89 Vestibule. 90 Mandibular salivary gland. 91 Sublingual salivary gland. 92 Parotid salivary gland. 93 Zygomatic salivary gland. 94 Nasal glands. 95 Palatine glands. 96 Lacrimal gland.



# 36

## SURFACE ANATOMY OF THE DOG – HEAD, NECK AND TRUNK

This drawing, and the final two (figs 37 & 38), attempt to portray most of the structures that are clearly related to the body surface, either palpable or visualizable in surface projection.

### *Surface features*

**1** Nasal plane (pigmented hairless skin). **2** External nostril (leading into nasal vestibule surrounded by nasal cartilages). **3** Philtrum. **4** Pinna (visible part of external ear). **5** External opening of ear canal. **6** Jugular fossa (triangular depression at base of neck). **7** Axilla. **8** Median pectoral groove. **9** Umbilicus (navel – hairless scar denoting point of entry and exit of blood vessels in foetus). **10** Fold of flank. **11** Fold of groin. **12** Position of superficial (subcutaneous) opening of inguinal canal. **13** Femoral triangle (bordered by sartorius, pectineus and abdominal wall muscles).

### *Bones, joints and ligaments of head*

**14** Nasal cartilages (movably articulated with bone of nasal cavity and surrounding nasal vestibule). **15** Nasal process of incisive bone (bordering bony nasal opening leading into nasal cavity proper). **16** Infraorbital foramen (passage of infraorbital branches of maxillary artery and nerve). **17** Bony orbital margin. **18** Zygomatic (supraorbital) process of frontal bone. **19** Zygomatic arch (bar of bone con-

necting face and cranium below eye). **20** Orbital ligament (joining frontal bone and zygomatic arch and completing orbital rim). **21** Temporal line (rostral divergence of external sagittal crest). **22** External sagittal crest (in dorsal midline of cranium). **23** External occipital protuberance (occiput). **24** Nuchal crest (division between dorsal and caudal surfaces of cranium). **25** Mastoid process of temporal bone (sole representation on skull surface of petrous temporal bone). **26–28** Mandible (lower jaw). **26** Mandibular body. **27** Angular process of mandible. **28** Mandibular symphysis. **29** Mental foramen (passage of mental branches of mandibular alveolar nerve and vessels). **30** Auricular cartilage. **31** Scutiform cartilage. **32–34** Hyoid apparatus (suspending tongue and larynx in floor of throat). **32** Cranial horn of hyoid. **33** Basihyoid bone. **34** Caudal horn of hyoid (thyrohyoid bone). **35** Thyroid cartilage of larynx (forming 'laryngeal prominence' of voice box). **36** Cricoid cartilage of larynx. **37** Cricothyroid membrane. **38** Tracheal cartilages.

### *Vertebral column, ribs and sternum*

**39** Wing of atlas (transverse process of cervical vertebra 1). **40** Position of atlantooccipital joint. **41** Spinous process of axis (cervical vertebra 2). **42** Transverse process of axis. **43** Transverse processes of cervical vertebrae. **44** Nuchal ligament. **45** Supraspinous ligament. **46** Spinous process of thoracic vertebra 1. **47** Manubrium of sternum (1st sternebra elongated into base of neck). **48** Xiphoid process of sternum (cartilaginous prolongation of last sternebra into belly wall). **49** Rib 1. **50** Costal arch (fused costal cartilages of ribs 10–12 connected by fibrous tissue with costal cartilage of rib 9). **51** Rib 13 (last or floating rib united with costal arch by fibrous tissue).

### *Forelimb skeleton*

**52** Greater tubercle of humerus (point of shoulder). **53** Cranial border of scapula. **54** Cranial angle of scapula. **55** Medial epicondyle of humerus. **56** Medial surface of radial head. **57** Medial collateral elbow ligament. **58** Elbow joint (humeroulnar component). **59** Olecranon process of ulna (point of elbow). **60** Styloid process of radius. **61** Antebrachiocondylar joint (main component of carpal joint).

### *Hindlimb skeleton*

**62** Pubic pecten. **63** Cranial pubic ligament. **64** Ischiatic tuberosity (point of buttock). **65** Ischiatic arch. **66** Inguinal ligament. **67** Patella (knee cap). **68** Medial ridge of femoral trochlea. **69** Femoropatellar component of stifle joint. **70** Medial femoral condyle. **71** Medial tibial condyle. **72** Medial collateral ligament of stifle joint. **73** Femorotibial component of stifle joint. **74** Patellar tendon (continuation onto tibia of quadriceps femoris tendon). **75** Fat pad underlying patellar tendon. **76** Tibial tuberosity (insertion of patellar tendon). **77** Cranial border of tibia (tibial crest). **78** Subcutaneous medial surface of tibial shaft. **79** Medial malleolus of tibia. **80** Crurotarsal joint (main component of tarsal joint). **81** Calcaneal tuberosity (point of hock). **82** Metatarsal bone 1 (remains of).

### *Muscles*

**83** Temporal muscle. **84** Masseter muscle. **85** Mylohyoid muscle. **86** Sternohyoid muscle. **87** Sternocleidomastoid muscle. **88** Brachiocephalic muscle. **89** Triceps brachii muscle. **90** Flexor muscles of carpus and digits. **91** Supraspinatus muscle. **92** Superficial pectoral muscle. **93** Deep pectoral muscle. **94** Latissimus dorsi muscle. **95** Sartorius muscle. **96** Quadriceps femoris muscle. **97** Pectineus muscle. **98** Gracilis and adductor muscles.

### *Blood vessels and lymph nodes*

**99** Angular vein of eye (continuation of facial vein into orbit to connect with ophthalmic venous plexus). **100** Facial vein. **101** External jugular vein (in jugular groove). **102** Femoral artery. **103** Parotid lymph node (small, beneath parotid salivary gland). **104** Mandibular lymph nodes (prominent and normally palpable). **105** Medial retropharyngeal lymph node (large, deeply positioned and up to 5 cm long). **106** Superficial cervical lymph nodes (prominent, palpable if enlarged). **107** Axillary lymph node (related to rib 2, palpable if enlarged). **108** Accessory axillary lymph node (only occasionally present). **109** Superficial inguinal lymph node (often paired, palpable normally). **110** Popliteal lymph node (up to 2 cm long in popliteal fossa and normally palpable).

### *Nerves*

**111** Infraorbital nerve (from maxillary component of trigeminal nerve [5] ramifying on side of muzzle).

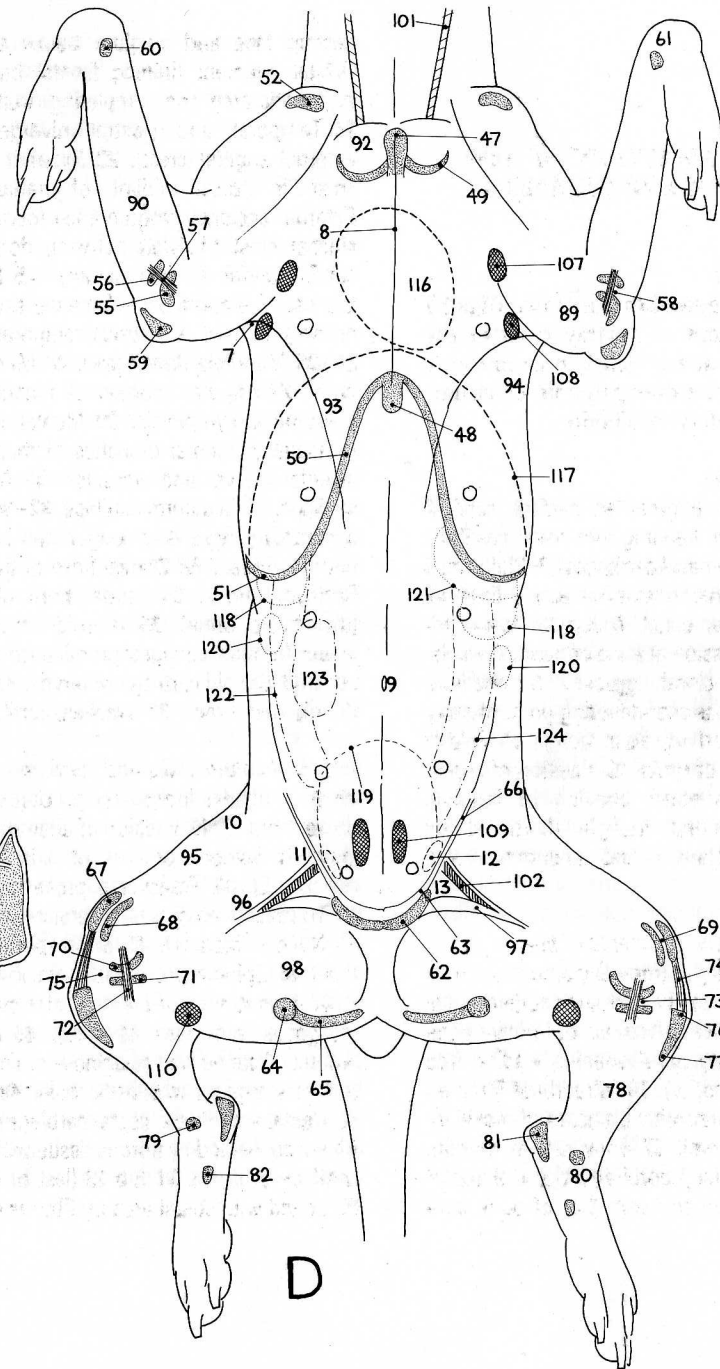
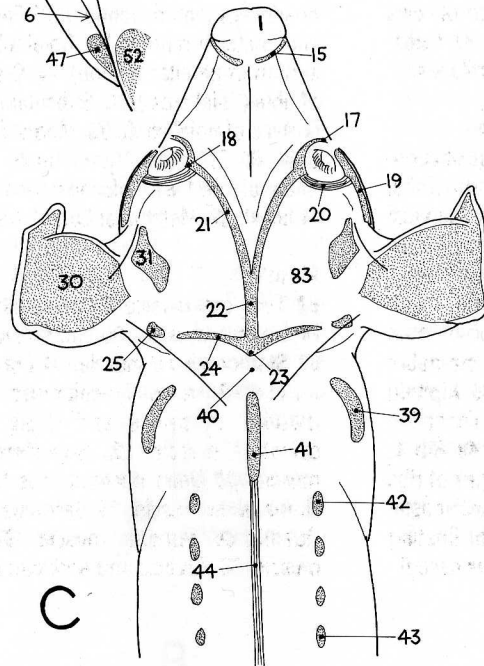
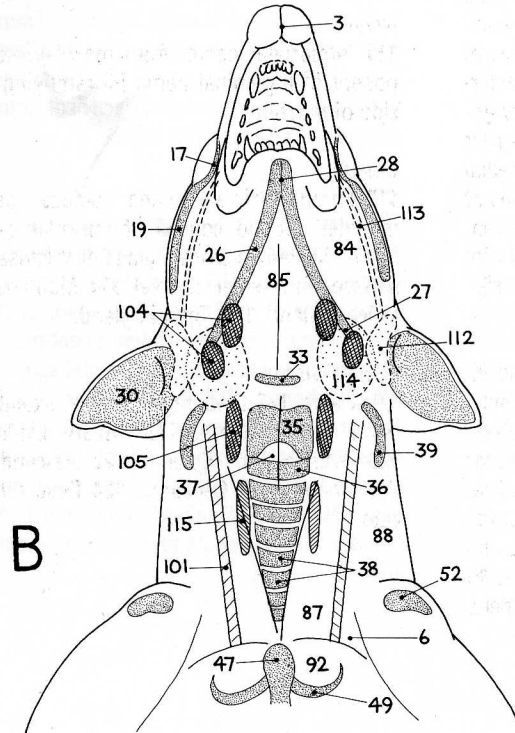
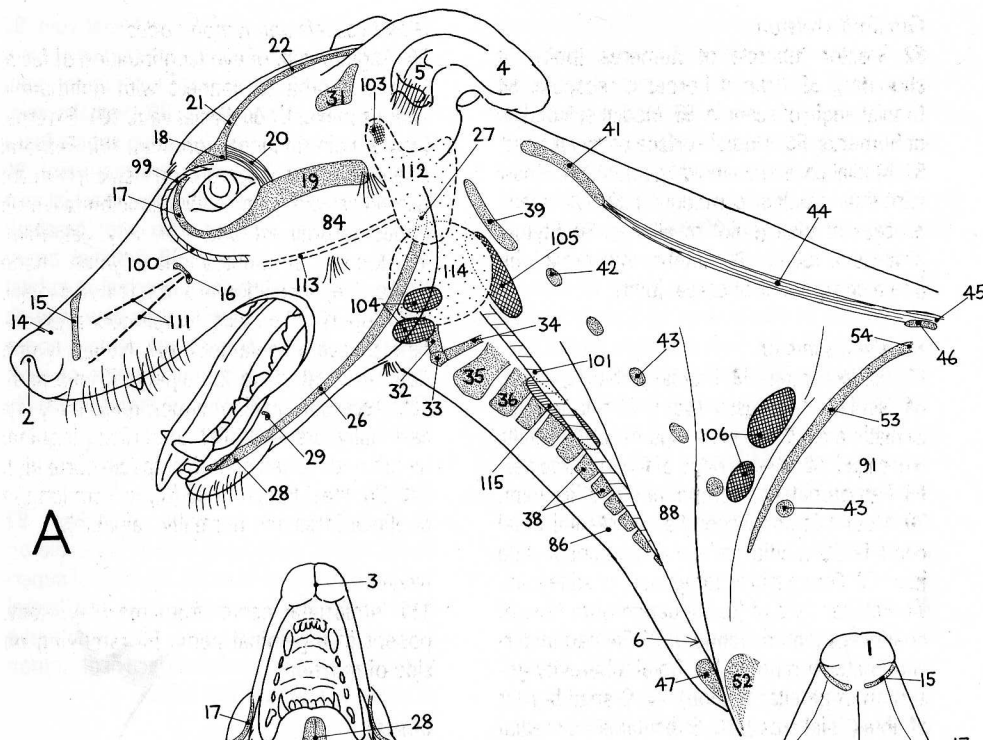
### *Glands*

**112** Parotid salivary gland (diffuse gland moulded around concha of auricular cartilage). **113** Parotid salivary gland duct (crossing surface of masseter muscle). **114** Mandibular salivary gland. **115** Thyroid gland.

### *Internal viscera*

**116** Heart. **117** Diaphragm (cranial extent of dome). **118** Kidneys. **119** Urinary bladder. **120** Ovaries. **121** Spleen. **122** Descending duodenum. **123** Caecum. **124** Descending colon.





# 37

## SURFACE ANATOMY OF THE DOG – NECK, THORAX AND FORELIMB

This drawing, and figs 36 & 38, attempt to portray most of the structures that are clearly related to the body surface, either palpable or capable of visualization in surface projection.

### Surface features

**1** Nasal plane (pigmented hairless skin). **2** External nostril (leading into nasal vestibule surrounded by nasal cartilages). **3** Philtrum. **4** Pinna (visible part of external ear based on auricular cartilage). **5** Jugular fossa (triangular depression at base of neck bordered by sternocephalic, brachiocephalic and superficial pectoral muscles). **6** Axilla ('armpit' between muscles of arm and muscles of chest wall). **7** Median pectoral groove. **8** Tricipital margin of arm (caudal margin of arm based on long head of triceps muscle). **9** Cubital fossa (depression on flexor surface of elbow joint). **10** Ventral boundary of epaxial musculature (thoracic iliocostal muscle attaching onto ribs).

### Bones, joints and ligaments

**11** Nasal process of incisive bone (bordering bony nasal opening leading into nasal cavity proper). **12** Bony nasal aperture. **13** Infra-orbital foramen (passage for infraorbital branches of maxillary artery and nerve). **14** Bony orbital margin. **15** Zygomatic (supra-orbital) process of frontal bone. **16** Zygomatic

arch (bar of bone connecting face and cranium below eye). **17** Orbital ligament (joining frontal bone and zygomatic arch and completing orbital rim). **18** Temporal line (rostral divergence of external sagittal crest). **19-20** Mandible (lower jaw). **19** Mandibular body. **20** Mandibular symphysis (fibrocartilaginous intermandibular joint). **21** Tracheal cartilages (approximately 35 linked by annular ligaments). **22** Transverse processes of cervical vertebrae 6 and 7. **23** Spinous process of thoracic vertebra 1. **24** Spinous process of thoracic vertebra 13. **25** Nuchal ligament (continuation of supraspinous ligament from summit of first thoracic spinous process to spine of axis vertebra). **26** Supraspinous ligament linking summits of spinous processes of trunk vertebrae. **27-29** Sternum. **27** Manubrium of sternum (1st sternebra elongated into base of neck). **28** Body of sternum (8 sternal segments linked by intersternbral cartilages). **29** Xiphoid process of sternum (cartilaginous prolongation of last sternebra into belly wall). **30** Rib 1. **31** Thoracic inlet (bordered by first thoracic vertebra, sternal manubrium and first pair of ribs). **32** Rib 6. **33** Costal arch (fused costal cartilages of ribs 10-12 connected by fibrous tissue with costal cartilage of rib 9). **34** Rib 13 (last or floating rib united with costal arch by fibrous tissue). **35** Dorsal (vertebral) border of scapula. **36** Cranial angle of scapula. **37** Cranial border of scapula. **38** Caudal angle of scapula. **39** Spine of scapula. **40** Acromion process of scapula. **41** Position of shoulder joint. **42** Greater tuberosity of humerus (point of shoulder). **43** Crest of greater tuberosity of humerus. **44** Deltoid tuberosity of humerus. **45** Lesser tuberosity of humerus. **46** Intertubercular (bicipital) groove of humerus (for passage of biceps tendon surrounded by bi-

cipital bursa and held in place by transverse humeral retinaculum). **47** Medial humeral condyle. **48** Medial humeral epicondyle (flexor epicondyle). **49** Lateral humeral condyle. **50** Lateral humeral epicondyle (extensor epicondyle). **51** Radial head. **52** Lateral radial tuberosity. **53** Medial edge of trochlear notch of ulna. **54** Medial collateral elbow ligament. **55** Lateral collateral elbow ligament. **56** Olecranon process of ulna (point of elbow). **57** Position of elbow joint. **58** Lateral styloid process of ulna. **59** Subcutaneous medial surface of radius. **60** Medial styloid process of radius. **61** Accessory carpal bone. **62** Medial collateral carpal ligament. **63** Lateral collateral carpal ligament. **64** Lateral surface of base of metacarpal bone 5. **65** Position of antebrachio-carpal joint (main component of composite carpal joint).

### Muscles

**66** Sternooccipital muscle. **67** Brachiocephalic muscle. **68** Supraspinous muscle. **69** Deltoid muscle. **70** Long head of triceps muscle (tricipital margin of arm). **71** Brachial muscle. **72** Biceps tendon (in intertubercular groove). **73** Biceps brachii muscle. **74** Superficial pectoral muscle. **75** Deep pectoral muscle. **76** Radial carpal extensor muscle. **77** Pronator teres muscle. **78** Extensor muscles of carpus and digits. **79** Flexor muscles of carpus and digits. **80** Tendon of ulnar carpal flexor muscle. **81** Tendon of lateral ulnar muscle. **82** Latissimus dorsi muscle. **83** Epaxial muscles (iliocostal muscle forms lateral component of group).

### Vessels and lymph nodes

**84** Angular vein of eye (continuation of facial vein into orbit where it anastomoses with ex-

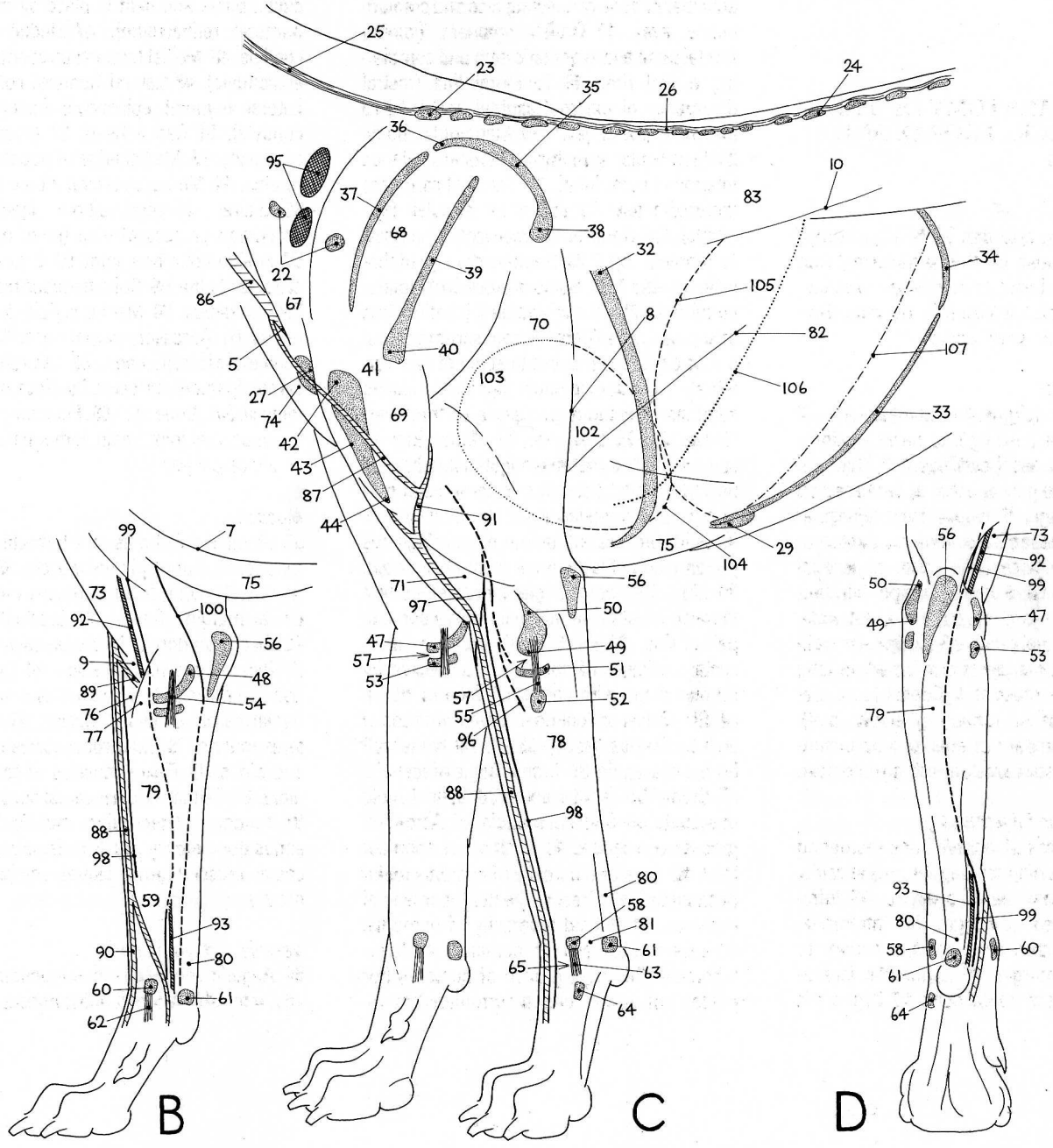
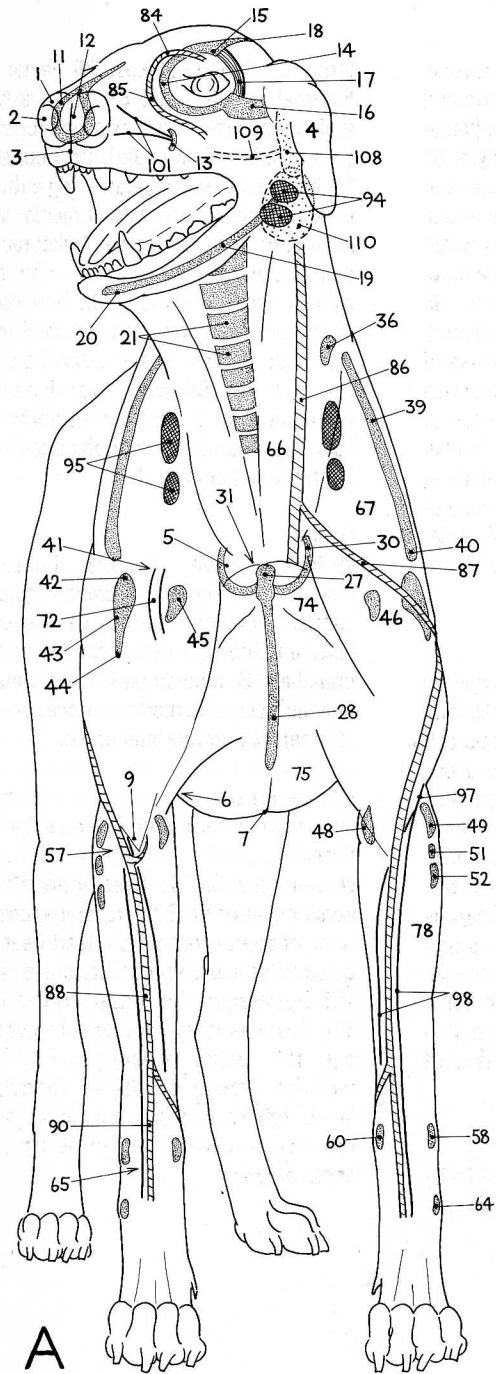
ternal ophthalmic plexus). **85** Facial vein. **86** External jugular vein. **87** Omobranchial vein (linking cephalic and external jugular vein across point of shoulder). **88** Cephalic vein. **89** Median cubital vein (entering cubital fossa to join cephalic vein with brachial vein). **90** Accessory cephalic vein. **91** Axillobrachial vein (connection of cephalic vein with brachial/axillary vein in armpit). **92** Brachial artery (pulse may be taken from brachial in cubital fossa). **93** Median artery (enters paw through carpal canal). **94** Mandibular lymph nodes (normally 2 or 3, palpable at angle of jaw). **95** Superficial cervical lymph nodes (normally 2, palpable if enlarged).

### Nerves

**96** Radial nerve, muscular branches. **97** Radial nerve, superficial branch (palpable on surface of brachial muscle). **98** Cranial superficial antebrachial nerve, medial and lateral branches. **99** Median nerve. **100** Ulnar nerve (palpable crossing medial surface of olecranon of ulna). **101** Infraorbital nerve.

### Internal organs

**102** Heart (in surface projection extending between ribs 3 and 6, overlapping into intercostal spaces 2 and 6). **103** Base of heart (in transverse plane of rib 3/intercostal space 3). **104** Apex of heart (from which heart beat may be detected at lower end of intercostal space 6). **105** Diaphragm. **106** Basal border of lung. **107** Costodiaphragmatic line of pleural reflection. **108** Parotid salivary gland (diffuse and moulded around concha of auricular cartilage). **109** Parotid salivary gland duct. **110** Mandibular salivary gland (oval, just caudal to angle of jaw).





# 38

## SURFACE ANATOMY OF THE DOG – PELVIS AND HINDLIMB

This drawing, and the previous two (figs 36 & 37), attempt to portray most of the structures that are clearly related to the body surface, either palpable or capable of visualization in surface projection.

### *Surface features*

**1** Ischiorectal fossa (lateral to root of tail where bordered by pelvic diaphragm, medial to rump muscles and sacrotuberous ligament). **2** Fold of flank (skin fold joining flank and thigh proximal to stifle joint). **3** Prepuce (sheath or foreskin protecting glans penis and providing a reserve fold of skin for erect penis). **4** Preputial opening (leading into preputial cavity around glans penis). **5** Anus (ducts of paranal sacs open on either side). **6** Circumanal skin (sparsely haired and studded with pores of circumanal glands – modified sebaceous glands producing odoriferous material attractive to other dogs). **7** Penile (urethral) bulb (expansion of spongy erectile tissue below anus and between divergent crura of penile root). **8** Penile crus (fibrous erectile tissue [cavernous body] surrounded by an ischio-cavernosus muscle and attached to ischiatic arch – pair of crura attach penis to pelvis and

form basis of penile root). **9** Scrotum (sparsely haired, thin skin). **10** Scrotal raphe (denoting internal subdivision of scrotum into two testicular compartments). **11** Popliteal fossa (depression on flexor surface of stifle joint bounded by diverging hamstring muscles and gastrocnemius muscles).

### *Bones, joints and ligaments*

**12** Crest of ilium. **13** Sacral tuberosity (point of croup). **14** Coxal tuberosity (point of haunch). **15** Median sacral crest. **16** Sacrotuberous ligament (extending from ischiatic tuberosity to lateral sacral crest and transverse process of first caudal vertebra). **17** Ischiatic tuberosity (point of buttock). **18** Ischiatic arch (joining ischiatic tuberosities of either side). **19** Greater trochanter of femur (roughly on same level as head of femur and is pointer to position of hip joint). **20** Position of hip joint (joint itself is not palpable). **21** Lateral ridge of femoral trochlea. **22** Medial ridge of femoral trochlea. **23** Patella ('knee cap' – sesamoid bone in tendon of insertion of quadriceps femoris muscle located in femoral trochlea). **24** Position of femoropatellar component of stifle joint. **25** Patellar tendon (tendon of insertion of quadriceps femoris muscle, major stifle extensor muscle). **26** Medial condyle of femur. **27** Medial epicondyle of femur. **28** Lateral condyle of femur. **29** Lateral epicondyle of femur. **30** Lateral fabella (sesamoid bone in tendon of origin of lateral head of gastrocnemius muscle). **31** Medial condyle of tibia. **32** Lateral condyle of tibia. **33** Lateral collateral stifle ligament. **34** Medial collateral

stifle ligament. **35** Position of femorotibial component of stifle joint. **36** Infrapatellar fat pad underlying patellar tendon. **37** Tibial tuberosity. **38** Cranial border of tibia. **39** Subcutaneous medial surface of tibia. **40** Head of fibula. **41** Lateral malleolus of fibula. **42** Medial malleolus of tibia. **43** Calcaneal tuberosity (point of hock). **44** Metatarsal bone 1. **45** Lateral surface of base of metatarsal bone 5. **46** Lateral collateral tarsal ligament. **47** Medial collateral tarsal ligament. **48** Position of crurotarsal component of hock joint (trochlea of talus is palpable). **49** Os penis (penile bone in glans penis formed from ossification in cavernous bodies – maintains glans penis in a permanently 'erect' state. Longitudinal groove on underside of bone houses urethra surrounded by spongy erectile tissue).

### *Muscles*

**50** Middle and superficial gluteal muscles (rump muscles). **51** Cranial margin of thigh based on sartorius muscle. **52** Biceps femoris component of hamstring muscles. **53** Semitendinosus component of hamstring muscles. **54** Gracilis muscle. **55** Quadriceps femoris muscle (beneath lateral femoral fascia). **56** Calf muscles (gastrocnemius and superficial digital flexor muscles). **57** Cranial tibial muscle. **58** Tendon of origin of long digital extensor muscle. **59** Tendon of deep digital flexor muscle. **60** Common calcaneal tendon (composite structure formed from Achilles' tendon, superficial digital flexor tendon and tarsal tendons from hamstring and gracilis muscles). **61** Superficial digital flexor tendon.

### *Vessels and lymph nodes*

**62** Medial saphenous vein. **63** Lateral saphenous vein. **64** Saphenous artery, caudal branch. **65** Cranial tibial artery (continuation of popliteal artery attaining front of crus by passing through interosseous space between tibia and fibula). **66** Dorsal pedal artery (continuation of cranial tibial artery across flexor surface of tarsus in company with tendon of long digital extensor muscle). **67** Perforating metatarsal artery (continuing dorsal pedal artery between metatarsal bones 2 and 3 into plantar surface of paw). **68** Popliteal lymph node (single prominent node in popliteal fossa, normally palpable).

### *Nerves*

**69** Ischiatic nerve (direct continuation of lumbosacral trunk leaving pelvis through lesser ischiatic notch in lateral wall of ischiorectal fossa). **70** Common peroneal nerve (crosses lateral head of gastrocnemius muscle beneath crural fascia). **71** Superficial peroneal nerve. **72** Deep peroneal nerve. **73** Tibial nerve (palpable in crus between common calcaneal tendon and deep digital flexor muscle).

### *Glands*

**74** Anal (paranal) sac (paired sacs sandwiched between external and internal anal sphincters – receive and temporarily store secretion from glands in its wall which is added to faecal surface when voiding occurs). **75** Opening of duct of anal sac.

