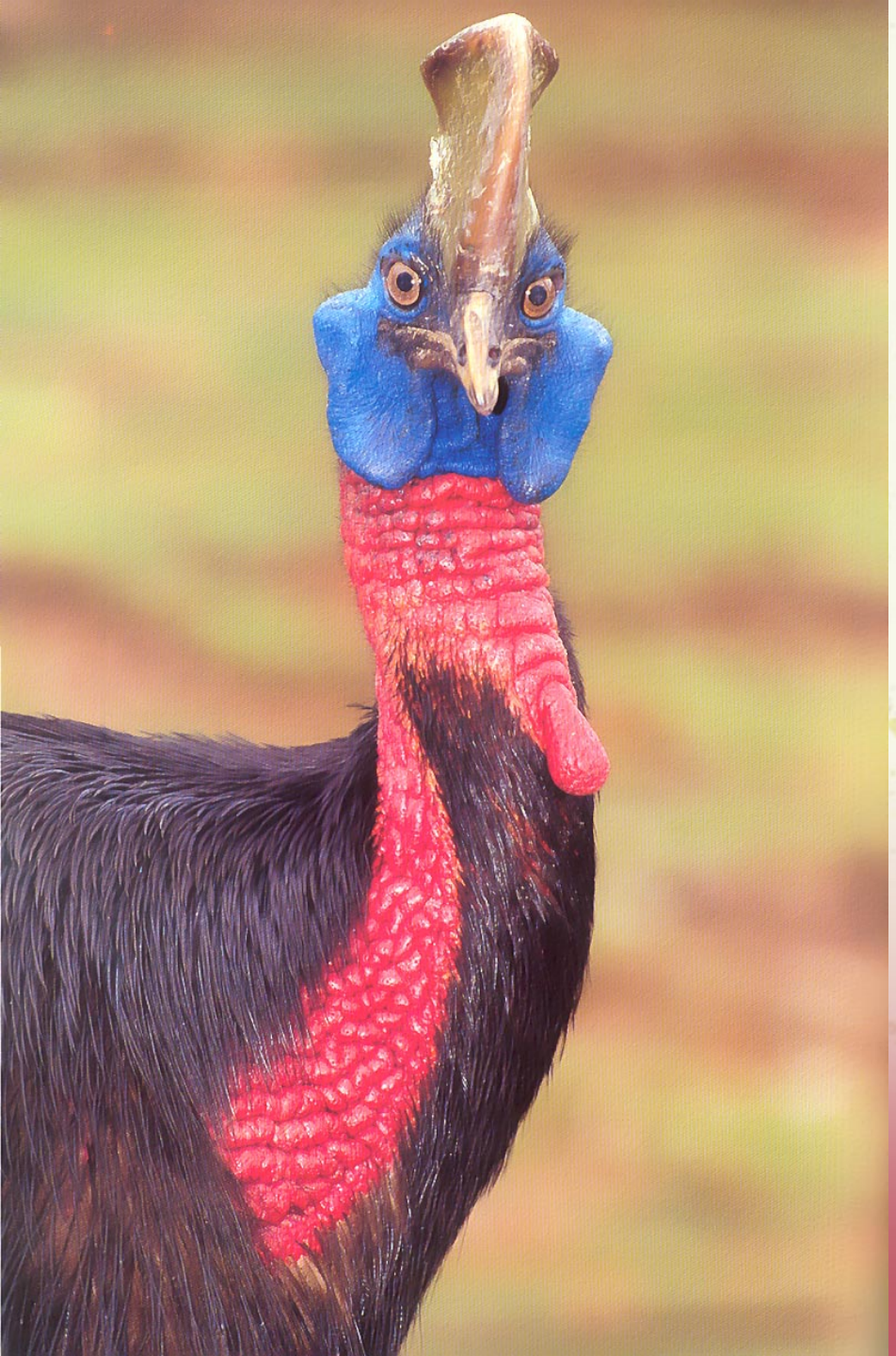
Avian Anatomy and Physiology

Christine Fiorello, DVM, PhD, Dipl. ACZM

Some slides from Heather Wilson, DVM, Dipl. ABVP Avian



Integument

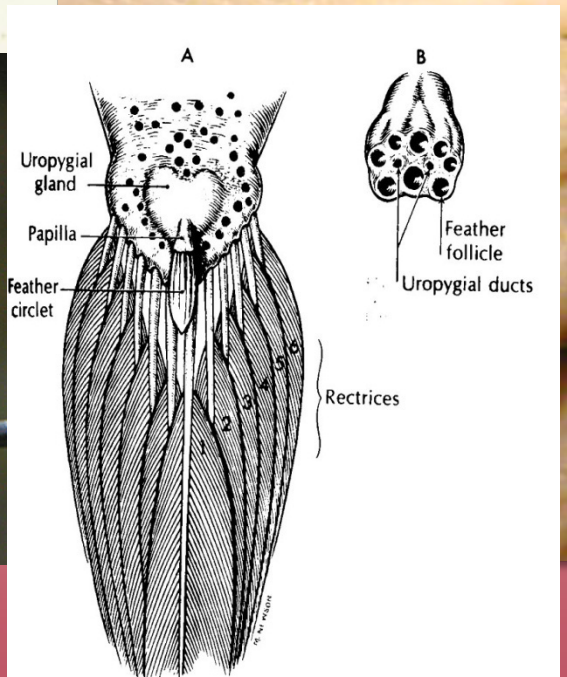
- 2 layers: Dermis and epidermis
- Epidermis thin except for certain areas
- Keratinization produces special structures: beak, nails, scales, feathers
- Lacks glands

Feathers-7 types

- Contour
  - wing & tail (flight)
- Semiplume
- Down
  - fluffy, no barbules
- Bristle
  - “eyelashes”
- Powder down
- Hypopenna
- Filoplume

Uropygial Gland

- "Preen gland"
- Bilobed holocrine gland
- Conditions feathers
- Not all species have one



Purpose of Feathers

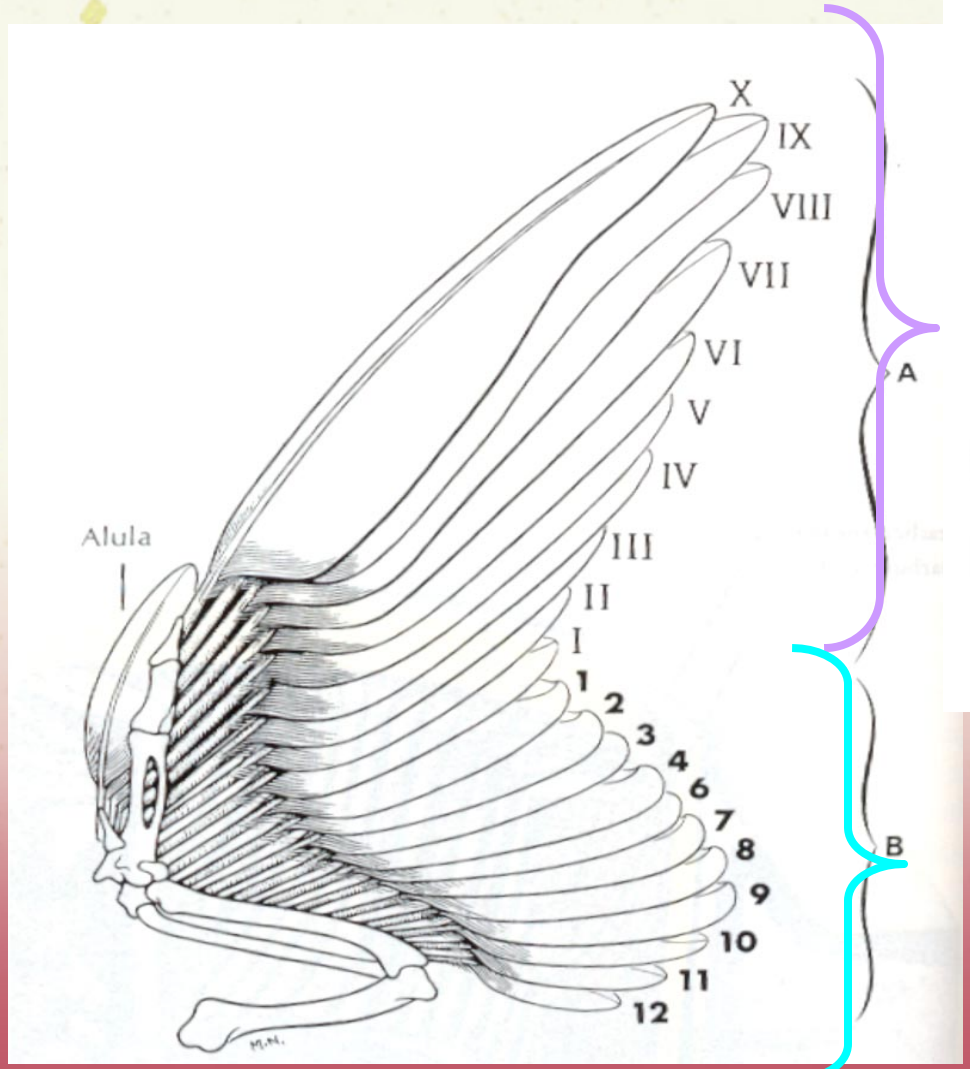
- Flight
- Courtship
- Defense
- Insulation
- Waterproofing

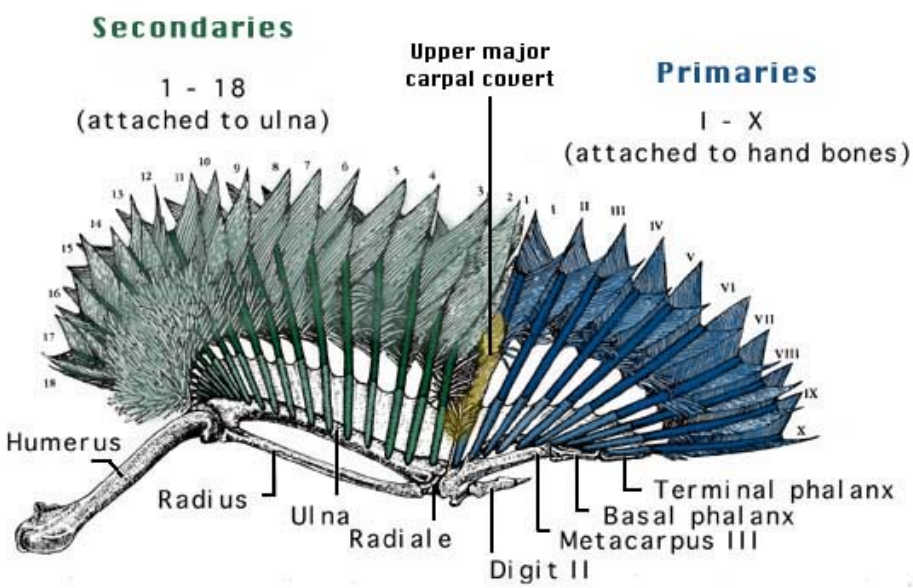
Contour Feathers

- Rows (pterylae) in most species
- Apteryla=feather-less tracts
- Remiges=Wing flight feathers
- Retrices=Tail flight feathers

Primaries attach to metacarpals

Secondaries attach to ulna





Waterproofing

- Preen gland secretions are not necessary
- Interlocking of feather barbules creates watertight barrier

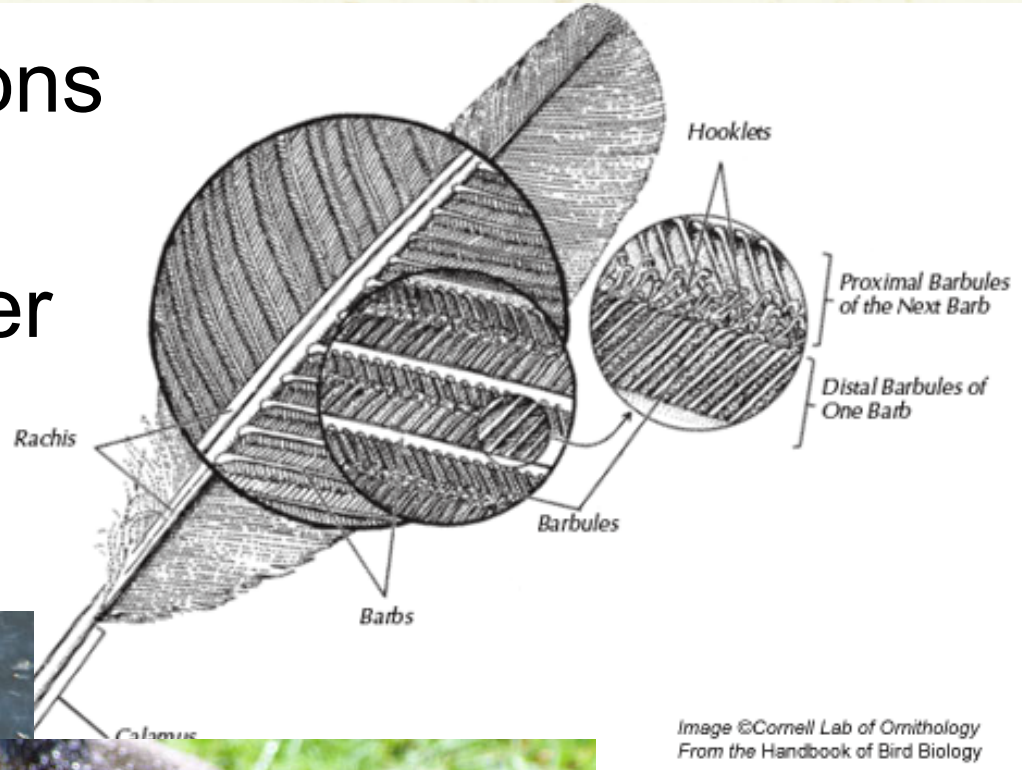
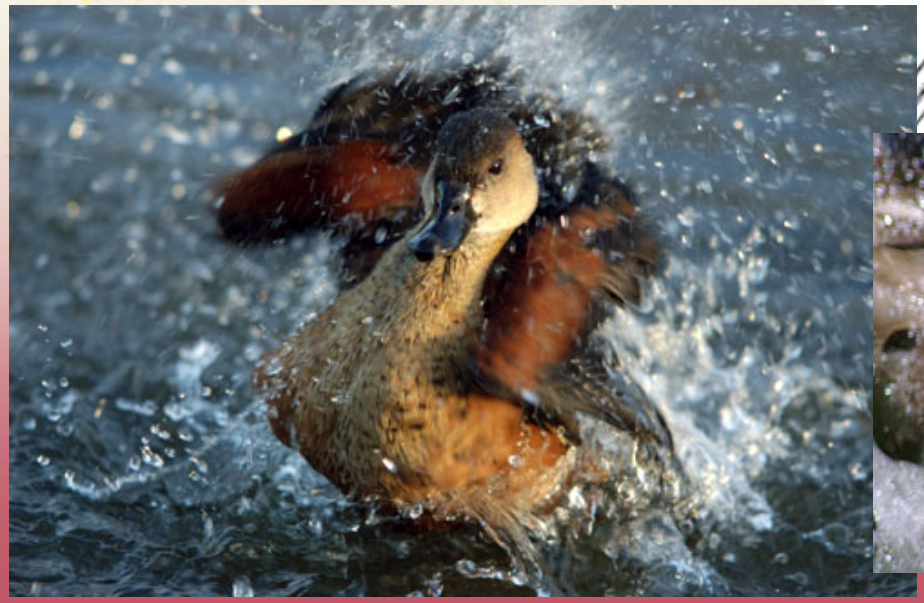
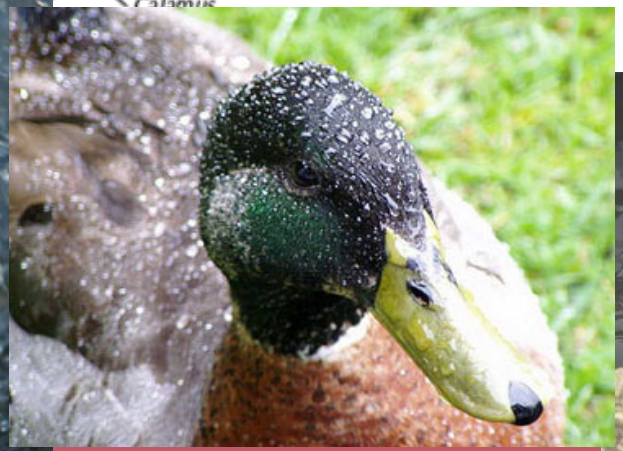
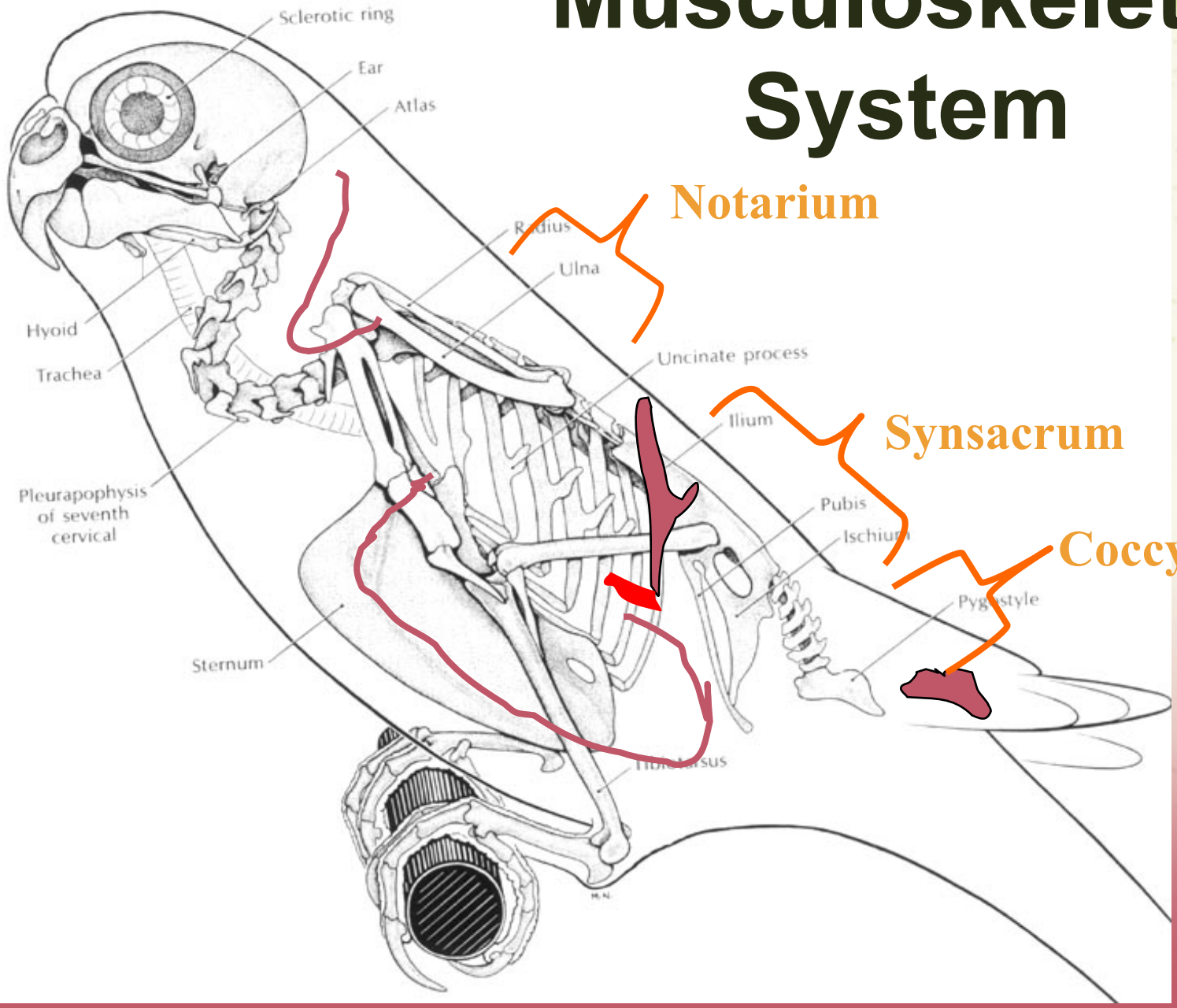


Image ©Cornell Lab of Ornithology
From the Handbook of Bird Biology





Musculoskeletal System



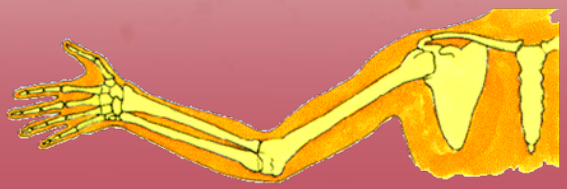
Avian wings

- Unique structure
- Flight feathers attached to ulna and metacarpals
- Ulna > radius

Bat

Pterodactyl

Superman



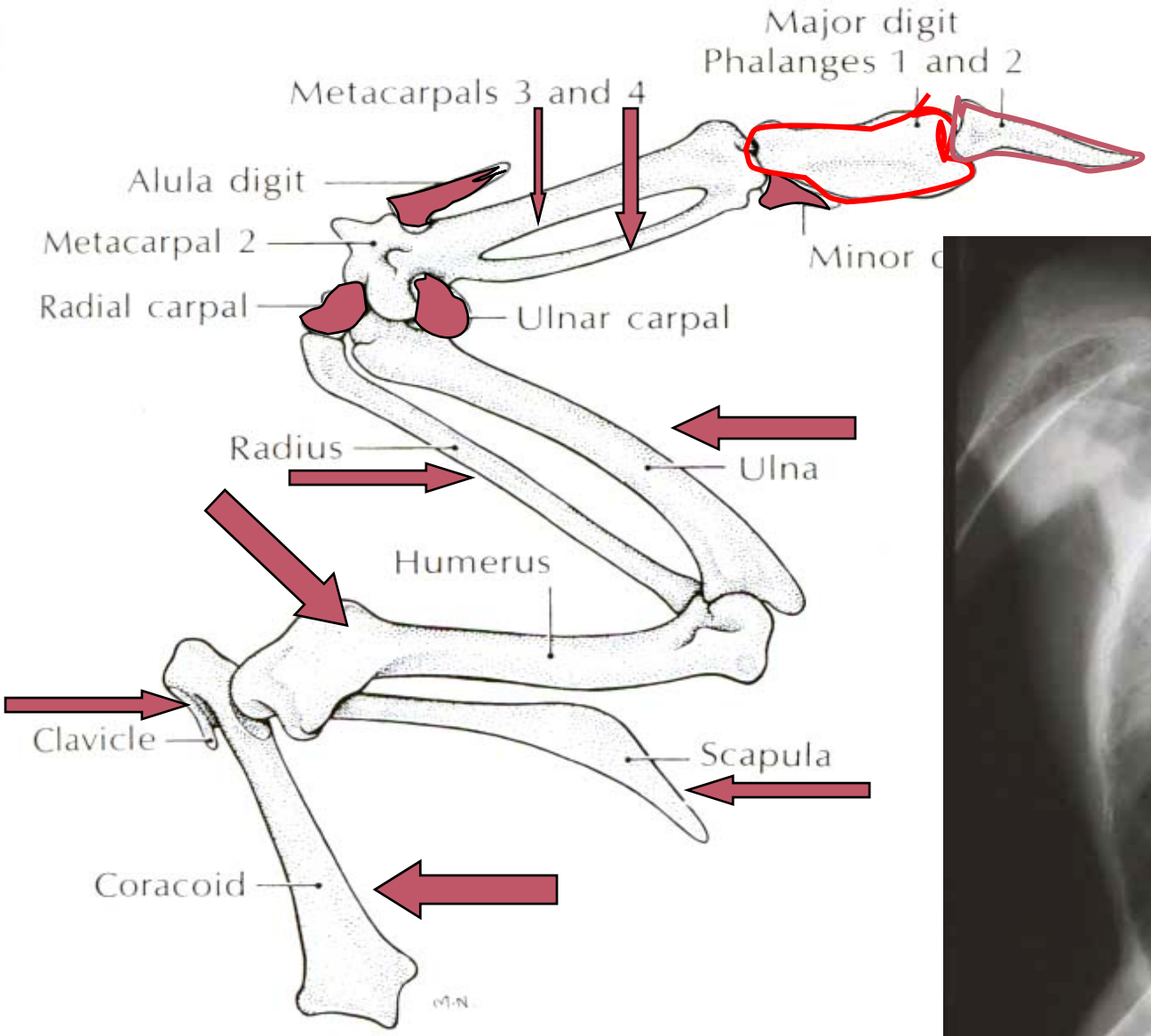
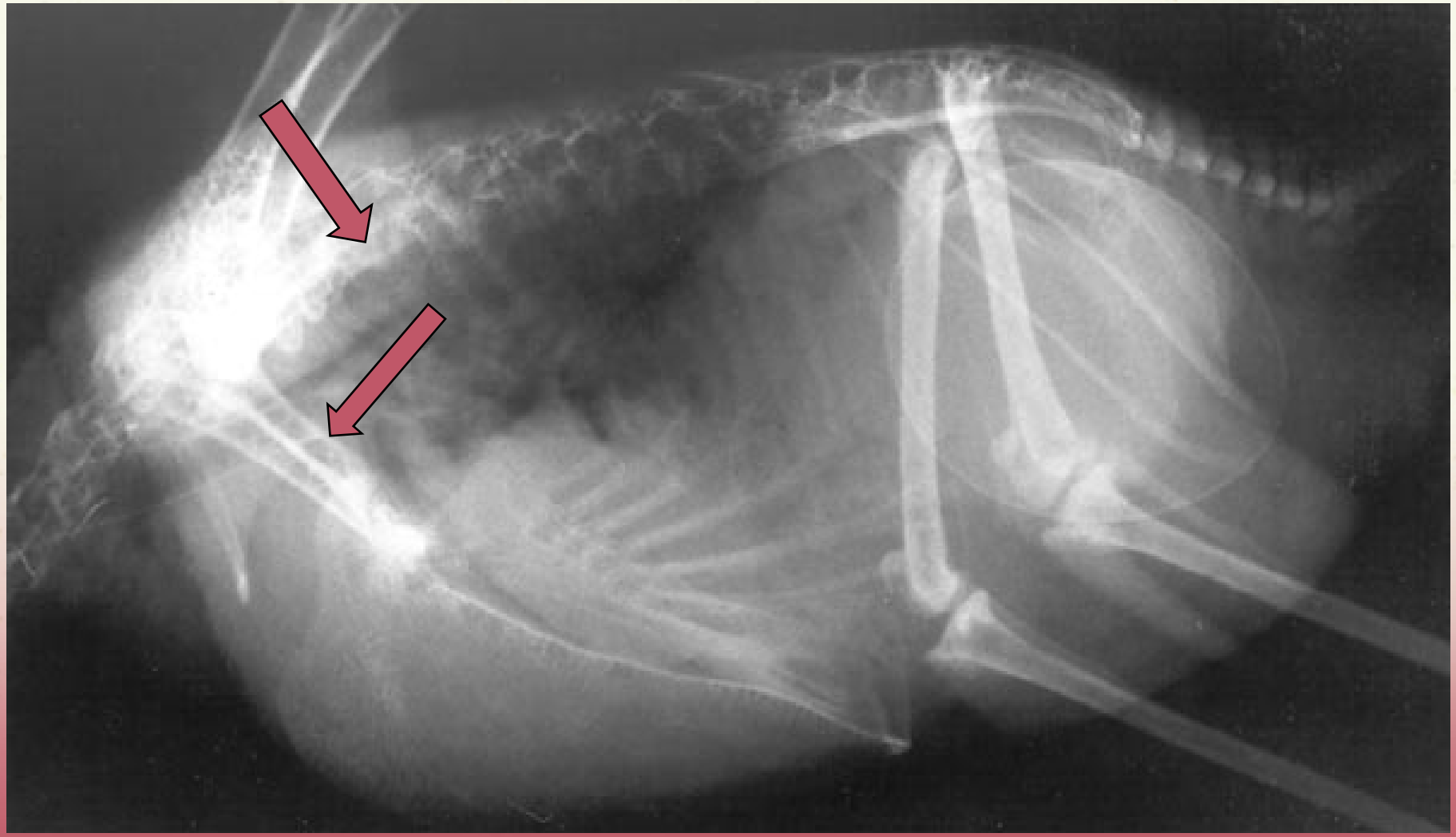


FIGURE 13-22. Left pectoral girdle and wing skeleton. elevated to show the ventral surface.

Pectoral girdle



Clinical skeletal anatomy

- Spinal fractures at juncture of notarium and synsacrum
- See with birds who flew into a window

Fractures

- Bones are more brittle compared to mammals
- Bones heal more rapidly
  - 4 weeks
- Fibrocartilagenous healing first
  - may not be visible radiographically

Pectoral Muscle

- Highly vascularized muscle
- IM injections here are absorbed rapidly
- Nonflighted birds have soft, “flabby” pectoral muscles

Lower limbs

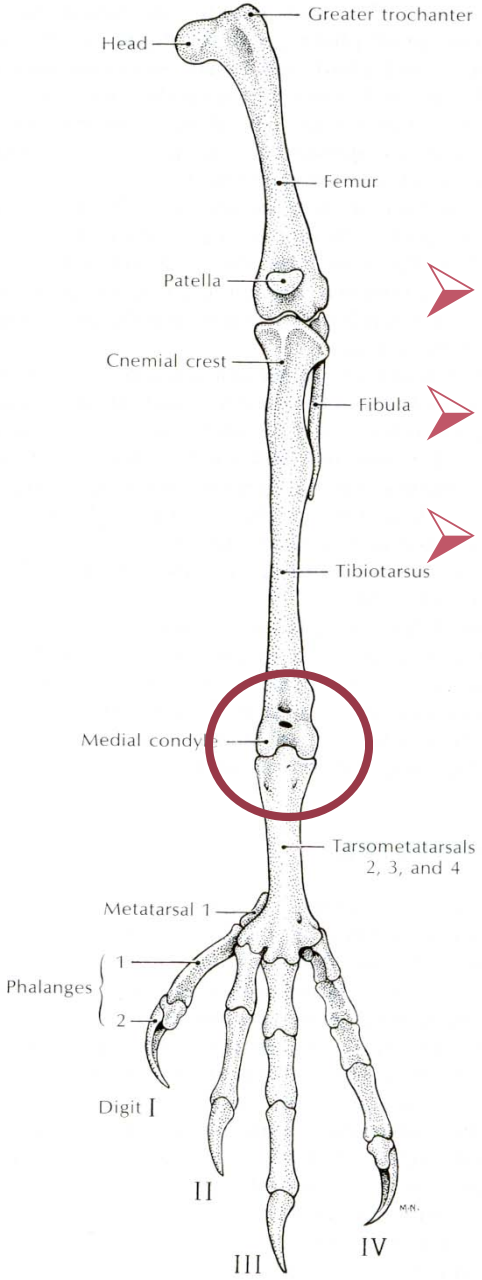
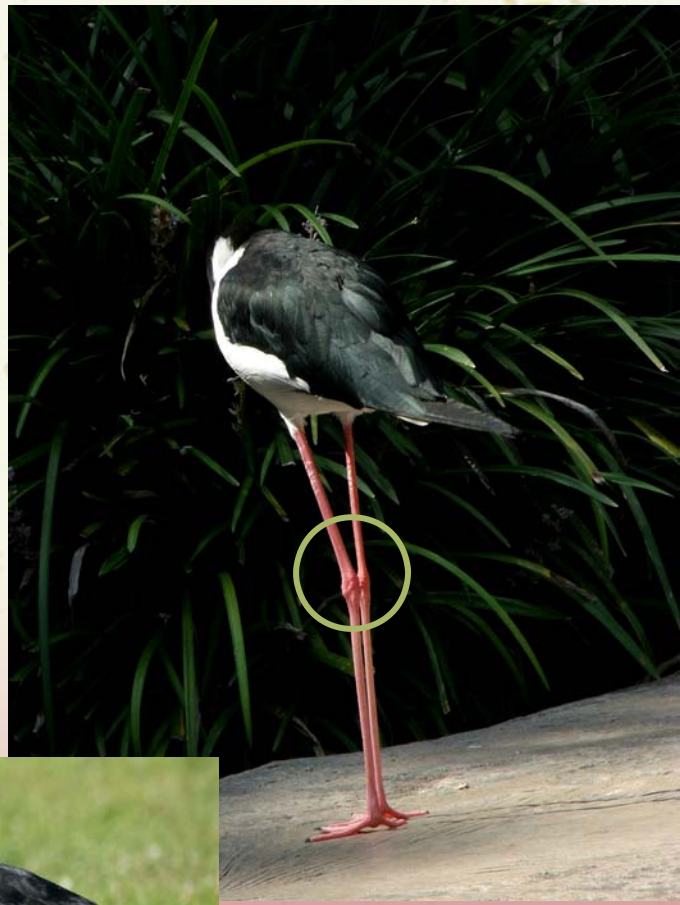


FIGURE 13-24. Left pelvic limb, cranial aspect.

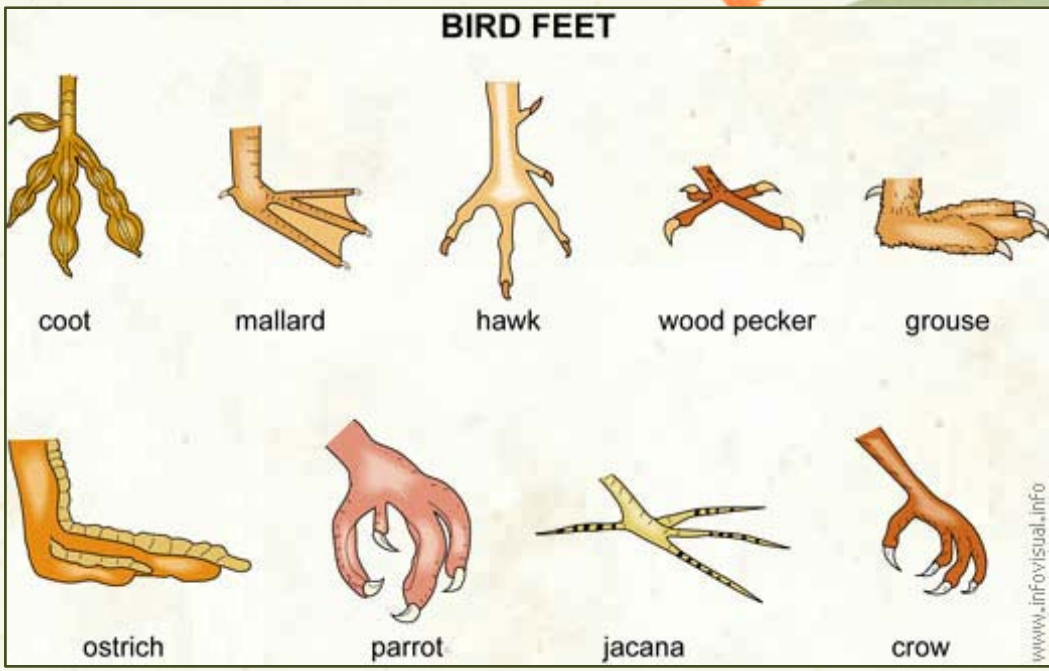
- Femur
- Tibiotarsus
- Tarsometatarsus
  - "Hock" is tibiotarsal-tarsometatarsal joint



Feet

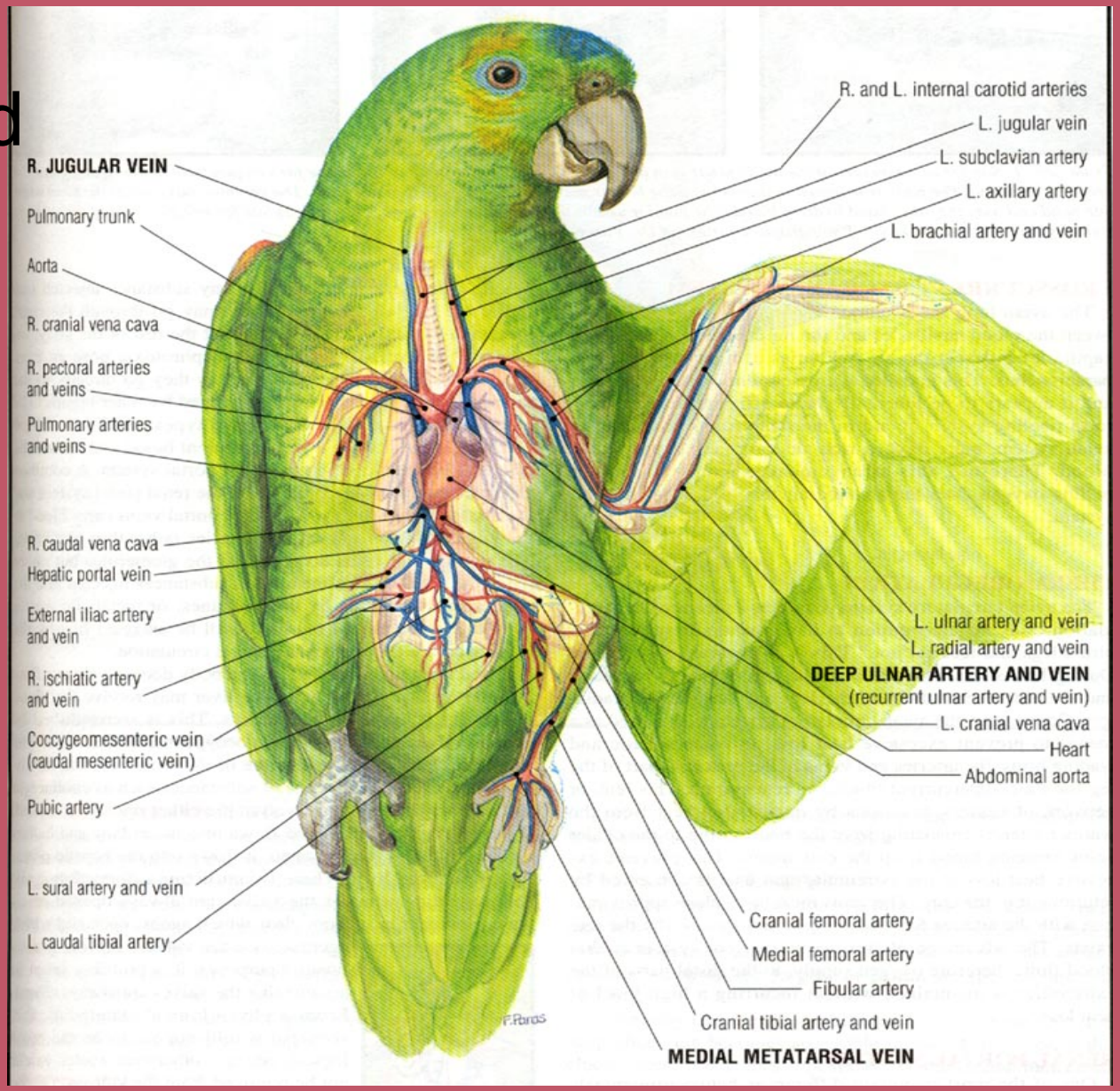
- Each digit has +1 phalanx
  - Digit one has 2 phalanges
  - Digit two has 3, etc
- Parrots are zygodactylus
  - Digits 1 & 4 face back

    Digits 2 & 3 face forward



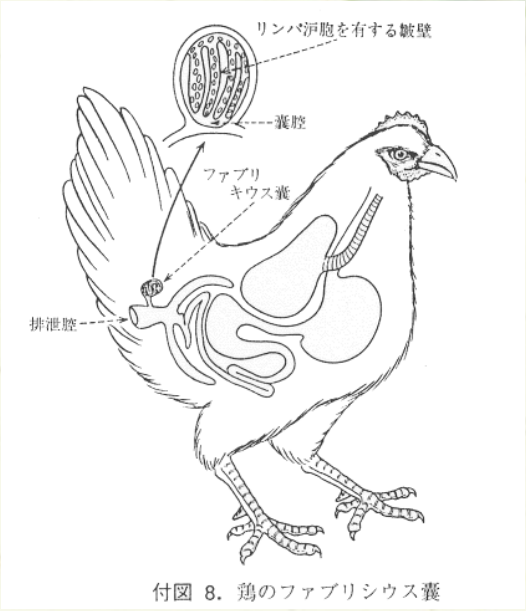
Cardiovascular system

- 4 chambered heart
- Encircled by liver
- Right jugular vein larger than left (which may be absent)



Lymphatic System

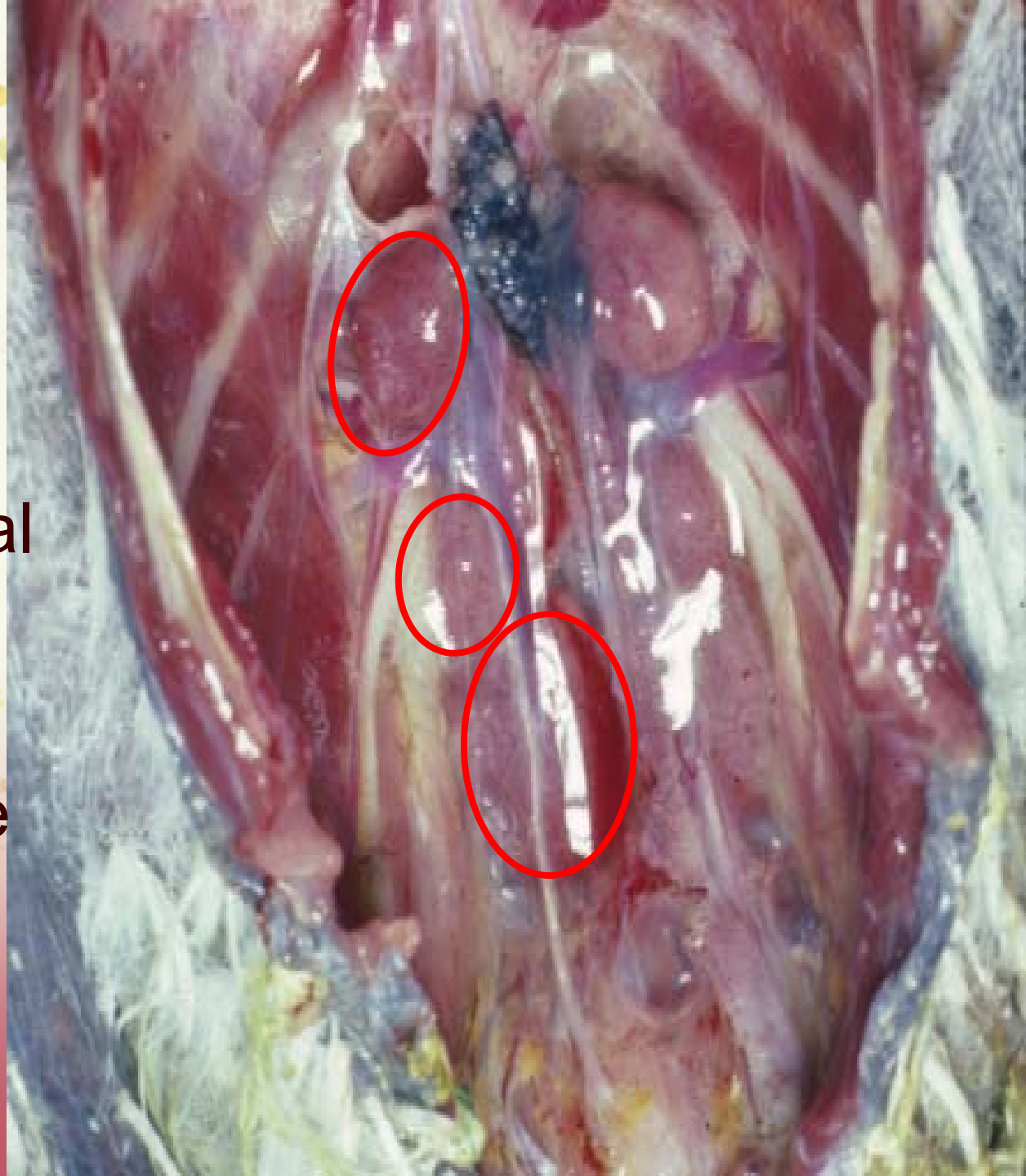
- No lymph nodes
- Lymph vessels follow veins
- Lymph plexuses (rete)
- Bursa of Fabricius
  - B-cells



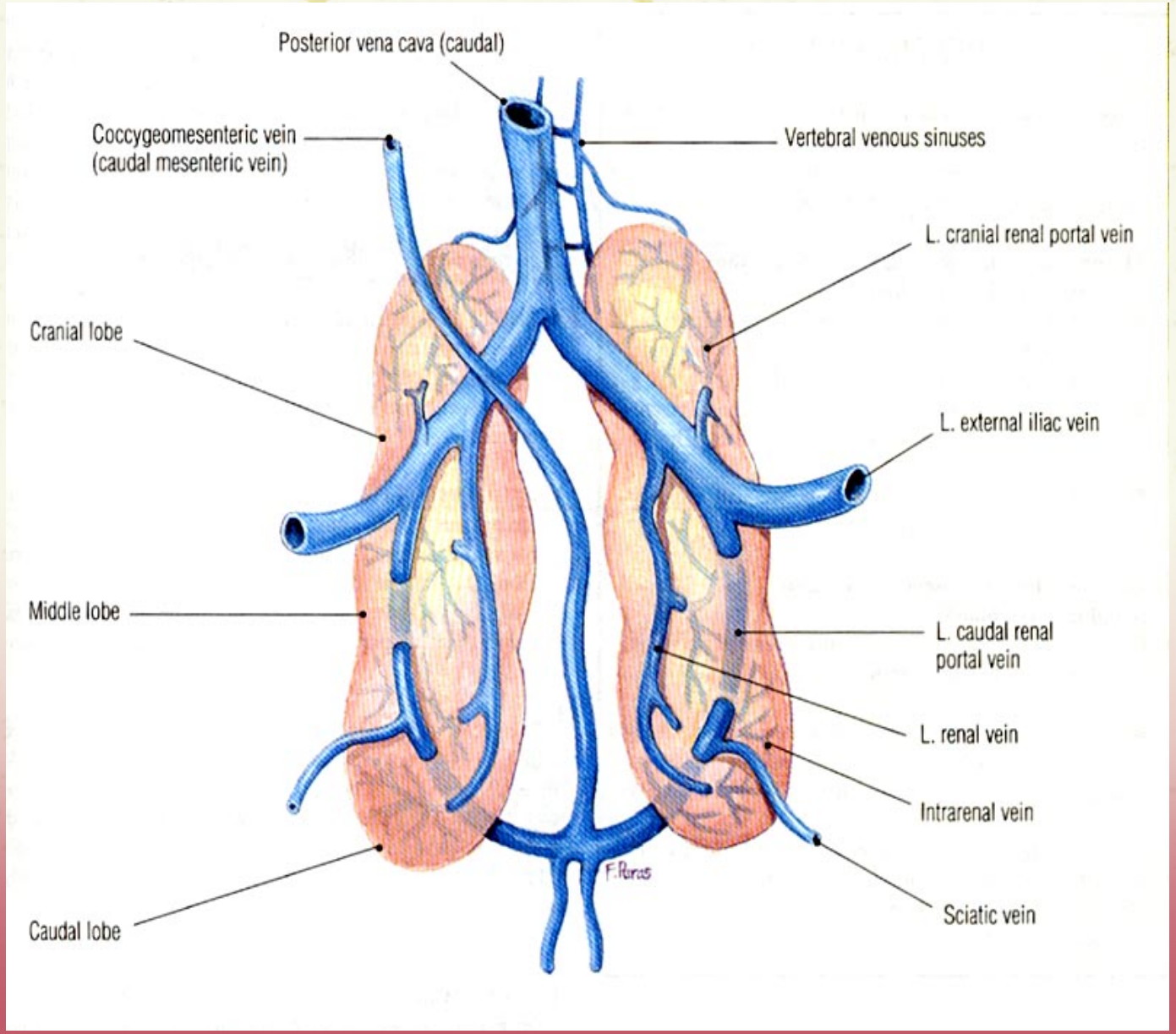
付図 8. 鶏のファブリシウス嚢

Kidneys

- Adhered to dorsal body wall
- Retroperitoneal
- 3 lobes
- Excrete uric acid and some urine

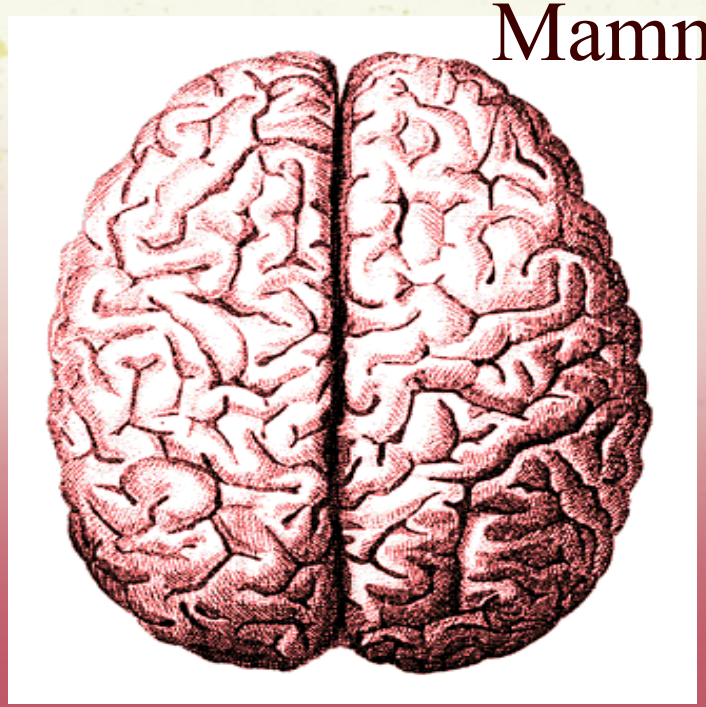


Renal Portal System



Nervous System

- Brain: 3 meniges & 12 CN as in mammals
- In contrast, birds have no neocortex
- Surface of cerebrum almost smooth
- Olfactory bulb relatively small



Bird Brain

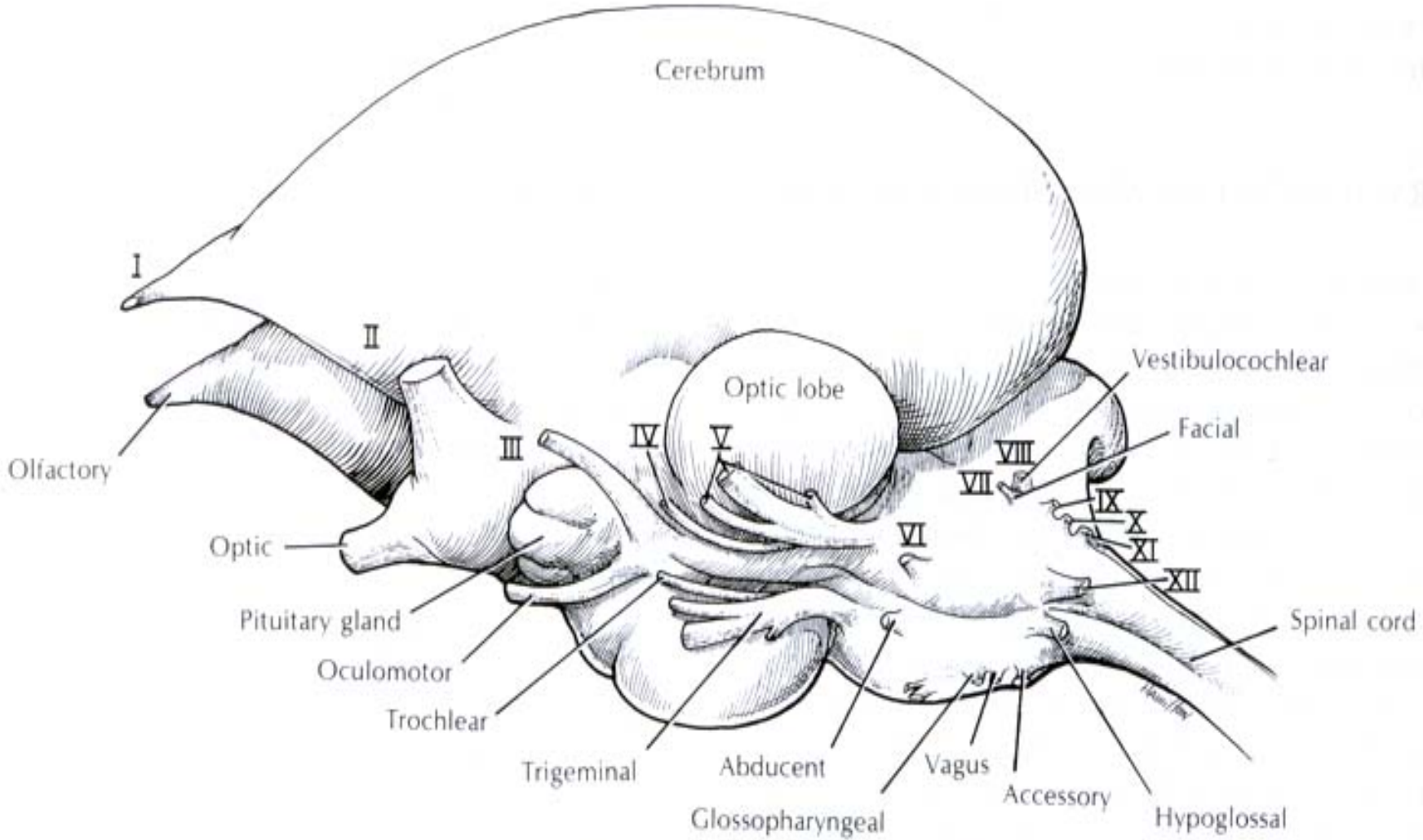
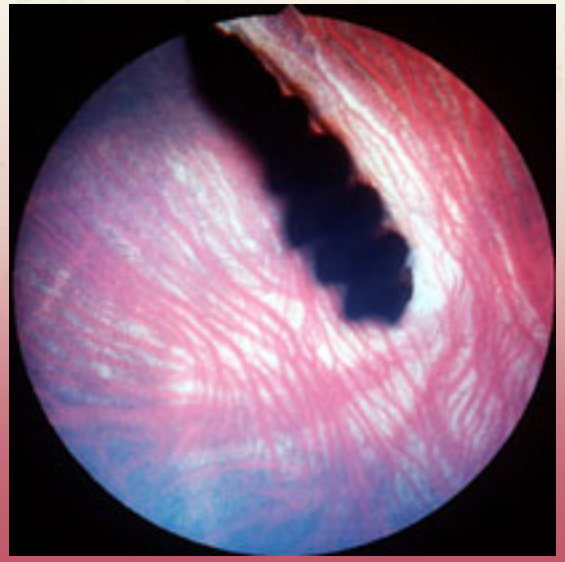
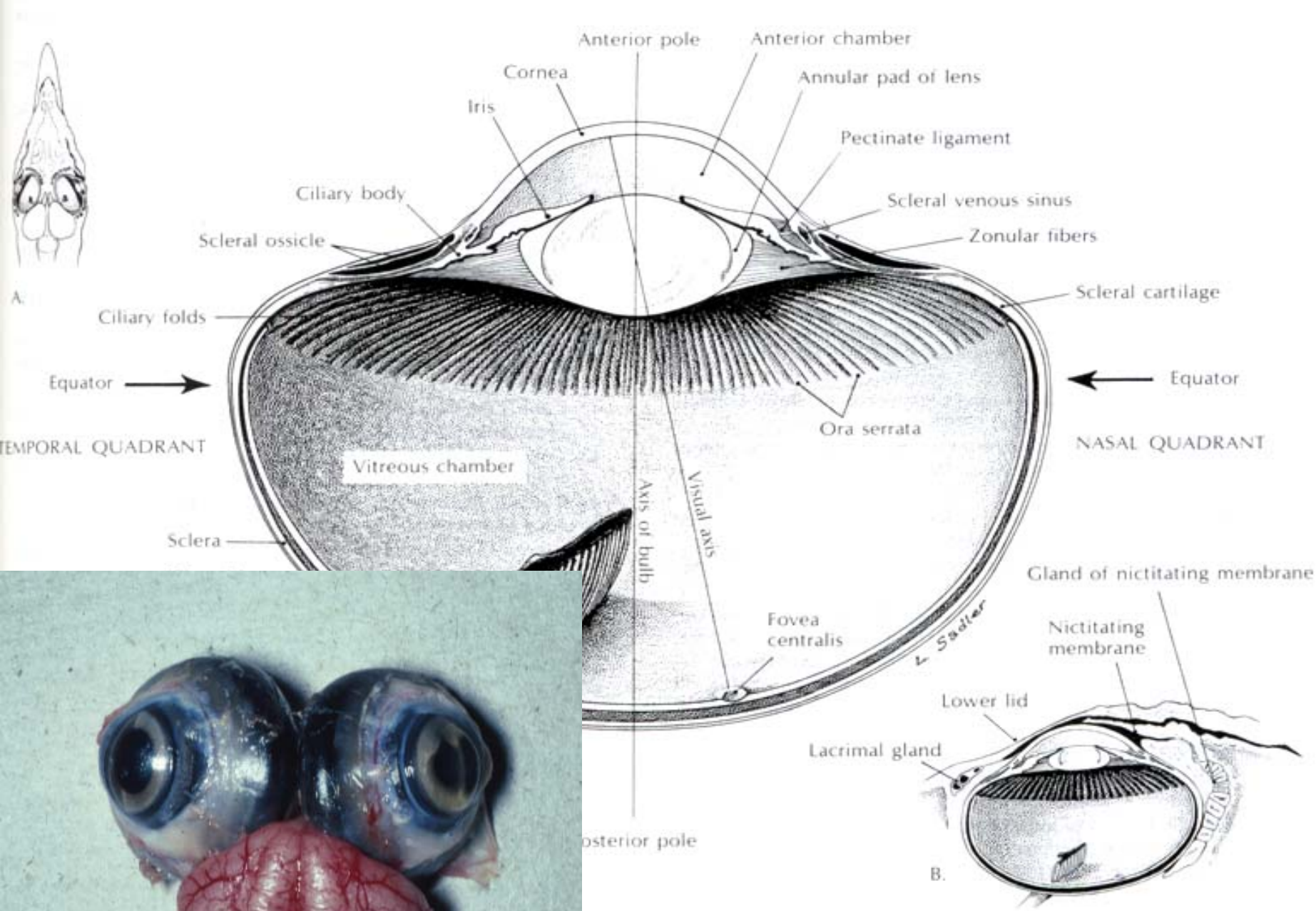


FIGURE 13-48. Brain and cranial nerves of the budgerigar.

Eyes

- Most birds have excellent vision
- More cones than rods (in general)
- No blind spot (no optic disk)
  - Pecten, unique to birds, provides nutrients
- Iris contains striated muscle--can't use atropine to dilate
  - Need curariform drugs





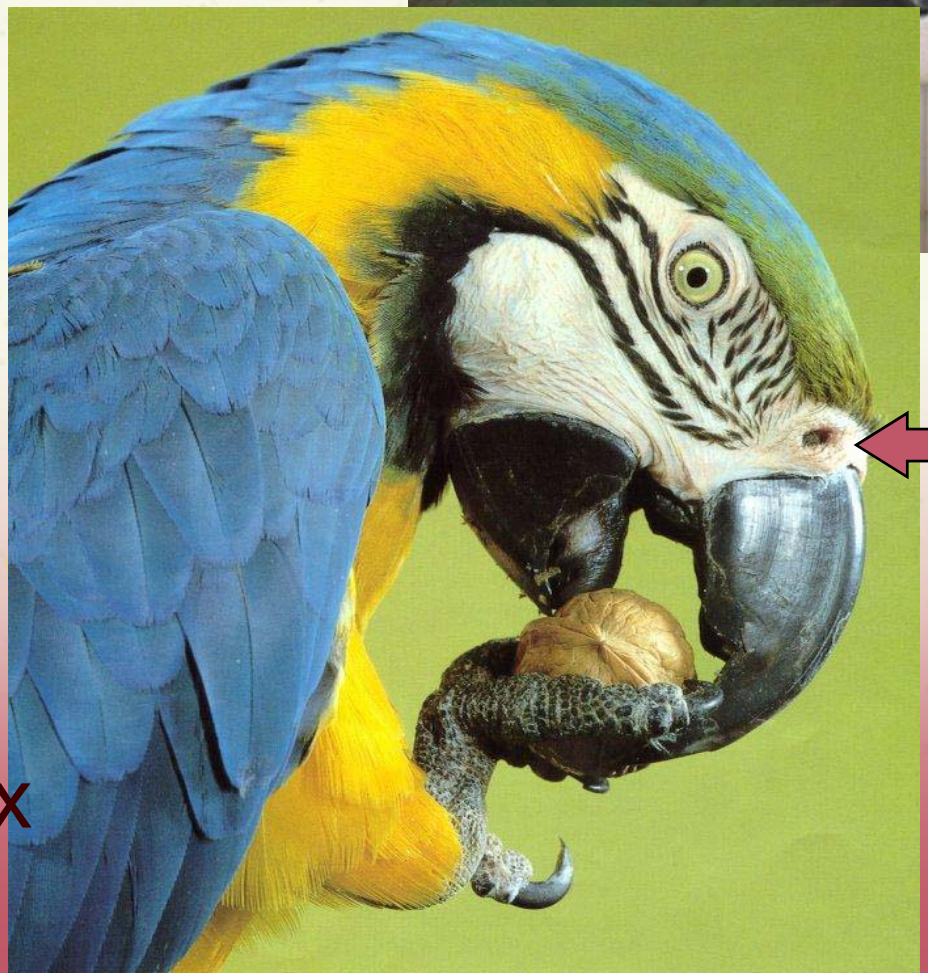
zontal section of the head. Note the position of the pecten in the fundus. B.
ection of the eyeball.

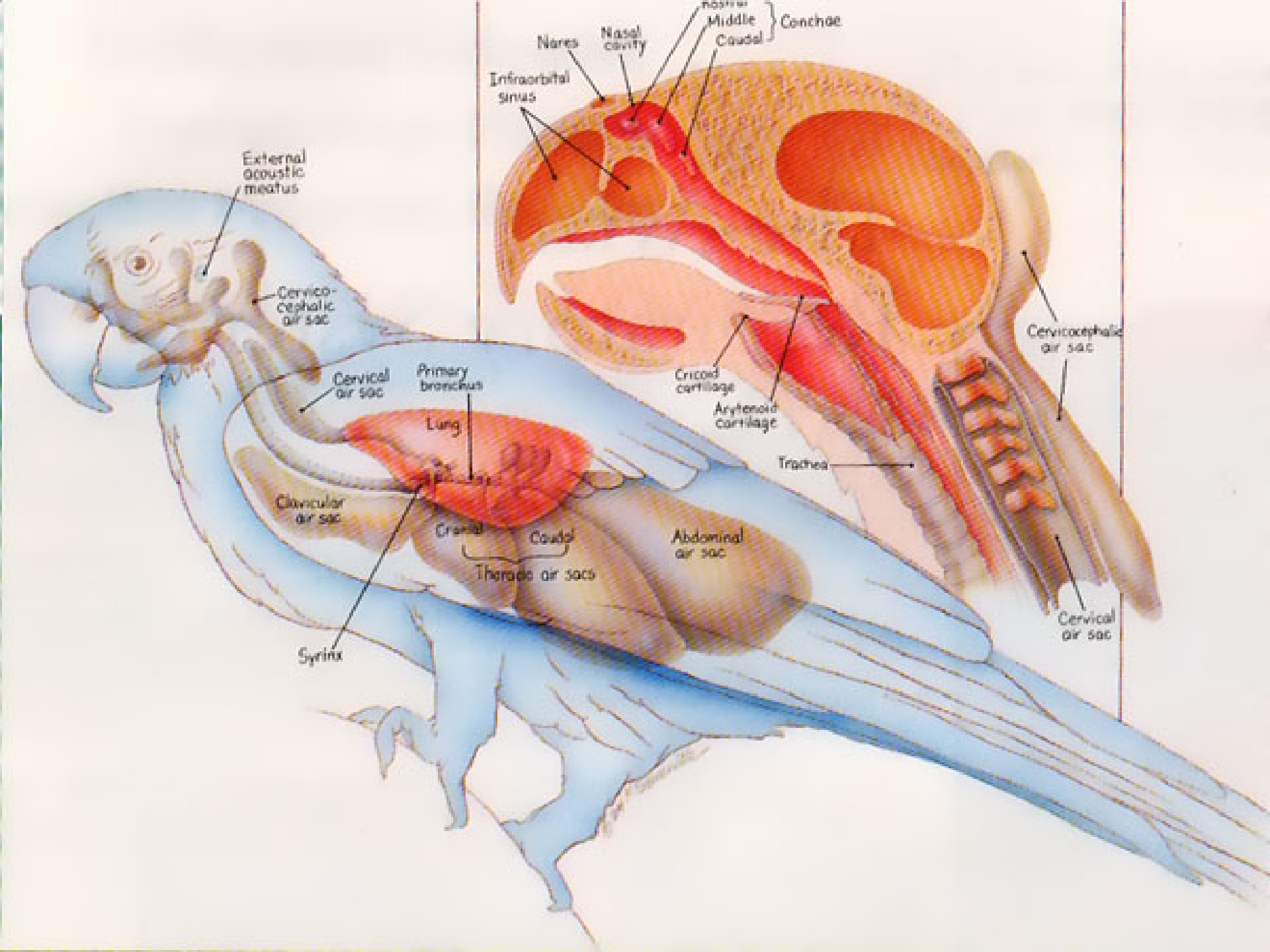
Coelomic Cavities

- 16 separate cavities within body
- 8 air sacs
- 5 peritoneal
- 2 pleural
- 1 pericardial

Upper Respiratory Tract

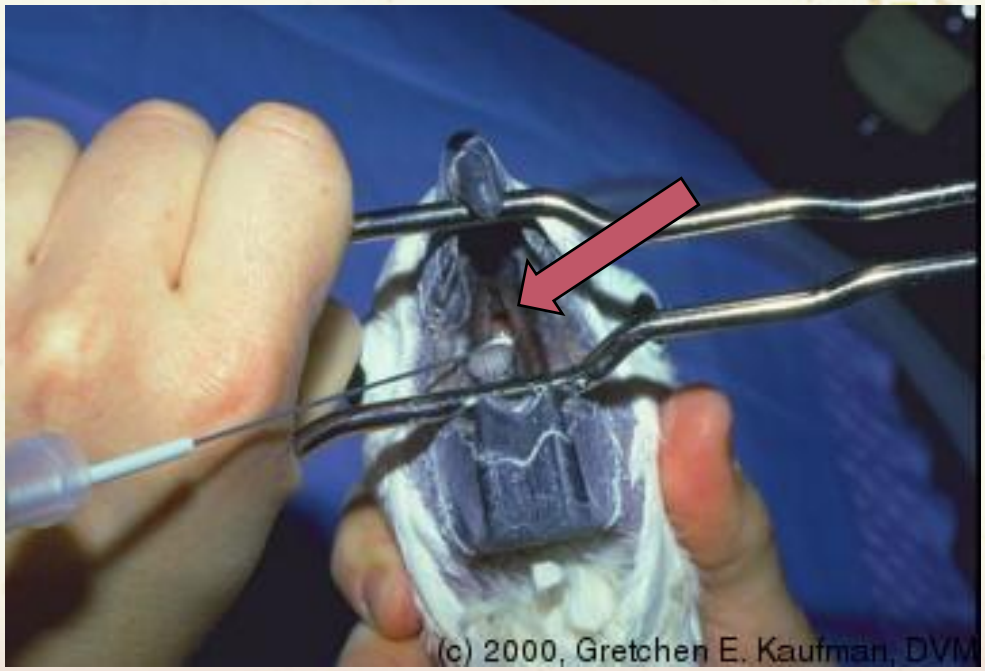
- Nares
  - Cere
- Operculum
- Sinuses
- Conchae
- Choana
- Oropharynx

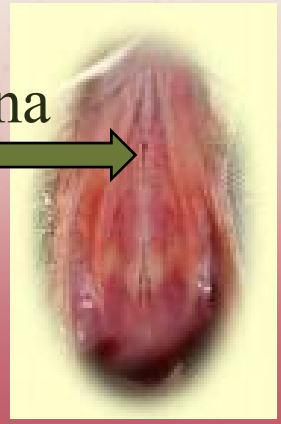



Rostral
Middle
Caudal
Conchae
Nares
Nasal cavity
Infraorbital sinus
External acoustic meatus
Cervico-cephalic air sac
Cervical air sac
Primary bronchus
Lung
Clavicular air sac
Cranial
Caudal
Thoracic air sacs
Abdominal air sac
Syrinx
Cricoid cartilage
Arytenoid cartilage
Trachea
Cervicocephalic air sac
Cervical air sac

Upper respiratory tract

- Nasal cavity
  - Communicates with oral cavity
- Choana
  - exceptions
- No soft palate





Respiratory anatomy

- Trachea
  - Relatively large
  - Glottis at base of tongue
  - Complete rings
- No diaphragm
- Syrinx (no larynx)

Clinical anatomy

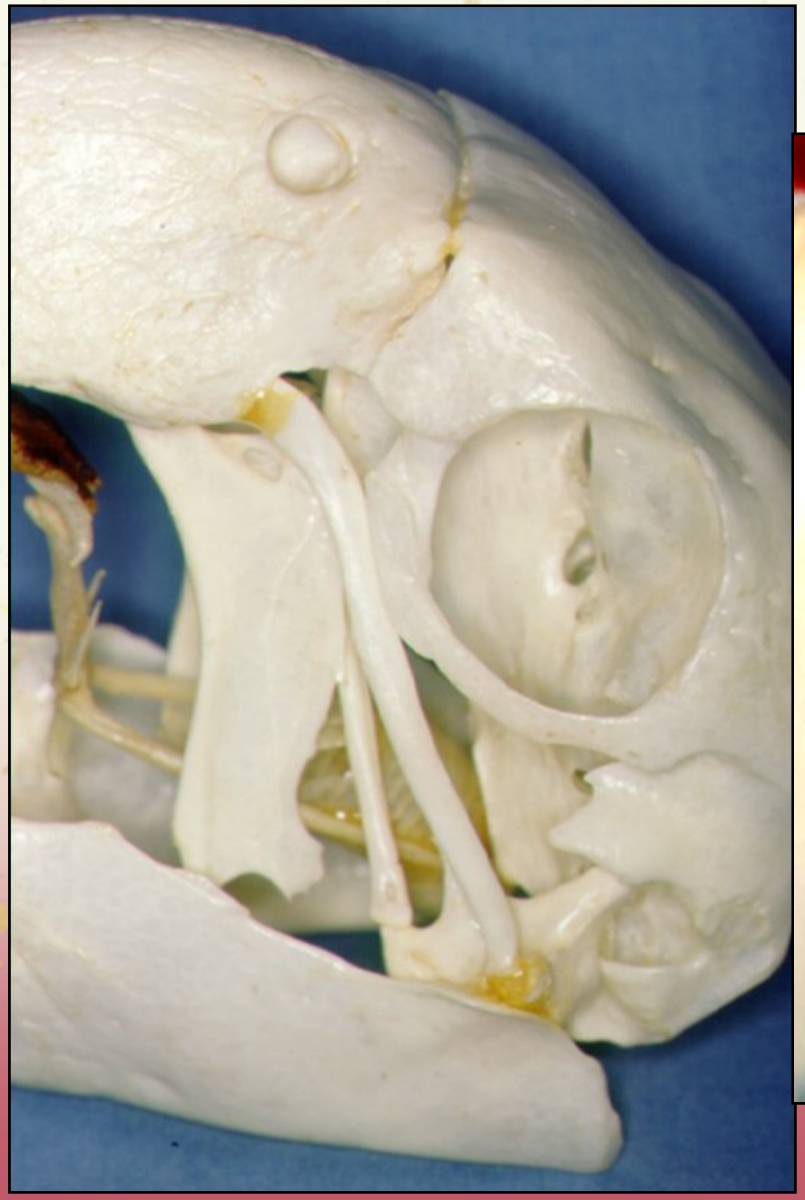
- Choanal swabs
  - *Chlamydiophila* testing
  - Bacterial culture
- Sinusitis

- Complete tracheal rings
  - Use extreme care with intubated birds

Infraorbital sinus

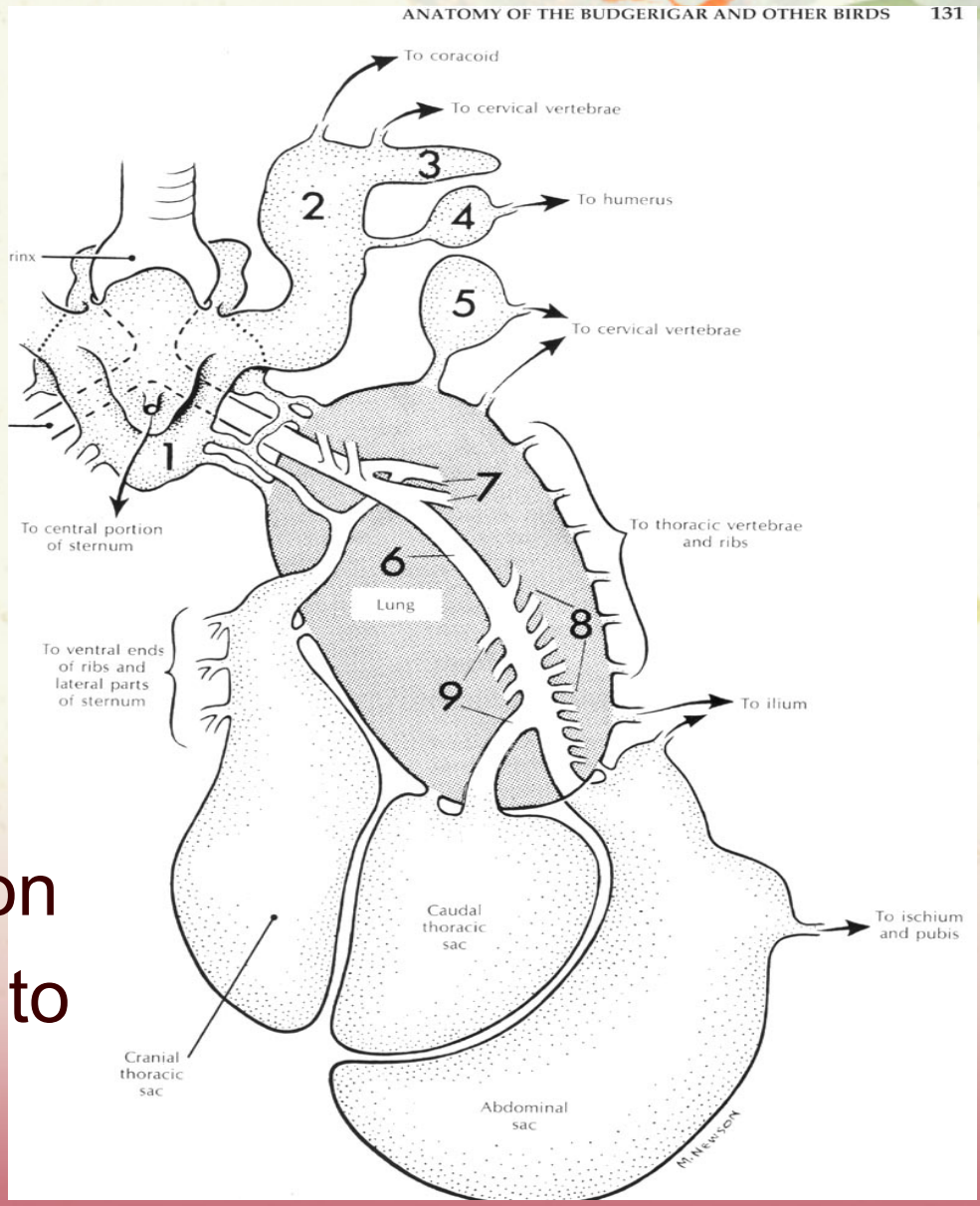
- Access: between medial canthus and oral commissure
  - Diagnositc samples
  - Therapeutic flushing
- Easier than trephining a horse!

Infraorbital sinus



Air sacs

- No gas exchange
- 9 air sacs in parrots
- Can ventilate via air sac cannula
- Poorly vascularized
  - Bad place for infection
  - Air sacculitis difficult to treat

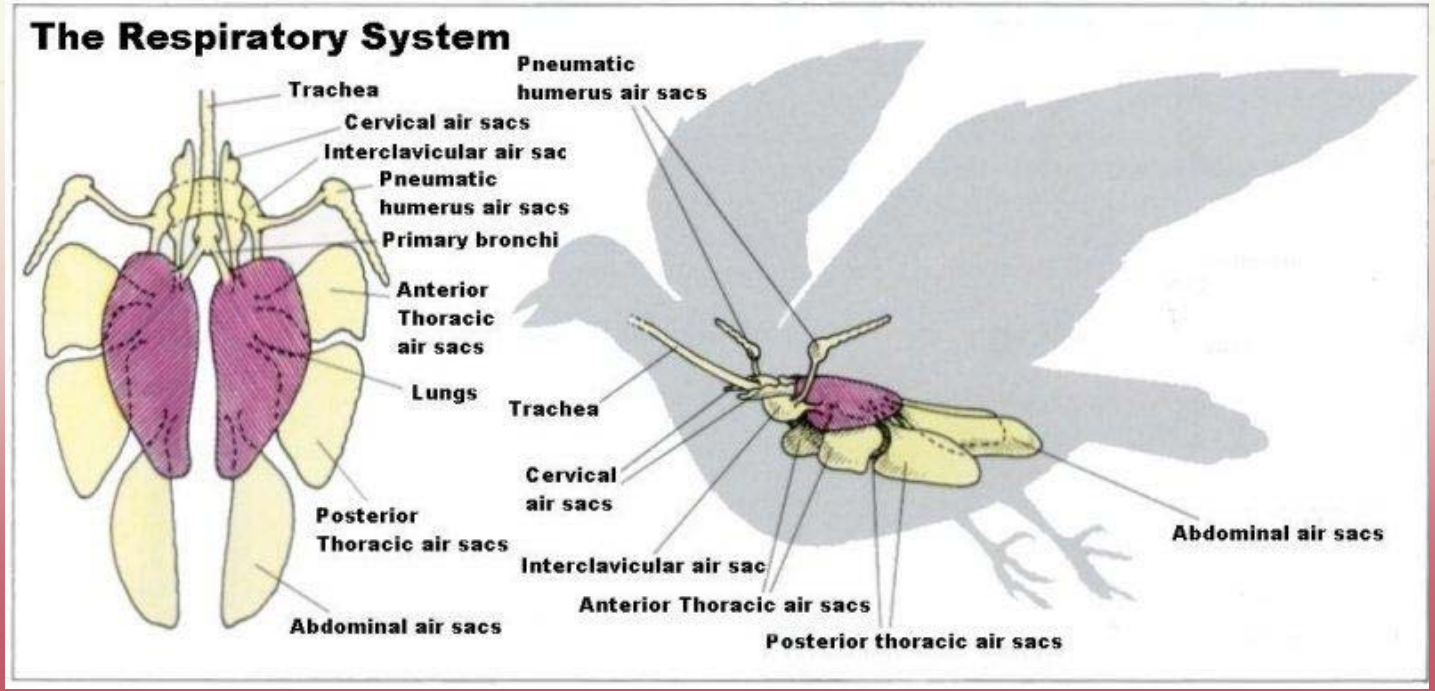


Air sacs

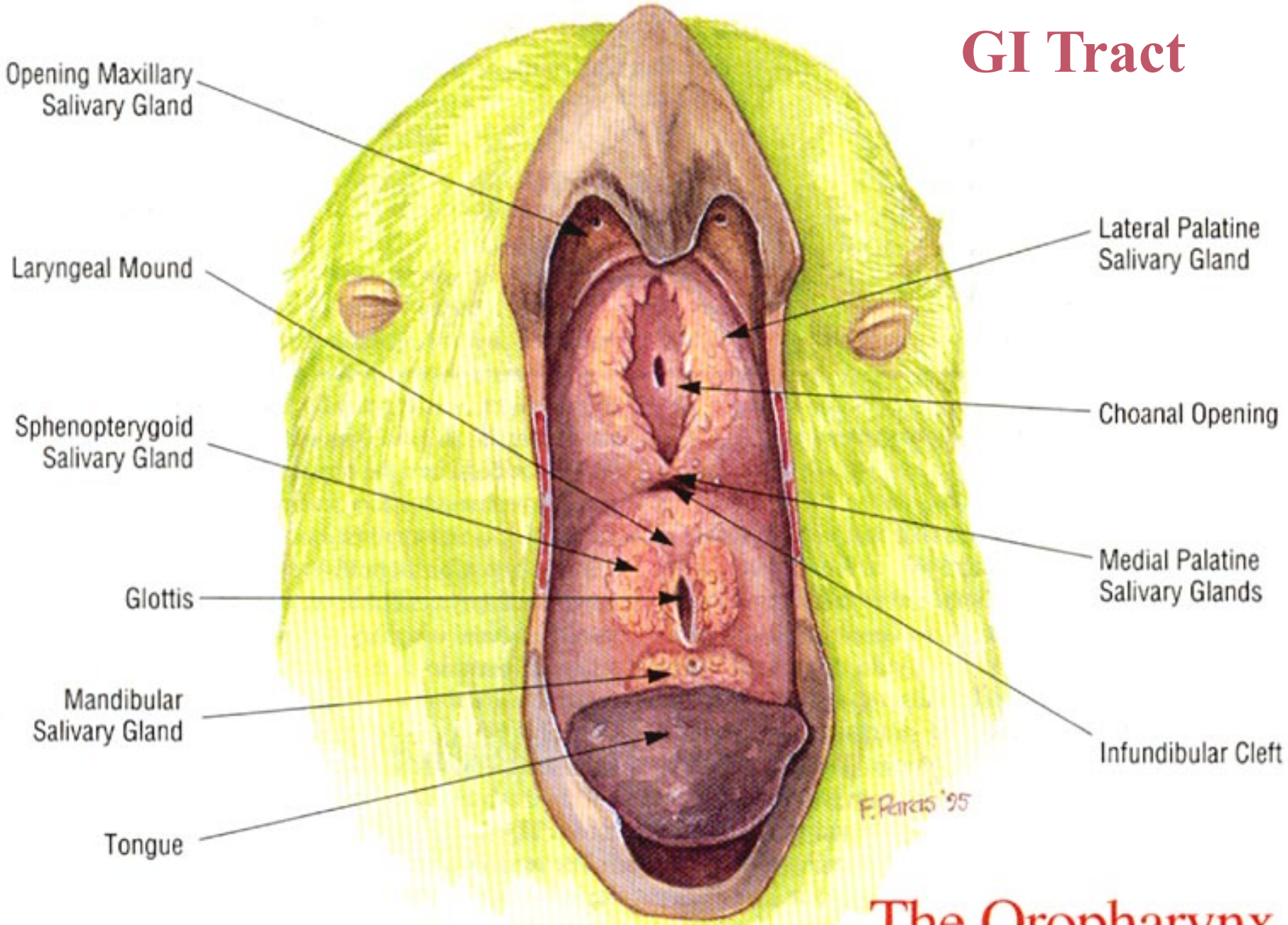
- Pneumatic bones
  - humerus, femur
  - Don’t put intraosseous catheters here
- Must move sternum to breathe
  - Don’t smush little birds during restraint
  - Don’t lean on chests of anesthetized birds

Avian lungs

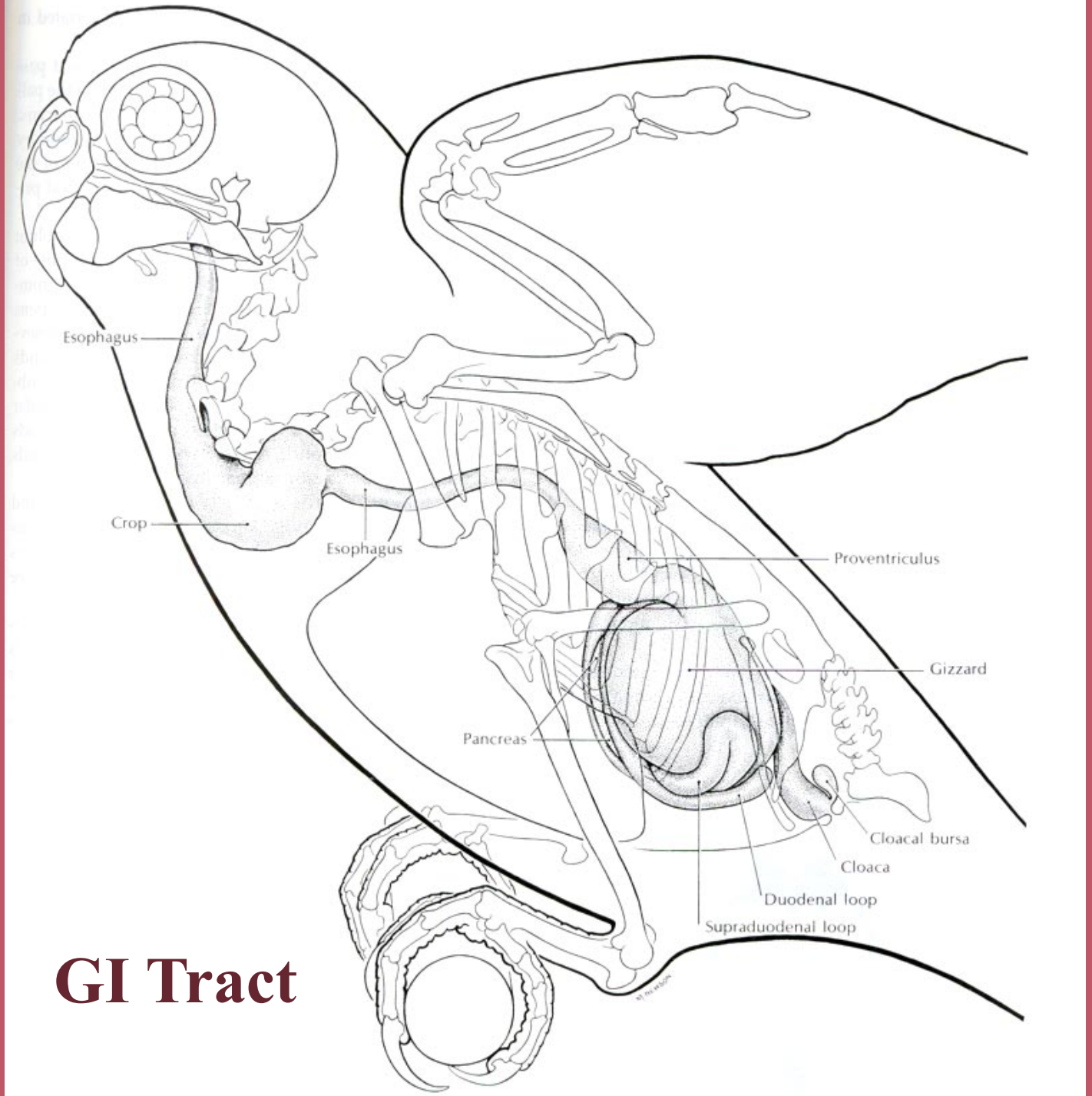
- Unidirectional air flow
  - Extremely efficient compared to mammals
- Gas exchange occurs in air capillaries of parabronchi
- Rigid lung



GI Tract



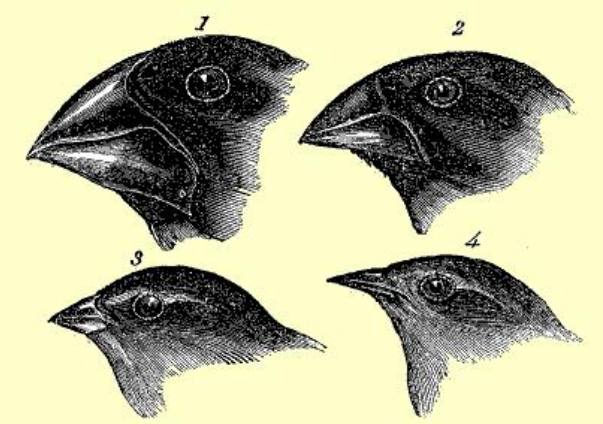
The Oropharynx


Esophagus
Crop
Esophagus
Proventriculus
Gizzard
Pancreas
Cloacal bursa
Cloaca
Duodenal loop
Supraduodenal loop

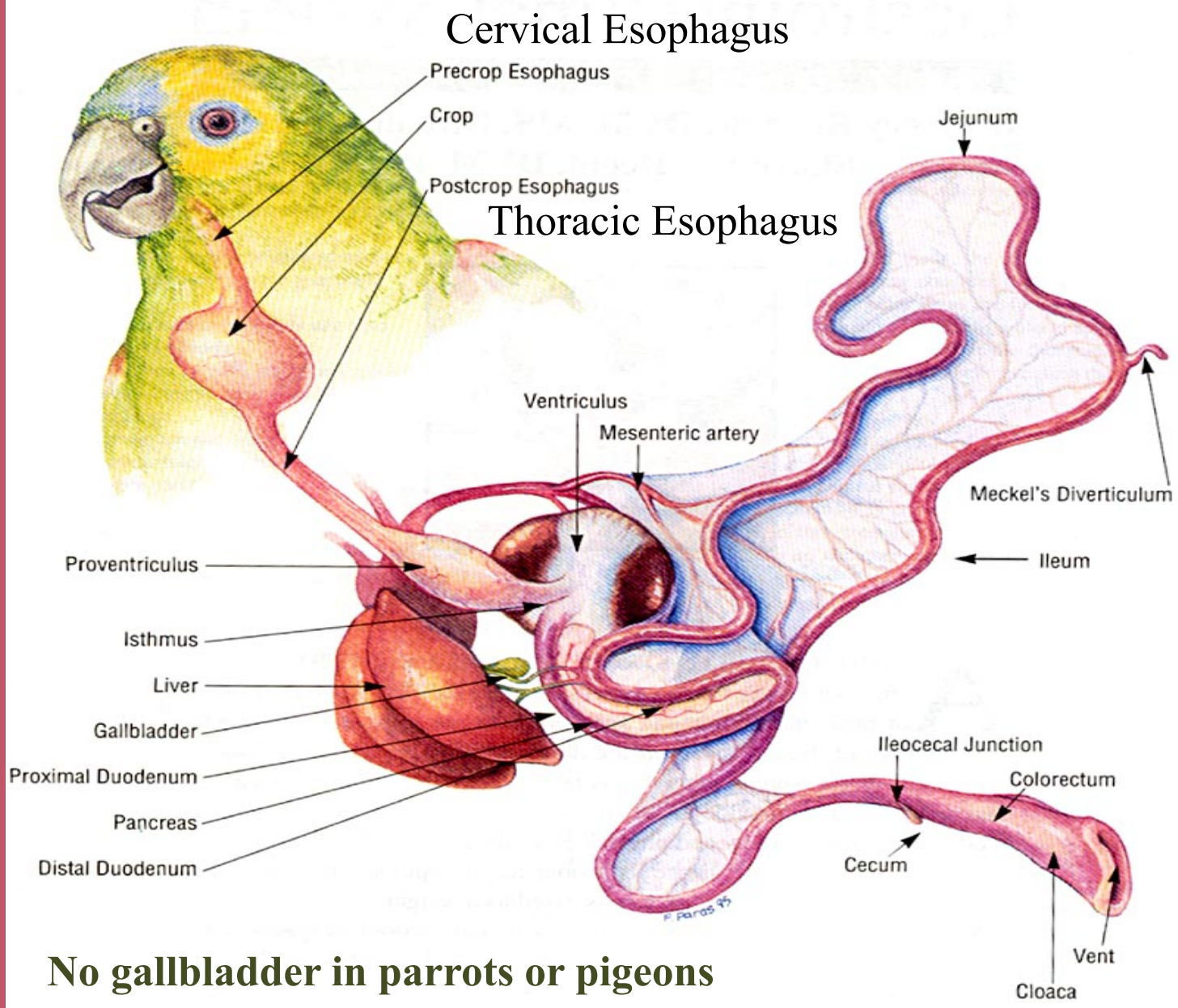
GI Tract

Oral cavity

- Ramphotheca-upper sheath
- Gnathotheca-lower sheath



The Gastrointestinal Tract



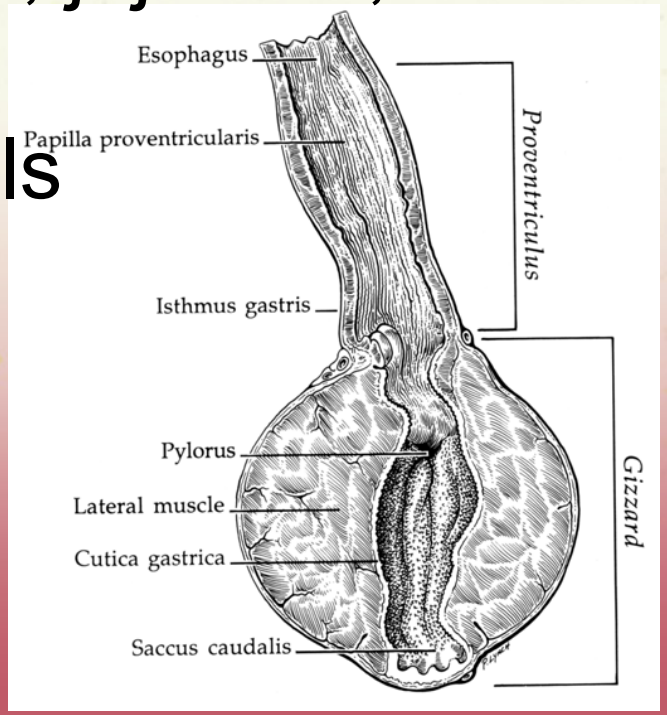
No gallbladder in parrots or pigeons

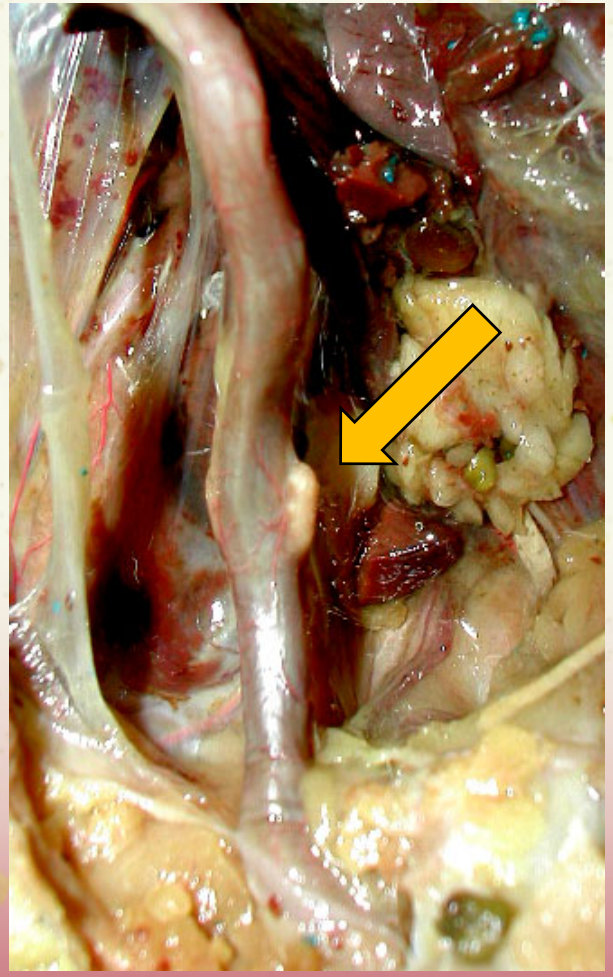
Upper GI Tract

- Crop not present in all species
- Proventriculus is glandular stomach
- Ventriculus (gizzard) is muscular
  - Lined with koilin

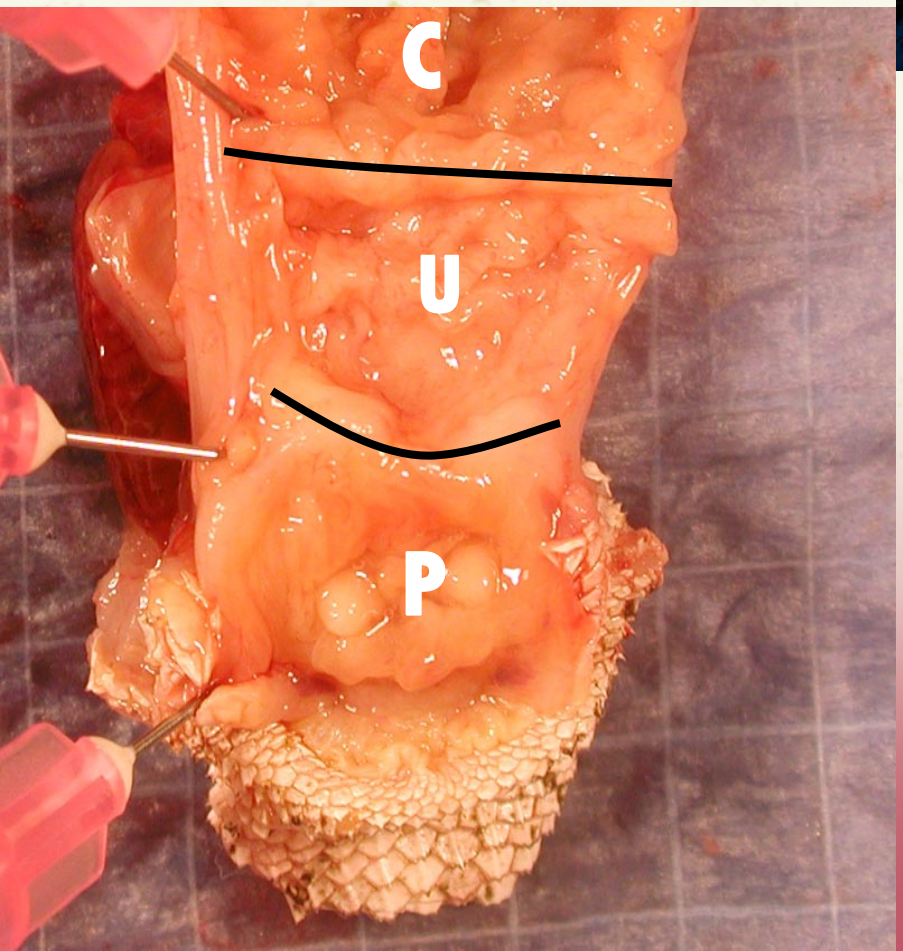
Intestines

- Paired cecae mark the junction between small and large intestine
- Duodenum, jejunum, ileum as in mammals





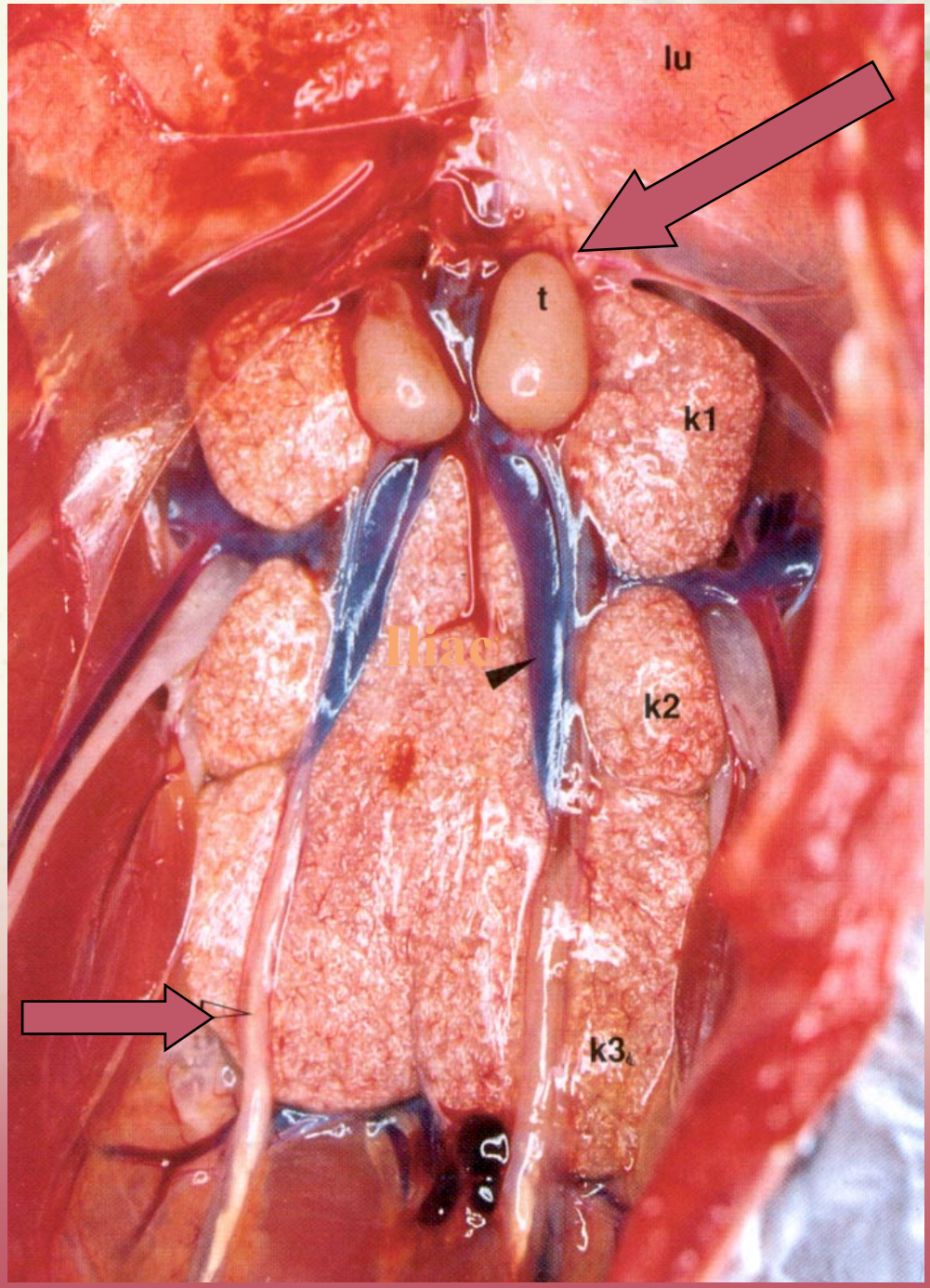
Cloaca and Vent



- GI and Urogenital tracts end in cloaca
- Coprodeum
- Urodeum
- Proctodeum
- Vent is opening into cloaca

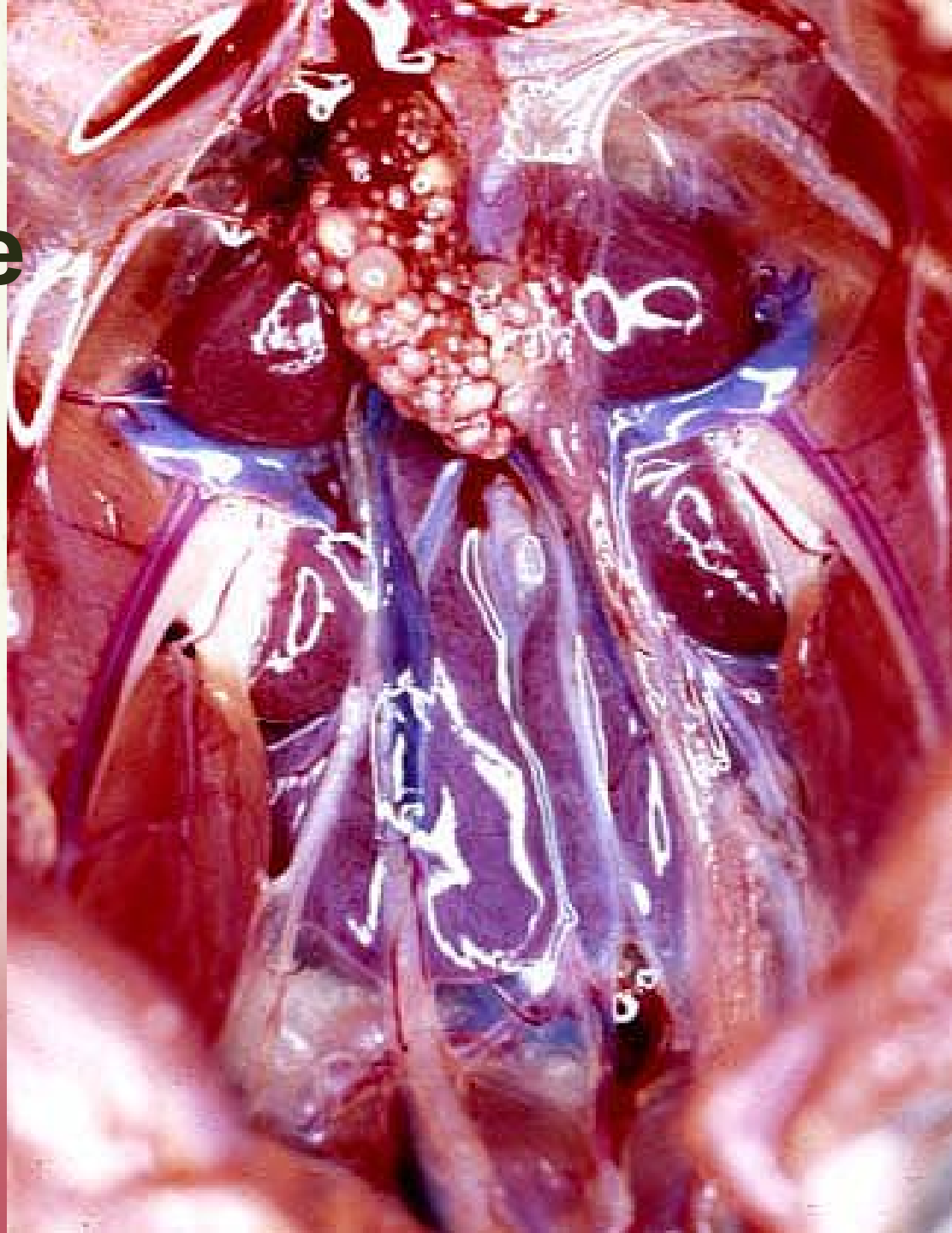
Male Reproductive Tract

- 2 testis
- Rudimentary phallus (may or may not be intromittant)
- Parrots non-intromittant



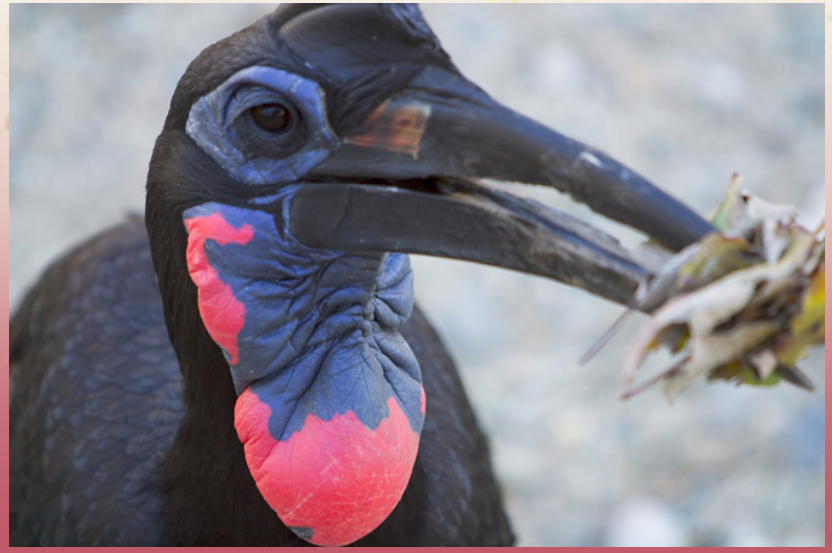
Female Reproductive Tract

- Left ovary
- Infundibulum
- Magnum
- Isthmus
- Uterus (shell gland or oviduct)



Adrenal Glands

- Paired
- Medial and cranial to kidneys and gonads
- Function similar to mammalian adrenals



Thyroid, Parathyroid & Thymus

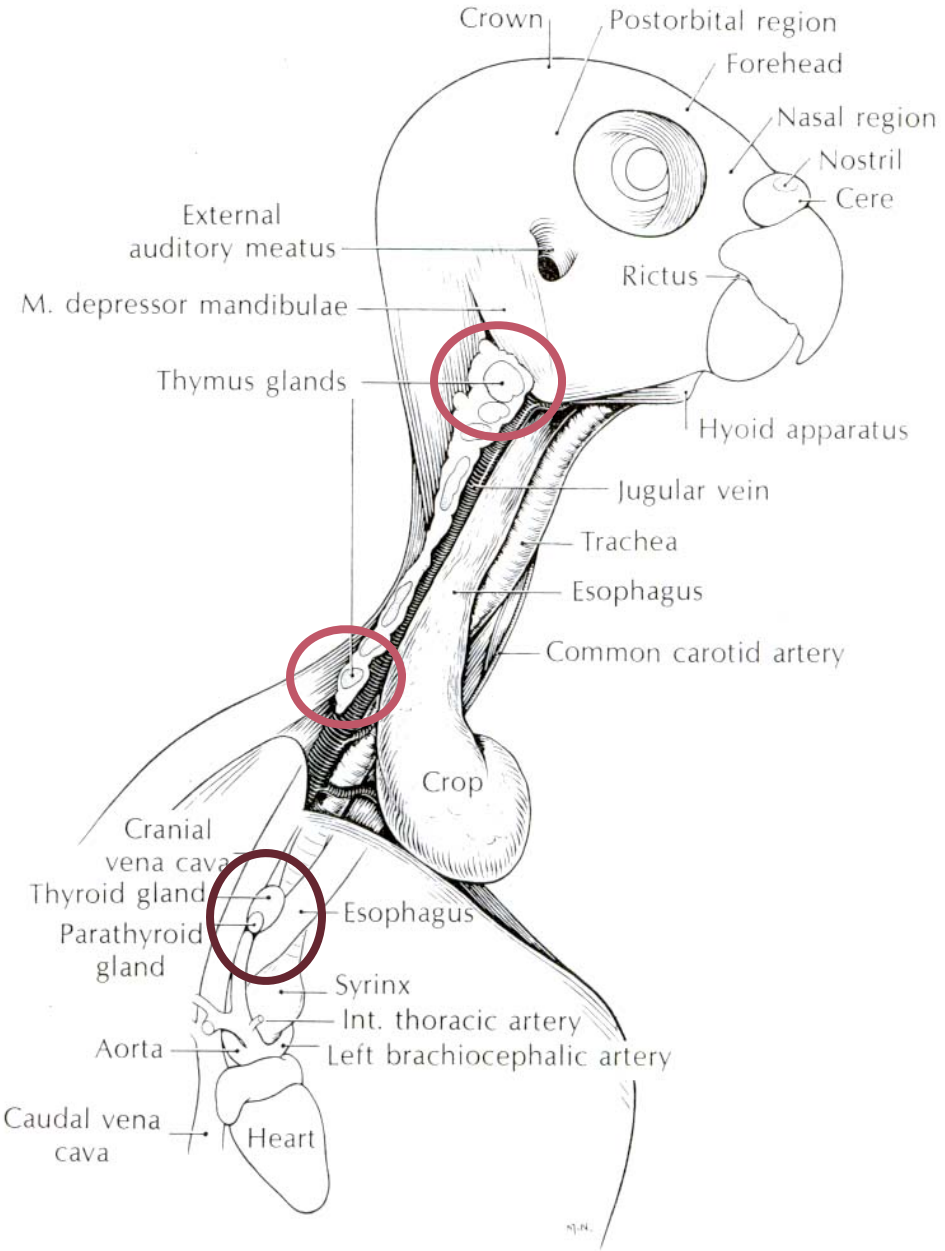


FIGURE 13-39. Structures of the head, neck, and thoracic inlet.