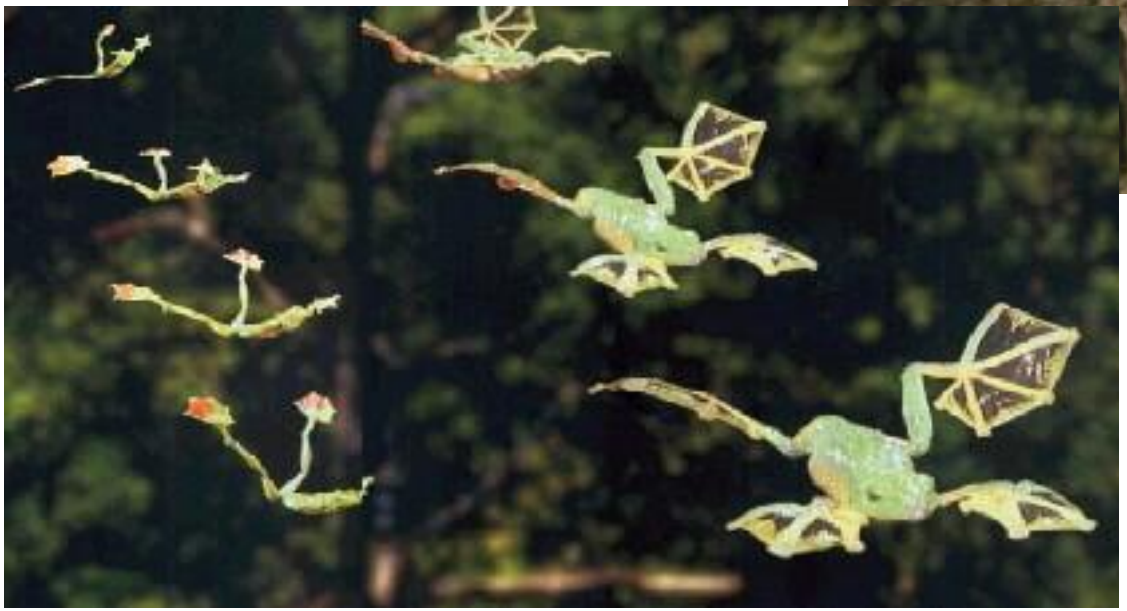
Полет

Osteichthyes

Полет

Amphibia



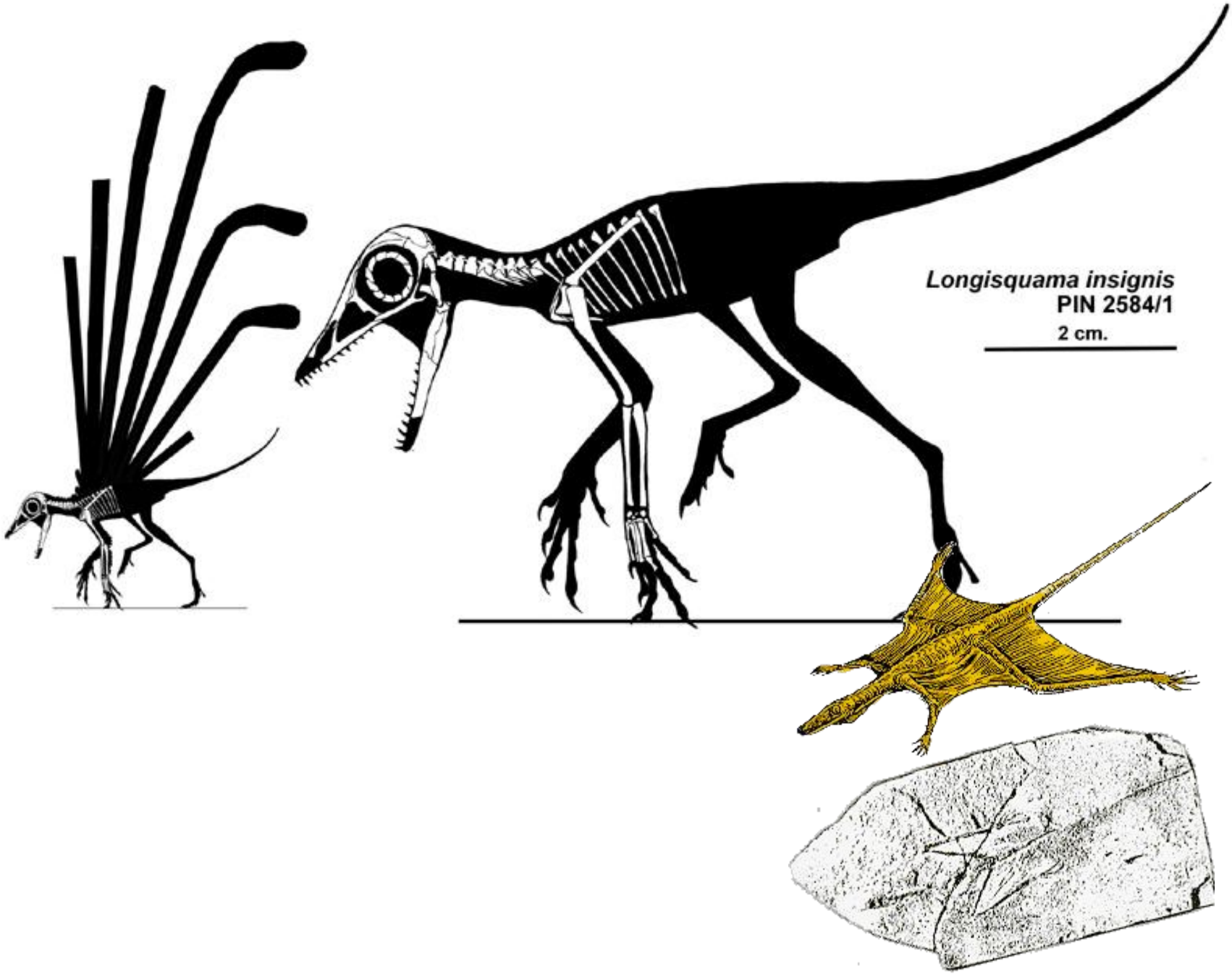
Полет

Reptilia

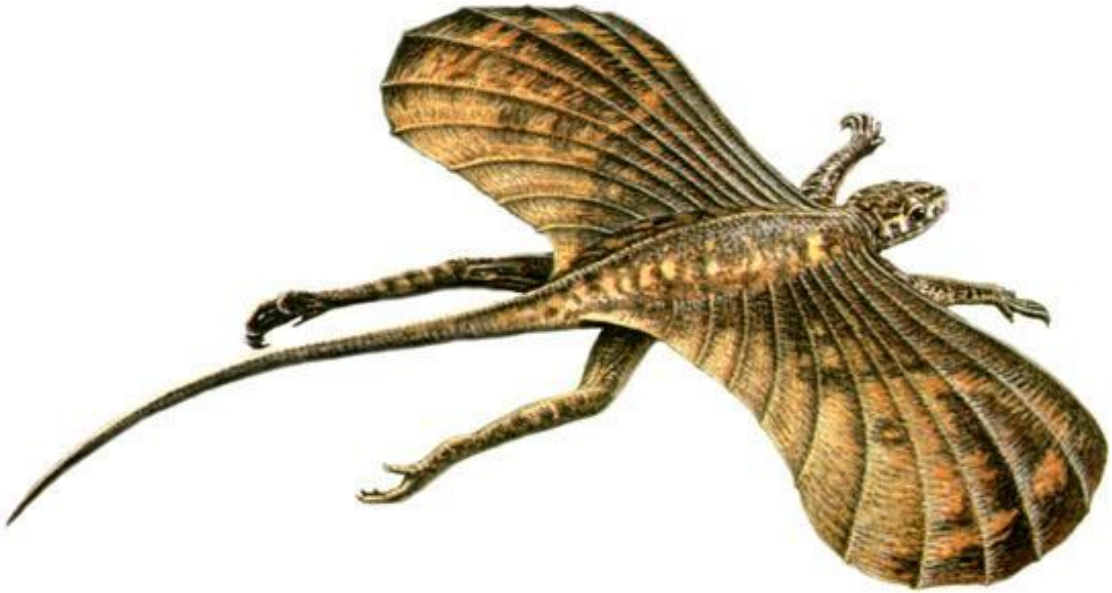
Prolacertiformes

Sharovipteryx

Longisquama


Longisquama insignis
PIN 2584/1
2 cm.

Icarosaurus

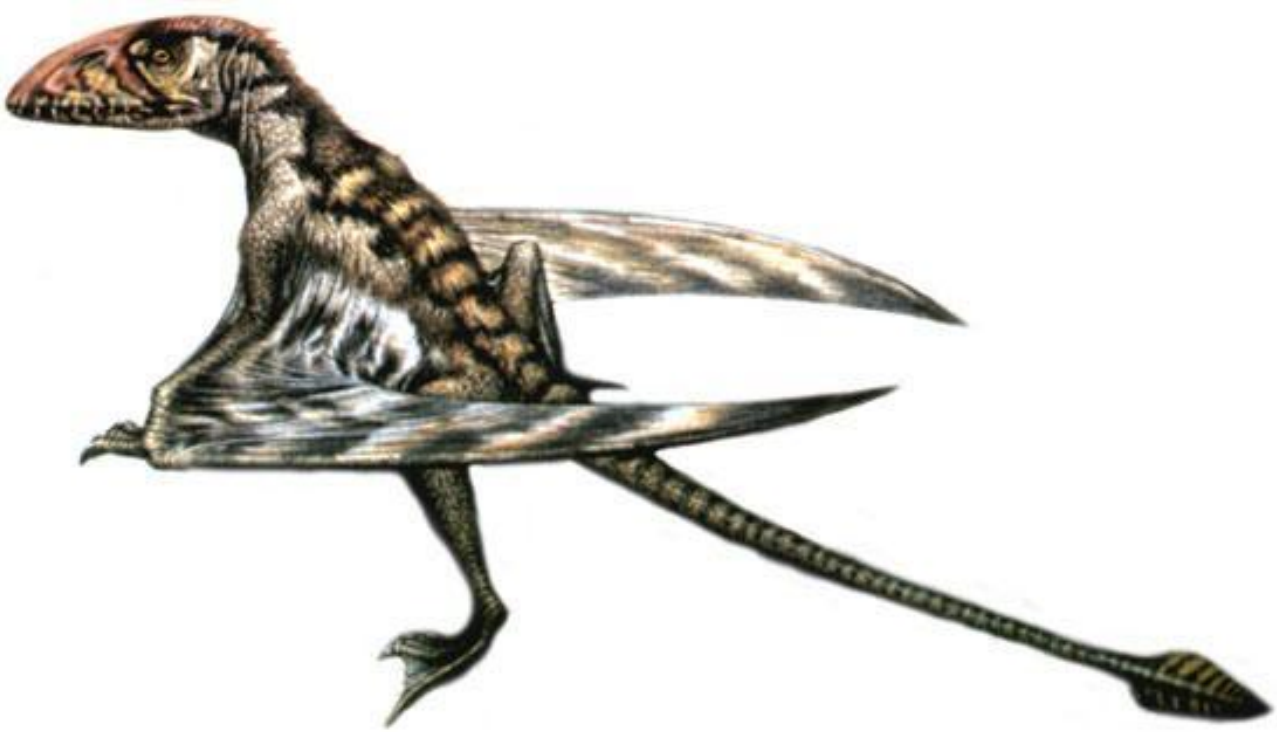


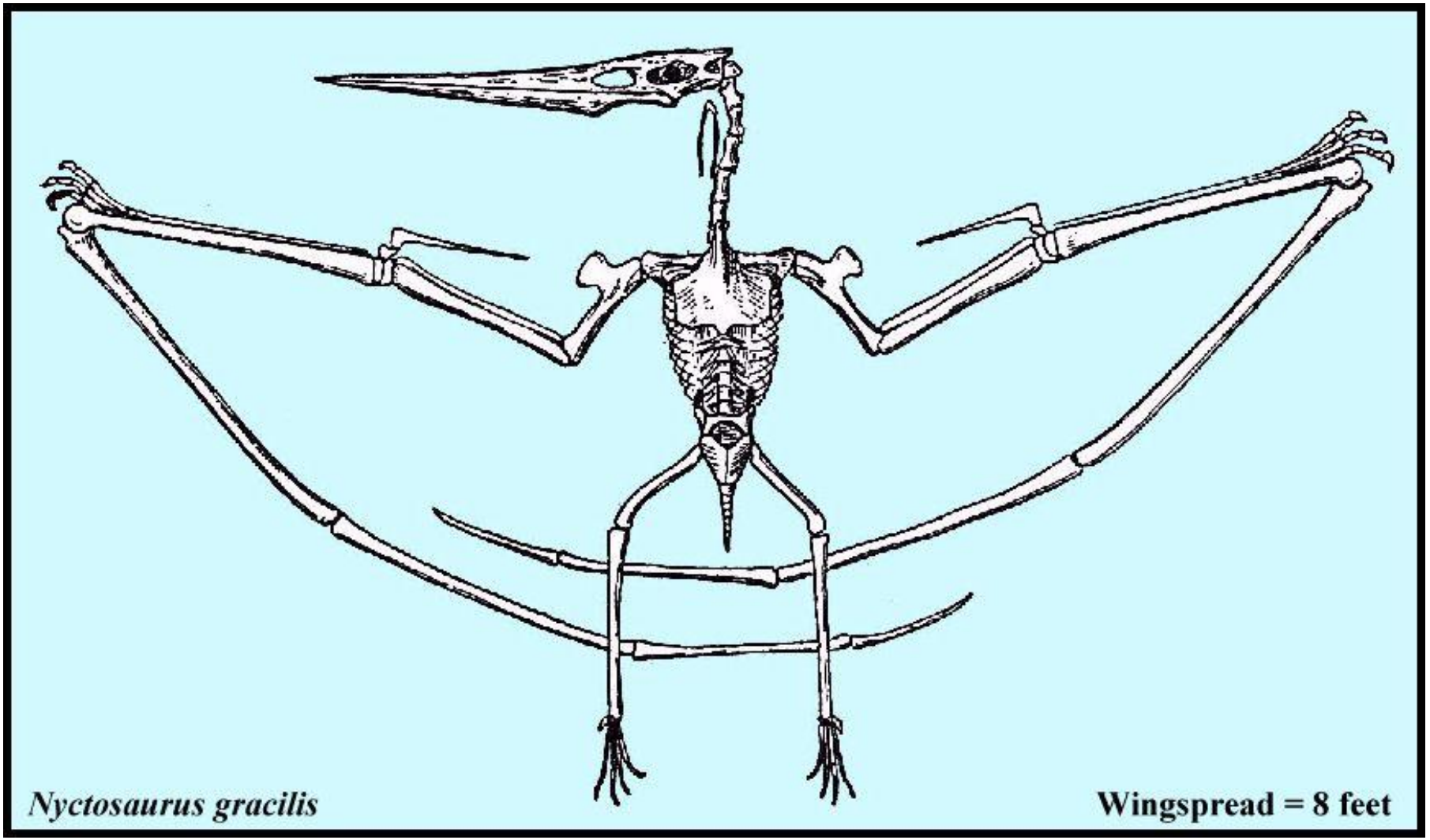
Полет

Mammalia

Активный полет

Pterosauromorpha




Nyctosaurus gracilis
Wingspread = 8 feet

Активный полет

Aves

Активный полет

Chiroptera (Mammalia)

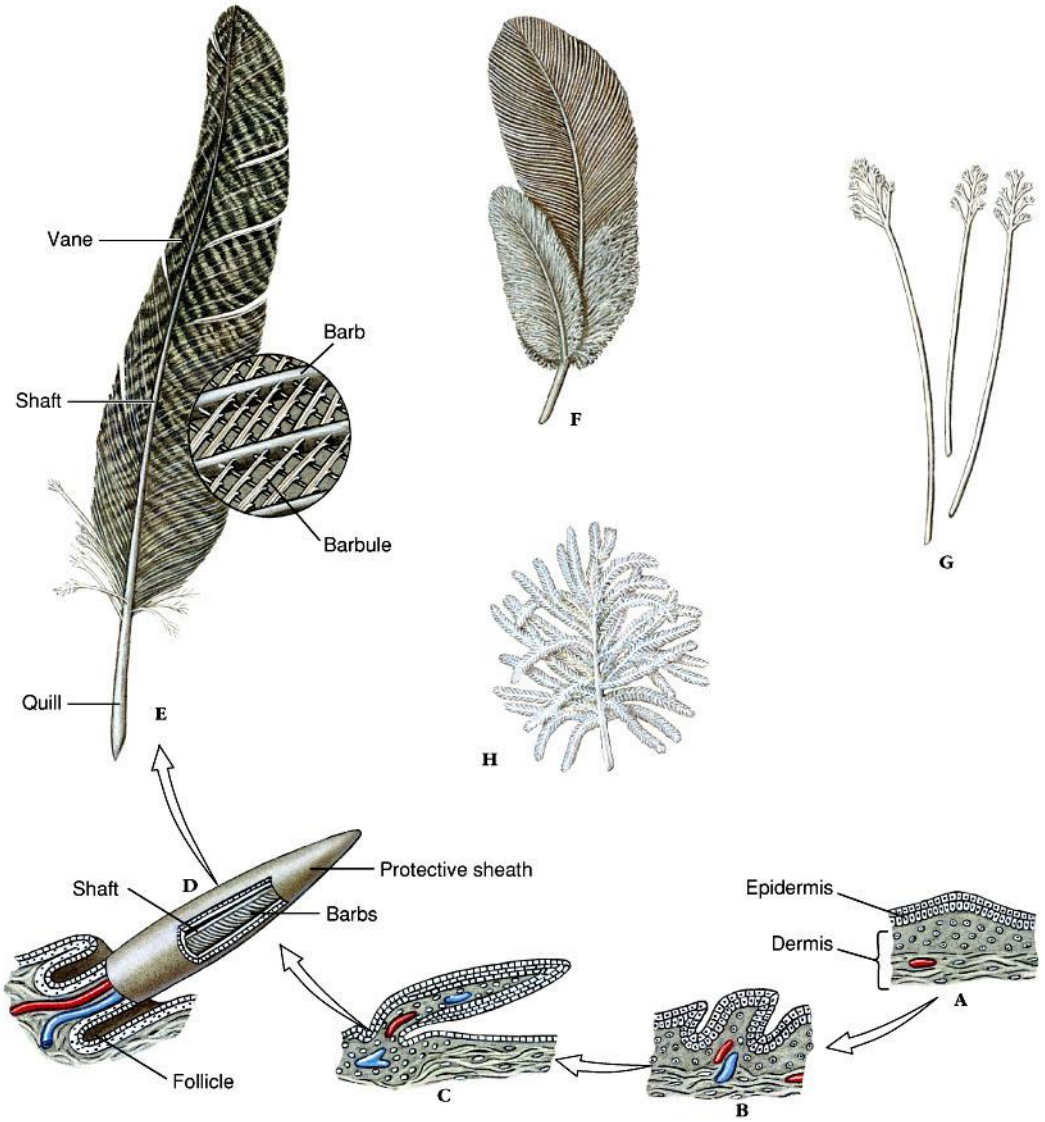
КТО ТАКИЕ ПТИЦЫ?

ОТ КОГО ОНИ ПРОИЗОШЛИ?

КАК ВОЗНИК ПОЛЕТ У ПТИЦ?

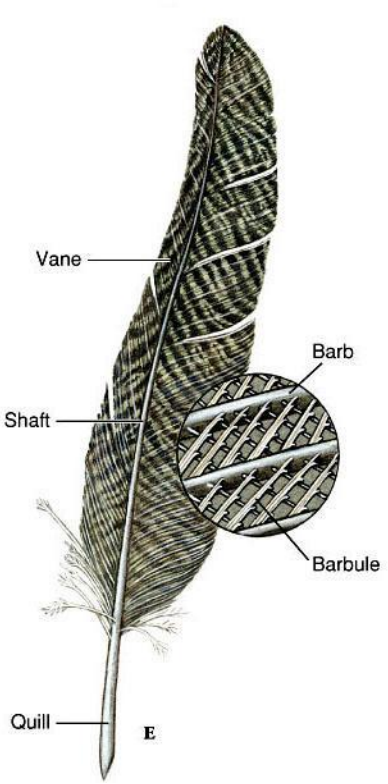
КТО ТАКИЕ ПТИЦЫ?

Перья



Контурные перья

- Hollow quill
- Rachis subdivided into barbs
- Barbs connected by barbules
- When used in flight, called flight feathers



Пух

- No barbules
- Found beneath contours
- Conserve head
- Abundant in waterfowl

Нитчатые перья

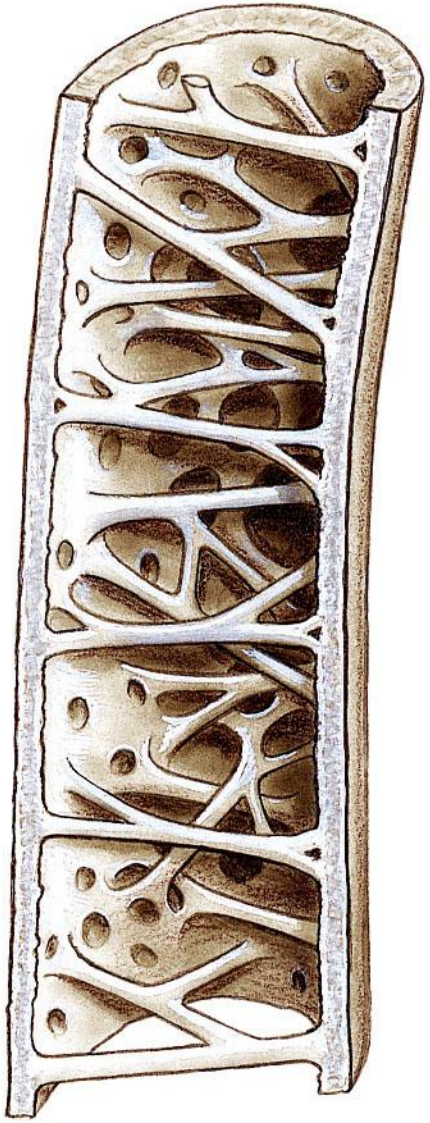
- Degenerate
- Hair-like
- Usually two at base of contour
- Possibly sensory in function

Пудретки

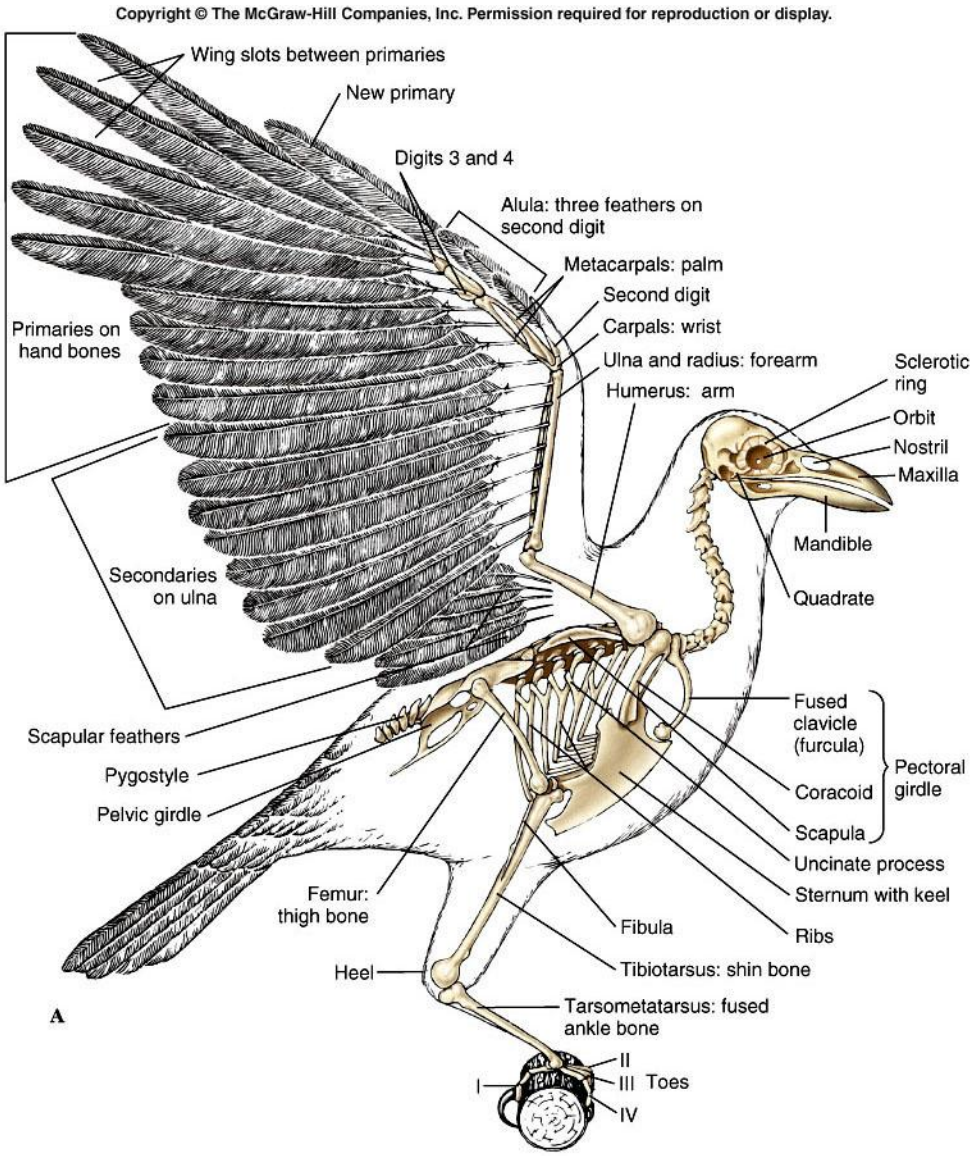
- Similar to down feathers
  - Tips disintegrate
  - Produce talc-like powder
  - Waterproofs animal

Скелет

- Strong yet light bones
- Pneumatized space with cross struts
- Spaces extend to air sacs of respiratory system
- Birds not any lighter than other mammals of same size
  - Distribution of weight over legs provide lower center of gravity
  - Aerodynamic stability

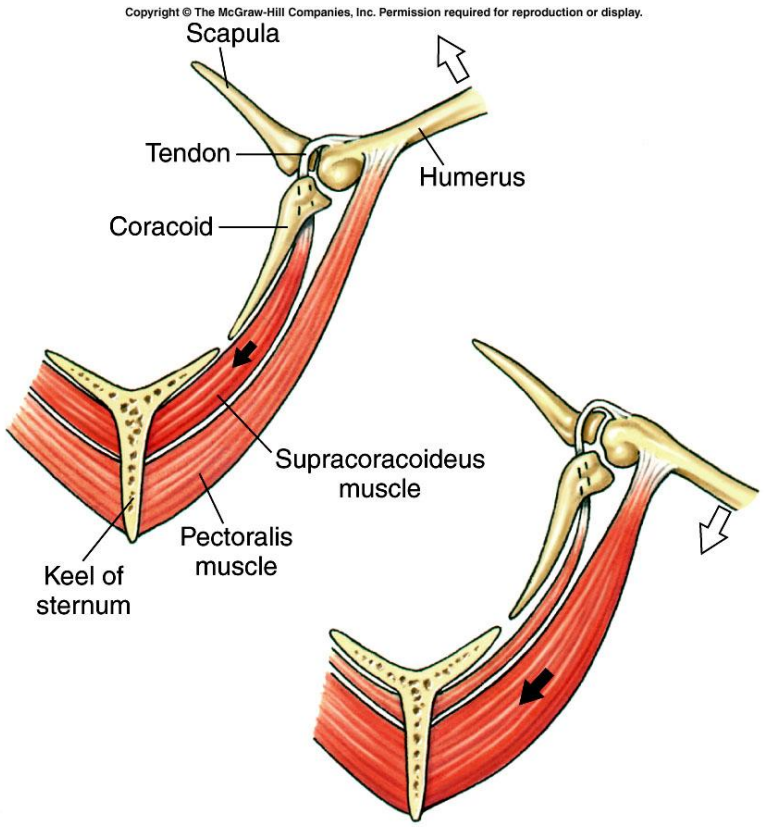


Skeleton


Copyright © The McGraw-Hill Companies, Inc. Permission required for reproduction or display.
Wing slots between primaries
New primary
Digits 3 and 4
Alula: three feathers on second digit
Metacarpals: palm
Second digit
Carpals: wrist
Ulna and radius: forearm
Humerus: arm
Primaries on hand bones
Secondaries on ulna
Scapular feathers
Pygostyle
Pelvic girdle
Femur: thigh bone
Heel
A
Sclerotic ring
Orbit
Nostril
Maxilla
Mandible
Quadrate
Fused clavicle (furcula)
Coracoid
Scapula
Pectoral girdle
Uncinate process
Sternum with keel
Ribs
Fibula
Tibiotarsus: shin bone
Tarsometatarsus: fused ankle bone
I
II
III Toes
IV

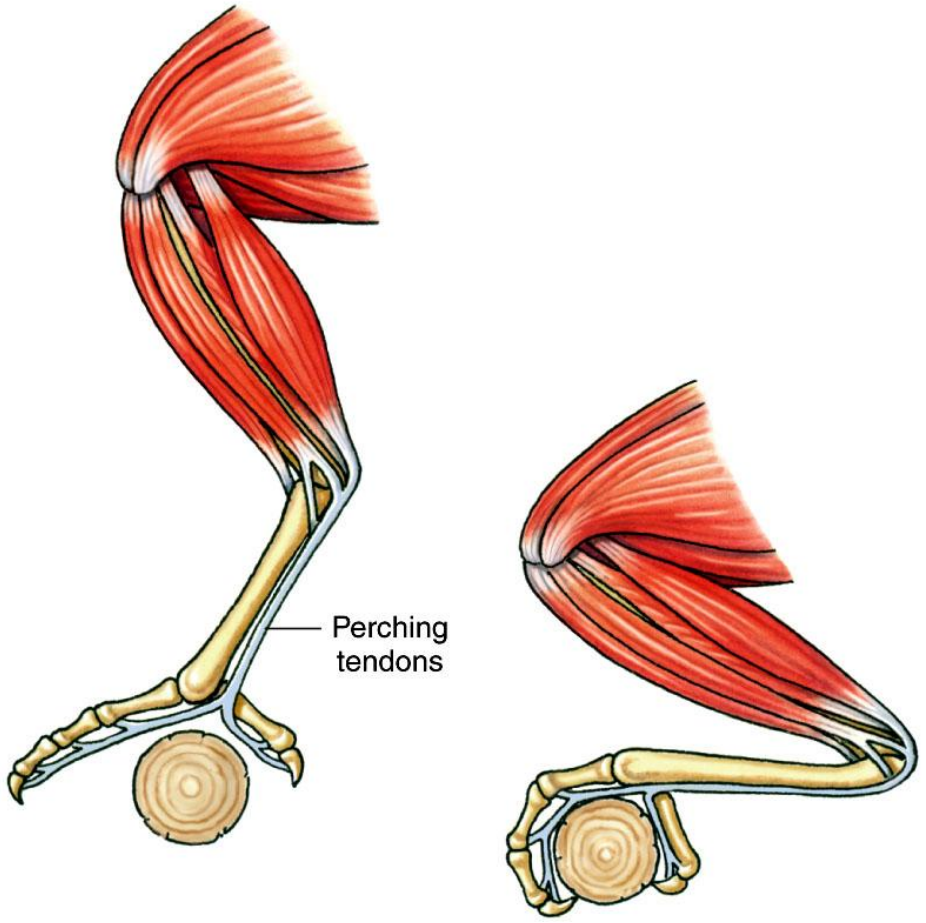
Мышцы

- Pectoralis largest
  - Downward beat of flight
- Surpacoracoideus raises wings
- Pectoralis connects to humerus with keeled sternum.
- Surpacoracoideus connect to coracoid bone with keeled sternum



Задние конечности

- Mostly bone, scales and skin
- Keeps bird from feeling cold and heat at foot
- Perching due to special tendons



Feeding & Digestion

- Diet
  - Euryphagous (omnivores)
  - Stenophagous (select diet)
- Large appetites due to high metabolic requirements
- No teeth
- Gizzard for grinding (keratinized plates)
- Proventriculus adds gastric juices
- Crop stores food
- Caeca – where small intestine joins cloaca
  - Hold bacteria in herbivorous birds
- Young birds have bursa of Fabricius
  - Process B cells of immune system

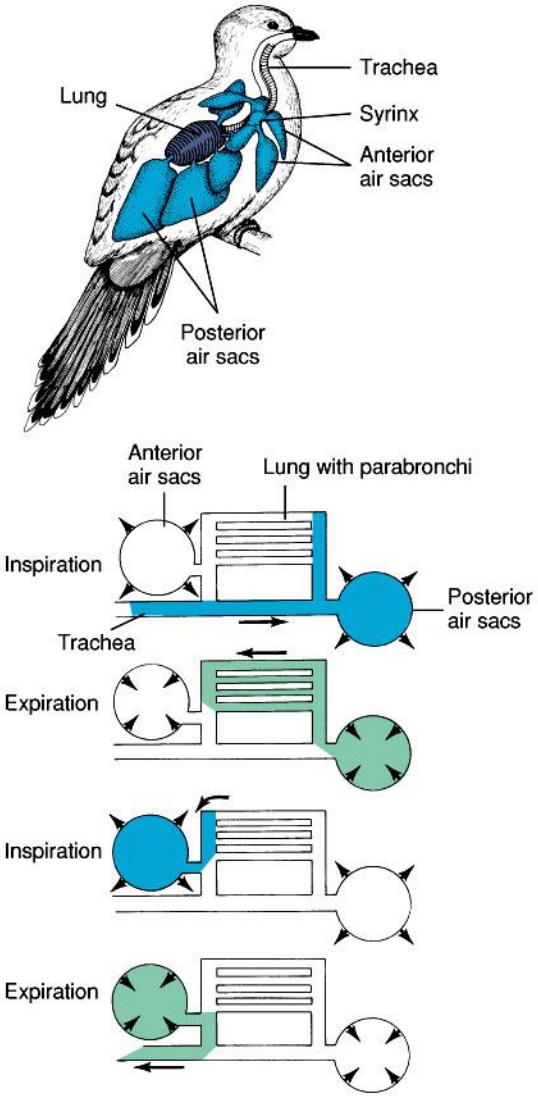
Circulatory System

- 4 chambered heart
- Closed system
- Separation of respiratory and systemic circulations
- Right aortic arch leads to dorsal aorta (left in humans)
- Larger the bird, slower the heartbeat
- Nucleated erythrocytes
- Phagocytes present

Respiratory System

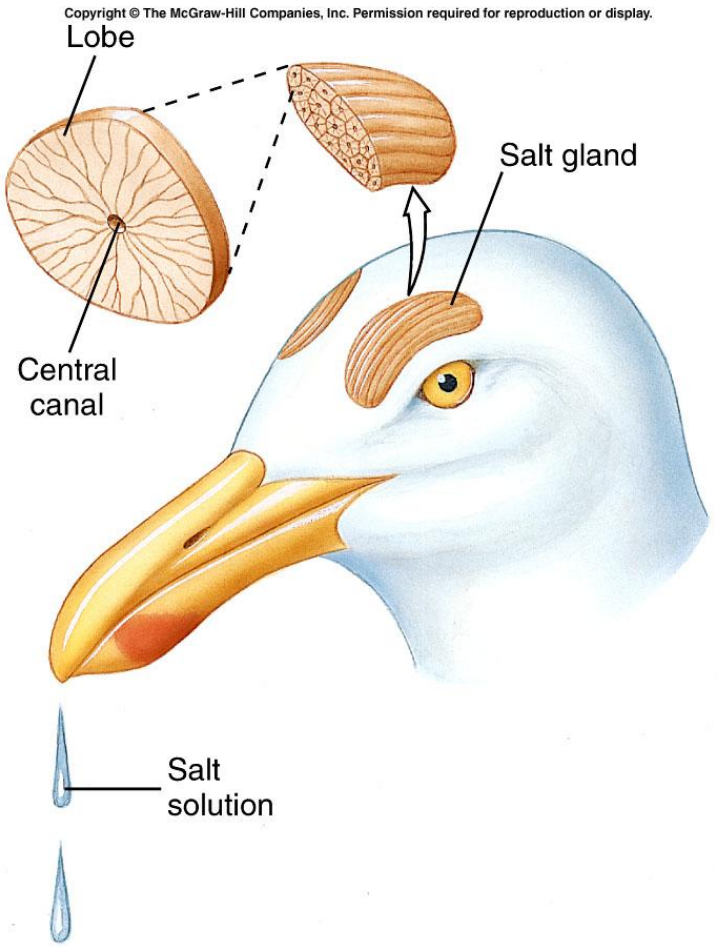
- 9 interconnecting air sacs paired in thorax and abdomen
  - Divide into extensions to bones
- Branches of bronchi don’t end in alveoli as in humans
  - Form parabronchi
  - Then into air sacs

- Takes two passes through respiratory system for a single “breath”



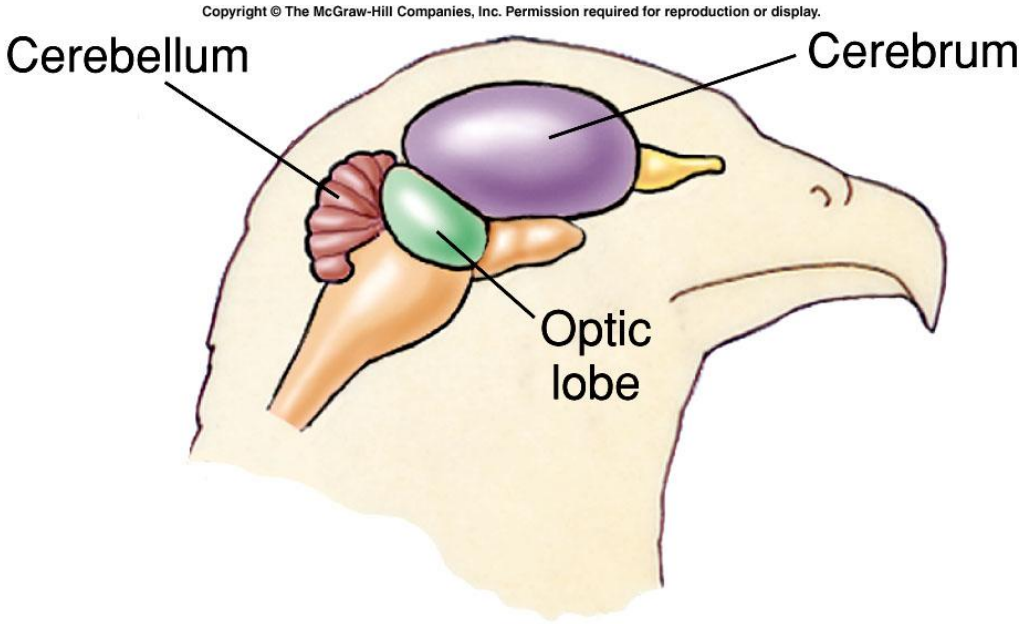
Excretory System

- Paired metanephric kidneys
  - Selective re-adsorption of solutes
- Urine formed and passed via ureters to cloaca
- No urinary bladder
- Water removed in cloaca and forms uric acid
- Salt glands, particularly in sea birds



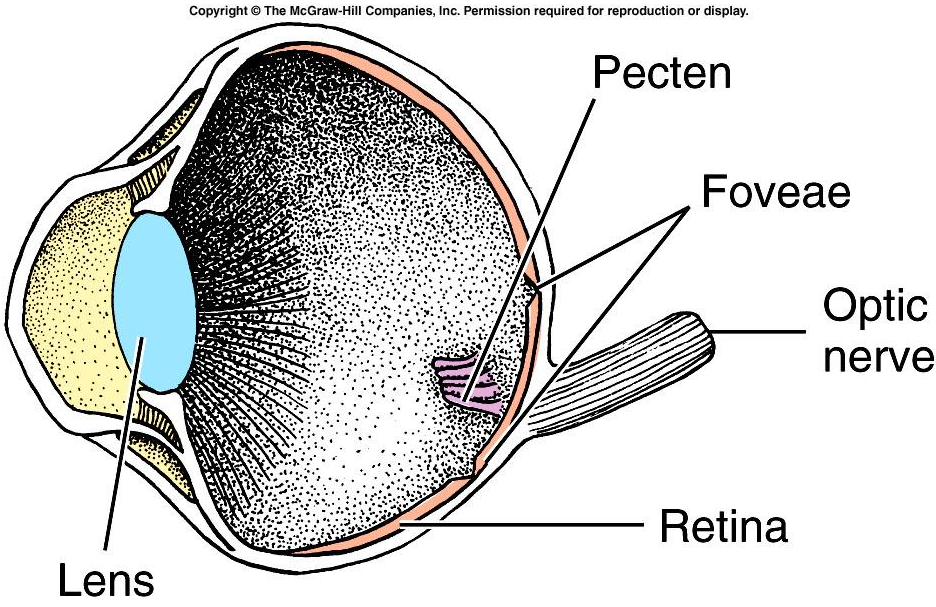
Nervous and Sensory System

- Need well developed brain
  - Cerebral hemispheres, cerebellum and optic lobes
  - Cerebral cortex less developed
- Cerebellum coordinates
  - Muscle position
  - Equilibrium
  - Visual clues
  - All necessary for movement and balance
- Poor sense of smell and taste (carnivorous, flightless, oceanic and waterfowl have good tasting ability
- Hearing good
  - External ear
  - Middle ear
  - Inner ear
  - Basic arrangement of mammals



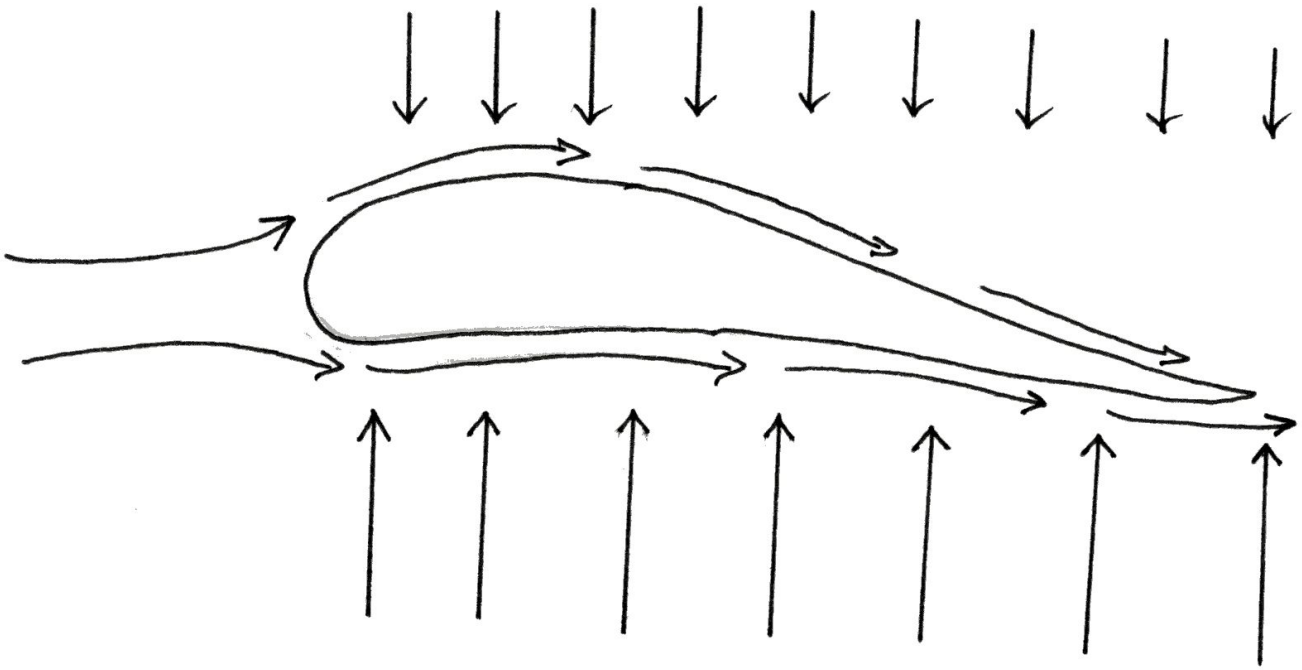
Vision

- Similar to humans
- Rods & cones
- Highly vascularized area near optic nerve called pecten (adds additional nutrients to eye)
- Fovea may be found in pits on retina
  - Some birds have two fovea
  - Binocular vision birds
    - Central fovea for sharp monocular images
    - Posterior fovea for sharp binocular vision



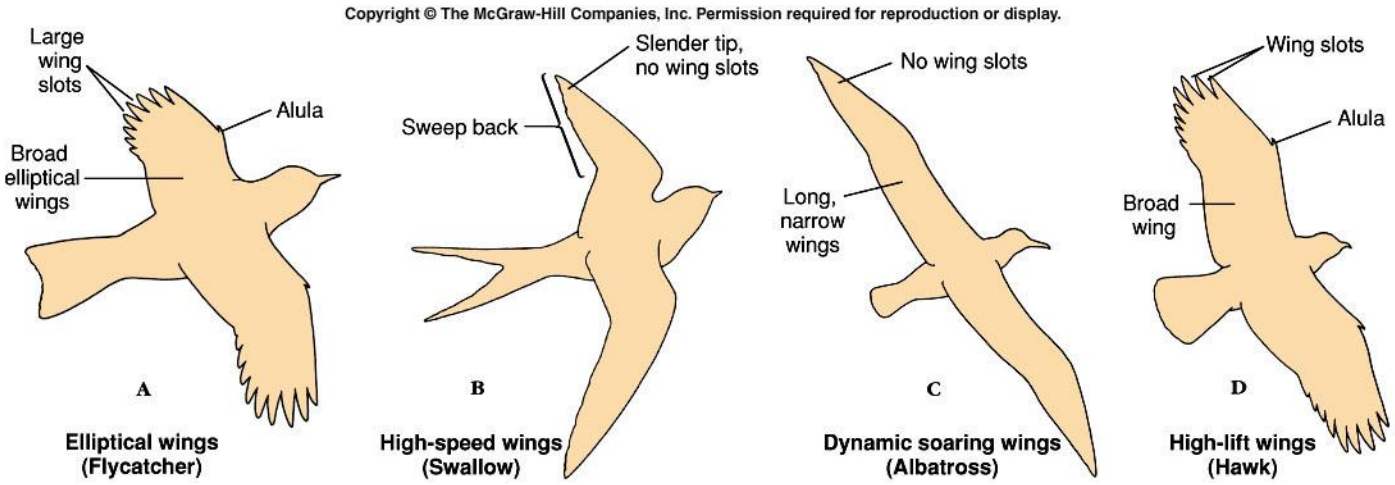
Flight

- Bernoulli Effect



Wing Types

- Elliptical
  - Low aspect ration (ratio of length to average width)
  - Greater maneuverability
- High speed
  - High aspect ratio
  - Stay aloft at low speeds
- Dynamic soaring
  - High aspect ratio
- High lift
  - Heavy, large bodies
  - High lift at low speed



Migration & Navigation

- Most have established routes
- ½ of all species migrate
  - Most from north to south in fall and south to north in spring
- Parameters of migration
  - Use of different routes in fall and spring
  - Time to complete route
  - Night *vs* day migration (or both)
  - Distance of migration
  - Use of landmarks

Direction Finding

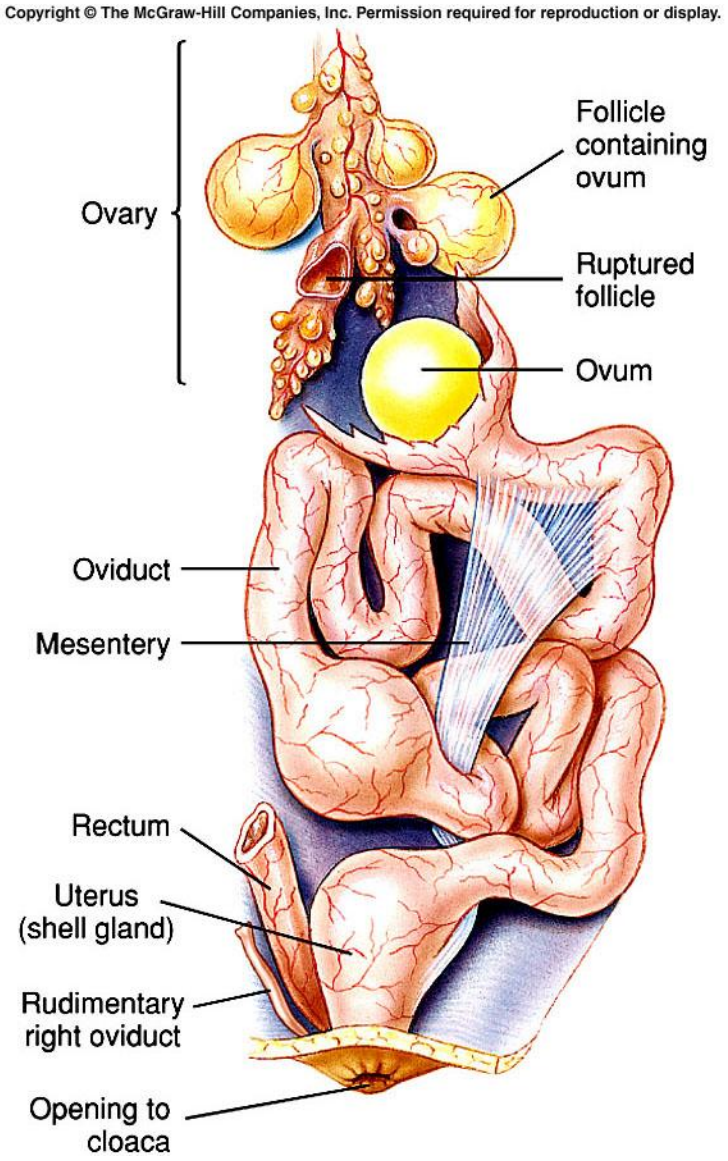
- Factors
  - Use of topographical landmarks
  - Flock behavior by following experienced birds
  - Innate sense of time
  - Use of earth's magnetic field
  - Celestial clues (both stars and sun)
    - Sun-azimuth orientation (use of sun and innate sense of time)

Behavior

- Complex behavior
  - Breeding
  - Nesting
  - Courtship
  - Feeding, etc.

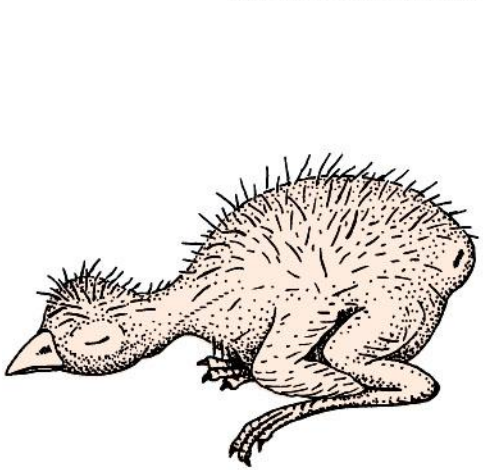
Reproduction

- Males with paired testes
- Females often have only left ovary and oviduct
- Males typically have no penis (waterfowl do)
- Egg captured by oviduct (infundibulum)
- Yolk added, then shell
- Sperm remains viable in some species 5-6 days

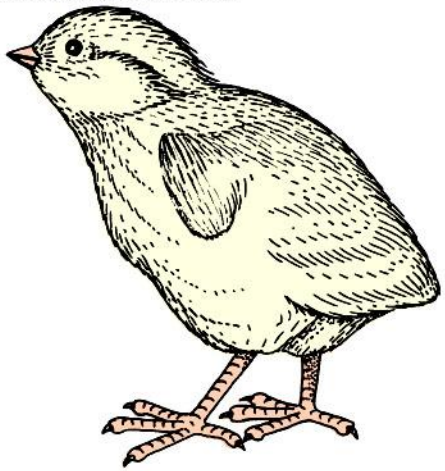


Nesting & Development

- Simple and complex nests
- Altricial and precocial



Altricial
One-day-old meadowlark



Precocial
One-day-old ruffed grouse

Первоначальная функция перьев?

Перьеподобные структуры характерны для Archosauria

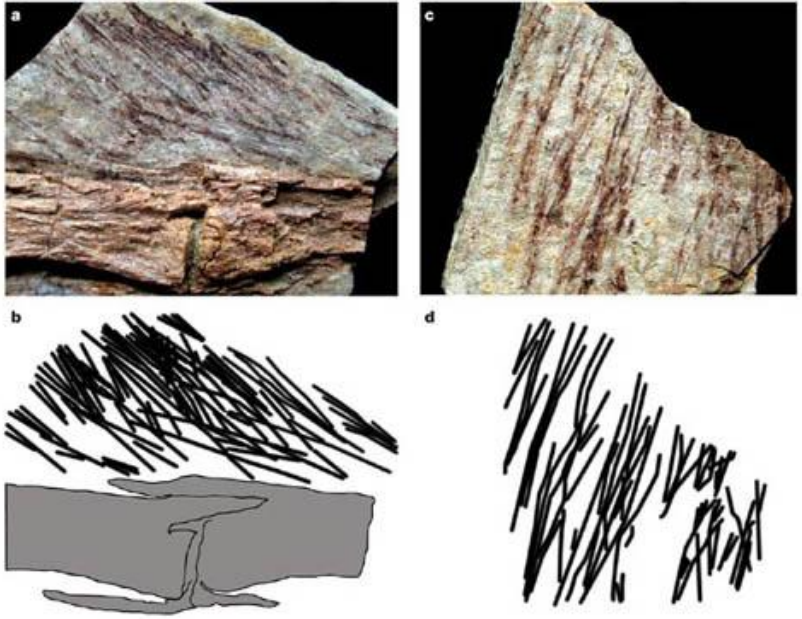
Возникновение полета

- «Лесная» гипотеза
- «Степная» гипотеза

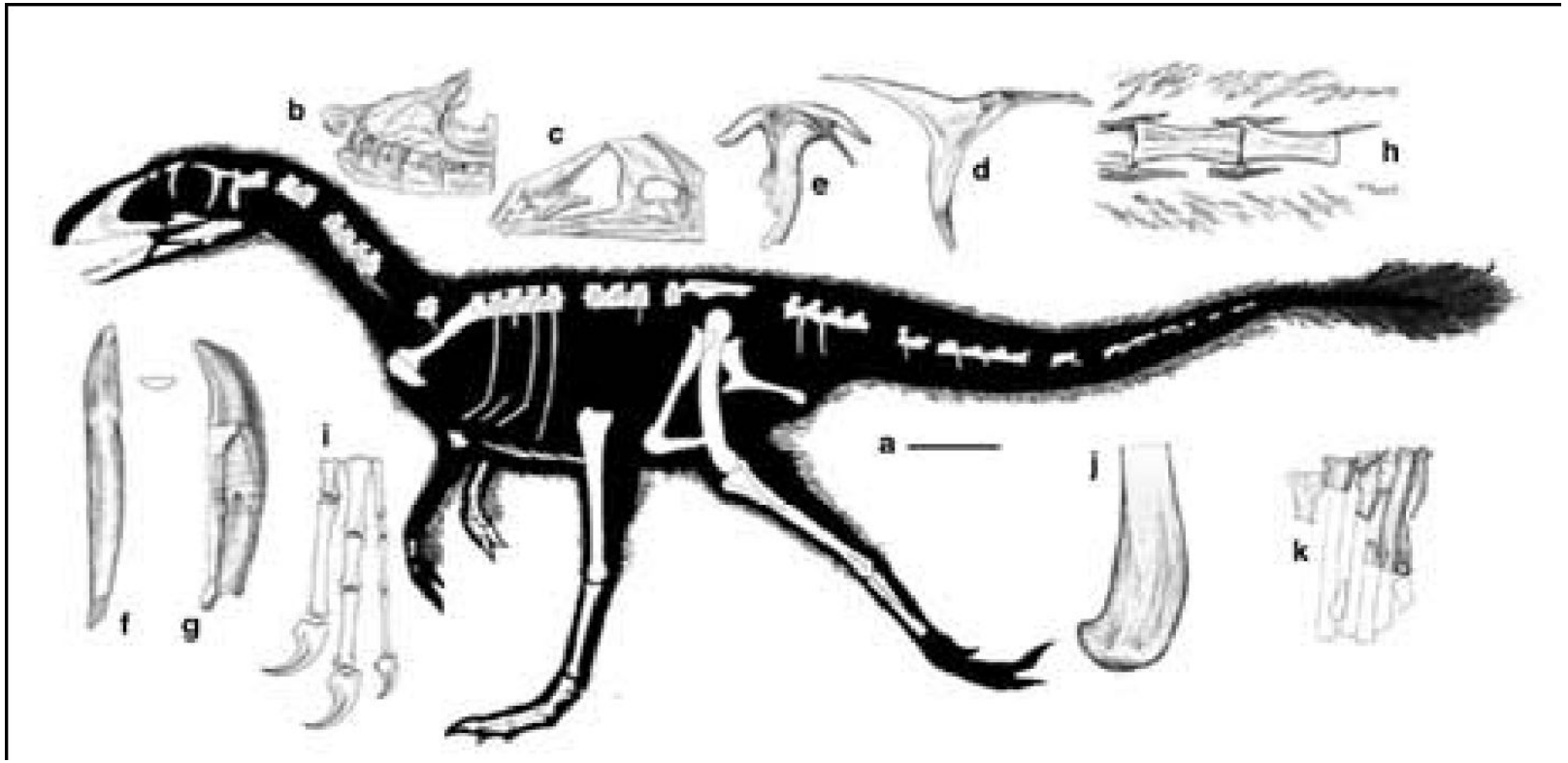
Гипотеза происхождения птиц от динозавров (теропод)

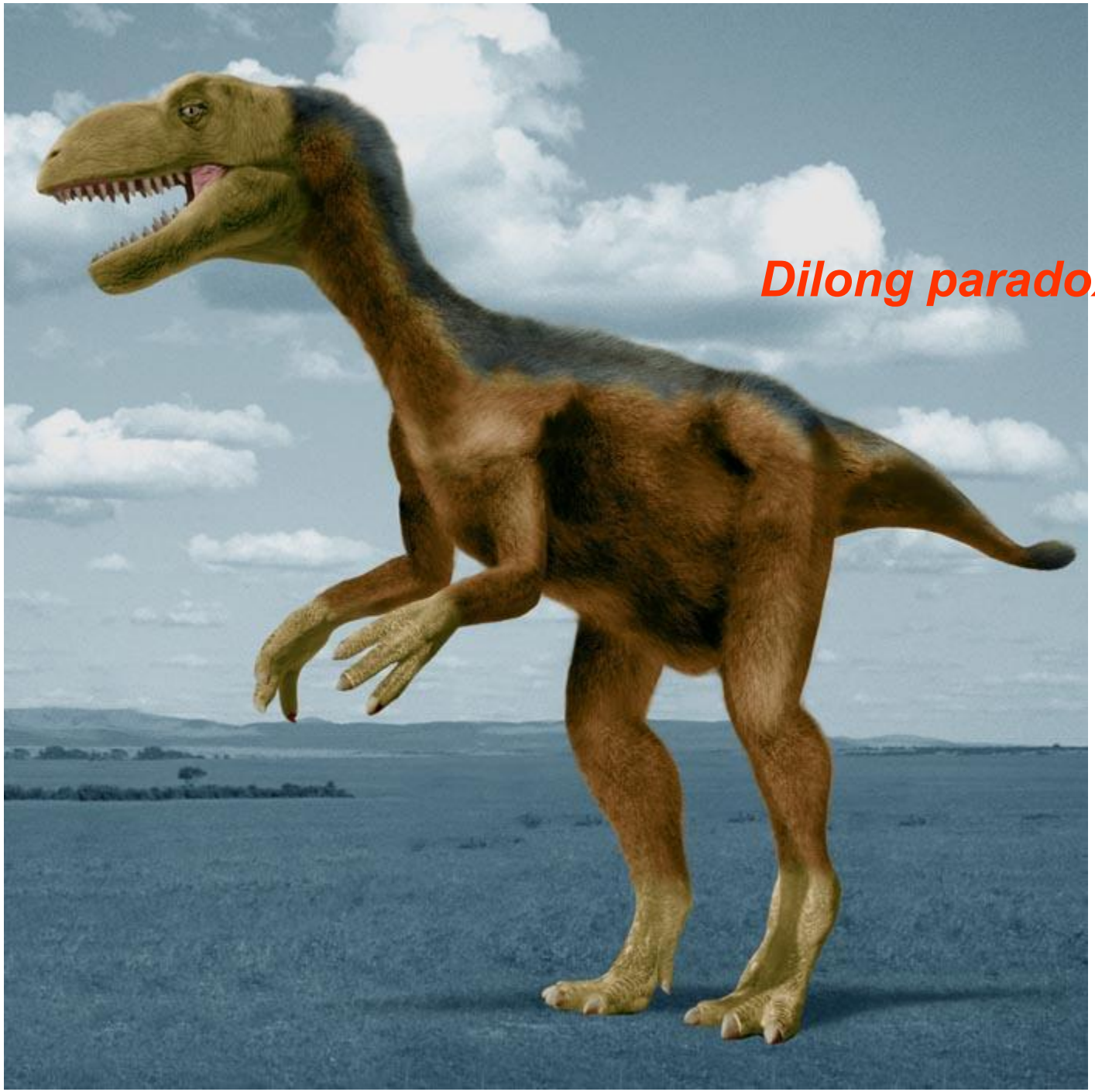
Авиализация теропод

Tyrannosauridae

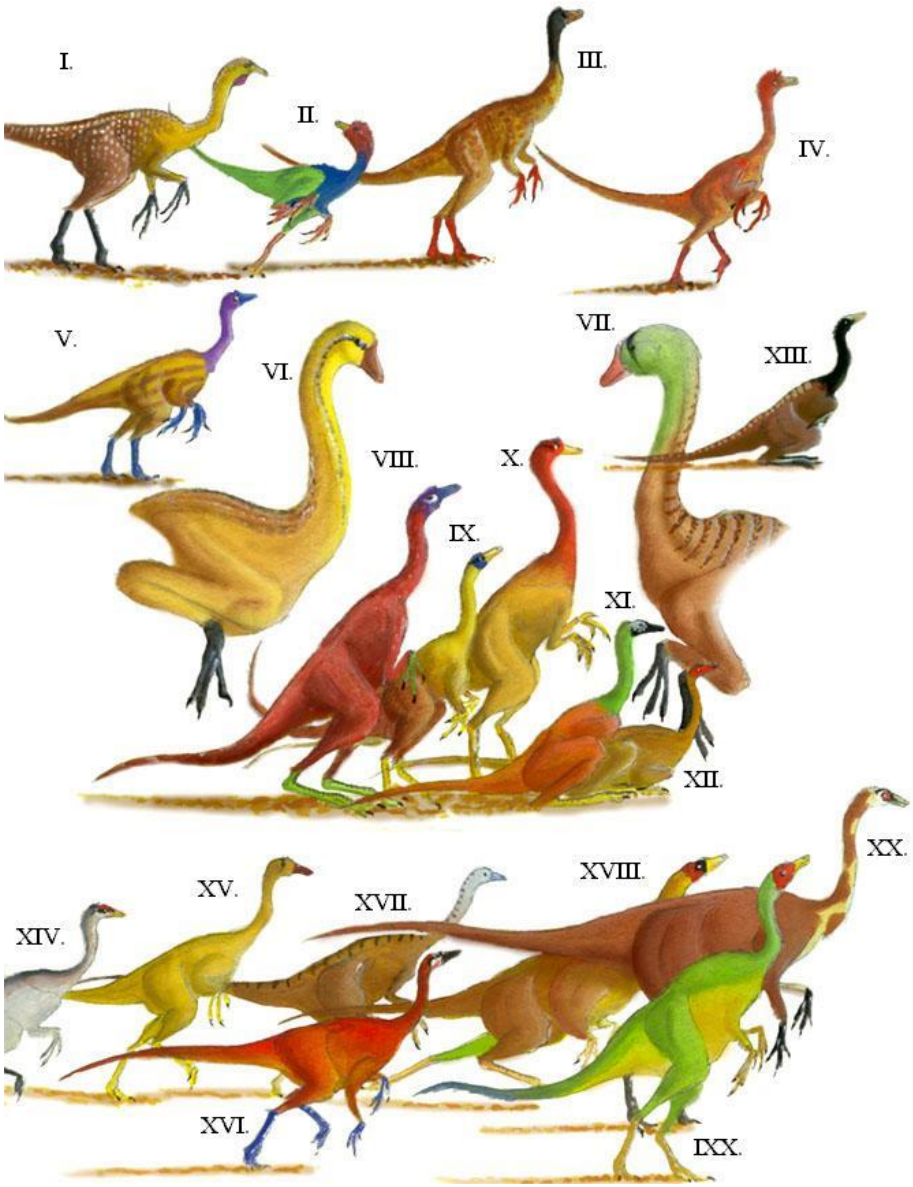


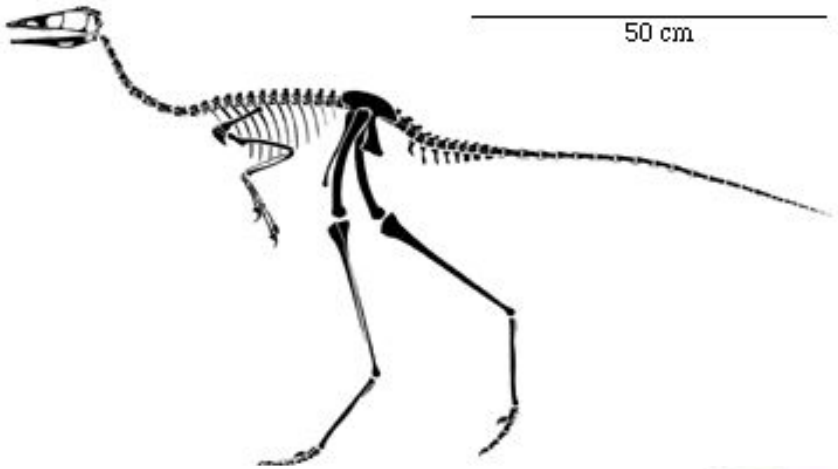
Dilong paradoxus

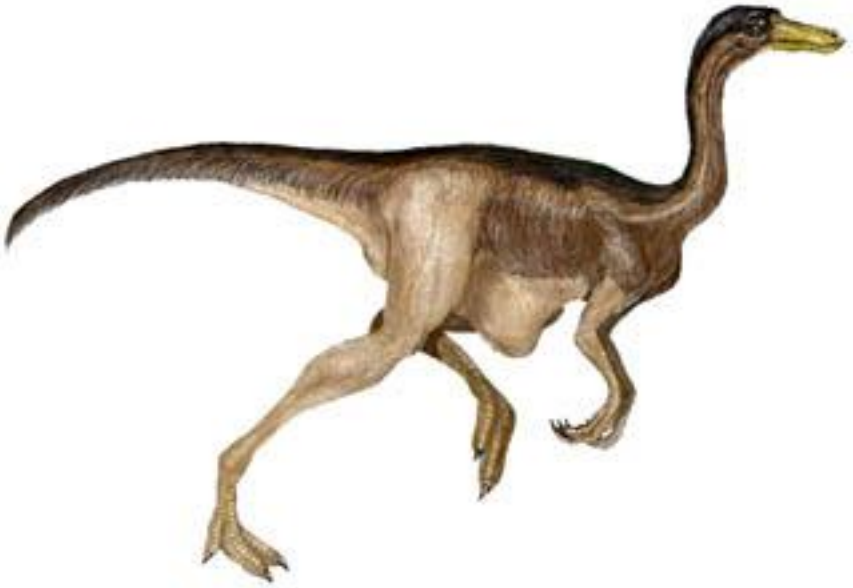



Dilong paradoxus

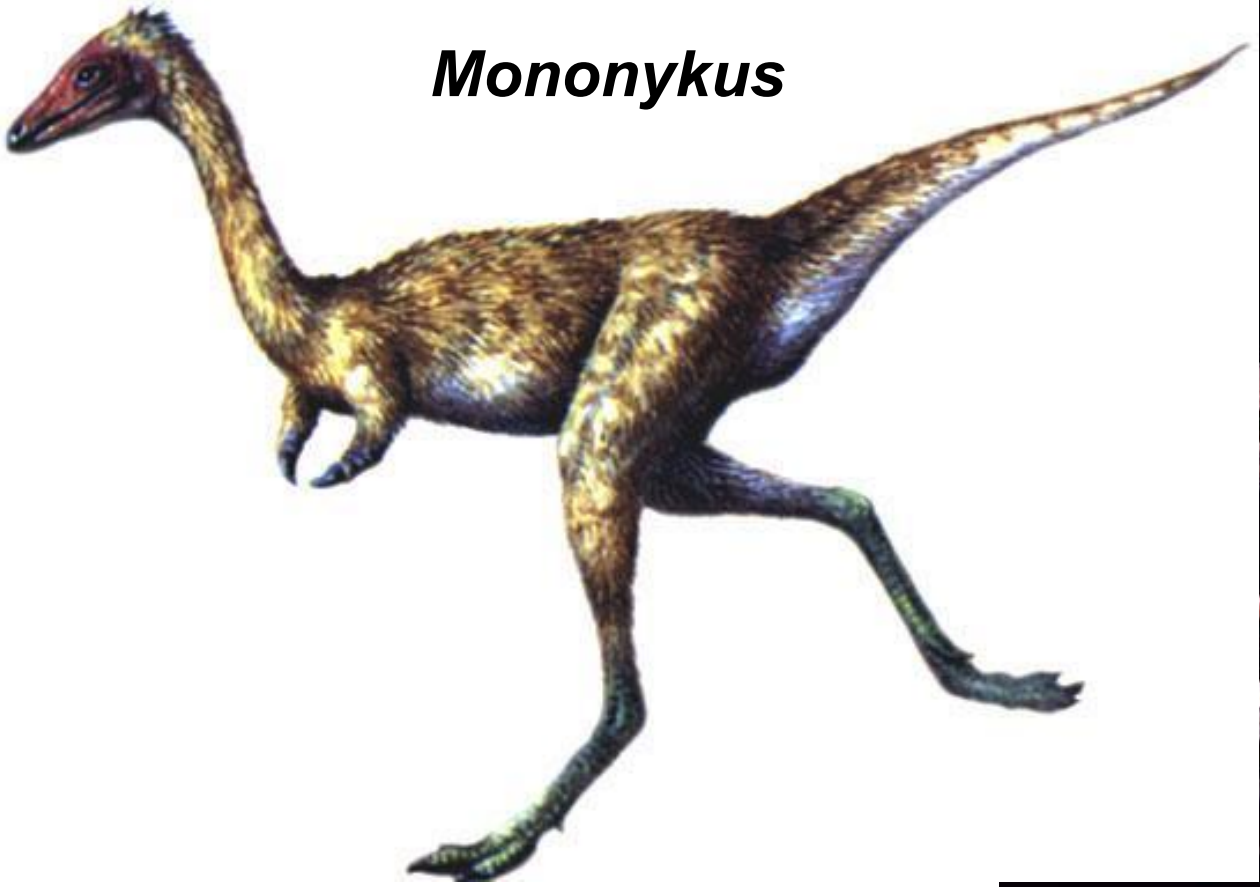
Ornithomimosauria



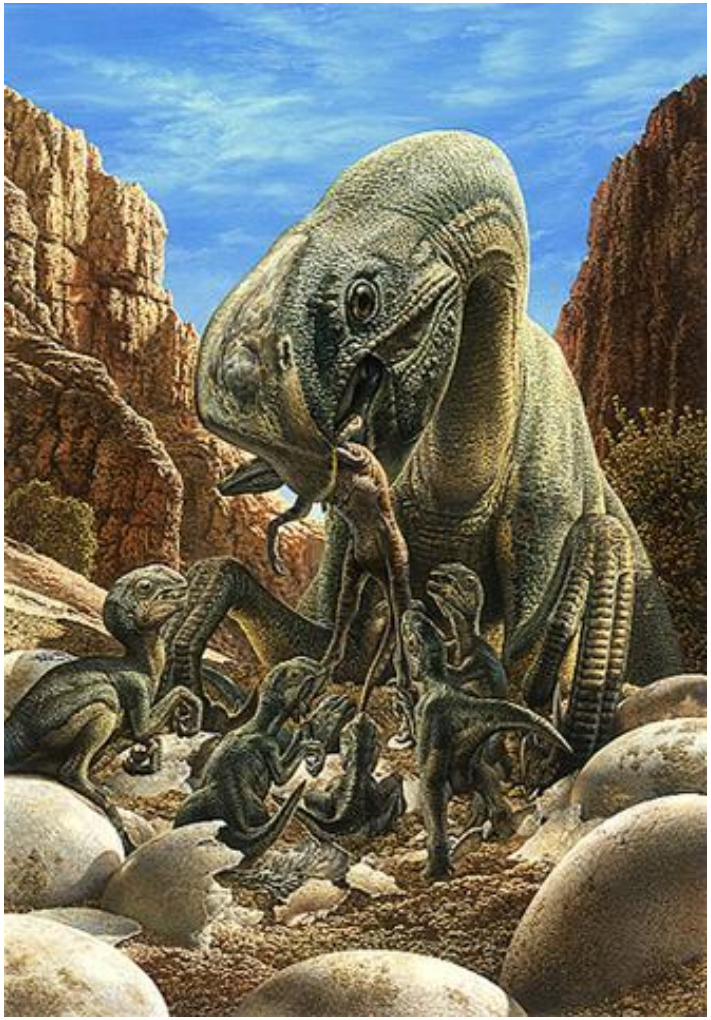


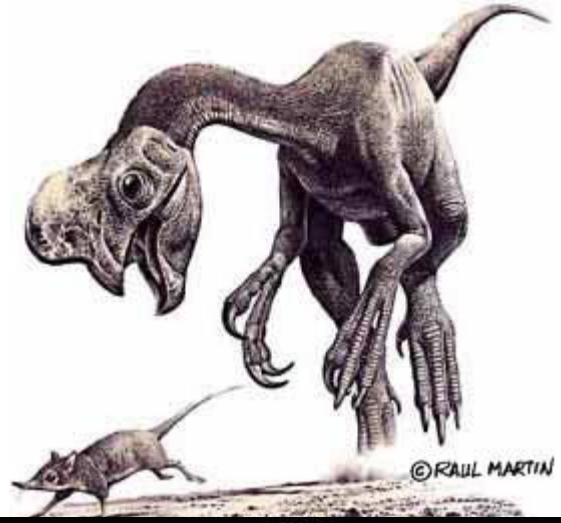


Alvarezsauridae



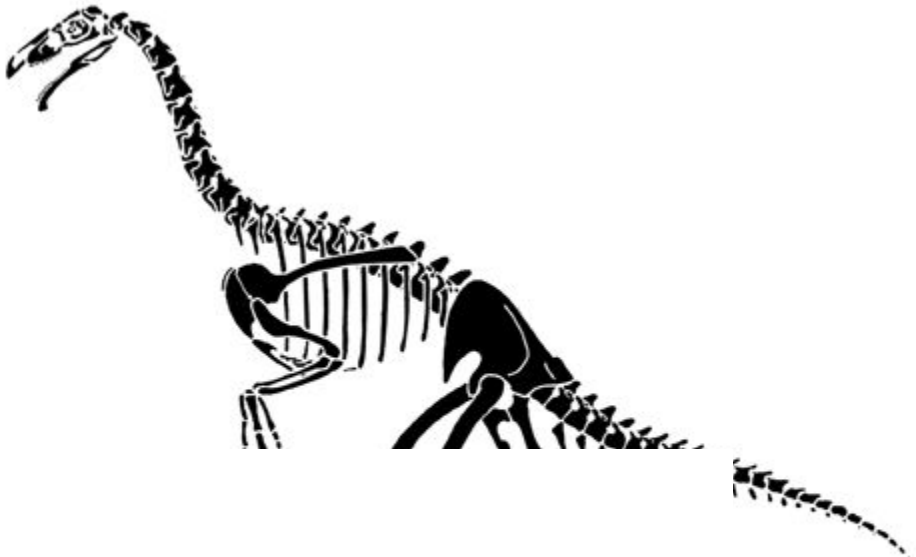
Oviraptosauria



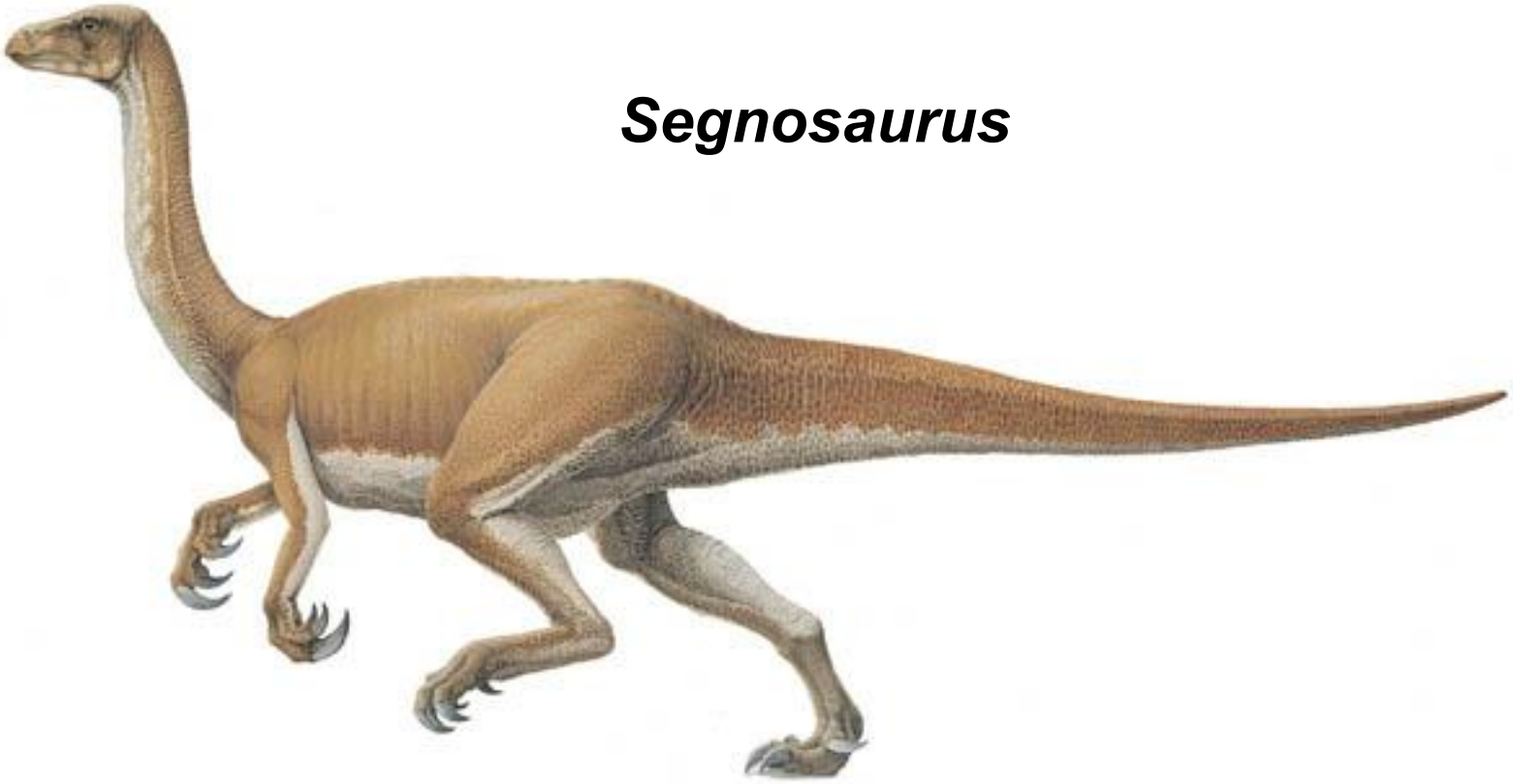


Oviraptor

Therizinosauria



Segnosaurus



Dromaeosauridae

Dromaeosaurus

Troodontidae

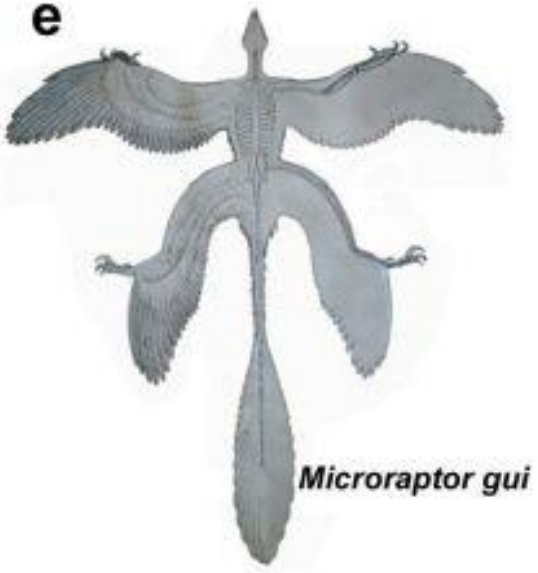
Troodon

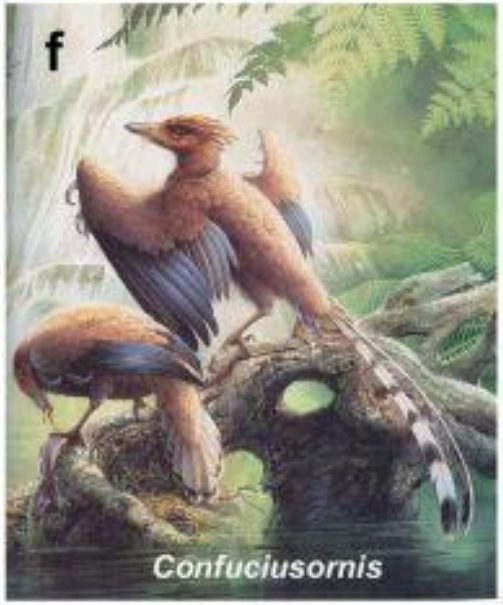

a
Jehol Biota


b
Sinosauropteryx


c
Sinornithosaurus


d
Caudipteryx


e
Microraptor gui


f
Confuciusornis


g

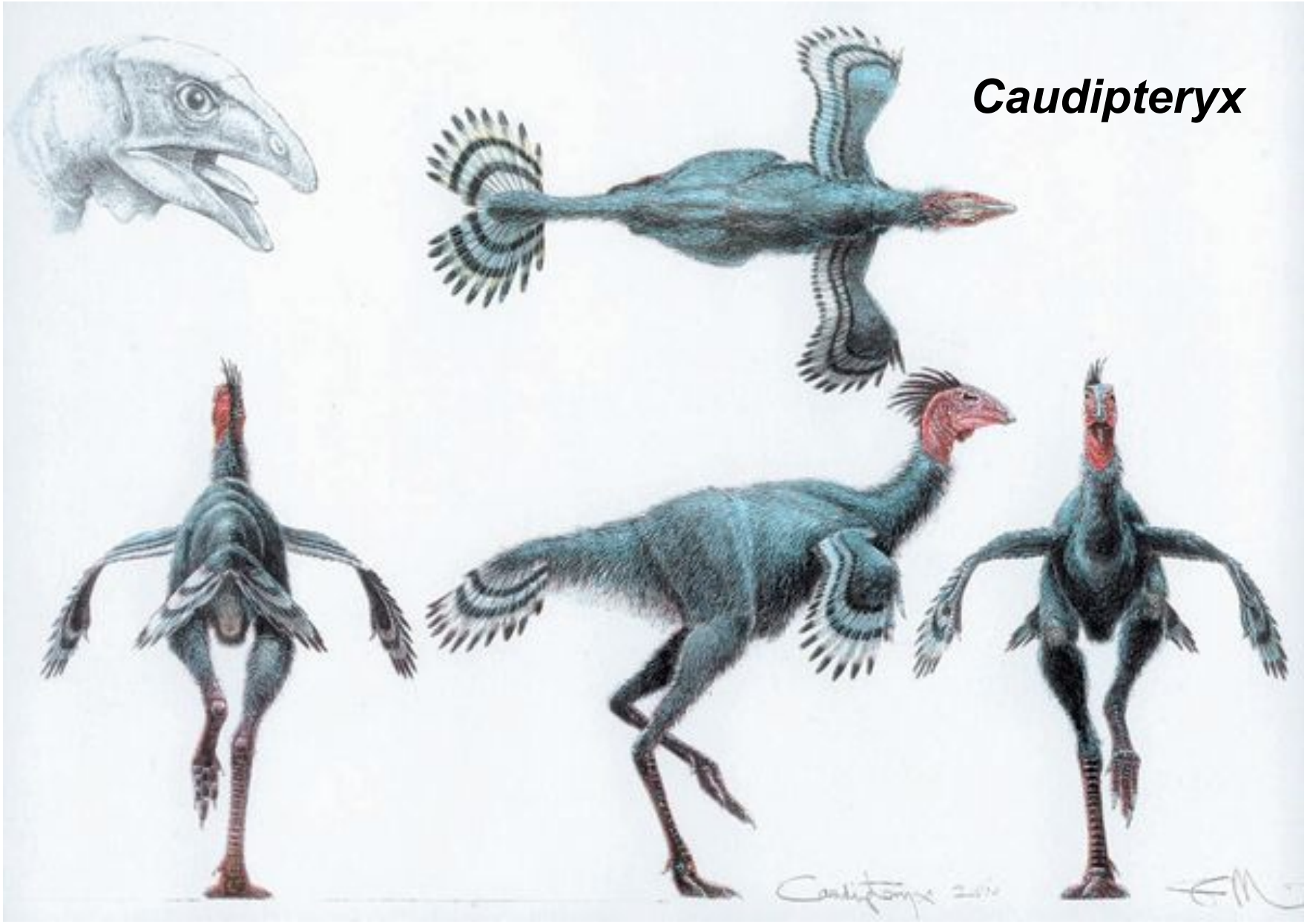

h


i


j

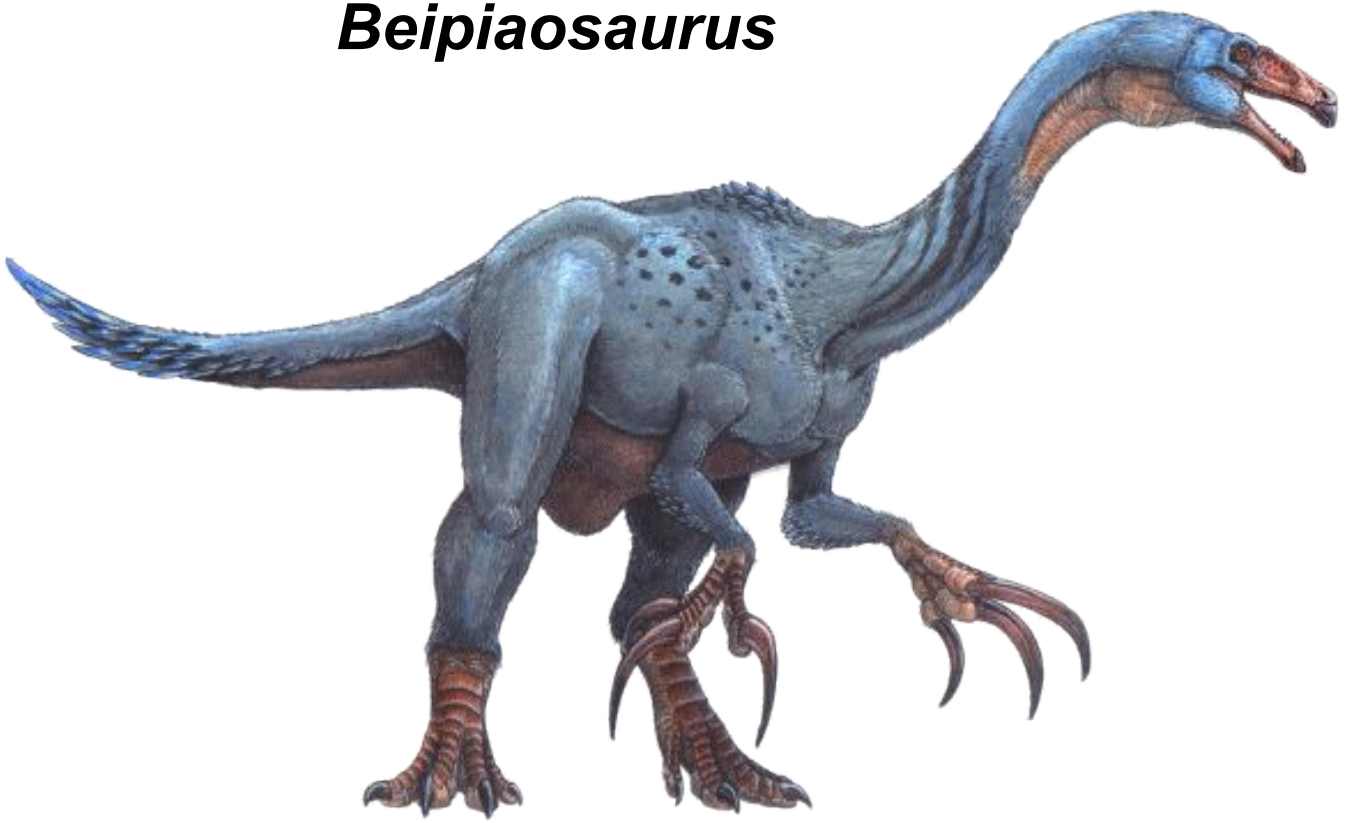

k


l

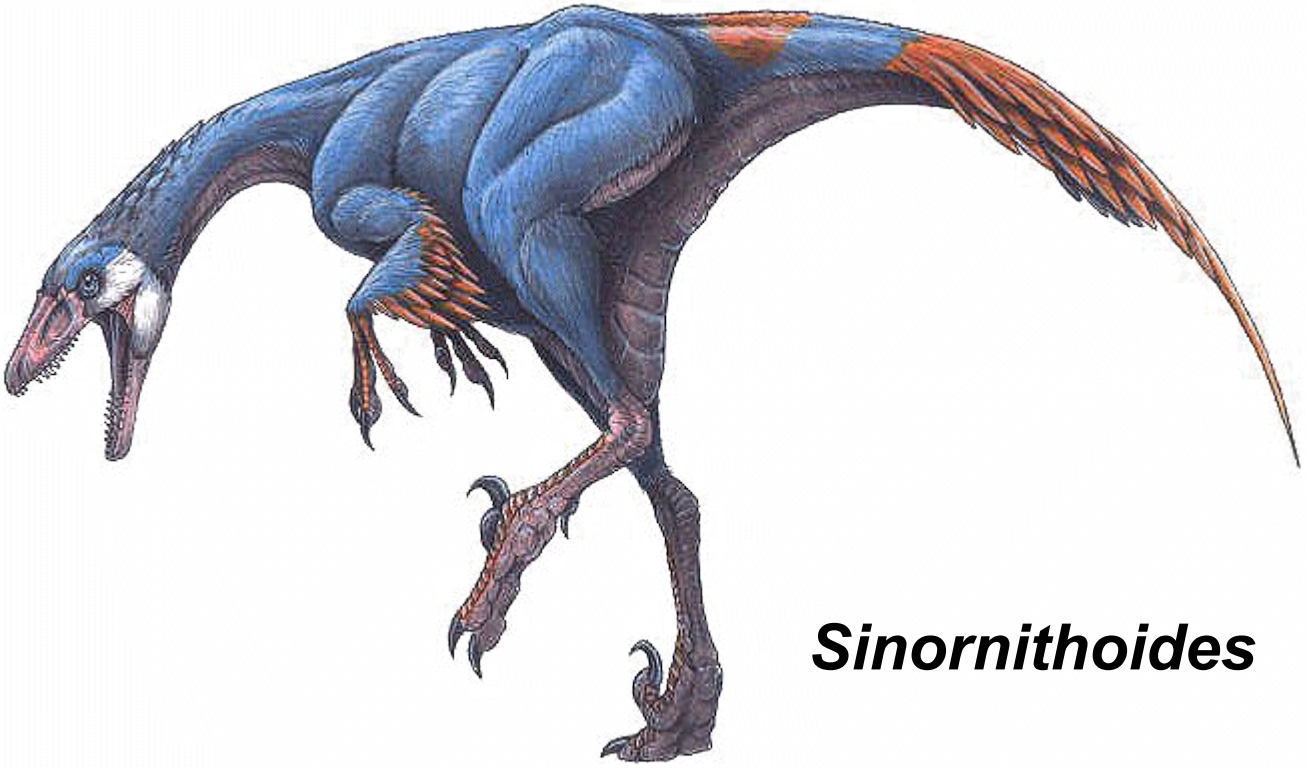


Овираптозавр

Beipiaosaurus



Теризинозаврид

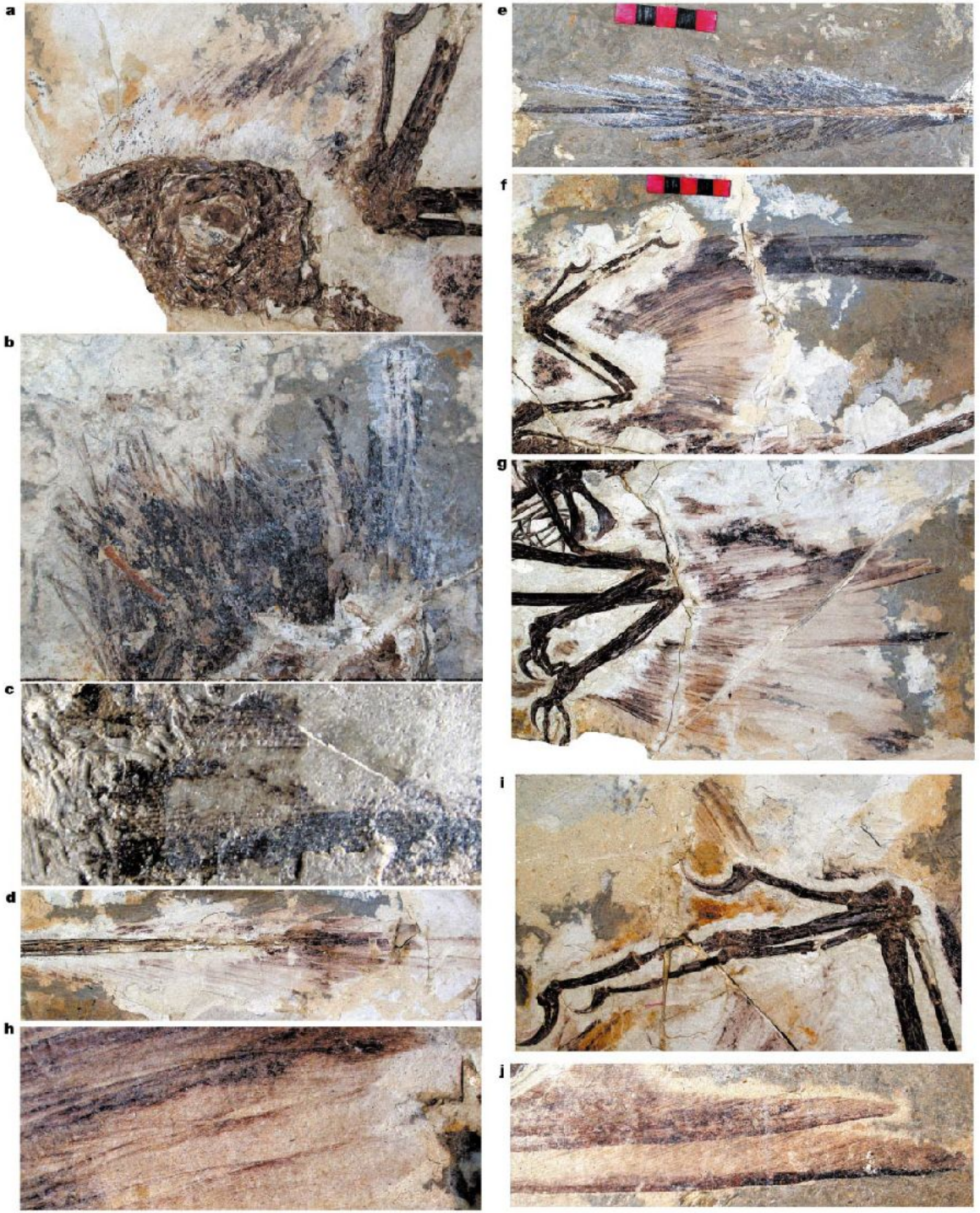


Sinornithoides

Троодонтид

Microraptor gui

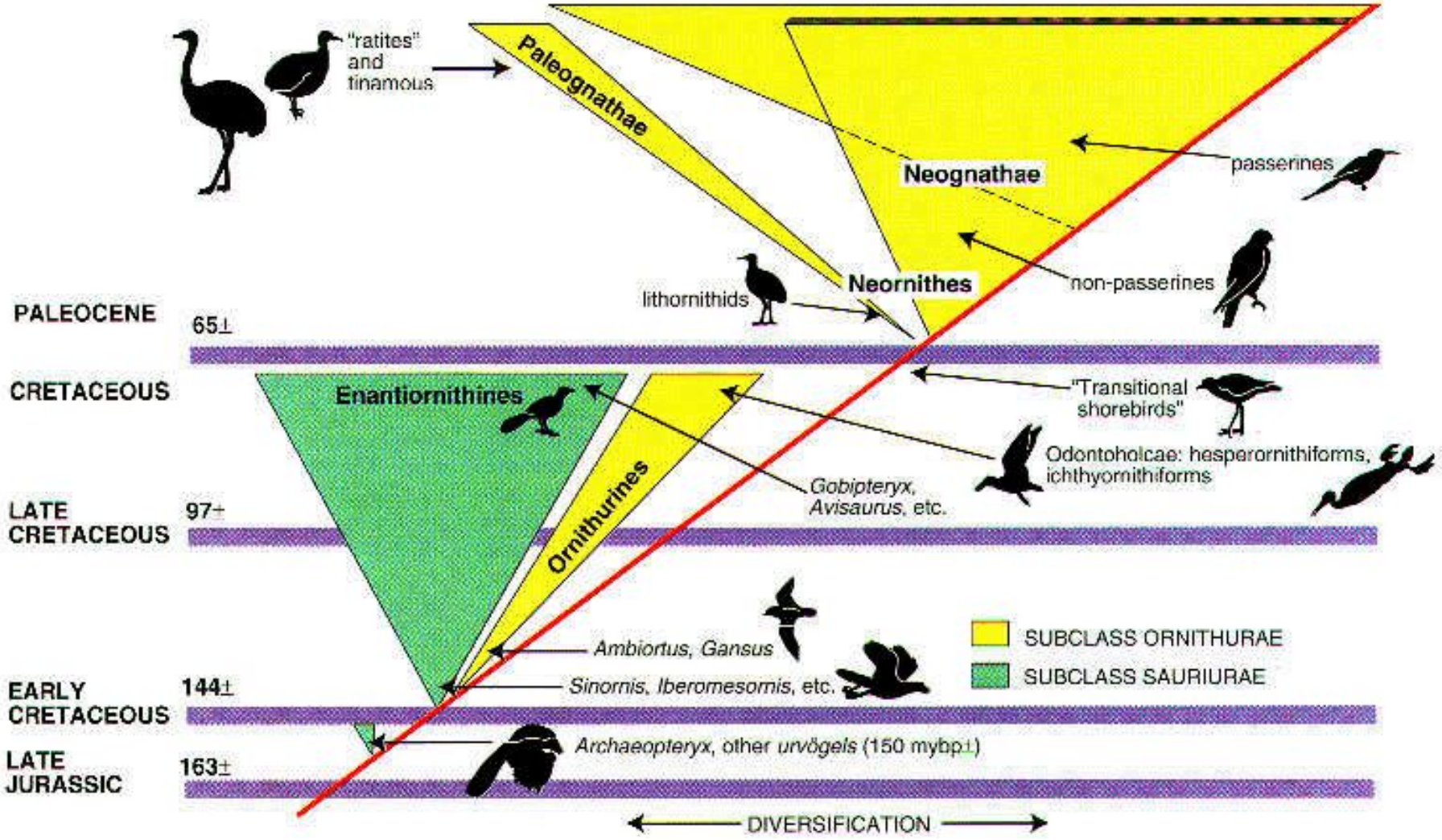
Дромеозаврид


a
b
c
d
h
e
f
g
i
j

Animal		Classification	Characteristics of skin appendage	Shape	Reference
Sinosauropteryx		Theropod Coelurosauria	Filaments (Protofeather), no regional specificity		Chen et al., 1998
Beipiaosaurus		Theropod Therizinosaur	Filaments (Protofeather)		Xu et al., 1999a
Sinusia		Alvarezsaurids	Fibers organized in small clumps	 ?	Schweitzer et al., 1999
Sinornithosaurus		Theropod Dromaeosaur	Filaments, having two types of branching structure, no barbules:	 or 	Xu et al., 1999b; Xu et al., 2001
Microraptor zhaoianus		Theropod Dromaeosaur	Have rachis, true feather?	 ?	Xu et al., 2000
Caudipteryx		Theropod Oviraptorosaur	Different feather tracts. Bilateral symmetric feather in wing and tail. True feather?		Ji et al., 1998
Protarchaeopteryx		Theropod Maniraptora	Bilateral symmetric feather on wing and tail which have rachis, barbs, barbules, body covered plumulaceous feather.		Ji et al., 1998
Unnamed		Theropod Dromaeosaur	Three types of filamentous structure: single fibres, long 'sprays' of fibres and symmetric feather		Ji et al., 2001
Unnamed		Theropod Dromaeosaur	Symmetric feather, have central rachis and symmetric barbs.		Norell et al., 2002
Microraptor gui		Theropod Dromaeosaur	Asymmetric flight feather in both wing and leg. The body was covered by plumulaceous feathers.		Xu et al., 2003
Psittacosaurus		Ceratopsia Psittacosauridae	Long and thick bristle-like, non-branched integumentary structure		Mayr et al., 2002

Кто такой археоптерикс?

Мезозойские группы птиц


"ratites" and tinamous
Paleognathae
Neognathae
passerines
Neornithes
non-passerines
lithornithids
PALEOCENE
65±
CRETACEOUS
Enantiornithines
"Transitional shorebirds"
Ornithurines
Odontoholcae: hesperornithiforms, ichthyornithiforms
Gobipteryx, Avisaurus, etc.
LATE CRETACEOUS
97±
Ambiortus, Gansus
SUBCLASS ORNITHURAE
SUBCLASS SAURIURAE
EARLY CRETACEOUS
144±
Sinornis, Iberomesornis, etc.
Archaeopteryx, other urvögels (150 mybp±)
LATE JURASSIC
163±
DIVERSIFICATION

Энантиорнисы

Гесперорнисы

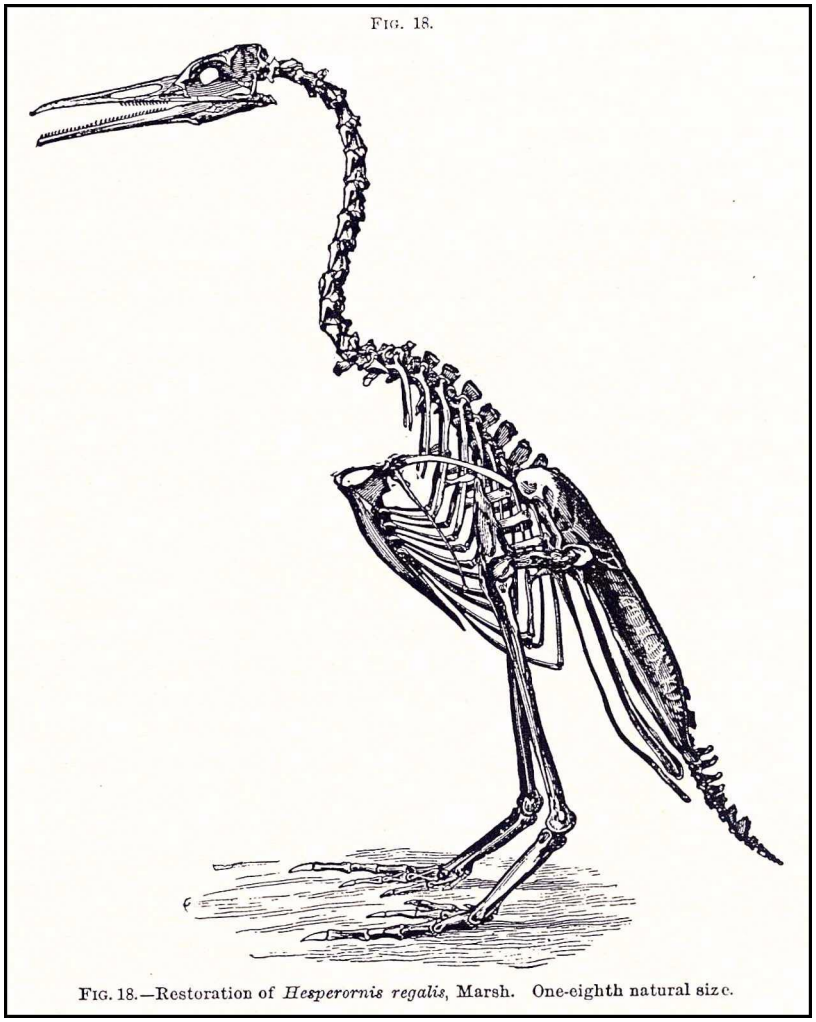
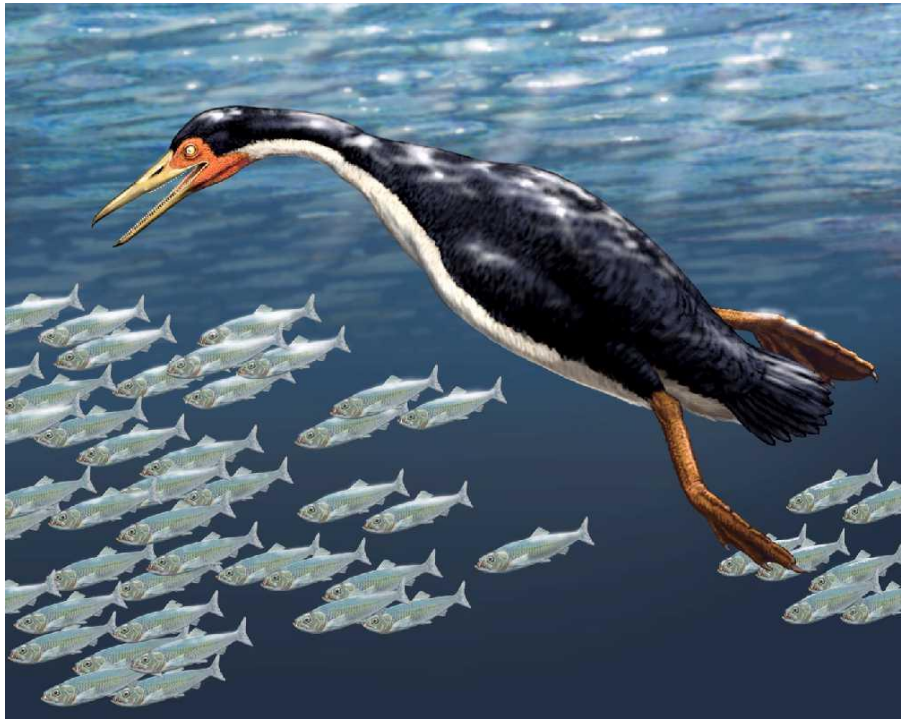
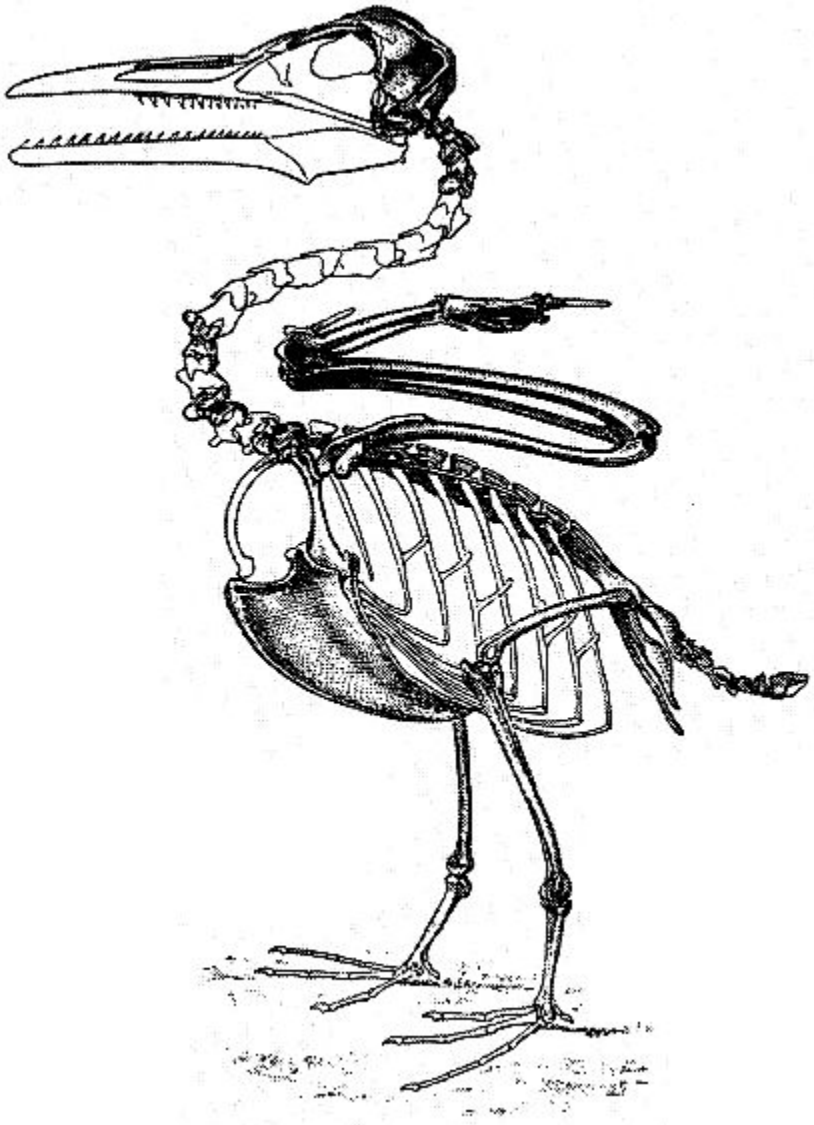


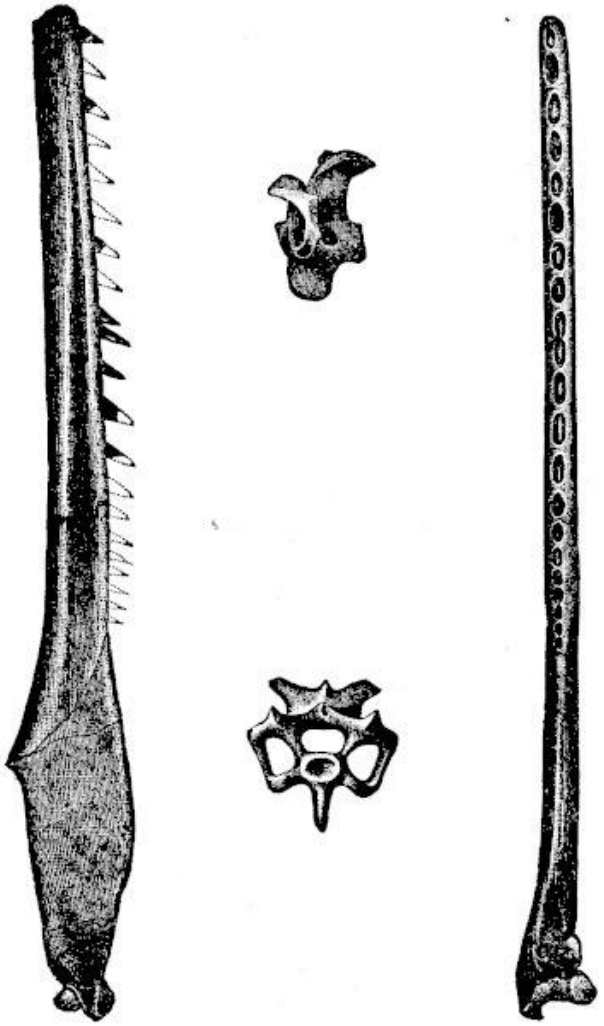
FIG. 18.

FIG. 18.—Restoration of *Hesperornis regalis*, Marsh. One-eighth natural size.



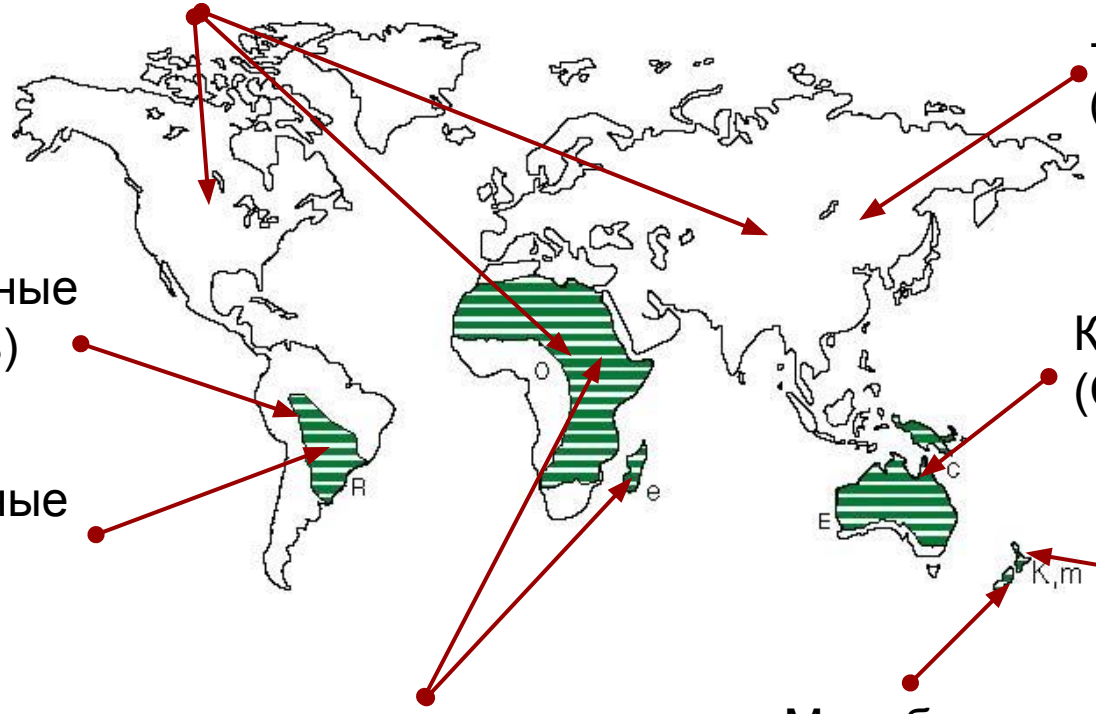
Ихтиорнисы





Надотряд Древненёбные (Palaeognathae)

3 ископаемых, 5 современных отрядов,
25 ископаемых, 12 современных родов,
ранний мел - современность



Страусообразные
(Struthioniformes)

+Амбиортиформы
(Ambiortiformes)

Тинамуобразные
(Tinamiformes)

Казуарообразные
(Casuariiformes)

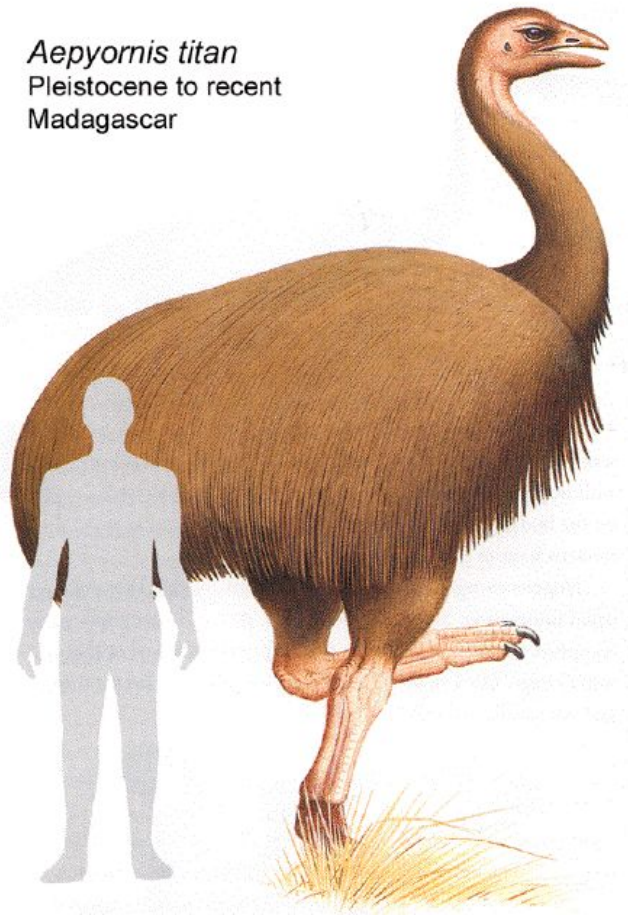
Нандуобразные
(Rheiformes)

Кивиобразные
(Apterygiformes)

+Моаобразные
(Dinornithiformes)

+Эпиорнисобразные
(Aepyornithiformes)

Отряд Эпиорнисобразные (Aepyornithiformes)



Отряд Моаобразные (Dinornithiformes)

Надотряд Новонёбные (Neognathae)

30 отрядов, около 3000 родов,
Поздний мел - современность

«Водные птицы»

Гагарообразные (Gaviiformes)
Поганкообразные (Podicipediformes)
Ржанкообразные (Charadriiformes)
Гусеобразные (Anseriformes)
Журавлеобразные (Gruiformes)
Аистообразные (Ciconiiformes)
Пеликанообразные (Pelecaniformes)
Трубконосые (Procellariiformes)
Пингвинообразные (Sphenisciformes)

«Наземные птицы»

Кукушкообразные (Cuculiformes)
Попугаеобразные (Psittaciformes)
Дневные хищные птицы (Falconiformes)
Курообразные (Galliformes)
Голубеобразные (Columbiformes)
Совообразные (Strigiformes)
Козодоеобразные (Caprimulgiformes)
Стрижеобразные (Apodiformes)
Дятлообразные (Piciformes)
Ракшеобразные (Coraciiformes)
Воробьинообразные (Passeriformes)
и некоторые другие.

Отряд Диатримообразные (Diatrymiformes)

2 рода
Палеоцен – эоцен
С. Америка, Евразия

Diatryma

Пеликанообразные (Pelecaniformes)

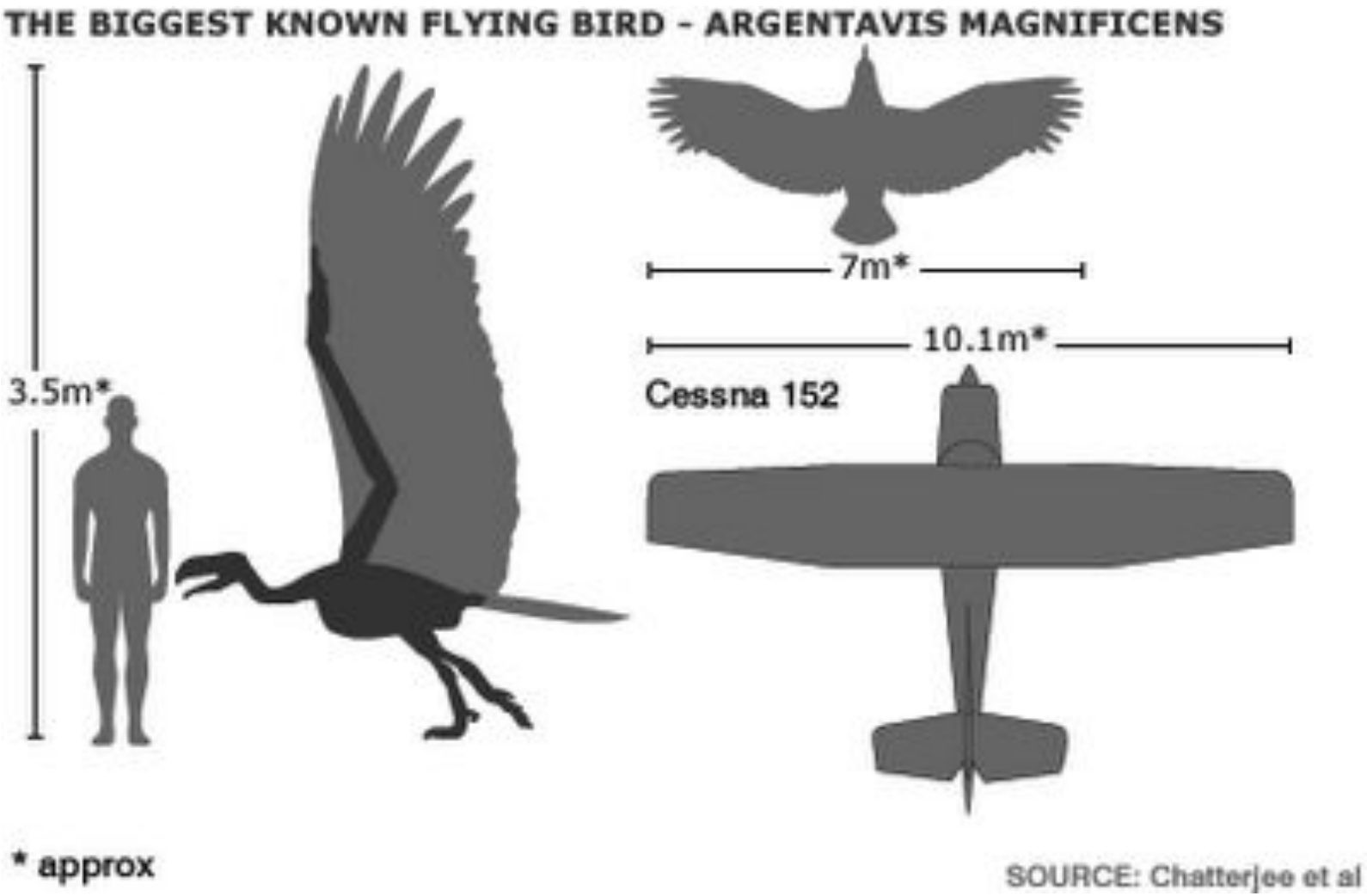
Фороракиды

Phororhacos

Палеоген – неоген
С. Америка, Евразия

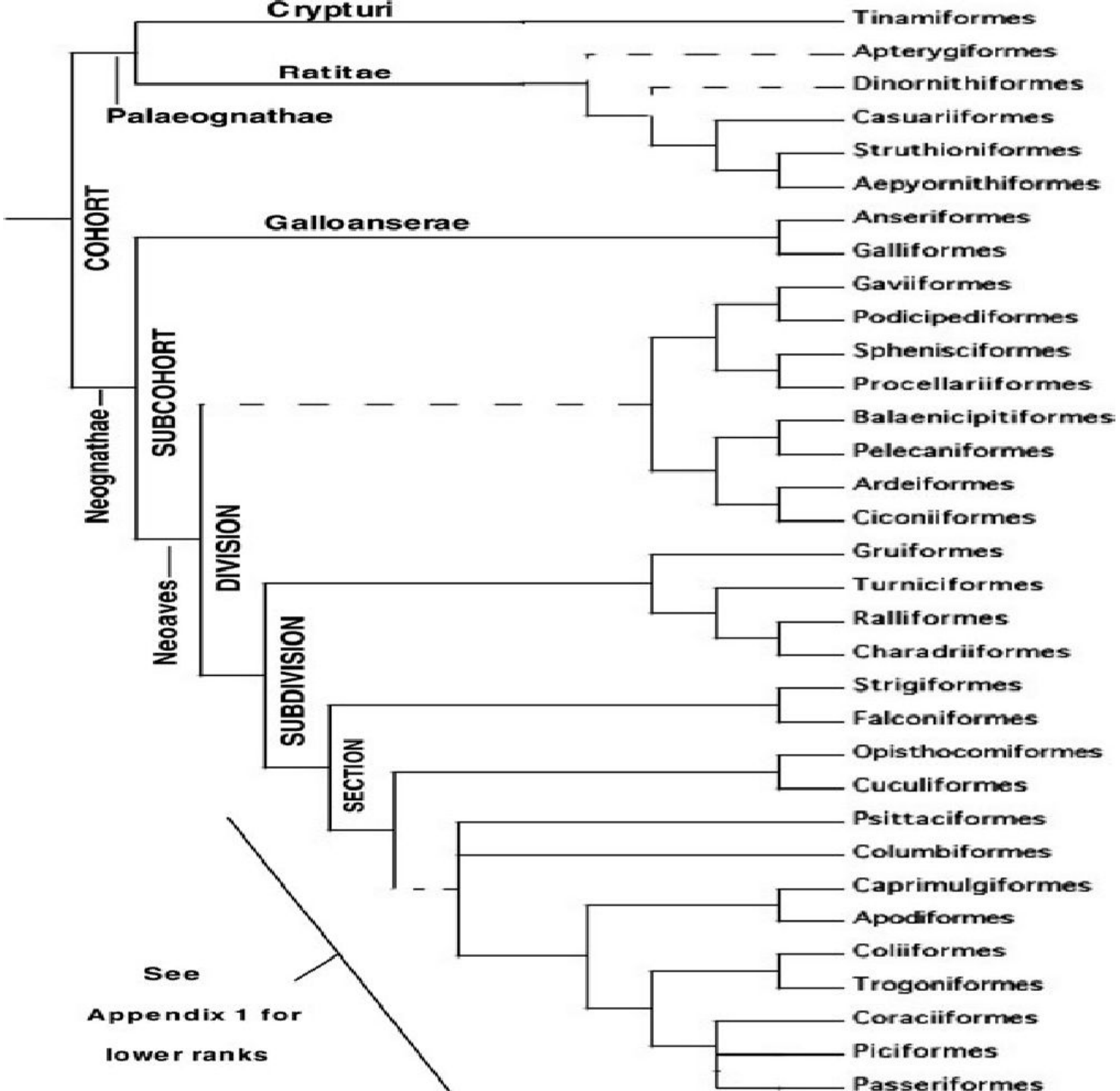
Дневные хищные птицы (Falconiformes)

Американские грифы



Higher-order phylogeny of modern birds (Theropoda, Aves: Neornithes) based on comparative anatomy. II. Analysis and discussion

Zoological Journal of the Linnean Society, 2007, **149**, 1–95.


Crypturi
Tinamiformes
Apterygiformes
Ratitae
Dinornithiformes
Palaeognathae
Casuariiformes
Struthioniformes
Aepyornithiformes
COHORT
Galloanserae
Anseriformes
Galliformes
Gaviiformes
Podicipediformes
SUBCOHORT
Sphenisciformes
Procellariiformes
Neognathae
Balaenicipitiformes
Pelecaniformes
Ardeiformes
Ciconiiformes
DIVISION
Gruiformes
Neoaves
Turniciformes
Ralliformes
Charadriiformes
SUBDIVISION
Strigiformes
Falconiformes
Opisthocomiformes
SECTION
Cuculiformes
Psittaciformes
Columbiformes
Caprimulgiformes
Apodiformes
Coliiformes
Trogoniformes
See
Appendix 1 for
lower ranks
Coraciiformes
Piciformes
Passeriformes