39

REPTILIA

M. J. Benton

The stratigraphical assignments of many of the terrestrial deposits containing fossil reptiles were difficult because of doubtful correlations with the marine standard stages summarized in Harland *et al.* (1982, 1990). This is particularly true for the Carboniferous and Lower Permian. Assignments of the Carboniferous units are based on Carroll (1984) and Milner (1987), and the Lower Permian formations of the south-western United States were dated according to summary tables in Olson and Vaughn (1970), Hentz (1989) and Hook (1989). The stage-level ages of many terrestrial Mesozoic formations were obtained from Weishampel's (1990) compilation on dinosaurian localities, and many Cainozoic ages were based on Savage and Russell's (1983) compilation of mammalian faunas. Note that the Guimarota locality in Portugal is accepted as Oxfordian in age on the basis of several lines of evidence, rather than the oft-quoted Kimmeridgian (see Evans, 1989), although the question is not settled.

Faunal zones in South Africa have been revised recently. The scheme used here (Rubidge, 1992) is:

Eodicynodon–Tapinocaninus Assemblage Zone (= lower part of the *Tapinocephalus* Zone, and lower portion of the Dinocephalian Assemblage Zone of Keyser and Smith (1979)).

Tapinocephalus–Bradysaurus Assemblage Zone (= middle part of the *Tapinocephalus* Zone, and upper portion of the Dinocephalian Assemblage Zone of Keyser and Smith (1979)).

Pristerognathus–Diictodon Assemblage Zone (= 'upper' *Tapinocephalus* Zone).

Tropidostoma–Endothiodon Assemblage Zone (= *Endothiodon* Zone, or *Tropidostoma microtrema* Assemblage Zone of Keyser and Smith (1979)).

Aulacephalodon–Cistecephalus Assemblage Zone (= *Cistecephalus* Zone, or *Aulacephalodon baini* Assemblage Zone of Keyser and Smith (1979)).

Dicynodon–Theriognathus Assemblage Zone (= *Daptocephalus* Zone, or *Dicynodon lacerticeps* Assemblage Zone of Keyser and Smith (1979)).

Lystrosaurus–Procolophon Assemblage Zone (= *Lystrosaurus* Zone).

Cynognathus–Diademodon Assemblage Zone (= *Cynognathus* Zone, or *Kannemeyeria* Assemblage Zone of Keyser and Smith (1979)).

Paraphyletic taxa are indicated by (p).

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Series AMNIOTA

AMNIOTA *incertae sedis*

F. UNNAMED C. (VIS) Terr. (see Fig. 39.1)

First and Last: *Westlothiana lizziae* Smithson and Rolfe, 1991, East Kirkton Limestone, Brigantian, West Lothian, Scotland, UK.

Comment: This specimen is said to be the oldest reptile, but the preliminary description (Smithson, 1989) did not indicate a familial assignment.

F. BOLOSAURIDAE Cope, 1878

P. (ART–KAZ) Terr.

First: *Bolosaurus striatus* Cope, 1878, lower Wichita Beds, Texas, USA.

Last: *Davletkulia gigantea* Ivakhnenko, 1990, upper KAZ, Davletkulovo settlement, right bank of Yaman-Yushatyr' River, Bashkirian, former USSR (Ivakhnenko, 1990).

F. ACLEISTORHINIDAE Daly, 1969

P. (ART) Terr.

The Fossil Record 2. Edited by M. J. Benton. Published in 1993 by Chapman & Hall, London. ISBN 0 412 39380 8

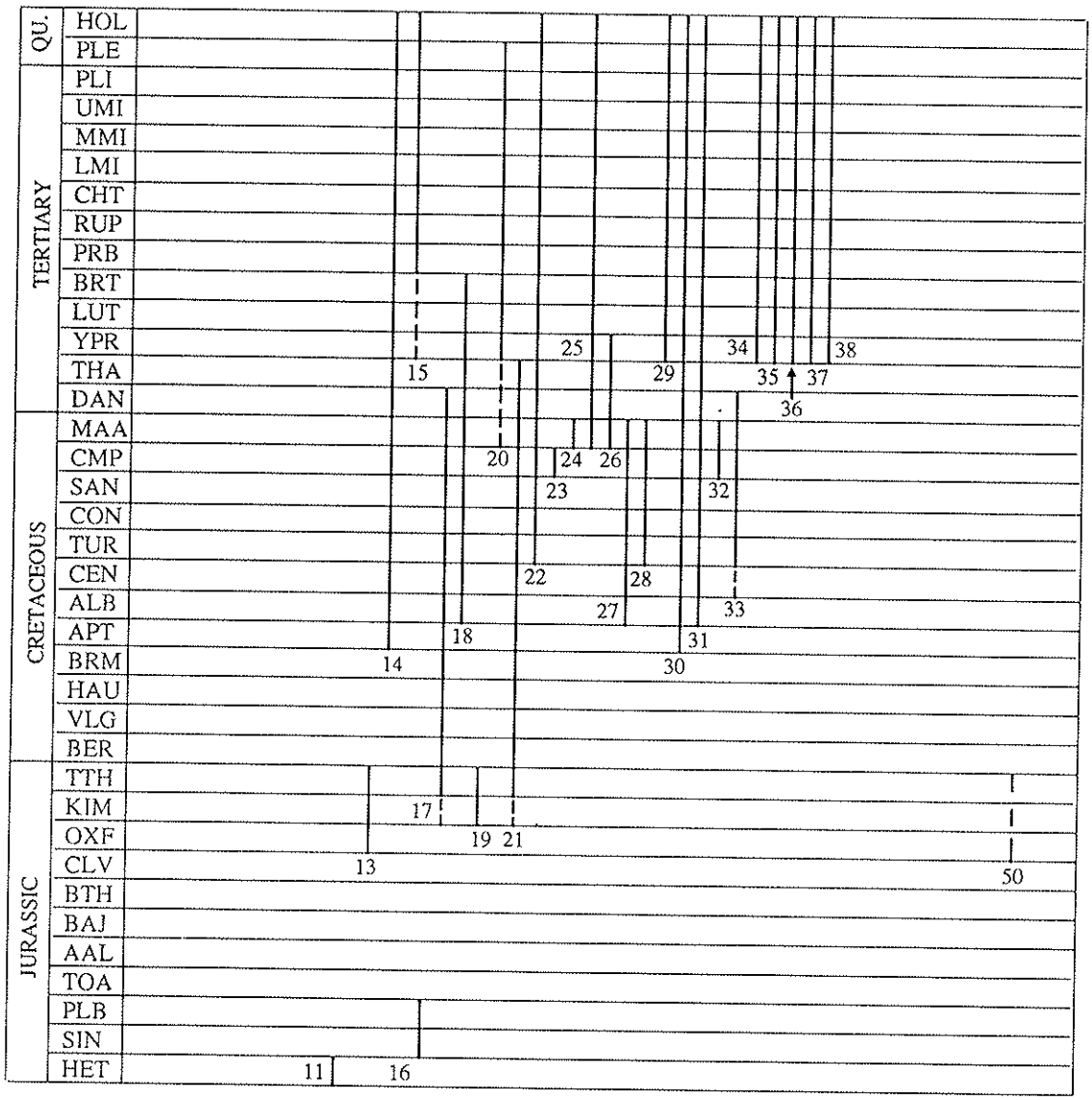

Fig. 39.1

First and Last: *Acleistorhinus pteroticus* Daly, 1969, Garber Formation, Oklahoma, USA.

F. EUNOTOSAURIDAE Romer, 1956
P. (UFI) Terr.

First and Last: *Eunotosaurus africanus* Seeley, 1892, Abrahamskraal Formation, *Tapinocephalus-Bradysaurus* Assemblage Zone, Beaufort West, Karoo Basin, South Africa.

Class REPTILIA Laurenti, 1768 (p)

Subclass ANAPSIDA Williston, 1917

The Procolophonidae have been proposed (Reisz and Laurin, 1991) as the closest known sister group of the Testudines. The Nyctiphruretidae are generally reckoned to be close relatives of the Procolophonidae, so they are placed here. The Captorhinidae were earlier (Gaffney and McKenna, 1979) proposed as turtle relatives, but Reisz and Laurin (1991) regard them as more distant than the procolophonids.

General information on the stratigraphical distribution of early anapsids was obtained from Kuhn (1969) and Anderson and Cruickshank (1978). The Mesosauridae, Millerettidae, Procolophonidae and Pareiasauridae were tentatively included in a new clade 'Parareptilia' by Gauthier et al. (1988). However, the Procolophonidae have been removed to the Anapsida, as a close sister group of the Testudines (Reisz and Laurin, 1991), and the Pareiasauridae and others may follow suit (P. S. Spencer, pers. comm., 1993).

F. MESOSAURIDAE Baur, 1889 P. (ART) Mar.

First and Last: *Mesosaurus tenuidens* Gervais, 1865, White Band, Ecca Group, South Africa, White Band equivalent, south-western Africa, and Irati Formation, Passa Dois Group, Paraná Basin, Brazil.

F. MILLERETTIDAE Romer, 1956
P. (KAZ–TAT) Terr.

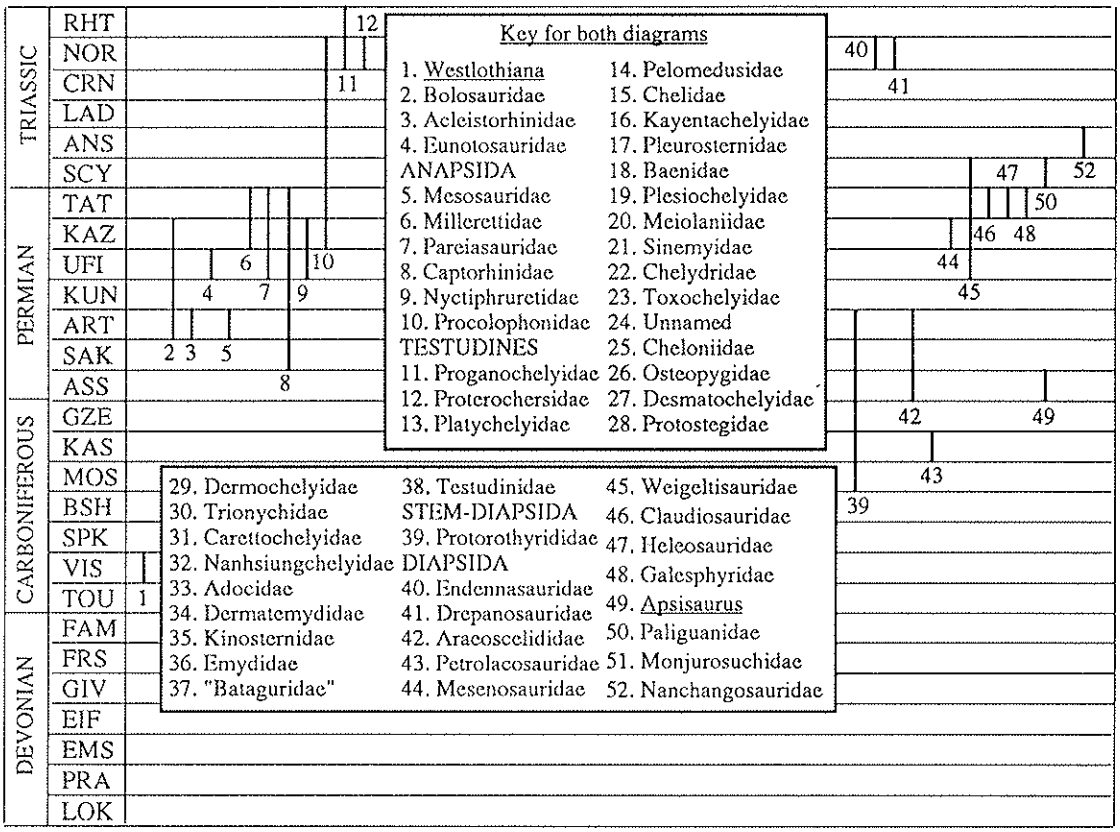

Fig. 39.1

First: *Broomia perplexa* Watson, 1914, *Tapinocephalus–Bradysaurus* Assemblage Zone, Karoo Basin, South Africa.
Last: *Milleretta rubidgei* Broom, 1938, and three or four other possible species, *Aulacephalodon–Cistecephalus* Assemblage Zone, Karoo Basin, South Africa.

F. PAREIASAURIDAE Cope, 1896
P. (UFI–TAT) Terr.

First: ?*Rhiphaeosaurus tricuspidens* Efremov, 1940, *Leptoropha novojilovi* Chudinov, 1955 and *Parabradysaurus udmurticus* Efremov, 1954, all from Zone II, Bashkir Republic and Kirov Province, former USSR.
Last: *Pareiasaurus serridens* Owen, 1876, *Dicynodon–Theriognathus* Assemblage Zone of the Karoo Basin, South Africa, and several other species from that formation, and equivalents, in the former USSR, China and Scotland, UK.
Intervening: KAZ.

F. CAPTORHINIDAE Case, 1911
P. (SAK–TAT) Terr.

First: *Romeria primus* Clark and Carroll, 1973, Moran Formation, Wichita Group, Archer County, Texas, USA (Clark and Carroll, 1973).
Last: *Moradisaurus grandis* Ricqlès and Taquet, 1982, Moradi Formation, Niger, and *Protocaptorhinus* sp., Middle Madumabisa Mudstones, Middle Zambezi Basin, Zimbabwe (Gaffney and McKenna, 1979).
Intervening: ART–KAZ.

F. NYCTIPHRURETIDAE Efremov, 1938
P. (UFI–KAZ) Terr.

First: *Nyctiphruretus acudens* Efremov, 1938, Zone III, Mesen district, former USSR.
Last: *Barasaurus besairiei* Piveteau, 1955, ?uppermost Permian, Madagascar.
Comment: It has been assumed that nyctiphruretids and procolophonids are related, but the material is poorly known. *Nyctiphruretus* may be related to procolophonids, but *Barasaurus* shows no clear affinities (P. S. Spencer, pers. comm., 1992).

F. PROCOLOPHONIDAE Cope, 1889
P. (KAZ)–Tr. (NOR) Terr.

First: *Owenetta rubidgei* Broom, 1939, *Aulacephalodon–Cistecephalus* Assemblage Zone, South Africa.
Last: *Hypsognathus fenneri* Gilmore, 1928, upper Passaic Formation, New Jersey and Pennsylvania, USA.
Intervening: ANS–CRN.
Comment: *Sphodrosaurus pennsylvanicus* Colbert, 1960, also upper Passaic Formation, New Jersey and Pennsylvania, USA, seems to be a diapsid, while the RHT or latest NOR 'procolophonoid' described by Cuny (1991) from the St Nicolas de Port locality in France is incorrectly identified (P. S. Spencer, pers. comm., 1992).

Order TESTUDINES Batsch, 1788

The classification of turtles used here is based on that of Gaffney and Meylan (1988), and information on stratigraphical distributions comes from Młynarski (1976), de Broin (1988) and Gaffney (1990). Authors of familial names are based on those authors, with corrections from Bour and Dubois (1984).

F. PROGANOCHELYIDAE Baur, 1888
Tr. (NOR)–J. (HET) Terr./FW

First: *Proganochelys quenstedtii* Baur, 1887, Mittlere and Obere Stubensandstein, Baden-Württemberg and Halberstadt, Germany.
Last: Unnamed proganochelyid, upper Elliot Formation (Red Beds), Orange Free State, South Africa (Gaffney, 1986).
Comment: The age of *P. ruchae* is assumed to be equivalent to the German formations, but that is not certain.

Suborder PLEURODIRA Cope, 1868

F. PROTEROCHERSIDAE Nopcsa, 1928
Tr. (NOR) Terr./FW

First and Last: *Proterochersis robusta* E. Fraas, 1913, Untere Stubensandstein, Baden-Württemberg, Germany.

F. PLATYCHELYIDAE Bräm, 1965
J. (OXF–TTH) FW/Terr.

First: cf. *Platychelys* sp., Oxfordian (formerly, Kimmeridgian), Guimarota Mine, Leiria, Portugal.
Last: *Platychelys oberndorferi* A. Wagner, 1853, Solothurn, Switzerland.
Intervening: KIM.

F. PELOMEDUSIDAE Cope, 1868
K. (APT)–Rec. FW/Mar.

First: *Araripemys barretoi* Price, 1975, Santana Formation, Ceará, Brazil. **Extant**
Intervening: ALB–PLE (de Broin, 1988).
Comment: Following Gaffney and Meylan (1988), the podocnemines and bothremydines are included here in the Pelomedusidae. Other authors, however, maintain the Podocnemididae Baur, 1888 (ALB–Rec) and Bothremydidae Baur, 1891 (ALB–YPR) as separate families (Antunes and de Broin, 1988; de Broin, 1988).

F. CHELIDAE Lindholm, 1929 (Gray, 1825)
T. (Eoc.)–Rec. FW

First: Unnamed form, Eocene, Tasmania, Australia (Gaffney, 1992). **Extant**
Intervening: ?THA, PRB, CHT, LAN–PLE (de Broin, 1988).
Comment: The oldest records of chelids given by de Broin (1988) are based on indeterminate material of uncertain age. The next oldest chelids noted by de Broin (1988, p. 136) are several species from the Campanian (Upper Cretaceous) and Palaeocene of Chubut Province, Argentina, but Gaffney (pers. comm.) regards these as pelomedusids. De Broin (1988, p. 138) also notes the chelid *Hydromedusa* sp. Wagler 1830, from the Upper Eocene of Chubut Province, Argentina. Gaffney (1975, 1990) indicates that the oldest chelid is Eocene.

Suborder CRYPTODIRA Cope, 1868

Infra-order STEM SELMACRYPTODIRES

F. KAYENTACHELYIDAE Gaffney *et al.*, 1987
J. (SIN/PLB) Terr./FW

First and Last: *Kayentachelys aprix* Gaffney *et al.*, 1987, Kayenta Formation, Coconino County, Arizona, USA (Gaffney *et al.*, 1987).

Infra-order SELMACRYPTODIRA Gaffney *et al.*, 1987

Superfamily PLEUROSTERNOIDEA Romer, 1956

F. PLEUROSTERNIDAE Cope, 1868
J. (KIM/TTH)–T. (DAN) Mar./FW

First: *Glyptops plicatulus* (Cope, 1877), Morrison Formation, Colorado, USA (Gaffney, 1979).
Last: *Compsemys victa* Leidy, 1859, Torrejonian, San Juan Basin, New Mexico, USA (Hutchison, 1987).
Intervening: BER, MAA.

Superfamily BAENOIDEA Williams, 1950

F. BAENIDAE Cope, 1882 K. (ALB)–T. (BRT) FW

First: *Trinitichelys hiatti* Gaffney, 1972, Trinity Sand, Trinity Group, Montague County, Texas, USA.
Last: *Chisternon undatum* (Leidy, 1871) and *Baena arenosa* Leidy, 1870, both with types from the Bridger Formation of Wyoming and Utah, but latest records from the Uinta Formation of Utah, USA (Gaffney, 1972).
Intervening: CMP–LUT.

Infra-order STEM POLYCRYPTODIRES

F. PLESIOCHELYIDAE Rütimeyer, 1873
J. (KIM–TTH) Mar.

First: *Plesiochelys etalloni* (Pictet and Humbert, 1857), Kimmeridgian, Solothurn, and other localities, Switzerland (Gaffney, 1975).
Last: *Portlandemys mcdowelli* Gaffney, 1975, Portland Stone, Dorset, England, UK (Gaffney, 1975).

F. MEIOLANIIDAE Lydekker, 1887
K. (MAA?)–Q. (PLE) Terr.

First: *Niolamia argentina* Ameghino, 1899, Upper Cretaceous? (Młynarski, 1976, p. 119), 'Pre-Oligocene, Post-Jurassic' (Gaffney, 1981, p. 20), Patagonia, Argentina.
Last: *Meiolania platyceps* Owen, 1881, *M. mackayi* Anderson, 1925, and *M. oweni* Woodward, 1888, Pleistocene of Lord Howe Island, Walpole Island (New Caledonia), and Queensland and New South Wales, Australia, respectively (Gaffney, 1981).
Intervening: YPR?, MMI.

Infra-order POLYCRYPTODIRA Gaffney and Meylan, 1988

F. SINEMYIDAE Wiman, 1930
J. (KIM?)–T. (THA) FW

First: *Sinemys lens* Wiman, 1930, Upper Jurassic, China.
Last: *Protochelydra zangerli* Erickson, 1973, Tongue River Formation, Billings County, North Dakota, USA (Erickson, 1973).
Intervening: TTH, APT, ALB, CMP, MAA (?) (Ckhikvadzé, 1988).

Superfamily CHELYDROIDEA Gaffney and Meylan, 1988

F. CHELYDRIDAE Gray, 1831 K. (TUR)–Rec. FW

First: Unnamed forms, Turonian, North America (Hutchison and Archibald, 1986). **Extant**
Intervening: CON–PLE.

Superfamily CHELONIOIDEA Baur, 1889

F. TOXOCHELYIDAE Baur, 1895 K. (CMP) Mar.

First and Last: *Toxochelys latiremis* Cope, 1873, Niobrara Formation, Kansas, USA.

F. UNNAMED K. (MAA) Mar.

First and Last: *Ctenochelys tenuitesta* Zangerl, 1953 and *C. acris* Zangerl, 1953, Selma Formation, Alabama, USA.

F. CHELONIIDAE Oppel, 1811 T. (MAA)–Rec. Mar.

First: *Dollochelys ('Toxochelys') atlantica* (Zangerl, 1953), Hornerstown Formation, Gloucester County, New Jersey, USA. **Extant**
Intervening: DAN–PLE.

F. OSTEOPYGIDAE Zangerl, 1953 K. (MAA)–T. (YPR) Mar.

First: *Osteopygis emarginatus* Cope, 1868, Hornerstown Formation, Gloucester County, New Jersey, USA.
Last: *Erquelinnesia gosseleti* (Dollo, 1886), Erquelinnes Sands, Upper Landenian and Sparnacian, Belgium.
Intervening: ?DAN.

F. DESMATOCHELYIDAE Gaffney, 1990 K. (ALB–MAA) Mar.

First: *Notochelone costata* (Owen, 1882), Toolebuc Formation, Flinders River, Queensland, Australia (Gaffney, 1981).
Last: *Desmatochelys lowi* Williston, 1898, Benton Group, Nebraska and South Dakota, USA (Zangerl and Sloan, 1960).
Intervening: CMP.

F. PROTOSTEGIDAE Cope, 1889 K. (TUR–MAA) Mar.

First: *Protostega eaglefordensis* Zangerl, 1953, Eagle Ford Shale, McLennan County, Texas, USA (Zangerl, 1953).
Last: *Pneumatoarthrus peloreus* Cope, 1870, ?Hornerstown Formation, Monmouth County, New Jersey, USA (Baird, 1978).
Intervening: SAN, CMP.

F. DERMOCHELYIDAE Baur, 1888 T. (YPR)–Rec. Mar.

First: *Eosphargis gigas* (Owen, 1861), London Clay, Kent, England, UK. **Extant**
Intervening: LUT-PLE.

Superfamily TRIONYCHOIDEA Gray, 1870

F. TRIONYCHIDAE Fitzinger, 1826 K. (APT)–Rec. FW/Terr.

First: Oldest trionychids, Aptian/Albian of Inner Mongolia, China (Nessov, 1988, pp. 9–10). **Extant**
Intervening: CEN, CMP–PLE.

F. CARETTOCHELYIDAE Boulenger, 1887 K. (ALB)–Rec. FW/Terr.

First: *Kizylkumemys* sp., lower or middle Chodzhakul Formation, Chodzhakul Lake, Kazakhstan, former USSR (Nessov, 1985). **Extant**
Intervening: CEN, YPR–PRB, PLE.
Comment: *Kizylkumemys schultzi* Nessov, 1977, was described from the upper part of the Chodzhakul Formation, dated as CEN, but Nessov (1985) notes older indeterminate specimens of this genus from older parts of the same formation.

F. NANHSIUNGCHELYIDAE Yeh, 1966 K. (CMP–MAA) Terr./FW

First: *Nanhsiungchelys wuchingensis* Yeh, 1966, Nanxiong Formation, Guandong, China, and *Zangerlia testudininorpha* Młynarski, 1972, lower Nemegt Formation, Nemegt Basin, Gobi Desert, Mongolia, both late CMP to MAA in age (Meylan and Gaffney, 1989; Weishampel, 1990).
Last: *Basilemys sinuosa* Riggs, 1906, Hell Creek Formation, Montana, USA.

F. ADOCIDAE Cope, 1870 K. (CEN/TUR)–T. (DAN) FW/Terr.

First: *Adocus amtgai* Narmandakh, 1985, upper Bainshireinskaya Formation, Amtgay, eastern Gobi, Mongolia (Narmandakh, 1985).
Last: *Adocus onerosus* Gilmore, 1919, Nacimiento Formation, Torrejonian, San Juan Basin, New Mexico, USA.
Intervening: CMP, MAA.

F. DERMATEMYDIDAE Gray, 1870 T. (YPR)–Rec. Terr./FW

First: *Baptemys tricarinata* Hay, 1908, Wind River Formation, Wasatchian, Wyoming, USA (Hutchison, 1980). **Extant**
Intervening: LUT, BRT, LMI.

F. KINOSTERNIDAE Gray, 1869 T. (YPR)–Rec. Terr./FW

First: *Baltemys staurogastros* Hutchison, 1991, Willwood Formation, Wasatchian, Wyoming, USA. **Extant**
Intervening: PLI, PLE.
Comments: Earlier records of supposed MAA kinosternids are given by Hutchison and Archibald (1986).

Superfamily TESTUDINOIDEA Baur, 1893

F. EMYDIDAE Gray, 1825 T. (YPR)–Rec. Terr./FW

First: *Chrysemys bicarinata* (Bell, 1849) and *C. testudiniformis* (Owen, 1844), London Clay, Kent, England, UK. **Extant**
Intervening: LUT–PLE.
Comment: Hutchison (pers. comm., 1991) notes that these European forms could be batagurids, and that all Eocene records of *Chrysemys* are in question.

F. 'BATAGURIDAE' Gray, 1869 T. (YPR)–Rec. Terr./FW

First: *Echmatemys testudinea* (Cope, 1872), Wasatch Formation, Wyoming, USA. **Extant**
Intervening: LUT–PLE.

F. TESTUDINIDAE Batsch, 1788 T. (YPR)–Rec. Terr.

First: *Hadrianus majusculus* Hay, 1904, Willwood and Wasatch Formations, Wasatchian, Wyoming, USA. **Extant**

Intervening: LUT–PLE.

STEM DIAPSIDA

F. PROTOROTHYRIDIDAE Price, 1937
C. (VRK)–P. (ART) Terr.

First: *Hylonomus lyelli* Dawson, 1860, Cumberland Group, Joggins, Nova Scotia, Canada.
Last: Unnamed protorothyridid, Arroyo Formation, Clear Fork Group, Fort Sill, Oklahoma, USA (Reisz, 1980).
Intervening: POD, MYA, ASS.

Subclass DIAPSIDA Osborn, 1903

The classification of early diapsids is based on Benton (1985), Evans (1988) and Laurin (1991). Stratigraphical ranges are taken from papers cited by those authors, as well as Kuhn (1969) and Anderson and Cruickshank (1978), as well as more recent references cited.

DIAPSIDA *incertae sedis*

F. ENDENNASAURIDAE Carroll, 1987
Tr. (NOR) Terr.

First and Last: *Endennasaurus acutirostris* Renesto, 1984, Calcare di Zorzino, Bergamo, Italy (Renesto, 1984).

F. DREPANOSAURIDAE Carroll, 1987
Tr. (NOR) Terr.

First and Last: *Drepanosaurus unguicaudatus* Pinna, 1980, Calcare di Zorzino, Bergamo, Italy (Pinna, 1980).

Order ARAEOSCELIDIA Williston, 1913

F. ARAEOSCELIDIDAE Williston, 1910
P. (ASS–ART) Terr.

First: *Zarcasaurus tanyderus* Brinkman *et al.*, 1984, Cutler Formation, Rio Arriba County, New Mexico, USA (Brinkman *et al.*, 1984).
Last: *Araeoscelis gracilis* Williston, 1910, Arroyo Formation, Clear Fork Group, Baylor County, Texas, USA.

F. PETROLACOSAURIDAE Peabody, 1952
C. (KAS) Terr.

First and Last: *Petrolacosaurus kansensis* Lane, 1945, Stanton Formation, Lansing Group, Garnett, Kansas, USA.

STEM-GROUP NEODIAPSIDA

F. MESENOSAURIDAE Romer, 1956
P. (KAZ) Terr.

First and Last: *Mesenosaurus romeri* Efremov, 1940, Zone II, Mezen' River, Archangel Province, former USSR.

F. WEIGELTISAURIDAE Romer, 1933
P. (UFI)–Tr. (SCY) Terr.

First: *Weigeltisaurus jaekeli* (Weigelt, 1930), Kupferschiefer, Hesse, Germany; Marl Slate, Durham, England, UK.
Last: *Wapitisaurus problematicus* Brinkman, 1988, Vega-Phroso Member, Sulphur Mountain Formation, British Columbia, Canada (Brinkman, 1988).
Intervening: KAZ.

F. CLAUDIOSAURIDAE Carroll, 1981
P. (TAT) FW

First and Last: *Claudiosaurus germaini* Carroll, 1981, upper part of the Lower Sakamena Formation, Leoposa, Madagascar.

?F. HELEOSAURIDAE Haughton, 1924
P. (TAT) Terr.

First and Last: *Heleosaurus scholtzi* Broom, 1907, *Aulacephalodon–Cistecephalus* Assemblage Zone, Victoria West, Karoo Basin, South Africa.

?F. GALESPHYRIDAE Currie, 1981 P. (TAT) Terr.

First and Last: *Galesphyrus capensis* Broom, 1914, *Aulacephalodon–Cistecephalus* Assemblage Zone, Cape Province, South Africa.

F. UNNAMED P. (ASS) Terr.

First and Last: *Apsisaurus witteri* Laurin, 1991, Archer City bone bed, Archer City Formation, Wichita Group, lower Wolfcampian, Archer County, Texas, USA (Laurin, 1991).

Infraclass NEODIAPSIDA Benton, 1985

NEODIAPSIDA *incertae sedis*

F. PALIGUANIDAE Broom, 1926 Tr. (SCY) Terr.

First and Last: *Paliguana whitei* Broom, 1903, *?Lystrosaurus–Procolophon* Assemblage Zone, Tarkastad, Karoo Basin, South Africa.

?F. MONJUROSUCHIDAE Endo, 1940 J. (u) Terr.

First and Last: *Monjurosuchus splendens* Endo, 1940, Chiufotang Formation, Lingyung Basin, Manchuria, China.

F. NANCHANGOSAURIDAE Wang, 1959
Tr. (ANS) Mar.

First and Last: *Nanchangosaurus suni* Wang, 1959 and *Hupehsuchus nanchangensis* Young and Dong, 1972, Jialingjiang Formation and Daye Limestone, Hubei Province, China (Carroll and Dong, 1991).

Division YOUNGINIFORMES Romer, 1933

F. UNNAMED P. (TAT) Terr. (see Fig. 39.2)

First and Last: *Acerosodontosaurus piveteaui* Currie, 1980, lower Sakamena Formation, Sakamena River Valley, Madagascar.

F. YOUNGINIDAE Broom, 1914 P. (TAT) Terr.

First and Last: *Youngina capensis* Broom, 1914, *Dicynodon–Theriognathus* Assemblage Zone, New Bethesda, Karoo Basin, South Africa.

F. TANGASAURIDAE Camp, 1945
P. (TAT)–Tr. (SCY) FW

First: *Hovasaurus boulei* Piveteau, 1926 and *Thadeosaurus colcanapi* Carroll, 1981, Lower Sakamena Formation, Benenitra to Ranohira region, Madagascar; *Tangasaurus mennelli* Haughton, 1924, 'Upper Permian', Tanga, Tanzania.
Last: *Kenyasaurus mariakaniensis* Harris and Carroll, 1977, Maji ya Chumvi Beds, lower Middle Duruma Sandstone Series, Mariakani, Kenya.

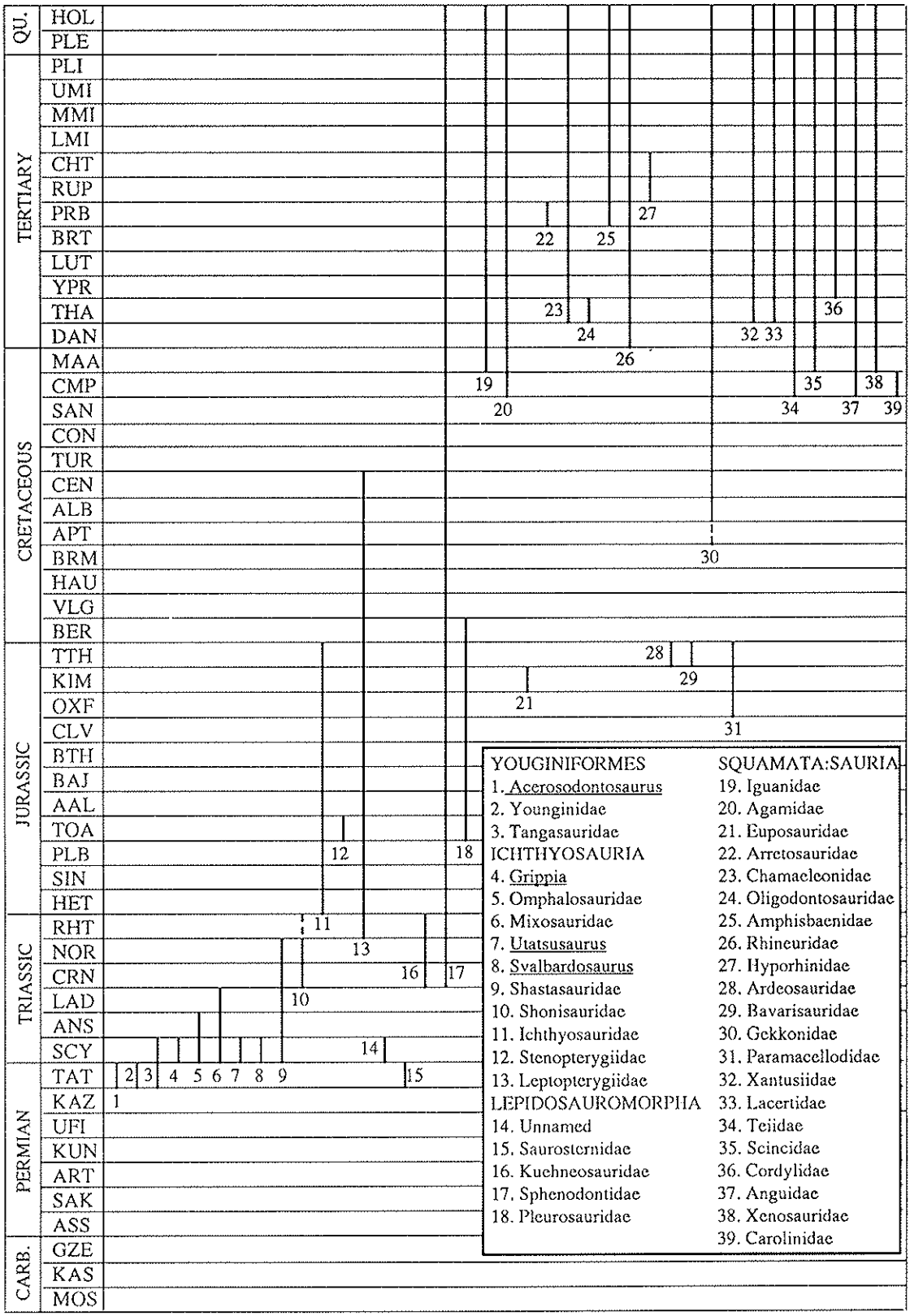

Fig. 39.2

Order ICHTHYOSAURIA de Blainville, 1835

Ichthyosaur classification and stratigraphical distributions are taken from Mazin (1982, 1988) and Massare and Callaway (1990), but there has been no recent comprehensive phylogenetic analysis of the group, and the families are rather fluid in composition. Massare and Callaway (1990) argue that the ichthyosaurs are closely related to the younginiforms.

F. UNNAMED Tr. (SCY) Mar.

First and Last: *Grippia longirostris* Wiman, 1928, Sticky Keep Formation (Spathian), Svalbard, Spitsbergen.

F. OMPHALOSAURIDAE Merriam, 1906
Tr. (SCY–ANS) Mar.

First: *Omphalosaurus nettarhynchus* Mazin and Bucher, 1987, Prida Formation (Spathian), Humboldt Range, Nevada, USA.
Last: *Omphalosaurus nevadanus* Merriam, 1906, Prida Formation, West Humboldt Range, Nevada, USA.

F. MIXOSAURIDAE Baur, 1887
Tr. (SCY–LAD) Mar.

First: *Mixosaurus* cf. *M. nordenskioeldii* (Hulke, 1873), Sulphur Mountain Formation, Wapiti Lake, British Columbia, Canada.
Last: *Mixosaurus nordenskioeldii* (Hulke, 1873), Tschermakfjellet Formation, Svalbard, Spitsbergen; *Mixosaurus* sp., upper Muschelkalk, Bavaria and Baden-Württemberg, Germany.
Intervening: ANS.

F. UNNAMED Tr. (SCY) Mar.

First and Last: *Utatsusaurus hataii* Shikama, Kamei and Murata, 1978, Osawa Formation, northern Honshu, Japan.

F. UNNAMED Tr. (SCY) Mar.

First and Last: *Svalbardosaurus crassidens* Mazin, 1981, Sticky Keep Formation, Svalbard, Spitsbergen.

F. SHASTASAURIDAE Merriam, 1902
Tr. (SCY–NOR) Mar.

First: *Cymbospondylus* sp., Thaynes Formation, Idaho, USA (Massare and Callaway, 1992).
Last: *Shastasaurus* cf. *S. osmonti* Merriam, 1902, Martin Bridge Formation, Wallowa Mountains, Oregon, USA.
Intervening: ANS–CRN.
Comment: Mazin (1988, p. 54) notes possible RHT shastasaurids from the Germanic Basin.

F. SHONISAURIDAE Camp, 1980
Tr. (CRN–NOR/RHT) Mar.

First: *Shonisaurus popularis* Camp, 1976, *S. mulleri* Camp, 1976, and *S. silberlingi* Camp, 1976, Luning Formation, Nye County, Nevada, USA.
Last: *Shonisaurus* sp., Kössen Formation, Switzerland.

F. ICHTHYOSAURIDAE Bonaparte, 1841
J. (HET–TTH) Mar.

First: *Ichthyosaurus communis* Conybeare, 1821, lower Lias (*Psiloceras planorbis* Zone), Somerset, England, UK.
Last: ?*Ophthalmosaurus* sp., Purbeck Beds, Dorset, England, UK.
Intervening: SIN.
Comment: McGowan (1978) notes a humerus of *Ichthyosaurus* sp. from the Lower Cretaceous of North-west Territories, Canada, but its exact age is uncertain.

F. STENOPTERYGIIDAE Kuhn, 1934
J. (TOA) Mar.

First: *Stenopterygius quadriscissus* (Quenstedt, 1858), and six other species, Posidonienschiefer (*Dactylioceras tenuicostatum* and *Harpoceras falciferum* Zones), Baden-Württemberg, Germany.
Last: *Stenopterygius acutirostris* (Owen, 1840), Alum Shales Formation (*Hildoceras bifrons* Zone), Yorkshire, England, UK.

F. LEPTOPTERYGIIDAE Kuhn, 1934
Tr. (RHT)–K. (CEN) Mar.

First: *Leptopterygius tenuirostris* Conybeare, 1822, Kössen Formation, Switzerland (McGowan, 1989).
Last: ??*Platypterygius* sp., lower SAN, Western Australia (Wade, 1990). If these are derived from older rocks, then *Platypterygius americanus* (Nace, 1939), Mowry Shales, Wyoming, USA, *P. kipijanoffi* (Romer, 1968), Sewerisch Sandstone, former USSR, and *P. campylodon* (Carter, 1846), upper Greensand and Lower Chalk, Cambridgeshire and Kent, England, UK (all CEN), are the youngest.
Intervening: HET, SIN, BTH, CLV, KIM, TTH, HAU–CEN.
Comment: Supposedly later ichthyosaurs, one from the New Egypt Formation of New Jersey, USA (late MAA in age), and one from the Bearpaw Shale of Saskatchewan, Canada (late CMP), turn out to be isolated bones of plesiosaurs (Baird, 1984). Ventura (1984) notes a Miocene ichthyosaur from Malta, but is doubtful of its true provenance!

Division LEPIDOSAUROMORPHA Benton, 1983

F. UNNAMED Tr. (SCY) Terr.

First and Last: *Palaeagama vielhaueri* Broom, 1926, ?*Lystrosaurus–Procolophon* Assemblage Zone, Mount Frere district, Karoo Basin, South Africa.

STEM-GROUP LEPIDOSAURIA

?F. SAUROSTERNIDAE Haughton, 1924
P. (TAT) Terr.

First and Last: *Saurosternon bainii* Huxley, 1868, *Cistecephalus* or *Dicynodon–Theriognathus* Assemblage Zone, Sneeuwberg, Karoo Basin, South Africa.

F. KUEHNEOSAURIDAE Romer, 1966
Tr. (CRN–RHT) Terr.

First: *Icarosaurus siefkeri* Colbert, 1966, Lockatong Formation (upper Carnian), North Bergen, New Jersey, USA; and '?kuehneosaur jaw fragments', Petrified Forest Member (uppermost Carnian), Chinle Formation, St Johns, Arizona, USA (Murry, 1987).
Last: *Kuehneosaurus latus* Robinson, 1962, Pant-y-ffynon Quarry, Glamorgan, Wales (Crush, 1983).
Comment: Pant-y-ffynon Quarry is dated as RHT. The type material of *K. latus* comes from Emborough Quarry, Somerset, England, UK, whose age is probably NOR, but this is not certain. Later supposed kuehneosaurs, or close relatives, such as *Cteniogenys antiquus* Gilmore, 1928 from the Upper Jurassic and *Litakis gilmorei* Estes, 1964 from the Upper Cretaceous (Estes, 1983) are very doubtful. *Cteniogenys* has been reclassified as a choristodere (Evans, 1989).

Superorder LEPIDOSAURIA Haeckel, 1866
(Duméril and Bibron, 1839)

Order SPHENODONTIA Williston, 1925

F. SPHENODONTIDAE Cope, 1870
Tr. (CRN)–Rec. Terr. (p)

First: 'sphenodontian cf. *Planocephalosaurus*', Turkey

Branch Formation, ?lower CRN, Virginia, USA (Sues and Olsen, 1990); *Brachyrhinodon taylori* Huene, 1912, Lossiemouth Sandstone Formation, ?Upper CRN, Elgin, Scotland, UK. **Extant**
Intervening: NOR, KIM, TTH, APT.
Comment: *Brachyrhinodon* is probably the oldest confirmed sphenodontid. Other upper Upper CRN examples have been reported from Arizona, New Mexico and Texas (Murry, 1986, 1987). Other Upper Triassic taxa from England, Germany, Zimbabwe, and the USA (Fraser and Benton, 1989) are probably NOR in age. Older supposed sphenodontids, such as *Palacrodon* from the Lower Triassic of South Africa, and *Anisodontosaurus* from the Middle Triassic of Arizona, may be procolophonids (Murry, 1987; Evans, 1988). *Elachistosuchus* is an archosauromorph (Evans, 1988). The family Sphenodontidae, as presented here, is paraphyletic because of the exclusion of the Pleurosauridae. *Sapheosaurus* is included here within the Sphenodontidae (Evans, 1988; Fraser and Benton, 1989) and is not given in a separate family. In addition, *Gephyrosaurus bridensis* Evans, 1980, from a fissure fill, Glamorgan, South Wales, UK (HET/SIN), is included within Sphenodontidae, and is not regarded as the representative of a separate family (Fraser and Benton, 1989).

F. PLEUROSAURIDAE Lydekker, 1888
J. (TOA)–K. (BER) Mar.

First: *Palaeopleurosaurus posidoniae* Carroll, 1985, Posidonienschiefer, Baden-Württemberg, Germany (Carroll, 1985).
Last: *Pleurosaurus ginsburgi* Fabre, 1974, Gisement des Bessons, Var, France.
Intervening: KIM, TTH.

Order SQUAMATA Oppel, 1811

Cladistic analyses of squamates (Evans, 1984; Estes *et al.*, 1988; Rieppel, 1988) show that the snakes (Serpentes) are a monophyletic group nested among the squamates. Hence the lizards (Sauria) form a paraphyletic group, which is retained here. The location of Serpentes among the 'lizard' groups is uncertain. The classification and stratigraphical distribution of families of Squamata are based on Estes (1983), Estes *et al.* (1988), and Rage (1984).

Suborder SAURIA McCartney, 1802 (p)

Infra-order IGUANIA Cuvier, 1817 (Cope, 1864)

F. IGUANIDAE Gray, 1827 K. (MAA)–Rec. Terr.

First: *Pristiguana brasiliensis* Estes and Price, 1973, Baurú Formation, Minas Gerais, Brazil. **Extant**
Intervening: THA–HOL.

F. AGAMIDAE Gray, 1827 K. (CMP)–Rec. Terr.

First: *Mimeosaurus crassus* Gilmore, 1943, Djadokhta Formation, Mongolia. **Extant**
Intervening: THA–PRB, UMI–HOL.

F. EUPOSAURIDAE Camp, 1923 J. (KIM) Terr.

First and Last: *Euposaurus thiollierei* Lortet, 1892, *E. cirinensis* Lortet, 1892, and *E. lorteti* Hoffstetter, 1964, all from Calcaire lithographique, Cerin (Ain), France.

?F. ARRETOSAURIDAE Gilmore, 1943
T. (PRB) Terr.

First and Last: *Arretosaurus ornatus* Gilmore, 1943, Ulan Gochu Formation, Shara Murun, Mongolia.

F. CHAMAELEONIDAE Gray, 1825
T. (THA)–Rec. Terr.

First: *Anquingosaurus brevicephalus* Hou, 1976, Wang-Hu-Dun Series, Qian-Shan District, Anhui, China. **Extant**
Intervening: LMI–UMI, PLE, HOL.

Infra-order SCLEROGLOSSA Estes, de Queiroz and Gauthier, 1988

SCLEROGLOSSA *incertae sedis*

Included here are the Dibamidae, Amphisbaenia and Serpentes (listing follows all the 'lizard' groups), according to Estes *et al.* (1988).

F. DIBAMIDAE Boulenger, 1884 **Extant** Terr.

Parvorder AMPHISBAENIA Gray, 1844

F. OLIGODONTOSAURIDAE Estes, 1975
T. (THA) Terr.

First and Last: *Oligodontosaurus wyomingensis* Gilmore, 1942, Fort Union Formation, Park County, Wyoming, and *Oligodontosaurus* sp., Tongue River Formation, Carter County, Montana and Bison Basin deposits, Fremont County, Wyoming, USA.
Comment: Possible amphisbaenians have been reported from the Upper Cretaceous (?MAA) of Spain (Astibia *et al.*, 1990).

F. AMPHISBAENIDAE Gray, 1865
T. (PRB)–Rec. Terr.

First: *Omoiotyphlops edwardsi* (de Rochebrune, 1884), Phosphorites de Quercy, France. **Extant**
Intervening: LMI, UMI.

F. RHINEURIDAE Vanzolini, 1951
T. (DAN)–Rec. Terr.

First: *Plesiorhineura tsentasi* Sullivan, 1985, upper part of Nacimiento Formation (Torrejonian), Torreon Wash, New Mexico, USA (Sullivan, 1985). **Extant**
Intervening: THA–LUT, RUP–UMI, PLE.

F. HYPORHINIDAE Baur, 1893
T. (RUP–CHT) Terr.

First: *Hyporhina tertia* Berman, 1972, White River Formation, Fremont County, Wyoming, USA.
Last: *Hyporhina antiqua* Baur, 1893, White River Formation, Washington County, South Dakota, USA.

F. BIPEDIDAE Taylor, 1951 **Extant** Terr.

F. TROGONOPHIDAE Gray, 1865 **Extant** Terr.

Parvorder GEKKOTA Cuvier, 1817

F. ARDEOSAURIDAE Camp, 1923 J. (TTH) Terr.

First and Last: *Ardeosaurus brevipes* Meyer, 1855, *A. digitalellus* Grier, 1914, and *Eichstaettosaurus schroederi* Broili, 1938, Solnhofener Schichten, Eichstätt, Germany.

Comment: Estes (1983) includes *Yabeinosaurus tenuis* Endo and Shikama, 1942, Tsaotzushan Formation, Manchuria, and *Y. youngi* Hoffstetter, 1964, Ketzutung, Liaoning, China, in this family. These occurrences are dated merely as 'Upper Jurassic', so may extend the range of the family.

F. BAVARISAURIDAE Kuhn, 1961 J. (TTH) Terr.

First and Last: *Bavarisaurus macrodactylus* Wagner, 1852 and *Palaeolacerta bavarica* Cocude-Michel, 1961, Solnhofener Schichten, Bavaria, Germany.

F. GEKKONIDAE Bonaparte, 1831
K. (APT/ALB)–Rec. Terr.

First: *Hoburogekko suchanovi* Alifanov, 1989, APT/ALB, Ubur-Khangay aymak, Mongolia (Alifanov, 1989). **Extant**
Intervening: MAA, THA, YPR, PRB, RUP, LMI–HOL.

F. PYGOPODIDAE Gray, 1845 **Extant** Terr.

Parvorder SCINCOMORPHA Camp, 1923

F. PARAMACELLODIDAE Estes, 1983
J. (OXF–TTH) Terr.

First: *Becklesius hoffstetteri* (Seiffert, 1973), *Saurillodon proraformis* (Seiffert, 1973), and *S. henkeli* (Seiffert, 1973), Guimarota Lignite Mine, Leiria, Portugal.
Last: *Paramacellodus oweni* Hoffstetter, 1967, *Pseudosaurillus becklesi* Hoffstetter, 1967 and *Saurillus obtusus* Owen, 1854, Purbeck Beds, Dorset, England, UK.
Intervening: KIM.

F. XANTUSIIDAE Baird, 1859
T. (THA)–Rec. Terr.

First: *Palaeoxantusia fera* Hecht, 1956, Tongue River Formation, Carter County, Montana, and Fort Union Formation, Carbon County, Wyoming, USA. **Extant**
Intervening: LUT–RUP, UMI, PLE, HOL.
Comment: *Eoxanta lacertifrons* Borsuk-Bialynicka, 1988, from the red beds of Khermeen Tsav (?middle Campanian) of the Gobi Desert, Mongolia, is classified as the sister group of the Xantusiidae (Borsuk-Bialynicka, 1988).

F. LACERTIDAE Gray, 1825 T. (THA)–Rec. Terr.

First: *Plesiolacerta? paleocenicus* (Kuhn, 1940) and *Pseudeumeces? wahlbeckensis* (Kuhn, 1940), upper Palaeocene, Wahlbeck, Germany. **Extant**
Intervening: YPR–HOL.
Comment: These two earliest species are based on material now lost, and hence diagnosis is uncertain (Estes, 1983). The next oldest lacertid is a specimen of *Plesiolacerta lydekkeri* Hoffstetter, 1942, from the Lower Eocene of Dormaal, Belgium.

F. TEIIDAE Gray, 1827 K. (CMP)–Rec. Terr.

First: ?*Polyglyphanodon sternbergi* Gilmore, 1940, El Gallo Formation, Baja California, Mexico (?middle CMP). **Extant**
Intervening: MAA, THA, CHT, LMI–HOL.
Comment: Numerous other teiids are reported from the CMP and MAA of North America and Mongolia, such as *Adamisaurus, Chamops, Cherminosaurus, Darchanosaurus, Erdenetesaurus, Haptosphenus, Leptochamops, Macrocephalosaurus, Meniscognathus, Paraglyphanodon* and *Peneteius*, but the exact ages of certain of the Mongolian formations in particular are uncertain.

F. GYMNOPHTHALMIDAE Merrem, 1820
Extant Terr.

F. SCINCIDAE Gray, 1825 K. (MAA)–Rec. Terr.

First: *Contogenys sloani* Estes, 1969, Hell Creek Formation, McCone County, Montana, and *Sauriscus cooki* Estes, 1964, Lance Formation, Niobrara County, Wyoming, USA. **Extant**
Intervening: DAN, THA, PRB, PUR–HOL.

F. CORDYLIDAE Gray, 1837 T. (YPR)–Rec. Terr.

First: *Pseudolacerta* sp., Lower Eocene, Dormaal, Belgium. **Extant**
Intervening: PRB, LMI, HOL.

Parvorder ANGUIMORPHA Fürbringer, 1900

F. ANGUIDAE Gray, 1825 K. (CMP)–Rec. Terr.

First: *Odaxosaurus piger* Gilmore, 1928, Mesaverde Formation, Natrona County, Wyoming and Judith River Formation, Chouteau County, Montana, and 'cf. *Gerrhonotus*', Fruitland Formation, San Juan County, New Mexico, USA. **Extant**
Intervening: MAA–HOL.

F. XENOSAURIDAE Cope, 1866
K. (MAA)–Rec. Terr.

First: *Exostinus lancensis* Gilmore, 1928, Lance Formation, Niobrara County, Wyoming, and Hell Creek Formation, McCone County, Montana, USA. **Extant**
Intervening: DAN–YPR, CHT.

F. CAROLINIDAE Borsuk-Bialynicka, 1985
K. (CMP) Terr.

First and Last: *Carusia intermedia* (Borsuk-Bialynicka, 1985), Red Beds of Khermeen Tsav, Omnogov, Mongolia and *Shinisauroides latipalatum* Borsuk-Bialynicka, 1985, Barun Goyot Formation, Omnogov, Mongolia.

F. DORSETISAURIDAE Hoffstetter, 1967
J. (OXF–TTH) Terr. (see Fig. 39.3)

First: *Dorsetisaurus purbeckensis* Hoffstetter, 1967, Guimarota Lignite Mine, Leiria, Portugal (described as *Introrsisaurus pollicidens* Seiffert, 1973).
Last: *Dorsetisaurus purbeckensis* Hoffstetter, 1967 and *D. hebetidens* Hoffstetter, 1967, Purbeck Beds, Dorset, England, UK.

F. NECROSAURIDAE Hoffstetter, 1943
K. (MAA)–T. (CHT) Terr.

First: *Parviderma inexacta* Borsuk-Bialynicka, 1984, Barun Goyot Formation, ?middle CMP, Khulsan, Nemegt Basin, Mongolia (Borsuk-Bialynicka, 1984).
Last: *Necrosaurus eucarinatus* (Kuhn, 1940), 'Middle' Oligocene, Europe (Augé, 1986).
Intervening: MAA–RUP.

F. HELODERMATIDAE Gray, 1837
K. (MAA)–Rec. Terr.

First: *Paraderma bogerti* Estes, 1964, Lance Formation, Niobrara County, Wyoming, USA. **Extant**
Intervening: THA, PRB–LMI, HOL.

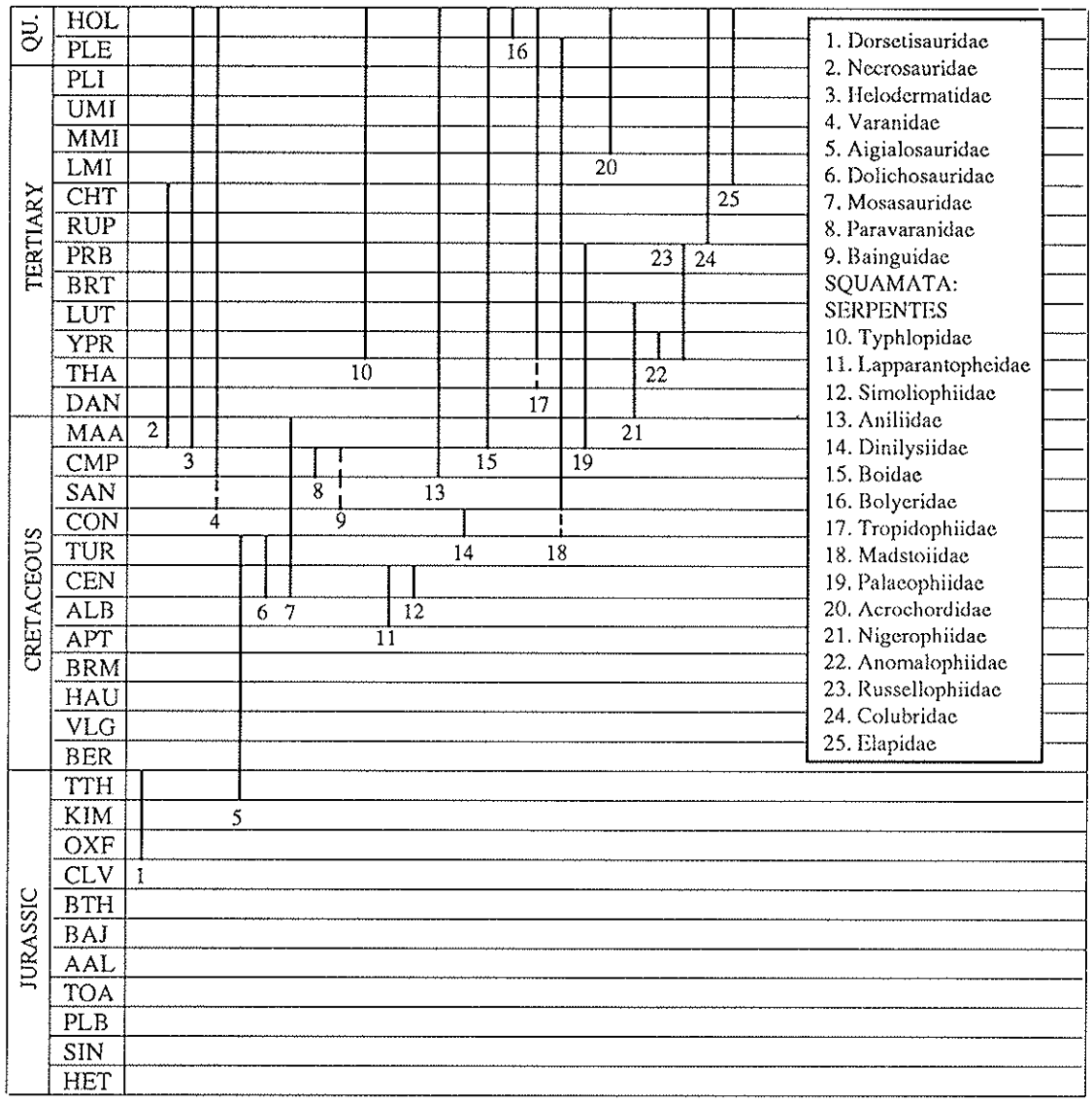

Fig. 39.3

F. VARANIDAE Gray, 1827 K. (SAN/CMP)–Rec. Terr. (includes LANTHANOTIDAE Steindachner, 1978)

First: *Telmasaurus grangeri* Gilmore, 1943, Djadokhta Formation, ?upper SAN and/or ?lower CMP, Bayn Dzak, Gobi Desert, Mongolia (Borsuk-Białynicka, 1984). **Extant**
Intervening: CMP–HOL.

F. AIGIALOSAURIDAE Gorjanovic-Kramberger, 1892 ?J. (TTH)–K. (TUR) Mar.

First: *Proaigialosaurus huenei* Kuhn, 1958, Solnhofener Schichten, Eichstättt, Bavaria, Germany.
Last: *Aigialosaurus dalmaticus* Kramberger, 1892, *Opetiosaurus buccichi* Kornhuber, 1901, and *Carsosaurus marchesetti* Kornhuber, 1893, Fischschiefer, Lesina and Comeno, Dalmatia, former Yugoslavia (Russell, 1967).
Intervening: CEN.
Comment: *Proaigialosaurus* is based on limited material, and it is not clear whether it is an aigialosaurid or not (Carroll and Debraga, 1992). *Carsosaurus* lacks a skull, and is also of uncertain familial assignment (Carroll and Debraga, 1992).

F. DOLICHOSAURIDAE Gorjanovic-Kramberger, 1892 K. (CEN–TUR) Mar.

First: *Dolichosaurus longicollis* Owen, 1850, Lower Chalk, Kent and Sussex, England, UK (Russell, 1967); *Coniasaurus crassidens* Owen, 1850, Lower Chalk, Sussex, England and Eagle Ford Group, Texas, USA (Bell *et al.*, 1982).
Last: *Acteosaurus tommasini* Meyer, 1860, *Pontosaurus lesinensis* Kornhuber, 1873, and *Eidolosaurus* Nopcsa, 1923, Fischschiefer, Lesina and Comeno, Dalmatia, former Yugoslavia (CEN–TUR; Russell, 1967).

F. MOSASAURIDAE Gervais, 1853 K. (CEN–MAA) Mar.

First: Mosasaur jaws, Middle Chalk, Cuxton, Kent (Russell, 1967); undescribed specimens, Eagle Ford Formation (CEN/TUR), Texas, USA.

Last: *Mosasaurus hoffmanni* Mantell, 1829, Maastricht Calcarenite, upper Gulpen Formation, Maastricht, The Netherlands; *Leiodon sectorius* Cope, 1871, Tuffeau of Maastricht, Maastricht Formation, Maastricht, The Netherlands; *Carinodens fraasi* (Dollo, 1913) and *Plioplatecarpus marshi* Dollo, 1882, both Craie Grossierea Silex Gris, Maastricht Formation, Limburg, The Netherlands; *Goronyosaurus nigeriensis* (Swinton, 1930 *pars*) and *Mosasaurus* sp., Dukamaje Formation, Sokoto, NW Nigeria and Niger (T. Lingham-Soliar, pers. comm., 1992); *Mosasaurus dekayi* Bronn, 1838, *M. maximus* Cope, 1869, *Liodon sectorius* Cope, 1871, and *Plioplatecarpus depressus* (Cope, 1869), all 'Navesink Formation and younger Cretaceous' (Russell, 1967), New Jersey, USA; *Prognathodon rapax* (Hay, 1902) and *Halisaurus platyspondylus* Marsh, 1869, New Egypt Formation, New Jersey, USA; all upper MAA (Russell, 1967).
Intervening: TUR–CMP.

SAURIA *incertae sedis*

F. PARAVARANIDAE Borsuk-Bialynicka, 1984
K. (CMP) Terr.

First and Last: *Paravaranus angustifrons* Borsuk-Bialynicka, 1984, Barun Goyot Formation, ?middle CMP, Khulsan, Nemegt Basin, Mongolia (Borsuk-Bialynicka, 1984).

F. BAINGUIDAE Borsuk-Bialynicka, 1984
K. (SAN/CMP) Terr.

First and Last: *Bainguis parvus* Borsuk-Bialynicka, 1984, Djadokhta Formation, ?upper SAN and/or ?lower CMP, Bayn Dzak, Gobi Desert, Mongolia (Borsuk-Bialynicka, 1984).

Suborder SERPENTES Linnaeus, 1758

The classification, and distributions, are taken from Rage (1984), unless otherwise stated.

Suborder SCOLECOPHIDIA Duméril and Bibron, 1844

F. ?TYPHLOPIDAE Gray, 1825
T. (YPR)–Rec. Terr.

First: Scolecophidia indet., Lower Eocene, Dormaal, Belgium. **Extant**
Intervening: PRB, MMI, HOL.

Suborder ALETHINOPHIDIA Hoffstetter, 1955

Superfamily SIMOLIOPHEOIDEA Nopcsa, 1925

F. LAPPARANTOPHIIDAE Hoffstetter, 1968
K. (ALB/CEN–CEN) Terr.

First: *Lapparantophis defrennei* Hoffstetter, 1960, 'Continental intercalaire', In Akhamil, Algeria.
Last: *Pouitella pervetus* Rage, 1988, lower or middle CEN, Maine-et-Loire, France (Rage, 1988).

F. SIMOLIOPHIIDAE Nopcsa, 1925
K. (CEN) Mar.

First and Last: *Simoliophis rochebrunei* Sauvage, 1880, CEN, south-western France, Portugal; *Simoliophis* sp., CEN, Egypt.

Superfamily ANILIOIDEA Fitzinger, 1826

F. ANILIIDAE Fitzinger, 1826
K. (CMP)–Rec. Terr.

First: *Coniophis cosgriffi* Armstrong-Ziegler, 1978, Fruitland Formation, New Mexico, USA. **Extant**
Intervening: MAA, LUT, PRB, MMI, PLI.

F. UROPELTIDAE Müller, 1832 **Extant** Terr.

Superfamily BOOIDEA Hoffstetter, 1955

F. DINILYSIIDAE Romer, 1956 K. (CON) Terr.

First and Last: *Dinilysia patagonica* Woodward, 1901, Rio Colorado Formation, Neuquén Group, Neuquén, Argentina.
Comment: The Rio Colorado Formation has been dated as tentatively CON by Bonaparte (1991).

F. XENOPELTIDAE Bonaparte, 1845 **Extant** Terr.

F. BOIDAE Gray, 1825 K. (MAA)–Rec. Terr.

First: Indeterminate boid, Hell Creek Formation, Montana, USA, and from equivalent deposits in Portugal and India (J.-C. Rage, pers. comm., 1991). **Extant**
Intervening: DAN–PLE.

F. BOLYERIIDAE Hoffstetter, 1946
Q. (HOL)–Rec. Terr.

First: Subfossil *Casarea*, Mauritius. **Extant**

F. TROPIDOPHIIDAE Cope, 1894
T. (THA?)–Rec. Terr.

First: 'Tropidophiid', Palaeocene, South America. **Extant**
Intervening: YPR.

F. MADSTOIIDAE Hoffstetter, 1961
K. (CON/SAN)–Q. (PLE) Terr.

First: *Madstoia* aff. *M. madagascariensis*, lower Senonian, Niger.
Last: *Wonambi naracoortensis* Smith, 1976, upper PLE, South Australia.
Intervening: CMP, YPR, PRB.

F. PALAEOPHIIDAE Lydekker, 1888
K. (MAA)–T. (PRB) FW

First: *Palaeophis* sp., MAA, Morocco.
Last: *Pterosphenus schucherti* Lucas, 1889, Jackson Formation, Alabama, USA; *P. schweinfurthi* (Andrews, 1901), Qasr el Sagha Formation, Fayûm Basin, Egypt; and *P. sheppardi* Hoffstetter, 1958, Seca Formation, Ancon, Ecuador.
Intervening: DAN–BRT.

Superfamily ACROCHORDOIDEA Bonaparte, 1838

F. ACROCHORDIDAE Bonaparte, 1838
T. (MMI)–Rec. FW/Mar.

First: *Acrochordus dehmi* Hoffstetter, 1964, Chinji Formation, Siwalik Group, Chhoinja, Pakistan. **Extant**

F. NIGEROPHIIDAE Rage, 1975
T. (DAN–LUT) FW/Mar.

First: *Nigerophis mirus* Rage, 1975, Palaeocene, Krebb de Sessao, Niger.
Last: *Woutersophis novus* Rage, 1980, Bruxellian, Brussels, Belgium.

Superfamily COLUBROIDEA Fitzinger, 1826

F. ANOMALOPHIIDAE Oppel, 1811 T. (YPR) FW

First and Last: *Anomalophis bolcensis* (Massalongo, 1859), Monte Bolca, Veneto, Italy.

F. RUSSELLOPHIIDAE Rage, 1978
T. (YPR–PRB) FW

First: *Russellophis* sp., Lower Eocene, Dormaal, Belgium.
Last: Russellophiid indet, Phosphorites de Quercy, France.

F. COLUBRIDAE Gray, 1825 T. (RUP)–Rec. Terr.

First: *Coluber cadurci* Rage, 1974 and *Natrix mlynarskii* Rage, 1988, Phosphorites de Quercy, upper Suevian, Lot, France. **Extant**
Intervening: CHT–PLE.

F. ELAPIDAE Boie, 1827 T. (LMI)–Rec. FW/Mar.

First: *Naja romani* (Hoffstetter, 1939), Orleanian, France. **Extant**
Intervening: MMI, PLI.

F. VIPERIDAE Gray, 1825
T. (LMI)–Rec. Terr. (see Fig. 39.4)

First: Viperid, Agenian, France. **Extant**
Intervening: MMI, UMI–PLE.

Division ARCHOSAUROMORPHA Huene, 1946

Order CHORISTODERA Cope, 1876

Relationships of the group, and division into families, are based on the cladogram of Evans (1990).

F. PACHYSTROPHEIDAE Kuhn, 1961
Tr. (RHT) FW/Mar.

First and Last: *Pachystropheus rhaeticus* E. von Huene, 1935, Rhaetic Bone Bed, southern England, UK, Germany.

F. UNNAMED J. (BTH–KIM) FW

First: *Cteniogenys antiquus* Gilmore, 1928, Chipping Norton Formation, lower BTH, Gloucestershire, England, UK (Metcalf *et al.*, 1993); Forest Marble Formation, upper BTH, Oxfordshire, England, UK (Evans, 1989).
Last: *Cteniogenys antiquus* Gilmore, 1928, Morrison Formation, Wyoming, USA.
Intervening: OXF.
Comments: The familial assignment of these early choristoderes has not been confirmed, and relationships to the pachystropheids and to later champsosaurs are unclear at present. Earlier choristoderes, perhaps belonging to this group have been noted from the Kayenta Formation (SIN/PLB: J. Clark, pers. comm., 1991).

F. CHAMPSOSAURIDAE Cope, 1876 (1884?)
K. (APT/ALB)–T. (RUP) FW

First: *Tchoiria namsarai* Efimov, 1985, Lower Cretaceous, Khamaril-Khural, Mongolia.
Last: *Lazarussuchus inexpectatus* Hecht, 1992, Stampian Limestone, Armissan quarry, Aude, France (Hecht, 1992).
Intervening: CMP–YPR.

F. SIMOEDOSAURIDAE Lemoine, 1884
K. (ALB/CEN)–T. (YPR?) FW

First: *Ikechosaurus sunailinae* Sigogneau-Russell, 1981, Middle Cretaceous, Otok District, Inner Mongolia (Sigogneau-Russell, 1981).
Last: *Simoedosaurus* sp., Clarkforkian, Park County, Wyoming, USA (Uppermost Palaeocene or Lowermost Eocene).
Intervening: CMP–THA.

Order RHYNCHOSAURIA Osborn, 1903

F. RHYNCHOSAURIDAE Huxley, 1887 (Cope, 1870)
Tr. (SCY–CRN) Terr.

First: *Howesia browni* Broom, 1905 and *Mesosuchus browni* Watson, 1912, *Cynognathus–Diademodon* Assemblage Zone, Karoo Basin, South Africa.
Last: *Hyperodapedon gordoni* Huxley, 1859, Lossiemouth Sandstone Formation, Morayshire, Scotland, UK; *Scaphonyx sanjuanensis* Sill, 1970, Ischigualasto Formation, San Juan, Argentina; *Scaphonyx sulcognathus* Azevedo and Schultz, 1988, Caturrita Formation, Rio Grande do Sul, Brazil; *Otischalkia elderae* Hunt and Lucas, 1991, Dockum Group, Texas, USA; undescribed rhynchosaur, Wolfville Formation, Nova Scotia, Canada (Hunt and Lucas, 1991b).
Intervening: ANS, LAD.
Comment: Carroll (1976) suggested that *Noteosuchus colletti* (Watson, 1912) from the *Lystrosaurus–Procolophon* Assemblage Zone of South Africa was the oldest rhynchosaur, but it lacks diagnostic characters of the group (Benton, 1985). Other upper Carnian rhynchosaurs are known, but these are dated as 'early' late Carnian by Hunt and Lucas (1991b), while the 'Lasts' listed above are given as 'late' late Carnian.

Order THALATTOSAURIA Merriam, 1904

F. ASKEPTOSAURIDAE Kuhn, 1952
Tr. (ANS/LAD) Mar.

First: *Askeptosaurus italicus* Nopcsa, 1925, Grenzbitumenzone, Monte San Giorgio, Kt. Tessin, Switzerland.
Last: Thalattosaurid indet., Pardonet Formation, British Columbia, Canada (Storrs, 1991b).

F. THALATTOSAURIDAE Merriam, 1904
Tr. (CRN–NOR) Mar.

First: *Thalattosaurus alexandrae* Merriam, 1904, and *Nectosaurus halius* Merriam, 1905, Hosselkus Limestone, California, USA.
Last: Thalattosaurid indet., Pardonet Formation, British Columbia, Canada (Storrs, 1991b).

F. CLARAZIIDAE Peyer, 1936
Tr. (ANS/LAD) Mar.

First and Last: *Clarazia schinzi* Peyer, 1936, and *Hescheleria ruebeli* Peyer, 1936, Grenzbitumenzone, Monte San Giorgio, Kt. Tessin, Switzerland.

F. TRILOPHOSAURIDAE Gregory, 1945
Tr. (CRN–RHT) Terr.

First: *Trilophosaurus buettneri* Case, 1928, lower Dockum Group, Crosby County, Texas, USA.
Last: *Tricuspisaurus thomasi* Robinson, 1957, Upper Triassic (?NOR/RHT), Ruthin Quarry fissure, Glamorgan, Wales, UK (Fraser, 1986).
Intervening: NOR.

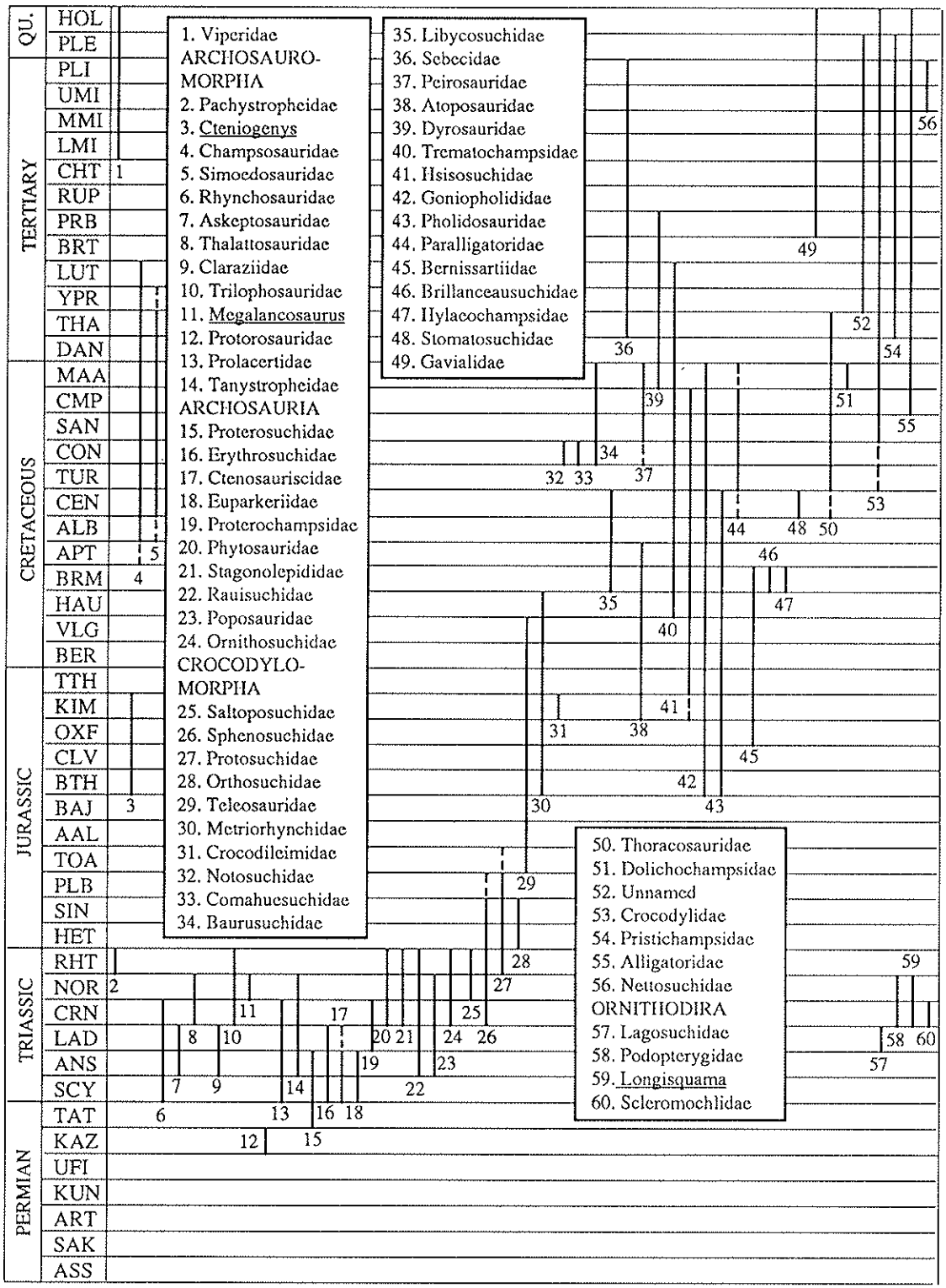

Fig. 39.4

Comment: Earlier supposed trilophosaurids, such as *Doniceps*, *Anisodontosaurus*, and *Gomphiosaurus*, as well as *Toxolophosaurus* from the Lower Cretaceous, are probably not trilophosaurids (Murry, 1987). It is unclear whether *Tricuspisaurus* and *Variodens*, both from the English–Welsh fissures, are trilophosaurids or not.

F. UNNAMED Tr. (NOR) Terr.

First and Last: *Megalancosaurus preonensis* Calzavara *et al.*, 1980, Dolomia di Forni, Udine, Italy.

Order PROLACERTIFORMES Camp, 1945

F. PROTOROSAURIDAE Baur, 1889 (Cope, 1871)
P. (KAZ) Terr.

First and Last: *Protorosaurus speneri* Meyer, 1832, Kupferschiefer, Thuringia, Germany.

F. PROLACERTIDAE Parrington, 1935
Tr. (SCY–CRN) Terr.

First: *Prolacerta broomi* Parrington, 1935, *Lystrosaurus–Procolophon* Assemblage Zone, Karoo Basin, South Africa, and Fremouw Formation, Antarctica.
Last: *Malerisaurus robinsonae* Chatterjee, 1980, Maleri Formation, Andhra Pradesh, India; and *M. langstoni* Chatterjee, 1986, Tecovas Member, lower Dockum Group, Howard County, Texas, USA.
Intervening: ANS, LAD.

F. TANYSTROPHEIDAE Romer, 1945 (Gervais, 1859)
Tr. (ANS–NOR) Terr./Mar.

First: *'Tanystropheus' conspicuus* Huene, 1931, Obere Buntsandstein, southern Germany.
Last: *Tanystropheus fossai* Wild, 1980, Argillite di Riva di Solto, Val Brembana, Italy.
Intervening: LAD, CRN.

Subdivision ARCHOSAURIA Cope, 1869

The classification of basal archosaurs ('thecodontians') is based on Benton and Clark (1988), Sereno and Arcucci (1990), and Sereno (1991b), and stratigraphical distributions are taken from Charig (1976), and more recent references noted.

F. PROTEROSUCHIDAE Huene, 1908
P. (TAT)–Tr. (ANS) Terr./FW

First: *Archosaurus rossicus* Tatarinov, 1960, Zone IV, Vladimir region, former USSR.
Last: *Chasmatosaurus ultimus* Young, 1964, Er-Ma-Ying Series, SE Shansi Province, China.
Intervening: SCY.

F. ERYTHROSUCHIDAE Watson, 1917
Tr. (SCY–LAD) Terr.

First: *Fugusuchus hejiapensis* Cheng, 1980, He Shang-gou Formation, Fuku County, Shanxi Province, North China, and *Garjainia prima* Ochev, 1958, Yarenskian Horizon, upper part of Stage V, Orenburg region, southern Urals, former USSR, both mid to late Scythian in age.
Last: *Cuyosuchus huenei* Reig, 1961, Cacheuta Formation, Mendoza Province, Argentina.
Intervening: ANS.

F. CTENOSAURISCIDAE Kuhn, 1964
Tr. (SCY–ANS/LAD) Terr.

First: *Ctenosauriscus koeneni* (Huene, 1902), Mittlere Buntsandstein, Göttingen, Germany.
Last: *Lotosaurus adentus* Zhang, 1975, Batung Formation, Hunan, China.
Comment: These two taxa of (?) archosaurs share long dorsal neural spines, but their systematic position is uncertain. It is not clear whether they are related to each other or not.

F. EUPARKERIIDAE Huene, 1920
Tr. (SCY–ANS) Terr.

First: *Euparkeria capensis* Broom, 1913, *Cynognathus–Diademodon* Assemblage Zone, Karoo Basin, South Africa.
Last: *Halazhaisuchus qiaoensis* Wu, 1982, Lower Er-Ma-Ying Formation, Shansi Province, China; *Turfanosuchus dabanensis* Young, 1973, Er-Ma-Ying equivalent, Sinkiang, China; and *T. shageduensis* Wu, 1982, Lower Er-Ma-Ying Formation, Inner Mongolia, China.
Comment: *Turfanosuchus* may be a pseudosuchian (J. M. Parrish, pers. comm., 1991).

F. PROTEROCHAMPSIDAE Sill, 1967
Tr. (LAD–CRN) Terr./FW

First: *Chanaresuchus bonapartei* Romer, 1971 and *Gualosuchus reigi* Romer, 1971, Chañares Formation, La Rioja Province, Argentina.
Last: *Proterochampsa barrionuevoi* Reig, 1959, Ischigualasto Formation, San Juan Province, Argentina.

Infradivision CRUROTARSI Sereno and Arcucci, 1990

F. PHYTOSAURIDAE Lydekker, 1888
Tr. (CRN–RHT) FW/Terr.

First: *'Rutiodon* sp.', Pekin Formation, middle CRN, North Carolina, USA (Olsen *et al.*, 1989).
Last: *Rutiodon* sp., Rhät, Switzerland, North Germany; 'phytosaurs', upper Passaic Formation, New Jersey, Upper New Haven Arkose, Connecticut, USA.
Intervening: NOR.
Comment: Apparently older phytosaurs, *Mesorhinosuchus fraasi* (Jaekel, 1910) from the Mittlere Buntsandstein (SCY) of Bernburg, Germany, and others from the Muschelkalk of Germany (ANS–LAD) are all doubtful records (Westphal, 1976). There are numerous upper CRN phytosaurs, *Paleorhinus bransoni* Williston, 1904, Popo Agie Formation, Fremont County, Wyoming, USA, and other species of *Paleorhinus* from Arizona and Texas, USA, Morocco, Germany, Austria and India (Hunt and Lucas, 1991a).

F. STAGONOLEPIDIDAE Lydekker, 1887
Tr. (CRN–RHT) Terr.

First: cf. *Typothorax*, Pekin Formation, middle CRN, Chatham County, North Carolina, USA (Olsen *et al.*, 1989); *Longosuchus meadei* (Sawin, 1947), lower Dockum Group, Howard County, Texas; Salitral Member, Chinle Formation, Rio Arriba County, New Mexico, USA (Hunt and Lucas, 1990).
Last: *Neoaetosauroides engaeus* Bonaparte, 1969, upper Los Colorados Formation, La Rioja, Argentina; aetosaur elements, Penarth Group ('Rhaetian'), SW England (Fraser, 1988).
Intervening: NOR.
Comment: There are numerous late CRN stagonolepidids, *Stagonolepis robertsoni* Agassiz, 1844, Lossiemouth Sandstone Formation, Morayshire, Scotland, UK; *Aetosauroides scagliai* Casamiquela, 1960 and *Argentinosuchus bonapartei* Casamiquela, 1960, Ischigualasto Formation, San Juan, Argentina; *Desmatosuchus haplocerus* (Cope, 1892), lower units of the Chinle Formation and Dockum Group, New Mexico and Texas, USA; unnamed aetosaur, Wolfville Formation, Nova Scotia, Canada.

F. RAUISUCHIDAE Huene, 1942
Tr. (ANS–RHT) Terr.

First: *Wangisuchus tzeyii* Young, 1964 and *Fenhosuchus cristatus* Young, 1964, Er-Ma-Ying Series, Shansi, China; *Vjushkovisaurus berdjanensis* Ochev, 1982, Donguz Series, Orenburg region, former USSR; *Stagonosuchus major* (Haughton, 1932) and '*Mandasuchus*', upper bone bed of the Manda Formation, Ruhuhu region, Tanzania; 'rauisuchid', Yerrapalli Formation, India.
Last: *Fasolasuchus tenax* Bonaparte, 1978, upper Los Colorados Formation, La Rioja, Argentina.
Intervening: LAD–NOR.
Comment: Some of the early 'rauisuchids' are of uncertain affinities, particularly *Fenhosuchus*, *Vjushkovisaurus*, and *Wangisuchus* (Bonaparte, 1984; Benton, 1986). Parrish (pers. comm., 1991) regards this family as non-monophyletic.

F. POPOSAURIDAE Nopcsa, 1928
Tr. (ANS–NOR) Terr.

First: *Bromsgroveia walkeri* Galton, 1985, Bromsgrove Sandstone Formation, Warwick, England, UK.
Last: Poposaurid, upper Redonda Formation, ?late NOR, New Mexico, USA.
Intervening: LAD, CRN.
Comment: If the 'last' record is not confirmed, there are several lower and middle NOR poposaurids, *Teratosaurus suevicus* Meyer, 1861, Mittlere Stubensandstein, Baden-Württemberg, Germany; *Postosuchus kirkpatricki* Chatterjee, 1985, upper Dockum Group, Texas, USA.

F. ORNITHOSUCHIDAE Huene, 1908
Tr. (CRN–RHT) Terr.

First: *Ornithosuchus longidens* Newton, 1894, Lossiemouth Sandstone Formation, Morayshire, Scotland, UK, and *Venaticosuchus rusconii* Bonaparte, 1971, Ischigualasto Formation, La Rioja, Argentina.
Last: *Riojasuchus tenuiceps* Bonaparte, 1969, upper Los Colorados Formation, La Rioja, Argentina.
Intervening: None.

Superorder CROCODYLOMORPHA Walker, 1968

The classification of crocodilomorphs is based on Clark, *in* Benton and Clark (1988), and stratigraphical distributions are taken from Steel (1973), Buffetaut (1982) and references cited below.

F. SALTOPOSUCHIDAE Crush, 1984
Tr. (NOR–RHT) Terr.

First: *Saltoposuchus connectens* Huene, 1921, Mittlere Stubensandstein, Württemberg, Germany.
Last: *Terrestrisuchus gracilis* Crush, 1984, Ruthin Quarry, Glamorgan, Wales, UK.

F. SPHENOSUCHIDAE Huene, 1922
Tr. (CRN)–J. (SIN/PLB) Terr. (p)

First: *Hesperosuchus agilis* Colbert, 1952, lower Chinle Group, Cameron, Arizona, USA.
Last: *Kayentasuchus* sp., Kayenta Formation, Arizona, USA (Clark, 1993).
Intervening: RHT, HET.
Comment: *Hallopus victor* (Marsh, 1877) is a crocodilomorph which may belong to this clade (Clark, *in* Benton and Clark, 1988). It is probably from the lower Ralston Creek Formation (CLV) of Freemont County, Colorado, USA (Norell and Storrs, 1989).

Order CROCODYLIA Gmelin, 1788

F. PROTOSUCHIDAE Brown, 1934
Tr. (RHT)–J. (PLB/TOA) Terr.

First: *Hemiprotosuchus leali* Bonaparte, 1969, upper Los Colorados Formation, La Rioja, Argentina.
Last: Unnamed form, Kayenta Formation (SIN/PLB), Arizona, USA (Clark, *in* Benton and Clark, 1988), or *Stegomosuchus longipes* Lull, 1953, upper Portland Group (PLB/TOA), Connecticut, USA.
Intervening: HET, SIN.
Comment: The range of Protosuchidae could be much greater if one includes *Dyoplax arenaceus* Fraas, 1867, Schilfsandstein, Germany (CRN), as Walker (1961) suggests, and *Edentosuchus tienshanensis* Young, 1973, Wuerho, China (VLG/ALB), as Clark (*in* Benton and Clark, 1988) suggests.

F. ORTHOSUCHIDAE Whetstone and Whybrow, 1983 J. (HET/SIN) FW/Terr.

First and Last: *Orthosuchus stormbergi* Nash, 1968, upper Elliot Formation, Lesotho, South Africa.

Suborder MESOEUCROCODYLIA Whetstone and Whybrow, 1983

Infra-order THALATTOSUCHIA Fraas, 1901

F. TELEOSAURIDAE Geoffroy, 1831
J. (TOA)–K. (VLG) Mar.

First: *Steneosaurus bollensis* (Jaeger, 1828), *S. brevior* Blake, 1876, and *S. gracilirostris* Westphal, 1961, Whitby Mudstone Formation, Yorkshire, England, UK; Posidonienschiefer, Baden-Württemberg, Germany.
Last: 'Teleosaurid', Valanginian, Bouches-du-Rhône, France.
Intervening: AAL–TTH.
Comment: Huene and Mauberge (1954) reported teleosaurid vertebrae from the Lotharingian (HET/SIN) of Lorraine, France.

F. METRIORHYNCHIDAE Fitzinger, 1843
J. (BTH)–K. (HAU) Mar./FW

First: *Teleidosaurus calvadosi* (J. A. Eudes-Deslongchamps, 1866), *T. gaudryi* Collot, 1905, and *T. bathonicus* (Mercier, 1933), Bathonian, Normandy and Burgundy, France.
Last: *Dakosaurus maximus* (Plieninger, 1846), Hauterivian, Provence, France.
Intervening: CLV–TTH.

?F. CROCODILEIMIDAE Buffetaut, 1979
J. (KIM) Mar.

First and Last: *Crocodileimus robustus* Jourdan, 1871, Calcaires lithographiques, Cerin, Ain, France.

Infra-order METAMESOSUCHIA Clark, *in* Benton and Clark, 1988

F. NOTOSUCHIDAE Dollo, 1914 K. (CON) Terr.

First and Last: *Uruguaysuchus aznaresi* Rusconi, 1933, Guichon Formation, Paysandú, Uruguay; *Notosuchus terrestris* Woodward, 1896, Rió Colorado Formation, Neuquén, Argentina.
Comment: The Rió Neuquén Formation is dated tentatively as CON by Bonaparte (1991).

F. COMAHUESUCHIDAE Bonaparte, 1991
K. (CON) Terr.

First and Last: *Comahuesuchus brachybuccalis* Bonaparte, 1991, Rió Colorado Formation, Neuquén, Argentina (Bonaparte, 1991).

F. BAURUSUCHIDAE Price, 1945
K. (CON–MAA) Terr.

First: *Cynodontosuchus rothi* Woodward, 1896, Rió Colorado Formation, Neuquén, Argentina.
Last: *Baurusuchus pachecoi* Price, 1945, Baurú Formation, Sao Paolo, Brazil.

F. LIBYCOSUCHIDAE Stromer, 1914
K. (BRM–CEN) Terr.

First: 'Libycosuchid', BRM, Niger.
Last: *Libycosuchus brevirostris* Stromer, 1914, Cenomanian, Baharija, Egypt.
Intervening: ALB.

F. SEBECIDAE Simpson, 1937
T. (THA–PLI) Terr.

First: *Sebecus* sp., Upper Palaeocene, Itaboraí, Brazil.
Last: cf. *Sebecus*, Pliocene, Australia.
Intervening: YPR, PRB–CHT, MMI.

F. PEIROSAURIDAE Gasparini, 1982
K. (?CON–MAA) Terr.

First: *Peirosaurus tormini* Price, 1955 and *Lomasuchus palpebrosus* Gasparini, Chiappe, and Fernandez, 1991, Rió Colorado Formation, Neuquén Province, Argentina (Gasparini *et al.*, 1991).
Last: *Peirosaurus tormini* Price, 1955, Baurú Formation, State of Minais Gerais, Brazil.

Parvorder NEOSUCHIA Clark, *in* Benton and Clark, 1988

F. ATOPOSAURIDAE Gervais, 1871
J. (KIM)–K. (APT) Terr.

First: *Alligatorium meyeri* Gervais, 1871, Calcaire lithographique, Cerin, Ain, France.
Last: Atoposaurid, BRM/APT, Spain.
Intervening: TTH, BRM.
Comment: The atoposaurids are essentially an Upper Jurassic group, but extend into the Lower Cretaceous if *Theriosuchus* is included in the family (Buffetaut, 1982; Clark, *in* Benton and Clark, 1988).

F. DYROSAURIDAE de Stefano, 1903
K. (MAA)–T. (PRB) FW/Mar.

First: *Sokotosuchus ianwilsoni* Halstead, 1975, Dukamaje Formation, Sokoto, Nigeria; *Hyposaurus rogersii* Owen, 1849, Hornerstown Formation, New Jersey, USA; *H. derbianus* Cope, 1886, MAA, Pernambuco Province, Brazil.
Last: 'Dyrosaurid', Upper Eocene, Burma.
Intervening: DAN–BRT.
Comment: An older possible dyrosaurid is reported from the CEN of Nazaré, Portugal (Buffetaut, 1982).

F. TREMATOCHAMPSIDAE Buffetaut, 1974
K. (HAU)–T. (LUT) FW/Terr.

First: *Amargasuchus minor* Chiappe, 1988, La Amarga Formation, Neuquén Province, Argentina (Chiappe, 1988).
Last: *Bergisuchus dietrichbergi* Kuhn, 1968, Messel lignite, Hesse, Germany (Buffetaut, 1988).
Intervening: ?CON, CMP, MAA, YPR, BRT.

F. HSISOSUCHIDAE Young and Chow, 1953
J. (?KIM)–K. (CMP) Terr.

First: *Hsisosuchus chungkingensis* Young and Chow, 1953, Upper Jurassic, Szechwan, China.
Last: ?*Doratodon carcharidens* (Bunzel, 1871), Gosau Formation, Austria.
Intervening: None.

F. GONIOPHOLIDIDAE Cope, 1875
J. (BTH)–K. (MAA) FW/Terr.

First: 'Goniopholids', Ostracod Limestone, Skye, Scotland, UK (Savage, 1984), Chipping Norton, White Limestone, and Forest Marble Formations, Gloucestershire and Oxfordshire, England, UK (Metcalf *et al.*, 1993).
Last: *'Goniopholis' kirtlandicus* Wiman, 1931, MAA, New Mexico, USA.
Intervening: KIM–ALB, TUR, SAN.

F. PHOLIDOSAURIDAE Eastman, 1902
J. (BTH)–K. (CEN) FW/Terr.

First: *Anglosuchus geoffroyi* (Owen, 1884), *A. laticeps* (Owen, 1884), White Limestone Formation, Oxfordshire, England, UK.
Last: *Teleorhinus mesabiensis* Erickson, 1969, CEN, Iron Range, Minnesota, USA.
Intervening: KIM–ALB.

F. PARALLIGATORIDAE Konjukova, 1954
K. (CEN/TUR–CMP/MAA)

First: *Shamosuchus major* (Efimov, 1981), *S. ulgicus* (Efimov, 1981), Baynshirenskaya Svita, Mongolia (Efimov, 1981).
Last: *Shamosuchus ancestralis* (Konjukova, 1954), Nemegt Formation, Omnogov, Mongolia.
Intervening: SAN.

F. BERNISSARTIIDAE Dollo, 1883
J. (OXF)–K. (BRM) Terr./FW

First: *Bernissartia* sp., Guimarota, Leiria, Portugal.
Last: *Bernissartia* sp., Wealden, Isle of Wight, England, UK.
Intervening: VLG, HAU.

F. BRILLANCEAUSUCHIDAE Michard *et al.*, 1990
K. (BRM?) Terr./FW

First and Last: *Brillanceausuchus babouriensis* Michard *et al.*, 1990, from the Lower Cretaceous of Babouri-Figuil Basin, north Cameroon (Michard *et al.*, 1990).

Suborder EUSUCHIA Huxley, 1875

F. HYLAEOCHAMPSIDAE Andrews, 1913
K. (BRM) Terr./FW

First and Last: *Hylaeochampsa vectiana* Owen, 1874, Wealden, Isle of Wight, England, UK.

F. STOMATOSUCHIDAE Stromer, 1925
K. (CEN) FW

First and Last: *Stomatosuchus inermis* Stromer, 1925, ?*Aegyptosuchus peyeri* Stromer, 1933, Baharija Formation, Marsa Matruh, Egypt.

F. GAVIALIDAE Cuvier, 1807 T. (PRB)–Rec.
FW/Terr.

First: *Eogavialis africanus* (Andrews, 1905), Upper Eocene,

Fayum, Egypt. **Extant**
Intervening: LUT–HOL.

F. THORACOSAURIDAE Cope, 1871
K. (CEN/TUR)–T. (THA) FW

First: *Thoracosaurus cherifiensis* Lavocat, 1955, southern Morocco.
Last: *Thoracosaurus macrorhynchus* (Blainville, 1839–1864), Bourgogne, Marne, France.
Intervening: CMP–DAN.
Comment: *T. cherifiensis* may be a pholidosaurid (E. Buffetaut, pers. comm., 1991), in which case the oldest *Thoracosaurus* species are MAA in age (Hornerstown Formation, New Jersey; Ripley Formation, Mississippi, USA).

F. DOLICHOCHAMPSIDAE Gasparini and Buffetaut, 1980 K. (MAA) FW

First and Last: *Dolichochampsa minima* Gasparini and Buffetaut, 1980, Yacoraite Formation, Salta Province, Argentina and El Molino Formation, southern Bolivia (Buffetaut, 1987).

F. UNNAMED T. (YPR–PLE) FW

First: ?*Eosuchus lerichei* Dollo, 1907, Ypresian, Jeumont, northern France.
Last: Unnamed form, Quaternary?, Murua Island, Solomon Sea (Molnar, 1982).
Intervening: LUT, LMI, UMI, PLI.

F. CROCODYLIDAE Cuvier, 1807
K. (TUR/SAN)–Rec. FW/Terr.

First: ?*Tadzhikosuchus macrodentis* Efimov, 1982, Yalovachskaya Formation, Tadzhikistan (Efimov, 1982). **Extant**
Intervening: CMP–HOL.

F. PRISTICHAMPSIDAE Kuhn, 1968
T. (THA–PLE) Terr.

First: *Planocrania datangensis* Li, 1976, Nonshan Formation, Guangdong, China; *P. hengdongensis* Li, 1984, Palaeocene (?) red beds, Hunan, China; *Wanosuchus atresus* Zhang, 1981, Palaeocene (?), Anhui, China.
Last: *Quinkana fortirostrum* Molnar, 1981, cave deposits, north Queensland, Australia (Molnar, 1981).
Intervening: YPR–BRT, PLI.

F. ALLIGATORIDAE Gray, 1844 (Cuvier, 1807)
K. (CMP)–Rec. FW/Terr.

First: *Albertochampsa langstoni* Erickson, 1972, Judith River Formation, Alberta, Canada; *Bottosaurus perrugosus* Cope, 1874, Belly River Formation, Alberta, Canada. **Extant**
Intervening: MAA–HOL.

F. NETTOSUCHIDAE Langston, 1965
T. (UMI–PLI) FW

First: *Mourasuchus atopus* (Langston, 1965), Honda Beds, La Venta, Huila, Colombia.
Last: *Mourasuchus amazonensis* Price, 1964, Acre State, Brazil.

Infradivision ORNITHODIRA Gauthier, 1986

F. LAGOSUCHIDAE Arcucci, 1987
Tr. (LAD) Terr.

First and Last: *Lagosuchus talampayensis* Romer, 1971, *Lagerpeton chanarensis* Romer, 1971, and *Pseudolagosuchus major* Arcucci, 1987, all Chañares Formation, La Rioja, Argentina (Arcucci, 1987).

F. PODOPTERYGIDAE Sharov, 1971
Tr. (CRN/NOR) Terr.

First and Last: *Sharovipteryx mirabilis* (Sharov, 1971), Madyigenskaya Svita, Fergana, Kirgizia, former USSR.

F. UNNAMED Tr. (CRN/NOR) Terr.

First and Last: *Longisquama insignis* Sharov, 1970, Madyigenskaya Svita, Fergana, Kirgizia, former USSR (Haubold and Buffetaut, 1987).

F. SCLEROMOCHLIDAE Huene, 1914
Tr. (CRN) Terr.

First and Last: *Scleromochlus taylori* Woodward, 1907, Lossiemouth Sandstone Formation, Morayshire, Scotland, UK.

Order PTEROSAURIA Owen, 1840 (Kaup, 1834)
(see Fig. 39.5)

The classification of pterosaurs is based on Wellnhofer (1978, 1991), Howse (1986), Bennett (1989), and Unwin (1991), with distribution data from Wellnhofer (1978, 1991), and other references noted.

Suborder RHAMPHORHYNCHOIDEA
Plieninger, 1901 (p)
F. UNNAMED Tr. (NOR) Terr.

First and Last: *Preondactylus buffarini* Wild, 1983, lower middle part of the 'Dolomia Principale', Udine Province, Italy (Wild, 1983).

F. DIMORPHODONTIDAE Seeley, 1870
Tr. (NOR)–J. (SIN) Terr.

First: *Peteinosaurus zambellii* Wild, 1978, upper half of the Calcare di Zorzino, Bergamo, Italy (Wild, 1978).
Last: *Dimorphodon macronyx* (Buckland, 1829), upper Blue Lias, Dorset, England, UK.
Intervening: None.

F. EUDIMORPHODONTIDAE Wellnhofer, 1978
Tr. (NOR) Terr.

First and Last: *Eudimorphodon ranzii* Zambelli, 1973, upper half of the Calcare di Zorzino, Bergamo, Italy.

F. ANUROGNATHIDAE Kuhn, 1937
J. (TTH) Terr.

First and Last: *Anurognathus ammoni* Döderlein, 1923, Solnhofener Schichten, Bavaria, Germany; and ?*Batrachognathus volans* Riabinin, 1948, Upper Jurassic, Karatau Mountains, Michailokva, Kazakhstan, former USSR.

F. UNNAMED J. (OXF–TTH) Terr.

First: *Nesodactylus hesperius* Colbert, 1969, OXF, Province Pinar del Rio, west Cuba.
Last: *Comodactylus ostromi* Galton, 1981, upper part of Morrison Formation, Wyoming, USA.
Intervening: KIM?

F. RHAMPHORHYNCHIDAE Seeley, 1870
J. (TOA–TTH) Terr.

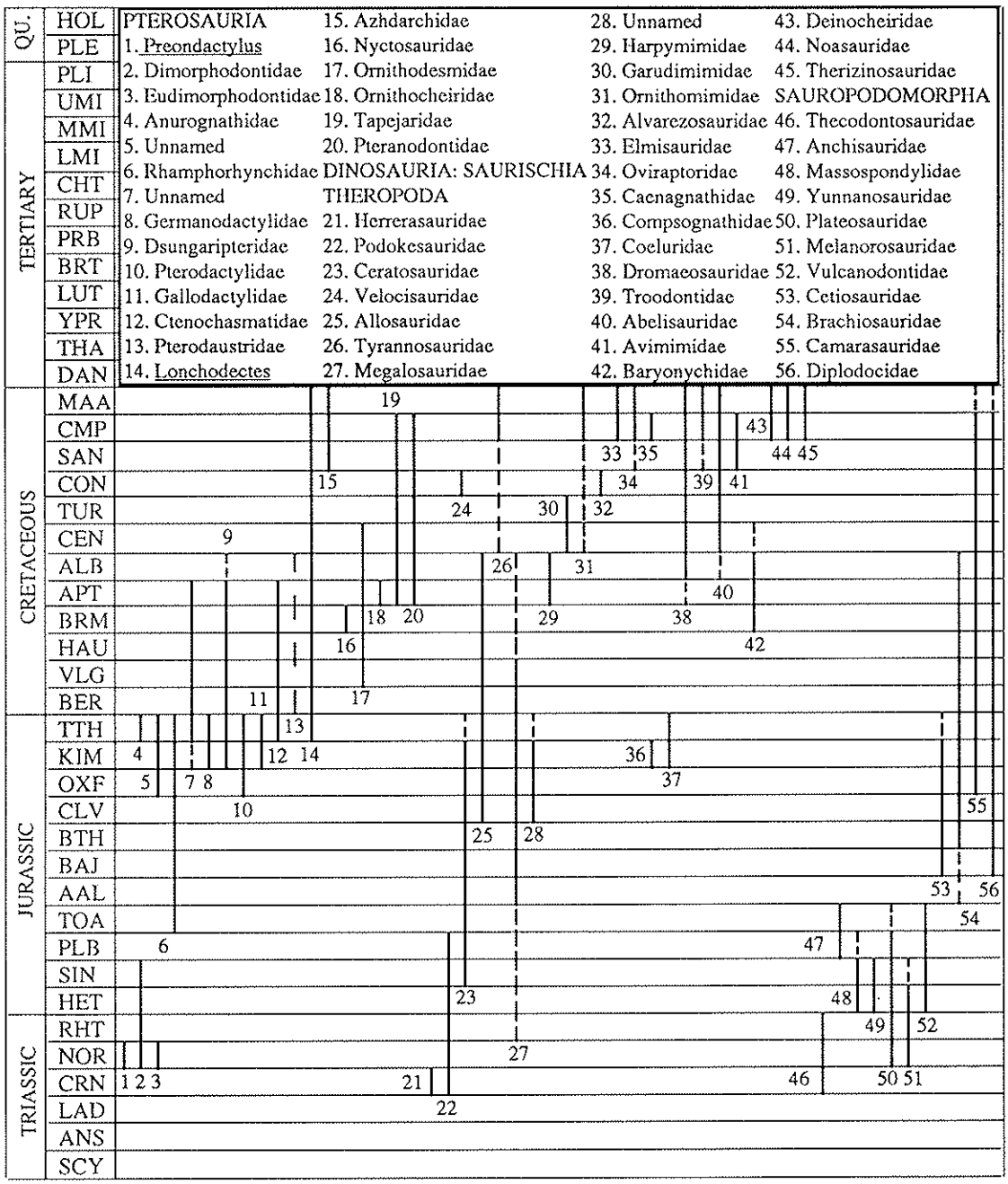

Fig. 39.5

First: *Parapsicephalus purdoni* (Newton, 1888), upper Lias, Yorkshire, England, UK; *Dorygnathus banthensis* (Theodori, 1930), upper Lias, Germany.
Last: *Rhamphorhynchus longicaudus* (Münster, 1839), *R. intermedius* Koh, 1937, *R. muensteri* (Goldfuss, 1831), *R. gemmingi* Meyer, 1846, *R. longiceps* Woodward, 1902, *Scaphognathus crassirostris* (Goldfuss, 1831), and *Odontorhynchus aculeatus* Stolley, 1936 (*?nom. nud.*), Solnhofener Schichten, Bavaria, Germany.
Intervening: BTH–KIM.

Suborder PTERODACTYLOIDEA Plieninger, 1901

Superfamily DSUNGARIPTEROIDEA Young, 1964

F. UNNAMED J. (KIM/TTH)–K. (APT) Terr.

First: *Dermodactylus montanus* (Marsh, 1878), Morrison Formation, Wyoming, USA.
Last: *Araripedactylus dehmi* Wellnhofer, 1977, Santana Formation, Estado do Ceará, Brazil.
Intervening: None.

F. GERMANODACTYLIDAE Young, 1964
J. (KIM–TTH) Terr.

First: *Germanodactylus* sp., Kimmeridge Clay, Dorset, England, UK (Unwin, 1987).
Last: *Germanodactylus cristatus* (Wiman, 1925), Solnhofener Schichten, Bavaria; *G. rhamphastinus* (Wagner, 1851), Mörnsheimer Schichten, Bavaria, Germany.

F. DSUNGARIPTERIDAE Young, 1964
J. (KIM)–K. (APT/ALB) Terr.

First: ?*Dsungaripterus brancai* (Reck, 1931), Tendaguru Beds, Tendaguru, Tanzania (Galton, 1980).
Last: *Dsungaripterus weii* Young, 1964 and *Noripterus complicidens* Young, 1973, Tugulu Group, Junggar Basin, Xinjiang, China; 'dsungaripterid', Qingshan Formation, Shandong, China.
Intervening: BER–HAU.
Comment: *Dsungaripterus brancai* is not noted as a dsungaripterid by Bennett (1989), so that the oldest certain member of the family is *Dsungaripterus parvus* Bakhurina, 1982, from the Tsagantsabskaya Svita, Khovd, Mongolia (VLG).

Superfamily UNNAMED

F. PTERODACTYLIDAE Bonaparte, 1838 (p)
J. (OXF–TTH) Terr.

First: *Pterodactylus* sp. (teeth), Guimarota lignite mine, Leiria, Portugal.
Last: *Pterodactylus antiquus* (Soemmerring, 1812), *P. kochi* (Wagner, 1837), *P. micronyx* Meyer, 1856, *P. elegans* Wagner, 1861, and *P. longicollum* Meyer, 1854, Solnhofener Schichten, Bavaria, Germany.
Comment: Evans and Milner (1991) note 'pterodactylid' teeth from the Forest Marble, upper BTH, of Oxfordshire, England, UK.

F. GALLODACTYLIDAE Fabre, 1974
J. (KIM–TTH) Terr.

First and Last: *Gallodactylus suevicus* (Quenstedt, 1855), Solnhofener Schichten, Bavaria, Germany and *G. canjuersensis* Fabre, 1974, 'Portlandien', Var, France.

F. CTENOCHASMATIDAE Nopcsa, 1928
J. (TTH)–K. (APT) Terr.

First: *Ctenochasma roemeri* Meyer, 1852, Purbeck, Hannover, Germany; *C. gracile* Oppel, 1862 and *Gnathosaurus subulatus* Meyer, 1834, Solnhofener Schichten, Bavaria, Germany; *Ctenochasma* sp., Portlandien inférieur, Haute Marne, France; *Huanhepterus quingyangensis* Dong, 1982, ?Tithonian, Ordos Basin, China.
Last: *Cearadactylus atrox* Leonardi and Borgomanero, 1985, Santana Formation, Estado do Ceára, Brazil.
Comment: *Aidachar paludalis* Nessov, 1981, Taykarshinskaya Member (TUR/SAN), Uzbekistan, former USSR, turns out to be based on the remains of a teleost fish (P. Wellnhofer, pers. comm., 1991). *Cearadactylus* is included here according to Unwin's (1991) cladistic analysis, although Wellnhofer (1991) places it in a separate family.
Intervening: None.

F. PTERODAUSTRIDAE Bonaparte, 1971
K. (l.) Terr.

First and Last: *Pterodaustro guinazui* Bonaparte, 1970, Lagarcito Formation, San Luis, Argentina.

F. UNNAMED K. (VLG–TUR) Terr.

First: ?*Lonchodectes sagittirostris* (Owen, 1874), Hastings Beds, Sussex, England, UK.
Last: *Lonchodectes compressirostris* (Owen, 1851), Middle Chalk, Kent, England, UK.
Intervening: ALB, CEN.
Comment: This family is based on Unwin's (1991) work.

F. AZHDARCHIDAE Nessov, 1984
J. (TTH)–K. (MAA) Terr.

First: *Doratorhynchus validus* Seeley, 1875, Purbeck, Dorset, England, UK.
Last: *Quetzalcoatlus' northropi* Lawson, 1975, Tornillo Group, Brewster County, Texas, USA; *Quetzalcoatlus* sp., Lance Formation, Wyoming, USA; MAA, New Jersey, USA; *Arambourgiana philadelphiae* (Arambourg, 1959), Maastrichtian, Amman, Jordan (Nessov, 1984; Bennett, 1989).
Intervening: ALB–CON, CMP.

Superfamily ORNITHOCHEIROIDEA Seeley, 1891

F. NYCTOSAURIDAE Williston, 1903
K. (SAN–MAA) Terr.

First: *Nyctosaurus gracilis* Marsh, 1876, Smoky Hill Chalk Member, upper Niobrara Formation, western Kansas, USA.
Last: *Nyctosaurus lamegoi* (Price, 1953), Gramame Formation, Paraíba, Brazil.
Intervening: None.

F. ORNITHODESMIDAE Hooley, 1913
K. (BRM) Terr.

First and Last: *Ornithodesmus latidens* Seeley, 1901, Wealden, Isle of Wight, England, UK.
Comment: *O. cluniculus* (Hooley, 1913), also from the Wealden of the Isle of Wight, is based on a dinosaur sacrum (A. R. Milner, in prep.).

F. ORNITHOCHEIRIDAE Seeley, 1870
K. (VLG–CEN) Terr.

First: *Coloborhynchus clavirostris* (Owen, 1874), Hastings Sand, Sussex, England, UK.
Last: *Anhanguera cuvieri* (Bowerbank, 1851), Lower Chalk, Kent, England, UK.
Intervening: APT, ALB.
Comment: This family is based on Unwin's (1991) analysis, and includes the Anhangueridae Campos and Kellner, 1985.

F. TAPEJARIDAE Kellner, 1990 K. (APT) Terr.

First and Last: *Tapejara wellnhoferi* Kellner, 1990 and *Tupuxuara longicristatus* Kellner and Campos, 1989, Santana Formation, Estado do Ceára, Brazil.

F. PTERANODONTIDAE Marsh, 1876
K. (APT–CMP) Terr.

First: *Ornithostoma sedgwicki* Seeley, 1891, Cambridge Greensand, Cambridgeshire, England, UK.
Last: *Pteranodon longiceps* Marsh, 1876 and *P. sternbergi* Harksen, 1966, Smoky Hill Chalk Member, upper Niobrara Formation and Pierre Shale, Kansas, South Dakota, and Wyoming, USA.
Intervening: CEN–SAN.
Comment: The Pteranodontidae, according to Bennett (1989) should be expanded to include pterosaurs assigned by Wellnhofer (1978, 1991), and others, to the families Criorhynchidae, Ornithocheiridae and Ornithodesmidae. However, the ornithodesmids and ornithocheirids are retained as separate families here, according to Unwin's (1991) work. Species of *Pteranodon* other than those named are regarded as synonyms or *nomina dubia* by C. Bennett (pers. comm., 1991).

Superorder DINOSAURIA Owen, 1842 (P)

The classification of dinosaurs, and stratigraphical distributions of families are taken from Weishampel *et al.* (1990).

Order SAURISCHIA Seeley, 1877

Suborder THEROPODA Marsh, 1881

F. HERRERASAURIDAE Benedetto, 1973
Tr. (CRN) Terr.

First and Last: *Staurikosaurus pricei* Colbert, 1970, *Scaphonyx Assemblage Zone*, Santa Maria Formation, Rio Grande do Sul, Argentina; *Herrerasaurus ischigualastensis* Reig, 1963, and *Ischisaurus cattoi* Reig, 1963, Ischigualasto Formation, San Juan, Argentina.

Infra-order CERATOSAURIA Gauthier, 1986

F. PODOKESAURIDAE Huene, 1914
Tr. (CRN)–J. (PLB) Terr.

First: *Coelophysis bauri* (Cope, 1889), lower part of Petrified Forest Member, Chinle Formation, Arizona, USA.
Last: *Syntarsus kayentakatae* Rowe, 1989, Kayenta Formation, Willow Springs, Arizona, USA.
Intervening: NOR, HET, SIN.
Comment: The famous *Coelophysis* quarry at Ghost Ranch, New Mexico, USA, is in the upper part of the Petrified Forest Member, dated lower NOR.

F. CERATOSAURIDAE Marsh, 1884 (P)
J. (SIN–KIM/TTH) Terr.

First: *Sarcosaurus woodi* Andrews, 1921, Lias, Leicestershire, England, UK.
Last: *Ceratosaurus nasicornis* Marsh, 1884, Morrison Formation, Canyon City, Colorado, USA.
Intervening: PLB?

F. VELOCISAURIDAE Bonaparte, 1991
K. (CON) Terr.

First and Last: *Velocisaurus unicus* Bonaparte, 1991, lower part of Rió Colorado Formation Neuquén Province, Argentina (Bonaparte, 1991).

Infra-order CARNOSAURIA Huene, 1920

F. ALLOSAURIDAE Marsh, 1879
J. (CLV)–K. (ALB) Terr.

First: *Piatnitzkysaurus floresi* Bonaparte, 1979, Cañadon Asfalto Formation, Chubut, Argentina.
Last: *Chilantaisaurus marotuensis* Hu, 1964, unnamed unit, Nei Mongol Zizhiqu, China.
Intervening: OXF–HAU, APT

F. TYRANNOSAURIDAE Osborn, 1905
K. (?CEN–MAA) Terr.

First: *Alectrosaurus olseni* Gilmore, 1933, Iren Dabasu Formation, Nei Mongol Zizhqu, China.
Last: *Tyrannosaurus rex* Osborn, 1905, Hell Creek Formation, Montana, and numerous other upper Maastrichtian formations in the mid-west of Canada and USA.
Intervening: CMP.

F. MEGALOSAURIDAE Huxley, 1869
Tr. (RHT)?–K. (VLG/ALB) Terr.

First: *Megalosaurus cambrensis* (Newton, 1899), Rhaetic, Glamorgan, Wales, UK.
Last: *Kelmayisaurus petrolicus* Dong, 1973, Lianmugin Formation, Xinjiang Uygur Zizhqu, China.
Intervening: AAL–BTH, OXF.
Comment: The family Megalosauridae is not accepted by Molnar *et al.* (1990), although they suggest that *Megalosaurus*, *Magnasaurus*, and *Kelmayisaurus* may be related. There is little evidence that *M. cambrensis* is a true megalosaur. If not, the earliest records of *Megalosaurus* are AAL and BAJ.

F. UNNAMED J. (CLV–KIM/TTH) Terr.

First: *Eustreptospondylus oxoniensis* Walker, 1964, Oxford Clay, Oxfordshire and Buckinghamshire, England, UK.
Last: *Torvosaurus tanneri* Galton and Jensen, 1979, Morrison Formation, Colorado, USA.
Intervening: None.
Comment: This family is hinted at by Molnar *et al.* (1990, p. 209), in suggesting a phyletic link between *Eustreptospondylus*, *Torvosaurus* and *Yangchuanosaurus*.

Infra-order ORNITHOMIMOSAURIA Barsbold, 1976

F. HARPYMIMIDAE Barsbold and Perle, 1984
K. (APT/ALB) Terr.

First and Last: *Harpymimus okladnikovi* Barsbold and Perle, 1984, Shinekhudukskaya Svita, Dundgov, Mongolia.

F. GARUDIMIMIDAE Barsbold, 1981
K. (CEN/TUR) Terr.

First and Last: *Garudimimus brevipes* Barsbold, 1981, Baynshirenskaya Svita, Omnogov, Mongolia.

F. ORNITHOMIMIDAE Marsh, 1890
K. (?CEN–MAA) Terr.

First: *Archaeornithomimus asiaticus* (Gilmore, 1933), Iren Dabasu Formation, Nei Mongol Zizhqu, China.
Last: *Ornithomimus velox* Marsh, 1890, Denver Formation, Colorado; Kaiparowits Formation, Utah, USA.
Intervening: CMP.
Comment: An older 'ornithomimid' has been reported from the Sebayashi Formation (BRM/APT) of Japan (Manabe and Hasegawa, 1991), but its exact affinities are unclear.

STEM-GROUP MANIRAPTORANS

?F. ALVAREZOSAURIDAE Bonaparte, 1991
K. (CON) Terr.

First and Last: *Alvarezosaurus calvoi* Bonaparte, 1991, Bajo de la Carpa Member, Rió Colorado Formation, Neuquén Province, Argentina (Bonaparte, 1991).

F. ELMISAURIDAE Osmólska, 1981
K. (CMP–MAA) Terr.

First: *Chirostenotes pergracilis* Gilmore, 1924 and *Elmisaurus elegans* (Parks, 1933), Judith River Formation, Alberta, Canada.
Last: *Elmisaurus rarus* Osmólska, 1981, Nemegt Formation, Omnogov, Mongolia.

F. OVIRAPTORIDAE Barsbold, 1976
K. (SAN/CMP–MAA) Terr.

First: *Oviraptor philoceratops* Osborn, 1924, Djadochta Formation, Omnogov, Mongolia.

Last: *Oviraptor mongoliensis* Barsbold, 1986, Nemegt Formation, Omnogov, Mongolia.

F. CAENAGNATHIDAE Sternberg, 1940
K. (CMP) Terr.

First and Last: *Caenagnathus collinsi* Sternberg, 1940 and *C. sternbergi* Cracraft, 1971, Judith River Formation, Alberta, Canada.

Infra-order MANIRAPTORA Gauthier, 1986

F. COMPSOGNATHIDAE Cope, 1871
J. (KIM) Terr.

First and Last: *Compsognathus longipes* Wagner, 1861, Solnhofener Schichten, Bavaria, Germany, and Lithographic Limestone, Canjuer, Var, France.

F. COELURIDAE Marsh, 1881 J. (KIM/TTH)

First and Last: *Coelurus fragilis* Marsh, 1879, Morrison Formation, Wyoming and Utah, USA.

F. DROMAEOSAURIDAE Matthew and Brown, 1922
K. (APT/ALB–MAA) Terr.

First: *Deinonychus antirrhopus* Ostrom, 1969, Cloverly Formation, Wyoming and Montana, USA.
Last: *Adasaurus mongoliensis* Barsbold, 1983, Nemegtskaya Svita, Bayankhongor, Mongolia.
Intervening: ?SAN, CMP.
Comment: Older (?) dromaeosaurid teeth have been noted from the Kitadani Formation (HAU/APT) of Japan (Manabe and Hasegawa, 1991). Even older dromaeosaurid/troodontid-type teeth have been noted from the BTH of the Cotswolds of England, UK (Metcalf *et al.*, 1993).

F. TROODONTIDAE Gilmore, 1924
K. (SAN/CMP–MAA) Terr.

First: *Saurornithoides mongoliensis* Osborn, 1924, Djadochta Formation, Omnogov, Mongolia.
Last: *Troodon formosus* Leidy, 1856, Hell Creek Formation, Montana, and Lance Formation, Wyoming, USA.

THEROPODA *incertae sedis*

F. ABELISAURIDAE Bonaparte and Novas, 1985
K. (ALB/CEN–MAA) Terr.

First: *Carnotaurus sastrei* Bonaparte, 1985, Gorro Frigio Formation, Chubut, Argentina.
Last: *Abelisaurus comahuensis* Bonaparte and Novas, 1985, Allen Formation, lower MAA, Rió Negro, Argentina; 'abelisaurid', Rognacien, Provence, France.
Intervening: CMP.

F. AVIMIMIDAE Kurzanov, 1981
K. (SAN/CMP) Terr.

First and Last: *Avimimus portentosus* Kurzanov, 1981, 'Barungoyotskaya' Svita, Omnogov, and 'Djadochtinskaya' Svita, Ovorkhangai, Mongolia.

F. BARYONYCHIDAE Charig and Milner, 1986
K. (BRM–ALB/CEN) Terr.

First: *Baryonyx walkeri* Charig and Milner, 1986, Weald Clay, Surrey, England, UK.
Last: *'Spinosaurus* cf. *aegypticus'*, continental red beds, Hammada du Guir, Morocco (Buffetaut, 1989).

F. DEINOCHEIRIDAE Osmólska and Roniewicz, 1970 K. (CMP/MAA) Terr.

First and Last: *Deinocheirus mirificus* Osmólska and Roniewicz, 1970, Nemegt Formation, Omnogov, Mongolia.

F. NOASAURIDAE Bonaparte and Powell, 1980
K. (CMP/MAA) Terr.

First and Last: *Noasaurus leali* Bonaparte and Powell, 1980, Lecho Formation, El Brete, Salta, Argentina.

F. THERIZINOSAURIDAE Maleev, 1954
K. (CMP/MAA) Terr.

First and Last: *Therizinosaurus cheloniformis* Maleev, 1954, Nemegt Formation, Omnogov, and White Beds of Khermeen Tsav, Bayankhongor, Mongolia.

Suborder SAUROPODOMORPHA Huene, 1932

Infra-order PROSAUROPODA Huene, 1920 (p)

F. THECODONTOSAURIDAE Huene, 1908
Tr. (CRN–RHT) Terr.

First: *Azendhosaurus laaroussi* Dutuit, 1972, Argana Formation, Marrakech, Morocco.
Last: *Thecodontosaurus antiquus* Riley and Stutchbury, 1836, Magnesian Conglomerate, Avon, England, UK; fissure fillings, Glamorgan, Wales, UK.
Intervening: NOR.

F. ANCHISAURIDAE Marsh, 1885
J. (PLB/TOA) Terr.

First and Last: *Anchisaurus polyzelus* (Hitchcock, 1865), Upper Portland Formation, Connecticut and Massachusetts, USA.

F. MASSOSPONDYLIDAE Huene, 1914
J. (HET–SIN/PLB) Terr.

First: *Massospondylus carinatus* Owen, 1854, upper Elliot Formation, Clarens Formation, and Bushveld Sandstone, South Africa; Forest Sandstone, Zimbabwe; upper Elliot Formation, Lesotho.
Last: *Massospondylus* sp., Kayenta Formation, Arizona, USA.

F. YUNNANOSAURIDAE Young, 1942
J. (HET/SIN) Terr.

First and Last: *Yunnanosaurus huangi* Young, 1942, upper Lower Lufeng Series, Yunnan, China.

F. PLATEOSAURIDAE Marsh, 1895
Tr. (NOR)–J. (PLB/TOA) Terr.

First: *Sellosaurus gracilis* Huene, 1907–1908, Untere and Mittlere Stubensandstein, Baden-Württemberg, Germany.
Last: *Ammosaurus major* (Marsh, 1891), upper Portland Formation, Connecticut; Navajo Sandstone, Arizona, USA.
Intervening: RHT.

F. MELANOROSAURIDAE Huene, 1929
Tr. (NOR–HET/SIN) Terr.

First: *Euskelosaurus browni* Huxley, 1866, lower Elliot Formation and Bushveld Sandstone, South Africa; lower Elliot Formation, Lesotho; Mpandi Formation, Zimbabwe; *Melanorosaurus readi* Haughton, 1924, lower Elliot Formation, South Africa.

Last: *Lufengosaurus huenei* Young, 1941, upper Lower Lufeng Series, Yunnan, China.
Intervening: RHT.
Comment: Dong *et al.* (1983) note cf. *Lufengosaurus* from the Zhenzhunchong Formation, Szechwan, China, dated as
TOA/BAJ (Weishampel, 1990).

Infra-order SAUROPODA Marsh, 1878

F. VULCANODONTIDAE Cooper, 1984 (p?)
J. (HET–TOA) Terr.

First: *Vulcanodon karibaensis* Raath, 1972, *Vulcanodon* Beds, Mashonaland North, Zimbabwe.
Last: *Ohmdenosaurus liasicus* Wild, 1978, Posidonienschiefer, Baden-Württemberg, Germany.
Intervening: PLB?

F. CETIOSAURIDAE Lydekker, 1888 (p)
J. (BAJ–KIM/TTH) Terr.

First: *Cetiosaurus medius* Owen, 1842, Inferior Oolite, West Yorkshire, England, UK; *Amygdalodon patagonicus* Cabrera, 1947, Cerro Carnerero Formation, Chubut, Argentina; *?Rhoetosaurus brownei* Longman, 1925, ?Injune Creek Beds, Queensland, Australia.
Last: *Haplocanthosaurus priscus* (Hatcher, 1903) and *H. delfsi* McIntosh and Williams, 1988, Morrison Formation, Colorado and Wyoming, USA.
Intervening: BTH, CLV.

F. BRACHIOSAURIDAE Riggs, 1904
J. (?AAL/BTH)–K. (ALB) Terr.

First: 'Brachiosaurid', Northamptonshire Sand Formation, Northamptonshire, England, UK (Cope *et al.*, 1980).
Last: *Brachiosaurus nougaredi* Lapparent, 1960, 'Continental Intercalaire', Wargla, Algeria; *Chubutisaurus insignis* Corro, 1974, Gorro Frigio Formation, Chubut, Argentina.
Intervening: BTH, CLV, KIM, TTH, VAL–APT.
Comment: If the Northamptonshire brachiosaurid is not confirmed, definite BTH examples include: *Bothriospondylus robustus* Owen, 1875, Forest Marble, Wiltshire, England, UK; *B. madagascariensis* Lydekker, 1895 and *Lapparentosaurus madagascariensis* Bonaparte, 1979, Isalo Formation, Majunga, Madagascar.

F. CAMARASAURIDAE Cope, 1877
J. (OXF)–K. (CMP/MAA) Terr.

First: *Tienshanosaurus chitalensis* Young, 1937, Shishugou Formation, Xinjiang, China.
Last: *Opisthocoelicaudia skarzynskii* Borsuk-Bialynicka, 1977, Nemegt Formation, Omnogov, Mongolia.
Intervening: KIM, TTH, HAU–BRM.

F. DIPLODOCIDAE Marsh, 1884
J. (BAJ)–K. (CMP/MAA) Terr.

First: *Cetiosauriscus longus* (Owen, 1842), Inferior Oolite, West Yorkshire, England, UK.
Last: *Nemegtosaurus mongoliensis* Nowinski, 1971, Nemegt Formation, Omnogov, Mongolia.
Intervening: BTH, CLV, KIM, TTH, ALB, ?SAN.

F. TITANOSAURIDAE Lydekker, 1885
J. (KIM)–K. (MAA) Terr. (Fig. 39.6)

First: *Tornieria robusta* (Fraas, 1908), upper Tendaguru Beds, Mtwara, Tanzania.
Last: *Alamosaurus sanjuanensis* Gilmore, 1922, Javelina Formation, upper MAA, Texas, USA; *Magyarosaurus dacus* (Nopcsa, 1915), *M. transsylvanicus* Huene, 1932, and *M. hungaricus* Huene, 1932, Sinpetru Beds, upper MAA, Hunedoara, Romania.
Intervening: VAL–BRM, ALB, TUR–CMP.
Comment: Titanosaurids are known from numerous CMP/MAA formations in Asia, South America, North America and Europe, but most are not dated as late MAA.

SAURISCHIA *incertae sedis*

F. SEGNOSAURIDAE Perle, 1979
K. (CEN/TUR–CMP) Terr.

First: *Enigmosaurus mongoliensis* Barsbold and Perle, 1983, *Erlikosaurus andrewsi* Perle, 1980, and *Segnosaurus galbinensis* Perle, 1979, Baynshirenskaya Svita, Omnogov and Dornogov, Mongolia.
Last: *Nanshiungosaurus brevispinus* Dong, 1979, Nanxiong Formation, Guandong, China.
Intervening: SAN, CMP.

Order ORNITHISCHIA Seeley, 1887

F. PISANOSAURIDAE Casamiquela, 1967
Tr. (CRN) Terr.

First and Last: *Pisanosaurus mertii* Casamiquela, 1967, Ischigualasto Formation, La Rioja Province, Argentina.

F. FABROSAURIDAE Galton, 1972
J. (HET/SIN) Terr.

First and Last: *Lesothosaurus diagnosticus* Galton, 1978, Upper Elliot Formation, Mafeting District, Lesotho.
Comment: Other supposed fabrosaurids such as *Technosaurus* and *Revueltosaurus* (CRN), *Scutellosaurus* (HET), *Fabrosaurus*, *Tawasaurus*, and *Fulengia* (HET/SIN), *Xiaosaurus* (BTH), *Alocodon* and *Trinucrodon* (OXF), *Nanosaurus* (KIM), and *Echinodon* (BER) are not regarded as fabrosaurids, but merely Ornithischia *incertae sedis*, or thyreophorans (e.g. *Scutellosaurus*), or prosauropods (e.g. *Fulengia*, *Tawasaurus*, *?Technosaurus*) (Weishampel and Witmer, 1990; Sereno, 1991a).

Suborder THYREOPHORA Nopcsa, 1915

F. SCELIDOSAURIDAE Huxley, 1869 (?p)
J. (SIN–TTH?) Terr.

First: *Scelidosaurus harrissoni* Owen, 1861, lower Lias, Dorset, England, UK.
Last: *Echinodon becklesi* Owen, 1861, middle Purbeck Beds, Dorset, England, UK.
Intervening: ?PLB.
Comment: The family Scelidosauridae is equated here with the 'basal Thyreophora' of Coombs *et al.* (1990). If *Echinodon* is not a 'basal thyreophoran', the family range becomes SIN–PLB?, with *Scutellosaurus lawleri* Colbert, 1981, as the youngest member.

Infra-order STEGOSAURIA Marsh, 1877

F. HUAYANGOSAURIDAE Dong *et al.*, 1982
J. (HET/PLB–BTH/CLV) Terr.

First: *Tatisaurus oehleri* Simmons, 1965, Dark Red Beds of the Lower Lufeng Group, Yunnan, China (Dong, 1990).
Last: *Huayangosaurus taibaii* Dong *et al.*, 1982, Xiashaximiao Formation, Szechwan, China.

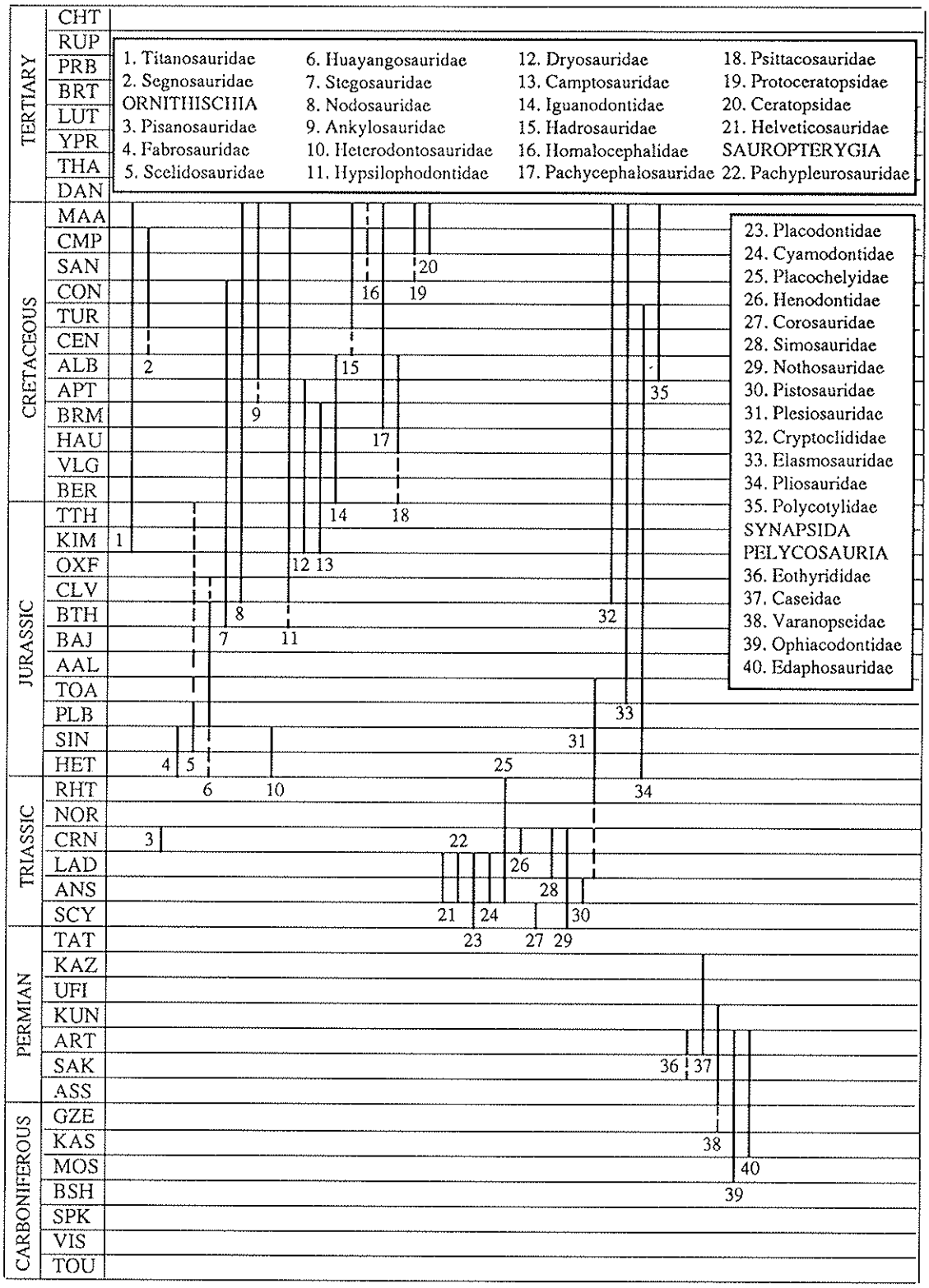

Fig. 39.6

F. STEGOSAURIDAE Marsh, 1880
J. (BTH)–K. (CON) Terr.

First: Unnamed stegosaur, Chipping Norton Formation, lower BTH, Gloucestershire, England, UK (Metcalf *et al.*, 1993); and from other BTH localities in Gloucestershire and Oxfordshire, England, UK (Evans and Milner, 1991).

Last: *Dravidosaurus blanfordi* Yadagiri and Ayyasami, 1979, Trichinopoly Group, Tamil Nadu, India.
Intervening: CLV–ALB.

Infra-order ANKYLOSAURIA Osborn, 1923

F. NODOSAURIDAE Marsh, 1890
J. (CLV)–K. (MAA) Terr.

First: *Sarcolestes leedsi* Lydekker, 1893, lower Oxford Clay, Cambridgeshire, England, UK.
Last: *'Struthiosaurus transilvanicus'* Nopcsa, 1915, Sinpetru Beds, Hunedoara, Romania; Gosau Formation, Niederösterreich, Austria; *Denversaurus schlessmani* Bakker, 1988, Lance Formation, South Dakota, USA.
Intervening: KIM, VLG–CEN, CMP.

F. ANKYLOSAURIDAE Brown, 1908
K. (APT/ALB–MAA) Terr.

First: *Shamosaurus scutatus* Tumanova, 1983, Khukhtekskaya Svita, Dornogov, Mongolia.
Last: *Ankylosaurus magniventris* Brown, 1908, Hell Creek Formation, Montana, USA; Lance Formation, Wyoming, USA; Scollard Formation, Alberta, Canada.
Intervening: CEN–CMP.

Suborder CERAPODA Sereno, 1986

Infra-order ORNITHOPODA Marsh, 1881

F. HETERODONTOSAURIDAE Romer, 1966
J. (HET/SIN–SIN) Terr.

First and Last: *Lycorhinus angustidens* Haughton, 1924, *Lanasaurus scalpridens* Gow, 1975, and *Abrictosaurus consors* (Thulborn, 1975), upper Elliot Formation, South Africa and/or Lesotho.
Last: *Heterodontosaurus tucki* Crompton and Charig, 1962, Clarens Formation, Cape Province, South Africa.

F. HYPSILOPHODONTIDAE Dollo, 1882
J. (BTH/CLV)–K. (MAA) Terr.

First: *Yandusaurus honheensis* He, 1979, Xiashaximiao Formation, Szechwan, China.
Last: *Thescelosaurus neglectus* Gilmore, 1913, Lance Formation, Wyoming, USA; Hell Creek Formation, Montana and South Dakota, USA; Scollard Formation, Alberta, Canada; *?T. garbanii* Morris, 1976, Hell Creek Formation, Montana, USA.
Intervening: KIM, TTH, BRM–ALB, CMP.

F. DRYOSAURIDAE Milner and Norman, 1984
J. (KIM)–K. (APT) Terr.

First: *Dryosaurus lettowvorbecki* (Virchow, 1919), Tendaguru Beds, Mtwara, Tanzania.
Last: *Valdosaurus nigeriensis* Galton and Taquet, 1982, El Rhaz Formation, Agadez, Niger.
Intervening: TTH–BRM.

F. CAMPTOSAURIDAE Marsh, 1885
J. (KIM)–K. (BRM) Terr.

First: *Camptosaurus prestwichi* (Hulke, 1880), Kimmeridge Clay, Oxfordshire, England, UK.
Last: *?Camptosaurus depressus* Gilmore, 1909, Lakota Formation, South Dakota, USA.
Intervening: TTH.

F. IGUANODONTIDAE Huxley, 1869
K. (BER–ALB) Terr.

First: *Iguanodon hoggi* Owen, 1874, upper Purbeck Beds, Dorset, England, UK.
Last: *'Iguanodon' orientalis* Rozhdestvensky, 1952, Khukhtekskaya Svita, Dundgov, Ovorkhangai; Shinekhudukskaya Svita, Dundgov, Mongolia.
Intervening: VLG–APT.

F. HADROSAURIDAE Cope, 1869
K. (?CEN–MAA) Terr.

First: *Gilmoreosaurus mongoliensis* (Gilmore, 1933) and *Bactrosaurus johnsoni* Gilmore, 1933, Iren Dabasu Formation, Nei Mongol Zizhiqu, China. The Iren Dabasu Formation is dated variously as CEN or MAA. If the latter, the oldest hadrosaurid is *Aralosaurus tubiferus* Rozhdestvensky, 1968, Beleutinskaya Svita, Kazakhstan, former USSR (?TUR/SAN).
Last: *Edmontosaurus regalis* Lambe, 1917, *E. annectens* (Marsh, 1892), *E. saskatchewanensis* (Sternberg, 1926), and *'Anatosaurus' copei* Lull and Wright, 1942, Scollard Formation, Alberta, Canada; Frenchman Formation, Saskatchewan, Canada; Hell Creek Formation, Montana, North Dakota, South Dakota, USA; Lance Formation, South Dakota, Wyoming, USA; Laramie Formation, Colorado, USA.
Intervening: TUR–CMP.

Infra-order PACHYCEPHALOSAURIA Maryanska and Osmólska, 1974

F. HOMALOCEPHALIDAE Dong, 1974
K. (?SAN–?MAA) Terr.

First: *Goyocephale latimorei* Perle *et al.*, 1982, unnamed unit, Ovorkhangai, Mongolia.
Last: *Homalocephale calathocercos* Maryanska and Osmólska, 1974, Nemegt Formation, Omnogov, Mongolia.
Intervening: CMP.

F. PACHYCEPHALOSAURIDAE Sternberg, 1945
K. (BRM–MAA) Terr.

First: *Yaverlandia bitholus* Galton, 1971, Wealden Marls, Isle of Wight, England, UK.
Last: *Pachycephalosaurus wyomingensis* Brown and Schlaikjer, 1943, Lance Formation, Wyoming, USA; Hell Creek Formation, South Dakota, Montana, USA; *Stegoceras edmontonense* (Brown and Schlaikjer, 1943), Hell Creek Formation, Montana, USA; *Stygimoloch spinifer* Galton and Sues, 1983, Hell Creek Formation, Montana, USA; Lance Formation, Wyoming, USA.
Intervening: CMP.

Infra-order CERATOPSIA Marsh, 1890

F. PSITTACOSAURIDAE Osborn, 1923
K. (BER/HAU–ALB) Terr.

First: *Psittacosaurus mongoliensis* Osborn, 1923, Shestakovskaya Svita, Gorno-Altayaskaya Autonomous Region, former USSR, and several formations in Mongolia and China.
Last: *Psittacosaurus guyangensis* Cheng, 1983, and *P. osborni* Young, 1931, Lisangou Formation, Nei Mongol Zizhiqu, China; and possibly other species of *Psittacosaurus* from China (Sereno, 1990, p. 589) in rocks dated as APT–ALB.
Intervening: APT.
Comment: An older 'psittacosaurid' has been reported from the Kitadani Formation (BRM) of Japan (Manabe and Hasegawa, 1991).

F. PROTOCERATOPSIDAE Granger and Gregory, 1923 K. (SAN/CMP–MAA) Terr.

First: *Protoceratops andrewsii* Granger and Gregory, 1923, Beds of Toogreeg and Beds of Alag Teg, Omnogov, Mongolia.

Last: *Leptoceratops gracilis* Brown, 1914, Scollard Formation, Alberta, Canada; Lance Formation, Wyoming, USA.

F. CERATOPSIDAE Marsh, 1890
K. (CMP–MAA) Terr.

First: *Chasmosaurus mariscalensis* Lehman, 1989, Aguja Formation, Texas, USA.
Last: *Torosaurus latus* Marsh, 1891 and *Triceratops horridus* Marsh, 1889, Lance Formation, Wyoming, USA; Evanston Formation, Wyoming, USA; Hell Creek Formation, Montana, South Dakota, USA; Laramie Formation, Colorado, USA; Javelina Formation, Texas, USA; Scollard Formation, Alberta, Canada; Frenchman Formation, Saskatchewan, Canada.

ARCHOSAUROMORPHA *incertae sedis*

F. HELVETICOSAURIDAE Peyer and Kuhn-Schnyder, 1955 Tr. (ANS/LAD) Mar.

First and Last: *Helveticosaurus zollingeri* Peyer, 1943, Grenzbitumen Horizon, Monte San Giorgio, Kanton Tessin, Switzerland.

NEODIAPSIDA *incertae sedis*

Superorder SAUROPTERYGIA Owen, 1860

Data on sauropterygian classification come from Sues (1987), Tschanz (1989) and Storrs (1991), and on distributions from Kuhn (1971), Mazin (1988) and Storrs (1991).

Order PACHYPLEUROSAURIA Sanz, 1980

F. PACHYPLEUROSAURIDAE Nopcsa, 1928
Tr. (ANS–LAD) Mar.

First: *Dactylosaurus gracilis* Gürich, 1884, lower Muschelkalk, Silesia, Poland; ?*Anarosaurus multidentatus* Huene, 1958, base of the Muschelkalk, Lechtaler Alpen, Germany; *Keichousaurus yuanensis* Young, 1965, basal Anisian, Kweichou, China.
Last: *Neusticosaurus pusillus* (Fraas, 1881), terminal Muschelkalk, Baden-Württemberg, Germany; *Psilotrachelosaurus toeplitschi* Nopcsa, 1928, upper Muschelkalk, Töplitsch, Germany.

Order NOTHOSAURIFORMES Storrs, 1991

Suborder PLACODONTIA Zittel, 1887–1890 (Owen, 1859)

F. PLACODONTIDAE Meyer, 1863
Tr. (SCY–LAD) Mar.

First: ?*Placodus impressus* Agassiz, 1839, upper Buntsandstein, Pfalz, Germany. A reputed upper SCY record from Makhtech Ramon, Israel is not a placodontian, but is rather a temnospondyl (Zanon, 1991).
Last: *Placodus gigas* Agassiz, 1833, Tonplatten, upper Muschelkalk, Bayreuth, Germany.
Intervening: ANS.

F. CYAMODONTIDAE Nopcsa, 1923
Tr. (ANS–LAD) Mar.

First: *Cyamodus tarnowitzensis* Gürich, 1884, lower Muschelkalk, Silesia, Poland.
Last: *Cyamodus rostratus* (Münster, 1830), upper Muschelkalk, Bayreuth, Germany.

F. PLACOCHELYIDAE Jaekel, 1907
Tr. (ANS–RHT) Mar.

First: *Saurosphargis volzi* Frech, 1903, Wellenkalk, lower Muschelkalk, Silesia, Poland.
Last: *Psephoderma alpinum* Meyer, 1858 and *P. raeticum* (Schubert-Klempnauer, 1975), Rät, Bavaria, Germany; *P. anglicum* Meyer, 1867, Rhaetic, Avon, England, UK.
Intervening: LAD, CRN, ?NOR.

F. HENODONTIDAE Huene, 1936
Tr. (CRN) Mar./FW

First and Last: *Henodus chelyops* Huene, 1936, Gipskeuper, Baden-Württemberg, Germany.

Suborder EUSAUROPTERYGIA Tschanz, 1989

Infra-order NOTHOSAURIA Seeley, 1882 (p)

F. COROSAURIDAE Kuhn, 1964 Tr. (SCY) Mar.

First and Last: *Corosaurus alcovensis* Case, 1936, Alcova Limestone, Chugwater Group, Natrona County, Wyoming, USA (Storrs, 1991a).

F. SIMOSAURIDAE Gervais, 1859
Tr. (LAD–CRN) Mar.

First: *Simosaurus gaillardoti* Meyer, 1842, upper Muschelkalk, France, Germany.
Last: *Simosaurus guilelmi* Meyer, 1855, Lettenkohle, Hoheneck, Germany.

F. NOTHOSAURIDAE Baur, 1889
Tr. (SCY–CRN) Mar.

First: ?*Nothosaurus mirabilis* Münster, 1834, Obere Buntsandstein, Germany; ?*Kwangsisaurus orientalis* Young, 1959, Lower Triassic, Kwangsi, China.
Last: *Nothosaurus edingerae* Schultze, 1970, Gipskeuper, Bayreuth, Germany.
Intervening: ANS, LAD.

Infra-order PLESIOSAURIA Blainville, 1835

Plesiosaur classification is based on Brown (1981) and Storrs and Langston (1993), and distributional data come from Persson (1963), Brown (1981), Mazin (1988) and Storrs and Langston (1993).

F. PISTOSAURIDAE Baur, 1887 Tr. (ANS) Mar.

First and Last: *Pistosaurus longaevus* Meyer, 1847–1855, upper Muschelkalk, Bayreuth, Bavaria, Germany.

F. PLESIOSAURIDAE Gray, 1825
Tr. (LAD??/RHT)–J. (TOA) Mar.

First: *Plesiosaurus priscus* Huene, 1902, Lettenkohle of Bibersfeld, Germany, is based on plesiosaur-like vertebrae (Mazin, 1988, p. 119). Other plesiosaurian vertebrae are known from the Middle Triassic German Muschelkalk and the Ladinian of the former USSR (Storrs, 1991a, p. 81). If these are not plesiosaurid, then the oldest remains are *Plesiosaurus costatus* Owen, 1840, and other species, from the Rhaetic of Avon, Leicestershire, and Nottinghamshire, England, UK; Morayshire, Scotland, UK; Autun, France; and Baden-Württemberg, Germany.
Last: *Plesiosaurus brachypterygius* Huene, 1923 and *P. guilelmiimperatoris* Dames, 1895, Lias-ε, Posidonienschiefer, Baden-Württemberg, Germany.
Intervening: HET–PLB.

F. CRYPTOCLEIDIDAE Williston, 1925
J. (CLV)–K. (MAA) Mar.

First: *Cryptoclidus eurymerus* (Phillips, 1871), Oxford Clay, Bedfordshire and Cambridgeshire, England, UK; *C. richardsoni* (Lydekker, 1889), Oxford Clay, Dorset, England, UK.
Last: *Aristonectes parvidens* Cabrera, 1941, Cañadon del Loro, Chubut, Argentina; *Turneria seymourensis* Chatterjee and Small, 1989, Lopez de Bertodano Formation, Seymour Island, Antarctica (Chatterjee and Small, 1989).
Intervening: KIM.

F. ELASMOSAURIDAE Cope, 1869
J. (TOA)–K. (MAA) Mar.

First: *Microcleidus macropterus* (Seeley, 1865) and *M. homalospondylus* (Owen, 1840), Alum Shale Member, Yorkshire, England, UK.
Last: *Mauisaurus haasti* Hector, 1874, Haumurian, South Island, New Zealand (Welles and Gregg, 1971); elasmosaurid vertebrae, Nacatoch Formation, Texas, USA (Storrs and Langston, 1993); elasmosaurid vertebrae and tooth, Nekum Chalk and Emael Chalk, Maastricht Formation, Limburg, The Netherlands (Mulder, 1990); elasmosaurid, Lopez de Bertodano Formation, Seymour Island, Antarctica (Chatterjee and Small, 1989).
Intervening: OXF–TTH, ALB–CMP.

F. PLIOSAURIDAE Seeley, 1874
J. (HET)–K. (TUR) Mar.

First: ?*Eurycleidus arcuatus* (Owen, 1840), and others, lower Lias, Zone of *Psiloceras planorbis*, Dorset, England, UK.
Last: *Polyptychodon hudsoni* Welles and Slaughter, 1963, Arcadia Park Formation, Eagle Ford Group, Dallas County, Texas, USA (Storrs and Langston, 1993).
Intervening: SIN–TOA, BTH–TTH, APT–CEN.
Comment: If *Eurycleidus arcuatus* and relatives are not pliosaurids, then the oldest confirmed examples are CLV and OXF from Europe.

F. POLYCOTYLIDAE Williston, 1908
K. (ALB–MAA) Mar.

First: *Trinacomerum* sp., Kiamichi Formation, Denton County, Texas, USA (Storrs and Langston, 1993).
Last: *Polycotylus* sp., Haumurian, South Island, New Zealand (Welles and Gregg, 1971), Fox Hills Formation, New Mexico, USA.

Subclass SYNAPSIDA Osborn, 1903(p)

Order PELYCOSAURIA Cope, 1878(p)

All pelycosaur records were obtained from Reisz (1986), unless otherwise stated. The ages of the terrestrial Lower Permian tetrapod-bearing formations of the United States are hard to correlate with the type Russian marine sections, so there is some uncertainty over the dating of many pelycosaur records (Olson and Vaughn, 1970).

F. EOTHYRIDIDAE Romer and Price, 1940
P. (SAK?–ART) Terr.

First: *Oedaleops campi* Langston, 1965, Abo/Cutler Formation, Cutler Group, Rio Arriba County, New Mexico, USA.
Last: *Eothyris parkeyi* Romer, 1937, Belle Plains Formation, Wichita Group, Archer County, Texas, USA.

F. CASEIDAE Williston, 1912
P. (ART–KAZ) Terr.

First: *Casea broilii* Williston, 1910, uppermost Arroyo Formation or lowermost Vale Formation, Clear Fork Group, Baylor County, Texas, USA.
Last: *Ennatosaurus tecton* Efremov, 1956, Zone II, Kazanian, Pinega River, former USSR.
Intervening: KUN.

F. VARANOPSEIDAE Romer and Price, 1940
C./P. (NOG/ASS)–P. (KUN) Terr.

First: *Aerosaurus greenleeorum* Romer, 1937, Abo/Cutler Formation, Cutler Group, Rio Arriba County, New Mexico, USA.
Last: *Varanodon agilis* Olson, 1965, Chickasha Formation, equivalent of the middle Flowerpot Formation, Blaine County, Oklahoma, USA.
Intervening: SAK, ART.

F. OPHIACODONTIDAE Nopcsa, 1923
C. (MYA)–P. (ART) Terr.

First: *Archaeothyris florensis* Reisz, 1972, Morien Group, Florence, Nova Scotia, Canada.
Last: *Ophiacodon major* Romer and Price, 1940, Clyde Formation, Clear Fork Group, Baylor County, Texas, USA.
Intervening: KRE/CHV, KLA–SAK.
Comment: A possible ophiacodontid, *Varanosaurus acutirostris* Broili, 1904, from the Arroyo Formation, Clear Fork Group of Texas, would be the youngest representative of that family (ART) if correctly determined. However, Reisz (1986, p. 85) regards it as 'Pelycosauria *incertae sedis*'.

F. EDAPHOSAURIDAE Case, 1907
C. (KRE/CHV)–P. (ART) Terr.

First: *Edaphosaurus ? raymondi* (Case, 1908), Round Knob Formation, Conemaugh Group, Pitcairn, Pennsylvania, USA.
Last: *Edaphosaurus pogonias* Cope, 1882, Arroyo Formation, Clear Fork Group, Baylor County, Texas, USA.
Intervening: KLA/NOG–SAK.

F. SPHENACODONTIDAE Williston, 1912
C. (KRE)–P. (UFI) Terr. (Fig. 39.7)

First: *Haptodus garnettensis* Currie, 1977, Stanton Formation, Lansing Group, Garnett, Kansas, USA.
Last: *Dimetrodon angelensis* Olson, 1962, upper San Angelo Formation, Pease River Group, Knox County, Texas, USA.
Intervening: ASS–KUN.

Order THERAPSIDA Broom, 1905

Therapsid classification is based broadly on Kemp (1982) and Hopson and Barghusen (1986). Distributional data and more detailed family designations are based on Sigogneau-Russell (1989) for Phthinosuchia, Biarmosuchia, Eotitanosuchia and Gorgonopsia, King (1988) for Dinocephalia and Dicynodontia, Tatarinov (1974), Mendrez-Carroll (1975) and Kemp (1982), and Hopson and Barghusen (1986) for the classification of Therocephalia, and Hopson and Kitching (1972), Tatarinov (1974), Battail (1982), Kemp (1982) and Hopson and Barghusen (1986) for the classification of Cynodontia. Additional distributional data came from Haughton and Brink (1954), Kitching (1977), Anderson and Cruickshank (1978), and Bonaparte (1978).

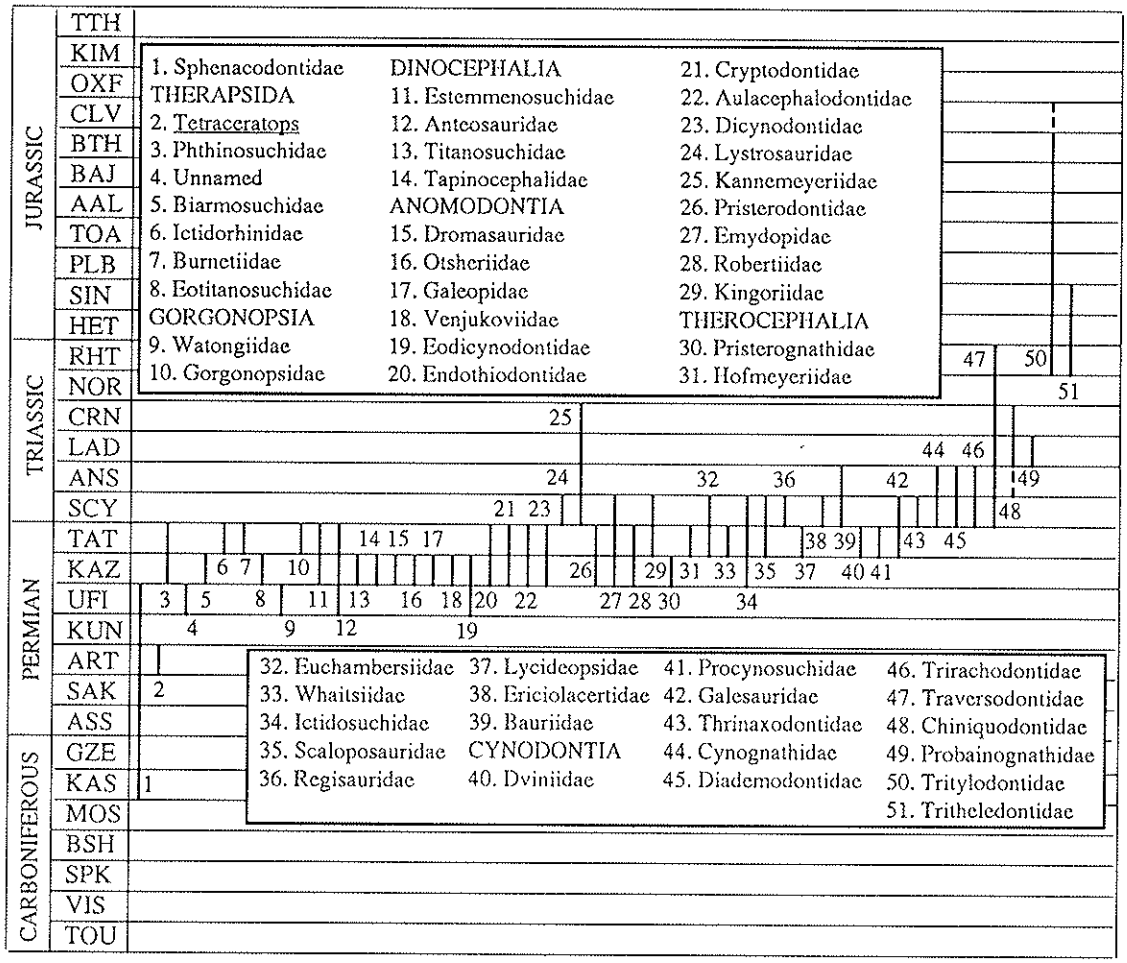

Fig. 39.7

F. UNNAMED P. (ART) Terr.

First and Last: *Tetraceratops insignis* Matthew, 1908, basal Clear Fork Group, Baylor County, Texas, USA (Laurin and Reisz, 1990).

Suborder PHTHINOSUCHIA Romer, 1961

F. PHTHINOSUCHIDAE Efremov, 1954
P. (KAZ–TAT) Terr.

First: *Phthinosaurus borissiaki* Efremov, 1940, Uralian Cupric Sandstones (Ezhovo), western Cisuraly, former USSR.
Last: *Phthinosuchus discors* Efremov, 1954, Uralian Cupric Sandstones (Isheevo), western Cisuraly, former USSR.

F. UNNAMED P. (UFI) Terr.

First: ?*Knoxosaurus niteckii* Olson, 1962, upper San Angelo Formation, Knox County, Texas, USA.
Last: *Steppesaurus gurleyi* Olson and Beerbower, 1953, lower Flower Pot Formation, Hardeman County, Texas, USA.

Suborder BIARMOSUCHIA Hopson and Barghusen, 1986

F. BIARMOSUCHIDAE Olson, 1962
P. (KAZ) Terr.

First and Last: *Biarmosuchus tener* Tchudinov, 1960, Ezhovo, Perm Province, former USSR.

F. ICTIDORHINIDAE Broom, 1932
P. (TAT) Terr. (including Hipposauridae)

First: *Hipposaurus boonstrai* Haughton, 1929 and *H. brinki* Sigogneau, 1970, *Eodicynodon–Tapinocaninus* Assemblage Zone, South Africa.
Last: *Ictidorhinus martinsi* Broom, 1913 and *Rubidgina angusticeps* Broom, 1942, *Dicynodon–Theriognathus* Assemblage Zone, Graaff-Reinet, South Africa.

F. BURNETIIDAE Broom, 1923 P. (TAT) Terr.

First and Last: *Proburnetia viatkensis* Tatarinov, 1968, upper TAT, Kirov Province, Kotelnitch, former USSR; *Burnetia mirabilis* Broom, 1923, *Dicynodon–Theriognathus* Assemblage Zone, Graaff-Reinet, South Africa.

Suborder EOTITANOSUCHIA Boonstra, 1963

F. EOTITANOSUCHIDAE Tchudinov, 1960
P. (KAZ) Terr.

First and Last: *Eotitanosuchus olsoni* Tchudinov, 1960, Ezhovo, Ocher Province, former USSR.

Suborder GORGONOPSIA Seeley, 1895

F. WATONGIIDAE Sigogneau-Russell, 1989
P. (UFI) Terr.

First and Last: ?*Watongia meieri* Olson, 1974, Chickasha Formation, Blaine County, Oklahoma, USA.

F. GORGONOPSIDAE Lydekker, 1890
P. (TAT) Terr.

First: *Broomisaurus planiceps* (Broom, 1913), *Eoarctops vanderbyli* Haughton, 1929, *Galesuchus gracilis* Haughton, 1925, and *Scylacognathus parvus* Broom, 1913, *Eodicynodon–Tapinocaninus* Assemblage Zone, South Africa.
Last: *Aelurosaurus wilmanae* Broom, 1940, *Aloposaurus ? tenuis* (Brink and Kitching, 1953), *Arctognathus curvimola* (Owen, 1876), *Arctops watsoni* Brink and Kitching, 1953, *Broomicephalus laticeps* (Broom, 1940), *Clelandina scheepersi* (Brink and Kitching, 1953), *Cyonosaurus rubidgei* (Broom, 1947), *Dinogorgon pricei* (Broom and George, 1950), *Leontocephalus cadlei* Broom, 1940, *Lycaenops angusticeps* (Broom, 1913), *Paragalerhinus rubidgei* (Broom, 1936), *Prorubidgea maccabei* Broom, 1940, *Rubidgea platyrhina* Brink and Kitching, 1953, and *Sycosaurus laticeps* Haughton, 1924, *Dicynodon–Theriognathus* Assemblage Zone, South Africa; *Inostrancevia alexandri* Amalitsky, 1922 and *Pravoslavlevia parva* (Pravoslavlev, 1927), Northern Dvina Horizon, Archangelsk Province, former USSR; *?Niuksenitia sukhonensis* Tatarinov, 1977, Vologda Province, former USSR.

Infra-order DINOCEPHALIA Seeley, 1894

F. ESTEMMENOSUCHIDAE Tchudinov, 1960
P. (KAZ–TAT) Terr.

First: *Estemmenosuchus uralensis* Tchudinov, 1960, *E. mirabilis* Tchudinov, 1968, *Anoplosuchus tenuirostris* Tchudinov, 1968, and *Zopherosuchus luceus* Tchudinov, 1983, upper KAZ, Ezhovo, former USSR.
Last: *Molybdopygus arcanus* Tchudinov, 1964, lower TAT, Kirov, former USSR.

F. ANTEOSAURIDAE Boonstra, 1954
P. (UFI–TAT) Terr. (= Brithopidae)

First: *Eosyodon hudsoni* Olson, 1962, San Angelo Formation, Knox County, Texas, USA.
Last: *Notosyodon guvesi* Tchudinov, 1968, *Syodon biarmicum* Kutorga, 1838, *Titanophoneus potens* Efremov, 1938, *Doliosauriscus yanshinovi* (Orlov, 1958), *Deuterosaurus biarmicus* Eichwald, 1860, and *Admetophoneus kargalensis* Efremov, 1954, lower TAT, southern Cisurals region, former USSR; *Anteosaurus magnificus* Watson, 1921 and *Paranteosaurus primus* Boonstra, 1954, *Tapinocephalus–Bradysaurus* Assemblage Zone, South Africa.
Intervening: KAZ.

F. TITANOSUCHIDAE Boonstra, 1972
P. (KAZ) Terr.

First and Last: *Jonkeria truculenta* Van Hoepen, 1916 and six other species, and *Titanosuchus ferox* Owen, 1879, *Tapinocephalus–Bradysaurus* Assemblage Zone, South Africa.

F. TAPINOCEPHALIDAE Lydekker, 1890
P. (KAZ) Terr.

First: *Ulemosaurus svigagensis* Riabinin, 1938, Zone II, Isheevo, Tatar Republic former USSR; *Tapinocaninus pamelae* Rubidge, 1988, *Eodicynodon–Tapinocaninus* Assemblage Zone, South Africa.
Last: *Struthiocephalus whaitsi* Haughton, 1915, and 17 other species, *Tapinocephalus–Bradysaurus* Assemblage Zone, South Africa.

Infra-order ANOMODONTIA (DICYNODONTIA) Owen, 1859

F. DROMASAURIDAE Abel, 1919 P. (KAZ) Terr.

First: *Patronomodon nyaphulii* Rubidge and Hopson, 1991, *Eodicynodon–Tapinocaninus* Assemblage Zone, South Africa (Rubidge and Hopson, 1991).
Last: *Galepus jouberti* Broom, 1910, *Aulacephalodon–Cistecephalus* Assemblage Zone, South Africa.

F. OTSHERIIDAE Tchudinov, 1960 P. (KAZ) Terr.

First and Last: *Otsheria netsvetajevi* Tchudinov, 1960, Zone II, KAZ, Ezhovo, Ural region, former USSR.

F. GALEOPIDAE Broom, 1912 P. (KAZ) Terr.

First and Last: *Galeops whaitsi* Broom, 1912, *Tapinocephalus–Bradysaurus* Assemblage Zone, South Africa.

F. VENJUKOVIIDAE Efremov, 1940
P. (KAZ) Terr.

First: *Venjukovia prima* Amalitsky, 1922, Copper Sandstones, Zone II, KAZ, Ural region, former USSR.
Last: *Venjukovia invisa* Efremov, 1938, Copper Sandstones, Zone II, KAZ, Ural region, former USSR.

F. EODICYNODONTIDAE Cluver and King, 1983 P. (UFI/KAZ) Terr.

First and Last: *Eodicynodon oosthuizeni* Barry, 1974, *Eodicynodon–Tapinocaninus* Assemblage Zone, Cape Province, South Africa.

F. ENDOTHIODONTIDAE Owen, 1876
P. (KAZ–TAT) Terr.

First: *Chelydontops altidentalis* Cluver, 1975, *Tapinocephalus–Bradysaurus* Assemblage Zone, Cape Province, South Africa.
Last: *Endothiodon* sp., *Aulacephalodon–Cistecephalus* Assemblage Zone, South Africa. Equivalents in Brazil, India and Zambia.

F. CRYPTODONTIDAE Owen, 1859
P. (KAZ–TAT) Terr.

First: *Tropidostoma microtrema* (Seeley, 1889), *Cteniosaurus platyceps* Broom, 1935, *Rhachiocephalus magnus* (Owen, 1876), *Oudenodon bainii* Owen, 1860, and other species of these genera, *Tropidostoma–Endothiodon* Assemblage Zone, Beaufort West, South Africa.
Last: *Oudenodon baini* (Owen, 1860), *Dicynodon–Theriognathus* Assemblage Zone, South Africa. Equivalents from Zambia.

F. AULACEPHALODONTIDAE Cluver and King, 1983 P. (KAZ–TAT) Terr.

First: *Aulacephalodon baini* (Owen, 1845) and *Pelanomodon rubidgei* Broom, 1938, *Aulacephalodon–Cistecephalus* Assemblage Zone, South Africa, and equivalents in Zambia and Tanzania respectively.
Last: *Geikia elginensis* Newton, 1893, Cutties Hillock Sandstone Formation, Morayshire, Scotland, UK.

F. DICYNODONTIDAE Owen, 1859
P. (KAZ–TAT) Terr.

First: *Dicynodon acutirostris* Broom, 1935, and other species of this genus, *Tropidostoma–Endothiodon* Assemblage Zone, South Africa.

Last: *Dicynodon traquairi* (Newton, 1893), Cutties Hillock Sandstone, Morayshire, Scotland, UK.
Comment: Supposedly older species of *Dicynodon*, from the *Pristerognathus–Diictodon* Assemblage Zone of South Africa, are hard to substantiate (King, 1988).

F. LYSTROSAURIDAE Broom, 1903
Tr. (SCY) Terr.

First and Last: *Lystrosaurus murrayi* (Huxley, 1859), *Lystrosaurus–Procolophon* Assemblage Zone, Cape Province, South Africa; and 12 other species from this zone, and supposedly equivalent zones in Antarctica, the former USSR, China, India and Laos.

F. KANNEMEYERIIDAE Huene, 1948
Tr. (SCY–CRN) Terr.

First: *Kannemeyeria simocephalus* (Weithofer, 1888), Lower Etjo Beds, south-west Africa; *K. wilsoni* Broom, 1937, *Cynognathus–Diademodon* Assemblage Zone, South Africa; *K. argentinensis* Bonaparte, 1966, Puesto Viejo Formation, Mendoza Province, Argentina; *Vinceria andina* Bonaparte, 1967, Cerro de Las Cabras Formation, Mendoza Province, Argentina.
Last: *Jachaleria colorata* Bonaparte, 1971, boundary between Ischigualasto Formation and lower Los Colorados Formation, La Rioja Province, Argentina.
Intervening: ANS, LAD.

F. PRISTERODONTIDAE King, 1988
P. (KAZ–TAT) Terr.

First: *Pristerodon merwevillensis* (Broili and Schroeder, 1935), *Tapinocephalus–Bradysaurus* Assemblage Zone, South Africa.
Last: *Pristerodon mackayi* Huxley, 1868, and 13 other species of that genus, *Aulacephalodon–Cistecephalus* Assemblage Zone, South Africa.

F. EMYDOPIDAE Cluver and King, 1983
P. (KAZ)–Tr. (SCY) Terr.

First: *Emydops* sp., *Tapinocephalus–Bradysaurus* Assemblage Zone, South Africa.
Last: *Myosaurus gracilis* Haughton, 1917, *Lystrosaurus–Procolophon* Assemblage Zone, South Africa.
Intervening: TAT.

F. ROBERTIIDAE Cluver and King, 1983
P. (KAZ–TAT) Terr.

First: *Robertia broomiana* Boonstra, 1948, *Diictodon joubertii* (Broom, 1905), and four other species of the latter genus, *Tapinocephalus–Bradysaurus* Assemblage Zone, South Africa.
Last: *Diictodon nanus* (Broom, 1936), *Dicynodon–Theriognathus* Assemblage Zone, South Africa.

F. KINGORIIDAE King, 1988
P. (TAT)–Tr. (SCY) Terr.

First: *Kingoria nowacki* (Huene, 1942), Kawinga Formation, Kongori, Tanzania; *K. recurvidens* (Owen, 1876), and four other species of that genus, and *Dicynodontoides parringtoni* Broom, 1940, *Aulacephalodon–Cistecephalus* Assemblage Zone, South Africa.
Last: *Kombuisia frerensis* Hotton, 1974, *Cynognathus–Diademodon* Assemblage Zone, Cape Province, South Africa.

Suborder THEROCEPHALIA Broom, 1903

F. PRISTEROGNATHIDAE Broom, 1906
P. (KAZ) Terr.

First: *Porosteognathus efremovi* Vjuschkov, 1952, Zone I, Urals region, former USSR; 'pristerognathid', upper Ecca Group, Cape Province, South Africa (Rubidge *et al.*, 1983).
Last: *Pristerognathus polyodon* Seeley, 1895, and other species, upper *Pristerognathus–Diictodon* Assemblage Zone, South Africa.

F. HOFMEYERIIDAE Hopson and Barghusen, 1986
P. (TAT) Terr.

First and Last: *Hofmeyria atavus* Broom, 1935 and *Ictidostoma hemburyi* (Broom, 1912), *?Aulacephalodon–Cistecephalus* Assemblage Zone, South Africa (Brink, 1960).

F. EUCHAMBERSIIDAE Boonstra, 1934
P. (TAT)–Tr. (SCY) Terr. (= Moschorhinidae; Annatherapsidae; Akidnognathidae)

First: *Euchambersia mirabilis* Broom, 1931, *Aulacephalodon–Cistecephalus* Assemblage Zone; *Annatherapsidus petri* (Amalitzky, 1922), Zone IV, Urals region, former USSR.
Last: *Moschorhinus kitchingi* Broom, 1920, *Lystrosaurus–Procolophon* Assemblage Zone, South Africa.

F. WHAITSIIDAE Haughton, 1918
P. (TAT) Terr.

First: *Whaitsia* sp. *Aulacephalodon–Cistecephalus* Assemblage Zone, Graaf-Reinet, South Africa.
Last: *Whaitsia platyceps* Haughton, 1918, *Dicynodon–Theriognathus* Assemblage Zone, South Africa and equivalent, Ruhuhu Valley, Tanzania; *Moschowhaitsia vjushkovi* Tatarinov, 1963, Zone IV, TAT, Urals region, former USSR.

F. ICTIDOSUCHIDAE Broom, 1903
P. (KAZ)–Tr. (SCY) Terr.

First: *Icticephalus polycynodon* Broom, 1915, *Tapinocephalus–Bradysaurus* Assemblage Zone, South Africa.
Last: *Olivieria parringtoni* Brink, 1965, *Lystrosaurus–Procolophon* Assemblage Zone, Orange Free State, South Africa. Note that Colbert and Kitching (1981) regard *Olivieria* as a juvenile *Moschorhinus*.

F. SCALOPOSAURIDAE Broom, 1914
P. (TAT)–Tr. (SCY) Terr.

First: *Scaloposaurus constrictus* Owen, 1876 and *Nanictocephalus richardi* Broom, 1940, *Aulacephalodon–Cistecephalus* Assemblage Zone, South Africa (Mendrez-Carroll, 1979).
Last: *Pedaeosaurus parvus* Colbert and Kitching, 1981, Fremouw Formation, Antarctica.
Comment: Mendrez-Carroll (1979) and Hopson and Barghusen (1986) noted that the *Lystrosaurus–Procolophon* Assemblage Zone examples of scaloposaurids belong to other taxa, but Colbert and Kitching (1981) described *Pedaeosaurus* as a scaloposaurid.

F. REGISAURIDAE Hopson and Barghusen, 1986
Tr. (SCY) Terr.

First and Last: *Regisaurus jacobi* Mendrez, 1972, *Lystrosaurus–Procolophon* Assemblage Zone, Cape Province, South Africa.

F. LYCIDEOPSIDAE Broom, 1931 P. (TAT) Terr.

First and Last: *Lycideops longiceps* Broom, 1931,

Aulacephalodon–Cistecephalus Assemblage Zone, South Africa.

F. ERICIOLACERTIDAE Watson and Romer, 1956
Tr. (SCY) Terr.

First and Last: *Ericiolacerta parva* Watson, 1931, *Lystrosaurus–Procolophon* Assemblage Zone, Orange Free State, South Africa; Fremouw Formation, Antarctica (Colbert and Kitching, 1981).

F. BAURIIDAE Broom, 1911 Tr. (SCY–ANS) Terr.

First: *Bauria cynops* Broom, 1909, *Sesamodon browni* Broom, 1932, *Cynognathus–Diademodon* Assemblage Zone, South Africa.
Last: *Dongusaurus schepetovi* Vjuschkov, 1964 and *Nothogomphodon danilovi* Tatarinov, 1974, Donguz Series, Urals region, former USSR; *Herpetogale marsupialis* Keyser and Brink, 1979, Omingonde Formation, Etjo Mountain, south-west Africa (Keyser and Brink, 1979).

Suborder CYNODONTIA Owen, 1860

F. DVINIIDAE Tatarinov, 1968 P. (TAT) Terr.

First and Last: *Dvinia prima* Amalitzky, 1922, Zone IV, Urals region, former USSR.

F. PROCYNOSUCHIDAE Broom, 1937
P. (TAT)

First and Last: *Procynosuchus delaharpeae* Broom, 1937, ?*Aulacephalodon–Cistecephalus* and *Dicynodon–Theriognathus* Assemblage Zones, South Africa; Madumabisa Mudstones, Luangwa Valley, Zambia; *Procynosuchus* sp., Randkalk, northern Hessen, Germany (Sues and Boy, 1988).

F. GALESAURIDAE Lydekker, 1890
P. (TAT)–Tr. (SCY) Terr.

First: *Cynosaurus suppostus* (Owen, 1876), *Dicynodon–Theriognathus* Assemblage Zone, South Africa.
Last: *Galesaurus planiceps* Owen, 1859, *Lystrosaurus–Procolophon* Assemblage Zone, South Africa.

F. THRINAXODONTIDAE Seeley, 1894
Tr. (SCY) Terr.

First and Last: *Thrinaxodon liorhinus* Seeley, 1894, *Lystrosaurus–Procolophon* Assemblage Zone, South Africa; Fremouw Formation, Antarctica (Colbert and Kitching, 1977).

F. CYNOGNATHIDAE Seeley, 1895
Tr. (SCY–ANS) Terr.

First: *Cynognathus crateronotus* Seeley, 1895, *Cynognathus–Diademodon* Assemblage Zone, South Africa; *C. minor* Bonaparte, 1967, Puesto Viejo Formation, Argentina (Bonaparte, 1978).
Last: *Cynognathus* sp., Omingonde Mudstone Formation, south-west Africa.

F. DIADEMODONTIDAE Haughton, 1925
Tr. (SCY–ANS) Terr.

First: *Diademodon tetragonus* Seeley, 1894, *D. grossarthi* (Broili and Schröder, 1935) and *D. mastacus* Seeley, 1894, *Cynognathus–Diademodon* Assemblage Zone, South Africa.
Last: *Diademodon rhodesiensis* Brink, 1963, Ntawere Formation, Luangwa Valley, Zambia.

F. TRIRACHODONTIDAE Crompton, 1955
Tr. (SCY–ANS) Terr.

First: *Trirachodon berryi* Seeley, 1894, *Cynognathus–Diademodon* Assemblage Zone, South Africa.
Last: *Cricodon metabolus* Crompton, 1955, Manda Formation, Ruhuhu Valley, Tanzania.

F. TRAVERSODONTIDAE Huene, 1936
Tr. (SCY–RHT) Terr.

First: *Pascualgnathus polanskii* Bonaparte, 1966, Puesto Viejo Formation, and *Andescynodon mendozensis* Bonaparte, 1967 and *Rusconiodon mignonei* Bonaparte, 1972, Rio Mendoza Formation, Mendoza Province, Argentina (Bonaparte, 1978).
Last: *Microscalenodon nanus* Hahn *et al.* 1988, lower RHT Bone Bed, Gaume, southern Belgium (Hahn *et al.*, 1988).
Intervening: ANS–NOR.

F. CHINIQUODONTIDAE Huene, 1948
Tr. (?ANS–CRN) Terr.

First: *Aleodon brachyramphus* Crompton, 1955, Manda Formation, Ruhuhu Valley, Tanzania. If this is not a chiniquodontid (Battail, 1982; Kemp, 1982, p. 208), the oldest representatives are *Probelesodon lewisi* Romer, 1969 and *Chiniquodon* sp. from the Chañares Formation, La Rioja Province, Argentina (LAD).
Last: *Chiniquodon theotonicus* Huene, 1936, Santa Maria Formation, Estado Rio Grande do Sul, Brazil.
Intervening: LAD.
Comment: Hahn *et al.* (1987) report a chiniquodontid tooth, *Lepagia gaumensis* Hahn *et al.*, 1987, from the lower RHT Bone Bed of Gaume, southern Belgium.

F. PROBAINOGNATHIDAE Romer, 1973
Tr. (LAD) Terr.

First and Last: *Probainognathus jenseni* Romer, 1970, lower beds of Ischichuca Formation, La Rioja Province, Argentina.

F. TRITYLODONTIDAE Cope, 1884
Tr. (RHT)–J. (BTH/CLV) Terr.

First: 'cf. *Tritylodon*', upper beds of Los Colorados Formation, La Rioja Province, Argentina (Bonaparte, 1978).
Last: *Bienotheroides wanhsienensis* Young, 1982, upper Xiashaximiao Formation, Szechwan, China (Sues, 1986).
Intervening: HET–PLB, BTH.

F. TRITHELEDONTIDAE Broom, 1912
Tr. (RHT)–J. (SIN) Terr.

First: *Chaliminia musteloides* Bonaparte, 1980, Los Colorados Formation, La Rioja Province, Argentina.
Last: *Pachygenelus monus* Watson, 1913, Clarens Formation, South Africa, Lesotho.
Intervening: HET.
Comment: *Therioherpeton cargnini* Bonaparte and Barberena, 1975, Santa Maria Formation, Parana Basin, Brazil (CRN), was described as the oldest tritheledontid, but Shubin *et al.* (1991) argue that this assignment is incorrect.

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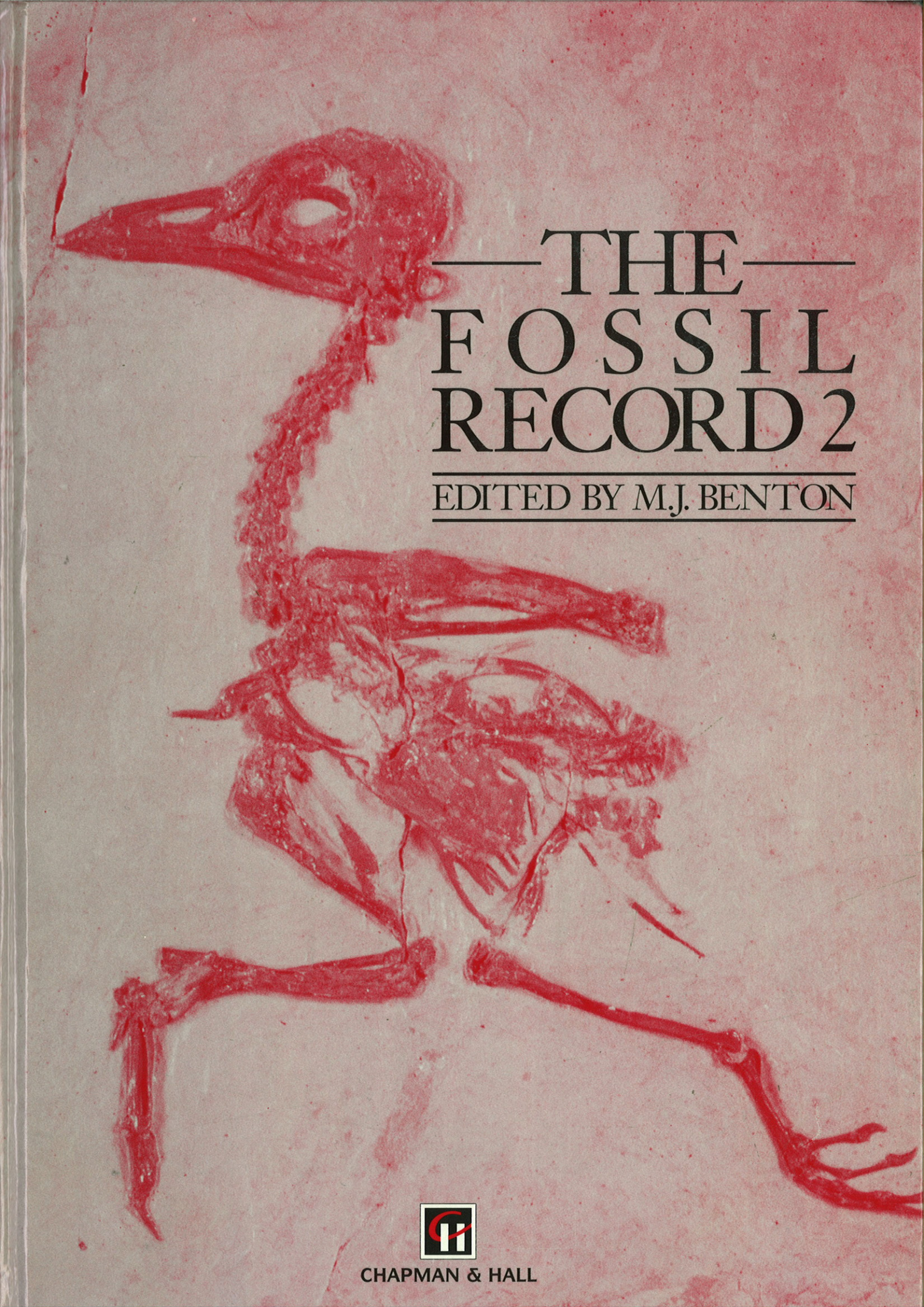

THE FOSSIL RECORD 2

EDITED BY M.J. BENTON

CHAPMAN & HALL

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43. Pteridophyta *C. J. Cleal* 779
44. Gymnospermophyta *C. J. Cleal* 795
45. Magnoliophyta ('Angiospermae') *M. E. Collinson, M. C. Boulter and P. L. Holmes* 809

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