The Mesozoic reptiles of China

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Fossil reptiles from the Chinese Mesozoic represent all major groups of the Reptilia: Cotylosauria, Testudines, Sauropterygia, Ichthyosauria, Lepidosauria. Thecodontia, Crocodilia, Pterosauria, Saurischia, Ornithischia and Therapsida. Fossil eggs and footprints, most of which are dinosaurian, are also common in the Mesozoic of China. Mesozoic reptilian faunas from China provide a nearly complete stratigraphic coverage of the Mesozoic and include five major faunal complexes, the dicynodont-*Sinokannemeyeria* faunal complex (Middle Triassic), the prosauropod-*Lufengosaurus* faunal complex (Upper Triassic or Lower Jurassic), the sauropod-*Shunosaurus* faunal complex (Middle Jurassic), the sauropod-*Mamenchisaurus* faunal complex (Upper Jurassic), the ornithopod-*Psittacosaurus* faunal complex (Lower Cretaceous) and the ornithopod-*Tsintaosaurus* faunal complex (Upper Cretaceous).

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Introduction

Although the bones of fossil reptiles are mentioned in several ancient Chinese manuscripts, the scientific study of Mesozoic reptiles in China did not begin until the Twentieth century. This study was initiated by the Chinese palaeontologist C.C. Young, the Russian palaeontologist A. Riabinin and the Swedish palaeontologist C. Wiman in the late 1920's. Since this initiation, Young and his students and colleagues in China, as well as some non-Chinese palaeontologists, have produced a large volume of scientific literature that documents the occurrence of all major groups of fossil reptiles in a succession of Chinese Mesozoic vertebrate faunas. This paper is the first attempt to review this literature in English and thereby present a summary of the Mesozoic reptiles of China. The presentation of this summary is in two parts: firstly a review of the taxa by taxonomic group and secondly, a review of the faunas arranged stratigraphically. Some new, previously unpublished, information also is included in this review. In this paper, BNHM = Beijing Museum of Natural History and IVPP = Institute of Vertebrate Palaeontology and Palaeoanthropology, both Beijing, People's Republic of China. All Chinese place-names are given in the Pinyin romanization.

Review of Taxonomic Groups

The following sections review, group by group, the Mesozoic reptiles known from China. The intention of these sections is not to present taxonomic revisions or phylogenetic inferences, but rather to summarize the known taxa and their distribution and thereby give an overview of the diversity of each group of reptiles known from the Chinese Mesozoic.

COTYLOSAURIA: Three procolophonid genera are known from China, *Neoprocolophon* Young 1957 from the Lower Triassic of northern Shanxi, *Paoteodon* Chow & Sun (1960) from the same horizon and province, and *Eumetabolodon* (Li, 1983) from the Lower Triassic of Nei Monggol. All these specimens are from the Heshangou and Ermaying Formations of the Shaanganning Basin in northern China.

TESTUDINES: Fossils of turtles are abundant, though mostly fragmentary, in Chinese Middle Jurassic-Upper Cretaceous deposits. Some undescribed shell fragments from the Lower Jurassic of Sichuan appear to represent the first occurrence of the Testudines in China (Yeh, 1979). The abundant turtle fossils that are found in the post-Lower Juras-

sic strata of China were first described by Bohlin (1953), Chow (1954a), Endo & Shikama (1942), Gilmore (1931, 1934), Riabinin (1930a), Wiman (1930) and Young & Chow (1953). Yeh (1963) presented a comprehensive review of Chinese fossil turtles, and since then has been the major contributor to the further understanding of the Testudines of China (e.g., Yeh 1965, 1966, 1973a, 1974, 1979, 1982). Yeh (1982) recently described *Chengyuchelys zigongensis* from the Middle Jurassic of Sichuan.

Late Jurassic turtles from China have been assigned to the Plesiochelyidae, Sinemydidae and Trionychidae (Yeh, 1963, 1979). Five species of *Plesiochelys* are recognized from the Upper Jurassic of Sichuan (Yeh, 1963; Young & Chow, 1953). *Plesiochelys* has also been reported from Yunnan (Yeh, 1973a). *Chengyuchelys baenoides* (Young & Chow, 1953) and *Tienfuchelys tzuyangensis* (Young & Chow, 1953) are also from the Upper Jurassic of Sichuan. *Manchurochelys manchouensis* (Endo & Shikama, 1942) from Liaoning is also considered to be of Late Jurassic age. *Sinemys, Scutemys* and *Sinochelys* were based on material from the Upper Jurassic of Shandong by Wiman (1930). *Sinaspideretes wimani* (Young & Chow, 1953) from the Upper Jurassic of Sichuan may be the oldest known trionychid.

Chinese Cretaceous turtles are sinemydids, dermatemydids, trionychids and nanhsiungchelyids (Yeh, 1963, 1966, 1979). The Early Cretaceous *Sinemys wuerhoensis* (Yeh, 1973b) is from Wuerho (Urho) in northwestern Xinjiang. Trionychids (e.g. *Aspideretes*) are well represented in the Upper Cretaceous of Nei Monggol and Gansu as are dermatemydids (Bohlin, 1953; Gilmore, 1931, 1934 Yeh, 1965). Riabinin (1930a) named *Aspideretes planicostatus* for a specimen from the Upper Cretaceous along the Amur River in Heilongjiang, *Mongolemys trufanensis* Yeh (1974) is a dermatemydid from the Upper Cretaceous of Xinjiang. Perhaps the most bizarre fossil turtle from the Chinese Mesozoic is *Nanhsiungchelys wuchingensis* Yeh (1966) from the Upper Cretaceous of Guangdong. Yeh (1966) erected the cryptodiran family Nanhsiungchelyidae for this large, long-snouted turtle. A variety of generically indeterminate turtle remains have been reported from throughout the Chinese Mesozoic: Yeh (1963) summarized earlier reports, but a summary of subsequent reports is beyond the scope of this paper.

SAUROPTERYGIA: Nothosaurs are widely distributed in the Middle Triassic strata of southern China (Dong, 1979a) and closely resemble central European forms. The described nothosaurs from China are: the nothosaurids *Chincheina sungi* Young, 1965a, *Sanchiaosaurus dengi* (Young, 1965a), *Kwangsisaurus orientalis* (Young, 1959a) and *K. lusiensis* (Young, 1978); the simosaurid *Shingyisaurus unexpectus* (Young, 1965a); and two species of *Keichousaurus, K. hui* (Young, 1958a) and *K. yunnanensis* (Young, 1965a), placed by Young (1965a) in their own family, Keichousauridae.

Chinese plesiousaurs have been allocated to three taxa in the Pliosauridae: *Sinopliosaurus fusuiensis* (Young, 1946a), *S. weiyuanensis* (Young, 1946a) and *Bishanopliosaurus youngi* (Dong, 1980). *S. fusuiensis* originally came from the Upper Jurassic of Sichuan but has since been found elsewhere, notably in Xinjiang and Guangxi. Romer (1966) considered *Sinopliosaurus* to be a junior synonym of *Pliosaurus,* and Persson (1963) considered the material referred to *Sinopliosaurus* to belong to the Pliosauridae, genus indeterminate. *B. youngi* from the Lower Jurassic marine shales in Sichuan is known only from a partial vertebral column and limb-girdles. No placodonts are known from China.

ICHTHYOSAURIA: Ichthyosaurs are neither common nor diverse in China, and all come from Triassic strata. The half-metre-long *Chaosaurus geishanensis* (Young & Dong, 1972), an omphalosaurid, from the Lower Triassic of Anhui is apparently the oldest known ichthyosaur. It is very similar to *Grippa* from Spitzbergen, but the Chinese form has a heterodont dentition and functional limbs. The Middle Triassic *Mixosaurus maotaiensis* (Young, 1965b) from Maotai in Guangdong is clearly related to European mixosaurs and, like *Chaohusaurus,* probably followed a Tethyan dispersal route. Young (1960a) first assigned *M. maotaiensis* to the Sauropterygia.

Himalayasaurus tibetensis (Dong, 1972), a shastosaurid, from the Tibetan Himalayas, comes from the Upper Triassic strata at an altitude of about 4 800 m; this must be the highest altitude of any fossil vertebrate locality on Earth. Dong (1972, 1979a) estimated that *Himalayasaurus* was about ten metres long.

LEPIDOSAURIA: A prolacertid, *Santaisaurus yuani* was collected in Xinjiang by a member of the Sino-Swedish Expedition and was later described by Koh (1940). This primitive Early Triassic form was thought by Young (1948a) to represent a type relating the Lacertilia with the Rhynchocephalia by virtue of its *Prolacerta* and sphenodontid characteristics. Later, Young (1973a) named a definite prolacertid, *Prolacertoides jinusarensis,* from the Lower Triassic *Lystrosaurus* zone of Qitai, Xinjiang.

Squamatids are relatively scarce in China with the following taxa currently known: *Fulengia youngi*

Table 1. Thecodonts from the Mesozoic of China.

Proterosuchia
Chasmatosaurus yuani Young 1937 b
C. ultimus Young 1964 a
Shansisuchus shansisuchus Young 1964 a
S. heiyuekouensis Young 1964 a
Vjushkovia sinensis Young 1973 d
Xilousuchus sapingensis Wu 1981

Pseudosuchia
Dibthrosuchus elaphros Simmons 1965
Fenhosuchus cristatus Young 1964 a
Halazhaisuchus qiaonensis Wu 1982
Lotosaurus adentus Zhang 1975
Platyognathus hsui Young 1944
Strigosuchus licinus Simmons 1965
Turfanosuchus dabanensis Young 1973 d
T. shageduensis Wu 1982
Wangisuchus tzeyii Young 1964 a

Parasuchia
Hupehsuchus nanchangensis Young & Dong 1972
Nanchangosaurus suni Wang 1959
Pachysuchus imperfectus Young 1951 a

(Carroll & Galton, 1977) from the Upper Triassic of Yunnan; *Conicodontosaurus kanhsiensis* (Young, 1973c) from the Lower Cretaceous of Sichuan and *Yabeinosaurus tenuis* (Endo & Shikama, 1942) from the Upper Jurassic of western Liaoning (but see Young, 1958b).

Monjurosuchus splendens (Endo, 1939) from the Middle Jurassic of southwestern Liaoning is the only true rhynchocephalian described from China.

THECODONTIA: (Table 1) Most Chinese thecodonts are from Yunnan (Simmons, 1965; Young, 1937a, 1951a) although there have been recent discoveries in Shanxi and Shaanxi (Wu, 1981, 1982). *Xilousuchus* (Wu, 1981), *Halazhaisuchus* (Wu, 1982) and *Turfanosuchus* (Young, 1973d) appear to be closely related to the proterosuchian *Chasmatosuchus* (known in China from the Junggur Basin, Xinjiang). However, *Xilousuchus* is relatively advanced and may be of Middle Triassic age.

Simmons (1965) named two pseudosuchians, *Dibthrosuchus* and *Strigosuchus,* from the Upper Triassic of Yunnan (Lufeng Basin). Young (1964a) named two pseudosuchians, *Wangisuchus* and the problematic *Fenhosuchus*. *Platyognathus* (Young, 1944) from Lufeng was based on an anterior jaw fragment which indicates a form with a short yet flat snout. Young (1951a) felt that a new pseudosuchian family could be justified for *Platyognathus* and, indeed, Simmons (1965), with additional material of the genus, erected the Platyognathidae as a family between the Proterosuchia and Pseudosuchia.

Parasuchians are not well known from China. *Pachysuchus* (Young, 1951a) is clearly parasuchian, although it is based on barely adequate material. Olshevsky (1978) has suggested that *Hupehsuchus* (Young & Dong, 1972) may represent a sixth archosaurian order, or may not even be an archosaur.

CROCODILIA: Mesozoic crocodilians from China (Table 2) are diverse and their numerous fossils come from strata ranging in age from Late Triassic to Late Cretaceous. Since Young's (1948b) review of the fossil Crocodilia of China, the following new taxa of Mesozoic crocodilians have been named: 1. *Microchampsa scutata* (Young, 1951a) from the Lufeng Basin, Yunnan, is not far removed morphologically from the thecodonts, thus Romer (1966) and Steel (1973) placed it in the Archosauria. 2. *Hsisosuchus chungkingensis* (Young & Chow, 1953) from the Upper Jurassic of Sichuan is of uncertain systematic position. Young & Chow (1953) suggested that it might be best placed in its own, new, suborder, but Romer (1966) located it in the Goniopholidae whereas Steel (1973) put it in the Mesosuchia in its own family Hsisosuchidae (Young & Chow 1953). 3. *Chiayusuchus cingulatus* (Bohlin 1953 from the Upper Cretaceous of Gansu in known only from an incomplete tooth and is best considered a *nomen dubium* although it was reluctantly placed in the Stomatosuchidae by Bohlin (1953). 4. *Edentosuchus tienshanensis* (Young, 1973e) is known from skull and jaw fragments from the Lower Cretaceous of northwestern Xinjiang. Despite its Early Cretaceous age, *Edentosuchus* is remarkably primitive in having a very short and posteriorly broad skull and short jaw bearing two rows of seven small teeth behind large "canines". Its greatest similarities are with Triassic protosuchians. 5. *Eotomistoma multidentata* Young (1964b) from the Upper Cretaceous of Nei Monggol is only known from a fragmentary snout. Steel (1973) considers it to be the oldest known thoracosaurine. 6. *Paralligator sungaricus* (Sun, 1958) is a Late Cretaceous paralligatorid known only from postcranial material from Jilin. 7. *Shantungosuchus chuhsiensis* (Young, 1961a) is an atoposaurid from the Upper Jurassic of Shandong. 8. *Dzungarisuchus manacensis* (Dong, 1974) is a crocodylid from the Lower Cretaceous of Xinjiang.

Other crocodilian taxa from the Chinese Mesozoic include *Peipehsuchus teleorhinus* (Young, 1948b) from the Upper Jurassic of Sichuan and *Sunosuchus*

Table 2. Crocodilia from the Mesozoic of China.

Archeosuchia
Notochampsidae
Microchampsa scutata Young 1951 a

Protosuchia
Edentosuchidae
Edentosuchus tienshanensis Young 1973 e

Mesosuchia
Teleosauridae
Teleosaurus sp. (Liu 1961)
Atoposauridae
Shantungosuchus chuhsienensis Young 1961 a
Hsisosuchidae
Hsisosuchus chungkingensis Young & Chow 1953
Goniopholidae
Paralligator sungaricus Sun 1958
Pholidosauridae
Peipehsuchus teleorhinus Young 1948 b
Sunosuchus miaoi Young 1948 b

Eusuchia
Stomatosuchidae
Chiayusuchus cingulatus Bohlin 1953
Crocodylidae
Dsungarisuchus manacensis Dong 1974
Eotomistoma multidentata Young 1964 b

miaoi (Young, 1948b) from the Upper Jurassic of Gansu. Liu (1961) has reported the presence of *Teleosaurus* (but see Young (1964b) for a different taxonomic assignment) in the Middle Jurassic of Sichuan, and there are a wide variety of other, indeterminate, crocodilians that have been reported from the Mesozoic of China.

PTEROSAURIA: Pterosaurs are surprisingly rare in China, but the few forms known are remarkable. Three taxa are present: 1. The dsungaripterid *Dsungaripterus weii* (Young, 1964c) from the Early Cretaceous of northwestern Xinjiang has a distinctive skull in which there is an incipient parietal crest and a pointed premaxilla that only bears very small teeth (probably best called crenulations). *D. weii* appears to represent a divergent lineage that, in many ways, is transitional between Late Jurassic pterodactyloids and the Late Cretaceous pteranodontids (Young, 1964c, 1973f). 2. *Noripterus complicidens* (Young, 1973f), is a second dsungaripterid from the Early Cretaceous of Xinjiang and, being much smaller, may represent the juvenile of *D weii*. 3. *Huanhepterus qingyangensis* (Dong, 1982), from the Upper Jurassic of the Ordos Basin, Gansu, is closely allied to *Gnathosaurus* of the European Jurassic.

SAURISCHIA: The earliest scientific discoveries of dinosaurs in China were made in 1913–1915 by an American geologist, Louderback (1935) in Sichuan, and in 1916 by a German mining engineer Behagel, in Shandong (Dong *et al.*, 1983; T'an, 1923; Young, 1937a). Camp (1935) and Wiman (1929) first reported on these fossils. Fossils of the great diversity of Chinese saurischians (Table 3) are abundant and widespread, and it is clear that current taxonomy is in need of revision.

Young (1941a, 1941b) described three "prosauropods", *Gyposaurus, Yunnanosaurus,* and *Lufengosaurus,* from the Upper Triassic of the Lufeng Basin, Yunnan. An additional genus from Lufeng, *Sinosaurus,* was added by Young (1948c). Rozhdestvensky (1964), however, regarded all of these genera as synonymous, and Galton (1976), Galton & Cluver (1976) and Olshevsky (1978) also considered *Gyposaurus* and *Yunnanosaurus* to be based on juvenile specimens of *Lufengosaurus.* Olshevsky

Table 3. Sauropod Saurischia from the Mesozoic of China.

Plateosauridae
Lufengosaurus huenei Young 1941 a
L. magni Young 1941 a

Brachiosauridae
Asiatosaurus mongoliensis Osborn 1924
A. kwangshiensis Hou, Yeh & Zhao 1975
Euhelopus zdanskyi (Wiman 1929)
Omeisaurus jungshiensis Young 1939 b
O. changshuoensis Young 1958 f
O. fuxiensis Dong, Zhou & Zhang 1983
Shunosaurus lii Dong, Zhou & Zhang 1983
Tienshanosaurus chitaiensis Young 1937 c
Zigongosaurus fuxiensis Hou, Yeh & Zhao 1976
Zizhongosaurus chuanchensis Dong, Zhou & Zhang 1983

Titanosauridae
Chiayusaurus lacustris Bohlin 1953
Mamenchisaurus constructus Young 1954 a
Mongolosaurus haplodin Gilmore 1933
Nemegtosaurus pachi Dong 1977
Nanshingosaurus brevispinus Dong 1979 b
Sanpasaurus yaoi Young 1946 a

(1978) also considered *Sinosaurus* to be a synonym of *Lufengosaurus*. Finally, new specimens of "prosauropoda" from the Jurassic of Sichuan have caused Dong *et al.* (1983) to defend the traditional view that "prosauropods" gave rise to sauropods, *contra* Charig *et al.* (1965) and Zhao (1983b).

Sauropod diversity in China is high, artificially so. *Euhelopus* (Romer, 1956) was the first sauropod to be described from China (Wiman, 1929) and is the only genus known from the extreme eastern part of the country, from the Upper Jurassic of Shandong (Chen et al., 1982a). A reinterpretation of the skull (Mateer & McIntosh, 1985) suggests that the *Euhelopus* is a brachiosaurid. *Tienshanosaurus* (Young, 1937c) from the Tien Shan, Xinjiang, is known from a partial skeleton and is very similar to, if not synonymous with *Euhelopus*. *Chiayusaurus* (Bohlin, 1953) from Gansu is based on isolated teeth and is probably best considered a *nomen dubium*. Dong (1977) has also assigned a fragmentary tooth from Xinjiang to this genus. *Shunosaurus* (Dong, Zhou & Zhang, 1983) from the Middle Jurassic of Sichuan is a very primitive sauropod, and, according to Dong *et al.* (1983) is a good candidate for a link between "prosauropods" and sauropods. *Mamenchisaurus* (Young, 1954a) (Fig. 1) from the Upper Jurassic of Sichuan, has an extremely long neck and complex cervical vertebrae suggesting that it may be a diplodocid. *Omeisaurus* (Young, 1939b) from Sichuan is similar to *Euhelopus*, but the lack of a skull of *Omeisaurus* precludes a more definite statement. Young (1939b) placed this genus in the "Helopinae". *Zigongosaurus* (Hou, Chao & Chu 1976) is a brachiosaurid from the Upper Jurassic of Sichuan based on postcranial material. This genus is not to be confused with *Zizhongosaurus* (Dong, Zhou & Zhang, 1983) from the Lower Jurassic of the same region. *Nemegtosaurus* (Nowinski, 1971) is best known from the Mongolian People's Republic, but Dong (1977) named a new species, *N. pachi*, from the Upper Cretaceous of Xinjiang. The Late Cretaceous *Asiatosaurus* (Osborn, 1924) from Nei Monggol has also been reported from the Lower Cretaceous of Guangxi (Hou *et al.*, 1975). *Mongolosaurus* (Gilmore, 1933) is from the Upper Cretaceous of Nei Monggol.

Fig. 1. Skeleton of the sauropod dinosaur *Mamenchisaurus hochuanensis.*

As for the sauropods, the great diversity of theropods from China is artificial. For the purposes of this review, we divide theropods into coelurosaurs and carnosaurs (Table 4).

Apart from *Archaeornithomimus* (Gilmore, 1933) from the Upper Cretaceous of Nei Monggol, all Chinese coelurosaurs are from Central Asia and southeastern China. *Lukosaurus* (Young, 1948c) from the Upper Triassic of Yunnan is known from a single skull. According to Rozhdestvensky (1977), it is a synonym of *Sinocoelurus* (Young, 1942) from the same area. Except *Archaeornithomimus, Velociraptor* and *Lukosaurus,* Olshevsky (1978) regards all Chinese coelurosaur taxa as *nomina dubia.*

Table 4. Theropod saurischians from the Mesozoic of China.

Coelurosauria
- *Archaeornithomimus asiaticus* Gilmore 1933
- *Lukousaurus yini* Young 1948 c
- *Phaedrolosaurus ilikensis* Dong 1973a
- *Shanshanosaurus houyanshiensis* Dong 1977
- *Sinocoelurus fragilis* Young 1942
- *Sinosaurus triassicus* Young 1948 c
- *Tugulusaurus faciles* Dong 1973a
- *Velociraptor mongoliensis* Osborn 1924

Carnosauria
- *Albertosaurus periculosus* Riabinin 1930 a
- *Alectrosaurus olseni* Gilmore 1933
- *Chienkosaurus ceratosauroides* Young 1942
- *Chilantaisaurus maortuensis* Hu 1964
- *C. tashiukouensis* Hu 1964
- *C. zheziangensis* Dong 1979 c
- *Chingkankousaurus fragilis* Young 1958 e
- *Kelmayisaurus petrolicus* Dong 1973a
- *Prodeinodon kwangshiensis* Hou, Yeh & Zhao 1975
- *Szechuanosaurus campi* Young 1942
- *S. yangdoensis* Dong, Li, Chang & Zhou 1978
- *Tarbosaurus* sp. (Dong 1977)
- *Tyrannosaurus turpanensis* Zhai, Zheng & Tong 1978
- *T. huanchuanensis* Dong 1979 b
- *Yangchuanosaurus shangyouensis* Dong, Li, Chang & Zhou 1978
- *Y. magnus* Dong, Zhou & Zhang 1983

Fig. 2. Skeleton of the theropod dinosaur *Yangchuanosaurus shangyouensis.*

Thus, *Tugulusaurus* (Dong, 1973a) and *Phaedrolosaurus* (Dong, 1973a), from the Upper Cretaceous of Xinjiang are based on fragmentary material. Similarly, *Sinocoelurus* (Young, 1942) is known only from four isolated teeth. *Velociraptor* (Osborn, 1924) from the Upper Cretaceous of Nei Monggol has also been reported from elsewhere in Nei Monggol by Bohlin (1953) and from northern Shanxi by Young (1958d) on fragmentary material.

Carnosaurs from China are also based largely on fragmentary specimens and many appear to be *nomina dubia. Szechuanosaurus campi* (Young, 1942) from the Upper Jurassic and Lower Cretaceous of Sichuan and Shandong, respectively, is considered, for example, a *nomen dubium* by Olshevsky (1978) since its holotype consists of tooth-fragments. Nevertheless, Dong *et al.* (1977) erected a new species of *Szechuanosaurus, S. yangdoensis,* on much better material than was available to Young (1942). Rozhdestvensky (1977) considered *Chienkosaurus* Young 1942 to be a synonym of *Szechuanosaurus*. The only other carnosaur from Shandong, the Late Cretaceous *Chiankankousaurus* (Young, 1958e) is known from a large right scapula. *Yangchunosaurus shangyouensis* Dong, Li, Zhou & Chang (1977) (Fig. 2) and *Y. magnus* (Dong, Zhou & Zhang, 1983) from the Lower and Upper Jurassic of Sichuan, respectively, are known from good skeletons. As with other theropods from Xinjiang, *Kelmayisaurus* (Dong, 1973a) is based on fragmentary material and best considered a *nomen dubium* according to Olshevsky (1978). Dong (1977) reported *Tarbosaurus* from the Upper Cretaceous of Xinjiang, and Riabinin (1930a) reported *Albertosaurus* from the Amur River in Heilongjiang. It is possible that *Tyrannosaurus turpanensis* from the Upper Cretaceous of Xingjiang may pertain to *Tarbosaurus. Prodeinodon* has been reported from the Lower Cretaceous of Nei Monggol (Bohlin, 1953; Osborn, 1924) and Guangxi (Hou *et al.,* 1975).

ORNITHISCHIA: The ornithischian dinosaurs (Table 5) are probably the most diverse and abundant fossil reptiles of the Mesozoic of central and eastern China (Rozhdestvensky, 1977). Perhaps the richest fossil localities for ornithischians are in the southern Mongolian People's Republic and adjacent areas of China which, undoubtedly, harbour very similar faunas, particularly during the Late Cretaceous.

Jurassic ornithischians from China are best known from Sichuan, western Xinjiang and Shandong. Of the primitive ornithischians from China, only *Probactrosaurus* (Rozhdestvensky, 1966) is a well-known and obviously valid taxon. *"Gubisaurus"* is mentioned by Dong *et al.* (1983), but is not otherwise described. *Gongbusaurus* (Dong, Zhou & Zhang, 1983) from the Upper Jurassic of Sichuan is only based on isolated teeth. Simmons (1965) erected *Tatisaurus* for teeth from Lufeng, but this presumed heterodontosaurid is regarded as "ornithischian, *incertae sedis*" by Olshevsky (1978).

With the exception of *Wuerhosaurus* (Dong,

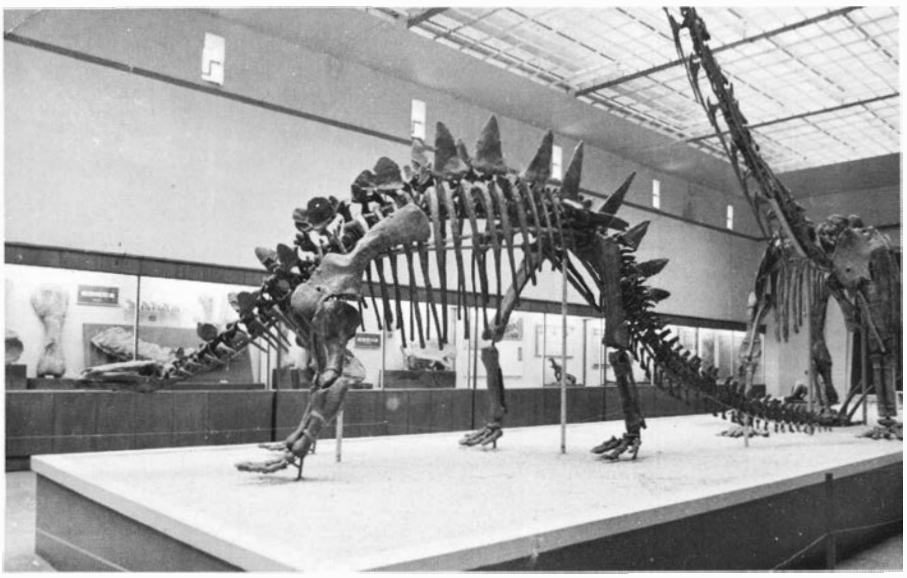

Fig. 3. Skeleton of the stegosaur *Tuojiangosaurus multispinus*.

1973a) from northwestern Xinjiang, all known Chinese stegosaurs are from Sichuan. Of these, only *Chiaolingosaurus* Young 1959b, *Tuojiangosaurus* (Dong, Li, Zhou & Chang, 1977) (Fig. 3) and *Chungkingosaurus* (Dong, Zhou & Zhang, 1983) are known from specimens sufficiently complete to warrant their validity.

Nine species of hadrosaurs (Fig. 4, 5) are known from China, mainly from Nei Monggol and Shandong (Dong, 1979b; Gilmore, 1933; Hu, 1964; Wi-

Table 5. Ornithischia from the Mesozoic of China.

Fabrosauridae
Gongbusaurus shiyii Dong, Zhou & Zhang 1983
Xiaosaurus dashpanensis Dong, Tang & Zhou 1982

Heterodontosauridae
Tatisaurus oeheri Simmons 1965

Iguanodontidae
Probactrosaurus gobiensis Rozhdestvensky 1966
P. alashanicus Rozhdestvensky 1966

Hadrosauridae
Bactrosaurus johnsoni Gilmore 1933
Mandschurosaurus amurensis Riabinin 1930 b
M. mongoliensis Gilmore 1933
Microhadrosaurus nanshingensis Dong 1979 b
Shantungosaurus giganteus Hu 1974
Tanius sinensis Wiman 1929
T. chingkankouensis Young 1958 e
T. laiyangensis Zhen 1976
Tsintaosaurus spinorhinus Young 1958 e

Stegosauridae
Chiaolingosaurus kuani Young 1959 b
Chungkingosaurus jiangbeiensis Dong, Zhou & Zhang 1983
Huayangosaurus taibaii Dong, Tang & Zhou 1982
Tuojiangosaurus multispinus Dong, Li, Zhou & Chang 1977
Wuerhosaurus homheni Dong 1973a

Nodosauridae
Heishanosaurus pachycephalus Bohlin 1953
Peishanosaurus philemys Bohlin 1953
Pinacosaurus ningshiensis Young 1935a
Sauroplites scutiger Bohlin 1953

Psittacosauridae
Proiguanodon mongoliense Osborn 1923
Psittacosaurus mongoliensis Osborn 1923
P. tingi Young 1931
P. osborni Young 1931
P. sinensis Young 1958e
P. youngi Chao 1962

Protoceratopsidae
Microceratops sulcidens Bohlin 1953
M. gobiensis Bohlin 1953
Protoceratops andrewsi Granger & Gregory 1923

Pachycephalosauridae
Micropachycephalosaurus hontuyanensis Dong 1978
"Troodon" bexelli Bohlin 1953
Wannanosaurus yansiensis Hou 1977

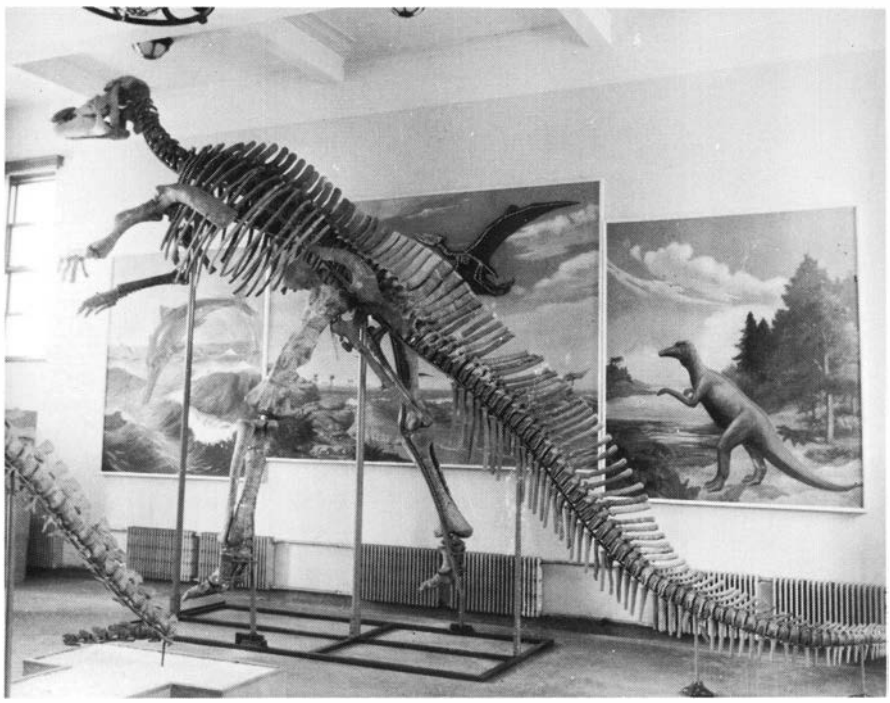

Fig. 4. Skeleton of the hadrosaur *Shantungosaurus giganteus.*

Fig. 5. Skeleton of the hadrosaur *Tsintaosaurus spinorhinus.*

man, 1929; Young, 1958e; Zhen, 1976). According to Rozhdestvensky (1977), *Mandschurosaurus mongoliensis* (Gilmore, 1933) is probably synonymous with *Bactrosaurus johnsoni* (Gilmore, 1933).

Nodosaurid ankylosaur remains are present in China, but except for *Pinacosaurus grangeri* (Gilmore, 1933) (=*P. ninshiensis* (Young, 1935a; Coombs, 1971, 1982; Maryanska, 1977), the named taxa are based on very fragmentary specimens. Although Bohlin (1953) erected four genera of ankylosaurs from Nei Monggol, their type specimens are so fragmentary, and therefore undiagnostic at the generic level, that *Peishanosaurus, Heishanosaurus, Stegosaurides* and *Sauroplites* should be considered *nomina dubia* (Coombs, 1971).

The psittacosaurid ceratopsians are an almost exclusively Chinese group composed of two genera, *Psittacosaurus* (Osborn, 1923) and *Protiguanodon* (Osborn, 1923), both originally from Nei Monggol. According to Rozhdestvensky (1977), *Protiguanodon* is monospecific since *P. protiguanodoniensis* (Young, 1958d) is a junior synonym of *P. mongoliense* (Osborn, 1923). Several species of *Psittacosaurus* have been named, but Olshevsky (1978) considered *P. tingi* (Young, 1931) to be a synonym of *P. osborni* (Young, 1931) (both are from Nei Monggol) and Rozhdestvensky (1977) regarded *P.*

osborni as a synonym of *P. mongoliensis* (see also Coombs, 1982). Moreover, Rozhdestvensky (1955, 1964, 1977) considered *Protiguanodon mongoliense* to be a synonym of *Psittacosaurus mongoliensis,* a possibility originally entertained by Osborn (1923). *Psittacosaurus sinensis* (Young, 1958e) from the upper Cretaceous of Shandong still would appear to be valid. The only other Chinese ceratopsian, *Protoceratops* (Granger & Gregory, 1923) is known from good material from Nei Monggol.

Bohlin (1953) first identified a pachycephalosaurid from China, but his taxon, *"Troodon" bexelli,* is considered a *nomen dubium* by Olshevsky (1978). *Micropachycephalosaurus* (Dong, 1978) from Shandong and *Wannanosaurus* (Hou, 1977) from northwestern China are based on fragmentary material.

Zhao (1983b) recently presented a substantial reorganization of dinosaurian higher-level taxonomy based largely on new material from Xizang (Zhao, 1983a). Ten new genera and two new superfamilies (of which two, Polysacralosauroidea and Chaoyoungosauroidea, are new names), and one new suborder, Armatosauria, were erected by Zhao (1983a, 1983b).

THERAPSIDA: Therapsids are among the most diverse and abundant reptiles in Chinese Triassic faunas (Table 6), as they are in most other parts of the world. Understanding of the Chinese mammal-like reptiles is hindered by taxonomic and phylogenetic problems, as the following two examples well demonstrate: 1. Six species of *Lystrosaurus* have been named from China, *L. hedini* (Young, 1935b), *L. weidenreichi* (Young, 1937d), *L. broomi* (Young, 1939c), *L. youngi* (Sun, 1964), *L. robustus* (Sun, 1973), and *L. latifrons* (Sun, 1973). *L. weidenreichi* is based on postcrania only, so it is probably best considered a *nomen dubium.* Colbert (1982, p.377) has argued that *L. youngi* is probably the same taxon as *L. curvatus* from South Africa. A revision of Chinese *Lystrosaurus* is obviously needed. 2. Debate over the systematic position of *Sinoconodon* has been active since Patterson & Olsen (1961) named this taxon. Although most workers (Hopson & Crompton, 1969; Kermack, 1967; Rigney, 1963) agree that *Sinoconodon* is a triconodont mammal, Crompton (1964, 1974) drew attention to its similarities to some cynodonts. Zhang & Cui (1983) recently described new material (and a new species) of *Sinoconodon* and assigned the genus to the cynodontia. They made this assigment largely because Zhang & Cui restricted the class Mammalia to the Theria and "pantotheres". We are skeptical of the value of such a restriction, and therefore follow Crompton & Jenkins (1979) by tentatively considering *Sinoconodon* to be a triconodont.

A great diversity of dicynodonts is recognized in Chinese Triassic faunas, and, indeed most Chinese therapsids are dicynodonts. Fossils assigned to *Jimusaria* (Yuan & Young, 1934a), *Dicynodon, Turfanodon* (Sun, 1973), *Sinokannemeyeria* (Young, 1937a), *Parakannemeyeria* (Sun, 1963), *Shansiodon* (Yeh, 1959), *Lystrosaurus* and/or *Shanbeikannemeyeria* Cheng (in Li, 1980) dominate Triassic (and some Late Permian) vertebrate faunas from Xinjiang and the northern Chinese provinces of Shanxi, Shaanxi and Nei Monggol (especially the important Triassic Ermaying faunas).

Chinese cynodonts include *Sinognathus* (Young, 1959c) from the Middle Triassic of Shanxi, *Ordo-*

Table 6. Therapsids from the Mesozoic of China.

Bienotherium yunnanensis Young 1940a
B. elegans Young 1940a
B. minor Young 1947
B. magnum Chow 1962
Dianzhongia longirostrata Cui 1981
Dicynodon tienshanensis Sun 1973
Jimusaria sinkiangensis Yuan & Young 1934a
J. taoshyuanensis Sun 1973
Kunmina minima Young 1947
Lufengia delicata Chow & Hu 1959
Lystrosaurus broomi Yuan & Young 1934b
L. hedini Young 1935b
L. weidenreichi Young 1937a
L. youngi Sun 1964
L. robustus Sun 1973
L. latifrons Sun 1973
Oligokyphus sinensis Young 1974b
Ordosia youngi Hou 1979
Ordosiodon linchenguensis Young 1961b
Parakannemeyeria dolichocephala Sun 1960
P. youngi Sun 1960
P. ningwuensis Sun 1960
P. brevirostris Sun 1972
Shanbeikannemeyeria buerdongia Li 1980
S. xilougouensis Cheng in Li 1980
Shansiodon wangi Yeh 1959
S. wuhsiangensis Yeh 1959
Sinognathus gracilis Young 1959c
Sinokannemeyeria pearsoni Young 1937a
S. yingchiaoensis Sun 1963
Traversodontoides wangwuensis Young 1974a
Turfanodon bogdaensis Sun 1972
Urumchia lii Young 1957
Yunnania brevirostre Cui 1976

siodon (Young, 1961b), also from the Middle Triassic of Shanxi and *Traversodontoides* (Young, 1974a) from the same area, a taxon that Sun (1981) has recently argued is a bauriamorph.

The tritylodont *Bienotherium* (Young, 1940a) is the best known of the tritylodonts from the Upper Triassic of the Lufeng Basin, Yunnan. Four species of this genus, *Oligokyphus sinensis* (Young, 1974b), *Lufengia delicata* (Chow & Hu, 1959), *Yunnania brevirostre* (Cui, 1976) and *Dianzhongia longirostrata* (Cui, 1981) make up a diverse assemblage of tritylodonts from Lufeng.

DINOSAUR EGGS: The first reptilian eggs from Mesozoic strata in China were discovered by the Central Asiatic Expedition of the American Museum of Natural History in the Upper Cretaceous Iren Dabasu Formation at Erlian (Iren Dabasu) in Nei Monggol. Van Straelen (1925, 1928) believed that these eggs pertain to a hadrosaur, and, indeed all reptilian eggs from the Chinese Mesozoic have been considered to be dinosaur eggs.

Young (1954b, 1954c), following brief reports by Chow (1951) and Liu (1951), first described a large assemblage of Chinese Mesozoic reptilian eggs from the Upper Cretaceous Wangshi Formation in eastern Shangdong. Young's (1954b, 1954c) use of size, shape and surface texture to erect two taxa for these dinosaurian eggs, *Oolithes spheroides* and *O. elongatus,* (Fig. 6) was supported by microstructural studies of the same eggs by Chow (1954a, 1954b). Young & Chow also agreed that eggs from Manchuria assigned by Yabe & Ozaki (1929) to the Testudines pertain to *O. spheroides* and thus are dinosaurian. Young (1965c) later added the taxa *O. rugustus* and *O. nanhsiungensis* for dinosaur eggs from Upper Cretaceous strata in Jiangxi and Guangdong provinces.

Recent work has demonstrated that dinosaur eggs are widely distributed in the Upper Cretaceous of China. In addition to the areas just mentioned, Late Cretaceous dinosaur eggs are now known from various locaities in Shandong, Guangdong, Jiangxi, Hunan, Henan, Hubei, Anhui, Ningxi, Xinjiang, and Zheijiang (e.g., Geology Majors of the Geography Department of Zhongshan University 1979; Wu, 1979; Young, 1979a; Zeng & Zhang, 1979; Zhao, 1975, 1978, 1979a, 1979b, 1979c; Zhao & Ding, 1976). This work has also produced several generic names for dinosaur eggs that include *Elongatoolithus* (Zhao, 1975), *Paraspeheroolithus* (Zhao, 1979a), *Ovaloolithus* (Zhao, 1979a), *Placoolithus* (Zhao, 1979a), *Youngoolithus* Zhao 1979a, and *Phaceloolithus* (Zeng & Zhang, 1979). All the species Young subsumed under *Oolithus,* as well as additional species, are apportioned among these genera. Zhao (1979c) has presented the most recent review of Chinese dinosaur eggs, and in this review also erected families (Spheroolithidae, Elongatoolithidae) for dinosaur eggs. Zhao (1978) has also demonstrated that the youngest Cretaceous dinosaur eggs from China have thinner shells than older eggs, and therefore he has suggested that eggshell thinning may be related to dinosaur extinction. Finally, it is worth noting that all dinosaur eggs from China occur in strata that can be termed redbeds, a fact used by Carpenter (1982) to support his argument that eggs are most likely to be preserved in well-drained, high-pH-depositional environments.

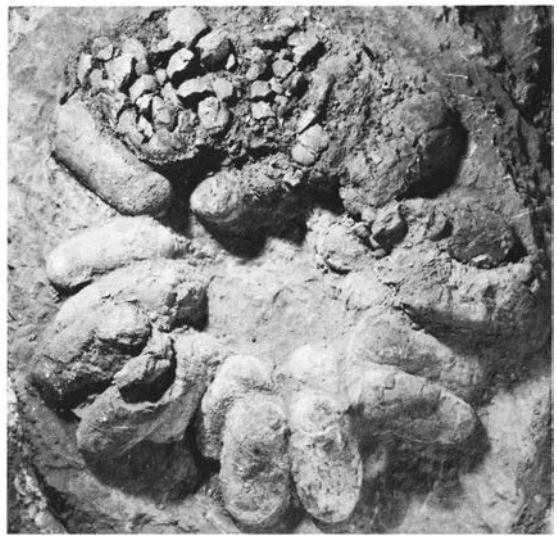

Fig. 6. Dinosaur eggs, *Oolithes elongatus,* from the Upper Cretaceous of Jiangxi. The largest eggs are about 22-cm-long.

FOOTPRINTS: Relatively few footprints of Mesozoic reptiles have been reported from the Chinese Mesozoic. Most of these tracks derive from dinosaurs and were described by Young (1943, 1960b, 1966, 1979b, 1979c). The footprints named are: 1. *Jeholosauripus ssatoi* (Yabe, Inai & Shikama, 1940), are probable coelurosaur footprints from the Upper Triassic or Lower Jurassic of Yangshan, Liaoning. Baird (1957) considered *Jeholosauripus* to be identical to *Anchisauripus* (Lull, 1904). 2. *Shensipus tungchuanensis* (Young, 1966) from the lower part of the Xilou Group at Dongzhuan in Shaanxi (Middle Jurassic) also are probable coelurosaur tracks. 3. *Changpeipus carbonicus* (Young, 1960b) and *C. luanpingensis* (Young, 1979b) are probable carnosaur tracks from Jurassic strata in Liaoning (Fusin

Coal Measures) and Luanping, Hebei, respectively. 4. Iguanodontid tracks, *Sinoichnites youngi* Kuhn 1958, are known from the Upper Jurassic at Shenmu in northern Shaanxi. 5. Otherwise indeterminate ornithischian tracks, *Yangtzepus yipingensis* (Young, 1960b), come from the lower part of Jiadin "Series", Middle Jurassic of Guanyin, Yiping in Sichuan. 6. *Kuanyuanpus szechuanensis* (Young, 1943) are Middle Jurassic reptilian footprints from Guangyuan in Sichuan, Haubold (1971, p. 101) suggested that these may be footprints of a turtle. 7. *Laiyangpus liui* (Young, 1960b) also are reptilian tracks of uncertain affinities. Young (1960b) saw some similarity between these tracks, which are from the Upper Jurassic Laiyang Series at Laiyang in Shandong, and turtle tracks, *Chelonipus* (see Haubold, 1971, p. 90), described by Huene (1923, fig. 32).

The few remaining tracks reported from the Chinese Mesozoic include tridactyl footprints associated with the eggs *Youngoolithus* in the Cretaceous of the Xiaguan Basin, Henan (Zhao, 1979a) and possible footprints of an agamid lizard from the Upper Cretaceous at Jingheng, Yunnan (Young, 1979c).

Distribution and Biostratigraphy

INTRODUCTION: In this section, we briefly review the stratigraphic and geographic distribution as well as the age relationships of Chinese Mesozoic reptiles. In so doing, we follow Dong (1979c) and Dong et al. (1983), with minor modification, by recognizing six faunal "complexes" (*sensu* Olsen, 1966) in the Chinese Mesozoic (Table 7).

TRIASSIC: Major Triassic reptilian faunas from China are those from Xinjiang, "north China" (Shanxi, Shaanxi and Nei Monggol) and Yunnan (Fig. 7). Young (1946b) last presented a complete review of the Triassic vertebrate faunas of China, but since that paper appeared, knowledge of Chinese Triassic vertebrates has grown considerably. Most of this growth is the result of discoveries in Xinjiang and north China (e.g., Sun, 1980; Wu, 1981, 1982).

The fossil record of Mesozoic reptiles begins in China with the Jiuzaiyuanze fauna from the Turpan Basin, Xinjiang. This fauna includes *Lystrosaurus* and *Chasmatosaurus,* and thus is a clear correlative of the Early Triassic *Lystrosaurus* zone of the South African Karoo. This indicates that northwestern China was part of the "*Lystrosaurus* empire" during the Early Triassic (Anderson & Cruickshank, 1978).

Lystrosaurus has not been found in north China, and the Triassic vertebrate record there begins with the Heshangou fauna. This fauna lacks dicynodonts, but it does contain numerous procolophonids as well as scaloposaurs and a proterosuchian. It thus appears to be younger than the Jiuzaiyuanze fauna and probably is of Early Triassic age (Sun, 1980).

The upper Ermaying fauna from north China represents what is here termed the dicynodont-*Sinokannemeyeria* faunal complex. The lower Ermaying contains the procolophonid *Paoteodon,* the cynodont *Ordosiodon,* the kannemeyerids *Parakannemeyeria* and *Shanbeikannemeyeria,* and the scaloposaur *Ordosia.* In contrast, the upper Ermaying includes the procolophonid *Neoprocolophon,* the cynodonts *Sinognathus* and *Traversodontoides,* the kannemeyerids *Parakannemeyeria* and *Sinokannemeyeria,* and the thecodonts *Shansisuchus, Fenhosuchus* and *Wangisuchus.* The kannemeyerids and traversodontid of the upper Ermaying suggest a Middle Triassic age, and thus that it is approximately correlative with the Yerrapalii of India and the Dongus of the U.S.S.R. (Sun, 1980). The precise age of the lower Ermaying is unclear, but it may be of late Early Triassic age (Sun, 1980). The Gela-

Table 7. Reptilian faunal complexes of the Mesozoic of China.

Faunal Complex	Age	Major Fauna
Ornithopod-*Tsintaosaurus*	Late Cretaceous (Campanian-Maastrichtian)[a]	Wangshi, Shandong
Ornithopod-*Psittacosaurus*	Early Cretaceous (Aptian-Albian)[a]	Qingshan, Shandong
Sauropod-*Mamenchisaurus*	Late Jurassic (Kimmeridgian-Portlandian)[b]	Shangshaximiao, Sichuan Basin
Sauropod-*Shunosaurus*	Middle Jurassic (Bajocian-Bathonian)[b,c]	Xiashaximiao, Sichuan Basin
Prosauropod-*Lufengosaurus*	Early Jurassic (Hettangian-Pliensbachian)[c,e]	"lower Lufeng", Yunnan
Dicynodont-*Sinokannemeyeria*	Middle Triassic (Anisian)[d]	Ermaying, north China

[a] Age determination primarily from Chen (1983).
[b] Age determination primarily from Dont *et al.* (1983).
[c] Age determination primarily from Chen *et al.* (1982b).
[d] Age determination primarily from Anderson & Cruickshank (1978) and Sun (1980).
[e] According to Anderson & Cruickshank (1978) of Late Triassic (Rhaetic) age; Dong (1979c) assigns a "Rhaeto-Liassic" age.

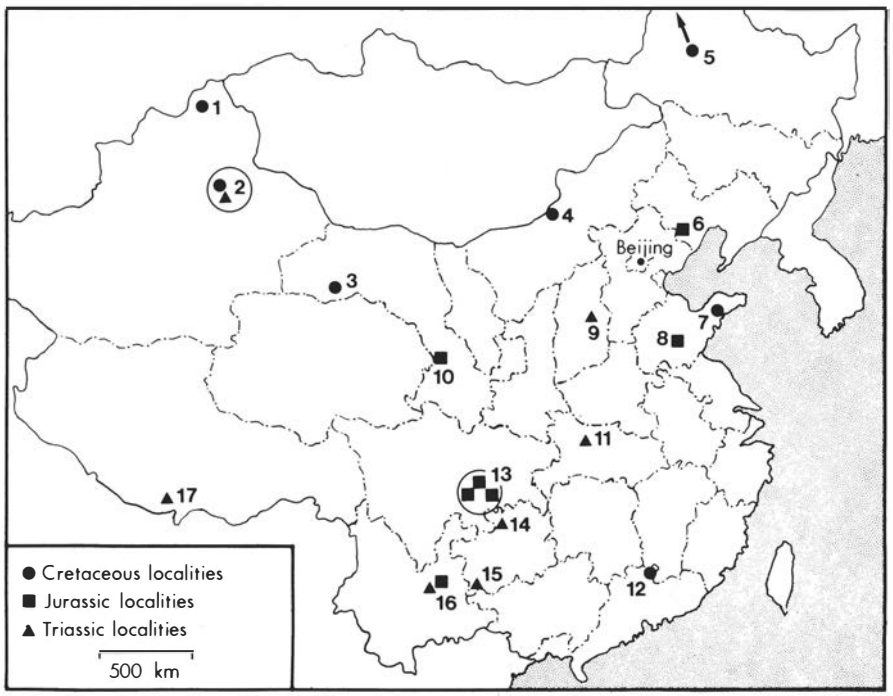

Fig. 7. Major localities for Chinese Mesozoic reptiles. Localities are: 1 – Urho (Wuerho), Xinjiang; 2 – Turpan Basin, Xinjiang; 3 – Yumen, Gansu; 4 – Iren Dabasu, Nei Monggol; 5 – Amur River, Heilongjiang; 6 – Lingyuan, Liaoning; 7 – Laiyang, Shandong; 8 – Mengyin, Shandong; 9 – Yushe, Shanxi; 10 – Lanxhou, Gansu; 11 – Nanzhang, Hebei; 12 – Nanxiong Basin, Guangdong; 13 – Sichuan Basin, Sichuan; 14 – Maotai, Guizhou; 15 – Xingyi, Guizhou; 16 – Lufeng, Yunnan; 17 – Tingri, Xizang (Tibet).

mayi fauna from Xinjiang also appears to be of about the same age as the upper Ermaying.

The Lufeng fauna from Yunnan is without question the most renowned Triassic vertebrate locality in China. The first discoveries here were reported by Bien (1940) and Young (1939a, 1940a, 1940b), and Young (1951a) summarized the majority of what has been published on the Lufeng vertebrates. The vertebrate fauna from Young's (1951a) "lower Lufeng series", now termed the Fengjiahe Formation (Chen *et al.,* 1982b), encompasses more than 30 named genera representing more than seven orders. It represents what is here termed the prosauropod-*Lufengosaurus* faunal complex. Representative reptilian taxa include the prosauropod *Lufengosaurus,* the dinosaurs *Lukosaurus, Sinosaurus* and *Tatisaurus* and the therapsids *Bienotherium, Oligokyphus, Lufengia, Kunmina* and *Dianzhongia.* Long considered (e.g., Young, 1951a), and still considered by some (Anderson & Cruickshank, 1978), to be of Late Triassic (Rhaetic) age, the prosauropod-*Lufengosaurus* faunal complex is now considered to be of Early Jurassic age by most Chinese workers (e.g., Chen *et al.,* 1982b; Dong, 1979c). In fact, on the basis of non-marine invertebrate fossils (Chen *et al.,* 1982a), Chen *et al.* (1982b) assigned a Hettangian-Pliensbachian age to the Fengjiahe Formation.

Triassic marine reptiles from China (nothosaurs and mixosaurid ichthyosaurs) are found along an arc that extends from Xizang (Tibet) to Anhui that approximates the paleoshoreline of the Tethyan sea (Dong, 1979a).

JURASSIC: The single most important area for Jurassic fossil vertebrates in China is the Sichuan Basin (Fig. 8). Here, a succession of continental deposits, beginning with the Upper Triassic Xujiahe Formation and extending through the Upper Jurassic Penglaizhan Formation, contains Early, Middle and Late Jurassic vertebrate remains. Arguably, this sequence should be the standard sequence for the continental Jurassic of China. Louderback (1935) and Camp (1935) first reported on the Jurassic stratigraphy and fragmentary dinosaur remains from the Sichuan Basin, and subsequent work,

mostly by C.C. Young, and new information was recently brought together by Dong *et al.* (1983).

The Zhenzhuchong Formation contains the oldest Mesozoic reptilian fauna in the Sichuan Basin, and, following, Dong *et al.* (1983), this fauna is part of the prosauropod-*Lufengosaurus* faunal complex of probable Early Jurassic age. Lacustrine deposits of the overlying Ziliujing Formation have produced the Liassic plesiosaur *Bishanopliosaurus*. The fauna from the fluviatile Xiashaximiao Formation above the Ziliujing includes the primitive sauropod *Shunosaurus*. Following Dong *et al.* (1983), this fauna represents the sauropod-*Shunosaurus* faunal complex. It appears to be a correlative of the fauna from Young's (1951a) "upper Lufeng series" or "variegated beds", now termed the Zhanghe Formation (Chen *et al.,* 1982b). Chen *et al.* (1982b), on the basis of non-marine invertebrates assigned a Middle Jurassic (Bajocian-Bathonian age to the Zhanghe Formation, well in accord with the Middle Jurassic age assigned by Dong *et al.* (1983) to the Xiashaximiao Formation.

The Shangshaximiao Formation overlies the Xiashaximiao Formation in the Sichuan Basin (in Chinese, *shang* means above and *xia* means below) and has produced a diverse dinosaurian fauna that includes the theropods *Sinocoelurus* and *Szechuanosaurus,* the sauropods *Omeisaurus* and *Mamenchisaurus,* the stegosaurus *Chialingosaurus* and *Tuojiangosaurus*. As Young (1951b) long ago suggested, approximate temporal equivalence of this, the sauropod-*Mamenchisaurus* faunal complex, with the dinosaurian fauna of the Upper Jurassic (Klimmeridgian-Portlandian) Morrison Formation of the western United States seems clear (Dong *et al.,* 1983).

Although there are extensive non-marine Lower Jurassic deposits in China, few Early Jurassic reptile localities are known outside of the Sichuan Basin. The much more limited Upper Jurassic continental deposits of China have produced isolated and, or, fragmentary reptilian fossils from a number of localities that include central Gansu (the crocodilian *Sunosuchus),* the Ordos Basin (the pterosaur *Huanhepterus)* and the Turpan Basin where fragmentary dinosaur remains assigned to *Chiayusaurus* and *Szechuanosaurus* have been reported.

The best known Late Jurassic vertebrate fauna from China outside of the Sichuan Basin is the fauna from the Mengyin Formation in east-central Shandong. Dinosaur and turtle fossils from the Mengyin were originally described by Wiman (1929, 1930). These fossils come from localities near Ninjiagou from what is now the Mengyin Formation *sensu stricto;* the upper volcaniclastic part of the Mengyin of earlier authors is now assigned to the Xiwa Formation (Chen *et al.,* 1980). Conchostracans (especially *Eosestheria)* from the Xiwa and Mengyin Formations indicate a Late Jurassic (Tithonian) age according to Chen (1982) and Chen *et al.* (1982b), not an Early Cretaceous age as earlier workers thought (Morris, 1936; Rozhdestvensky, 1977; Wiman, 1929).

CRETACEOUS: Although there are extensive non-marine Cretaceous deposits in China, reptilian fossils from these only come from three major areas: the Junggur Basin in Xinjiang, the Laiyang area in the Shandong peninsula and the northern Gansu to central Nei Monggol region in northern China. For convenience, we recognize two faunal complexes from the terrestrial Cretaceous of China: the Early Cretaceous ornithopod-*Psittacosaurus* faunal complex and the Late Cretaceous ornithopod-*Tsintaosaurus* faunal complex.

A small and largely endemic reptilian fauna is known from the Wuerho (Urho) area in the Junggur Basin, Xinjiang (Dong, 1973a; Yeh, 1973b; Young 1973f). This fauna includes the bizarre pterosaur *Dzungaripterus* and appears to be of Early Cretaceous age (Dong, 1973b).

The Qingshan Formation in Shandong contains fossils of *Psittacosaurus* and the turtle *Peishanemys* as well as indeterminate pterosaur remains (Young, 1958e). This fauna, the key representative of the ornithopod-*Psittacosaurus* faunal complex, is clearly of Early Cretaceous (probably Aptian-Albian) age based on the non-marine invertebrates from the Qingshan Formation (Chen, 1983). The fauna from Wuerho may be temporally equivalent. Occurrences of *Psittacosaurus* in Nei Monggol (Guyang Formation), Gansu, Liaoning, Hubei and Ningxia extend the geographic range of this faunal complex.

Late Cretaceous reptilian remains, especially those of dinosaurs, occur throughout China. In the Turpan Basin the Subash Formation has produced dinosaur material referred to *Nemegtosaurus* and *Tarbosaurus*. This suggests approximate equivalence with the Campanian Nemegt Formation of the Mongolian People's Republic (Gradzinski *et al.,* 1977; Karczewska & Ziembinska-Tworzydlo, 1983). The Iren Dabasu Formation of Nei Monggol appears to be Maastrichtian. The Wangshi Formation of eastern Shandong is up to 4000-m-thick and, according to Chen's (1983) interpretation of the non-marine invertebrates, represents the entire Late Cretaceous. The dinosaur fauna from the Wangshi includes the hadrosaurs *Tanius* and *Tsintaosaurus* and comes from the upper strata (Campanian-Maastrichtian) of the formation. It well represents the ornithopod-*Tsintaosaurus* faunal complex, as does the fauna from the Nanxiong Formation in

the Nanxiong Basin, Guangdong. This Maastrichtian fauna occurs in a sequence where dinosaur fossils are separated by a short stratigraphic section from overlying mammals of Paleocene age. The dinosaurs are latest Cretaceous and the mammals are the oldest Tertiary mammals known from Asia. This makes the Nanxiong Basin section an extremely important one for students of the Cretaceous-Tertiary transition.

Acknowledgements. – We dedicate this paper to the memory of C.C. Young, the father of Chinese vertebrate palaeontology and a great palaeontologist who laid the foundation for all further studies of the Mesozoic reptiles of China.

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NOTE ADDED IN PROOF:

Since submission of this paper, two further reptile fossils, both from the Middle Jurassic of the Sichuan Basin, have come to our attention. Two species of the hypsilophodont *Yandusaurus, Y. multidens* and *Y. hungheensis* (He & Cai, 1983) have recently been found near Zigong, Sichuan, in the Xiashaximiao Formation. At the same locality and horizon, a new rhamphorhynchid pterosaur, *Angustinaripterus longicephalus* has been described by He, Yan & Su (1983). A further description of these specimens will be forthcoming (Lucas, Mateer & Dong, in preparation).

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