A NEW XINJIANGCHELYID TURTLE (TESTUDINES, EUCRYPTODIRA) FROM THE JURASSIC QIGU FORMATION OF THE SOUTHERN JUNGGAR BASIN, XINJIANG, NORTH-WEST CHINA

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ABSTRACT. A new eucryptodiran turtle, *Xinjiangchelys qiguensis* sp. nov. from the Upper Jurassic (Oxfordian – ?Kimmeridgian) Qigu Formation of the southern Junggar Basin (north-west China) is described. The type material consists of a partial skeleton, including the complete carapace, plastron, nearly all cervical vertebrae, both scapulae, the pelvis and one ulna. It is clearly identifiable as a basal eucryptodire since it lacks the mesoplastron. It is distinguished from other species of *Xinjiangchelys* by several autapomorphies of the carapace and plastron, such as the first and fifth vertebrals extending on the peripherals, the plastron with three pairs of gulars, and an intergular which does not contact the hyoplastron. In the postcranium, the scapula with a long acromial and a small scapular process, the pelvis with a short ilial shaft and the elongated cervical vertebrae are characteristic. A new phylogenetic analysis of the in-group phylogeny of the Xinjiangchelyidae is proposed and discussed, resulting in a new classification of the family. *Xinjiangchelys* (*Toxocheloides*) *narynensis* is regarded as a *nomen dubium*. *Shartegemys* is referred to *Xinjiangchelys*, whereas the holotypes of '*Plesiochelys*' *chungkingensis* and '*P*'. *latimarginalis* are excluded from the genus *Xinjiangchelys* but included in the Xinjiangchelyidae.

KEY WORDS: Testudines, Eucryptodira, Xinjiangchelyidae, phylogeny, Upper Jurassic, Junggar Basin, China.

IT has long been known that the Junggar Basin is very rich in fossil vertebrates and it is not surprising that this interesting region has been under study for many years. Much work was done during the expeditions of the Sino-Canadian Dinosaur Project (1987–90). They focused on the north-eastern and central parts of the Junggar Basin, where they collected several complete dinosaurs, turtles and other faunal elements from the Middle Jurassic Wucaiwan and Upper Jurassic Shishugou formations at the Jiangjunmiao and Pingfengshan localities.

The new Sino-German Cooperation Project (SGP) (Maisch *et al*. 2001; Maisch *et al*. 2003) with teams from the Geological Survey No.1 of Xinjiang, the Nanjing Institute of Geology and Paleontology of the Academia Sinica, the Paleontology Institute of the Jilin University, Changchun, and the Institut für Geologie und Paläontologie der Universität Tübingen started extensive fieldwork in 2000 around the city of Urumchi, along the southern margin of the Junggar Basin. The main outcrops investigated belong to the Middle Jurassic Toutunhe Formation and the Upper Jurassic Qigu Formation. The only fossil vertebrates hitherto described from this region are the ankylosaur *Tianchisaurus nedegoapeferima* and associated theropod remains from the Toutunhe Formation near Fukan (Dong 1993).

In this paper we describe the first vertebrate fossil, a well-preserved xinjiangchelyid turtle, from the Qigu Formation. It was found west of the Toutunhe River in the Liuhonggou section (Hendrix *et al.* 1992) approximately 40 km south-west of Urumchi. It clearly belongs to the genus *Xinjiangchelys*. This genus is common in Middle–Upper Jurassic sediments of Central Asia. The first xinjiangchelyid turtles were described as '*Plesiochelys*' *latimarginalis*, *P. radiplicatus* and '*P.* ' *chungkingensis* by Young and Chow (1953) from the Upper Jurassic Xishaximiao Formation of Sichuan (China). Later Kaznyshkin *et al*. (1990) assigned them to the genus *Xinjiangchelys*, which was erected by Yeh (1986) on the basis of a

nearly complete carapace, plastron, pelvis, humerus, femur and parts of the tibia from the Shishugou Formation of the north-eastern Junggar Basin. From the Fergana Depression of Kirghizia many xinjiangchelyid turtle remains were described from the Middle–Upper Jurassic by Nesov and Kaznyshkin (1985), Nesov (1987), Kaznyshkin (1988) and Kaznyshkin *et al*. (1990). Later Nesov (1995) erected the species *Xinjiangchelys tianshanensis* for part of the material. From Pingfengshan in the northern Junggar Basin, Peng and Brinkman (1993) described 13 specimens which they referred to *Xinjiangchelys latimarginalis*, and one unusual plastron as *Xinjiangchelys* sp.. Sukhanov (2000) published a review of the Mesozoic turtles of Central Asia. He provided preliminary descriptions of two new genera of Upper Jurassic turtles, *Annemys* and *Shartegemys*, which belong to the Xinjiangchelyidae, but he did not include a phylogenetic ingroup analysis in his paper.

The Xinjiangchelyidae are currently considered a monophyletic (see below) group of Upper Jurassic turtles that are morphologically close to the more basal eucryptodire *Plesiochelys*, and the more derived Meiolaniidae and Sinemydidae, which are basal members of the Centrocryptodira (Peng and Brinkman 1993; Gaffney 1996; Gaffney *et al*. 1998). Here we present a new phylogenetic analysis of the Xinjiangchelyidae and on this basis we recoded the family for the analysis provided by Gaffney (1996) and Gaffney *et al*. (1998).

Institutional abbreviations. CCMGE, Chernyshev Central Museum of Geological Exploration, St. Petersburg; GIN, Mongolian Academy of Science; IVPP, Institut of Vertebrate Palaeontology and Palaeoanthropology, Academia Sinica, Beijing; PIN, Palaeontological Institute, Russian Academy of Sciences, Moscow; SGP, Sino-German Project (China-Germany).

SYSTEMATIC PALAEONTOLOGY

Order TESTUDINES Linnaeus, 1758
Suborder CASICHELYDIA Gaffney, 1975
Infraorder CRYPTODIRA Cope, 1868
Parvorder EUCRYPTODIRA Gaffney, 1975
Family XINJIANGCHELYIDAE Nesov, 1990, *in* Kaznyshkin *et al*. 1990

Genus XINJIANGCHELYS Yeh, 1986*a*

Xinjiangchelys qiguensis sp. nov.

Plate 1; Text-figures 1–11

Derivation of name. After the Qigu Formation, the type stratum.

Holotype. SGP 2000/5, a partial skeleton with carapace, plastron, both scapulae, pelvis, ulna and almost all cervical vertebrae.

Type locality. Liuhonggou section near the Toutunhe River, south-west of Urumchi, southern Junggar Basin, Xinjiang Uygur Autonomous Region, People's Republic of China.

Diagnosis. Peripherals 1–6 guttered; increased width of the first vertebral scute compared to the width of the nuchal, pygal large with emarginated anterior edge; the first and fifth vertebrals extend onto the peripherals; three pairs of gulars; intergular without contact to humeral; axillary scute enlarged and first inframarginal reduced in size; neck longer than half of the carapace length, with elongated amphicoelous cervical vertebrae, all neural spines low, ventral keel increasing from the anterior to the posterior vertebrae; centrum of first thoracic vertebra anteriorly orientated; two sacral vertebrae present, only the first bears a sacral rib; scapula with long acromial process and shorter scapular process, anteromedial tip of acromial process curves ventrally with small ventral projection, angle between both processes about 100 degrees; broad pelvis with short ilium, posterior iliac process longer than iliac shaft, encloses an angle of 90 degrees with iliac shaft, ilium with long anteromedial projection, two separate thyroid fenestrae.

Potential autapomorphies. Peripherals 1–6 guttered; the first and fifth vertebrals extend onto the peripherals; wide first vertebral scute relative to the width of the nuchal; three pairs of gulars; intergular without contact to humeral; axillary scute enlarged and first inframarginal reduced in size; posterior iliac process longer than iliac shaft, thyroid fenestra divided.

Distribution. Lowermost part of the Qigu Formation, Upper Jurassic, Oxfordian (Eberth *et al*. 2001), about 48 m above the boundary with the underlying Toutunhe Formation.

DESCRIPTION

The carapace

Sutures of the carapace. The carapace (Pl. 1) is nearly complete; only the posterolateral part of the right side with the lateralmost parts of the fifth costal and the seventh–tenth peripherals are missing. On the left side, the peripherals are preserved, but the lateralmost parts of the fifth–seventh costal are somewhat weathered. The carapace and the plastron have undergone some tectonic deformation. They are extended in an anterosinistral – posterodextral direction and compressed in the other direction, but the maximum difference in length between these two directions only amounts to 15 mm. Apart from these distortions the original curvature of the carapace is well preserved and shows that is was comparatively low.

The carapace is prepared from the dorsal and ventral sides. The neural series is depressed with respect to the costals, as seen best in dorsal view. The outline is oval with a length of 375 mm from the anterior nuchal emargination to the posteriormost edge of the pygal, and a width of 335 mm measured over the sixth peripherals.

The carapace is formed by eight neurals, eight pairs of costals, 11 pairs of peripherals, the nuchal, at least one suprapygal and one pygal. There are no fontanelles. The nuchal has a trapezoidal shape, with a small anterior emargination 48 mm wide. Exactly in the middle of this emargination, a tiny, sinusoidal, anterior extension is exposed. The nuchal is broadest posteriorly (73 mm) and is 44 mm long along the midline. It is sutured to the first peripheral, the first costal and the first neural. It is more similar to that of *X.* '*latimarginalis*' of Peng and Brinkman (1993, fig. 12a), than to the posteriorly expanded nuchal of *X. tianshanensis* which separates the first peripheral from the first costal. The width of the nuchal relative to the width of the first vertebral scute is the smallest among the Xinjiangchelyidae.

The first neural is rectangular and with a length of 42 mm, the longest of the series. The size of the following neurals decreases continuously. Neurals 1, 2, 4 and 6 are rectangular, whereas the others have a more trapezoidal shape, with neurals 3 and 5 being broader anteriorly, and neurals 7 and 8 broader in their posterior region. The shape of the eighth neural is asymmetrical. None of the neurals shows a clear hexagonal shape with clearly visible edges, as described for the other species of the Xinjiangchelyidae. The first three and the eighth neurals are very well preserved with clear sutures and sulci. The neurals 4–7 are somewhat crushed and damaged, because parts of the right half of the carapace extending from the fourth to the seventh costal are posteromedially rotated and partially pressed for about 5 mm onto the right portion of the neurals. Nevertheless most of the sutures and sulci are still clearly visible.

Eight pairs of costals are present in *X. qiguensis*. In *X.* '*latimarginalis*' (Peng and Brinkman 1993) and *X. qiguensis* the first peripheral contacts the first costal, whereas in *X. tianshanensis* (Nesov 1995) a broad nuchal separates them from each other. On the ventral surface of the first costal a sharp anteroventral ridge is exposed medially, which runs laterally up to the anterior part of the bridge. This ridge is formed by the partially fused first and second thoracic ribs. The first rib is reduced and reaches laterally only half-way to the bridge. This condition is only known from three other *Xinjiangchelys* specimens, *X.* '*latimarginalis*' *sensu* Peng and Brinkman, *X. tianshanensis* and *Annemys latiens* (Kaznyshkin *et al*. 1990; Peng and Brinkman 1993; Nesov 1995; Sukhanov and Narmandakh *in* Sukhanov 2000). The anteroproximal end of the first rib forms an anteromedially elongated projection which builds a bluntly tipped rib head. From there it runs more posteriorly, and then curves continuously in a lateral direction. Half-way to the bridge it is fused with the second thoracic rib. A ventrally orientated crest forms the anterior edge of the anteromedial half of the first rib. Posterior to this crest, the suture of the first and second ribs, situated on a low ridge, runs in an anteromedial – lateral – anterolateral direction. It contacts the bridge at the level of the suture between the third and fourth peripherals. Medially, the pronounced anterior crest of the first costal rib extends ventrally for 15 mm whereas in the lateral part it only protrudes for 5 mm. The overhang of this crest is formed only by the first rib.

In dorsal view the rest of the costals (2–8) resemble the costal pattern of *X. tianshanensis* (Kaznyshkin *et al*. 1990; Nesov 1995). In ventral view the heads of the ribs of the costals 1–3 and probably 4, are crushed and pressed onto the internal surface of the carapace. This shows that they were not completely co-ossified with the costals medially, but formed a ventral arch. The rest of the ribs (5–8 and the rib of the first sacral vertebra) are completely fused with the costals, showing three-dimensional preservation. Only one sacral rib is present. The second sacral vertebra must have had a free rib that was not fused to the costal.

On the ventrolateral sides of the eighth costals the articulation facets for the pelvis are exposed. The right facet is best preserved. The first sacral rib runs posterolaterally and about 20 mm from the midline it widens posteriorly. There, the rib and the pelvis articulation facet are fused. The articulation facet is broadest in the anterior region, just 5 mm posterior to the anterior tip. From there it gets narrower posteriorly and after about 20 mm it forms a posteriorly directed tip. The pelvic facet builds a ventrally thickened platform. This platform is anteroposteriorly divided into two nearly equal-sized portions which are situated at different levels. The lateral one forms a more dorsal and the medial one a more ventral platform. The surface of the facets is rugose. The preservation on the left side is not very good, but the anteriormost part of the facet apparently extends slightly onto the seventh costal.

Eleven pairs of peripherals are preserved, except the right seventh–tenth peripherals. Peng and Brinkman (1993), in their revised diagnosis of the genus *Xinjiangchelys* (Yeh 1986*a*), stated that the bridge peripherals 2–7 have upturned lateral edges. This feature is similarly found in *X. qiguensis*, but with the difference that the peripherals 1–6 are guttered, of which the first and the anterior half of the sixth peripheral only show slightly upturned edges. In *X. qiguensis* the posterior half of the sixth, the seventh and the eighth peripherals are clearly not guttered, but they are bridge peripherals. The first peripheral is guttered but not supporting the bridge.

The first peripheral is anteroposteriorly elongated and has a sutural contact with the first costal. The second peripheral is widest in its anterior region. The third–fifth peripherals are narrower mediolaterally. From the sixth peripheral backwards, they again increase in size and up to the tenth they are considerably widened.

The region where the suprapygal bones are located is heavily damaged, parts of the carapace are missing and the dorsal and ventral surface is crushed and weathered. Nevertheless, the anterior suture with the eighth costals, the eighth neural and the posterior suture with the pygal and the eleventh and tenth peripherals are visible. It is impossible to decide if there were one or two suprapygal bones present in this species. The right part is partially well preserved but does not show any suture in dorsal or ventral view. The pygal is well preserved and surprisingly large compared to other xinjiangchelyids. It is almost rectangular with an anteriorly curved posterior margin.

Sulci of the carapace. Of these the cervical scute, the vertebrals, the pleurals, the first six and the twelfth marginals are observable (Pl. 1, fig 1). The sulci of the cervical scute are restricted to the nuchal. It is a small trapezoidal scute with medially curved lateral sulci. The first vertebral is the shortest but broadest being more than twice as broad as long. It covers the anterolateral region of the carapace up to the medial part of the second peripheral. It is much broader than the nuchal. This condition is not found in any other xinjiangchelyid turtle. The specimen of *X.* '*latimarginalis*' described by Peng and Brinkman (1993) (IVPP V9537-1) also shows a vertebral which extends onto the peripherals, but there it covers a small part of the first peripheral only, and the vertebral is not laterally expanded as much. In *X. tianshanensis* (Nesov 1995) and the *X.* '*latimarginalis*' specimen described by Kaznyshkin (1988: CCMGE 1/12486) the anterior part of the vertebral is located on the nuchal only.

The second and fourth vertebrals are the longest, whereas the third is again small. The fifth vertebral is of medium size. It is longer than the third but shorter than the fourth and it is broader than the third and fourth. The posterior region of the fifth vertebral is not well preserved, but a deep sulcus which runs over the eleventh peripherals and the pygal is visible. The suture between the suprapygal and the pygal/peripherals is only visible in ventral view and if the suture is projected onto the dorsal surface it is more anterior than the posterior sulcus of the fifth vertebral. This means that the fifth vertebral extends onto the posterior peripherals and pygal, a condition which is only found in *X. qiguensis* among xinjiangchelyids.

The first pleural is the smallest. On the right side it extends onto the second and third peripherals, left only onto the second. In the posterior region, the lateral sulci of the third and fourth pleurals are not visible.

Of the marginals, the first six, the medial parts of the seventh and the twelfth are well exposed. The first marginal is small, being less than one-third as large as the second. This condition is also found in *X. tianshanensis* (Kaznyshkin *et al*. 1990; Nesov 1995), but there most of the first marginal is located on the nuchal, whereas in *X. qiguensis* most of it is located on the first peripheral. The fourth to the seventh marginal on the left side and the fourth to the sixth on the right side extend onto the second to fourth costals.

Together with *X. tianshanensis* and *X. radiplicatus*, *X. qiguensis* is the third species of this genus which shows dorsal ornamentation of the carapace, but the pattern and the intensity of ornamentation is different. In *X. qiguensis* the ornamentation is weakest, *X. radiplicatus* shows the strongest, and *X. tianshanensis* is intermediate. The ornamentation

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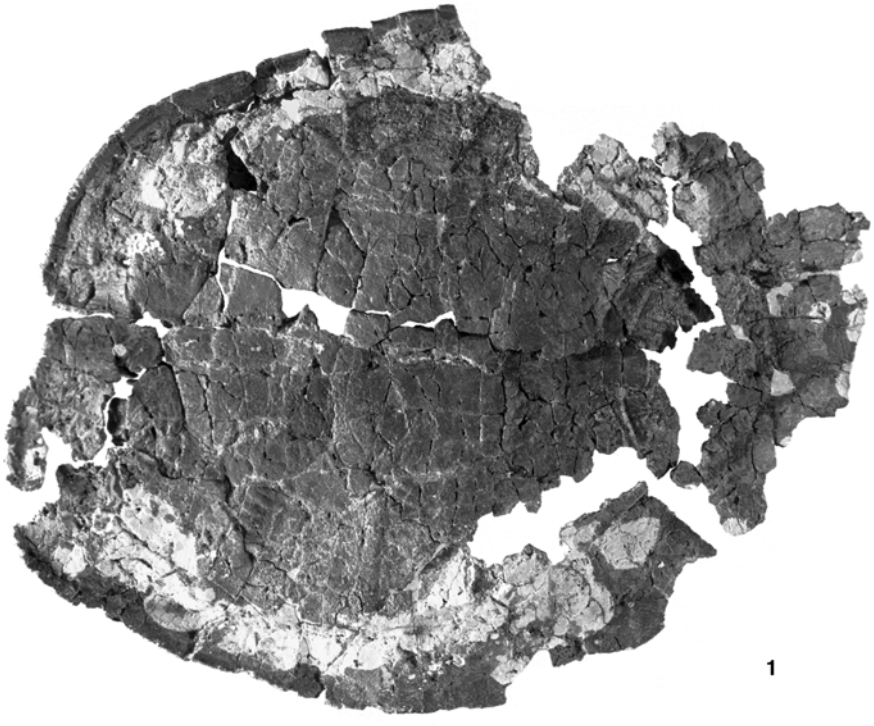
EXPLANATION OF PLATE 1

Figs 1–2. *Xinjiangchelys qiguensis*, holotype, SGP 2000/5, Lower Qigu Formation, Xinjiang, China. 1, carapace in dorsal and, 2, ventral views; both ×0·3.



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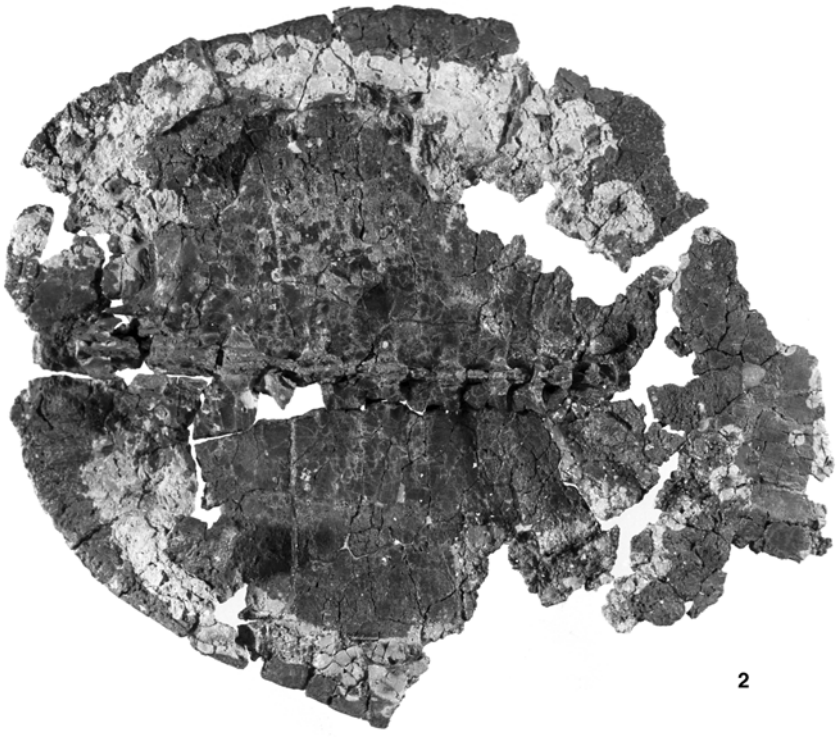

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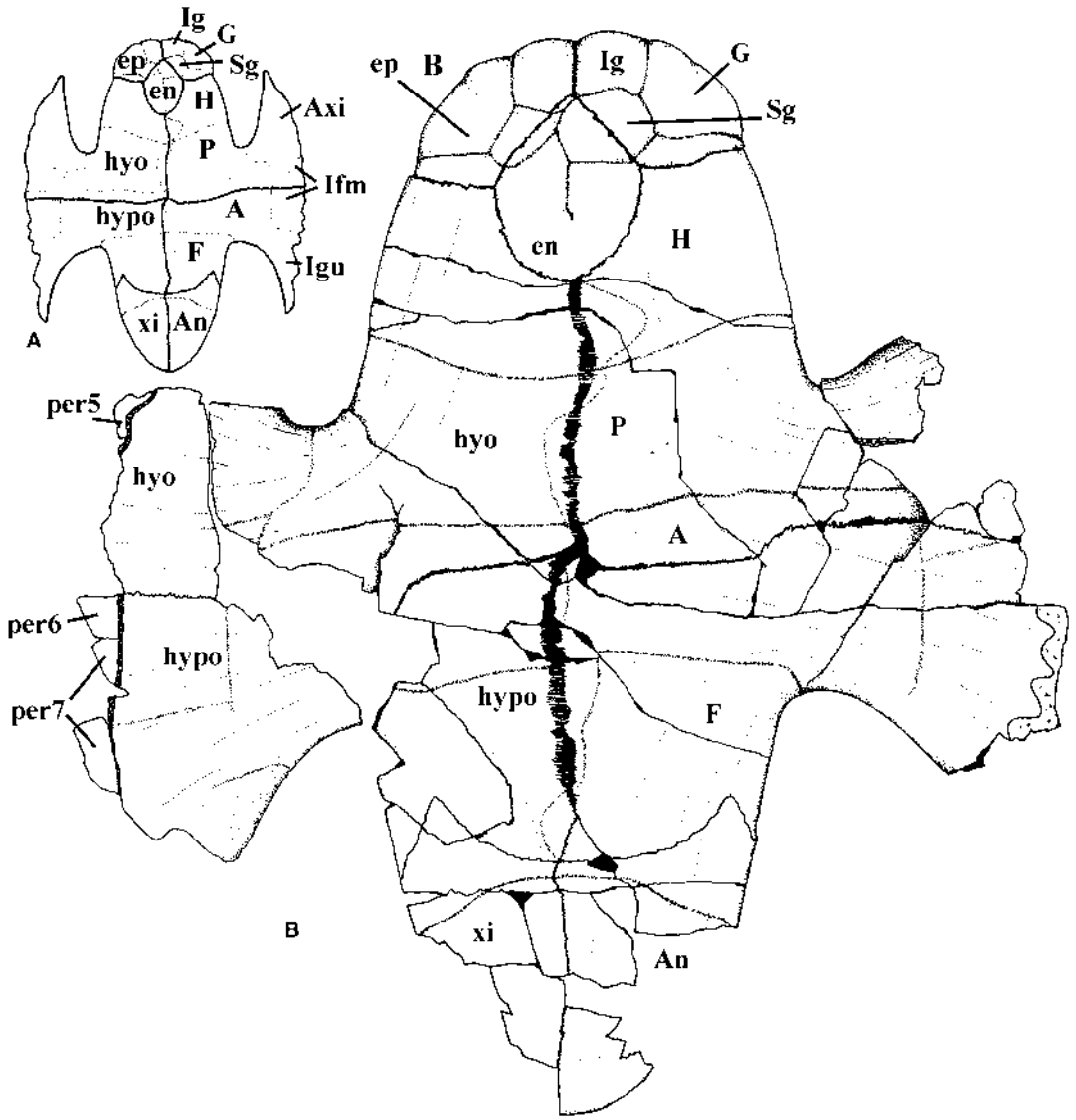
MATZKE *et al.*, *Xinjiangchelys*



TEXT-FIG. 1. *Xinjiangchelys qiguensis*, holotype, SGP 2000/5; Lower Qigu Formation, Xinjiang, China. A, reconstruction of plastron in ventral view; not to scale. B, plastron in ventral view; ×0·5.

in *X. qiguensis* consists of small ridges and grooves which are only visible in the anterior regions of the vertebrals and the pleurals. On the second and third vertebral the ornamentation is weak and only visible on the left side. On the fourth vertebral it is visible on both sides. The ornamentation of the fifth vertebral is strongest, with ridges running from the anteriormost sulcus of the fifth vertebral in a posteromedial direction. Only the second and third pairs of the pleurals are ornamented, but here the ridges are clearly visible on both sides.

The Plastron

Sutures of the plastron. The plastron (Text-figs 1–3) is 283 mm long and well preserved. Only some fragments of the right inguinal buttress and the xiphiplastra are missing. It is 240 mm broad, well ossified and the ventral surface looks

TEXT-FIG. 2. *Xinjiangchelys qiguensis*, holotype, SGP 2000/5, Lower Qigu Formation, Xinjiang, China. A, plastron in ventral view. B, detail of anterior dorsal region with the epiplastra, the clavicular processes of the epiplastra and the entoplastron with its long posterior process. C, detailed view of anterior ventral region of plastron with the three pairs of gulars. A–B, ×0·5; C, ×0·75.

smooth, but on closer inspection shows very small pits and grooves. There are no fontanelles. The mesoplastra are absent, an important derived character of the Eucryptodira (Gaffney and Meylan 1988; Gaffney 1996). The plastron is in close contact with the carapace from the anterior tip of the second peripheral to the anterior tip of the eighth peripheral but is not sutured as is the case in '*Plesiochelys*' *latimarginalis* and '*P.*' *chungkingensis* (Young and Chow 1953). As seen only on the right side, the anteriormost part of the bridge makes a small contact with the first costal anterolateral to the first costal rib. The inguinal buttress extends onto the anteriormost lateral tip of the sixth and onto the posterolateral part of the fifth costal. At the level of the fourth peripheral, the bridge of the plastron is thin, only two or three millimetres in thickness at maximum. In dorsal and ventral view the sutures between the two hyoplastra, the two hypoplastra and the hyoplastra/hypoplastra are strongly serrate.

The anterior margin of the plastron shows six slight convexities (Text-figs 1B, 2A, C), three located on each epiplastron. Four of the incisions correspond to the points where the gular scutes meet the anterior edge of the plastron. The others are located in the anterior third of the gulars (= extragulars of Hutchison and Bramble 1981). Four prominent broad ridges are found on the epiplastra. They run anteroposteriorly on the intergulars, where they are situated far laterally, close to the sulcus with the gulars. On the gulars they run anteriorly–posterolaterally and are almost centrally situated.

The epiplastra and the entoplastron are equal in size. The entoplastron is nearly as wide as long and separates the epiplastra and the hyoplastra to the same extent. It is broadest at the level of the epiplastron/hyoplastron suture, measuring 29 mm. The shape of the entoplastron in its anterior portion is triangular, with the lateral margins enclosing an angle of about 90 degrees; in the posterior half it is more oval in shape. In dorsal view the entoplastral suture is completely different. The entoplastron extends surprisingly far posteriorly, beyond the anteriormost margin of the plastral bridge. The two processus claviculares of the epiplastra are separated by the anterior medial process of the entoplastron, which at the level of the processus clavicularis is only 4 mm broad. On the median axis of the entoplastron a prominent ridge is developed, which starts at the anterior medial process of the entoplastron and broadens backwards. Posteriorly, the entoplastron forms a long narrow triangle. The triangle is 53 mm long and posteriorly encloses an angle of only 28 degrees.

In dorsal view (Text-figs 2B, 3), the outline of each of the two epiplastra is like a quadrant of a circle. The medial suture between the epiplastra is only 16 mm long, before they are separated by the anterior medial process of the entoplastron. The posteromedial tips of the epiplastra bear two long, posterolaterally curved dorsal processes, the processus claviculares. Anterolateral to the processus claviculares a slight depression for muscle attachment is visible.

The hyoplastra are sutured anteriorly to the epiplastra and the entoplastron, posteriorly, exactly at the middle of the plastron, to the hypoplastra, and laterally with the second to fifth peripherals. The suture with the peripherals shows slight sinusoidal curvature for the whole of its length.

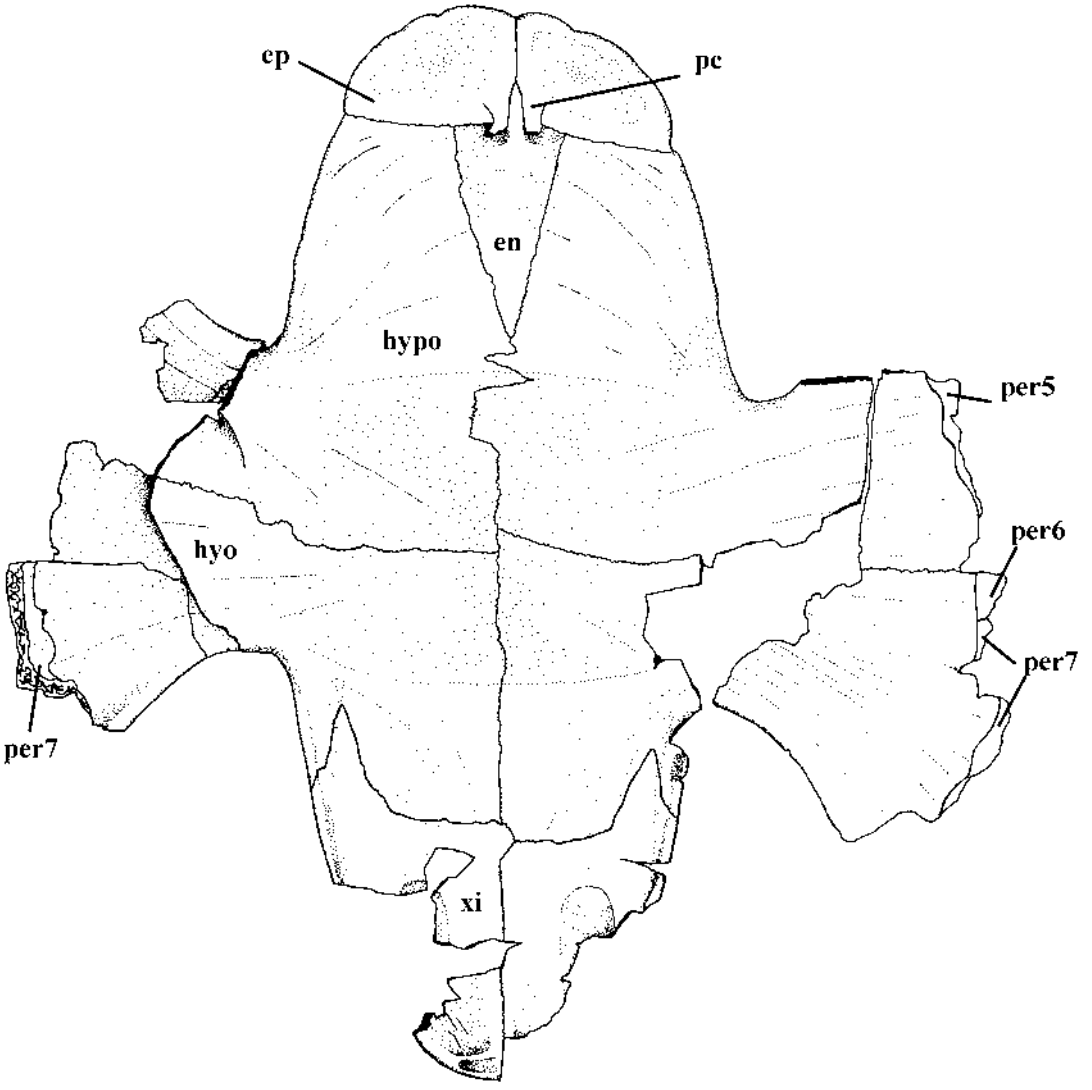
The hypoplastra are in contact laterally with the sixth, seventh and eighth peripherals. The outline of the lateral suture with the peripherals is sinusoidally curved. Lateral pegs of the hyo- and hypoplastra are well developed, but not as strong as in *X.* '*latimarginalis*' (Peng and Brinkman 1993) and *X. tianshanensis* (Nesov 1995).

The xiphiplastra are well preserved, with only some posterolateral parts missing. The suture with the hypoplastra is similar in dorsal and ventral view. It runs from the medial suture straight laterally, and at approximately one-third of the way to the lateral edge it curves slightly anteriorly; and after three-quarters of the way it turns posteriorly, forming a triangular tip with an angle of approximately 30 degrees. This pattern is very typical for the Xinjiangchelyidae; only '*P.*' *chungkingensis* lacks the anterior process of the xiphiplastron, as in *Plesiochelys*.

In dorsal view a deep posterolateral depression is exposed on each xiphiplastron. As visible only on the right side, it starts approximately 10 mm lateral to the median suture and 10 mm posterior to the hypoplastron-xiphiplastron suture as a slight, 12-mm-broad channel, which deepens rapidly. Along the median suture of the xiphiplastra a clear thickening is established. The posteriormost edges are preserved on both xiphiplastra, and the above-mentioned depressions are again visible anterolaterally.

The sulci of the plastron. The sulci of the main body of the plastron are visible (Text-figs 1–2), except the medial sulcus of the analia. On the bridge they are more difficult to see, but one axillary, two inframarginals and one inguinal are identifiable.

The sulci in the anterior region of the plastron (Text-figs 1B, 2A–B) show, apart from the 'normal' full set of intergulars and gulars (=extragulars of Hutchison and Bramble 1981), two additional gulars (here called subgulars), located posterior to the intergulars and posteromedial to the gulars. The right subgular only slightly extends onto the entoplastron, whereas about fifty per cent of the left subgular is located thereon. In addition, a small part of the right intergular reaches onto the entoplastron. The right and left subgulars are of different size and shape. The right one is only half as large as the left one. The gulars are the biggest gular scutes, the left subgular comes next, followed by the intergulars. The right subgular is smallest. It is noteworthy that the intergulars have no contact with the humerals, because of the intervening subgulars.



TEXT-FIG. 3. *Xinjiangchelys qiguensis*, holotype, SGP 2000/5, Lower Qigu Formation, Xinjiang, China; plastron in dorsal view; ×0·5.

The subgulars are an uncommon feature. It is not known whether they are neomorphic scutes or only the posterior portions of subdivided intergulars. The asymmetrical development of the subgulars suggests that these scutes are developmental anomalies. One specimen from Pingfengshan, described as *Xinjiangchelys* sp. (Peng and Brinkman 1993, IVPP V-9537–10) shows a similar gular pattern with one large, unpaired, subgular posterior to the intergulars. No other xinjiangchelyid has any shields that extend onto the entoplastron, whereas in *Plesiochelys* the intergulars reach the entoplastron.

The hyoplastron bears sulci between the humeral-pectoral and pectoral-abdominal scutes. The humeral-pectoral sulcus curves anteriorly slightly in a mediolateral direction, whereas the pectoral-abdominal sulcus is straight, apart from a slight sinusoidal curvature. The median sulcus between the humerals and the pectorals is strongly sinusoidal and differs completely from the hyoplastral suture. The median sulcus of the humeral scutes extends far on the left side, then it meets the humeral-pectoral sulcus and 5 mm posterior to it crosses the median suture of the hyoplastra. Further

TABLE 1. Comparison of the third to sixth and eighth cervical vertebrae; all measurements in mm.

Cervical No.	3	4	5	6	8
length at maximum	39·5	40	40	44·5	32, but poz missing
length of centrum	32	31	32	34·5	26·5
height posterior	15	16	18·5	20	about 25
height anterior	11	9	14	13·5	18
width, at level of transverse process	about 16	17	18	22	at minimum 17
ventral keel from anterior to posterior	small, concave	small, concave	slightly concave	straight, posteroventrally curved	clearly convex and elongated
orientation of prz	anterolaterally and slightly dorsally	anterolaterally	anterolaterally	anterolaterally and slightly dorsally	more dorsally only slightly anteriorly

posteriorly, it extends onto the right side and then curves strongly posteriorly. It meets the median suture at the same point as the pectoral-abdominal sulcus. There it becomes indistinguishable from the strongly serrated median suture.

The sulcus between the abdominal-femoral scutes runs straight laterally from the median suture, but for the last 15 mm curves strongly posteriorly and ends at the posterior extension of the bridge. The median sulcus is only visible for half of its length, located a few millimetres left of the midline suture. The sulcus between the femorals is completely visible. It starts on the left side about 20 mm from the midline suture. From there it runs posteriorly and slightly medially for the first third of its length. Then it runs posteriorly, parallel to and about 8 mm away from the median suture before it crosses the midline and turns onto the right side. For its last third, the sulcus forms a half circle and meets the suture again exactly at the point where the median suture and the hypoplastron-xiphiplastron suture meet each other.

Four scutes are found laterally on the hyo- and hypoplastron. The axillary scute on the hyoplastron is by far the largest. The anterior inframarginal is reduced. It varies slightly in size and shape on both sides, but is only half as large as the posterior inframarginal. The second inframarginal and the inguinal scute are nearly the same size.

The femoral-anal sulcus is clearly visible. It does not cross the hypo-xiphiplastron suture, in contrast to '*P*'. *latimarginalis* (Young and Chow 1953), *X*. '*latimarginalis*' (Peng and Brinkman 1993), *X. tianshanensis* (Nesov 1995) and *Annemys latiens* (Sukhanov and Narmandakh, *in* Sukhanov 2000). In *X. qiguensis* the femoral-anal border extends from the median xiphiplastral suture, just 3 mm posterior to the hypoplastra-xiphiplastra suture, curving slightly posterolaterally.

Vertebral column (Text-figs 4–7; Table 1)

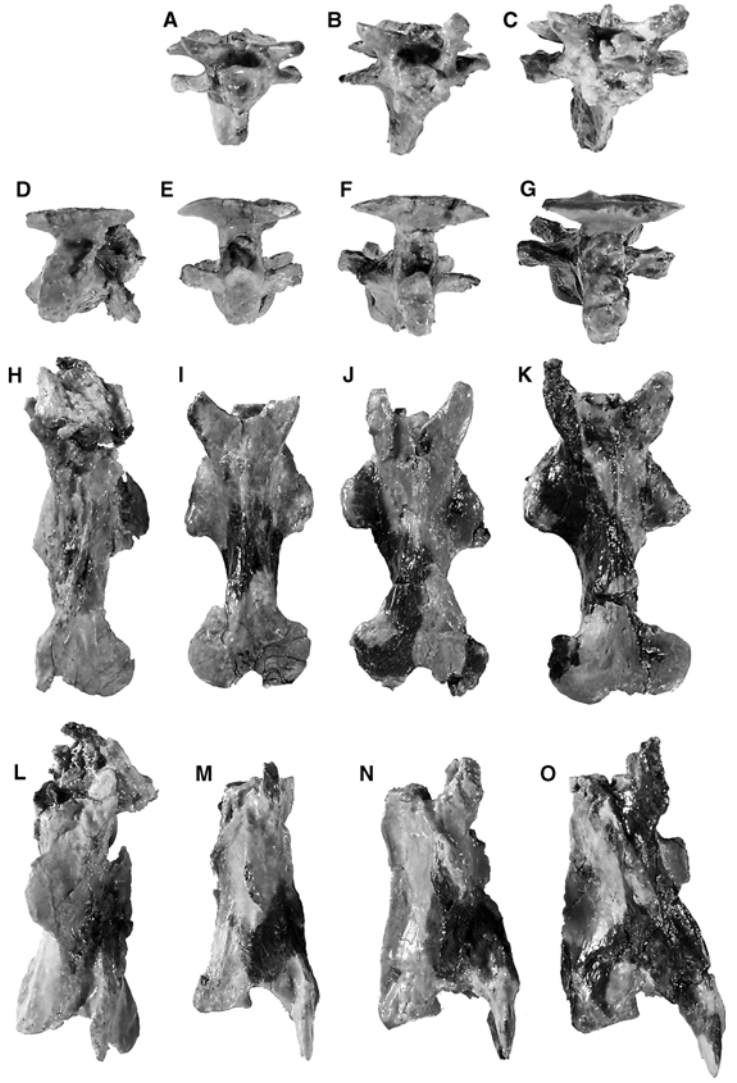
Cervical vertebrae (Text-figs 4–5). The cervical vertebral column is preserved by fragments of the second, complete third–sixth, fragments of the seventh and most of the eighth vertebrae.

The complete neck of *Xinjiangchelys qiguensis* was more than half of the length of the carapace. The length of cervical centra 3–6 and 8 amounts to 159 mm. The seventh is missing, but it can be assumed that its length was no less than 30 mm. For the first and second cervical at least 20 mm can be assumed. For the entire neck, we therefore estimate a length of about 230 mm.

The preserved cervicals are remarkable by the fact that the anterior articulation area of the centrum is far more dorsal than the posterior one. The ventralmost margin of the anterior surface of the centrum is always level with the dorsalmost margin of the posterior surface of the centrum.

Third cervical vertebra (Text-fig. 4D, H, L). The third cervical lacks only the right prezygapophyses. Both transverse processes, the small low neural spine and the left postzygapophyses are deformed.

The whole vertebra measures 39·5 mm from the prezygapophyses to the postzygapophyses, whereas the centrum has a length of 31 mm. The vertebra is slender, gracile and the centrum is only 9 mm wide at maximum. It is highest in the posterior region, measuring 15 mm. Of the anterior articulatory surface nothing is visible, as fragments of the second cervical are pressed onto this region. The centrum is very slender and elongated. In lateral view, the anterior



TEXT-FIG. 4. *Xinjiangchelys qiguensis*, holotype, SGP 2000/5, Lower Qigu Formation, Xinjiang, China. A–C, anterior views of cervicals: A, four; B, five, C, six. D–G, posterior views of cervicals: D, three; E, four; F, five; G, six. H–K, dorsal views of cervicals: H, three; I, four; J, five; K, six. L–O, left lateral views of cervicals: L, three; M, four; N, five; O, six. All × 1·0.

and posterior articulatory surfaces extend furthest ventrally. In between, the ventral margin of the centrum is concave. A sharp ventral keel is formed along the entire length of the centrum. The middle of the centum is triangular in cross section, with two projections to the transverse process and one to the ventral keel.

The left prezygapophysis is small, slender, and anterodorsally and laterally orientated. It extends far more anteriorly than the centrum. Dorsal to the anterior articulatory area a small, sharp, bony flange is present on the left side. It probably represents the parapophysis.

The neural spine is slender and low. It is 20 mm long. At its anterior end, it forms a free overhanging tip 2 mm long, which is orientated strictly anteriorly. The spine extends posteriorly onto the fused postzygapophyses, but it never broadens or increases in height. In the anterior region it is highest, measuring 4 mm, being level with the postzygapophyses. Just half the way posteriorly, it clearly fuses to the anterior part of the postzygapophyses. There, it divides into two ridges which run posterolaterally for a short distance, forming small thickenings at their ends.

The postzygapophyses are fused medially. In dorsal view they have a heart-like outline. Part of the left lateral margin is missing, but they can be reconstructed with a width of about 15 mm.

The transverse processes are anteriorly situated with three-quarters anterior to the middle of the centrum. They curve ventrolaterally. They are extremely thin and of semicircular shape. In lateral view, they extend ventrally below the ventral margin of the centrum.

Fourth cervical vertebra (Text-fig. 4A, E, I, M). The fourth cervical is three dimensionally preserved. Only the anteriormost tips of the prezygapophyses are missing. It is slender, 40 mm long with a centrum length of 31 mm. Anteriorly it is 9 mm high, then it increases in height and posteriorly reaches the maximum height of 16 mm. It is broadest at the level of the transverse processes measuring 17 mm. The articulation surfaces of the centrum are 5 mm high anteriorly and 7 mm high posteriorly. The anterior surface is triangular with rounded edges, the posterior one is oval. On the right side of the anterior central margin a tiny ventrolaterally situated parapophysis is preserved. Immediately posterior to the parapophysis there is an oval depression, leading into a foramen. On both sides this is 3 mm long and 1·5 mm wide. The ventral side of the centrum bears a sharp ventral keel.

The prezygapophyses are anterolaterally orientated with flat horizontal articulation facets. The low and slender neural spine starts 9 mm posterior to the anteriormost tip of the vertebra and runs posteriorly for 17 mm onto the postzygapophyses. There it divides into two 8-mm-long ridges that curve posterolaterally and end with pronounced knobs. The transverse processes are very thin, fragile plates which are laterally orientated. They start ventral to the prezygapophyses, just 3·5 mm posterior to the anterior margin of the vertebral centrum. From there they spread laterally for 13 mm. Three millimetres posterior to the middle of the centrum, they terminate abruptly. From their posterior margins onwards, pronounced, slightly posteroventrally running ridges extend to the posterior margin of the dorsalmost third of the vertebral centrum. The postzygapophyses are as large as those of the third cervical and show the same heart-shaped outline.

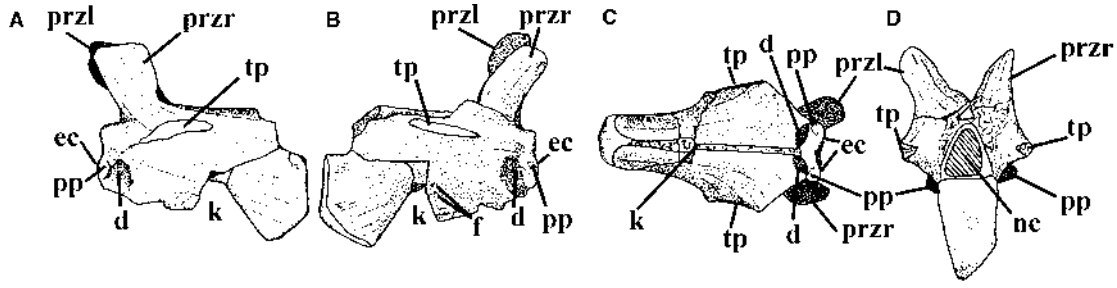
Fifth cervical vertebra (Text-fig. 4B, F, J, N). Only the anteriormost tip of the left prezygapophysis is missing and the lateral part of the left transverse process is depressed dorsally. The rest of the vertebra is three dimensional and well preserved. It has a length of 40 mm. From anterior to posterior its height increases from 14 to 18·5 mm. It is, like the others, widest at the level of the posterior parts of the transverse process.

The centrum of the vertebra is 32 mm in length. The anterior articulation surface is pentagonal with a horizontal dorsal margin. The posterior articulation surface is oval, being 8 mm high and 4 mm wide. In lateral view, a parapophysis is exposed on the ventral half of the anterior margin of the centrum, which is twice as large as the parapophysis of the fourth cervical. No foramen or depression is found posterior to the parapophysis. The ventral keel extends further ventrally. It is stronger than in the fourth cervical and runs nearly straight in a posteroventral direction, with only its middle part slightly concave.

The lateral parts of the prezygapophyses are dorsolaterally orientated and not horizontal as in the fourth cervical. The neural spine begins 4 mm posterior to the anterior margin of the dorsally fused prezygapophyses. It is at maximum only 3 mm in height. After 14 mm the neural spine divides into two ridges, which run 7 mm posterolaterally and end in knoblike thickenings, which are larger than those found on the fourth cervical. The right transverse process is undistorted and, as for the others, situated largely on the anterior half of the vertebra. It starts 4 mm posterior to the anterior margin of the centrum and terminates just 2 mm posterior to the middle of the centrum. A small ridge extends from its posterior margin which, in contrast to the fourth cervical, is only exposed for a few millimetres. The postzygapophyses are fused, horizontally orientated and show the usual heart-shape.

Sixth cervical vertebra (Text-fig. 4C, G, K, O). The sixth vertebra is the largest of the whole preserved series. Only a 4-mm-long piece of the neural spine is missing. The vertebra has a length of 44·5 mm and it increases in height from 13·5 mm anteriorly to 20 mm posteriorly. In anterolateral view, a surprisingly large parapophysis is found on the anterior region of the centrum; it is 8 mm long and 1·5 mm thick. Ventral to it a depression of the same size is seen on the left side only. The anterior articulation of the centrum is 8 mm broad, 4·5 mm high and oval in shape. The posterior end is also oval, being 5·5 mm wide and 8 mm high. A thin, prominent ventral keel runs straight in a posteroventral direction without any concavity.

Compared to those of the fifth cervical, the prezygapophyses have increased in width by about 25 per cent. They are again not horizontial, as in the third and fourth cervicals, but are more dorsolateral in orientation as in the fifth cervical. The prezygapophyses are fused dorsomedially. The neural spine starts abruptly 6 mm posterior to their anteromedial margin. The neural spine is the highest and most prominent of all the cervicals. It runs posteriorly for only 14 mm, then it splits into three ridges of which the lateral two are prominent and end in knob-like thickenings. The transverse process is thick and broad rather than thin and fragile as in the third to fifth cervicals. It starts ventral to the prezygapophyses at the anterodorsal margin of the centrum as a low ridge, then, after 5 mm, it begins to spread laterally



TEXT-FIG. 5. *Xinjiangchelys qiguensis*, holotype, SGP 2000/5, Lower Qigu Formation, Xinjiang, China; eighth cervical vertebra in A, left lateral, B, right lateral, C, ventral, and D, posterior views; ×1.

and thickens rapidly from 0·5 to 2 mm. The lateralmost parts of the transverse processes lie 18 mm posterior to the anterior margin and 1 mm posterior to the middle of the centrum. At this point they terminate and merge into a small ridge which runs posteriorly for only 6 mm.

Seventh cervical vertebra. Of the seventh cervical vertebra only the anteriormost right part with the prezygapophyses, half of the vertebral centrum with the anterior part of the transverse process, and the parapophysis is preserved. The parapophysis is intermediate in size and degree of dorsal displacement between those of the sixth and eighth cervicals. It is knoblike and situated far anterior at the anterolateral margin of the centrum.

Eighth cervical vertebra (Text-fig. 5). Both postzygapophyses with the neural spine, parts of the prominent ventral keel and the lateralmost parts of the transverse processes are missing from the vertebra.

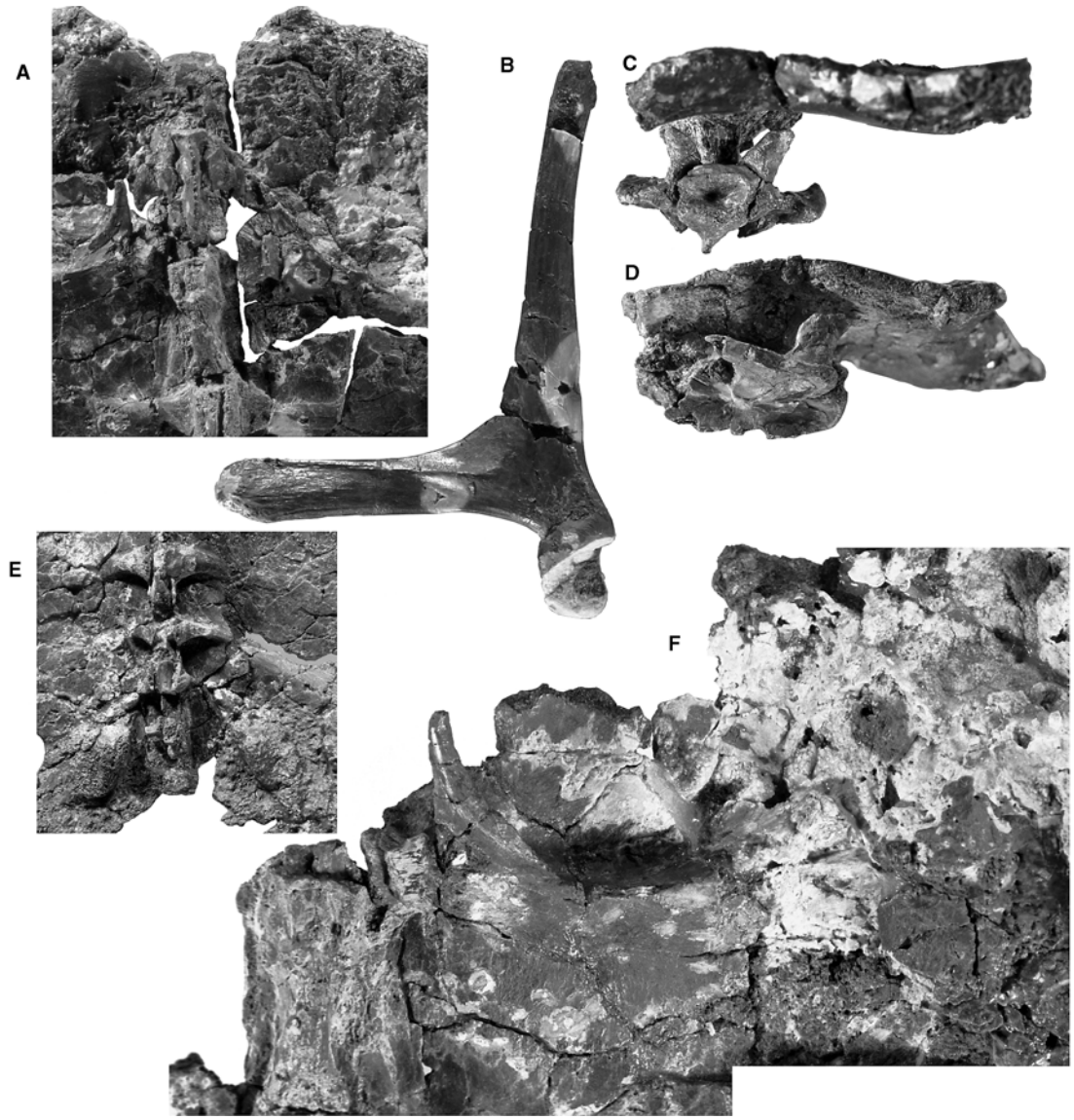
The vertebral centrum is 27 mm long and, at the level of the transverse process, it is 12 mm in width. The anterior articulation area of the centrum is deeply concave. Its outline is roughly rectangular. The posterior articulation surface is largely flat, with only the central part slightly concave. The dorsal margin is straight. The articulation surface is 7 mm high, 6 mm wide dorsally and 4·5 mm wide ventrally. The ventralmost part of the articulatory surface is triangular and merges in anteroventral curvature into the posterior termination of the ventral keel. Ventral to the transverse processes, the vertebral centrum becomes very narrow and develops a sharp ventral keel. One large and three small foramina are situated in the centre of the lateral surface of the centrum.

The prezygapophyses are well preserved, anterodorsally orientated, and reach beyond the anterior margin of the vertebral centrum for approximately 4 mm. The height of the prezygapophyses measured from the anterodorsalmost margin of the vertebral centrum, is 11·5 mm. The cross sections of the bases of the prezygapophyses are triangular with posterolateral, anterolateral and medial tips. The medial processes of the prezygapophyses meet medially and form the dorsal and anterior margins of the neural canal. A few millimetres dorsally, the posterolateral tip thins out. Dorsally, the prezygapophyses increase in width and the medial flanges terminate. In lateral view, the dorsal parts of the prezygapophyses are blade-like. The articulatory surfaces are oval and inclined medially and somewhat posteriorly.

The transverse process of the vertebra starts approximately 6 mm posterior to the anterior margin. It is 9 mm in length. Anteriorly and posteriorly the transverse processes merge into low lateral ridges. The anterior ridge contacts the anterior margin of the vertebral centrum. In lateral view the transverse process is slightly curved dorsally and runs somewhat in an anteroventral – posterodorsal direction.

In anterior view the parapophyses are ventrolaterally orientated. The articulation facets for the ribs, visible in lateral view, are well preserved on both sides. They measure 3 mm in diameter and are posterodorsally – anteroventrally inclined. The vertebral centrum narrows rapidly 3–5 mm posterior to the parapophysis and shows a deep, semicircular depression on its lateral surface.

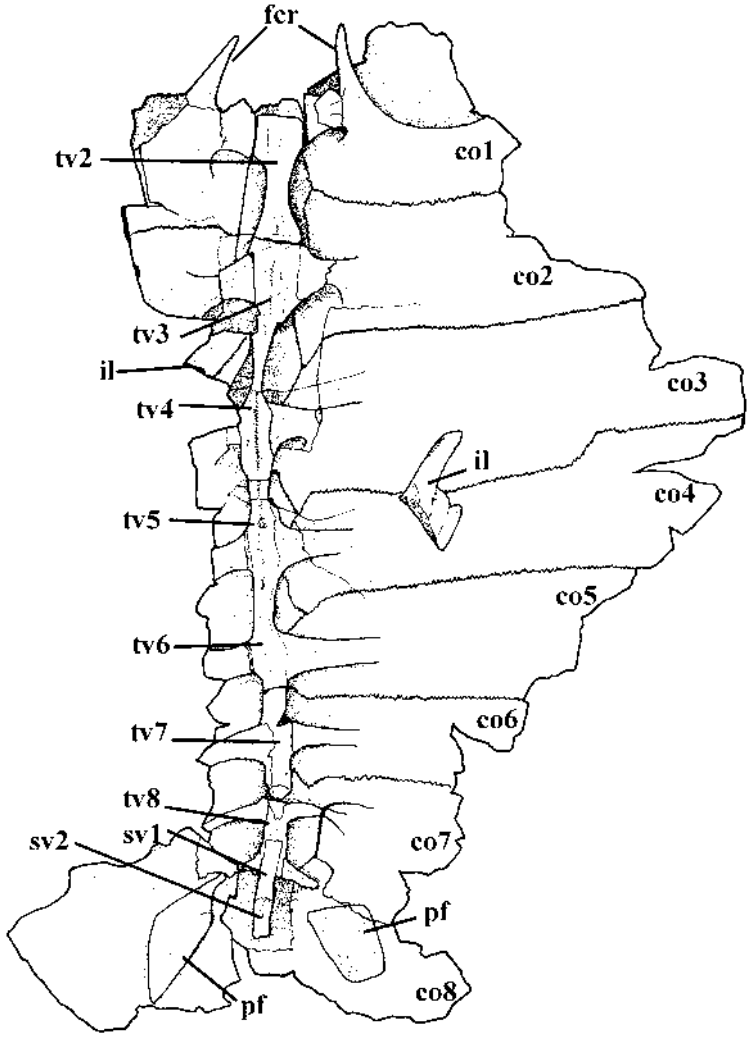
First thoracic vertebra (Text-fig. 6A, C–D). The first thoracic vertebra is well preserved in natural articulation with the carapace. The posteriormost part of the centrum with the articulation surface is missing. With a length of 31·5 mm the first thoracic is nearly as long as the eighth cervical. The neural spine is fused to the ventral surface of the nuchal. It starts 17 mm posterior to the anterior margin of the nuchal and 5 mm anterior to the centrum. It runs 25 mm in a posterolateral direction up to the level where the nuchal ends and the first neural is exposed in dorsal view. The neural spine is 10 mm high and about 3 mm wide. It extends dorsally from the level of the posterior margin of the prezygapophyses, forming an anterodorsally curving crest which tapers out 5 mm anterior to the vertebral centrum. Posteriorly it extends over the whole length of the vertebra.



TEXT-FIG. 6. *Xinjiangchelys qiguensis*, holotype, SGP 2000/5, Lower Qigu Formation, Xinjiang, China. A, first thoracic vertebra in ventral view. B, right scapula in anterior view. C–D, first thoracic vertebra in anterior and right lateral views. E, sacral region. F, first costal rib with second thoracic vertebra. A, E ×0·5; B–D, F ×1.

The prezygapophyses are dorsally orientated and only slightly anteriorly curved. They terminate only 2 mm ventral to the ventral surface of the carapace. The anterior crest of the neural spine is prominently exposed in between the two prezygapophyses. Thus, the postzygapophyses of the eighth cervical must have been very short and low. There was certainly little possibility of movement between these two vertebrae.

The first thoracic is widest at the level of the transverse processes, measuring 29 mm. The transverse process starts at the anteriormost margin of the centrum and runs backwards with a strong posteromedial curvature. Posteriorly it forms a pronounced, pointed, hook-like process. It terminates 16 mm posterior to the anterior central margin and merges into a lateral ridge which extends along the rest of the lateral surface of the centrum.



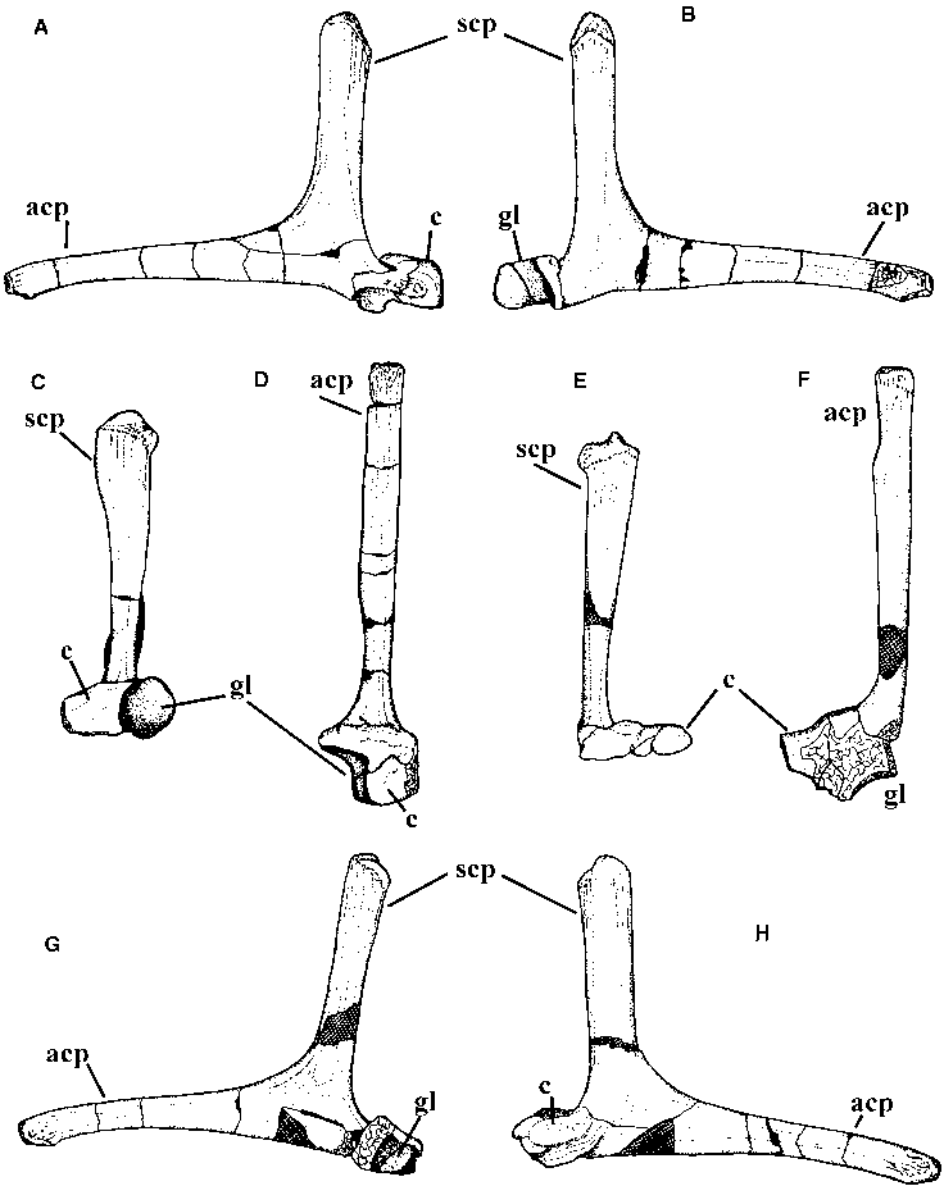
TEXT-FIG. 7. *Xinjiangchelys qiguensis*, holotype, SGP 2000/5, Lower Qigu Formation, Xinjiang, China; middle part of the carapace in ventral view, with the first costal rib, the second to eighth thoracic vertebrae, two sacral vertebrae and the two articulation facets for the pelvis; ×0·5.

The anterior articulation surface of the centrum is amphicoelous and faces strictly anteriorly. Ventrally the centrum bears a prominent ventral keel, of which the ventralmost parts are broken off, but which seems to have had a convex outline in lateral view.

Second to eighth thoracic vertebrae (Text-figs 6A, E–F, 7). The remaining thoracic vertebrae are incomplete and not very well preserved. The fourth, sixth, the anterior half of the seventh and most of the eighth vertebra are missing. The remaining vertebrae are strongly weathered. All preserved centra are crushed and pressed onto the ventral side of the carapace. They show no osteological detail. Only the length of the second (34 mm) and third (32 mm) can be measured.

Sacral vertebrae (Text-figs 6E, 7). There are two sacral vertebrae. The anterior one is well preserved, but only some weathered remains are left of the second.

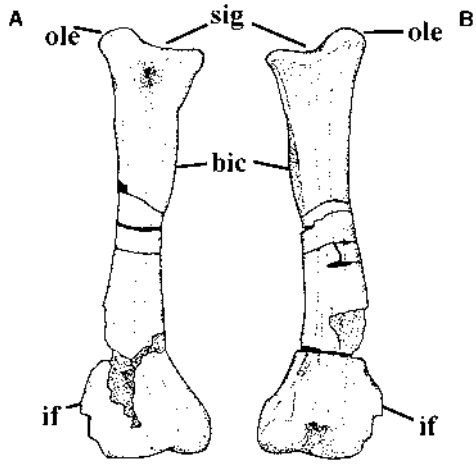
The first sacral vertebra is preserved in natural articulation with the carapace and the heads of the sacral ribs. The rib heads are attached to the anterior half of the vertebra. Half of the shaft of the right rib is broken off. On the other side the rib is preserved but somewhat weathered. The anterior articulation is small compared to that of the posterior. The outline of the centrum is hourglass-shaped in ventral view, and in lateral view the ventral outline is clearly concave. The anterior half of the vertebra is situated further dorsally than the posterior one.



TEXT-FIG. 8. *Xinjiangchelys qiguensis*, holotype, SGP 2000/5; Lower Qigu Formation, Xinjiang, China. Right scapula in A, posterior; B, anterior; C, lateral; D, ventral views. Left scapula in E, lateral; F, ventral; G, anterior, H, posterior views; ×0·75.

Of the second sacral vertebra only weathered remains of the medial part of the centrum are preserved. Compared to the first sacral vertebra it is only half as long and no trace of the sacral rib can be found.

The trend is continued along the thoracic-sacral series whereby the vertebra orientation changes from a dorsal–horizontal to a more ventral one. The last thoracic vertebra is closely attached to the ventral side of the carapace, as is the anterior region of the first sacral vertebra. Then a keel-like crest starts to separate the sacral vertebrae from a close connection with the carapace. The posteriormost part of the second sacral vertebra is situated about 10 mm ventral to



TEXT-FIG. 9. *Xinjiangchelys qiguensis*, holotype, SGP 2000/5, Lower Qigu Formation, Xinjiang, China; right ulna in A, anterior, and B, posterior views; ×1.

the level of the ventral surface of the carapace. Posterior to the last sacral vertebra this crest decreases in size immediately, and ends after 2 mm.

Shoulder girdle (Text-figs 6B, 8)

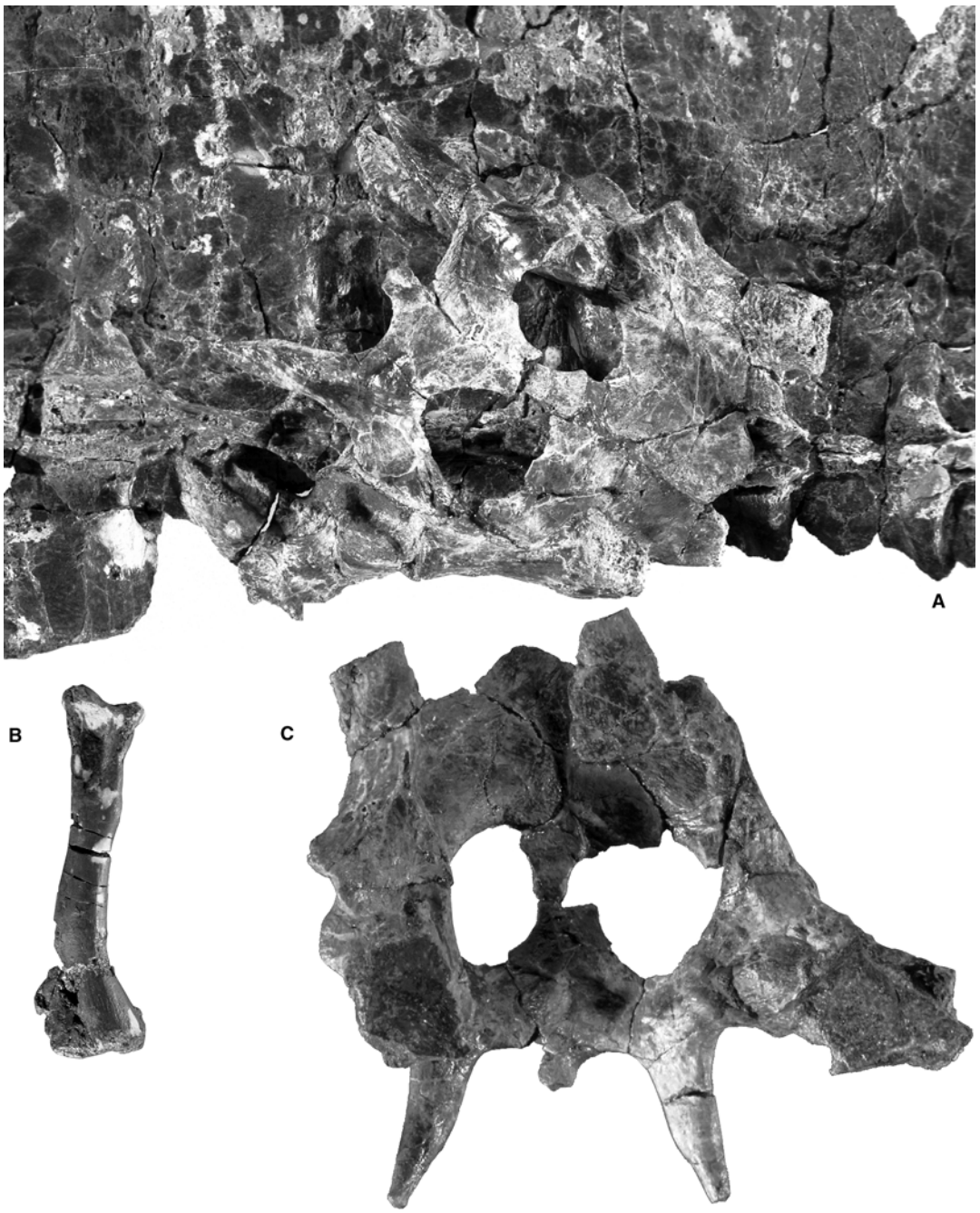
The right scapula is three dimensionally preserved, with only small fragments missing. The coracoidal part of the glenoid region is also preserved, but the posteromedially orientated coracoid process is absent. The left scapula is also well preserved. Both scapulae show the typical triradiate shape found in modern turtles. The scapular and acromial processes enclose an angle of 100 degrees, as in *Xinjiangchelys* '*latimarginalis*' (Peng and Brinkman 1993). The acromial process, which is medially orientated, curves slightly ventrally. With a length of 63 mm (measured from the margin of the glenoid region), it is very long and slender compared to the surprisingly thick scapular process which is only 47 mm long. In cross section the acromial process is oval whereas the scapular process is triangular. The surface of the tip of the acromial process is covered with rugosities and shows a marked ventral thickening. The distal end of the acromial process articulates with the ventral depression of the entoplastron, which is covered dorsally by the processus clavicularis. In lateral view, a strong, dorsally orientated ridge is developed which merges with the anteromedial edge of the scapular process. The glenoidal shaft is short and thick. The shape of the glenoid facet is a quarter of a sphere. The lateral half of the glenoid facet is formed by the coracoid. The glenoid is supported by a distinct neck.

Forelimb (Text-figs 9, 10B)

The only preserved limb bone is a right ulna. It is 55 mm long. The proximal and distal ends are somewhat crushed. In lateral view the diaphysis curves dorsally. The proximolateral end shows a well-developed olecranon for the attachment of the triceps muscle system. Medial to the olecranon a slight, proximally curved sigmoid notch represents the articulation area for the humerus, which forms a small platform-like plate. In lateral view a small rugose process, the bicipital tubercle (Walker 1973; Gaffney 1990), is situated at a distance of 10–19 mm from the proximal end. Distally, at about two-thirds of its length, the diapophysis thickens medially and thins out laterally. The distal end, which is 17 mm wide, is markedly broader than the proximal end, which is only 12 mm wide. In distal view the distal carpal articulation facet for the ulnare and intermedium has a drop-like shape with the larger part on the medial side. In lateral view a narrow articulation facet for the intermedium is well exposed for 5 mm along the shaft in a proximal direction.

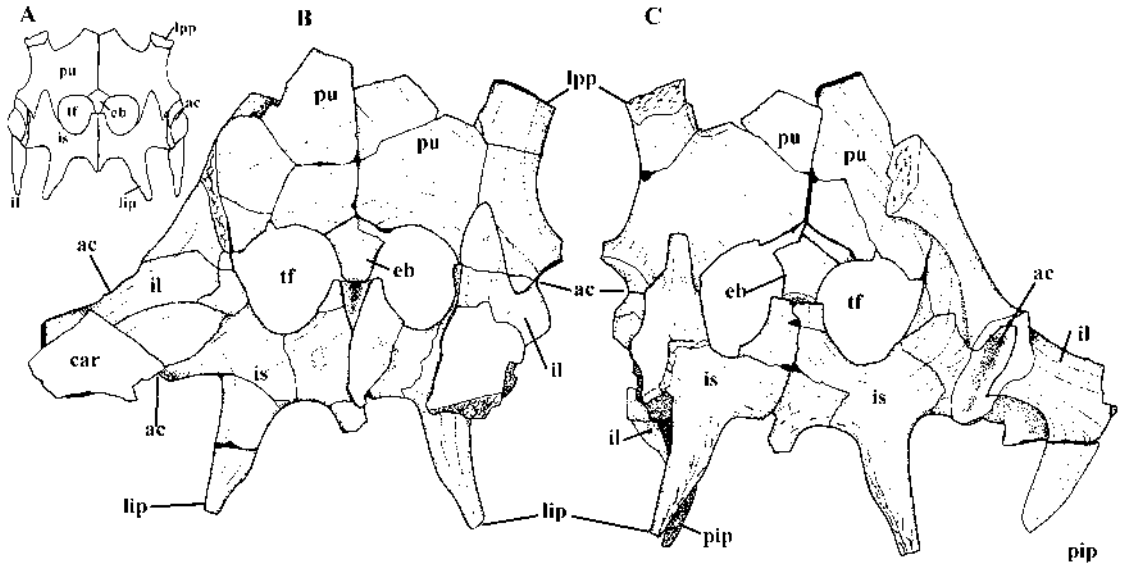
Pelvic girdle (Text-figs 10A, C, 11)

The complete articulated pelvis was preserved between the carapace and the plastron. It was originally dislocated anterior to the level of the third and fourth thoracic vertebrae. It is three-dimensionally prepared, but due to the difficult preparation the posteriormost parts of the posterior iliac processes are still attached to the ventral side of the carapace.



TEXT-FIG. 10. *Xinjiangchelys qiguensis*, holotype, SGP 2000/5, Lower Qigu Formation, Xinjiang, China. A, pelvic girdle in ventral view. B, right ulna in anterior view. C, pelvic girdle in ventral view. All × 1.

The left ilium is complete. It is only 26 mm in height. The posterior iliac process curves strongly posteriorly at an angle of 90 degrees. With a length of 29 mm this process is longer than the dorsal shaft of the ilium. Ventrally the ilium forms the dorsal part (11 mm) of the acetabulum. The acetabular surface is strongly set off from the posterodorsal iliac



TEXT-FIG. 11. *Xinjiangchelys qiguensis*, holotype, SGP 2000/5, Lower Qigu Formation, Xinjiang, China. A, reconstruction of pelvic girdle in ventral view. B–C, pelvic girdle in dorsal and ventral views; ×0·75.

shaft by a sharp ventrolateral edge. In posterior view, the outline of the acetabular border of the ilium encloses an angle of 90 degrees with the ischial acetabular portion. In dorsal view the ilium has a long anteroventral process which is medially and laterally sutured to the pubis.

The right pubis in dorsal view and the acetabular region of the left pubis are well preserved. The pubes have a complete medial suture. Posteromedially they are sutured to a supernumary ossification that meets the ischia posteriorly. Together these bones form a complete median thyroidal bridge. Laterally, a well-developed lateral pubic process forms a strong, sharply keeled, posterior pillar to support the acetabular region. The pubis forms the anteroventral portion of the acetabulum and is in strong sutural contact with the ilium and ischium. Anteriorly the pubis forms a thin (3 mm) but broad plate. At its anterior tip rugose, suture-like, surface structures might indicate that the anteriormost parts of the pubes had a cartilaginous continuation. The anterior plate and the lateral pubic process enclose a deep V-shaped emargination. The anterior part of the lateral pubic process is slightly expanded and has a rugose articulation surface for contact with the xiphiplastron on which, however, no corresponding attachment area is found. This is probably due to a cartilaginous attachment, a view supported by the unfinished look of the attachment area on the lateral pubic process. Posteromedially the pubis forms half of the border of the thyroid fenestra. In dorsal view two posterolateral processes of the pubis are exposed. One builds the posterolateral part of the thyroid fenestra, the other one runs posterolaterally and forms part of the acetabulum. Together they surround the long anteroventral process of the ilium.

Both ischia are well preserved, although the acetabular branch of the right in dorsal and the left in ventral view are somewhat distorted. The ischium is triradiate with an acetabular portion, a lateral ischiadic process and a medial plate. The anterolaterally orientated dorsal acetabular portion forms the posteroventral part of the acetabulum. In dorsal view a long serrated suture with the ilium is visible. The ischium shows an anterolateral projection which contacts the pubis anteriorly and, together with the anteromedial end of the medial ischiadic plate, borders the posterior half of the thyroid fenestra. The left and right plates are medially thickened where the ischia are sutured to each other. In dorsal view they show anterior processes which, together with the supernumary element and the posterior processes of the pubes, divide the thyroid fenestra. A slight, 7-mm-long, V-shaped depression is seen on the dorsal surface of the anteriormost end of each of the anterior processes of the ischia. The posteromedial end of the medial plate bears a small, flat, posterior process on its dorsal side. The lateral ischiadic process runs posteriorly from the exact middle of the ischium, half-way between the medial suture and the lateral acetabular end. Along its anterior two-thirds it is directed posteriorly, then it curves slightly posterolaterally. Anteriorly the process is 9–10 mm wide; after two-thirds it narrows to 6 mm, and at the posteriormost tip it is only 2·5 mm in width. Ventrally the lateral ischiadic process shows a strongly rugose medial surface with ridges and grooves. A well-developed ventral ridge runs in a posterolateral curve from the medial suture to the lateral ischiadic process, and follows it posteriorly exactly along its midline, terminating about 12 mm before the

posterior tip of the process. Posterior to this well-exposed ridge the surface is slightly rugose, whereas anterior to it, the surface of the ischium is smooth.

The acetabulum is well preserved on the left side. It is surrounded by sharp ridges. The outline is anteroposteriorly elongate, but it is low dorsoventrally, and oval in lateral view. The iliac portion is orientated at 90 degrees to the ventral half of the acetabulum, which is depressed by 7 mm with respect to the iliac shaft. Its ventral margin is deeply concave in ventral view.

A supernumary 'bridge' bone connects the pubes and the ischia as mentioned above. It is unpaired and has a strong suture with the pubes anteriorly. Posteriorly it does not fit exactly with the anterior process of the medial ischiac plate, because the anterior end of this process is 8 mm broad, whereas the posterior part of the supernumary bone is only 4 mm in width. In dorsal view it fits perfectly against the 4-mm-wide V-shaped depression (as described above) in the anterior process of the medial plate of the ischium.

COMPARISON

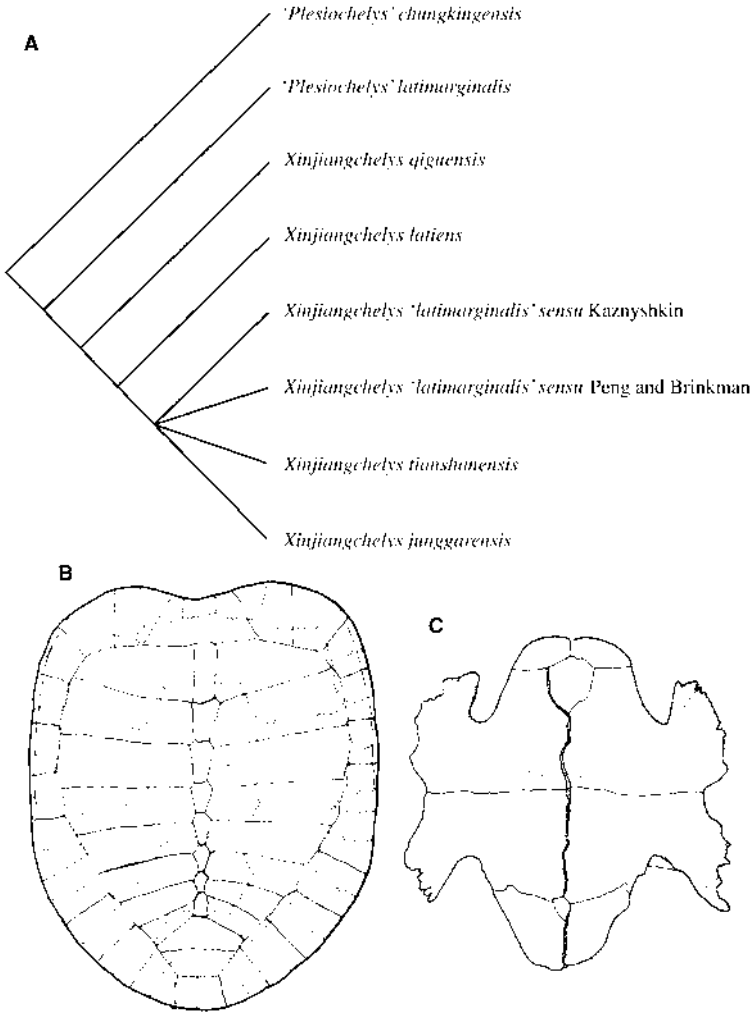
Xinjiangchelys qiguensis clearly shows all autapomorphies of the Xinjiangchelyidae and is identifiable as a new species of *Xinjiangchelys* (Yeh 1986*a*) by comparison with other taxa of the Xinjiangchelyidae. The Xinjiangchelyidae (Text-figs 12–14) consists of '*Plesiochelys*' *chungkingensis* (Young and Chow 1953), '*P*'. *latimarginalis* (Young and Chow 1953), *Annemys latiens* (Sukhanov and Narmandakh, *in* Sukhanov 2000), *Shartegemys laticentralis* (Sukhanov and Narmandakh, *in* Sukhanov 2000), *Xinjiangchelys junggarensis* (Yeh 1986*a*), *X. tianshanensis* (Nesov 1995), *X.* '*latimarginalis*' *sensu* Peng and Brinkman (1993), *X.* '*latimarginalis*' *sensu* Kaznyshkin (1988), *X.* (*Toxocheloides*) *narynensis* (Nesov and Kaznyshkin 1985) and *X.* (*Plesiochelys*) *radiplicatus* (Young and Chow 1953).

'*Plesiochelys*' *chungkingensis* (Young and Chow 1953) is not well known (Text-fig. 13A–B). The holotype shows only the left part of the carapace with the sulci and a few sutures. The nuchal, neurals, and suprapygals are unknown. *X. qiguensis* differs in having large, laterally expanded first and fifth vertebral scutes which extend onto the peripherals. The plastron of '*Plesiochelys*' *chungkingensis* is much better known. It clearly resembles *Plesiochelys* (Bräm 1965). The axillary and inguinal processes of '*P.*' *chungkingensis* are short whereas in *X. qiguensis* they are clearly elongated. Lateral pegs are not found on the hyo- and hypoplastron and the anterior xiphiplastral processes are absent in '*P.*' *chungkingensis*. The midline sulcus of the plastron of *X. qiguensis* is sinusoidally curved, whereas it is straight in '*P.*' *chungkingensis* (Young and Chow 1953).

In the morphology of the carapace, *X. qiguensis* is also clearly distinguishable from '*P.*' *latimarginalis* (Young and Chow 1953), because the first neural is larger than the second, the neurals do not show a clear hexagonal outline, the first vertebral is laterally expanded and the fifth is laterally and posteriorly expanded (Text-fig. 13C–D). In the plastron the axillary process of '*P.*' *latimarginalis* is anteriorly expanded, as compared to '*P.*' *chungkingensis* (Young and Chow 1953), but it clearly lies posterior to the level of the epi-hyoplastron suture if compared to *X. qiguensis*. Lateral pegs are absent in '*P.*' *latimarginalis*. The anal sulcus clearly meets the hypo-xiphiplastron suture and the anal sulcus near the midline is typically omega-shaped. Neither condition is found in *X. qiguensis*.

Sukhanov and Narmandakh (*in* Sukhanov 2000) described a new xinjiangchelyid turtle, *Annemys latiens* (Text-fig. 13E–F), from which *X. qiguensis* differs in the following conditions. The vertebrals of *A. latiens* are clearly small whereas the laterals are laterally expanded and larger than the vertebrals. In *X. qiguensis* it is reversed and the first and fifth vertebrals extend onto the peripherals. The anterior sulcus of the fourth vertebral crosses the middle axis of the shell at the level of the anterior region of the sixth neural, whereas in *X. qiguensis* it is the fifth neural. The eighth neural is reduced and the seventh costals contact the suprapygal in *Annemys latiens*. The axillary process of *A. latiens* is also expanded, but in contrast to *X. qiguensis* it is anteromedially curved. The anal sulcus is omega-shaped and clearly extends onto the hypoplastron, whereas in *X. qiguensis* the sulcus is only slightly curved and does not reach the hypoplastron.

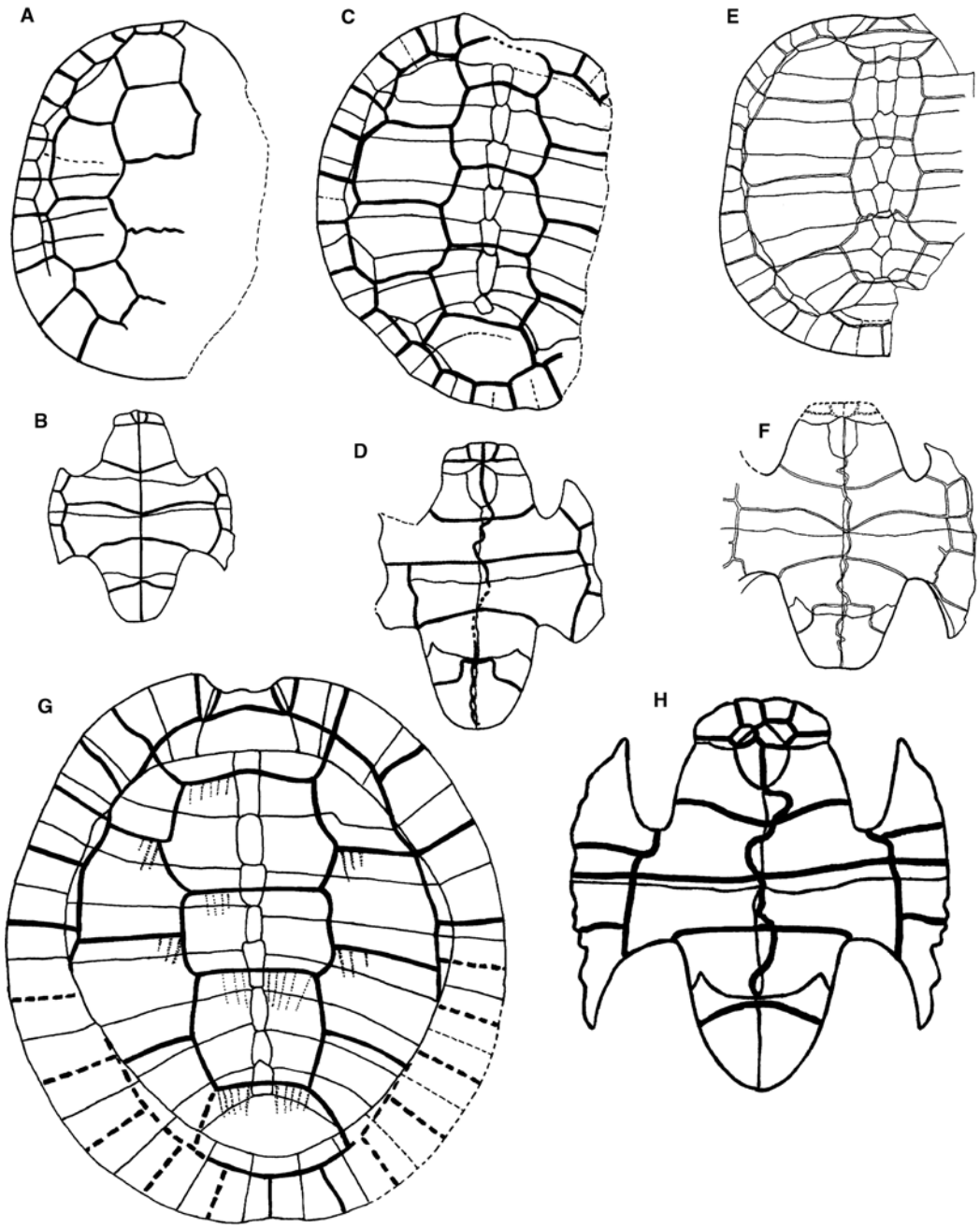
Another xinjiangchelyid taxon newly erected by Sukhanov and Narmandakh (*in* Sukhanov 2000) is the Upper Jurassic *Shartegemys laticentralis* (Text-fig. 14C–D). This species is at present not well known, due to the preliminary character of the description. In the carapace it differs from *X. qiguensis* in having clearly hexagonal neurals, a first neural which is clearly smaller than the second neural and showing a gap between



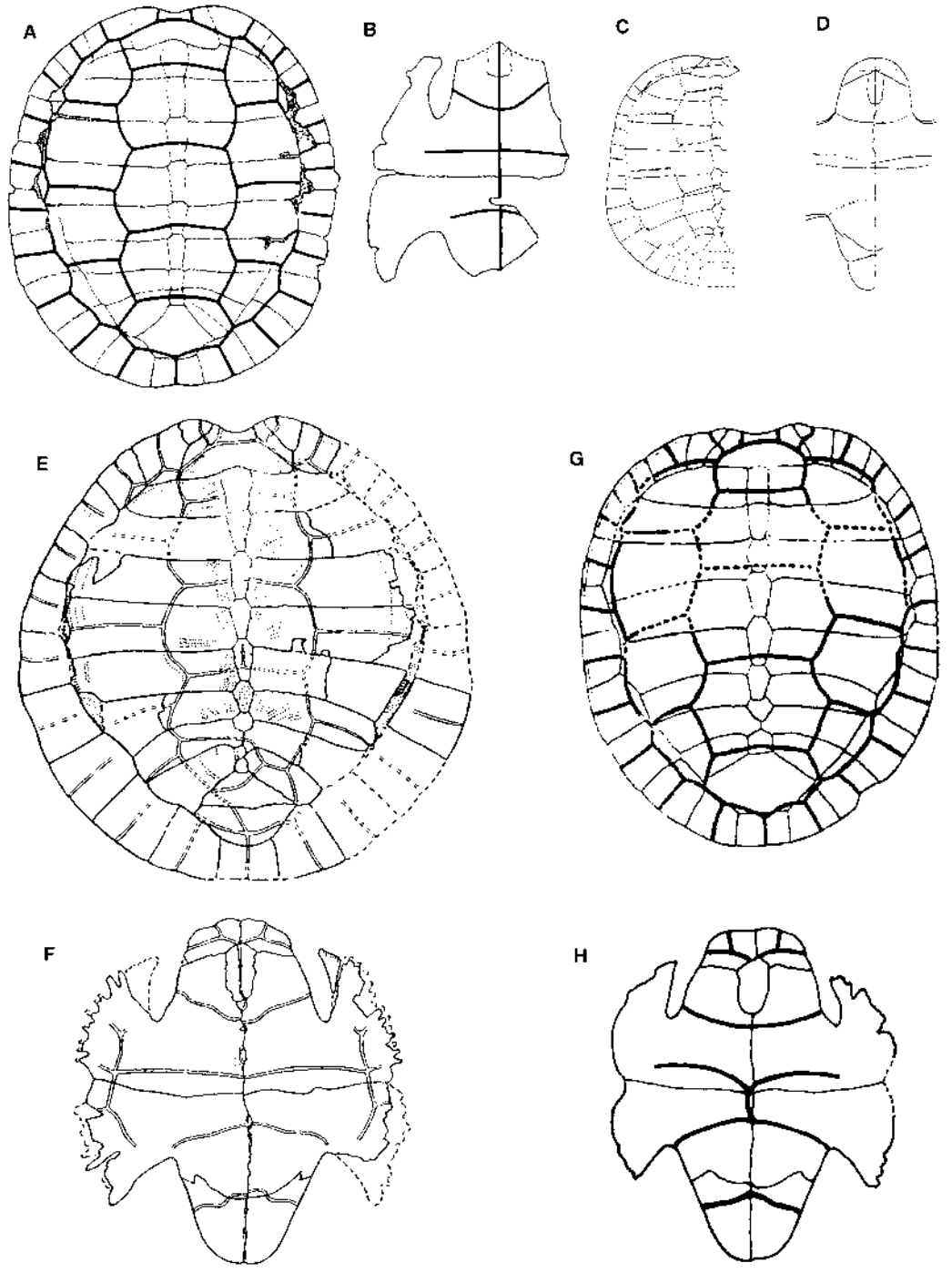
TEXT-FIG. 12. A, strict consensus tree of seven most parsimonious trees showing the phylogenetic relationships of the Xinjiangchelyidae with eight taxa, 18 characters and *Plesiochelys* as outgroup. A computer analysis with Paup* 4.0b05 for Windows with Heuristic random search modus with 10000 replications yields seven most parsimonious trees with the following indices: tree length, 22 steps; consistency index, 0·82; retention index, 0·8; rescaled consistency index, 0·66. Reconstruction of *Xinjiangchelys* '*latimarginalis*' *sensu* Peng and Brinkman, 1993, holotype; IVPP V-9537–1. B, carapace in dorsal view; C, plastron in ventral view; both after Peng and Brinkman 1993 and ×0·2.

the seventh and eighth neural. The whole carapace is oval in shape with more or less straight lateral edges, and it is broadest in the posterior half, whereas that of *X. qiguensis* is more rounded and clearly broadest in the middle of the carapace. The plastron of *S. laticentralis* is known only from a figure published by Sukhanov (2000, fig. 17.3B). It lacks the axillary and inguinal processes. The only clear difference between the plastra of *S. laticentralis* and *X. qiguensis* is the epi-hyoplastron suture, which runs posterolaterally in the former and anterolaterally in the latter. It also seems that the midline sulcus of *S. laticentralis* is sinusoidally curved only in the anterior region, where the humerals and pectorals are situated.

The preservation of the carapace of *X. junggarensis* (Yeh 1986*a*) is quite good, but the plastron is only partly known (Text-fig. 14A–B). According to Peng and Brinkman (1993) the apparent lack of the first peripherals and marginals could be due to fusion with the second peripherals and marginals. It is also



TEXT-FIG. 13. Reconstructions of members of the Xinjiangchelyidae. '*Plesiochelys*' *chungkingensis* Young and Chow, 1953, holotype, IVPP V706: A, carapace; B, plastron. '*Plesiochelys*' *latimarginalis* Young and Chow, 1953, holotype, IVPP V705: C, carapace; D, plastron. *Xinjiangchelys* (*Annemys*) *latiens* Sukhanov and Narmandakh, *in* Sukhanov, 2000, holotype, GIN: E, carapace; F, plastron. *Xinjiangchelys qiguensis* sp. nov.; holotype, SGP 2000/5: G, carapace; H, plastron. A–D after Young and Chow 1953; E–F after Sukhanov 2000; all ×0·2.



TEXT-FIG. 14. Reconstructions of members of the Xinjiangchelyidae. *Xinjiangchelys junggarensis* Yeh, 1986; holotype, IVPP V7648: A, carapace; B, plastron. *Xinjiangchelys* (*Shartegemys*) *laticentralis* Sukhanov and Narmandakh, *in* Sukhanov 2000, holotype, PIN 4636: C, carapace; D, plastron. *Xinjiangchelys tianshanensis* Nessov, 1995, holotype, CCMGE 1/12526: E, carapace; F, plastron. *Xinjiangchelys latimarginalis sensu* Kaznyshkin, CCMGE 1/12486: G, carapace; H, plastron. A–B after Yeh 1986; C–D after Sukhanov 2000; E–F after Nessov 1995; G–H after Kaznyshkin 1988; all ×0·2.

claimed that *X. junggarensis* has a ninth costal and an unpaired suprapygal. We agree with Kaznyshkin (1988) and Peng and Brinkman (1993) that the mesoplastra are absent, contra Yeh (1986*a*). *X. junggarensis* (Yeh 1986*a*) differs from *X. qiguensis* in having hexagonal neurals and a small eighth neural. The axillary process of the plastron is anteromedially elongated. The angle between the acromial and scapular processes of the scapula is clearly less than 100 degrees. The pelvic girdle of *X. junggarensis* (Yeh 1986*a*) is surprisingly small by comparison with *X. qiguensis*. The ischia have no medial contact and the thyroid fenestra is not divided as in *X. qiguensis*.

In *X. tianshanensis* (Nesov 1995) the carapace outline is round (Text-fig. 14E–F), whereas it is more oval in *X. qiguensis*. In contrast to *X. qiguensis* the first peripheral is separated from the first costal, the seventh neural is missing and costals 7 and 8 meet medially. The first and fifth vertebral do not extend onto the peripherals. The plastron is also different from that of *X. qiguensis* in having a loose connection to the carapace, two lateral fontanelles, long extending lateral pegs on the hyo- and hypoplastron, an anteromedially curved axillary process and an anal that extends onto the hypoplastron. The cervical vertebrae are much shorter than those of *X. qiguensis*, although the specimen size is nearly the same. The angle between the acromial and scapular process of the scapula is clearly less than 90 degrees and, therefore, more than 10 degrees narrower than in *X. qiguensis*. The posterodorsal process of the ilium is clearly shorter than the acetabular shaft.

The best known and described xinjiangchelyid turtle to date is the specimen IVPP V9537-1 of *X.* '*latimarginalis*' (Peng and Brinkman 1993) (Text-fig. 12B–C). The carapace is nearly as large as that of *X. qiguensis* but the lateral outline of the carapace is straight, the nuchal emargination is shallow and the pygal is posteriorly rounded. In contrast to *X. qiguensis*, the first vertebral extends only slightly onto the peripherals and the fifth vertebral does not. The plastron differs from that of *X. qiguensis* in having a loose connection to the carapace, a broad bridge, only two pairs of gulars, and an anal sulcus that extends onto the hypoplastron. The cervical vertebrae are shorter than those of *X. qiguensis*. Three sacral vertebrae with at least two sacral ribs are described, one more vertebra and rib than in *X. qiguensis*. The elements of the pelvic girdle are only loosely sutured to each other. The posterodorsal process of the ilium is shorter than the acetabular shaft.

X. latimarginalis sensu Kaznyshkin (1988) also has a shallow nuchal emargination and a straighter lateral margin of the carapace (Text-fig. 14G–H). In contrast to *X. qiguensis* the seventh neural is reduced and the seventh costals meet each other medially. The first and the fifth vertebral shields do not extend onto the peripherals, in contrast to *X. qiguensis*. The plastron is loosely connected to the carapace and probably a small fontanelle is situated laterally, the axillary processes are curved medially, and only two pairs of gulars are present.

A comparison between *X.* (*Toxocheloides*) *narynensis* (Nesov and Kaznyshkin 1985) and *X. qiguensis* is not possible, because the holotype specimen of *X.* (*Toxocheloides*) *narynensis* is only known from isolated fragments of the carapace and plastron that are not well preserved.

The two described specimens of *Xinjiangchelys* (*Plesiochelys*) *radiplicatus* (Young and Chow 1953; Yeh 1986*b*) both have a very small carapace length and agree quite well in size (180 and 240 mm), but they are only half the size of *X. qiguensis*. A remarkable feature of *X. radiplicatus* is the strong sculpturing of the dorsal carapace surface. This sculpturing is independent of the bony pattern, but is associated with the sulci. The centre of the radially arranged ridges and grooves of the surface sculpturing is located in the middle of the posterior third of the vertebrals and in the posteromedial third of the laterals. The border between the different sulci is always associated with two grooves and a ridge lying in between. This strong and unusual surface pattern is not found in *Xinjiangchelys qiguensis*. It is also important that small peripheral fontanelles are found in the specimen described by Yeh (1986*b*). Both the strong sculpture and the peripheral fontanelles might be juvenile features (see Yeh 1986*b*), and the possibility exists that *X. radiplicatus* consists of juvenile material of other xinjiangchelyid species. For this reason it was not included in the phylogenetic analysis, although it is comparatively well known.

Peng and Brinkman (1993) referred remains of a single individual from the Pingfengshan area, including fragments of the carapace and a nearly complete plastron, to *Xinjiangchelys* sp. In contrast to *X. qiguensis* the anterior and posterior portions of the plastron are long and narrow, and the plastral bridge is relatively short. The epiplastra are posterolaterally expanded and the entoplastron shows a strongly

TABLE 2. Data matrix for the cladogram of the phylogenetic relationships of the Xinjiangchelyidae shown in Text-figure 8.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Plesiochelys	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
'*P*'. *chungkingensis*	?	?	?	?	1	?	1	0	?	0	0	0	0	0	1	?	1	0
'*P*'. *latimarginalis*	1	1	?	1	1	1	1	0	1	1	0	0	0	1	1	0	1	1
X. qiguensis	1	1	1	1	1	0	1	1	1	1	0	1	1	1	0	0	1	0
X. (*Annemys*) *latiens*	1	1	1	1	1	1	1	?	1	1	1	1	1	1	1	0	1	1
X. tianshanensis	1	1	?	1	1	1	?	1	1	1	1	1	1	1	1	1	1	1
X. '*latimarginalis*' *sensu* Peng and Brinkman	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
X. '*latimarginalis*' *sensu* Kaznyshkin	1	1	?	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
X. junggarensis	1	1	?	1	1	1	1	1	?	1	1	1	?	?	?	?	1	?

serrated suture with the hyoplastron posteriorly. The xiphiplastra are posteriorly elongated. Apart from these differences there are two similarities. This specimen shows a gular pattern with one large unpaired additional gular posterior to the intergulars (Peng and Brinkman 1993, p. 2024, text-figs 13C, 14). Apart from the paired subgulars in *X. qiguensis* these unusual additional scutes are not known in xinjiangchelyids. *X. qiguensis* and *X.* sp. are also the only members of the group where the gulars extend onto the entoplastron.

Peng and Brinkman (1993) also described the posterior part of the carapace of the same specimen (p. 2024, text-fig. 13B). They identified the fifth–seventh neurals, the fifth–ninth costals and the eighth peripheral. In our opinion this is incorrect and the preserved carapace parts are from the middle to posterior region of the carapace, preserving the third–fifth neurals, the third–seventh costals and the sixth peripheral. Under this interpretation the postulate of an additional ninth costal and neural by Peng and Brinkman (1993) becomes redundant and *X.* sp. becomes more similar in morphology to other xinjiangchelyids.

THE IN-GROUP PHYLOGENY OF THE XINJIANGCHELYIDAE

In 1993, Peng and Brinkman published a phylogenetic discussion where they established the family relationships of the Xinjiangchelyidae. They used five derived characters to distinguish the Xinjiangchelyidae and the macrobaenids from *Plesiochelys*. These characters are included in the matrix presented here as characters 4, 5, 7, 8, and 18. They also found two synapomorphies for *Xinjiangchelys*, which are recorded as characters 3 and 14 in our analysis.

A data matrix with 18 characters (below and Table 2) of the carapace and plastron was analyzed with the computer program Paup* 4.0b5 for Windows.

As outgroup we chose *Plesiochelys* (Peng and Brinkman 1993). The character codings for '*P*'. *chungkingensis*, '*P*'. *latimarginalis*, *A. latiens*, *X.* '*latimarginalis*' *sensu* Peng and Brinkman, *X.* '*latimarginalis*' *sensu* Kaznyshkin, *X. junggarensis* and *X. tianshanensis* were taken from the literature (Text-figs 12–14).

The analysis yields seven most parsimonious trees with a length of 22 steps, a consistency index of 0·82, a retention index of 0·8 and a rescaled consistency index of 0·66. The analysis demonstrates that the Xinjiangchelyidae are monophyletic. *X. junggarensis*, *X. tianshanensis*, *X.* '*latimarginalis*' *sensu* Peng and

Brinkman and *X*. '*latimarginalis*' *sensu* Kaznyshkin form a polytomy in our analysis and together with *A*. *latiens* and *X*. *qiguensis* they are taken, for reasons discussed below, to constitute the genus *Xinjiangchelys*, whereas '*Plesiochelys*' *chungkingensis* and '*P*.' *latimarginalis* are excluded from the genus *Xinjiangchelys*, but retained in the family Xinjiangchelyidae.

List of characters and discussion

1. First neural strongly indents the nuchal (0), no or only small indentation (1)

The first character is an autapomorphy for the Xinjiangchelyidae. In the outgroup *Plesiochelys* (Bräm 1965), the first neural always strongly and abruptly indents the nuchal, with an anterior semicircular prolongation. This is visible, for example, in *P*. *solodurensis* and *P*. *jaccardi* (Bräm 1965). In '*Plesiochelys*' *latimarginalis* (Young and Chow 1953) and in *Xinjiangchelys* the anterior edge of the first neural is always straight. The character state for '*Plesiochelys*' *chungkingensis* is unknown.

2. First neural much smaller than the second neural (0), as large or larger (1)

In *Plesiochelys* the first neural is always much smaller than the second one. In the Xinjiangchelyidae the first neural increases in size and is at least as large as the second in '*P*' *latimarginalis* and almost all species of the genus *Xinjiangchelys*. There is only one exception known in the literature. Sukhanov and Narmandakh (*in* Sukhanov 2000) preliminarily pictured and described a new turtle *Shartegemys laticentralis* from Central Asia which clearly belongs to the genus *Xinjiangchelys*, but in this case the plesiomorphic condition, a small first and a large second neural is retained. In '*P*.' *chungkingensis* the state of this character is not known.

3. First thoracic rib contacts plastron (0), reduced (1)

This character is taken from Peng and Brinkman (1993). It is a potential autapomorphy of the Xinjiangchelyidae, but only known in three of the eight taxa included in the analysis, because the ventral side of the carapace is not prepared or inadequately described in most species. *Plesiochelys* (Bräm 1965) shows the plesiomorphic state with a long, well-exposed first thoracic rib which contacts the plastron. In *X*. *qiguensis*, *A*. *latiens* and *X*. '*latimarginalis*' *sensu* Peng and Brinkman, the first rib is reduced and runs only half-way lateral to the bridge. It is always fused with the second thoracic rib. For *X*. '*latimarginalis*' *sensu* Kaznyshkin and for the more primitive '*Plesiochelys*' *latimarginalis* and '*P*.' *chungkingensis* this condition is unknown.

4. Anterior peripherals without (0), with dorsal thickening (1)

In *Plesiochelys* the anterior peripherals are all flat without any sign of dorsally thickened and guttered peripherals. Peng and Brinkman (1993) also used this character but with a slightly different definition. In their definition the peripherals 2–7 should have upturned edges. In our opinion it is not important how many or which of the anterior peripherals are guttered, because this is variable within *Xinjiangchelys* (*X*. '*latimarginalis*' *sensu* Peng and Brinkman IVPP V9537-1 and *A*. *latiens* peripherals 2–7; *X*. *qiguensis*, peripherals 1–6). In *Xinjiangchelys* these guttered peripherals are ubiquitous, while the condition remains unknown for the basal taxon '*P*.' *chungkingensis.* The derived state is considered here as an autapomorphy of the Xinjiangchelyidae. However, these guttered peripherals are also widespread in other primitive eucryptodires like *Otwayemys* (Gaffney *et al*. 1998).

5. Peripherals 7–11 of normal width (0), strongly widened (1)

The transversely expanded and widened posterior peripherals are typical for all xinjiangchelyids. This character was also first introduced by Peng and Brinkman (1993). The distinct widening always starts with the seventh peripherals and ends with the eleventh. This condition is known for all valid species and specimens that are included in our in-group analysis and therefore the derived state of this character is a clear autapomorphy of the Xinjiangchelyidae.

6. Fifth vertebral extends strongly onto peripherals (0), does not or only slightly extends onto peripherals (1)

In *Plesiochelys* (Bräm 1965) the fifth vertebral clearly overlaps the tenth and eleventh peripherals but not the pygal. In *X*. *qiguensis* the fifth vertebral overlaps parts of the tenth and eleventh peripherals (Text-figure 13G) and, in contrast to *Plesiochelys*, also the pygal. *X*. *qiguensis* is therefore coded for the primitive condition. It is the only species of the Xinjiangchelyidae retaining this plesiomorphy. In all others, except '*P*.' *chungkingensis* where the condition is not known, the fifth vertebral never or only very slightly overlaps the peripherals. In *A*. *latiens* and '*P*.' *latimarginalis* the overlap is somewhat stronger but, if compared to *Plesiochelys* or *X*. *qiguensis*, it is still small and these taxa were therefore coded for the derived character condition.

7. Marginals do not (0), do reach onto costals (1)

This character is again an autapomorphy (Peng and Brinkman 1993) of the Xinjiangchelyidae. In *Plesiochelys* none of the marginals extends onto the costals. The situation is vice versa in the Xinjiangchelyidae. In *Plesiochelys* all laterals are laterally expanded and extend onto the peripherals. In all xinjiangchelyids the marginals are laterally expanded and extend onto the costals at least in the anterolateral region, mainly costals 1–4.

8. Plastron closely (0), loosely (1) connected to carapace

Peng and Brinkman (1993) suggested that the loose connection between plastron and carapace is a derived condition

for xinjiangchelyids and macrobaenids. This character is problematic, because most of the published descriptions do not explicitly mention this condition. It is only definitely known for *Plesiochelys* (Bräm 1965), *X. latimarginalis sensu* Peng and Brinkman and Kaznyshkin, *X. tianshanensis* and *X. qiguensis*. Nevertheless, this character is, in our opinion, assessable in the figures and photographs given in the original descriptions. In '*Plesiochelys*' *chungkingensis* and '*P.*' *latimarginalis* it is clear that the plastra are strongly connected to the carapace, and therefore these taxa are coded for the plesiomorphic character state. In *X. qiguensis* the plastron is weakly connected to the carapace if compared to the condition found in '*P.*' *chungkingensis* and '*P.*' *latimarginalis* and therefore it is coded for the derived character state. The condition for the newly erected *A. latiens* is not verifiable, and it is therefore coded with a question-mark. There are only four species, *X. latimarginalis sensu* Peng and Brinkman (1993) and Kaznyshkin (1988), *X. tianshanensis* and *X. junggarensis*, that clearly show the derived condition, a loose connection between the carapace and the plastron.

9. Entoplastron smaller than epiplastron (0), of similar size or larger (1)

In *Plesiochelys*, for example *P. solodurensis*, the entoplastron is very small compared to the epiplastra. In *P. jaccardi* (Bräm 1965) the difference is not so extensive, but nevertheless clearly observable. In '*P.*' *chungkingensis* the anterior region of the plastron is not well exposed, none of the sutures is known and therefore it is coded with a question-mark. For the remaining members of the Xinjiangchelyidae the entoplastron is always as large as, or even larger than, the entoplastron. This condition is an autapomorphy of the Xinjiangchelyidae.

10. Axillary process short (0), markedly elongated (1)

The axillary process of *Plesiochelys* is very similar to the one found in '*P.*' *chungkingensis* and therefore they are both coded for the plesiomorphic condition. The more derived members of the Xinjiangchelyidae all show the derived condition with an anteriorly elongated axillary process.

11. Axillary process directed anteriorly (0), medially (1)

This character is a synapomorphy for *A. latiens*, *X. tianshanensis*, *X.* '*latimarginalis*' *sensu* Peng and Brinkman, *X.* '*latimarginalis*' *sensu* Kaznyshkin and *X. junggarensis*. In these taxa, the axillary process of the plastron clearly curves anteromedially, whereas all other species have an anteriorly orientated axillary process.

12. Lateral pegs on hyo- and hypoplastron absent (0), present (1)

The lateral pegs are not found in the outgroup (*Plesiochelys*) nor in '*P.*' *chungkingensis* and '*P.*' *latimarginalis*. In all other species included in this analysis the pegs are clearly developed. In most of these species the pegs are not strongly exposed but nevertheless clearly visible (*X. qiguensis*, *X.* '*latimarginalis*' *sensu* Kaznyshkin, *A. latiens*). In *X.* '*latimarginalis*' *sensu* Peng and Brinkman (IVPP V9537-1) and *X. tianshanensis* (FBX-30) these pegs are very strongly developed. The condition for *X. junggarensis* remains somewhat unclear because of the poor preservation and description, but from the drawing given by Yeh (1986*a*) it seems that the anteriormost parts of the inguinal processes together with the pegs are well preserved and therefore the species is coded for the derived condition. This character is a clear autapomorphy for *Xinjiangchelys.*

13. Inguinal process reaches back to hypo-xiphiplastron suture (0), reaches beyond suture (1)

This character is another autapomorphy of the genus *Xinjiangchelys*, whose members all possess a posteriorly elongated inguinal process which clearly reaches beyond the level of the hypo-xiphiplastron suture. In *Plesiochelys*, '*P.*' *chungkingensis* and '*P.*' *latimarginalis* the inguinal buttress is short and therefore these taxa are coded for the plesiomorphic condition.

14. Midline sulcus of plastral scutes straight (0), at least partially sinusoidal (1)

This character is taken from Peng and Brinkman (1993) but they took only the midline sulcus of the humerals into account. We changed the definition because in most of the Xinjiangchelyidae the complete midline sulcus is strongly meandering. In *Plesiochelys*, the midline sulcus is always straight, marks the exact middle of the plastron, and runs parallel to the midline suture. This is also the case in '*P.*' *chungkingensis*, where the plastron is very similar to that of *Plesiochelys*. For '*P.*' *latimarginalis* and the members of the genus *Xinjiangchelys* the midline sulcus and the midline suture are always completely different from each other. The sulcus is strongly sinusoidal and meanders from the right to the left side crossing the midline suture several times. This condition is not clearly seen in the figures given by Kaznyshkin *et al*. (1988, p. 30, text-figs A–B) nor in the version given by Peng and Brinkman (1993), reproduced from Kaznyshkin for *X.* '*latimarginalis*', but the information can be obtained from the excellent photographs in the original description by Kaznyshkin (1988, p. 29, text-figs 1–2).

15. Gularia reach onto entoplastron (0), gularia do not reach entoplastron (1)

The intergulars of *Plesiochelys solodurensis* have a large overlap onto the entoplastron, while in *Plesiochelys jaccardi* (Bräm 1965) the intergulars reach only onto the anteriormost tip of the entoplastron. In the Xinjiangchelyidae the gulars do not usually extend onto the entoplastron but, as before, there is one exception, *X. qiguensis*. Here (as described above) a third pair of gulars, the subgulars, are mainly situated on the entoplastron. There is also another exception, a nearly complete plastron (IVPP V9537-10 *Xinjiangchelyis* sp.) described by Peng and Brinkman (1993), where an unpaired third gular is exposed posterior to the paired intergulars. These subgulars are probably neomorphs or they developed from subdivided intergulars, but the problem cannot be solved with the present data. Nevertheless,

X. qiguensis shows a clear overlap of the gulars onto the entoplastron and is therefore coded for the primitive condition. The situation for *X. junggarensis* (Yeh 1986*a*) remains unclear from the original description.

16. Anteriormost part of humeral-pectoral sulcus maximally reaches the level of the entoplastron (0), clear overlap (1)

This character is found in *X. tianshanensis* and in *X.* '*latimarginalis*' *sensu* both Peng and Brinkman and Kaznyshkin where the anteriormost level of the humeral-pectoral sulcus is clearly situated anterior to the posteriormost part of the entoplastron. The condition is unknown for '*P.*' *chungkingensis* and *X. junggarensis*. In '*P.*' *latimarginalis* the humeral-pectoral sulcus and the posterior tip of the entoplastron are nearly on the same level, but in *X. qiguensis* and *A. latiens* they are far from each other, and therefore these are coded for the plesiomorphic condition.

17. Pectoral scute much smaller than abdominal scute (0), of similar size or larger (1)

This is also a clear autapomorphy of the Xinjiangchelyidae. In *Plesiochelys* the pectoral scute is always smaller than the abdominal. In the Xinjiangchelyidae they are equal in size and in *X. qiguensis* and *X.* '*latimarginalis*' *sensu* Kaznyshkin the condition is reversed, with the pectorals larger than the abdominals.

18. Anal scute only on xiphiplastron (0), reaches suture with or extends onto hypoplastron (1)

This is the fifth character proposed by Peng and Brinkman (1993) as an autapomorphy of the Xinjiangchelyidae. However, on closer inspection it turns out to be highly problematic. Only four species have an overlap of the anal scute onto the hypoplastron: '*P.*' *latimarginalis*, *A. latiens, X. tianshanensis* and *X. latimarginalis sensu* Peng and Brinkman. There is no contact or overlap verifiable in '*P.*' *chungkingensis*, *X. latimarginalis sensu* Kaznyshkin, *X. qiguensis* or '*Shartegemys*' *laticentralis.* Instead, the anal scute and the xiphiplastron suture are always well separated from each other. For *X. junggarensis* the condition is unknown. This character must be considered as strongly variable within the Xinjiangchelyidae and is only provisionally included here. It is probably without strong phylogenetic significance.

CLASSIFICATION OF THE FAMILY XINJIANGCHELYIDAE

With a few exceptions, most of the taxa recognized here are represented by single specimens. This means there is no way of evaluating whether or not the characters identified as differentiating species are variable within a population. As the holotype and only specimen of *Plesiochelys latimarginalis* (Young and Chow 1953) is no longer included in the genus *Xinjiangchelys* (Yeh 1986*a*), the referred specimens (Peng and Brinkman 1993; Kaznyhkin 1988) must be excluded. They clearly show the autapomorphies of *Xinjiangchelys*. There was no opportunity for us to study the other xinjiangchelyids directly, therefore we refrain from erecting new genera or species for these taxa. In this classification only the taxa discussed in this paper are included.

Family XINJIANGCHELYIDAE Nesov, 1990 *in* Kaznyshkin *et al*. 1990

Type genus. *Xinjiangchelys* Yeh, 1986*a*.

Diagnosis. Moderate sized basal eucryptodire turtles, carapace 400 mm long at maximum; shell flat; first neural does not deeply indent the nuchal and is at least as large as the second neural; first rib reduced, reaching only half-way to the axillary buttress and fused with the second rib; anterior peripherals with prominent guttered edges; peripherals 7–11 transversely expanded; marginals reach onto costals mainly in the anterior region; entoplastron and epiplastron similar in size; pectoral and abdominal scutes equal in size or pectoral larger; except for *X. qiguensis*, which retains the plesiomorphic condition, the fifth vertebral does not reach onto the peripherals and the gulars do not reach onto the entoplastron.

Occurrence. Middle–Upper Jurassic of central Asia. Upper Xiaximiao Formation, Sichuan; Shishugou and Qigu formations, Xinjiang, China; Balabansai Formation, Fergana Depression, Kirghizia; Shar Teeg, Transaltai Gobi, Mongolia.

'*Plesiochelys*' *chungkingensis* (Young and Chow, 1953)

Type species and holotype. *Plesiochelys chungkingensis* Young and Chow, 1953; IVPP V706.

Diagnosis. Combines the primitive plastral conditions of *Plesiochelys* with the derived conditions of the carapace of *Xinjiangchelys*; plastron and carapace closely connected; bridge of the plastron short with

short axillary and inguinal processes; midline sulcus of bridge straight; anal scutes restricted to xiphiplastron.

Occurrence. Upper Jurassic, Upper Xiaximiao Formation, Chungking, Sichuan, China; exact locality and horizon unknown.

'*Plesiochelys*' *latimarginalis* (Young and Chow, 1953)

Type species and holotype. *Plesiochelys latimarginalis* Young and Chow, 1953; IVPP V705.

Diagnosis. Sixth neural enlarged, seventh small and eighth probably reduced; midline sulcus of plastron sinusoidal for whole length; axillary process of hyoplastron markedly elongated, inguinal process short, omega-shaped anal sulcus.

Occurrence. Upper Jurassic, Upper Xiaximiao Formation, Chungking, Sichuan, China; exact locality and horizon unknown.

Genus XINJIANGCHELYS Yeh, 1986*a*

Type species. *Xinjiangchelys junggarensis* Yeh, 1986*a*.

Synonyms. *Shartegemys* Sukhanov and Narmandakh, *in* Sukhanov 2000; *Annemys* Sukhanov and Narmandakh, *in* Sukhanov 2000.

Diagnosis. Plastron loosely attached to the carapace, lateral pegs on hyo- and hypoplastron present; inguinal process reaches posteriorly beyond the level of the hypo-xiphiplastron suture.

Xinjiangchelys junggarensis Yeh, 1986*a*

Diagnosis. First neural broad, eighth neural small; first peripheral and first marginal probably each fused with the second ones; probably an additional ninth costal; angle between the acromial and scapular processes of the scapula is less than 100 degrees; pelvis small and fused, ischia have no medial contact, pubes anteriorly expanded, one large thyroid fenestra.

Occurrence. Upper Jurassic, Shishugou Formation, Xinjiang Uygur Autonomous Region, north-west China.

Xinjiangchelys qiguensis sp. nov.

Diagnosis and occurrence. See the Systematic Palaeontology part of this paper.

Xinjiangchelys latiens comb. nov. (Sukhanov and Narmandakh, *in* Sukhanov 2000)

Diagnosis. Shallow nuchal emargination; eighth neural reduced; two suprapygals, with first suprapygal much smaller than second and no contact with peripherals; vertebrals small; sulcus of third and fourth vertebral on sixth neural; pleurals enlarged laterally; posterior margin of xiphiplastron straight, not elongated; anal extends onto the hypoplastron.

Occurrence. Upper Jurassic, Shar Teeg, Transaltai Gobi, Mongolia.

Discussion. The newly erected turtle species *Annemys latiens* shows all of the major synapomorphies of the genus *Xinjiangchelys.* Inclusion of this taxon in our analysis shows that it clearly belongs to *Xinjiangchelys* and is, therefore, excluded from the genus *Annemys*.

Xinjiangchelys tianshanensis Nesov, 1995

Diagnosis. Rounded carapace, nearly as long as wide; eighth neural reduced, seventh and eighth costals meet medially; first peripheral without contact to first costal, anteromedially orientated axillary process; lateral pegs on hyo- and hypoplastron very strongly developed; anal extending onto hypoplastron by forming a slightly omega shaped sulcus; cervical vertebrae short; angle between acromial and scapular processes of scapula less than 90 degrees, tip of acromial process reduced in width; long iliac shaft; pubes small and anteriorly elongated.

Occurrence. Middle Jurassic (Callovian), Balabansai Formation, Sarykamyshsai, Fergana Depression, Kirghizia.

Xinjiangchelys radiplicatus Young and Chow, 1953

Diagnosis. Small turtle reaching 250 mm carapace length at maximum; carapace pear-shaped with its broadest part in the posterior third; lateral fontanelles between costals and peripherals; strong dorsal surface ornamentation, two ridges and one prominent groove between all scutes of the carapace; plastron with small inguinal process; anal scute reaches onto hypoplastron, forming an omega shaped sulcus.

Occurrence. Upper Jurassic, Upper Xiaximiao Formation, Chungking, Sichuan, China; exact locality and horizon unknown.

Xinjiangchelys latimarginalis sensu Peng and Brinkman (1993)

Diagnosis. Lateral margins of carapace straight; first neural elongated, eighth neural larger than seventh; two suprapygals of which the first contacts the peripherals; plastron large with anteromedially orientated axillary process; prominent lateral pegs on hyo- and hypoplastron, anal reaches onto hypoplastron by forming an omega-shaped sulcus; cervical vertebrae short; three sacral vertebrae with at least two sacral ribs; pelvis loosely sutured, ilium with long iliac shaft, one thyroid fenestra.

Occurrence. Upper Jurassic, Shishugou Formation; Pingfengshan, Xinjiang Uygur Autonomous Region, China.

Xinjiangchelys latimarginalis sensu Kaznyshkin (1988)

Diagnosis. Gap between seventh and eighth neurals; seventh costals meet medially; probably lateral fontanelles between carapace and plastron; axillary process anteromedially orientated; prominent lateral pegs on hyo- and hypoplastron; anal scute only on xiphiplastron; pelvis strongly sutured; posterior iliac process long.

Occurrence. Middle–Upper Jurassic, Balabansai Formation, Fergana Depression, Kirghizia.

INVALID GENERA AND SPECIES

SHARTEGEMYS Sukhanov and Narmandakh, *in* Sukhanov 2000

Type species. *Shartegemys laticentralis* Sukhanov and Narmandakh, *in* Sukhanov 2000 (PIN 4636).

Discussion. *Shartegemys* is only poorly figured and described, but it shares most of the important characters of the family Xinjiangchelyidae and the genus *Xinjiangchelys*, and must therefore be considered as a junior subjective synonym of *Xinjiangchelys* (Yeh 1986*a*).

Occurrence. ?Upper Jurassic, Shar Teeg, Transaltai Gobi, central Mongolia.

Xinjiangchelys naryensis (Nesov and Kaznyshkin, 1985)

Synonym. *Toxocheloides narynensis* Nesov and Kaznyshkin, 1985.

Discussion. From the original description and figures given by Nesov and Kaznyshkin (1985), it is known that only isolated bones of this turtle are preserved. The largest preserved fragment is a part of the plastron, more exactly from the hyo-, hypo and xiphiplastron, but this material is not diagnostic. The reconstructions given by the original authors are combinations of the isolated bones and fragments. In our opinion the material is extremely fragmentary and undiagnostic and therefore *X. narynensis* is considered to be a *nomen dubium*.

Occurrence. Middle Jurassic (Callovian), Balabansai Formation, Sarykamyshsai, northern Fergana Depression, Kirghizia.

CONCLUSIONS

Following the work of Yeh (1986*a*), fossil turtles are known from abundant material in the northern Junggar Basin. *Xinjiangchelys qiguensis* sp. nov. is the first turtle to have been found in the Upper Jurassic sediments of the southern margin of the basin. It is one of the most complete xinjiangchelyid turtles known. Xinjiangchelyid turtles were common in the Upper Jurassic of Central Asia (Sukhanov 2000) and numerous specimens and taxa have previously been described and published. They are all clearly different from *X. qiguensis*, which can be diagnosed by several autapomorphies of the carapace and plastron, such as the first and fifth vertebrals extending onto the peripherals, the plastron with three pairs of gulars, and an intergular which does not contact the hyoplastron. In the postcranium, the scapula has long acromial and small scapular processes, the pelvis has a short ilial shaft, and elongated cervical vertebrae.

A phylogenetic analysis of xinjiangchelyid in-group phylogeny demonstrates that '*P.*' *chungkingensis* and '*P.*' *latimarginalis* (Young and Chow 1953) can no longer be included in the genus *Xinjiangchelys* as previously proposed (Kaznyshkin 1988; Kaznyshkin *et al*. 1990; Peng and Brinkman 1993), although they are clearly included in the family Xinjiangchelyidae. The genus *Xinjiangchelys* now consists of six valid species of which one, *Xinjiangchelys qiguensis* sp. nov., is the most plesiomorphic. The phylogenetic relationships of *X. tianshanensis* (Nesov 1995), *X. junggarensis* (Yeh 1986*a*) and the two morphospecies attributed to *Xinjiangchelys* '*latimarginalis*' by Kaznyshkin (1988) and Peng and Brinkman (1993) remain problematic, as these taxa form a polytomy. The recently erected *Annemys latiens* and *Shartegemys laticentralis*, both described by Sukhanov and Narmandakh (*in* Sukhanov 2000) can also be included in the genus *Xinjiangchelys*. They show all major synapomorphies of the Xinjiangchelyidae and of *Xinjiangchelys*, and are referred to that genus as *Xinjiangchelys latiens* and *Xinjiangchelys laticentralis*. *Shartegemys* is thus a junior subjective synonym of *Xinjiangchelys*. *Xinjiangchelys* (*Toxocheloides*) *narynensis* is regarded as a *nomen dubium*, because of the fragmentary state of the holotype material.

The completeness of the new xinjiangchelyid turtle presented here makes it possible to check the Xinjiangchelyidae in the phylogenetic analysis proposed by Gaffney (1996) and Gaffney *et al*. (1998). Only two character states should be corrected: character 28 (1) and character 37 (0).

All findings of xinjiangchelyid turtles are single specimens sometimes associated with fragmentary bones of other individuals. Only the Pingfengshan locality has yielded a considerable number of specimens. Unfortunately, there are at least two different xinjiangchelyids represented in the fauna and these are only distinguishable by the plaston, which is not preserved in most of the specimens of Peng and Brinkman (1993). Therefore, the present data do not permit a study of the variability and ontogeny of the xinjiangchelyids. This will only be possible when more specimens are found.

The new xinjiangchelyid from the Qigu Formation, which hitherto had yielded no identifiable material, demonstrates the importance of the Junggar Basin in the reconstruction and understanding of the Jurassic vertebrates of Central Asia, and the need for continued exploration.

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APPENDIX

Abbreviations used in figures

A	abdominal
ac	acetabulum
acp	acromial process of scapular
An	analia
Axi	axillary
bic	bicipital attachment area
c	coracoid
co 1–8	costal 1–8
d	depression in anterior region of seventh cervical vertebra
eb	extraossified 'bridge' bone
ec	extra condyle area in anterior condyle of seventh cervical vertebra
en	entoplastron
ep	epiplastron
f	foramen in seventh cervical vertebra
F	femoral
fcr	first costal rib
G	gular (extragular or second pair plastral scales)
gl	glenoid
H	humeral
hyo	hyoplastron
hypo	hypoplastron
if	intermedial facette
Ifm	inframarginals
Ig	intergular (first pair plastral scales)
Igu	inguinal
il	ilium
is	ischium
k	ventral keel
lip	lateral ischium process
lpp	lateral pubic process
nc	neural channel
ole	olecranon process
P	pectoral
pc	processes clavicularis
per	peripheral
pf	pelvic facette
pg	pygal
pip	posterior ilial process
pp	parapophysis
przl	left prezygapophysis
przr	right prezygapophysis
pu	pubis
scp	scapular process
Sg	subgular (supernumary or third pair plastral scales)
sig	sigmoid notch
sv 1–2	sacral vertebrae 1–2
tf	thyroid fenestra
tp	transverse process
tv 1–8	thoracic vertebrae 1–8
xi	xiphiplastron