*On some Mesozoic Fossils from the Khorat Series of East Thailand and a Note on the Khorat Series.**

Contributions to the Geology and Palaeontology of Southeast Asia, VII.

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[With Plate XI]

The so-called Khorat series is extensively distributed on the Khorat plateau. Hence the name Khorat series. It is nearly horizontal or gently undulated and overlies the folded Upper Palaeozoic formations on the western border of the plateau unconformably. It is known for a long time that the series contains bones, molluscan shells and silicified woods, but these fossils have never been studied in detail, notwithstanding that they bear great importance for the chronology of the series and accordingly for the dating of the pre-Khorat orogeny. Recently KOBAYASHI has described the Cretaceous Ban Na Yo fauna from the eastern part of the plateau. Here are described two other materials procured from the northern and southern part.

In the drilling operation (Core Hole No. M-3) at Ban Krok Namtao, km. 49.80, southwest of Khorat along Khorat-Krabin Buri road a few pelecypod shells were found contained in red siltstone pieces of drill cores at the depth 70′ to 75′2″. Messrs. Jamchet C. JAVANAPHET and Phongpan Na CHIENGMAI have afforded KOBAYASHI these specimens for determination.

Another lot of fossils were collected by Dr. Dwight E. WARD of the United States Operations Mission to Thailand (USOM) and Messrs. Sirichai PRUANGKARN and Sangat PIYASIN of the Royal Thai Department of Mines (RTDM) in their field survey along the Loei-Udon Thani highway and sent to KOBAYASHI through Mr. Kaset PITAKPAIVAN. This collection comprises Reptilean teeth and bone fragments and Molluscan shells.

The Reptilean remains were studied by TAKAI and the Molluscan shells from the two areas by KOBAYASHI and HAYAMI. These studies resulted in two chapters in this paper. On this occasion a note is presented by KOBAYASHI on the Khorat series. Here the authors wish to record their sincere thanks to all of the above mentioned geologists.

Before going further, the fossil occurrence in the northern Khorat plateau is described on the basis of Dr. WARD's report. The fossils were collected

* Received Nov. 20, 1962.

at three points along the highway from Changwat Udon Thani to Amphoe Nong Bua Lamphu, kilometer 33.180 to 43.465. The Khorat series at this part is composed of sandstone, siltstone and conglomerate; cross-bedding and lenticular bedding are characteristic of the sandstone. Maximum dips of 16°NE were measured in the western or lower part of the section where the strike is N 40° W. The dip decreases gradually to 4° NE in the eastern or upper part where the strike is N 11° W.

The section is divided into 62 lithologic units and the fossils were found in the units 9, 47 and 48 (km. 43.15, km. 39.25 and km. 39.05 respectively) in ascending order, more precisely,

9: Conglomerate, greenish to yellowish grey, hard, with grey to dark grey pebbles of limestone and calcareous siltstone cemented. 1.2 m. thick.

47: Sandstone, pale red to light brownish gray, hard, calcareous conglomeratic zones with fragments of grayish red siltstone up to 1 cm. Scattered fossils resemble gastropod *Natica* and pelecypod *Mytilus*. 10.5 m. thick.

48: Conglomerate, pale red, hard with grayish red siltstone pebbles up to 2 cm. in fine- to medium-grained, calcareous sandy matrix. 2.1 m. thick.

Tables 1-2. Fossils from 3 localities on Highway from Changwat Udonthai to Amphoe Bang Bua Lamphu.

I	Km.	Unit	Rock	Collector	Date
Aa	39.04	48	Calcareous conglomerate	D.E. WARD	6-17-1962.
Ba	39.25	47	Calcareous sandstone	S. PRUANGKARN	7- 4-1961.
Bb	do	do	do	WARD	do
Ca	43.15	9	Calcareous conglomerate	do	6-12-1962.
Cb	do	do	do	PRUANGKARN	do
Ab	39.04	48	Calcareous conglomerate	WARD	6-17-1962.

II	A	B	C
Naticoid gastropod	a	b	
Mytilus rectangularis	a		
Cardinioides magnus		a	
Thick shell fragment	a		
Ichtyosauria tooth		b	
Plesiosauria tooth			b
Bone fragment	a	b	a

The fossils of these localities are shown in two tables. *Cardinioides* as a genus has so far been restricted to occur in the Carnic and Liassic in Japan. *Cardinioides magnus* is a species most allied to *C. varidus* from the Liassic Kuruma formation in Central Japan. Any further restriction cannot

be made with *Mytilus* (*Pachymytilus*?) *rectangularis* on the chronology. *Pachymytilus* is an Upper Jurassic genus, but its reference to the genus cannot be warranted. *M. rectangularis* on the other hand looks similar to *M.* (*Falcimytilus*) *stricapillatus* which is another member of the Liassic Kuruma fauna, but the resemblance could be superfacial. It is noted further that Ichtyosaurian and Sauropterigian teeth appear also Jurassic ones.

In looking through these aspects of the fossils the age of the bone beds is considered Jurassic rather than Upper Triassic and more probably Liassic than later Jurassic.

Beside these teeth there is a small indeterminable fossil obtained from a sandstone pit km. 20, south of Khorat, on road to Pak Thongchai. It may be a Reptilean tooth, but too imperfect to say any further.

The occurrence of *Cardinioides* and *Mytilus* tells that the bone beds of Amphoe Nong Bua Lamphu are marine deposits, instead of non-marine, and probably a near-shore part of an embayment like the Liassic Kuruma and Carnic Heki embayments.

Although the generic position is indeterminable, the shells of the bore core of Ban Krok Namtao show stronger affinity to marine genera than non-marine one. It is certain, however, that a part of the Khorat series is non-marine, because the faunas characterized by *Trigonioides*, *Plicatounio* and *Nippononaia* which occur in East Thailand and Lower Laos are either limnic or limno-paralic.

1. Note on the Khorat Series

by Teiichi KOBAYASHI

The Khorat series was primarily proposed by BROWN and others (1953) for a collective term to include all of the Mesozoic formations in Thailand which were considered Jurasso-Triassic in age. Triassic marine fossils were known in North Thailand and Jurassic marine ones in West Thailand, but none from the Khorat plateau in East Thailand whence the term was derived. These fossiliferous formations are the sediments of the Burmese-Malayan geosyncline which were folded by the late Mesozoic orogeny.

The Khorat series s. str. on the Khorat plateau on the other hand overlies the folded Upper Palaeozoic formations of Loei, Phu-kadung, Petchabun and so forth on the western border of the plateau and is itself subhorizontal or gently undulated. LAMOREAUX and others (1959) later segregated the beds of Jurassic and Cretaceous (?) age from the series and divided the series into three members in naming them Phu Kadung, Phra Vihan and Phu Phan in ascending order. There was, however, no fossil evidence for the Triassic age of the Khorat series s. str. and its contact with the Jurasso-Cretaceous (?) beds is said obscure.

HÖGBOM (1914) has already called attention to silicified woods which are

often contained in gravel beds at north Loei and other places. The specimens which he collected were determined by G. HALLE to be Dicotyledons and Conifers and they were considered Tertiary plants.

Because silicified woods might have been derived from any part of the Khorat series, they bear importance for chronology. Among the specimens examined by OGURA there were a few kinds of dicotyledonous plants beside *Araucaryoxylon* from Karasin. According to him the dicotyledonous plant from Khorat (i.e. Nakhon Ratchasima) is by no means a primitive Cretaceous form. Therefore it was noted previously that the Khorat series probably includes a non-marine formation not older than Middle Cretaceous and that the marine Triassic and Jurassic formations in North and West Thailand must be excluded from the Khorat series (KOBAYASHI, 1960).

In the Khorat plateau there are horizontal sand and gravel deposits or the so-called Quaternary deposits which were distinguished from the Jurasso-Cretaceous Khorat series in the Geological Map of Thailand (1953). The silicified woods in question were obtained from such beds but they were thought to have been derived from the series.

In the Geological Map of the Khorat plateau (LAMOREAUX et al., 1959) the Quaternary deposits are omitted. It shows that their Jurassic and younger beds constitute the Khorat and Sakon Nakhon basin respectively in the south-central and northern part of the plateau. In the text it is noted that the beds in the central part of the basin may be Cretaceous or younger, but the localities of silicified woods are Khorat, Chaiyaphum and Karasin which are all in the marginal part of the Khorat basin. In the description of the beds no mention was given of petrified woods, but petrified woods are simply said to occur in the upper 20 feet of the Phra Vihan member of the Khorat series. Is this the source of the petrified woods?

Petrified woods were later found *in situ* in a sediment at Karasin, but whether this find means the presence of the Phra Wihan member at Karasin or whether it represents a new fossil horizon in the so-called Jurassic and younger beds must be answered after a careful field survey.

Recently I have visited a locality adjacent to the southwest of Khorat and made a collection of petrified woods from the sand and gravel beds in question. The dicotyledonous characteristics are well preserved in all of the petrified woods in my collection. Beside these there occur Permian fusulinids bearing gravels which are completely silicified. Because they belong to the Rat Buri limestone formation, it is certain that Upper Palaeozoic rocks were well exposed in the hinterland at the time of the fluvio-lacustrine sediments.

The Geological Map of the Khorat series (1959) shows that the Khorat and Sakon Nakhon basins are separated from each other by the Phu Phan range where the Khorat series repeats gentle anticlines and synclines. The *Nippononaia* fauna described recently was procured from Ban Na Yo adjacently

to and south of Mukdahan. Therefore this is a definite evidence showing that the Khorat series comprises Lower Cretaceous sediments.

There are two additional facts on the chronology of the Khorat series. One is the fossiliferous sandstone and conglomerate of Amphoe Nong Bua Lamphu, west of Udon Thani and the other the fossiliferous red siltstone drill core of Ban Krok Namtao, southwest of Khorat. As these fossils are here described, the former is most probably Liassic. The latter is, though imperfect, likely a Jurassic form.

On the basis of the known facts on the stratigraphy and palaeontology the so-called Khorat series of the plateau is classified into three parts as follows:

III. The upper Khorat series forming the northern and south-central basins.
..... Upper Cretaceous or Tertiary.
..... Weak discordance ? .....
II. The middle Khorat series yielding the Lower Cretaceous fauna.
..... Relation unknown .....
I. The lower Khorat series, gently folded and containing Liassic bone beds.
..... Strong discordance

It is quite probable that the upper Khorat series is roughly equivalent to the beds of Jurassic and Cretaceous age of LaMoreaux et al. (1959) and that it is a source of the Tertiary silicified woods. It is then a question what is the relation of the Khorat series to the Mesozoic formations in the neighbouring territories.

It is certain that the Khorat series of the plateau is related to Grès supérieurs or Indosinias supérieurs as well as Indosinias moyennes in part which are distributed on the north and east sides of the Mekong river and in Cambodge to the south of the Dang Raek range.

The Sakon Nakhon basin extends into le pays des grès du Moyen Laos to the north beyond the Mekong river. There the Indosinias supérieurs are unfossiliferous. The Indosinias moyennes which probably lie on the preceding with weak discordance on the west side of the basin are said to yield Noric fossils such as *Rhaetidia* sp., *Myophoricardium lineatum* Wohrm. and *Cardinia* sp. This occurrence suggests the possibility of the Upper Triassic in the basal part of the lower Khorat series to the east of Loei.

As noted elsewhere, les grès supérieurs of Muong Phalane in Bas Laos yield *Manchurosaurus*, *Titanosaurus* and other reptiles as well as *Trigonioides*, *Plicatounio* and *Unio*. The age of the fauna is considered Campanian or Lower Senonian. Therefore the *Nippononaia* fauna of Ban Na Yo and the *Trigonioides* fauna of Muong Phalane are combined to indicate the presence of the Lower and Upper Cretaceous sediments in the Khorat series.

It is noteworthy that *Araucarioxylon* sp. and *Xenoxylon latiporosum* are described from the Série de Tho-Lam in Chaine annamitique and the plateau

of Bas Laos, because the former was found at Karasin and because the latter is very common in the middle Tetori series in Central Japan whence *Nippononaia tetoriensis* is known. *Psiloceras* and other Hettangian fossils are found in the basal part of the Tho-Lam series which is underlain by the Rhaetic plant-bearing coal measures of Nong-son near Tourane. This coal-bearing formation overlies the crystalline and granitic basement.

In the terrain rouge near the southern border of the Annam cordillera there is a Liassic marine wedge yielding scales of *Lepidotus* and teeth of *Acrodus* and Plesiosaurid in a part and *Alectryonia vallata, Gervillia* and so forth in another part. This wedge may not be widely apart from the bone beds of Amphoe Neng Bua Lamphu in age.

During the older Mesozoic period sea flooded into the south-eastern part of the Indochinese peninsula repeatedly as indicated by some localities of *Halobia* shale, ammonite beds and so forth. The Liassic sea was probably more extensive than the Carno-Noric sea.

In north Cambodge the Rhaetic plant shale and *Cardita* cfr. *buruca* sandstone occur near 1'0-Kombor. Mesozoic bone beds are known from Ea-Hléo, Province of Darlac, east Cambodge. *Ficoxylon saurini* is described from the valley of l'Houei-Sam-Lian, also in east Cambodge, while a dicotyledonous fruit was found at Anlong-Chán in north Cambodge. These plant beds may indicate the southern extension of the Upper Khorat series.

From the standpoint of comparative stratigraphy it can be concluded that the Khorat series of the plateau may be correlated mainly to the Grès supérieurs or the Indosinias supérieurs to which a part of the Indosinias moyennes is possibly added. The major part of the series is Jurassic and Cretaceous in age, but the Upper Triassic and older Tertiary sediments may be added to them. They on the whole constitute the upper part of the so-called. Terrain rouge on the two sides of the Middle and Lower Mekong valley. Reptilean remains occur therein in the Liassic and Senonian sediments. Non-marine shell beds are intercalated in the Lower and Upper Cretaceous formations. Petrified woods so far known from this region are mostly younger Tertiary or Quaternary and partly Jurasso-Cretaceous. The marine Carnic facies is so far restricted to the south of Rovieng and Darlac, while the marine Noric is reported from the northwestern hills of the Viantianne basin. The Liassic sea has ingressed the region extensively, in forming embayments.

In conclusion it may be said that the major part of the Khorat series s. str. is the sediments in the intermontane basin on the Indosinian massif after the Triassic Akiyoshi orogeny. It is marine in the lower but non-marine in the upper part. This change of the facies through the sequence and the difference of the deformation between these parts indicate the sympathetic movements of the Sakawa orogenic cycle of the Burmese-Malayan geosyncline in the Middle and Late Mesozoic periods.

2. Ichthyosaurian and Sauropterygian teeth from the Khorat Series in Thailand

by Fuyuji TAKAI

The two specimens described here were collected at two localities between Lat. 17°12′–17°16′N. and Long. 102°26′–102°30′E. along the highway from Changwat Udon Thani to Amphoe Nong Bua Lamphu as shown in tables 1-2.

The both specimens are too fragmental to determine the correct generic names, but the following identification shall be provisionally introduced until the further occurrence of well-preserved specimens, namely the larger tooth may belong to the order Ichthyosauria and the other smaller one to the Sauropterygia.

Ichthyosauria gen. and sp. indet. (Plate XI, Figs. 1a, b). The tooth-crown sharply pointed and vertically striated. Length of crown 39 mm., section circular; diameter of its basal part 11 mm. Total number of striae more than 24. The root already damaged.

Plesiosauria gen. and sp. indet. (Plate XI, Figs. 2a, b). The tooth-crown sharply pointed, posteriorly curved and vertically striated. Length of crown 13 mm., section circular; diameter of its basal part 5 mm. Total number of striae 54. The root already damaged. The tooth is clearly discriminated from the former one by its more dense striation and its curvature. Among three suborders of the order Sauropterygia, the tooth rather belongs to the suborder Plesiosauria than to other two suborders.

It is considered that the fossil beds must belong to the Jurassic from the occurrences of these two marine reptiles.

3. Some Molluscan Fossils from the Khorat Series

by Teiichi KOBAYASHI and Itaru HAYAMI

Here three new species of pelecypods are added to the Khorat fauna as follows:

Mytilus (*Pachymytilus*?) *rectangularis* KOBAYASHI and HAYAMI, new species.

Cardinioides magnus KOBAYASHI and HAYAMI, new species.

Goniomya (?) *khoratensis* KOBAYASHI and HAYAMI, new species.

The first and second species occur respectively at the locality of rock unit 48 and 47 in the above mentioned section of the Loei-Udon highway. *Cardinioides* as a genus ranges from Upper Triassic to Lower Jurassic, but *C. magnus* is most allied to Liassic *C. varidus*. Therefore the fossil beds are considered probably Lower Jurassic rather than Upper Triassic. This conclusion is supported by the similarity of *Mytilus rectangularis* to Liassic *M. stricapillatus*.

Out of *Goniomya* (?) *khoratensis* much cannot be mentioned of the chronology, because it is possible that the species represents an undescribed genus.

Its resemblances are, however, found with *Goniomya* on one side and with Trigoniids and Trigonioids on the other. Therefore the age of the pelecypod is Mesozoic and probably not older than Jurassic.

Mytilus (*Pachymytilus*?) *rectangularis*

KOBAYASHI and HAYAMI, new species

Plate XI, Figure 7

A left valve at hand is trigonally hemicircular in outline and moderately convex; umbo subterminal; umbonal angle measuring about 60 degrees; hinge line slightly convex, passing gradually into posterior margin; anterior margin long, strongly geniculated at about one-third a distance from umbo; umbonal carina runs along this margin, in keeping a short distance, also geniculated, roof-shaped, coinciding with the maximum inflation; angle of the geniculation measures about 135 degrees on the carina; shell thick; surface apparently smooth.

Holotype, left valve, 28.0 mm. long, 29.0 mm. high, 6.5 mm. thick.

In the outline of the shell this species is very much like *Pachymytilus petasus* (D'ORBIGNY), although the cardinal and posterior margins constitute a more regular curve in that species. Further, one must confirm the presence of grooves at the anterior situation before its reference to *Pachymytilus* ZITTEL, 1881. *Mytilus* (*Falcimytilus*) *stricapillatus* HAYAMI, 1958, looks somewhat similar to this species. The carina is, however, marginal not only in *stricapillatus* but also in most other species of *Falcimytilus* COX, 1937. The thick test is unusual for normal species of *Falcimytilus*.

Occurrence:—Calcareous conglomerate at km. 39.04 on Highway from Changwat Udon Thani to Amphoe Neng Bua Lamphu, N.E. Thailand. Dwight E. WARD, Specimen No. 2, 6-17-61. Associated with a low spired *Natica*-like gastropod.

Cardinioides magnus KOBAYASHI and HAYAMI, new species

Plate XI, Figure 3a-c

Shell large for genus, roundly ovate, transversely elongated, moderately convex, about 1.4 times longer than high; test thick; umbo broad, not very prominent, prosogyrous, placed at about one-fifth the shell-length from anterior end; posterior carina blunt, obscurely defining postero-dorsal slope; presence of lunule and escutcheon doubtful; lower margin of nymph nearly straight, as long as half the shell; anterior adductor scar comparatively small but strongly impressed close to the anterior end of shell, delimited by a strong subvertical buttress; small pedal scar clearly impressed on buttress; posterior adductor scar subovate, placed near postero-dorsal margin, much larger but not so strongly impressed; pallial line simple; hinge unknown.

Holotype, closed valves 64.5 mm. long, 46.0 mm. high, 31.5 mm. thick.

This is represented by an internal mould of closed valves whose test is preserved only in the dorsal part and recrystallized. The outline may remind at a glance of some species of the Arcticidae such as *Pseudotrapezium dustonense* Cox, 1946, from the Inferior Oolite of England. However, the umbo is less prominent than *Pseudotrapezium*, and the position of adductor scars is of pre-heterodont type. The wedge-shaped and strongly impressed anterior adductor scar and presence of anterior inner buttress suggest that this is a member of *Cardinioides* instead of the Arcticidae.

Cardinioides ranges from Carnic to Lias, and its distribution has been restricted to the Inner Zone of Southwest Japan. Among the Upper Triassic species this is most allied to *Cardinioides japonicus* KOBAYASHI and ICHIKAWA, 1952, which is the type species of the genus. Compared with this species, however, the outline is more trigonal and the carina stronger and more marginal in that species. This agrees better with *Cardinioides varidus* HAYAMI, 1957, from the Liassic Kuruma group, but the umbo is placed more anteriorly and the umbonal cavity probably shallower in the present specimen.

Occurrence:—Calcareous sandstone at km. 39.25 on highway from Changwat Udon Thani to Amphoe Nong Bua Lampho, N.E. Thailand. (Specimen No. 4, Sirichai PRUANGKARN, 7-4-61).

Goniomya (?) *khoratensis* KOBAYASHI and HAYAMI, new species

Plate XI, Figures 4-6

Shell medium in size for *Goniomya*, subequilateral, trigonally ovate in outline, not strongly inflated, longer than high; antero- and postero-dorsal margins nearly straight, forming an apical angle of about 110 degrees; postero-dorsal margin more or less longer than antero-dorsal; umbo placed slightly anterior from mid-point of length; a weak carina extends along postero-dorsal margin, obscurely defining a narrow postero-dorsal slope; neither median carina nor groove present on the slope; surface ornamented with non-tuberculate, V-shaped and stout costae which are eight or slightly more in number and separated from one another by deep grooves of similar breadth; they form chevrons on the median line with the basal angle of 60–70 degrees; ribs of posterior set cross postero-dorsal carina and reach peripheral region; escutcheon indiscernible; hinge structure unknown.

Holotype (Fig. 4), right valve, 26.0 mm. long, 18.5 mm. high.

Three specimens are at hand, but all incomplete. The greater part of the surface of right valve is represented by the holotype, on which it is seen that the costae and their intervals tend to be broadened very slowly through growth. Its ventral and posterior parts are imperfectly preserved. The very umbonal part is also not revealed on the specimen. The costae impressed on the second specimen (external mould, figs. 5a–b) are very

slender. The aspect of posterior periphery is seen on the third specimen (fig. 6), but the inclination of posterior costae does not agree with that of the holotype. Therefore the specific identity of the second and third specimens with the holotype is not very clear.

Such a peculiar V-shaped ornament appears in *Trigonioides* KOBAYASHI and SUZUKI, 1936, *Nippononaia* SUZUKI, 1941, *Vaugonia* CRICKMAY, 1930, *Geratrigonia* KOBAYASHI, 1952, *Pentagrammysia* TSCHERNYSCHEW, 1950, *Undulomya* FLETCHER, 1946, *Het roglypta* VON MARTENS, 1880 and a few other genera besides *Goniomya* AGASSIZ, 1838 (=*Lysianassa* MÜNSTER, 1836, non MILNE-EDWARD, 1830).

The basal angle of the Vs is much larger than those of *Trigonioides* and *Nippononaia*, and the ribs are too broad and too small in number. The non-tuberculate costae may remind one of the ornamentation of *Vaugonia*, but the absence of distinct marginal and median carinae suggests that it is almost improbable for the holotype to belong to the Trigoniidae. It happens in *Vaugonia* very commonly that Vs of the costae are indistinct near the umbo and gradually emphasized ventrally. In many species of the genus the Vs are seen quite asymmetrical and their angles are located near the marginal carina.

In these respects the ornament agrees better with those of *Pentagrammysia*, *Undulomya* and *Goniomya*. *Pentagrammysia* of the Grammysiidae from the Carboniferous of U.S.S.R. (see ORLOV, 1960, ed.) and *Undulomya* of the Arcomyacidae (?) from the Permian of Australia (see DICKINS, 1956) has similar V-shaped costae, but the two genera are unknown at all in the Mesozoic. This species has a more centrally placed umbo and smaller basal angle of chevrons than the type species of *Undulomya*.

In many species of *Goniomya* subhorizontal ribs of median set appear in the early stage and are preserved on the umbonal surface of adult shells, while they are indiscernible in the present specimens. The development of the costation in *Goniomya* seems to constitute a case of neoteny, since Cretaceous species generally have more persistent median ribs than Jurassic ones. In this respect this species remind us of primitive forms of *Goniomya*. The outline of *Goniomya* is, however, generally more transversely elongated, the apical angle being larger than this species. *Goniomya literata* (SOWERBY, 1819) from the Oxfordian is closest in the undeveloped median ribs among numerous species of the genus. The illustrations of *literata* in GOLDFUSS (1836) and AGASSIZ (1842) show comparatively small apical angles, but the Corallian specimens of that species including the holotype (ARKELL, 1935) seem to have more elongated outline and weaker costation.

It is quite probable that it belongs to none of the above cited genera but it represents an undescribed genus.

Occurrence:—The specimens are contained in three red siltstone pieces of drill cores which were obtained from Core Hole No. 3 at the depth of

70′–72′2″ at km 49.8, Ban Krok Namtao, southeast of Khorat i.e. Nakhon Ratchasima on Khorat-Krabin Buri Road. The siltstone is a member of the Khorat series.

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Explanation of Plate XI

Ichthyosauria, gen. and sp. indet. ..... p. 187
Figures 1a-b. Anterior and lateral view. ×1.5.

Pleisiosauria, gen. and sp. indet..... p. 187
Figures 2a-b. Anterior and lateral views. ×3.

Cardinioides magnus KOBAYASHI and HAYAMI, n. sp..... p. 188
Figures 3a-c. Left, right and anterior views. ×1.

Goniomya (?) *khoratensis* KOBAYASHI and HAYAMI, n. sp..... p. 189
Figure 4. Holotype. ×1½.
Figures 5a-b. Two views of an internal mould. ×2.
Figure 6. Fragmentary valve. ×2.

Mytilus (*Pachymytilus* ?) *rectangularis* KOBAYASHI and HAYAMI, n. sp..... p. 188
Figure 7. Left valve of the species and *Natica*-like shell on the left side. ×1.

See Tables 1-2 for the fossil localities of Figures 1-3 and 7.

Specimens in Figures 4-6 from in bore-core of Ban Krok Namtao, km. 49,80 southwest of Khorat along Khorat-Krabin Buri Road.

1a

1b

3a

3b

2a

2b

3c

4

5a

5b

6

7