

NEW FOSSIL TURTLES, *Chinemys pani* n. sp. (Testudinidae)
FROM THE CHI-TING FORMATION (PLEISTOCENE), TAINAN
DISTRICT, TAIWAN ISLAND*

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Abstract

A new species of fossil turtle, *Chinemys pani*, is described. It was collected from the Chi-ting Formation (Pleistocene), Tainan District, Taiwan Island. *Chinemys pani* n. sp. is similar to *Chinemys reevesi* (Gray) (a living turtle from the same island) in having a tri-carinated carapace and neural plate, but differs as follows: 1. The abdominal laminae are shorter than the femoral laminae. 2. The sulci between the neural and pleural plates are on the more anterior part of the neural plates. 3. The body is wider. 4. The 2nd to 7th neural plates is longer. 5. The 4th and 6th neural plates are shorter. 6. The 7th neural plate is longer.

Introduction

The purpose of this report is to describe a new species of fossil turtle, *Chinemys pani* n. sp., from Tsai-liao-chi, Tsochen County, Tainan District, Taiwan Island (Fig. 1).

The fossil was imbedded in an unconsolidated muddy sandstone, which also contains abundant mammalian bones, fish teeth, mollusks, foraminifers, bryozoa and crabs. The fossil turtle is the first to be found in the Chi-ting Formation. The head, limb and tail were missing, but the carapace and the plastron are almost complete. The shell is 112 mm long, 93 mm wide and 57 mm high.

Since this fossil turtle is so rare that the author has had to compare it with the morphologically similar living turtle, *Chinemys reevesi* (Gray) (Family Testudinidae) (Chen 1969, Mao 1971, Pope 1935, Wang & Wang 1956, Tao 1973) which was found in this island. The result of this study indicates that some mor-

phologic differences are recognizable between them. However, they resemble each other in general.

C. pani can be identified by the following characteristics. 1. The abdominal laminae are shorter than the femoral laminae. 2. The sulci between the neural and pleural plates are on the anterior $\frac{1}{4}$ of neural plates. 3. The ratio of maximum body width/middle point of plastron to the end of plastron is longer. 4. The ratio of length from anterior end of 2nd neural plate to posterior end of 7th neural plate/maximum body width is larger. 5. The ratios of the length of the 4th and 6th neural plates to their width are smaller. 6. The length/width ratio of 7th neural plates is longer (Table 4 & 5).

The geological age of the fossil turtle is Pleistocene (Lin & Chon 1974).

Abbreviations

Anatomical

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Epidermal Laminae

Carapace

- LT, lateral
- M, marginal
- PR, precentral

Plastron

- ABD, abdominal
- AN, anal
- F, femoral
- GUL, gular
- HUM, humeral
- M, marginal
- PECT, pectoral
- A-F, suture between abdominal and femoral
- F-A, suture between femoral and anal
- FEM-A, anterior part of femoral
- FEM-P, posterior part of femoral
- H-P, suture between humeral and pectoral
- P-A, suture between pectoral and abdominal

Bony plates

Carapace

- N, neural
- P, peripheral
- PL, pleural
- PN, proneural
- PY, pygal
- SP, suprapygal

Plastron

- ENT, entoplastron
- EP, epiplastron
- HY, hyoplastron

HYP, hypoplastron

XIPH, xiphiplastron

- E-H, sulcus between epiplastron and hyoplastron
- H-H, sulcus between hyoplastron and hypoplastron
- H-X, sulcus between hypoplastron and xiphiplastron
- HYP-A, anterior part of hypoplastron
- HYP-P, posterior part of hypoplastron
- XIPH-A, anterior part of xiphiplastron
- XIPH-P, posterior part of xiphiplastron
- A-N, axillary notch
- I-N, inguinal notch

Institutional

NTUM, National Taiwan University, Museum of Zoology.

Measuring

- L, Length
- Ld, length along the distal border
- Lm, length along the median line
- W, maximum width
- Wd, width along the distal border of pleural plate (along the peripheral plate)
- Wp, width along the proximal border of pleural plate (along the neural plate)
- Trans, transverse
- Long, longitudinal
- Hexag, hexagonal
- Trig, trigonal
- Tetra, tetragonal

Systematic Paleontology

Order	Testudininae (Chelonia)	Linnaeus, 1758
Suborder	Casichelydia	Gaffney, 1975
Infraorder	Cryptodira	(Cope, 1868)
Parvorder	Eucryptodira	Gaffney, 1975
Superfamily	Testudinoidea	Baur, 1893
Family	Testudinidae	Gray, 1825
Subfamily	Batagurinae	McDowell, 1964
Genus	Chinemys	Smith, 1931
	<i>Chinemys pani</i> n. sp.	

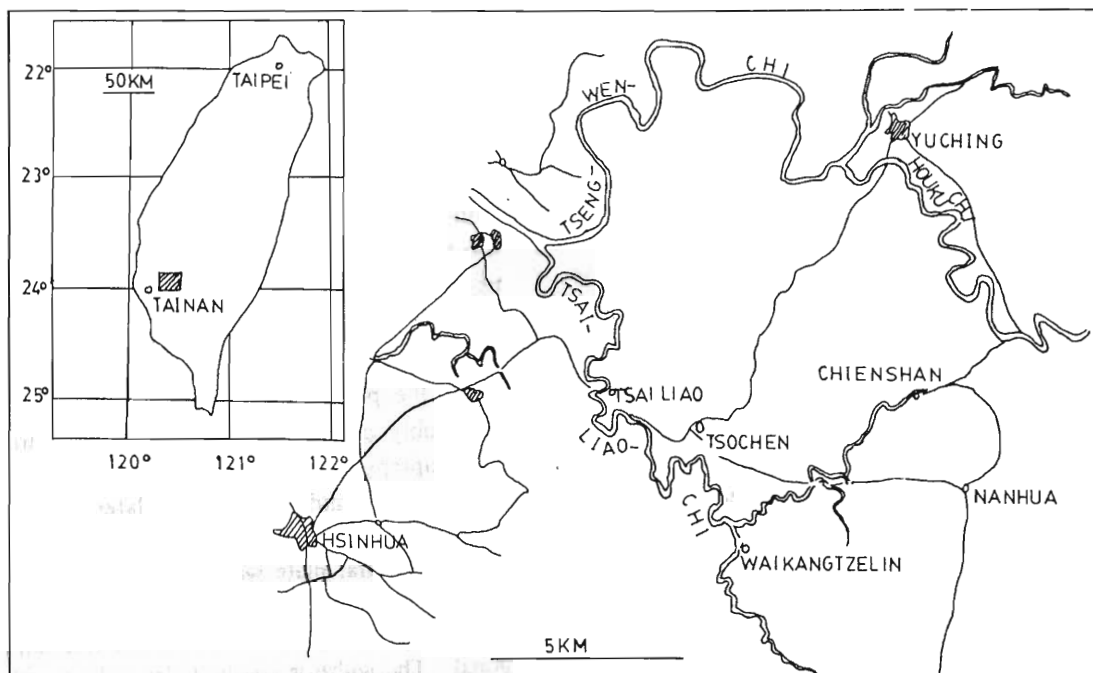


Fig. 1. Geographic map showing the fossil locality.

Taipei 台北 Tainan 台南 Tsengwenchi 曾文溪 Yuching 玉井 Tsailiao 菜寮 Tsochen 左鎮
Chienshan 尖山 Nanhua 南化 Hsinhua 新化 Waikangtzelin 外岡子林 Tsailiao-chi 菜寮溪

Chinemys pani n. sp.

Fig. 1-4, Text-fig. 1-3, Table 1-5.

Holotype and Cotype: The figured specimen is stored in the personal museum of Mr. Chang-Wu Pan, Tainan City. The plastic model is in the Museum of Zoology, National Taiwan University, Taipei. The specimen No. is NTUM R0001. (possible male form).

Locality: Tsochen, Tsai-liao-chi, Tainan, Taiwan.

Geologic age and Horizon: Chi-Ting Formation, Pleistocene.

Diagnosis:

Carapace strongly tri-carinated, convex and quadrate-oval in outline; plastron quadrate and forked posteriorly, flat and slightly concave in the middle part. The shell is almost complete preserved; however, the anterior end is partly eroded away.

Carapace: (Fig. 2, Text-fig. 1 & 3).

The carapace contains 7 neural plates, a single 5th central lamina on the middle line, 7 pairs of pleural plates laterally and 9 pairs of

peripheral plates marginally. The proneural plate, 2 pairs of peripheral plates and part of the pygal plate were lost. The 8th neural plate, 8th pleural plate, and 0-2 suprapygal plates may be covered by the 5th central lamina, which is situated behind the 7th neural plate. The sulci which lie between the neural and pleural plates are marked at the anterior $\frac{1}{4}$ portion of the neural plates.

Plastron: (Fig. 3, Text-fig. 2).

The abdominal, femoral, and anal laminae are well marked by sutures. The hyoplastron, hypoplastron and xiphiplastron are clearly marked by sulci. The gular laminae, humeral laminae, epiplastron and entoplastron were lost. The anterior part of femoral laminae is slightly longer than the posterior part. The abdominal laminae are shorter than the femoral laminae.

The strong bony bridge is formed by 3 pairs of marginal laminae.

The shell has lost its epidermal laminae, but bony plates and sutures are present; the external surface is smooth. The head, tail and limbs are unknown.

Description:

The carapace is strong tri-carinated, convex and quadrate-oval in outline. The plastron is quadrate and flat. The mid-portion of plastron is slightly concave (152°), and forked posteriorly. The bony bridge are strong. The shell is nearly completely preserved. The anterior end was partly broken and had an hole of 18.8 cc. in capacity toward the body cavity. The posterior end is nearly complete. The total volum of the shell box is 266.5 cc. (include the broken anterior hole of 18.8 cc.).

Carapace: (Fig. 2 & 4, Table 1, 2, 4, 5, Text-fig. 1, & 3).

Seven neural, 14 pleural, 16 peripheral plates and 1 central lamina are known. The proneural, 8th neural, 8th pleural, 0-2 suprapygal and pygal plates are absent. Therefore, the measurements of the size and shape of the carapace are uncomplete and are given as text-fig. 1. The first neural plate is not well preserved but is oblong and its lateral border is slightly convex. The second neural plate is tetragonal to pentagonal in shape and its anterior border is longer than the posterior. The third neural plate is truncated, tetragonal or hexagonal, and the anterior border is longer than the posterior. The 4th and 5th neural plates are the same shape as the 3rd, except more or less wider than the more anterior ones. The median lines of the 4th and 5th neural plates form a 167° of angle. The 6th neural plate is transverse tetra-hexagonal and is rather broader than the preceding one. The median lines of the 5th and 6th neural plates form a 166° of angle. The 7th neural plate is a smallest and tetra-hexagonal. The median lines of the 6th and 7th neural plates form a 171° of angle. The 7th neural plate and 5th central lamina are flattened and horizontal (Fig. 4).

The central axis of each neural plate is well carinated. The short anterolateral border of neural plates is articulated with posteriolateral inner border of the next most anterior pleural plate.

The lateral border of the neural plates is arched and convex. The 4th neural plate is situated on the highest portion of the shell;

from there the connecting plates slope downward to the peripheral margin. The first neural plate is the longest and narrowest, and the 6th neural plate is the shortest and widest (Table 1). The 5th central lamina is on the posterior end of 7th neural plate; it possibly covers the 8th neural, 8th pleural and suprapygal plates (Fig. 2, Text-fig. 1).

The left and right pleural plates are symmetrically arranged (Table 2, Text-fig. 1). The 1st pleural plate was slightly broken, the Wd and Wp are the widest. The 2nd, 3rd, 4th and 5th pleural plates are transverse and tetragonal. The width is nearly 3 times the length. The 4th pleural plate is longest. The 5th pleural plate is the narrowest in Wd. The 6th pleural plates are transverse pentagons and the 7th pleural plates are transverse tetragons. They are smaller than the more anterior ones. The 7th pleural plate is the shortest and narrowest in Wp.

There are 9 pairs of peripheral plates; among these 6 pairs are distinctly marked by a deep sulcus whereas on the others, the sulcus is faint. The peripheral plates are tetragonal and almost quadrate in shape. The anterior 2 pairs of peripheral plates are absent and the last pair of them was partly broken.

Plastron: (Fig. 3, Table 3, 4 & 5, Text-fig. 2).

The pectoral, abdominal, femoral and anal laminae are well preserved; the gular and humeral laminae were lost. The anterior border of the pectoral was broken. The sutures between pectoral and abdominal laminae are not as clear as the other sutures. The pectoral laminae and abdominal laminae are transverse tetragons. The femoral laminae are elongate tetragon; the anal laminae are smaller than the femoral laminae and are rhomboidal. The femoral laminae are separated into two parts by the hypoplastron and xiphiplastron sulci. The anterior part of the femoral lamina is larger than the posterior.

The hypoplastron and xiphiplastron are clearly marked by sulci. The epiplastron and entoplastron were absent. The hypoplastron is a transverse pentagon, and its anterior border was broken. The hypoplastron is an elongate

tetragon. The inguinal notches are situated at the posterior outer border of hypoplastron. The hypoplastron was separated by the sutures of the abdominal and femoral laminae into two parts: the anterior part is larger than the posterior. The hypoplastron is the largest and longest plate in the plastron. The xiphiplastron is small and rhomboidal in shape. It is separated into two parts by the sutures of femoral and anal laminae. The anterior part is larger than the posterior part.

The bony bridge are formed by 3 pairs

of marginal laminae. The inguinal notch is better developed than the axillary notch. The slightly concave plastron indicates that this fossil turtle is possibly a male form and is 4 to 5 years old by comparison with *Chinemys reevesi* of the same size.

The color of the fossil turtle is black. Its head, neck, limbs and tail were lost.

Etymology:

The species name is in honor of Mr. C. W. Pan, who discovered the type specimen.

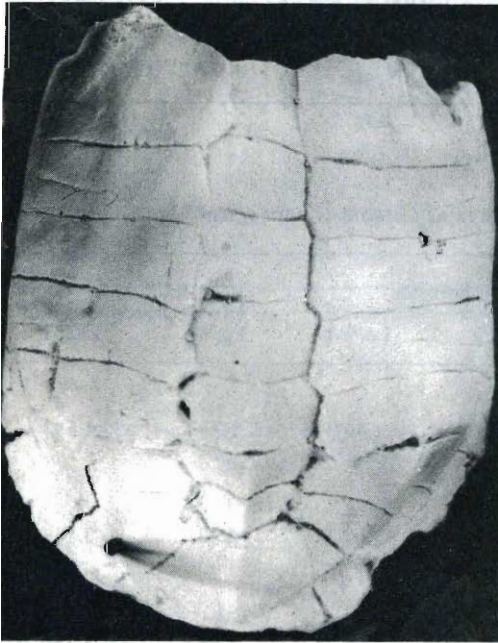


Fig. 2. Dorsal view of *Chinemys pani* n. sp. Showing the structures of carapace. (Total length 112 mm.)

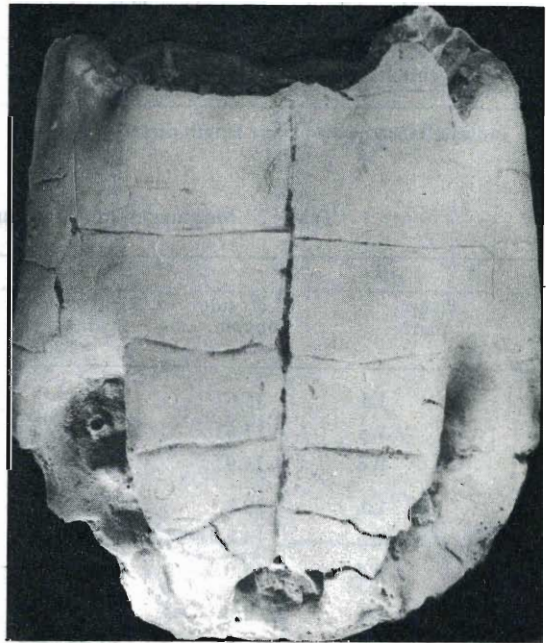


Fig. 3. Ventral view of *Chinemys pani* n. sp. Showing the structures of plastron. (Total length 112 mm.)

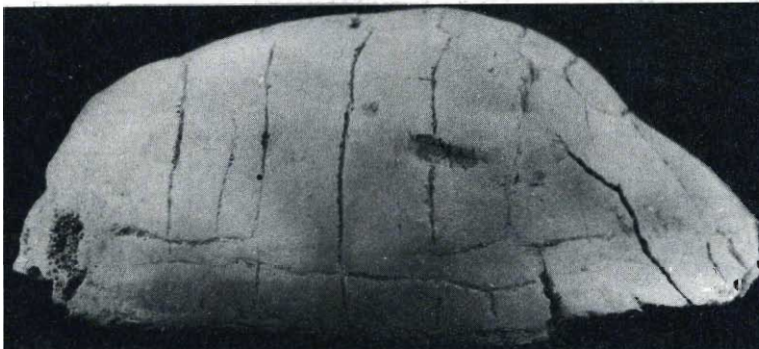


Fig. 4. Sinistral view of *Chinemys pani* n. sp. Showing the pleurals and peripherals. (Total length 112 mm.)

Table 1. Measurements of neural plates and 5th central lamina of *Chinemys pani* n. sp.

Neural plate	Median longitudinal length (L) in mm.	Maximum transverse width (W) in mm.	L/W
1st	17.8	13.1	1.36?
2nd	13.4	19.1	0.70
3rd	14.2	20.2	0.70
4th	13.0	22.4	0.58
5th	12.5	24.4	0.51
6th	9.0	25.9	0.35
7th	11.2	18.6	0.60
5th central lamina	24.7	39.0	0.63

?: Indicated damaged and true length probably longer.

Table 2. Measurements of pleural plates of *Chinemys pani* n. sp.

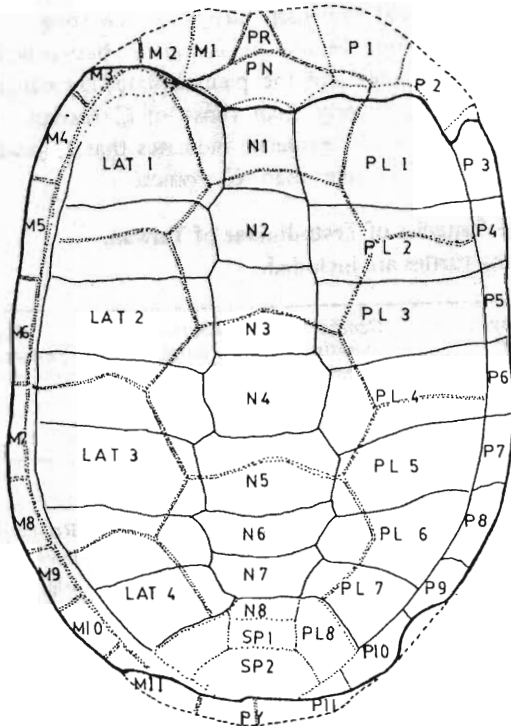
Pleural plate		Left side in mm.	Right side in mm.	Left side		Right side	
				Ld/Wp	Ld/Wd	Lp/Wp	Ld/Wd
1st	Ld	36.6?	37.6?				
	Wp	17.6?	16.8?	2.08?	1.41?	2.34?	1.69?
	Wd	25.9?	22.2?				
2nd	Ld	39.3	39.2				
	Wp	14.4	14.0	2.73	3.02	2.80	3.11
	Wd	13.0	12.6				
3rd	Ld	42.0	41.3				
	Wp	14.6	13.8	2.88	3.44	2.99	3.33
	Wd	12.2	12.4				
4th	Ld	40.5	40.5				
	Wp	12.4	12.8	3.27	3.09	3.16	3.24
	Wd	13.1	12.5				
5th	Ld	33.7	36.3				
	Wp	13.1	10.3	2.57	3.15	3.52	3.30
	Wd	10.7	11.0				
6th	Ld	26.3	28.0				
	Wp	11.2	8.4	2.35	1.41	3.33	1.41
	Wd	18.6	19.9				
7th	Ld	23.2	24.0				
	Wp	10.2	9.7	2.27	1.30	2.47	2.12
	Wd	17.9	11.3				

?: Indicated damaged and true length probably longer.

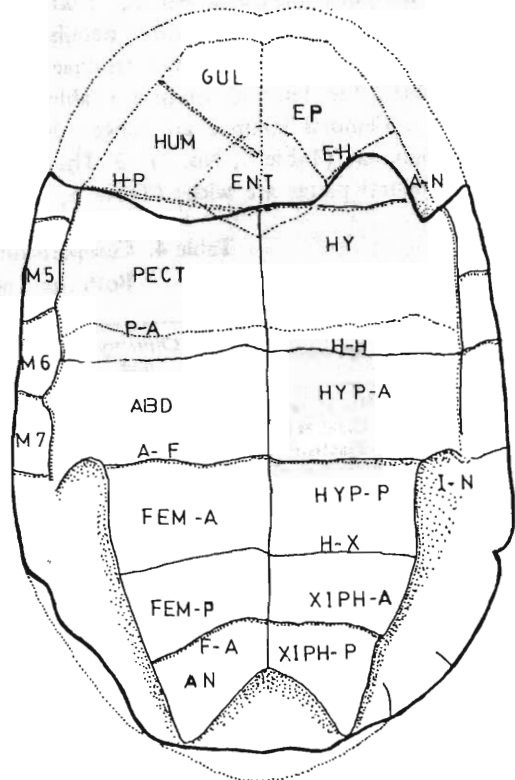
Table 3. Measurements of bony plates and epidermal laminae on
 plastron of *Chinemys pani* n. sp. (in mm.)

	Right side	Lm/Wp	Left side	Lm/Wp
Pectoral laminae (part)	Lm	19.3?		19.3?
	Wp	36.2?	0.53?	36.6?
Abdominal laminae	Lm	26.0	0.92	26.0
	Wp	28.4		28.0
Femoral laminae	Lm	25.8	1.29	25.8
	Wp	20.0		20.6
Anal laminae	Lm	10.2	0.56	10.2
	Wp	18.2?		17.6
Hyoplastron (part)	Lm	25.3?	0.70	25.3
	Wp	36.1		35.8
Hypoplastron	Lm	35.7	1.36	35.7
	Wp	26.2		26.6
Xiphiplastron	Lm	21.0	1.15	19.8
	Wp	18.2		17.6
Bony bridge	Lm	48.6	---	47.9

?: Indicated damaged and true length probably longer.



Text-fig. 1. Dorsal view of *Chinemys pani* n. sp.



Text-fig. 2. Ventral view of *Chinemys pani* n. sp.

Remarks: (Table 4 & 5, Text-fig. 3)

There are four species of living turtles that are found on Taiwan Island. These are *Chinemys reevesi* (Gray), *Ocadia sinensis* (Gray), *Clemmys mutica* (Cantor) and *Cuora flavomarginata* (Gray). The morphologic characteristics of the present species is not similar to the last three, but to the first one. Therefore, the generic affinities of this species should be with *Chinemys*, owing to: 1. The carapace has 3 strong longitudinal keels. 2. The last neural plate is wider than the anterior ones (Table 4, No. 9; Text-fig. 3). 3. The sulci which connected the neural plates and pleural plates are on the anterior border of neural plates (Table 4, No. 8; Text-fig. 3). 4. The shapes of last 3 neural plates are transverse hexagonal (Table 4, No. 5; Text-fig. 3). But differences in certain minor details can be seen, as well: 1. Abdominal laminae are shorter than the femoral laminae (Table 5, No. 1). 2. Femoral laminae are longer than the anal laminae (Table 5, No. 2). 3. The 4th and 6th neural plates are wider (Table 5, No. 3 & 4).

4. The 7th neural plate is narrower (Table 5, No. 5). 5. The 2nd pleural plates Lm/Wp is smaller (Table 5, No. 6). 6. The 4th pleural plates Ld/Wp is larger (Table 5, No. 7). 7. The 6th pleural plate Ld/Wp is smaller (Table 5, No. 8). 8. The position of the sulci, which connected the neural plates and pleural plates is more anterior than that of *C. reevesi*. 9. The ratio (= the length from anterior end of 2nd neural plate to the posterior end of 7th neural plate/maximum body width) in *C. pani* is 0.75 and in *C. reevesi* is 0.64, showing that *C. pani* in this part is longer than *C. reevesi*. 10. The ratio (= maximum body width/middle point of plastron to anterior end of plastron fork) in *C. pani* is 1.64 and in *C. reevesi* is 1.57, showing that *C. pani* is wider than *C. reevesi* in posteriorly.

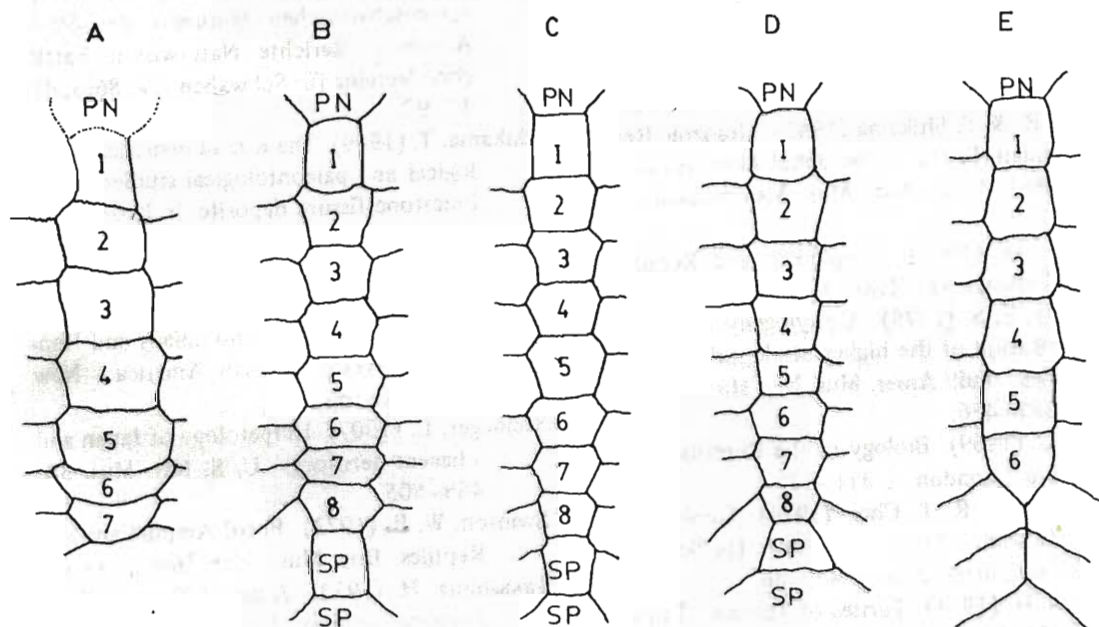
Therefore, these characteristics indicate that the fossil turtle is a new species. In addition, the sulci of *C. pani* lie between the neural plates and the pleural plates are situated more anteriorly than those of *C. reevesi*. This important evidence indicates that *C. pani* is more primitive than *C. reevesi*.

Table 4. Comparison of the 5 species of Testudinidae of Taiwan.
Both fossil and living turtles are included.

Sp. name	<i>Chinemys pani</i>	<i>Chinemys reevesi</i>	<i>Ocadia sinensis</i>	<i>Clemmys mutica</i>	<i>Cuora flavomarginata</i>
No. exam.	1	9	6	12	4
Carapace	1	8	6	10	3
Plastron					
1. Posterior end	Forked	Forked	Forked	Forked	Round of conical
2. hinge	no	no	no	no	have
3. shape of AN	tetra.	tetra.	tetra.	tetra.	trig.
Carapace					
4. No. of dorsal long. keels	3 strong	3 strong	1 strong 2 weak	1 strong	1 strong
5. shapes of last 3 N	trans. hexag.	trans. hexag.	long. hexag.	long. hexag.	square (5th) trig. (6th)
6. No. of N.	7 or 8?	8	8	8	6
7. No. of SP.	no appear	2	2	2	0
8. Loc. of point of sulcus connected N. and PL.	0-1/4 of N.	1/3-1/2 of N.	1/4-1/2 of N.	1/5-1/3 of N.	2/3-3/4 of N.
9. Width of 1st N./last N.	< 1	< 1	> 1	> 1	≠ 1

Table 5. Comparative differences between the *Chinemys pani* and *Chinemys reevesi*.

Characters	<i>C. pani</i>			<i>C. reevesi</i>		
	Range	No.	Mean	Range	No.	Mean
1. Suture L. of ABD/F		1	0.78	1.09–1.55	9	1.32
2. Suture L. of F/AN		1	2.91	1.26–3.11	9	2.47
3. Lm/W of 4th N.		1	0.58	0.59–0.67	4	0.64
4. Lm/W of 6th N.		1	0.35	0.38–0.43	4	0.41
5. Lm/W of 7th N.		1	0.60	0.28–0.41	4	0.35
6. Ld/Wp of 2nd PL.	2.73–2.80	2	2.77	3.05–3.43	4	3.23
Ld/Wd of 2th PL.	3.02–3.11	2	3.07	2.79–2.95	4	2.89
7. Ld/Wp of 4th PL.	3.16–3.27	2	3.22	2.96–3.25	4	3.09
8. Ld/Wd of 6th PL.	1.41	2	1.41	1.43–2.32	4	1.73



Text-fig. 3. Showing the arrangements of the neural plates (No. 1 to No. 8)

A. *Chinemys pani* n. sp. B. *Chinemys reevesi* (Gray). C. *Ocadia sinensis* (Gray). D. *Clemmys mutica* (Cantor). E. *Cuora flavomarginata* (Gray).

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