DOI:10.19800/j.cnki.aps.1987.02.007

——, 1954: 温度对淡水枝角类生长的影响。厦门大学学报, **4**: 83—91。

——, 1959: 淡水枝角类的生殖。动物学杂志, **1**: 22—28。

堵南山、赖伟, 1959: 太湖枝角类生殖周期的观察。水生生物学集刊, **3**: 303—314。

——, 1963: 中国淡水枝角类的地理分布。动物学报, **15**(3), 403—416。

沈嘉瑞等, 1962: 中国动物图谱, 甲壳动物, 第一册。科学出版社。

石油化学工业部石油勘探开发规划研究院, 中国科学院南京地质古生物研究所, 1978: 渤海沿岸地区早第三纪介形类。科学出版社。

蒋雯治、堵南山, 1979: 中国动物志, 节肢动物门, 甲壳纲, 淡水枝角类。科学出版社。

李应培, 1980: 渤海沿岸地区早第三纪化石群。国际交流地质学术论文集(地层、古生物), 113—120。地质出版社。

李应培、赖星蓉, 1982: 枝角类冬卵化石在我国油区首次发现及其意义。石油勘探与开发, **5**: 22—28。

Dickinson, K. A. & Swain, F. M., 1961: Ostracoda and Cladocera of the Late Tertiary Humboldt Formation Northeastern Nevada.-Soc. Econ. Paleont. Mineral., Program (Denver)., p. 91.

Frey, D. G., 1958: The late-glacial Cladoceran fauna of asmall lake.-Archiv f. Hydrobiologie, **54**: 209—275.

————, 1964: Remains of animalis in quaternary lake and bog sediments and their interpretation.-Archiv Hydrobiologie, Beih., Ergebn. Limnol., **2**: 1—114.

Fryer, G., 1972: Observations on the ephippia of certain macrothricid cladocerans.-Zool. J. Linn., **51**: 79—96.

Heyden, C., 1861: Gliederthiere aus der Braunkohle des Niederrhein's, der Wetteran und der Röhn.-Palaeontographica, **10**: 62—63.

Poulsen, E. M., 1945: Entomostraceans from a Late-Glacial Lacustrine Deposit at Naestved, Denmark.-Medd. fra Dansk Geol. Forening, **10**: 405—414.

Tasch, P., 1969: Branchiopoda. Treatise on Invertebrate Paleontology, Part R, Arthropoda, **4**, **1**: 163—171.

Wesenberg-Lund, C., 1896: Om Ferskvandsfaunaens Kitin-og Kisellevninger i Torvelagene.-Medd. fra Dansk Geologisk Forening, **3**: 51—85.

Смирнов Н. Н., 1970: Cladocera (Crustacea) из перических отложений Восточного Казахстана.-Палеонт. Журнал, **3**: 95—100.

[1985 年 12 月 25 日收到]

EPHIPPIA OF CLADOCERA FROM THE TERTIARY OF CHINA

Lai Xing-rong and Li Ying-pei

(Research Institute of Petroleum Exploration and Development, Beijing)

Summary

The present paper deals with the fossil ephippia of Cladocera obtained separately from the Shahejie (Late Eocene to Oligocene) and Dongying (Oligocene) Formations in the coastal region of the Bohai Sea, the 2nd and 3rd members of the Hetaoyuan Formation (Late Eocene to Oligocene) in Southwest and Central Henan, the Shangzashai member of the Anjihaihe Formation (Eocene to Oligocene) in the Junggar Basin in Xinjiang and the Linxia Formation (Pliocene) in the Jingyuan area in Gansu. They contain 8 new species and 2 indeterminable species assigned to 3 genera (*Daphnia, Ceriodaphnia* and *Simocephalus*) of the family Daphnidae.

Description of New Species

Daphnia gansuensis sp. nov., ephippium

(Pl. I, figs. 1—5)

Material: Well-preserved and calcified specimens in light brown colour and transparent.

Diagnosis: Ephippium pod-shaped in lateral view. Dorsal margin long and nearly straight; ventral margin arched. Antero-dorsal angle a little smaller than 90°, angular and projecting forward with a small concave area beneath it; postero-dorsal angle obtuse, slightly larger than 90°. Highest portion in the middle; surface finely punctate. Two oval winter eggs lying obliquely and separately in the anterior and posterior parts of the ephippium; their major axes forming an angle of about 45° with the dorsal margin.

Measurements (in mm)

Ser. No.	Length	Height	Width
G-1 (Holotype)	1.25	0.65	0.40
G-2 (Paratype)	1.15±	0.55±	0.41

Comparison: The specimen described is similar to the recent ephippium of *Daphnia magna* Straus, but it can be easily distinguished from the latter, in which the highest point is near the front and the ornamentation on the surface is reticulate.

Occurrence; Pliocene, Linxia Formation; Jingyuan area, Gansu.

Daphnia dorsiconvexa sp. nov., ephippium

(Pl. I, figs. 6—9)

Material: Calcified specimens brown or light brown in colour and transparent.

Diagnosis: Ephippium pod-shaped in lateral view, with dorsal margin slightly arched and ventral margin prominently convex. Both anterior and posterior ends round, with the former a little higher than the latter. Antero-dorsal angle a little smaller than 90°, forming a round projection toward anterior with indentation beneath it; postero-dorsal angle round, nearly 90°. Highest portion in the middle of ephippium. Surface covered by tubercles. Two elongate-oval winter eggs contained in the ephippium with their length axes oblique to the major axis of the ephippium.

Measurements (in mm)

Ser. No	Length	Height	Width
X-1 (Holotype)	1.15	0.65	0.35
X-2 (Paratype)	0.90	0.50	0.30

Comparison: The present species looks like the recent *Daphnia magna* Straus ephippium, but the latter has nearly straight dorsal margin and reticular ornamentation. It differs from *D. gansuensis* sp. nov. ephippium and *D. xinjiangensis* sp. nov. ephippium in having tubercular ornamentation on the surface.

Occurrence: Eocene to Oligocene, Shangzashai member of Anjihaihe Formation; Junggar Basin, Xinjiang.

Daphnia henanensis sp. nov., ephippium

(Pl. II, figs. 8—22)

Material: Specimens preserved in oil shale and calcareous shale, becoming very thin due to compression, brown and transparent, with the winter eggs dark-brown and translucent; their size and colour generally changing in degree of maturity, with immature ones in light colour while mature ones in dark colour.

Diagnosis: Ephippium in the shape of a long-pod in lateral view; dorsal margin nearly straight and ventral margin curved. Anterior end slightly higher than posterior one; both roundly arched. Surface densely punctate. Two oval winter eggs in the ephippium with their length axes oblique to that of the ephippium.

Measurements (in mm)

Ser. No.	Length	Height	Diameter of winter egg
H-11a (Holotype)	1.15	0.51	0.30
H-10 (Paratype)	1.00	0.50	0.25
H-1a (Paratype)	0.95	0.50	0.24
H-5a (Paratype)	0.80	0.38	0.23
H-4b (Paratype)	0.65	0.35	0.20

Comparison: In general the species is similar to *Daphnia xinjiangensis* sp. nov. ephippium, but in the latter the distance between two winter eggs is greater than that in the former.

Occurrences: Late Eocene to Oligocene, 2nd to 3rd members of the Hetaoyuan Formation in the Nanyang and Biyang Depressions and 2nd member of the Hetaoyuan Formation in the Wuyang Depression in Henan; Oligocene, 2nd and 3rd members of the Shahejie Formation in the Dongming Depression in Shandong; Late Eocene to Oligocene, 3rd and Upper 4th members of the Shahejie Formation in the West Liaohe Depression in Liaoning.

Daphnia xinjiangensis sp. nov., ephippium

(Pl. I, figs. 10—17)

Material: Well-preserved and all calcified specimen in cream colour, opaque or light brown, transparent to translucent.

Diagnosis: Ephippium in the shape of a long pod in side view, about 2 times as long as high, not great in thickness. Dorsal margin nearly straight and ventral margin slightly convex. Antero-dorsal angle larger than 90° while postero-dorsal

angle obtuse and round, slightly larger than 90°. Anterior end higher than posterior one and roundly arched. Highest point at the middle-anterior part. Surface ornamented with punctations. Two elongate oval winter eggs in the ephippium lying distantly from each other, with their major axes oblique to that of the ephippium.

Measurements (in mm)

Ser. No.	Length	Height	Width
X-3 (Holotype)	1.40	0.70±	0.30
X-5 (Paratype)	1.05±	0.50±	0.25
X-4 (Paratype)	0.90	0.50	0.25

Comparisons: This species is close to the recent *Daphnia magna* Straus ephippium, but the latter's surface is covered by reticulate ornamentation. It can be distinguished by its longer and punctate ornamentation from *Daphnia dorsiconevexa* sp. nov. ephippium from the Shangzashai member of the Anjihaihe Formation at the Kuitunhe section in the same locality and from *Daphnia gansuensis* sp. nov. ephippium from the Linxia Formation in the Jingyuan area in Gansu.

Occurrence: Eocene to Oligocene, Shangzashai member of Anjihaihe Formation; Wulanbulake section in Junggar Basin, Xinjiang.

Ceriodaphnia dagangensis sp. nov., ephippium

(Pl. I, figs. 26—37)

Material: Specimens all calcified and perfectly preserved in light brown or milky white colour and translucent.

Diagnosis: Ephippium semi-circular in lateral view. Dorsal margin straight and vertral margin convex. Anterior and posterior dorsal angles obtuse and round, larger than 90°. Anterior end higher than posterior one, both round. Highest portion at middle anterior part. Surface with close punctate ornamentations. A big oval winter egg in the ephippium with its longitudinal axis parallel to dorsal margin of the ephippium.

Measurements (in mm)

Ser. No.	Length	Height	Width
S-1 (Holotype)	0.58	0.43	0.30
S-3 (Paratype)	0.60	0.40	0.23
S-5 (Paratype)	0.55	0.40	0.25
D-2 (Paratype)	0.55	0.40	0.30
D-4 (Paratype)	0.63	0.45	0.30
D-5 (Paratype)	0.58	0.38	0.30
D-12 (Paratype)	0.55	0.41	0.25

Comparison: This ephippium is similar in appearance to the recent ephippium of *Ceriodaphnia laticandata* Müller, but the latter has a honeycomb-like ornamented surface and a smaller winter egg.

Occurrences: Oligocene, 1st member of the Shahejie Formation and Dongying Formation; Huanghua Depression in Hebei and Jiyang Depression in Shandong.

Ceriodaphnia elliptica sp. nov., ephippium

(Pl. I, figs. 20—25)

Material: Specimens all calcified and well-preserved in light brown colour and transparent.

Diagnosis: Ephippium elongate-oval in lateral view. Dorsal margin nearly straight and ventral margin convex. Antero-dorsal and postero-dorsal angles obtuse and round, larger than 90°. Anterior end high and round; lower part of posterior end sloping and narrowly rounded. Highest portion at middle-anterior part and surface obviously punctate. A big long subelliptical winter egg in the ephippium near the dorsal part with its major axis almost parallel to that of the ephippium.

Measurements (in mm)

Ser. No.	Length	Height	Width
S-7a (Holotype)	0.95	0.52	0.23
S-7b (Paratype)	0.85	0.50	0.21
S-10 (Paratype)	1.10±	0.60	

Comparison: The ephippium resembles the recent ephippia of *Ceriodaphnia megalops* (Sars) and *C. pulchella* Sars. But in the latter, the heights of two ends are equal and the posterior ends are slightly shorter; moreover, in the ephippium of *C. pulchella* Sars, the lower part has honeycomb-

like ornamentation. By these features the latter can be distinguished from the former.

Occurrences: Oligocene, 1st member of the Shahejie Formation and Dongying Formation; Yihezhuang at Zhanhua County in Shandong and Dagang area in Tianjin.

Ceriodaphnia liaoningensis sp. nov., ephippium

(Pl. II, figs. 4—7)

Materail: Abundant specimens collected from the shale and brownish grey oil shale, flake-shaped in appearance because of compression.

Diagnosis: Ephippium semi-circular in lateral view. Dorsal margin nearly straight and ventral margin convex. Anterior end round, higher than posterior end. Antero-dorsal angle larger than 90° and postero-dorsal angle less than 90°, both round. An elongate-oval winter egg lying obliquely in the ephippium, with its major axis not parallel to that of the ephippium.

Measurements (in mm)

Ser. No.	Length	Height	Diameter of winter egg
L-9 (Holotype)	0.53	0.38	0.30
L-6 (Paratype)	0.45	0.40	0.20
L-7 (Paratype)	0.43	0.40	0.20

Comparison: The species is similar to *Ceriodaphnia dagangensis* sp. nov. ephippium, but the latter is larger, with its surface covered by punctate ornamentation and its winter egg lying erect in the middle of the ephippium.

Occurrence: Late Eocene to Oligocene, 3rd and Upper part of the 4th member of Shahejie Formation; West Liaohe Depression, Liaoning.

Ceriodaphnia sp., ephippium

(Pl. I, figs. 18, 19)

Material: Specimen calcified and well-preserved, light brown and semi-transparent. Species indeterminable because of only one specimen with posterior end broken.

Diagnosis: Ephippium ovate in lateral view, with slightly convex dorsal margin and arched ventral margin; anterior end high and round, with clear punctate ornamentation on the surface. A big and long winter egg located in the ephippium with major axis nearly parallel to that of the ephippium.

Measurements (in mm)

Ser. No.	Length	Height	Width
D-8	0.84	0.60	0.30

Occurrence: Oligocene, 1st member of Shahejie Formation and Dongying Formation; Kongdian area in Hebei.

Simocephalus postidelivis sp. nov., ephippium

(Pl. II, figs. 1, 2)

Material Specimens calcified and well-preserved, abundant, in brown colour and transparent.

Diagnosis: Ephippium heart-shaped in lateral view. Dorsal margin evenly convex and ventral margin roundly convex. Anterior end higher and round; posterior end shrunken, forming a narrow, sharply round structure. Highest portion in the middle; surface with punctate ornamentation. A big long elliptic winter egg in ephippium with major axis parallel to that of ephippium.

Measurements (in mm)

Ser. No.	Length	Height
D-11 (Holotype)	1.15±	0.60±
D-9 (Paratype)	1.00±	0.50±

Comparison: The ephippium is similar to the recent ephippium of *Simocephalus vetulus* Müller, but the latter has a nearly straight dorsal margin, an obliquely lying winter egg and dense reticulate ornamentation on the surface.

Occurrence: Oligocene, 1st member of Shahejie Formation and Dongying Formation; Huanghua Depression, Hebei.

Simocephalus sp., ephippium

(Pl. II, fig. 3)

Material: Specimen dark-brown and opaque, preserved in brownish grey oil shale and strongly compressed, with winter egg clear in outline and antero-dorsal part slightly destroyed.

Diagnosis: Ephippium heart-shaped in lateral view. Dorsal margin nearly straight and ventral margin roundly convex. Anterior end high and round; posterior end narrowly round due to shrinkage. Highest portion in middle anterior part. A big long elliptical winter egg lying obliquely in ephippium with its major axis oblique to that of ephippium.

Measurements (in mm)

Ser. No.	Length	Width
L-8	1.15±	0.55±

Comparison: The species differs from *Simocephalus postidelivis* sp. nov. ephippium in the straight dorsal margin, the winter egg lying obliquely in the ephippium and the shorter posterior end.

Occurrence: Late Eocene, Upper part of the 4th member of the Shahejie Formation; West Liaohe Depression, Liaoning.

图 版 说 明

标本保存在石油工业部石油勘探开发科学研究院。全部图影除注明者外，均放大 40 倍。

图 版 I

1—5. *Daphnia gansuensis* sp. nov., ephippium
1—3.右侧视、左侧视、背视，Holotype，标本号：G-1。4，5.右侧视、背视，Paratype，标本号：G-2，自由边缘被损坏。甘肃靖远地区；上新统临夏组。

6—9. *Daphnia dorsiconvexa* sp. nov., ephippium
6,7.右侧视、背视，Holotype，标本号：x-1。8,9.左侧视、背视，Paratype，标本号：x-2，自由边缘被损坏。新疆准噶尔盆地南缘奎屯河；始新统一渐新统安集海河组上杂色段。

10—17. *Daphnia xinjiangensis* sp. nov., ephippium
10—12，右侧视、左侧视、背视，Holotype，标本号：x-3，腹边微向上卷曲。13—15.左侧视、右侧视、背视，Paratype，标本号：x-5，自由边缘损坏。16，17.左侧视、背视，Paratype，标本号：x-4，自由边缘损坏。新疆准噶尔盆地南缘乌兰布拉克；始新统一渐新统安集海河组上杂色段。

18，19. *Ceriodaphnia* sp., ephippium
18.右侧视，19.背视，标本号：D-8，后部被损坏。河北孔店地区；渐新统沙河街组一段和东营组。

20—25. *Ceriodaphnia elliptica* sp. nov., ephippium
20—24.同一标本，Holotype，标本号：S-7a。20.系图 21 的局部放大(扫描电镜图像)，×550。21.左侧视，扫描电镜图像，×110。22—24.左侧视、右侧视、背视。25.左侧视，Paratype，标本号：S-7b，背部受压变形。山东沾化义和庄地区；上渐新统东营组。

26—37. *Ceriodaphnia dagangensis* sp. nov., ephippium
26.右侧视，Paratype，标本号：D-4；27.左侧视，Holotype，标本号：S-1。28.背视，Paratype，标本号：S-3。29.左侧视，Paratype，标本号：D-2；30.右侧视，Paratype，标本号：S-5。31.右侧视，Paratype，标本号：D-12。32.左侧视，Paratype，标本号：D-5。33.右侧视，Paratype，标本号：D-6。34.左侧视，Paratype，标本号：S-1a。35,36.右侧视、背视，Paratype，标本号：D-3。37.左侧视，Paratype，标本号：D-1。河北黄骅拗陷，山东济阳拗陷；渐新统沙河街组一段和东营组。

图 版 II

1,2. *Simocephalus postidelivis* sp. nov., ephippium
1.右侧视，Holotype，标本号：D-11。2.左侧视，Paratype，标本号：D-9。河北黄骅拗陷；渐新统沙河街组一段和东营组。

3. *Simocephalus* sp., ephippium
左侧视，标本号：L-8。辽宁辽河拗陷西部凹陷；上始新统一下渐新统沙河街组四段上部。

4—7. *Ceriodaphnia liaoningensis* sp. nov., ephippium
4.右侧视，Holotype，标本号：L-9。5.右侧视，Paratype，标本号 L-7，受挤压有点变形。6.右侧视，Paratype，标本号：L-6，后背角被损坏。7.侧视，Paratype，标本号：L-1。辽宁辽河拗陷西部凹陷；上始新统一下渐新统沙河街组四段上部至三段。

8—22. *Daphnia henanensis* sp. nov., ephippium
8,9.右侧视，卵鞍及其内储冬卵均受挤压，Paratype，标本号：H-8a，H-8b。10—17.侧视，不同成熟阶段的冬卵，Paratype，标本号：H-12，H-7，H-4a，H-4b，H-4c，H-5a，H-5b，H-9。18.右侧视，Holotype，标本号：H-11a。河南南阳凹陷、泌阳凹陷和舞阳凹陷；上始新统一渐新统核桃园组二、三段。
19.右侧视，Paratype，标本号：L-5。20—22.示不同成熟阶段的冬卵，标本号：L-3a，L-3b，L-3c。辽宁辽河拗陷西部凹陷；上始新统一下渐新统沙河街组四段上部至三段。