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NOTE ON SOME OPERCULA OF THE CENOZOIC GASTROPODA FROM KIANGSU PROVINCE

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(Summary)

The present paper deals with the opercula that were collected from Kiangsu Province. The opercula were found to be in association with ostracods, lamellibranches, gas-

tropod shell and charophyta. They comprise 2 recognizable types, namely Spiral type Subspiral section and Spiro-concentric type.

In this paper the following forms are described:

Parafossarulus striatulus (Benson)

Spiro-concentric type form 1

Spiro-concentric type form 2

Spiro-concentric type form 3

Spiro-concentric type form 4

Spiral type, Subspiral section form 1

Of the above list, the opercula of *Parafossarulus striatulus* (Benson) and the form 1 of Spiro-concentric type were found to be associated with the Quaternary ostracods *Cypris subglobosa* Sowerby, *Ilyocypris errabundis* Mandel. and *Candoniella albicans* (Brady); the form 2 of Spiro-concentric type with the Quaternary ostracods *Candona* sp., *Ilyocypris* sp., *Candoniella* sp., *Cyclocypris* sp., and *Cyprinotus* sp.; the form 3 of Spiro-concentric type with the shell of *Parafossarulus striatulus* (Benson); and the form 4 of Spiro-concentric type with the Quaternary ostracods *Lineocypris namanganica* Schneider. The form 1 of Subspiral section of Spiral type occurs together with the Tertiary ostracods *Ilyocypris* sp., *Limnocythere* sp. and the Tertiary charophytes *Tolypella* sp., *Obusochara* sp., and *Chara* sp. (cf. *Chara saderi* Unger).

DESCRIPTION OF OPERCULAR TYPE

Subclass Procobranhia

Family Bithyniidae

Genus *Parafossarulus* Annandale 1924

Parafossarulus striatulus (Benson)

(Pl. I, figs. 1—3, 14)

1950 *Parafossarulus manchouricus japonicaus* (Pilsbry) = (*striatulus* Benson), Taki, Venus, 16, 1—4, p. 36, text-fig. 3.

Operculum of Spiro-concentric type, rather large and thick, slightly calcified. Margin thick. Outer circle narrower on the side of outer lip-edge than on the side of inner lip-edge. Outer lip-edge less convex than inner lip-edge. Posterior end rather sharp, anterior end rounded. Spiral lines of inner circle fine. Nucleus slightly concave, located anteriorly or slightly near columellar edge.

Measurements of *Parafossarulus striatulus* (Benson) (in mm)

Cat. No.	16123	16124	16125	16126	16127	16128	16129	16130	16131	16132	16133
Height	3.02	3.48	3.23	3.76	2.96	2.92	3.52	3.88	3.72	3.32	3.76
Width	2.40	2.60?	2.48	2.72?	2.28	2.24	2.96	2.88	2.68	2.84	2.72

Locality and Horizon: Yan-Cheng hsien and Hai-An hsien of Northern Kiangsu; Quaternary Da-Feng zu. Cat. Nos. 16123—16133.

Unnominated opercula Spiro-concentric type, form 1

(Pl. I, fig. 10)

Operculum of Spiro-concentric type, large and thick, chitinous. Margin of outer circle thick. Concentric lines present on outer circle. Margin of inner circle elevated on the side of outer lip-edge and depressed on the side of inner lip-edge. Spiral lines of inner circle fine and dense. Nucleus located anteriorly. Length 3.2 mm, width 2.5 mm.

This form differs from *P. striatulus* (Benson) in the depressed margin of the inner circle near inner lip-edge and the elevated margin of the inner circle on the side of outer lip-edge.

Locality and Horizon: Yan-Cheng hsien in Northern Kiangsu; Quaternary Da-feng zu. Cat. No. 16134.

Spiro-concentric type, form 2

(Pl. I, figs. 7—9)

Operculum of Spiro-concentric type, small chitinous. Margin thick. Outer circle moderately wide. Outer lip-edge convex. A few fine spiral lines present on inner circle. Nucleus located anteriorly or slightly near columellar edge. Arcuate ridge originating from nucleus and extending along the margin of inner circle.

Measurements of the form 2 of Spiro-concentric type (in mm)

Cat. No.	16135	16136	16137	16138
Height	1.44	1.44	1.36	1.56
Width	1.08	1.04	0.99	1.16

This form is easily distinguished from *Parafossarulus striatulus* (Benson) by its more convex outer lip-edge but thinner and smaller. It differs from the form 1 of Spiro-concentric type in the smaller size and not elevated inner circle.

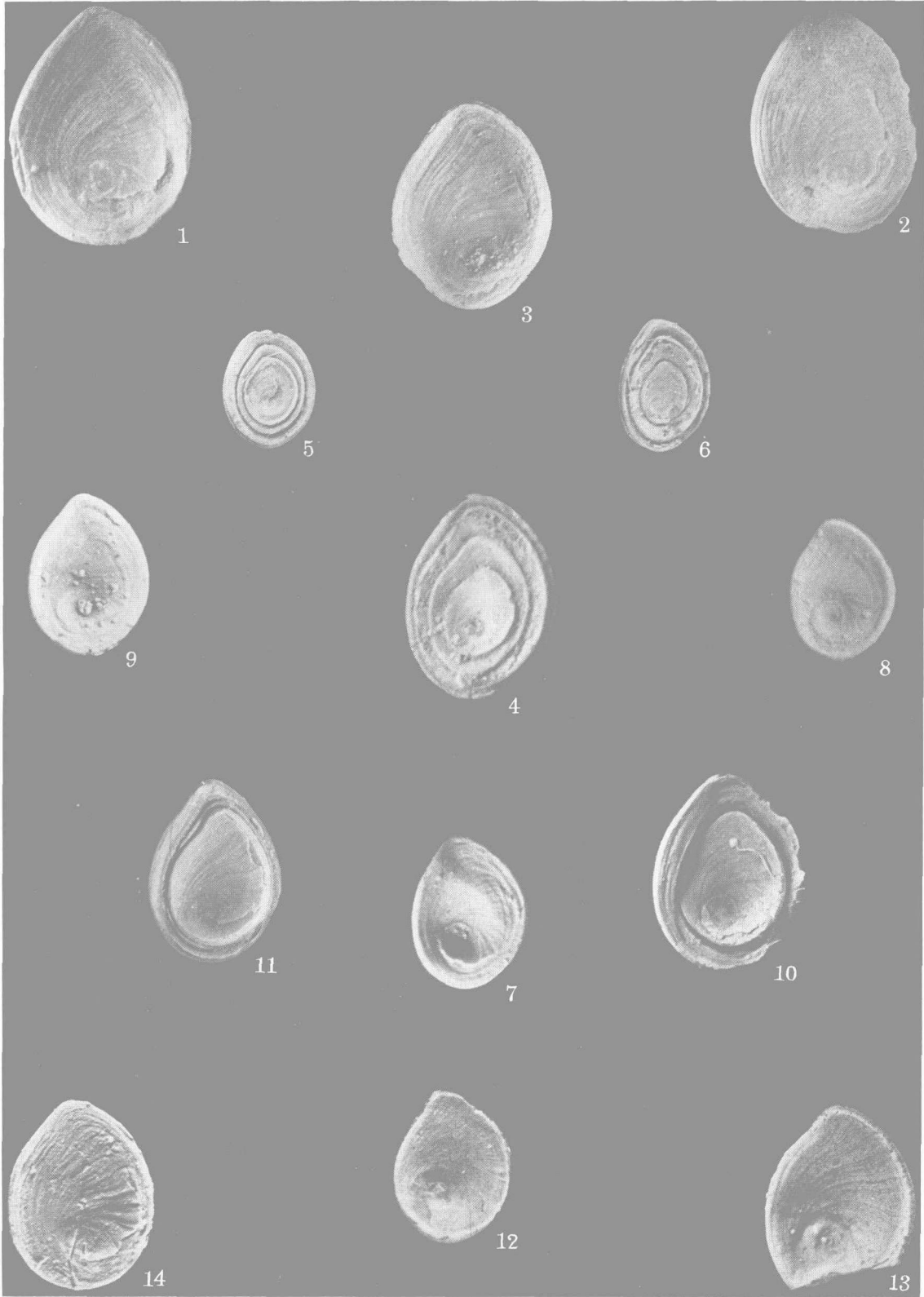
Locality and Horizon: Ru-Gao hsien of Northern Kiangsu; Quaternary Da-feng zu. Cat. Nos. 16135—16138.

Spiro-concentric type form 3

(Pl. I, fig. 11)

Operculum rather large, slightly calcified, similar in shape to form 2. Outer circle moderately wide. Outer circle narrower on the side of outer lip-edge than on the side of inner lip-edge. Margin of inner circle elevated. A distinct ring seen between the two circles. Spiral lines fine on inner circle. Inner circle slightly curved near the parietal edge. Nucleus located anteriorly or near columellar edge. Length 3.0 mm, width 2.2 mm.

This form is distinguished from *Parafossarulus striatulus* (Benson) and the form 2 of Spiro-concentric type by a distinct ring between the two circles. It differs from the form 1 of Spiro-concentric type in that the inner circle is not concave close to the inner lip-edge.



Locality and Horizon: Hai-An hsien of Northern Kiangsu; Quaternary, probably Da-feng zu. Cat. No. 16136.

Spiro-concentric type, form 4

(Pl. I, figs. 4—6)

Operculum of spiro-concentric type, rather large, calcified. Dorsal surface flat. Outer circle narrow. Margin of inner circle elevated. Outer and inner circles separated by one or two broad rings. Nucleus located anteriorly.

Measurements of the form 4 of Spiro-concentric type (in mm)

Cat. No.	16140	16141	16142
Height	2.0	2.0?	2.24
Width	1.44	1.56	1.56

This form is distinguished from the preceding forms by having one or two broad rings between the two circles.

Locality and Horizon: Yang-Cheng hsien and Feng hsien of Northern Kiangsu; Quaternary Dong-tai zu. Cat. Nos. 16140—16142.

Spiral type, Subspiral section, form 1

(Pl. I, figs. 12—13)

Operculum small and thin, sinistral. Dorsal surface marked by obviously spiral lines. Sinistral and dextral spiral lines forming net pattern in the posterior part. Parietal edge slightly concave. Nucleus slightly concave, located anteriorly.

Measurements of this form (in mm)

Cat. No.	16143	16144	16145
Height	1.60	1.44	1.70?
Width	1.20	1.12	1.48

This form can be distinguished from the above described forms by that the peripheral concentric lines are absent.

Locality and Horizon: Chang-Zhou of Southern Kiangsu; Tertiary. Cat. Nos. 16143—16145.

产地及层位: 江苏如皋,大丰组。登记号: 16135—16138。

旋轮型 3 形 Spiro-concentric type, form 3

(图版 I, 图 11)

口盖大,为旋轮型,含少量钙质。外圈适度阔,近外唇边之外圈比相对的一边窄。内圈之边缘高起,旋线细,近壁唇之内圈稍弯曲。核位于稍近轴唇边之前端。内外圈之间有一环。高 3.04 毫米;宽 2.24 毫米。

本形之内圈高起,与 *Parafossarulus striatulus* (Benson) 及旋轮型 2 形不同。在内外圈间有一环及近轴唇边之内圈不凹,可与旋轮型 1 形相区分。

产地及层位: 江苏海安,第四系,可能是大丰组。登记号: 16139。

旋轮型 4 形 Spiro-concentric type, form 4

(图版 I, 图 4—6)

口盖为旋轮型,钙质,较大。外圈窄。内圈具旋线。内圈之边缘高起。在内外圈之间存在着两个或一个宽的环。背面平。核位于稍近前端处。

旋轮型 4 形之量度(毫米):

标 本 号	16140	16141	16142
高	2.0	2.0?	2.24
宽	1.44	1.56	1.56

本形在内、外圈之间存在着两个或一个宽的环,因此与上述四形均可区分。

产地及层位: 江苏盐城及丰县,东台组。登记号: 16140—16142。

螺旋型亚旋族 1 形 Spiral type, Subspiral section, form 1

(图版 I, 图 12—13)

口盖之背面只具螺旋形的旋转,薄且小,角质,左旋。后端具左右两组旋线,相交成网状。壁唇边稍内凹。核位于前端,稍凹。

本形之量度(毫米):

标 本 号	16143	16144	16145
高	1.60	1.44	1.70?
宽	1.20	1.12	1.48

本形之标本周缘无同心圆的线纹,不同于上述诸形。

产地及层位: 江苏常州,第三系。登记号: 16143—16145。

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