On the Occurrence of Cretaceous Estherids in North Kyushu

By

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with 6 Text-figures and 1 Plate

ABSTRACT: The writer attempted to classify the fossil Estherids from Kokura city, Fukuoka Prefecture. He divided them into three forms—A · B and C—by the carapace outline. Among those three forms he could established two species—A and B—, for he reserved to establish "C" form as a distinct species by reason of its deformation.

CONTENTS

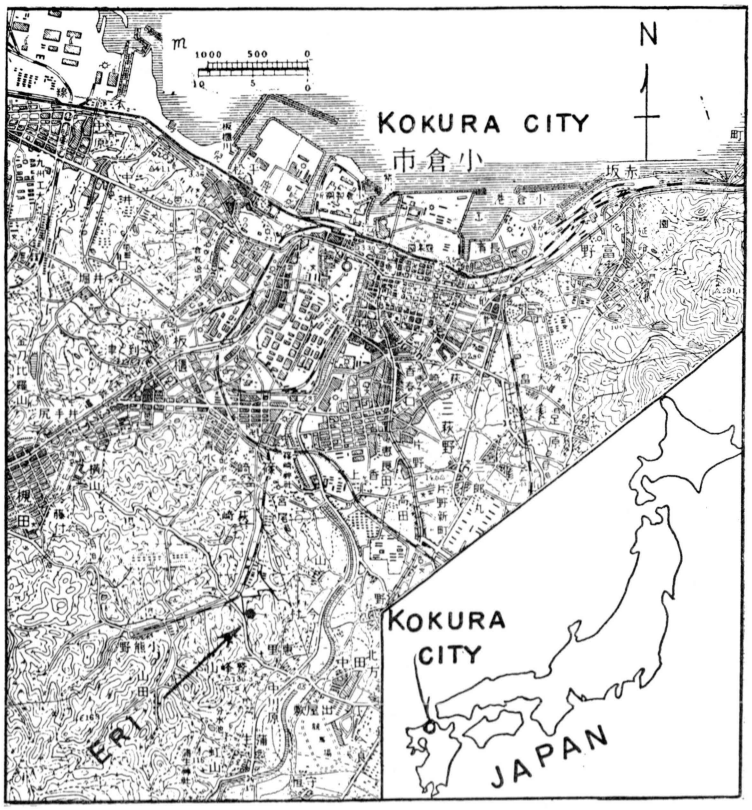

FIG. 1. Map showing the fossil locality at Kokura city.

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I. Introduction

Estherids were discovered by Akira Hase in 1948 from the Wakino subgroup, Kanmon group (Inkstone series) at Eri, Kokura city, Fukuoka Prefecture (see Fig. 1 for the locality). The non-marine fossils from the Wakino series have been investigated by T. Kobayashi and K. Suzuki (1936), and Y. Ota (1959) and known by the name of the Wakino fauna.

Since 1948, stratigraphy and palaeontology of the so-called Inkstone series have been gradually brought to light in the area from northern Kyushu to Western Yamaguchi Prefecture by the efforts of T. Matsumoto and others. According to A. Hase, its sequence is in descending order as follows:

Yahata formation			
Kwanmon group	Shimonoseki subgroup	Kitahikoshima formation	
		Shiohama formation	
	Wakino subgroup	Upper Wakamiya formation	
		Lower Wakamiya formation···containing Estherians	
		Nyoraida formation	
		Sengoku formation	
Palaeozoic rocks			

It is a remarkable fact that the Estherids of Kokura are evidently smaller than any other Cretaceous one in Eastern Asia. Nevertheless, they have numerous growth lines. The so-called ornaments in their intervals are all radial lirae and no reticulation is seen. Furthermore none in the collection is exactly identifiable with any known species in Eastern Asia. These small fossil Estherids are densely crowded in paper shales. Among them a close study is made with 61 selected carapaces. The proportion of height to length thus obtained is shown in fig. 2.

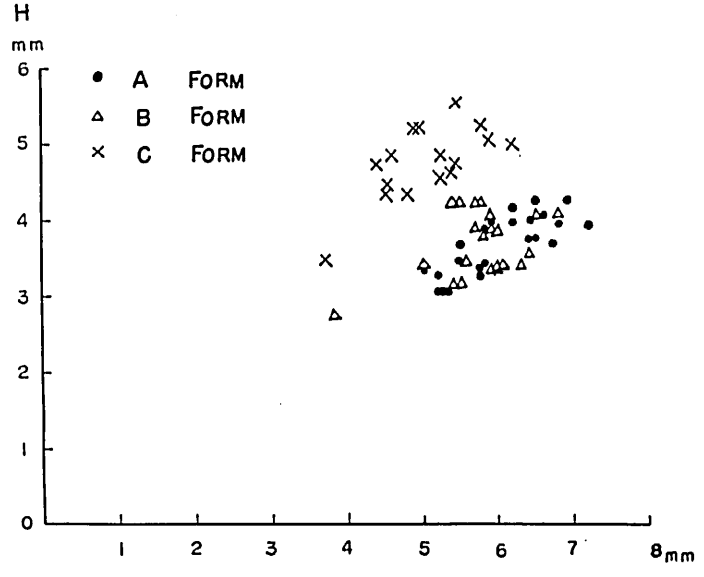

Fig. 2. Proportion of height to length of three fossil Estherian species.

As seen in fig. 2, C form is separable from the others by the proportion of height to length. Excluding the C form the specimens are measured, and the proportion of the distance from umbo to anterior end by the carapace length is shown in fig. 3. They can be distinguished into A and B forms, because the umbo is located near the anterior end or the median point on the dorsal margin respectively in the former or the latter.

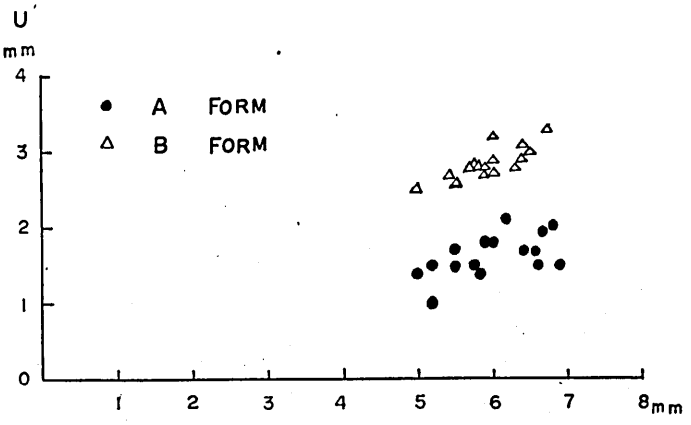

FIG. 3. Proportion of the distance from umbo to the anterior end of the dorsal margin by the carapace length of the A and B forms.

Thus the fossil Estherids collected at Eri, Kokura city can be divided into three forms by the carapace outline. Even when the deformation of the carapace is taken into consideration, A form is distinct. It is a question, however, whether the B and C forms represent two species or whether the two forms are combined in one species.

AOKNOWLEDGEMENT: The writer's thanks are due to Prof. T. KOBAYASHI for his kind guidance and encouragement throughout this work. At the same time he wishes to express his sincere gratitude to Prof. S. IMAMURA of the Hiroshima University and Prof. T. MATSUMOTO of the Kyushu University for their kind advices and to Assistant Prof. A. HASE of the Hiroshima University and Assistant Prof. Y. OTA of Fukuoka Liberal Arts College for the privilege of studying their collections.

II. DESCRIPTION OF THREE ESTHERIAN FORMS

Euestheria kokurensis KUSUMI, n. sp. (A form)

Pl. 4, figs. 1–3, 10.

Description:— Carapace oblongly ovate, and generally more inflated on the posterior side; dorsal margin slightly arcuate. Umbo terminal on the dorsal margin, located close to the anterior extremity of the carapace. As shown in the measurement, proportion of height to length varies from 1.512 to 1.870. Growth lines countable 26 to 40 on the carapace except for the umbonal side, where they are not well preserved. They are more densely distributed in the anterior than the other side. The so-called

surface ornaments are all radial lirae.

Measurements (in mm.):——

Specimen	Valve	Umbo to anterior end	L	H	L/H	Number of growth lines
Holotype No. 1	L	1.50	6.60	4.00	1.650	35
Paratype No. 91	L	2.00	6.80	3.85	1.766	28
No. 10	R	2.10	7.20	3.85	1.870	39
No. 37	L	1.70	5.70	3.00	1.900	26
No. 54	L	1.80	5.90	3.90	1.512	28
No. 63	L	2.10	6.50	3.70	1.756	32
No. 66	L	1.50	5.20	3.20	1.625	40
No. 72	R	1.40	5.00	3.30	1.515	37

Observation:— The holotype left valve (No. 1) is elliptical and somewhat swelling no the posterior side. Therefore it looks more or less elongated and slender. The proportion of height to length is 1/1.65; dorsal margin subarcuate; umbo located at about one-fourth the length from the anterior end; ventral margin describing a larger arc than the dorsal margin; growth lines number 35 including indistinct 3 near umbo, much denser on the anterior than the posterior side and about 4 close-set near the periphery; so-called ornaments are all radial lirae.

The paratype left valve (No. 91) is elliptical in form and longer and more slender than the holotype, its H/L being 1/1.766; umbo located at one-third the carapace length from the front and nearer the center than in the holotype; growth lines unknown in the umbonal region, but 19 lines are countable; 6 lines of them close-set near the periphery; total number of growth lines presumed about 28. The growth lines are spaced more broadly on the posterior side as in the holotype. As shown in fig. 10, on plate I, the ornaments are all radial lirae.

Among 24 specimens the right valve No. 10 has the longest carapace length (7.2 mm.) and the right valve No. 72 (5.0mm. long) is smallest. This smallest valve has about 37 growth lines. The tallest specimens (Nos. 25, 89) measure 4.2mm. and the shortest ones (Nos. 37, 38, 67) 3.0mm. In the tallest one (No. 54) L/H is 1.512. This proportion is, however, less than 1.180 in the smallest specimen (No. 24) which belongs to C form. Umbo is located nearest to the center in the valve No. 63. Its distance from the anterior end of the carapace is 2.1mm., and U/L is 0.323 where U means the distance from umbo to anterior end of carapace. Nevertheless their umbonal position is remarkably excentric, if compared to the smallest one (0.444) of Nos. 27 and 42 which belong to B form. Growth lines number about 40 in the largest (No. 66) and about 26 in the smallest (No. 37), but the number is generally difficult to count exactly in fossil Estherids, because they are generally ill-preserved at the umbonal region and sometimes extraordinarily close-set near the periphery. For example, in the specimen in fig. 11 on plate I, 4 lines are on the lower left side, but only

2 lines in their extension in the lower right side. If these facts are taken into consideration, there may be about 30 to 35 growth lines in this species. Ornaments are all radial lirae.

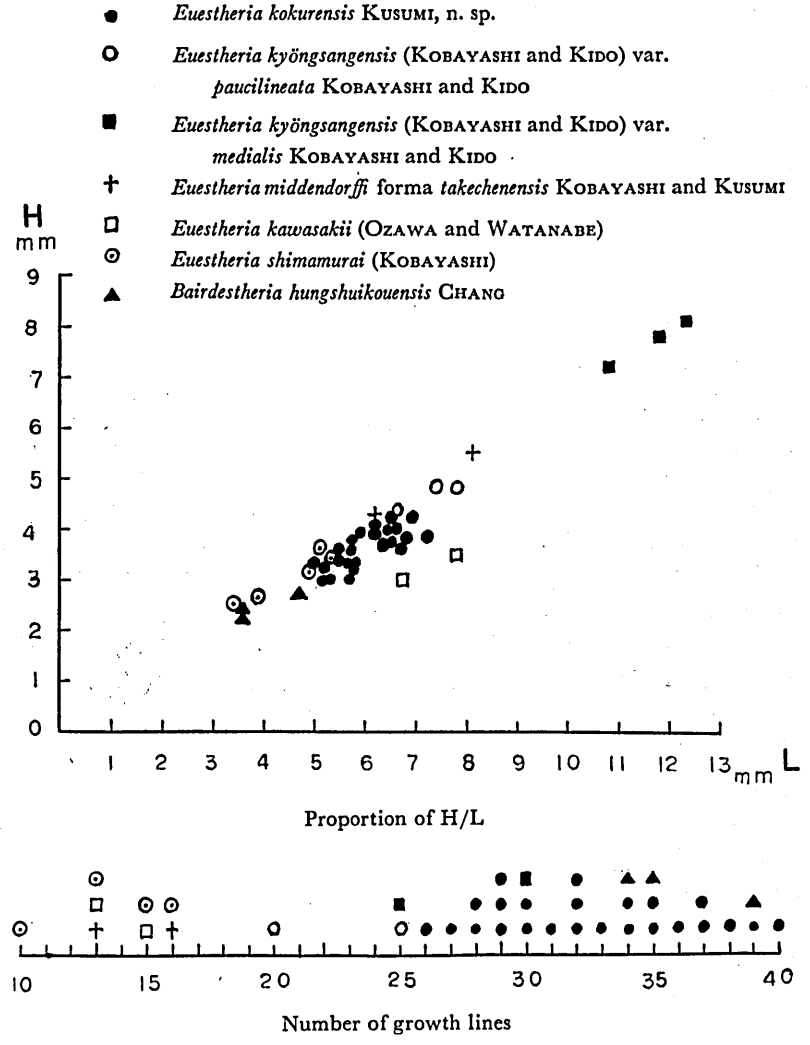

FIG. 4. Proportion of H/L to the number of growth lines of *Euestheria kokurensis* and allied species.

Comparison:— The proportion of height to length ranges 1.512 to 1.870 in this species i. e. A form, 1.285 to 1.880 in B form and 0.936 to 1.180 in C form. In other words A form is longer than B and C forms. The umbo is located close to the anterior extremity of the carapace in the A form, but lies near the center in the two other forms (see fig. 3).

The growth lines 26 to 40 in this species and 22 to 38 in B form, 23 to 37 in C

form. Therefore the author can not split them into distinct species by number of growth lines. The so-called surface ornaments are frequently ill-preserved in the umbonal region, but generally can be well seen in most other portions. The specimens from Eri cannot be classified by ornaments for they are all radial lirae. However, this species is distinguishable from B and C forms by the oblongly ovate outline of the carapace and subterminal umbo on the dorsal margin. The growth lines are not asymmetrical in this species like in B and C forms. They are more densely distributed in the anterior than the other side. As shown in fig. 5, the specimens are evidently throught to have suffered from lateral compression. These three forms may be thought to be produced by deformation. This interpretation is however, intenable because the umbones can not be brought to the same position by restoration. Such a great variability of the umbonal position is never seen in living Estherian species. Therefore it is quite warranted that this is specifically distinct from the B and C forms.

In the carapace outline this species is similar to *Euestheria kyöngsangensis* Kobayashi and Kido var. *paucilineata* Kobayashi and Kido, and *Euestheria kyöngsangensis* Kobayashi and Kido var. *medialis* Kobayashi and Kido from the Shiragi series, Kyöngsang groups in South Korea. But it is a little smaller than var. *paucilineata*, notwithstanding the fact that growth lines are more numerous. The carapace size is far smaller than that of var. *medialis*. *Euestheria middendorfii* forma *takechenensis* Kobayashi and Kusumi, 1953, from Jehol has the outline similar to this, but it is somewhat smaller and has more numerous growth lines. *Bairdestheria hungshuikouensis* Chang, 1957, from Tsaidam basin, Koko-nor in China has the almost same number of growth lines and the ornaments similar to this, but *Euestheria kokurensis* is much larger than the Tsaidam species.

Euestheria kawasakii Ozawa and Watanabe, 1923, from the Daido formation in Korea is long and slender. Growth lines are less in number in that than in this species. *Euestheria shimamurai* Kobayashi, 1950, is similar to this in size, but has less numerous growth lines. *Pseudestheria fallax* Novojilov, 1953, from the Devonian in South Siberia bears close resemblance to this species in outline and number of growth lines. However, it is too far separated from this species in the geologic age and the geographic distribution.

Estherites imamurai Kusumi, n. sp. (B form)

Pl. 4, figs. 4–6, 11

Description:— Outline elliptical; dorsal margin subarcuate; umbo located near the center of dorsal margin, and growth lines distributed almost symmetrically. The carapace length varies from 4.90 mm. to 6.80 mm. and so does the height from 2.90 mm. to 4.00 mm.; proportion of the distance from umbo to anterior end of dorsal margin by carapace length is 0.444 to 0.500. Growth lines countable about 22 to 38, but attain probably about 30 to 35 because some appear to be unpreserved. Ornaments of their interspaces are all radial lirae.

Measurements (in mm.):——

Specimen	Valve	Umbo to anterior end	L	H	L/H	Number of growth lines	
Holotype No. 30	L	3.00	6.50	4.00	1.625	35	
Paratype No. 32	R	3.00	6.00	3.80	1.578	34	
No. 39	R	1.80	3.80	2.70	1.407	18+	Larva?
No. 42	L	2.80	6.30	3.35	1.880	34	
No. 47	L	2.70	6.00	3.35	1.791	22+	
No. 79	L	3.30	6.80	4.00	1.700	30	
No. 83	L	2.20	4.90	2.90	1.689	35	
No. 84	L	3.10	6.40	3.50	1.828	38+	
No. 86	R	2.50	5.00	3.35	1.492	32+	

Observation:— Specimen No. 30 is typical of this species. The carapace is long and elliptical and the dorsal margin slightly arcuate. Proportion of the distance from umbo to anterior end by carapace length is 0.461/1, that is to say, the umbo is submedi-

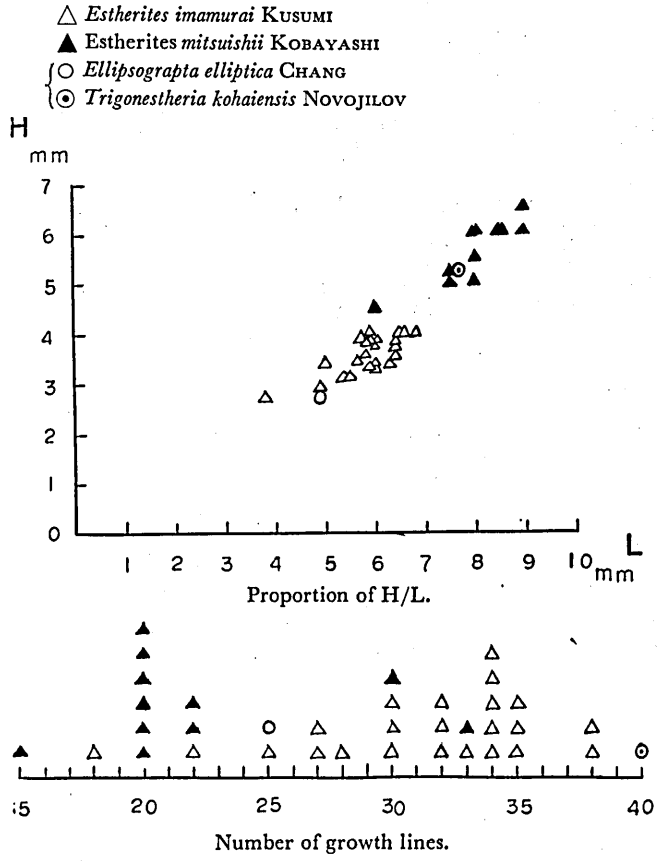

Fig. 5. Proportion of H/L and number of growth lines of *Estherites imamurai* and allied species.

an on the dorsal margin. Growth lines are countable 35 and distributed symmetrically. Some 15 growth lines on the umbonal side are closely set and the others widely spaced; 3 lines close-set near the periphery. The so-called ornaments in their intervales are all radial lirae. In the specimen No. 32 the umbo is located at the center of the dorsal margin. The right valve No. 39 which is smallest is 3.80mm. in length and 2.70mm. in height; growth lines number 18. This is probably an immature valve.

Comparison:— In outline this is similar to the preceding species, but they are different in the umbonal position and distribution of growth lines. It is similar to the succeeding form in the umbonal position and in the distribution of growth lines, but evidently different in outline. This species is similar to *Estherites mitsuishii* KOBAYASHI and HUZITA in the subcentral umbo, although that species is higher. This is long and slender, and has more numerous growth lines. It is similar to *Ellipsograpta elliptica* CHANG, 1957, in the subcentral umbo, but CHANG's is smaller and growth lines (12 to 14 lines) less than in this species. It is also similar to *Trigonestheria kohaiensis* NOVOJILOV, 1953, from the Devonian in Siberia in outline, but that species is larger (H. 5.2mm. L. 7.6mm.).

Genus and species indet. (C form)
Pl. 4, figs. 7–9, 12

The characteristics of this form are its rounded form, subcentral umbo on the dorsal margin, growth lines distributed symmetrical, and radial lirae in their intervals. It is different from *E. kokurensis* in the umbonal position, and distribution of the growth lines, and from *E. imamurai* in outline. The ornaments are radial all as in these species.

Measurements (in mm.):——

Specimen	Valve	Umbo to anterior end	L	H	L/H	Number of growth lines
Holotype No. 9	R	2.60	5.25	4.80	1.093	35
Paratype No. 8	L	2.20	4.40	4.70	0.936	28
No. 5	L	2.30	4.95	5.20	0.951	25
No. 24	L	2.80	5.90	5.00	1.180	30
No. 33	L	2.40	5.50	5.50	1.000	35
No. 46	R		6.20	4.90	1.265	32
No. 53	R	2.70	5.40	4.60	1.173	37
No. 55	R	1.95	4.80	4.30	1.116	23
No. 61	R	1.80	3.70	3.45	1.072	30

The right valve No. 9 is typical of this form. The dorsal margin is as arcuate as the ventral margin. Growth lines are 35 or so in number; 15 lines on the umbonal

side and 4 near the periphery more densely distributed than the others. In the central part of the carapace their intervals become gradually wider. The valve No. 8 is somewhat higher than long; valve No. 5 deformed. The largest valve No. 46 is 6.20 mm. and the smallest No. 61 3.70 mm. in length. The distance from the umbo to the anterior end is almost half as long as the carapace-length, that is to say, the umbo is located at the center on the dorsal margin. H/L is 1.265 in No. 46 but 0.936 in No. 8. Namely, the height is nearly equal to the length in this form.

Comparison:— This form is similar to *Asmussia tunghuensis* KOBAYASHI and KUSUMI, and *Asmussia khinganensis* KOBAYASHI in the carapace form, but it is smaller than the two species. Growth lines are more numerous in this than in them. This is different from *Cyclestherioides rampoensis* KOBAYASHI, and *Cyclestherioides koreanica* (OZAWA and WATANABE) in umbonal position. *Brachyestheria orbiculata* NOVOJILOV, 1953, from the Devonian of Siberia appear very similar to this form in outline and number of growth lines.

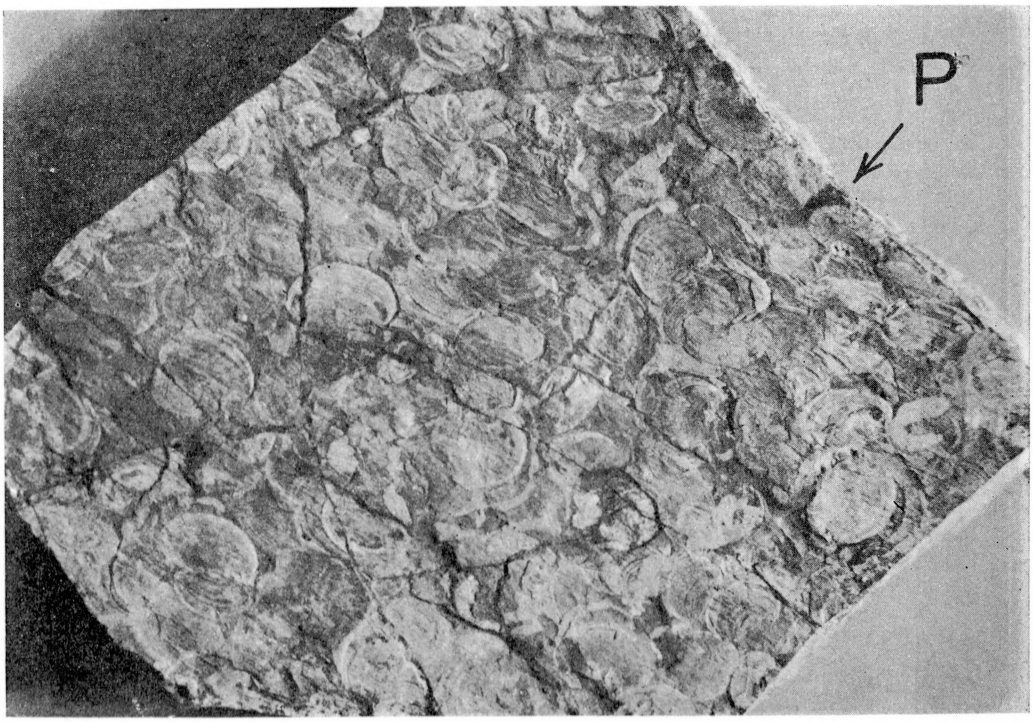

FIG. 6. Estherian paper shale showing the secondary deformation.

III. A QUESTION ON THE DEFORMATION

As seen in fig. 6, the elongated A and B forms, that is, *E. kokurensis* and *E. imamurai* are aligned in the same direction. Their umbones are located on the upper or lower

side in the photograph. None has the umbo on the left or right side. On the contrary the rounded C form has she umbo on the right or left side and not on the upper or lower side. The C form carapaces are disposed rectangularly to those of the A and B forms. It is possible that their difference in outline depends on the deformation. It is interesting to see wrinkles in the same direction on flattened valves. These wrinkles are thought to have been produced by lateral compression, and the direction of the pressure is suggested by an arrow in the fig. 6.

A form is so similar to B form in the carapace outline which are aligned in the same direction. But the A form is quite different from the B form in the umbonal position. Therefore these two do not belong to an identical species.

The B and C forms appear to have the umbo at the center of the dorsal margin. It is quite probable that these two have originally had the same outline and umbonal position. If the deformation is ignored, however, these two forms must be distinguished into two distinct species. At present the writer hesitates to accept the C form as a distinct species.

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Explanation of Plate IV

Euestheria kokurensis Kusumi n. sp. (A form)

Fig. 1. Holotype, left valve, No. 1. ×8.
Fig. 2. Paratype, left valve, No. 91. ×8.
Fig. 3. Left valve, No. 54. ×8.

Estherites imamurai Kusumi n. sp. (B form)

Fig. 4. Holotype, left valve, No. 30. ×8.
Fig. 5. Paratype, right valve, No. 32. ×8.
Fig. 6. Left valve, No. 79. ×8.

C form

Fig. 7. Right valve, No. 9. ×8.
Fig. 8. Right valve, No. 8. ×8.
Fig. 9. Left valve, No. 5. ×8.

Ornamentation

Fig. 10. *Euestheria kokurensis* Kusumi n. sp. No. 91. ×70.
Fig. 11. *Estherites imamurai* Kusumi n. sp. No. 32. ×70.
Fig. 12. C form, No. 93. ×70.

All specimens illustrated here are kept in the Institute of Earth Science, Faculty of Education, Hiroshima University.

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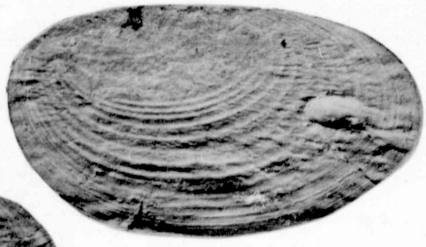

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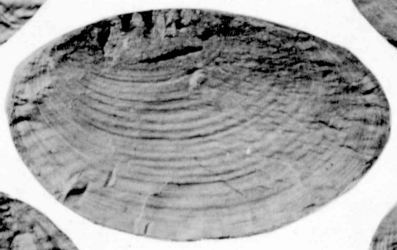

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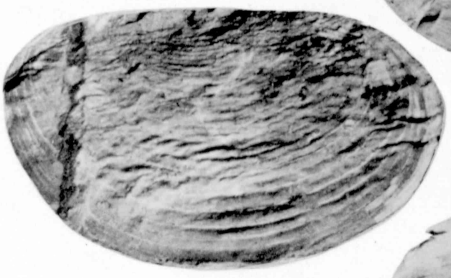

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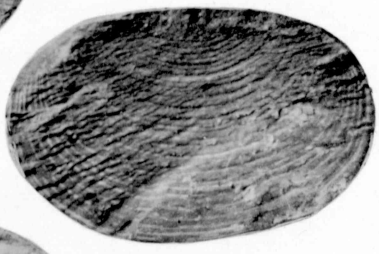

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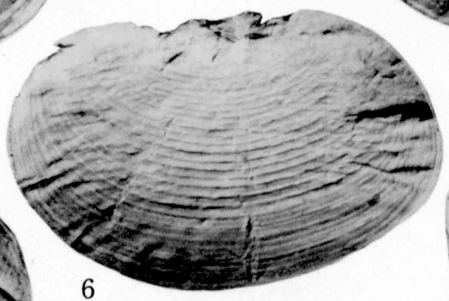

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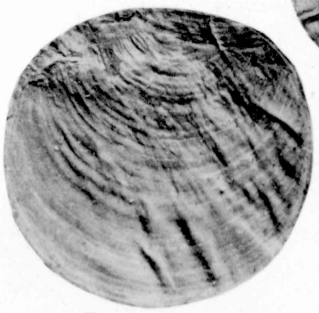

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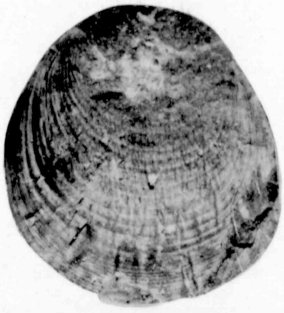

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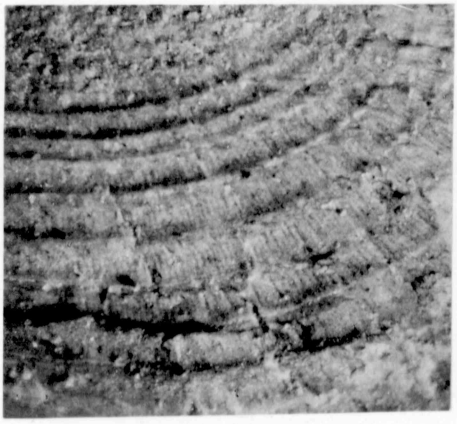

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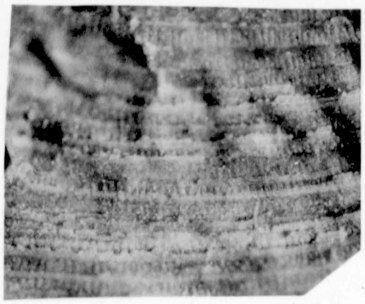

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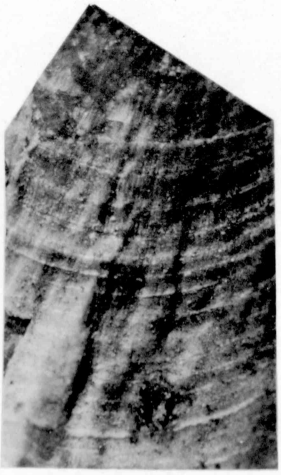

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