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Tertiary Mollusca from Shiobara in Shimotsuké

By

Matajiro YOKOYAMA, *Rigakuhakushi*

With 5 Plates

In the year 1898, Mr. N. Kanehara, now Director of the Imperial Geological Survey, while still a student in the Imperial University of Tokyo, undertook the geological investigation of the Takahara volcano, Shimotsuké, by order of the Earthquake Investigating Committee. This mountain is only a few kilometres south of Shiobara, a place noted for its hot springs, and has for its basement-rock a Tertiary formation containing marine shells. A description of this Tertiary formation was given in the report[1] of Mr. Kanehara on the above volcano published two years later.

According to the above author, the Tertiary Formation of Shiobara is divisible into two parts, which he calls the *Upper* and the *Lower*. The *Upper Part* is a lacustrine deposit consisting in greater part of indurated volcanic ash of a grey or light brown hue, thinly cleavable and embracing numerous impressions of plants, some of which had already been described by A. G. Nathorst in 1886.[2] This part is of limited extent and is generally believed to have been formed after the formation of the volcano.

The *Lower Part* which covers a much greater area than the Upper consists, according to Mr. Kanehara, counted from below, of the following eight layers in which he recognized four fossil zones :

1) Report on the Geology of the Takahara Volcano (in Japanese). Reports of the Earthquake Investigating Committee, No. 31, 1900.

2) Zur Fossilen Flora Japans. Palaeont. Abhandl., Bd. 4, Helt 8. 1888.

1. Stratified volcanic ash, indurated and hard, brecciated and of a greyish colour, intercalating a black-coloured zone containing a great quantity of quartz-grains, fragments of granite and other older rocks and also marine shells. This is what Mr. Kanehara calls *Fossil Zone I*, and is best exposed along the river Ojikagawa.

2. White volcanic tuff containing fragments of a green fibrous rock and well exposed near Fukuwada. The layer in its upper part becomes arenaceous and includes pebbles as well as marine shells. This is *Fossil Zone II* of Mr. Kanehara. What are commonly known as *imoishi* (*potato-stones*) are found in this zone, being fillings of club-shaped holes left by some rock-boring shell.

3. Platy tufaceous sandstone with abundance of distinct quartz grains.

4. White volcanic ash, fine-grained, compact and stratified, embracing nodules of a zonal structure. Utilized as whetstones.

5. Green and white, mottled volcanic tuff and dark-grey tufaceous shale, the latter containing innumerable remains of *Macoma dissimilis* Mart. This, together with the following, forms *Fossil Zone III* of Mr. Kanehara.

6. Tufaceous sandstone containing large nodules of a hard greyish sandstone in which shells abound.

7. Green tufaceous sandstone, brittle in character.

8. Greenish-grey sandy volcanic tuff with coarse quartz grains and shells. This is *Fossil Zone IV* of Mr. Kanehara.

The last layer, when it is in contact with lava, is covered by it.

The thickness of the above eight layers, taken altogether, is estimated by Mr. Kanehara as varying from 500 to 600 metres, of which about 130 metres are occupied by the lowest layer and about 240 metres by the one next above.

The fossils which form the subject of the present paper are those from the four zones before mentioned and were mostly collected by Mr. Kanehara. As to their preservation, it leaves much to be desired, for many of them are either only present as casts, or so firmly attached to the stone with the outer surface that it is not possible to detach them without breaking them into pieces. Such being the case, the number of species which I have been able to distinguish, in spite of the great number of specimens, is comparatively small. They are as follows :

	Zone				Geological Occurrence.
	I	II	III	IV	
1. Mitra pristina Yok.			+		Pliocene.
2. Volutharpa perryi Jay.			+		Pliocene-Recent.
3. Priene oregonensis Redf.				+	Pliocene-Recent.
4. Turritella saishuensis Yok.			+		Pliocene.
5. Polinices ampla Phil.			+	+	Pliocene-Recent.
6. Sigaretus festivus Yok.			+		Pliocene.
7. Dentalium complexum Dall.			+		Pliocene-Recent.
8. Dentalium sp.			+		
9. Panope generosa Gld.			+	+	Pliocene-Recent.
10. Mya arenaria L. var. japonica Jay.			+	+	Miocene-Recent.
11. Spisula grayana Schr.			+		Miocene-Recent.
12. Cultellus izumoensis Yok.				+	Pliocene.
13. Macoma dissimilis Mart.			+		Pliocene-Recent.
14. Macoma praetexta Mart.			+		Miocene-Recent.
15. Dosinia troscheli Lke.			+		Pliocene-Recent.
16. Dosinia kaneharai Yok.			+		
17. Cardium burchardi Dkr.			+		Pliocene-Recent.
18. Cardium shiobarense Yok.		+	+	+	
19. Cardium sp.			+	?	
20. Lucina borealis L.			+	+	Miocene-Recent.
21. Mytilus giganteus Holm.			+		Recent.
22. Pecten swiftii Bern.		+			Pliocene-Recent.
23. Pecten yessoensis Jay.				+	Pliocene-Recent.
24. Pecten kaneharai Yok.		+	+		
25. Ostrea sp.				+	
26. Arca sp.	+		+	+	
27. Pectunculus yessoensis Sow.			+		Pliocene-Recent.
28. Pectunculus sp.	+			+	
29. Yoldia ensicula Yok.				+	
30. Nucula mirabilis Ad. et. Rve.			+	+	Pliocene-Recent.

Of the four fossil zones before mentioned, Zone III is most rich, not only in individuals, but also in species, the number of the latter being 23. Next comes Zone IV in which 13 species were found. Then comes Zone II with 3, and Zone IV with 2 species. Also a single species, viz., *Cultellus izumoensis* Yok., has been found in a layer between zones III and IV.

Taking all the zones together, the number of species found as shown in the foregoing table, amounts to 30, of which 5 are not exactly determined. Of the remaining 25, 4 are quite new, 4 hitherto confined to the Pliocene, 4 ranging between the Miocene and the Recent, 12 ranging between the Pliocene and the Recent, while 1 is only Recent. From this it is quite clear that the number of those species not yet known to be living is 8, or 32 % of the whole. Therefore we may safely conclude that the entire fauna is *Pliocene* in age, and very probably not younger than *Middle Pliocene*. As to the four zones, there seems to be no great difference in their faunal characters, or at least the number of species already found is too small to enable us to give the characteristics of each zone.

CM22774 – 1c
CM22775 – 2
CM22776 – 3

Description of the Species.

1. Mitra pristina, Yokoyama.

Pl. XVI. Figs. 1c, 2, 3.

Mitra pristina. Yokoyama. Tert Moll. Dainichi, p. 8, pl. I, figs. 8–12.

Tolerably frequent, though well-preserved specimens are rare.

Fossil occurrence.—Zone III. Pliocene of Dainichi.

CM22777

2. Volutharpa perryi, Jay.

Volutharpa perryi. Yokoyama, Foss. Miura Penin., p. 55, pl. IV, fig, 11. Foss. Up. Musash., p. 57, pl. II, fig. 19. Moll. Rem. Up. Part Jô-Ban Coalf., p, 10.

A single specimen. The spiral striation, generally indistinct, is well preserved on the body-whorl.

Fossil occurrence.—Zone III. Musashinos. Shirado Beds.

Living.—Northern and Central Japan.

CM22778

3. Priene oregonensis, Redfield.

Priene oregonensis. Yokoyama, Foss. Miura Penin., p. 64, pl. III, figs. 10, 12. Foss. Up. Musash., p. 68. Moll. Remains Upperm. Part Jô-Ban Coalf., p. 11. Moll. Rem. Middle Part, p. 12. Tert. Moll. Shinano a. Echigo, p. 6. Moll. Tert. Basin Chichibu, p. 116.

One small specimen.

Fossil occurrence.—Zone IV. Pliocenes of Chichibu and Shinano. Shirado Beds. Musashino.

Living.—Northern Japan. Alaska down to Washington.

CM22779

4. **Turritella saishuensis,** YOKOYAMA.

Turritella saishuensis. Yokoyama, Some Foss. Shells Saishu, p. 3, pl. I, fig. 2. Tert. Moll. Shinano a. Echigo, p. 6.

A worn specimen and a few fragments which are readily recognized by three strong spiral ridges.

Fossil occurrence.—Zone III. Upper Musashino of Saishu. Pliocene of Shinano and Echigo.

CM22780
CM22781

5. **Polinices (Neverita) ampla,** (PHILIPPI).

Polinices (Neverita) ampla. Yokoyama, Foss. Miura Penin., p. 78, pl. V, figs. 5, 6. Foss. Up. Musashino, p. 84. Moll. Rem. Up. Part. Jô-Ban Coalf., p. 14. Moll. Rem. Mid. Part, p. 14. Tert. Moll. Jô-Ban Coalf., p. 14. Moll. Mem. Mid. Part, p. 14. Tert. Moll. Shinano a. Echigo, p. 7.

Quite frequent.

Fossil occurrence.—Zones III and IV. Musashinos. Shirado Beds. Minato Beds. Pliocenes of Kii, Totomi, Shinano and Echigo.

Living.—Northern, Central and Western Japan. Philippines.

CM22782

6. **Sigaretus festivus,** YOKOYAMA.

Sigaretus festivus. Yokoyama, Tert. Moll. Shinano and Echigo, p. 8, pl. I, fig. 6.

A single example somewhat deformed.

Fossil occurrence.—Zone III. Pliocene of Shinano.

CM22783

7. **Dentalium complexum,** DALL.

Pl. XVII. Fig. 6.

Dentalium complexum. Yokoyama, Foss. Miura Penin., p. 101, pl. VI. fig, 27. Foss. Moll. Neog. Izumo, p. 4. Moll. Rem. Up. Part. Jô-Ban Coalf., p. 16, pl. II, fig. 9. Moll. Tert. Basin Chichibu, p. 117.

Two examples, one of which is about 50 millim. long and lacks only the apex. Much water-worn.

Fossil occurrence.—Zone III. Pliocenes of Izumo and Chichibu. Shirado Beds. Lower Musashino.

Living.—Central Japan. Sandwich Islands.

CM22784

8. **Dentalium**, SP.

Fragments of a smooth-surfaced *Dentalium*.

Fossil occurrence.—Zone III.

CM22785
CM22786

9. **Panope generosa**, (GOULD).

Panope generosa. Yokoyama, Foss. Up. Musash., p. 121, pl. V. figs. 14, 15. Foss. Moll. Neog. Izumo, p. 4. Tert. Moll. Dainichi, p. 14. Moll. Rem. Up. Part, p. 16, pl. VI, fig. 6. Moll. Rem. Mid. Part Jô-Ban Coalf., p. 16. Tert. Moll. Shinano and Echigo, p. 10. Moll. Tert. Basin Chichibu, p. 118.

Several specimens.

Fossil occurrence.—Zones III and IV. Pliocenes of Shinano, Izumo, Totomi and Chichibu. Shirado Beds. Upper Musashino.

Living.—Northern Japan. West coast of America.

CM22787
CM22788

10. **Mya arenaria, Linné, var. japonica**, JAY.

Mya arenaria var. japonica. Yokoyama, Moll. Rem. Up. Part Jô-Ban Coalf., p. 16, pl. VI, fig. 4. Tert. Moll. Shinano and Echigo, p. 10, pl. III, fig. 3. Jô-Ban Tanden Kabu no Kwaseki (Jour. Geol. Soc. Tokyo. March, 1925) p. 92.

Very rare.

Fossil occurrence.—Zones III and IV. Asagai Beds of Iwaki. Pliocene of Shinano. Shirado Beds.

Living.—Northern, Central and Western Japan.

CM22789

11. **Spisula grayana**, (SCHRENCK).

Spisula grayana. Yokoyama, Foss. Up. Musash., p. 130, pl. VIII, figs. 1, 2. Moll. Rem. Mid. Part, p. 16. Tert. Moll. Shinano and Echigo, p. 11. Jô-Ban Tanden Kabu Kwaseki (Jour. Geol. Soc. Tokyo. March, 1925) p. 93.

A few specimens.

Fossil occurrence.—Zone III. Asagai Beds of Iwaki. Shirado Beds. Pliocene of Shinano. Musashinos.

Living.—Northern Japan. Sea of Okhotsk.

CM22790

12. **Cultellus izumoensis**, YOKOYAMA.

Cultellus izumoensis. Yokoyama, Foss. Moll. Neog. Izumo, p. 5, pl. II, fig. 1. Moll. Rem. Up. Part. Jô-Ban Coalf., p. 18, pl. V, figs. 2, 3.

Impressions of the anterior part of the right and left valves.

Fossil occurrence.—Between Zones II and III. Pliocene of Izumo. Shirado Beds.

CM 22791 - 4
CM 22792

13. Macoma dissimilis, (Martens).

Pl. XVI. Fig. 4.

Macoma dissimilis. Yokoyama, Foss. Miura Penin., p. 116, pl. VII, figs. 19, 20. Foss. Up. Musashino, p. 143, pl. x, fig. 4.

CM 24742
CM 24743

Quite frequent in shaly layers, rarely in sandstones.

Fossil occurrence.—Zone III. Zone IV? Shirado Beds. Musashinos.

Living.—Central Japan.

CM 22793

14. Macoma praetexta, (Martens).

Macoma praetexta. Yokoyama, Tert. Moll. Dainichi, p. 15. Moll. Rem. Low. Part Jô-Ban Coalf., p. 13. Moll. Tert. Basin Chichibu, p. 118. Foss. Up. Musashino, p. 142. pl. X, figs. 2, 3.

Several examples.

Fossil occurrence.—Zone III. Asagai Beds (Miocene). Pliocenes of Totomi and Chichibu. Upper Musashino.

Living.—Central and Western Japan.

CM 22794 - 16
CM 22795

15. Dosinia troscheli, Lischke.

Pl. XVI. Fig. 1 b.

Dosinia troscheli. Yokoyama, Foss. Miura Penin., p. 119, pl. VIII, figs. 5, 6. Foss. Up. Musash., p. 144. Tert. Moll. Dainich, p. 15. Moll. Rem. Upperm. Part Jô-Ban Coalf., p. 19. Moll. Rem. Mid. Part, p. 17. Moll. Tert. Basin Chichibu, p. 118.

A few, well-preserved specimens.

Fossil occurrence.—Zone III. Pliocenes of Totomi and Chichibu. Shirado Beds. Minato Beds. Musashinos.

Living.—Central and Western Japan.

CM 22796 - 11
CM 22797 - 2
CM 22798 - 3
CM 22799 - 4
CM 22800 - 5
CM 22801 - 2
CM 22802
CM 24694
CM 24735

16. Dosinia kaneharai, Yokoyama.

Pl. XVII. Figs. 1–5. Pl. XVIII. Fig. 2.

Shell large, solid, moderately convex, roundly ovate, nearly as long as high, inequilateral. Postero-dorsal border usually more abruptly sloping than antero-dorsal and anterior border more broadly rounded than posterior. Surface regularly concentrically furrowed. Beaks small, pointed. Lunula elongato-cordate, somewhat longer than broad. Pallial sinus deep, obliquely ascending and bluntly pointed at end. Diameter measuring up to 55 millim.

Owing to rock-pressure, most of the specimens are more or less deformed, some being quite orbicular while others are drawn out in the direction of the length.

Fossil occurrence.—Zone III. Numerous.

CM 22803-3
CM 22804-4
CM 22805

17. Cardium burchardi, DUNKER.

Pl. XIX. Figs. 3, 4.

Cardium burchardi. Yokoyama Foss. Miura Penin., p. 153, pl. XII, Fig. 3. Moll. Tert. Basin Chichibu p. 120.

Not rare.

Fossil occurrence.—Zone III. Pliocene of Chichibu. Lower Musashino.

Living.—Central and Western Japan.

CM 22806-2
CM 22807-3
CM 22808-4
CM 22809-5
CM 22810
CM 22811
CM 22812
CM 24744
CM 24752

18. Cardium shiobarense, YOKOYAMA.

Pl. XX. Figs. 2,-5.

Shell large, inflated, with outline obliquely ovate, higher than long, rounded in front, truncate behind, broadly arched at ventre, with postero-ventral corner bluntly angulate. Surface radiately ribbed ; ribs about 30 in number, elevated, flat above, squarish in cross-section, separated by narrower interspaces. Beaks prominent, high, incurved and pointed.

Specimens are quite frequent, but almost all are present as casts. Deformation is great, but the height, length, and depth of isolated valves are approximately in the ratios of 10 : 10 : 3.2. The largest example which we possess is that of a right valve, 65 millim. in height, 57 milllm. in length and 21 millim. in depth.

Fossil occurrence.—Zones II (rare), III (rare) and IV (frequent).

CM 22839

19. Cardium, SP.

A few casts which look like those of *Cardium shinjiense* Yok. (Foss. Moll. Neog. Izumo, p. 7, pl. II, fig. 6).

Fossil occurrence.—Zone III and also IV ?

R CM 22813
CM 22814

20. Lucina (Phacoides) borealis, LINNÉ.

Lucina (Phacoides) borealis. Yokoyama, Foss. Miura Penin., p. 133, pl. X, fig. 7. Foss. Up. Musash., p. 160. Tert. Foss. Kii, p. 67, pl. VI, fig. 11. Moll. Rem. Upperm. Part Jô-Ban Coalf., p. 24, pl. V, figs. 5-8. Moll. Rem. Mid. Part, p. 7, pl. I, fig. 2. Tert. Moll. Shinano a. Echigo, p. 14. Moll. Tert. Basin Chichibu, p. 121.

Fossil occurrence.—Zone III (rare) and IV (quite common). Mizunoya Beds (Miocene). Shirado Beds. Pliocene of Shinano and Chichibu.

Living.—Central Japan.

CM 22815-1
CM 22816

21. Mytilus giganteus, Holmberg.

Pl. XX. Fig. 1. CM 24753

Mytilus giganteus. Yokoyama, Foss. Miura Penin., p. 145, pl. XI, fig. 20. Holmberg, Bull. Soc. Imp. Nat. Moscou, 1862, p. 422, pl. XI, fig. 12. Lischke, Jap. Meeresconch., I. p. 150. Pilsbry, Catalogue, p. 139.

Several specimens of this large elongated pointed form with some up to 153 millim. in length and 76 millim. in breadth. In the "Systematisches Conchylien Cabinet" of Martini and Chemnitz, this species is united with *Mytilus grayanus* Dkr. as to which I am now not in a position to forward any opinion.

Fossil occurrence.—Zone III. Musashino. CM 22817

Living.—Western Japan. Sitka.

22. Pecten swiftii, Bernard.

Pecten swiftii. Yokoyama, Foss. Miura Penin., p. 154, pl. XIV, fig. 11. Moll. Rem. Upperm. Part, Jô-Ban Coalf., p. 27, pl. II, fig. 1. Moll. Tert. Basin Chichibu, p. 123, pl. XV, fig 3.

An ill-preserved left valve.

Fossil occurrence.—Zone II. Pliocene of Chichibu. Shirado Beds. Lower Musashino. CM 22818

Living.—Northern Japan. Sea of Okhotsk. Alaska.

23. Pecten yessoensis, Jay.

Pecten yessoensis. Yokoyama, Foss, Miura Penin., p. 159, pl. XIII, figs. 14. 15. Moll. Rem. Upperm. Part, p. 27. Tert. Moll. Shinano and Echigo, p. 17, pl. IV, fig. 4.

Fragmentary left valves.

Fossil occurrence.—Zone IV. Pliocene of Shinano, Shirado Beds. Lower Musashino.

Living.—Northern Japan. Sea of Okhotsk. CM 22819-1
CM 22820-1
CM 22821-2
CM 22822-5
CM 22823-6
CM 22824-7
CM 22825

24. Pecten kaneharai, Yokoyama.

Pl. VIII. Fig. 1. Pl. XIX. Fig. 1, 2, 5-7. CM 22826

Shell large, compressed, orbicular, somewhat inequivalve. Right valve slightly more convex than left, ornamented by more than 20 radiating ribs separated by valleys usually a little broader than the ribs themselves; ribs high and elevated, rounded, divided into three parts by two longitudinal furrows with the middle part broader than the lateral ones and more elevated; valleys also with a single intercalary riblet; ribs as CM 24736
CM 24737
CM 24738
CM 24739
CM 24740
CM 24741

well as riblets closely scaled; ears unequal, anterior elongated, and provided with a few scaled radiating riblets and a deep byssal notch below, posterior triangular with lateral (posterior) side shortest. Left valve slightly flatter than right, with surface-sculpture similar, but with the ribs usually bipartite instead of tripartite and the intercalaries more prominent with occasionally a smaller intercalary between them and the main ribs ; ears both triangular.

The largest specimen attains a diameter of 100 millim.

It is much to be regretted that, in spite of its very frequent occurrence it is almost impossible to secure perfect specimens. Moreover, they are so firmly attached to the stone that what we get are either their casts or those with only their inner side exposed. On this account, it is difficult even to distinguish the right valve from the left.

Fossil occurrence.—Zones II and III (most frequent).

CM22827
CM22828

25. **Ostrea,** SP.

Many examples of a thick-shelled oyster, apparently of *Ostrea gigas* Thunb., though not quite certain.

Fossil occurrence.—Zone IV.

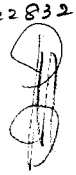
CM22829
CM22830
CM22831

26. **Arca,** SP.

Several specimens of an *Arca*, which on account of their imperfect state of preservation are not determinable.

Fossil occurrence.—Zones I, III and IV (most frequent).

CM22832



27. **Pectunculus yessoensis,** LOWERBY.

Pectunculus yessoensis. Yokoyama, Foss. Miura Penin., p. 168, pl. XVIII, figs. 1, 2. Foss. Up. Musashino, p. 189, pl. XVI, figs. 6, 7.

A few examples.

Fossil occurrence.—Zone III, Lower Musashino.

Living.—Northern Japan.

CM22833-5
CM22834
CM22835

28. **Pectunculus,** SP.

Pl. XVI. Fig. 5.

Several casts of a *Pectunculus* which may possibly be those of *Pectunculus albolineatus* Lke. (Foss. Up. Musashino, pl. XVII, figs. 1–3).

Fossil occurrence.—Zones I and IV.

29. Yoldia ensicula, Yokoyama.

Pl. XVI. Fig 6.

Shell small, transversely elongated, short-lanceolate, strongly compressed, somewhat inequilateral, with posterior side shorter than anterior, sharply rounded both in front and behind, broadly arched at ventre, antero-dorsal border only slightly arched, postero-dorsal excavated. Surface concentrically and shallowly furrowed. Beaks small but pointed. Length 23 millim. Height 11 millim. Thickness 4 millim.

Only a single specimen was obtained.

Fossil occurrence.—Zone IV.

30. Nucula mirabilis, Adams et Reeve.

Pl. XVI. Fig. 1 a.

Nucula mirabilis. Yokoyama, Foss. Miura Penin., p. 180, pl. XIX, fig. 9. Foss. Moll. Izumo, p. 9. Moll. Rem. Upperm. Part, Jô-Ban Coalf., p. 30. Moll. Rem. Mid. Part, p. 21, pl. III, fig. 6. Moll. Tert. Basin Chichibu, p. 125.

Tolerably frequent.

Fossil occurrence.—Zones III and IV. Pliocenes of Izumo, and Chichibu. Shirado Beds. Minato Beds. Lower Musashino.

Living.—Central and Western Japan.

INDEX.

PLATE XVI.

Plate XVI.

Fig. 1a. Nucula mirabilis Ad. et Rve. Zone III. P. 137.

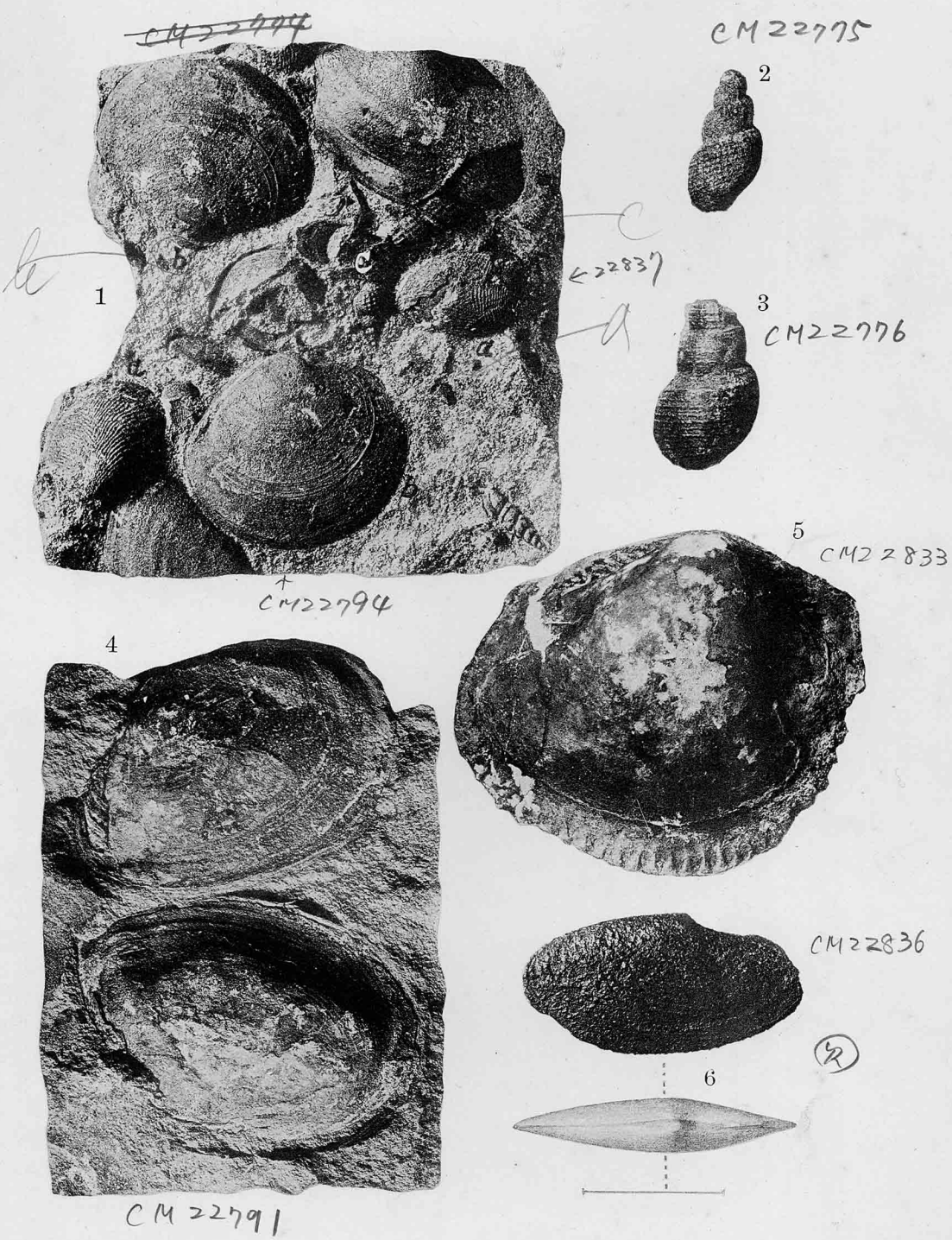
Fig. 1b. Dosinia troscheli Lke. Zone III. P. 133.

Figs. 1c, 2, 3. Mitra pristina Yok. Zone III. P. 130.

Fig. 4. Macoma dissimilis Mart. Zone III (shale). P. 133.

Fig. 5. Pectunculus sp. Zone I. P. 136.

Fig. 6. Yoldia ensicula Yok. Zone IV. P. 137.

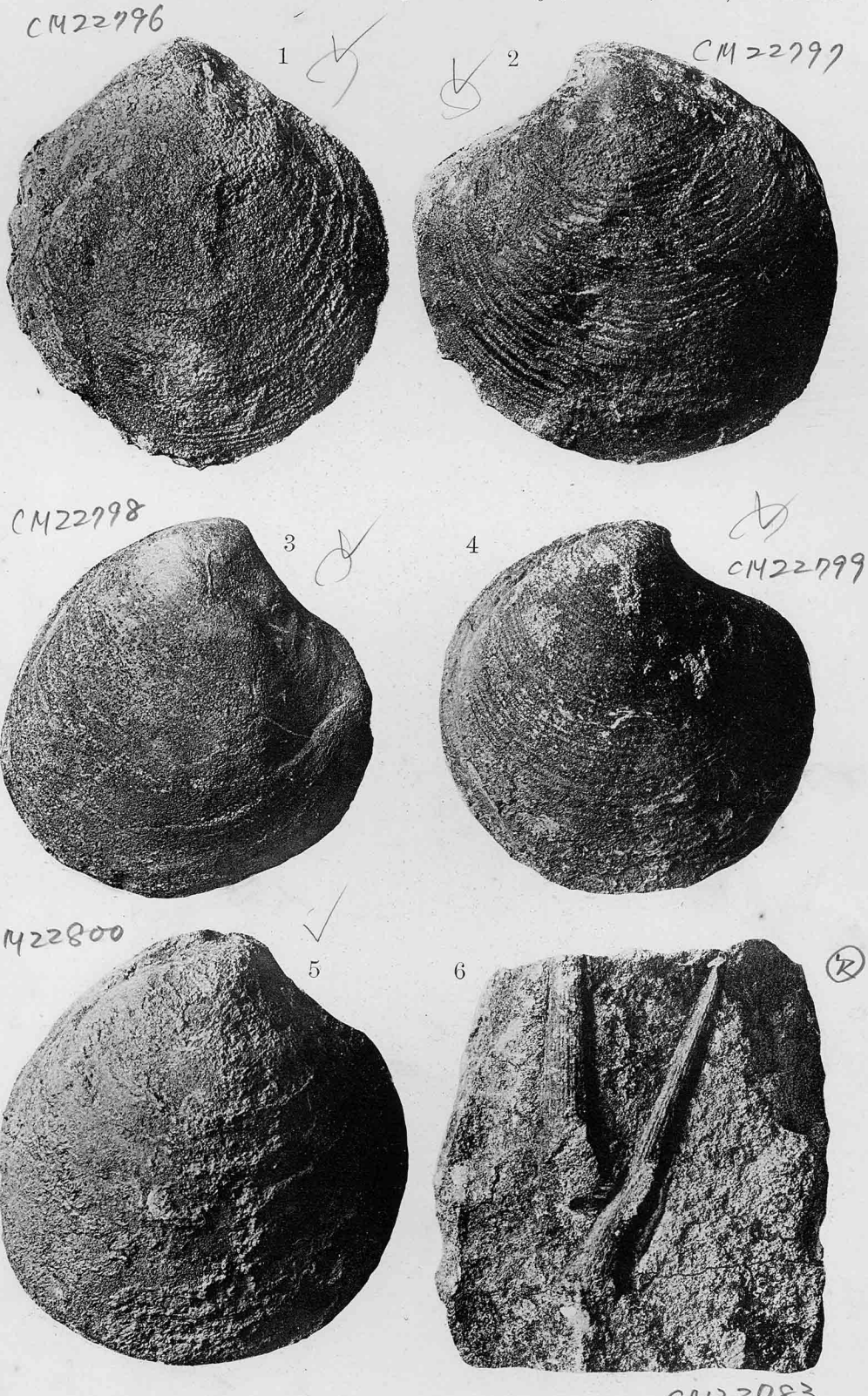


M. Yokoyama: Tertiary Mollusca from Shiobara.

Plate XVII.

Figs. 1-5. Dosinia kaneharai Yok. 3. Much deformed. Zone III. P. 133.

Fig. 6. Dentalium complexum Dall. Zone III. P. 131.



M. Yokoyama: Tertiary Mollusca from Shiobara.

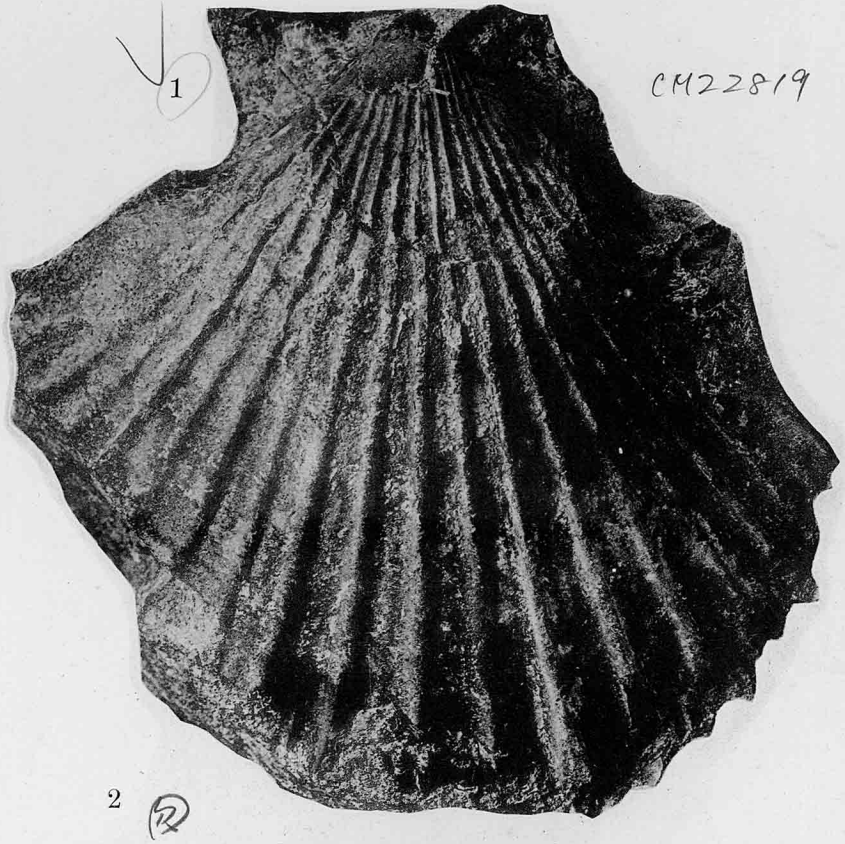
Plate XVIII.

Fig. 1. Pecten kaneharai Yok. Right valve (cast). Zone III. P. 135.

Fig. 2. Dosinia kaneharai Yok. Zone III. P. 133.

1

CM22819



2

CM22801

M. Yokoyama: Tertiary Mollusca from Shiobara.

Plate XIX.

Fig. 1. Pecten kaneharai Yok. Right valve. Zone III. P. 135.

Fig. 2. Pecten kaneharai Yok. Right? valve (cast). Zone III. P. 135.

Fig. 3, 4. Cardium burchardi Dkr. Right valves. Zone III. P. 134.

Fig. 5, 6. Pecten kaneharai Yok. Fragments of left? valves, showing surface sculpture. Zone III. P. 135.

Fig. 7. Pecten kaneharai Yok. Right valve (inner side). Zone III. P. 135.

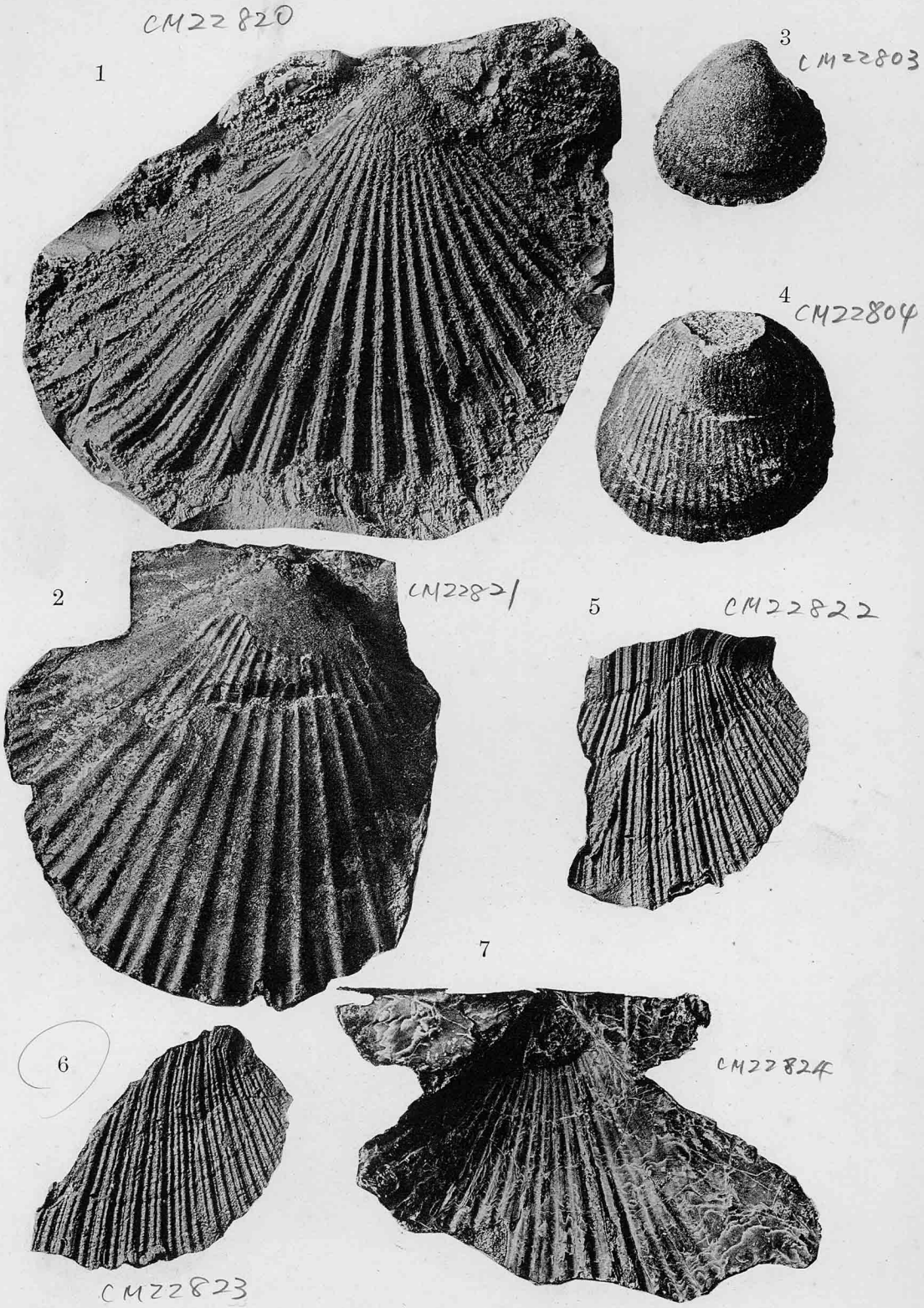


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Plate XX.

Fig. 1. Mytilus giganteus Holm. Zone III. P. 135.

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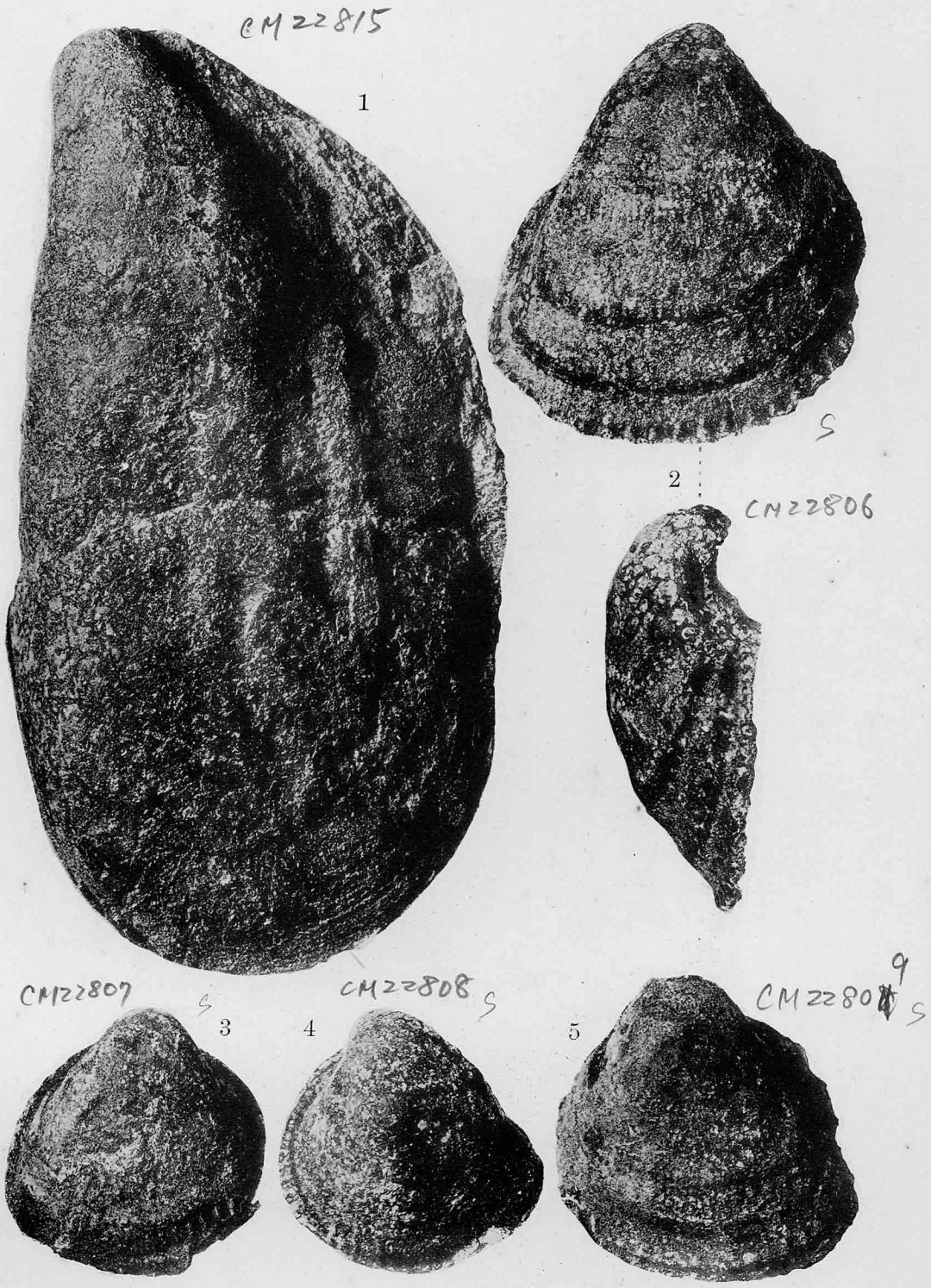

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