311. AMUSSIOPECTAN IITOMIENSIS (OTUKA) AND ITS ALLIES FROM JAPAN

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The genus Amussiopecten has been reported from many localities of Japan and Formosa (Text-fig. 1).

Amussiopecten praesignis (YOKOYAMA) was first described by M. YOKOYAMA in 1922 from an unknown locality. In 1926 he pointed out "that its locality lies somewhere in Southern Totomi", Shizuoka Prefecture. This species is also recorded by the same author from the Lower Byoritsu beds in Taiwan (1928) and Tonohama in Tosa (1929). As was pointed out by T. KURODA (1931), the specimen recorded from the former locality should be referred to another species. In 1932 S. NOMURA and H. NIINO reported the present species from the Nawachi gold mine, Izu Peninsula, but this specimen also represents another species. S. NOMURA and N. ZINBO recorded this species from the Shimaziri beds, Okinawa in 1936. Y. OTUKA also reported the present species from the Tanna tunnel, Shizuoka Prefecture (1933), northern foot of Mt. Minobu, Yamanashi Prefecture (1934), and south of Murono, Shizuoka Prefecture (1938), but the specimens from the second locality should be referred to another species.

Amussiopecten planicostulatum (NOMURA and NIINO) was first described by S. NOMURA and H. NIINO in 1932 from the Shirahama group at Ichiya near Yugashima, Izu Peninsula, but no subsequent record of occurrence has been published.

Amussiopecten yabei (NOMURA) was first described by S. NOMURA in 1933 from Taiwan.

Recently, T. SHUTO (1955) described Amussiopecten hyugaensis SHUTO and Amussiopecten praesignis (YOKOYAMA) from Hyuga, Miyazaki Prefecture, and discussed their stratigraphic significance.

The writer studies some specimens of Amussiopecten praesignis which are probably topotypes, many individuals of "A. praesignis" and some of "Pecten iitomiensis OTUKA" from the southern foot of Mt. Minobu, Yamanashi Prefecture, and some of A. planicostulatum from Abuzuri, Zushi City, Kanagawa Prefecture.

As the result of his study, it becomes clear that the topotype specimens of "Pecten iitomiensis OTUKA" represent Amussiopecten iitomiensis (OTUKA),

* Read June 20, 1956; received Sept. 8, 1956.
* It is questionable whether these specimens can be assigned to *Amussiopecten praesignis* (Yokoyama).

including the individuals from the northern foot of Mt. Minobu which Y. Otuka (1934, 1936) once assigned to *A. praesignis*, and that *Amussiopecten hyugaensis* Shuto is a synonym of this species.

In this paper the writer discusses the above mentioned four species and clarifies their variations and interspecific relationships.

Acknowledgements are due to Dr. Haruyoshi Fujimoto, Dr. Kotora Hatai and Mr. Masae Omori of the Geological and Mineralogical Institute, Tokyo University of Education, for their valuable suggestions and reading of this manuscript. Thanks are due to Mr. S. Akagi, Mr. T. Matsuzaki and Mr. T. Omori, for co-operating with him in collecting some of the present specimens.
Amussiopectan iitomiensis (OTUKA) and Its Allies from Japan

Family Pectinidae
Subfamily Amusiinae
Genus Amussiopecten SACCO, 1897
Amussiopecten praesignis (YOKOYAMA)

Pl. 7. Figs. 5, 6.


1926 Pecten praesignis, YOKOYAMA. Jour. Fac. Sci., Imp. Univ. Tokyo, Sec. 2, vol. 1, pt. 3, pp. 357-358, pl. 40, figs. 1, 2; pl. 41, fig. 1.

1931 Amussiopecten praesignis. KURODA, Venus vol. 3, appendix, pp. 76-77, fig. 80.


The six specimens collected by the writer and his friends from the Dainichi sand, Shizuoka Prefecture take the following description.

Shell large, rather thin, longer than high, orbicular in outline; right valve more convex than the left; both valves radiately ribbed. Right valve equilateral, with 16-17 broad, elevated, flat-topped, straight ribs, which become gradually lower towards the ventral and the lateral margins, and sometimes bifurcate at the lateral borders and sometimes are single; interstices narrower than ribs themselves; internal ribs 13 pairs in number, wide and flat at the beginning but later becoming prominent and concave to have prominent ridges on both sides; interstices becoming as wide as the ribs at the ventral border. Growth line weak but distinct. Ears subequal; anterior ear being somewhat wavy and with weak but distinct byssal notch. Hinge line wing-like. Left valve almost flat, ornamented with external and internal ribs and growth lines; external ribs rounded and as wide as interstices.

The measurements are shown in Table 1 (in mm.).

Table 1

<table>
<thead>
<tr>
<th>Reg. No.</th>
<th>L</th>
<th>H</th>
<th>D</th>
<th>Hinge</th>
<th>H/L</th>
<th>D/L</th>
<th>Hinge/L</th>
<th>No. of Ribs</th>
<th>Apical Angle</th>
<th>Valve</th>
</tr>
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<tbody>
<tr>
<td>5391</td>
<td>104</td>
<td>102</td>
<td>14</td>
<td>46</td>
<td>.98</td>
<td>.13</td>
<td>.44</td>
<td>17</td>
<td>127</td>
<td>R.</td>
</tr>
<tr>
<td>5392</td>
<td>93</td>
<td>80</td>
<td>8</td>
<td>48</td>
<td>.86</td>
<td>.09</td>
<td>.52</td>
<td>16</td>
<td>127</td>
<td>R.</td>
</tr>
<tr>
<td>5393</td>
<td>114</td>
<td>108</td>
<td>7</td>
<td></td>
<td>.95</td>
<td>.07</td>
<td></td>
<td></td>
<td></td>
<td>R.</td>
</tr>
<tr>
<td>5394</td>
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<td>64</td>
<td>10</td>
<td></td>
<td>.97</td>
<td>.15</td>
<td></td>
<td></td>
<td></td>
<td>R.</td>
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<tr>
<td>5395</td>
<td>84</td>
<td>73</td>
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<td>36</td>
<td>.87</td>
<td>.10</td>
<td>.43</td>
<td>16</td>
<td>120</td>
<td>R.</td>
</tr>
</tbody>
</table>

Remarks:—This species is characterized by the rather thin, large shell which is provided with 16-17 elevated, flat-topped, bifurcating, radial ribs which have prominent ridges on both sides. The ribs become obsolete towards the ventral and the lateral margins and are broader than the interstices. The umbonal angle exceeds 120 degrees. It is noteworthy that the bifurcating ribs are hardly recognized in one specimen and the ratio of height to length of the shell varies between .86 and .98.

The specimen figured by M. YOKOYAMA (1928) from Lower Byoritsu beds should not be included in this species, as was suggested by T. KURODA (1931). The specimens reported by Y. OTUKA (1934) from the Shizukawa formation should be assigned to A. iitomiensis (OTUKA), and the one recorded by S. NOMURA and H. NHNO from the Nawachi...
gold mine may be also included in A. itomimensis.

Locality and horizon:—In the tunnel near Nishiyama, Haranoya-mura, Ogasagun, Shizuoka Prefecture; Dainichi sand.


Distribution*:—1) Hamashidake conglomerate, Shizuoka Prefecture; 2) Tonohama group, Kochi Prefecture; 3) Takanabe member, Miyazaki Prefecture.

Amussiopecten planicostulatum
(Nomura and Niino)

Pl. 7, Figs. 2, 3, 4.


The original description of Amussiopecten planicostulatum (Nomura and Niino) is as follows.

"Shell large, about 110 mm. in height, compressed, length nearly equal to height, subequivalve, subequilateral; sides straight, with margins smooth; umbonal angle about 110 degrees. Test rather thin. Right valve ornamented by 18 low, rounded, subequal ribs which are sometimes dichotomous or branching: in some specimens the ribs are almost obsolete near the ventral margin; interspaces subequal, very shallow, much narrower than the ribs, rarely provided with interstitial riblets; whole surface covered by numerous fine growth lines and a few stronger periodic ones; hinge line less than one-half of disk-length. Ears subequal in length; anterior ear rounded in front and ornamented by almost obsolete radials as well as concentric lines of growth; byssal notch rather shallow and broad; posterior ear is obliquely truncated, ornamented by only concentric lines. Left valve quite similar to the right except for almost unequal ears." The four specimens of the right valve and a single one of the left which were collected by the writer from the Zushi formation at Abuzuri, Kanagawa Prefecture take the following description.

Shell large, rather thick, longer than high, orbicular in outline; almost equilateral and inequivalved; umbonal angle 110-120 degrees. Right valve with 15-18 broad, rounded, straight ribs, which become gradually obsolete towards the ventral and the lateral margins and are rarely provided with interstitial riblets; interspaces much narrower than ribs themselves. Internal ribs with prominent ridges on both sides at the ventral side. The shell surface has fine distinct concentric lines near the ventral margin. Ears subequal and wing-like: anterior ear larger than posterior one. Byssal notch shallow but distinct. Imperfectly preserved left valve with low, rounded, radial ribs which are as wide as interstices and provided with interstitial riblets. Concentric lines are weak but distinct.

The measurements are shown in Table 2 (in mm.).
Table 2.

<table>
<thead>
<tr>
<th>Reg. No.</th>
<th>L</th>
<th>H</th>
<th>D</th>
<th>H/L</th>
<th>D/L</th>
<th>Hinge/L</th>
<th>No. of Ribs</th>
<th>Apical Angle</th>
<th>Valve</th>
</tr>
</thead>
<tbody>
<tr>
<td>5397</td>
<td>104</td>
<td>90</td>
<td>7</td>
<td>.87</td>
<td>.07</td>
<td></td>
<td>18</td>
<td>110</td>
<td>R.</td>
</tr>
<tr>
<td>5398</td>
<td>94</td>
<td>92</td>
<td>11</td>
<td>.98</td>
<td>.11</td>
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<td>15</td>
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</tr>
<tr>
<td>5399*</td>
<td>91</td>
<td>87</td>
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<td>.53</td>
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<td>R.</td>
</tr>
<tr>
<td>5400</td>
<td>106</td>
<td>95</td>
<td>9</td>
<td>.90</td>
<td>.09</td>
<td>.52</td>
<td>17</td>
<td>120</td>
<td>R.</td>
</tr>
</tbody>
</table>

Remarks:—This species is characterized by the rather thick, large shell which is provided with 15-18 low, rounded, radial ribs and with interstitial riblets on the left valve. The ribs become obsolete towards the ventral and the lateral margins, and are much broader than the interstices. The umbonal angle is less than 120 degrees.

The type specimens have sometimes dichotomous ribs which are never recognized in the present specimens from the Zushi formation. The left valve (NOMURA and NIINO 1932, pl. 12, fig. 5) to which S. NOMURA and H. NIINO assigned their specimen may belong to the right valve.

*Amussiopecten praesignis* (YOKOYAMA) is closely allied to this species, but the former has more elevated, flat-topped, radial ribs, larger umbonal angle and broader interstices which are never provided with interstitial riblets.

Locality and horizon:—Abuzuri, Zushi City, Kanagawa Prefecture; Zushi formation.

Repository:—The Geological and Mineralogical Institute, Tokyo University of Education: Reg. No. 5396-5400.

Distribution:—Shirahama group near Yugashima, Izu Peninsula.

*Amussiopecten yabei* (NOMURA)


The type specimens figured by S. NOMURA are ill preserved. S. NOMURA pointed out that it is distinguishable from *A. praesignis* by the numerous internal ribs, however it may be suggested from Text-figure 2 that his specimens should be included in *A. planicostulatum*.

Text-figure 2. Variation diagram of the apical angle to the number of ribs with regard to right valves of four species of *Amussiopecten*. 

- ○: *Amussiopecten praesignis* (YOKOYAMA).
- ×: *Amussiopecten iitomiensis* (OTUKA).
- ●: *A. planicostulatum* (NOMURA and NIINO).
- △: *A. yabei* (NOMURA).

* This specimen was collected by teachers of natural science at the Meguro Fourth Middle School in Tokyo, to whom the writer expresses his sincere thanks for their gift of it.
Amussiopecten iitomiensis (Otuka)

Pl. 6. Figs. 1, 2, 3, 4, 5, 6; Pl. 7. Fig. 1.


1934 Amussiopecten praesigne. Otuka, ibid., p. 567.


Y. Otuka (1934) assigned some of the scallops from the Shizukawa formation to Amussiopecten praesignis (Yokoyama) and Pecten iitomiensis Otuka, but as the result of the writer's study, it becomes clear that they represent the same species, Amussiopecten iitomiensis (Otuka).

The original description of "Pecten iitomiensis Otuka" (in Japanese) is as follows. "This new species resembles Pecten naganumana Yokoyama, but the former has a flatter and higher shell than the latter. Patinopecten yessoensis Jay is allied to the present species, which has narrower and shallower interstices.

The measurements are as follows:

<table>
<thead>
<tr>
<th>Specimen 1; (R. G. No. 1879)</th>
<th>Specimen 2; (R. G. No. 1880)</th>
</tr>
</thead>
<tbody>
<tr>
<td>height</td>
<td>length</td>
</tr>
<tr>
<td>50</td>
<td>47</td>
</tr>
<tr>
<td>57</td>
<td>49</td>
</tr>
</tbody>
</table>

Ribs 14-15 in number.

The apical portion of this species is flat and resembles Pecten laqueatus Sowerby. Ears are simple and triangular; byssal notch indistinct. Radial ribs rounded and become gradually flatter and obsolete towards the ventral and the lateral margins. The interstices narrower than the ribs themselves."

The specimens collected by the writer from the Shizukawa sandstone take the following description.

Shell large, rather thin, varying in outline from opithocline to prothocline through orthocline. Right valve a little convex, slightly curved near the beak, provided with 12-15 low, rounded, straight ribs, which become obsolete

Explanation of Plate 6

Fig. 1. Amussiopecten iitomiensis (Otuka), Topotype, Reg. No. 5312, Right valve. ×1. Loc. near Kannon-bashi, west of Hayakawa-bashi, Nakatomi-machi. Minamikoma-gun, Yamanashi Prefecture.

Fig. 2. Amussiopecten iitomiensis (Otuka), Reg. No. 5315, Right valve. ×2/3. Loc. Osozawa, Nakatomi-machi, Minamikoma-gun, Yamanashi Prefecture.

Fig. 3. Amussiopecten iitomiensis (Otuka), Reg. No. 5316, Right valve. ×1/2. Loc. Same as above.

Fig. 4. Amussiopecten iitomiensis (Otuka), Reg. No. 5317, Right valve. ×2/3. Loc. West of Oharazima, Nakatomi-machi, Minamikoma-gun, Yamanashi Prefecture.

Fig. 5. Amussiopecten iitomiensis (Otuka), Reg. No. 5324. Inner surface of right valve. ×2/3. Loc. Osozawa, Nakatomi-machi, Minamikoma-gun, Yamanashi Prefecture.

Fig. 6. Amussiopecten iitomiensis (Otuka), Topotype, Reg. No. 5311, Left valve. ×1. Loc. Near Kannon-bashi, west of Hayakawa-bashi Nakatomi-machi, Minamikoma-gun, Yamanashi Prefecture.
M. Akiyama: *Amussiopecten*

Plate 6

1
2
3
4
5
6
Amussipecten iitomiensis (OTUKA) and Its Allies from Japan

Table 3.

<table>
<thead>
<tr>
<th>Reg. No.</th>
<th>L.</th>
<th>H.</th>
<th>D.</th>
<th>Hinge line</th>
<th>H/L</th>
<th>Hinge/L</th>
<th>No. of Ribs</th>
<th>Apical Angle</th>
<th>Inequability</th>
<th>Valve</th>
</tr>
</thead>
<tbody>
<tr>
<td>5311</td>
<td>48</td>
<td>50</td>
<td>10</td>
<td>28</td>
<td>1.04</td>
<td>.58</td>
<td>13</td>
<td>105</td>
<td>.44</td>
<td>R.</td>
</tr>
<tr>
<td>5312</td>
<td>42</td>
<td>48</td>
<td>9</td>
<td>22</td>
<td>1.10</td>
<td>.52</td>
<td>12</td>
<td>112</td>
<td>.52</td>
<td>L.</td>
</tr>
<tr>
<td>5315</td>
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<td>.46</td>
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<td>55</td>
<td>.84</td>
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<td>11</td>
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<td>R.</td>
</tr>
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<td>76</td>
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<td>26</td>
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<td>.84</td>
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<td>120</td>
<td>.54</td>
<td>R.</td>
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<tr>
<td>5320</td>
<td>62</td>
<td>49</td>
<td>5</td>
<td>26</td>
<td>.79</td>
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<td>13</td>
<td>120</td>
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<td>R.</td>
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<td>120</td>
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<td>57</td>
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<td>1.09</td>
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<tr>
<td>5328</td>
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<td>81</td>
<td>1</td>
<td>1.00</td>
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<td>14</td>
<td>110</td>
<td>.46</td>
<td>110</td>
<td>R.</td>
</tr>
</tbody>
</table>

Gradually towards the ventral and the lateral margins; interstices much narrower than ribs themselves. Internal ribs have inconstant width and prominent ridges on both sides near the ventral border. Concentric striations weak but distinct. Ears subequal, anterior one being somewhat wavy and with weak but distinct byssal notch. Hinge line wing-like. Left valve flat, ornamented with 11-12 round-topped, radial ribs and a few interstitial riblets: interstices broader than ribs at the upper half of the disc; on the other hand, near the ventral side interstices as wide as ribs.

The measurements of the selected specimens are shown in Table 3 (in mm).

Remarks:—This species is characterized by the rather thin, large shell which is provided with 11-15 rounded, straight, radial ribs. The ribs become obsolete at the ventral and the lateral margins, and are much broader than the interstices. The present species, as was pointed out by T. SHUTO (1955), has variable characters. Above all, the shell outline varies from orthocline to prothocline through orthocline and from .33 to .62 in Inequilarity.

Amussipecten hyugaensis SHUTO is synonymous with this species.

A. praesignis (YOKOYAMA) is closely allied to the present species, but the latter has less numerous, rounded, radial

* Inequility:—This term is proposed by the writer to express a degree of an inequilateral shell. We draw a perpendicular from the beak to length-line ab, where the point a is at the anterior, and call a point of intersection c. Here, ac/L is defined as "Inequility".
ribs which never split into riblets and the interstices are much narrower.

_A. planicostulatum_ (Nomura and Nino) is also allied to the present species, but the latter has less numerous ribs which never split into riblets.

**Geological significance:**—T. Shuto has stated that "_A. hyugaensis_" occurs from the lower part of the Miyazaki group in south-east Kyushu, while _A. praesignis_ is found from the upper horizon of the Takanabe member. Considering the above mentioned facts and the morphological relationship of these two species, it may be suggested that _A. praesignis_ is derived from _A. iitomiensis_ (_A. hyugaensis_). If this is true, the Shizukawa sandstone (Otuka 1955) in Yamanashi Prefecture which yields _A. iitomiensis_ may be Upper Miocene in age. Unfortunately, the writer has had no chance to examine _A. praesignis_ (?) reported from the Sagara formation, but in the future, he wishes to collect and study those specimens and to clarify the phylogenetic relationship between _A. praesignis_ and _A. iitomiensis_.

Y. Otuka (1938) stated that the fauna occurring in association with _A. praesignis_ and _Venericardia panda_ (Yokoyama) is characteristic in the Lower Pliocene deposits along the Pacific coast of Japan. The genus _Amusiapecten_ therefore is to be considered to have valuable stratigraphic significance.

**Localities and horizon.**—Osozawa and near Kannon-bashi in Nakatomi-machi and Oharazima in Minobu-machi, Minamikoma-gun, Yamanashi Prefecture; Shizukawa sandstone.


**Distribution:**—Lower part of the Miyazaki group.

**Literature Cited**


* The specimen recorded by S. Nomura and H. Nino from the Nawachi gold mine, Izu Peninsula may be assigned to this species, considering that it has less numerous ribs.

**Explanation of Plate 7**

Fig. 1. _Amusiapecten iitomiensis_ (Otuka). Reg. No. 5318. Left valve. ×2/3, Loc. Osozawa, Nakatomi-machi, Minamikoma-gun, Yamanashi Prefecture.

Fig. 2. _Amusiapecten planicostulatum_ (Nomura and Nino). Reg. No. 5400. Right valve. ×1/2, Loc. Abuzuri, Zushi City, Kanagawa Prefecture.

Fig. 3. _Amusiapecten planicostulatum_ (Nomura and Nino). Reg. No. 5399. Right valve. ×1/2, Loc. Same as above.

Fig. 4. _Amusiapecten planicostulatum_ (Nomura and Nino). Reg. No. 5396. Left valve. ×1, Loc. Same as above.

Fig. 5. _Amusiapecten praesignis_ (Yokoyama), Reg. No. 5391. Right valve. ×1/2, Loc. In the tunnel near Nishiyama, Haranoya-mura, Ogasa-gun, Shizuoka Prefecture.

Fig. 6. _Amusiapecten praesignis_ (Yokoyama), Reg. No. 5392. Right valve. ×1/2, Loc. Same as above.
Amussiopecten iitomiensis (Otuka) and Its Allies from Japan


