

Pharmacognostical Studies on the Molluscan Drugs (XIII)¹⁾
Original Bivalves of "Walengzi (瓦楞子)" on Hong Kong Market²⁾TOSHIYUKI HAMADA,^a NOBUYOSHI MURAKAMI,^a SHINYU NUNOME^b and TSUNEO NAMBA^{b,*}^aFaculty of Pharmaceutical Sciences, Kumamoto University,^bResearch Institute for Wakan-yaku, Toyama Medical and Pharmaceutical University

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The commercial samples of "Walengzi (瓦楞子)" on Hong Kong market were investigated morphologically (figures, size, number of the ribs, state of periostracum, cross section) and chemically (amino acid residues contained in those shells).

They were identified as the shells of four species of the ark shells (1-4, Arcidae) and two of the cockle shells (5, 6, Cardiidae) as follows:

(1) *Anadara maculosa* (REEVE), (2) *Potiarca pilula* (REEVE), (3) *Scapharca globosa* (REEVE), (4) *Tegillarca nodifera* (MARTENS), (5) *Maoricardium mansitii* (OTUKA), (6) *Vepricardium sinense* (SOWERBY).

Shells of the examined samples did not contain larger amount of the acidic amino acids which were contained a large amount in the shells of cowries and ear shells. Amino acid contents of the ark and cockle shells were similar to each other.

A key to these species with some related species of the family Arcidae such as *Scapharca broughtonii* (SCHRENCK), *S. globosa ursus* TANAKA, *S. subcrenata* (LISCHKE) and *Tegillarca granosa* (L.) were given.

Keywords—"Walengzi"; ark shell; cockle shell; Arcidae; Cardiidae; shell structure; analysis of amino acids

"Walengzi (瓦楞子)," also called "Kuige (魁蛤)" and "Han (蚶)," has been described in old and modern Chinese and Japanese literatures. The historical and herbolological studies on them were reported in the previous paper.³⁾ The investigation on the commercial drugs on Taiwan market was also reported in the same paper. Among the commercial drugs of "Walengzi" on Hong Kong market, were found several bivalves which have not been described as the drugs in any literatures. Those commercial samples were investigated and identified by the morphological characteristics and examined the amino acids contents of the shells with few related specimens.

Experimental

I. Materials

1) Commercial samples on Hong Kong market

"Walengzi" A, B, C, D, E and F: Tochimoto-tenkaidō, September 1981.

2) Fresh samples

(a) Ark shells

Anadara maculosa (REEVE), collected in Amami-ōshima, Japan.

Potiarca pilula (REEVE), collected in Philippine.

Scapharca broughtonii (REEVE), collected in Chiba Prefecture, Japan and Pusan, Korea.

S. globosa (REEVE), collected in Indonesia.

S. globosa ursus TANAKA, collected in Ariake Sea, Japan.

S. subcrenata (LISCHKE), collected in Ariake Sea, Japan and Pusan, Korea.

Tegillarca granosa (L.), collected in Ariake Sea, Japan, Pusan, Korea and Taipei, Formosa.

T. nodifera (MARTENS), collected in Philippine and Penang island, Malaysia.

(b) Cockle shells

Maoricardium mansitii (OTUKA), collected in Formosa.

II. Identification of the commercial samples

A: Large-sized shells with many serial teeth on a straight hinge line. Thick, inflated, rather rectangular shells of 60–75, 45–56 and 38–51 mm in length, height and width respectively. 36–38 radial ribs with 2–4 fine stripes on the surface of them. White with brown velvety periostracum (most of them were taken off). These characteristics identified these shells as *Anadara maculosa* (REEVE),^{4a,5a,6a} Arcidae.

B: Medium-sized shells with many serial teeth on a straight hinge line. Rather thin, very inflated, rectangular shells of 48–57, 41–45 and 36–38 mm. 34–35 radial ribs. White with black hairy periostracum (most of them were taken off). These characteristics identified these shells as *Scapharca globosa* (REEVE),^{4a,6b} Arcidae.

C: Only one piece of small-sized shell of many serial teeth on a straight hinge line. Thick, very inflated, elliptical shells with 34, 23 and 22 mm. 20 radial ribs with many rough tubercles. White with brown smooth and scaly periostracum (most of them were taken off). These characteristics identified this shell as *Tegillarca nodifera* (MARTENS),^{4b,5b,6c} Arcidae.

D: Two pieces of small-sized shells of many serial teeth on a straight hinge line. Very thick, inflated, oval shells with 22–25, 23.5–26 and 22–24 mm. 25 radial ribs with many tubercles. White with brown smooth and scaly periostracum (most of them were taken off). These characteristics identified these shells as *Potiarca pilula* (REEVE)^{4a,5b,6d} Arcidae.

E: Two pieces of medium-sized shells with two cardinal teeth. Thick, inflated, oval shells with 38, 35 and 27 mm. Very strong 20 radial ribs. White with whitish yellow periostracum, especially spinous on the anterior

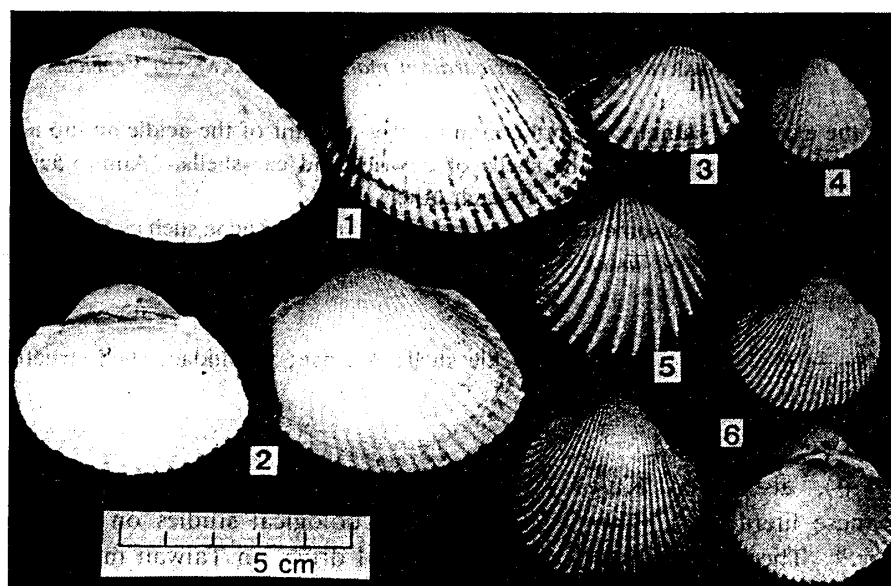


Plate I. Commercial Samples of "Wanlengzi" on Hong Kong Market

1, *Anadara maculosa*; 2, *Scapharca globosa*; 3, *Tegillarca nodifera*; 4, *Potiarca pilula*; 5, *Vepricardium sinense*; 6, *Maoricardium mansitii*.

TABLE I. Species of the Commercial Samples and Their Related Shells

Family Arcidae	フネガイ科
<i>Anadara maculosa</i> (REEVE)	リュウキュウサルボウガイ*
<i>Potiarca pilula</i> (REEVE)	タマサルボウガイ*
<i>Scapharca broughtonii</i> (SCHRENCK)	アカガイ
<i>S. globosa</i> (REEVE)	ホンクマサルボウガイ*
<i>S. globosa ursus</i> TANAKA	クマサルボウガイ
<i>S. subcrenata</i> (LISCHKE)	サルボウガイ
<i>Tegillarca granosa</i> (L.)	ハイガイ**
<i>T. nodifera</i> (MARTENS)	ホソスジハイガイ*
Family Cardiidae	マンシチザルガイ科
<i>Maoricardium mansitii</i> (OTUKA)	マンシチザルガイ*
<i>Vepricardium sinense</i> (SOWERBY)	シナザルガイ*

*: commercial samples, **: on Taiwan market.

and posterior ribs. These characteristics identified these shells as *Vepricardium sinense* (SOWERBY),^{4c,5c,6e} Cardiidae.

F: Medium-sized shells with two cardinal teeth. Thin, inflated, oval shells with 42, 41 and 35 mm. Strong 38–40 radial ribs. Creamy with pale purple at the anterior and posterior parts of inside, covered with yellow periostracum, especially spinous on the anterior and posterior ribs. These characteristics identified these shells as *Maoricardium mansitii* (OTUKA),^{4c,5c,6f} Cardiidae.

There were four ark shells and two cockle shells on Hong Kong market. Commercial samples were shown in Plate I. The related ark shells, *Scapharca broughtonii* (SCHRENCK),^{4a,5a} *S. globosa ursus* TANAKA,^{4a,5d} *S. subcrenata* (LISCHKE)^{4a,5d} and *Tegillarca granosa* (L.)^{4b,5b} were added to the commercial samples as the comparative materials and all of them were given in TABLE I.

III. Structures of the shells

1) Morphological structures of the whole shells

Length (L), height (H) and width of each species were examined and compared the rate of L/H. Colour and state of periostracum were observed. The numbers of the ribs of each shells were calculated. These characteristics of ten species were given in TABLE II. The state of the ribs with periostracum were shown in Plate II.

2) Cross section

Eight ark shells and two cockle shells in TABLE I were used and their cross sections were examined. Shells were grinded with the glass-grinder at the longest line of the shells paralleled to the straight hinge line and in the same situation of the cockle shells. The specimens were put horizontal and measured the thickness of the central part of the shell, height and width of the rib, and width of the furrow. The shape of the rib of each shell was examined. These characteristics of the cross sections were given in TABLE II. The figures of the cross sections were shown in Plate III.

3) Amino acid analysis

Shells of nine species in TABLE I were subjected to amino acid analysis. The assay specimens were carefully cleaned, then prepared following method reported previously⁷⁾ and the analysis was performed with KLB 4400 in the usual method.

These bivalves belonging to two families were found not to contain a large amount of acidic amino acids which were observed in the shells of cowries and ear shells. Proline, Glycine and Leucine were contained larger than other amino acids.

The results of the amino acid analysis of nine species were given in TABLE III.

IV. Key to the species of "Walengzi" and their related bivalves

A Key to these species was given as follows:

TABLE II. Characteristics of the Shells of "Walengzi" and Their Related Species

Species	Whole shell							Cross section						
	teeth	L	H	W	L/H	periostracum	rib	rib's shape	a	b	c	d	a/b	c/d
<i>Anadara maculosa</i>	serial	85	53	55	1.6	dark brown velvety	37	low, rectangular	2.3	0.6	2.0	1.0	3.8	2
<i>Potiarca pilula</i>	serial	22	24	22	0.9	brown smooth and scaly	25	low, flat	0.9	0.2	0.7	1.0	4.5	0.7
<i>Scapharca broughtonii</i>	serial	120	90	75	1.3	black velvety	42	low, flat	2.0	0.6	2.3	1.2	3.3	1.9
<i>S. globosa</i>	serial	60	46	40	1.3	black velvety	35	low, flat	1.0	0.3	1.2	0.9	3.3	1.3
<i>S. globosa ursus</i>	serial	90	80	75	1.1	black velvety	34	low, flat	2.3	0.5	2.0	1.6	4.6	1.3
<i>S. subcrenata</i>	serial	75	55	50	1.4	black velvety	32	low, flat	1.6	0.3	1.3	1.1	5.3	1.2
<i>Tegillarca granosa</i>	serial	50	40	35	1.2	brownish yellow smooth	19	triangular	1.8	1.2	1.9	1.4	1.5	1.4
<i>T. nodifera</i>	serial	33	23	21	1.4	brown smooth and scaly	20	wavy	1.0	0.6	1.5	0.9	1.7	1.7
<i>Maoricardium mansitii</i>	cardinal	42	41	35	1.0	yellowish spinous on rib	41	triangular	0.8	0.5	1.0	0.5	1.6	2
<i>Vepricardium sinense</i>	cardinal	38	35	27	1.1	yellowish spinous on rib	21	pentagonal	1.0	1.6	2.1	1.2	0.6	1.8

L: length, H: height, W: width (mm), a: thickness of shell, b: height of rib, c: width of rib, d: width of furrow (mm).

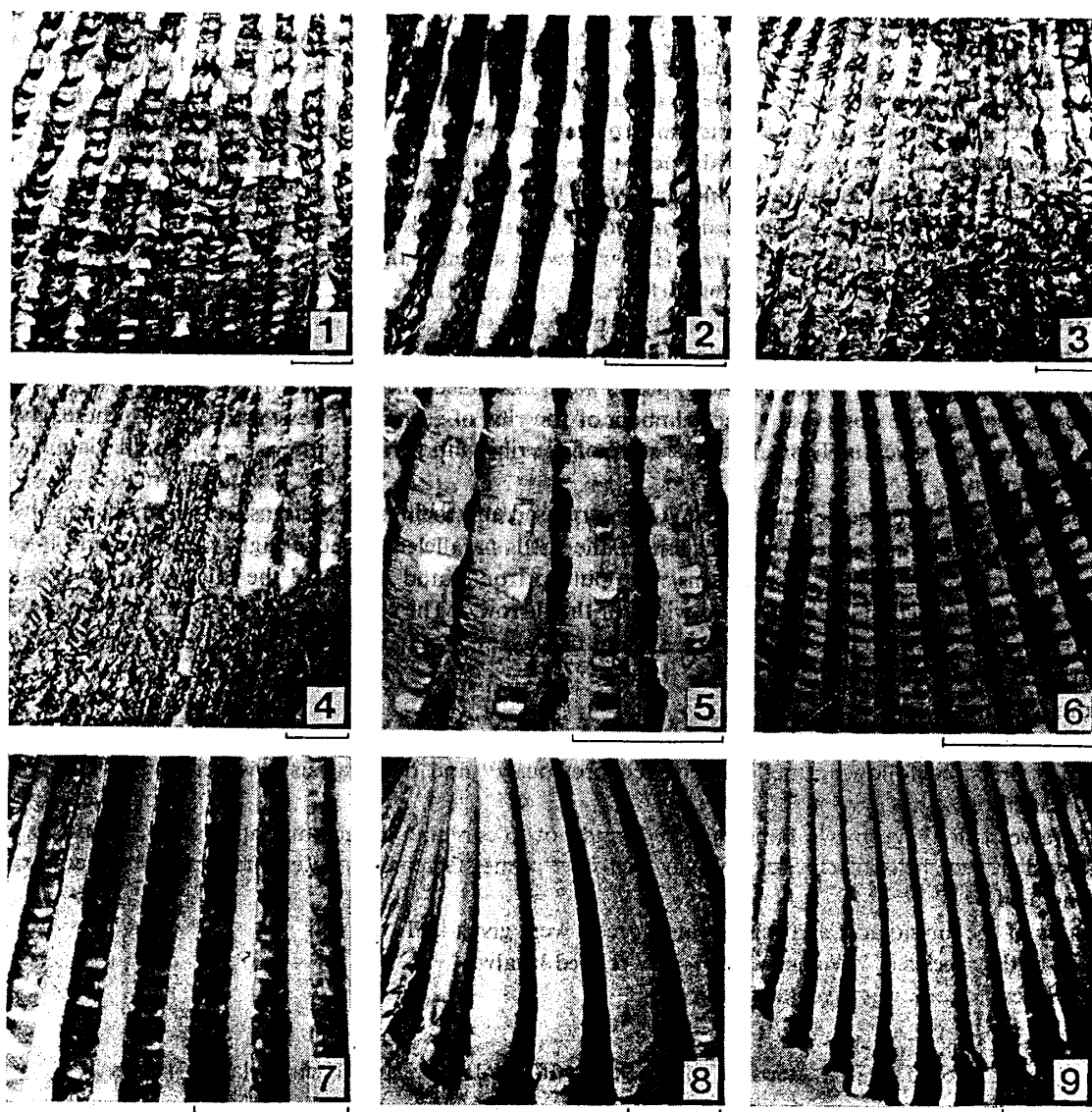


Plate II. State of the Ribs with Periostracum of the Shells of "Walengzi"

1, *Scapharca broughtonii*, collected in Chiba Prefecture; 2, *S. subcrenata*, coll. in Pusan; 3, *S. globosa ursus*, coll. in Ariake Sea; 4, *Anadara maculosa*, coll. in Amami-ōshima; 5, *Tegillarca granosa*, coll. in Ariake Sea; 6, *T. nodifera*, coll. in Philippine; 8, *Vepricardium sinense*, commercial sample; 9, *Maoricardium mansitii*, commercial sample; each scale shows 5 mm long.

- A Shell with serial teeth.
 - B Shell is almost oval, 25 ribs *Potiarca pilula*
 - B Shell is rather rectangular, especially with a straight hinge line of teeth.
 - C More than 30 ribs, periostracum is velvety and thick.
 - D 2-4 fine stripes on the ribs, 37 ribs *Anadara maculosa*
 - D No stripes on the ribs.
 - E 42 ribs, shell is large (10-12 cm) *Scapharca broughtonii*
 - E 32 ribs, shell is small (5-7 cm) *S. subcrenata*
 - E 34-35 ribs, shell is more inflated.
 - F Teeth are thick, distributed in South-east Asia *S. globosa*
 - F Teeth are slightly rough, distributed in south area of Japan *S. globosa ursus*
 - C 19-20 ribs, periostracum is smooth or scaly.
 - D Shell elongate, 19 ribs with apparent tubercles, shape of cross section of the rib is triangular *Tegillarca granosa*
 - D Shell more elongate, 20 smooth ribs, shape of cross section of the rib is wavy *T. nodifera*

TABLE III. Amino Acid Composition of "Walengzi" ($\mu\text{mol/g}$)

Amino acid	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 9	No. 10
Aspartic acid	2.97	0.88	2.42	2.67	0.73	4.55	0.64	1.42	3.73	2.92
Threonine	0.83	0.86	0.27	0.82	1.37	2.80	0.36	0.56	0.39	0.81
Serine	2.95	1.59	3.41	3.04	4.32	5.80	1.80	4.15	1.99	2.37
Glutamic acid	0.73	0.44	2.23	0.62	1.62	5.28	0.92	3.46	3.88	1.34
Proline	3.89	3.10	0.41	3.46	2.01	3.80	3.89	3.05	5.33	2.42
Glycine	4.03	2.28	3.47	2.88	4.11	7.12	1.67	7.45	5.17	2.33
Alanine	0.70	1.53	2.41	1.61	1.46	1.73	1.09	4.30	1.26	0.95
Cystine	0.31	1.26	0.10	0.56	0.60	0.83	0.65	0.88	0.86	0.43
Valine	0.46	trace	trace	0.21	trace	trace	trace	trace	trace	trace
Methionine	trace	trace	trace	trace	trace	trace	trace	trace	trace	0.40
Isoleucine	1.42	1.13	1.06	2.21	1.15	2.29	1.03	1.20	2.13	0.94
Leucine	2.04	2.95	1.78	2.30	1.64	3.40	1.26	2.18	4.72	1.42
Tyrosine	trace	trace	1.43	trace	trace	trace	0.25	trace	trace	trace
Phenylalanine	1.29	2.12	1.01	0.95	0.96	1.95	0.90	1.27	2.36	1.17
Histidine	0.29	0.47	0.32	1.07	0.83	0.98	3.48	0.89	1.13	trace
Lysine	1.80	0.78	1.43	1.19	0.99	3.43	0.56	0.48	3.80	1.75
Arginine	0.78	0.53	1.26	0.60	1.67	2.31	0.89	0.52	1.61	0.71

No. 1: *Anadara maculosa*, 2: *Scapharca broughtonii*, 3: *S. globosa*, 4: *S. globosa ursus*, 5: *S. subcrenata*, 6, 7: *Tegillarca granosa* (7: commercial sample), 8: *T. nodifera*, 9: *Maoricardium mansitii*, 10: *Vepricardium sinense*.

A Shell with two cardinal teeth.

B 40 ribs, shape of cross section of the rib is triangular..... *Maoricardium mansitii*

B 20 ribs, shape of cross section of the rib is pentagonal..... *Vepricardium sinense*

Discussion

According to the old description of "Walengzi," those shells have the ribs on the surface. Many species belonging to the genera *Anadara*, *Scapharca*, *Potiarca* and *Tegillarca* have apparent ribs and they look like a tiled roof. Because some species of *Maoricardium* and *Vepricardium* have the same appearance, they are used in the commercial samples of "Walengzi."

Amino acid analysis did not show the different contents between the shells of Arcidae and Cardiidae.

There found four new species of Arcidae and two of Cardiidae in the commercial samples on Hong Kong market. As the result of this investigation, *Anadara maculosa*, *Potiarca pilula*, *Scapharca globosa*, *Tegillarca nodifera*, *Maoricardium mansitii* and *Vepricardium sinense* were recognized as the origins of "Walengzi."

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References and Notes

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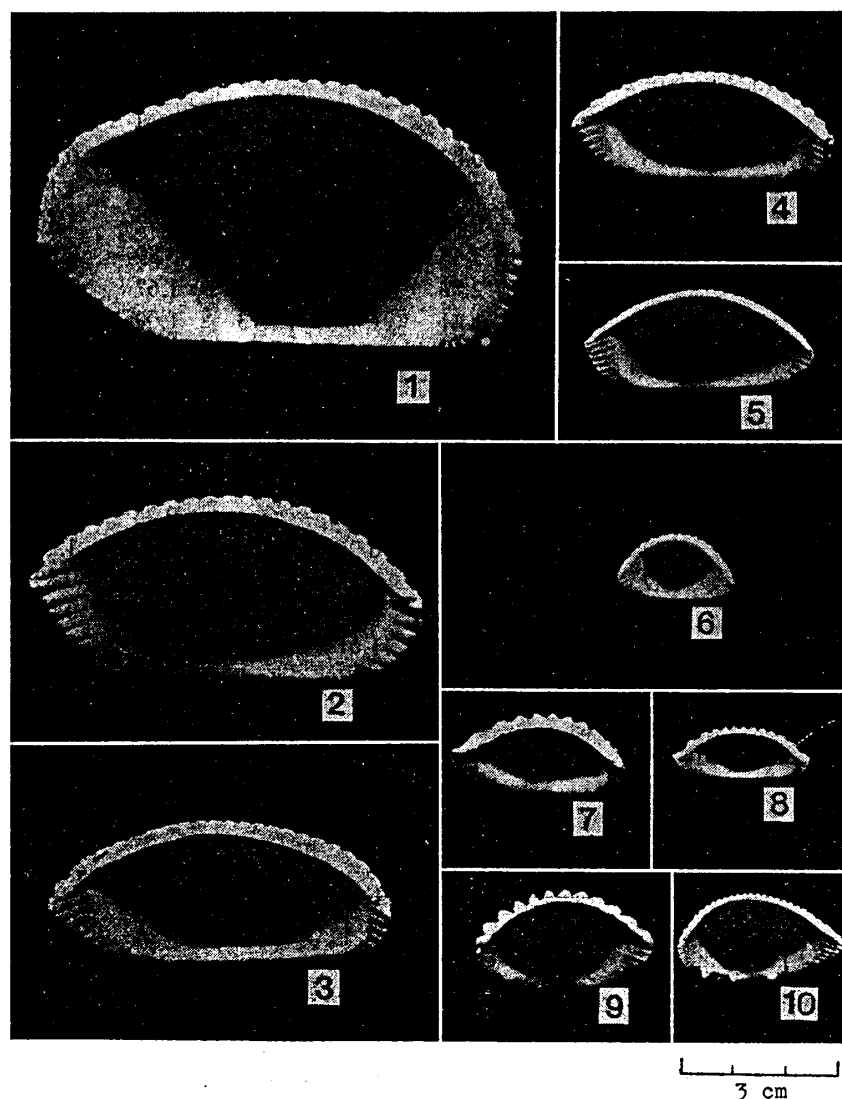


Plate III. Cross Sections of the Shells of "Walengzi"

1, *Scapharca broughtonii*, colld. in Chiba Prefecture; 2, *S. globosa ursus*, colld. in Ariake Sea; 3, *Anadara maculosa*, commercial sample; 4, *Scapharca subcrenata*, colld. in Pusan; 5, *S. globosa*, commercial sample; 6, *Potiarca pilula*, commercial sample; 7, *Tegillarca granosa*, colld. in Taipei; 8, *T. nodifera*, colld. in Philippine; 9, *Vepricardium sinense*, commercial sample; 10, *Maoricardium mansitii*, commercial sample.

fig. 5; e) *ibid.*, p. 153, pl. 59, fig. 5; f) *ibid.*, p. 152, pl. 58, fig. 6.

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