

Contributions

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***PSEUDOATRYPA KESLINGI*, A NEW MIDDLE DEVONIAN BRACHIOPOD FROM THE LONG LAKE LIMESTONE, ALPENA COUNTY, MICHIGAN, U.S.A.**

BY

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Abstract — A new species, *Pseudoatrypa keslingi*, is described from the Middle Devonian Genshaw Member of the Long Lake Limestone, in Alpena County, Michigan. An abundant species in the Genshaw Member and Ferron Point Formation, *P. keslingi* was originally illustrated in Ehlers and Kesling (1970) as *Atrypa* sp., but never formally named. A holotype and three paratypes are designated herein, and a complete description of the new species is given, based on 273 measured specimens from both the taxonomic collection and three stratigraphic collections in the University of Michigan Museum of Paleontology.

INTRODUCTION

Pseudoatrypa keslingi n. sp., was originally named and illustrated by Ehlers and Kesling (1970, p. 51, pl. 18, figs. 1-8) as *Atrypa* sp. from the Middle Devonian Genshaw Formation (now considered the lower member of the Long Lake Limestone). It has also been recovered from the Middle Devonian Ferron Point Formation.

Despite its abundance, this species has never been formally described and named. In fact, the well-preserved, abundant, and diverse brachiopod faunas from the Traverse Group of Michigan are in need of restudy and revision. Interestingly, *Pseudoatrypa keslingi* n. sp. is one of the most abundant species in both the Genshaw Member and Ferron Point Formation brachiopod assemblages, and because of this, we are formally naming it herein.

Middle Devonian brachiopod faunas are both abundant and diverse and have been described from many localities in the North American craton. Among those pertinent to this study are those reported by Stumm (1951, 1961), Imbrie (1959), and Ehlers and Kesling (1970) from Michigan; Kesling and Chilman (1975) from the Silica Shale of Ohio; Fenton and Fenton (1930,

1932, 1935), Stainbrook (1938), Day (1989, 1992, 1994), Day and Koch (1994), and others from Iowa; and Stumm and Wright (1958) from Ontario, Canada.

A reexamination of the Middle Devonian brachiopod faunas from Michigan is needed, but this paper is only concerned with the formal taxonomic treatment of *Pseudoatrypa keslingi*, n. sp., an abundant member of the diverse brachiopod fauna from the Genshaw Member of the Long Lake Limestone and Ferron Point Formation.

LOCATION AND STRATIGRAPHY

The outcrop nomenclature for the Traverse Group of Michigan consists of six formations, all of which are Middle Devonian in age (= Erian of North American terminology; Catocsinos et al., 2001; Figure 1).

The Genshaw Formation, from which *Pseudoatrypa keslingi* n. sp. was originally illustrated (as *Atrypa* sp.; Ehlers and Kesling, 1970, p. 51, pl. 18, figs. 1-8), was first named by Warthin and Cooper (1935, p. 526) for exposures near Genshaw School, Alpena County, Michigan. Warthin and Cooper (1935, p. 583) revised their definition of the Genshaw Formation to include the strata between the underlying Ferron Point Formation and the base of the overlying Newton Creek Formation (now considered to be the basal member of the Alpena Limestone). According

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System	Series	North Am. Stage	Group	Formation	Member
Devonian	Middle	Erian	Traverse	Thunder Bay Formation	Partridge Point Member
					Potter Farm Member
					Norway Point Member
				Alpena Limestone	Four Mile Dam Member
					Newton Creek Member
				Long Lake Limestone	Killians Member
					Genshaw Member
				Ferron Point Formation	
				Rockport Quarry Ls.	
				Bell Shale	

FIGURE 1 — Stratigraphy of the Middle Devonian (Erian) Traverse Group of Michigan (Catacosinos et al., 2001).

to Catacosinos et al. (2001, p. 26), the Genshaw is now considered to be the lower of two members of the Long Lake Limestone, conformably overlying the Ferron Point Formation and conformably underlying the Killians Member of the Long Lake Limestone (Figure 1).

Two specimens of *Pseudoatrypa keslingi* n. sp. were illustrated by Ehlers and Kesling (1970). These are housed in the University of Michigan Museum of Paleontology (UMMP) Type and Figured collection. One was published as *Atrypa* sp., UMMP 57602 (accession number 1950/D-1, pl. 18, figs. 1-5); and the other was UMMP 57598 (accession number 1960/D-18, pl. 18, figs. 6-8). The museum label attached to specimen UMMP 57602 is as follows: "*Atrypa* sp., Middle Devonian, Traverse Gp., Lower Genshaw Fm. Ditch along new Long Lake Rd. about 1/3 to 1/2 mi. NW. of Hwy. 23, Alpena County, Michigan. Coll: G. M. Ehlers, R. V. Kesling, P. Kier. Id: R. V. Kesling;" whereas the label for specimen UMMP 57598 states: "*Atrypa* sp., Middle Devonian, Traverse Gp., Genshaw Fm. Ditches beside Co. Hwy. 634, about 1/3 mi. N. of boundary between Alpena & Presque Isle Co., Mich. Coll: G. M. Ehlers & E. Driscoll 1962, Id: R. V. Kesling."

The University of Michigan Museum of Paleontology contains both taxonomic and stratigraphic collections. In addition to the two specimens from the taxonomic collection, we examined three stratigraphic collections from the Genshaw Formation that contain *Pseudoatrypa keslingi* n. sp., from which we measured 271 specimens (Appendix 1).

The collections examined, by accession number, are 1934/D-9, 1950/D-1, and 1957/D-21, described as follows.

1934/D-9.— Collection 1934/D-9 is from the "Genshaw" and was found in "Ditches beside road at southern tip of Long Lake, Alpena County, NE 1/4, Sec. 22, T. 32N., R. 8E. Coll.: Expedition of 1934. Aug. 15, 1934." A total of 136 specimens

in two boxes are present in this collection, and 118 specimens were measured. The 18 unmeasured specimens were incomplete, crushed, or covered with extraneous sediment, rendering accurate measurement impossible.

1950/D-1.— Collection 1950/D-1 is from the "M. Devonian (Traverse Gr. – Genshaw Fm. – lower part)" and was found in "Ditch along new Long Lake road in NE 1/4, Sec. 22, T. 32N., R. 8E., about 1/3 to 1/2 mi. NW of U.S. Hwy. 23, Alpena Co., Mich. Coll.: G. M. Ehlers, R. V. Kesling, and P. Kier. Aug. 8, 1950." A total of 114 specimens in two boxes are present in this collection, and 94 specimens were measured. The 20 unmeasured specimens were incomplete, crushed, or covered with extraneous sediment, rendering accurate measurement impossible.

1957/D-21.— Collection 1957/D-1 is from the "M. Devonian (Traverse Gr. – Genshaw Fm. – lower part)" and was found in "Ditch along old Long Lake Road in NE 1/4, Sec. 22, T. 32N., R. 8E., about 1/2 mi. NW of U.S. 23, Alpena Co., Mich. Coll.: Mr. and Mrs. G. M. Ehlers. Aug. 14, 1957." A total of 67 specimens from this collection were examined, and 59 specimens were measured. The eight unmeasured specimens were incomplete, crushed, or covered with extraneous sediment, rendering accurate measurement impossible.

Based on the locality and stratigraphic information attached to the two specimens of *Atrypa* sp. illustrated in Ehlers and Kesling (1970), it seems reasonable to conclude that they come from locality 32-8-22 NE (Ehlers and Kesling, 1970, p. 12; Figure 2). This locality is described as "Ditches along county road 634 (Long Lake Road) south of Long Lake, near junction with US 23, Alpena County. Long Lake Road was changed about 1950, but both old and new sections have roadside exposures. Survey Loc. 58. Genshaw, *Sieberella romingeri* zone." The 32-8-22 NE designation corresponds to "number of the Township North, number of the Range East, number of the section, and letters for the part of the section (as close as possible to the actual site)" (Ehlers and Kesling, 1970, p. 3). Thus, the two illustrated specimens, as well as the specimens from the three stratigraphic collections, are all from the same locality (although they might be from different ditches within the locality) as locality 32-8-22 NE in Ehlers and Kesling (1970; Figure 2).

The Genshaw Formation, as described by Ehlers and Kesling (1970, p. 63), consists of 15 units, in which "Units 1-6 are exposed in the shale pit at Locality 32-9-18 SE; units 5-10 exposed along Long Lake Road at Locality 32-8-22 NE; units 8-13 exposed along French Road at Locality 32-8-8 E; and units 13-15 exposed in the quarry at 31-8-13 W." Units 5-10 (Locality 32-8-22 NE) comprise the upper half of the lower part of the Genshaw Formation, with the fauna from unit 7 described as "fauna dominated by large *Atrypa*, *Sieberella romingeri*, *Billingsastrea pauciseptata*, *B. romingeri*, *Schizophoria striatula traversensis*, *Hexagonaria* sp., and *Clathrodictyon* cf. *retiforme*." Specifically, the two taxonomic specimens and the specimens from the three stratigraphic collections are all from units 5-10 of the Genshaw Formation, Locality 32-8-22 NE, of Ehlers and Kesling (1970), and most likely from unit 7 specifically.

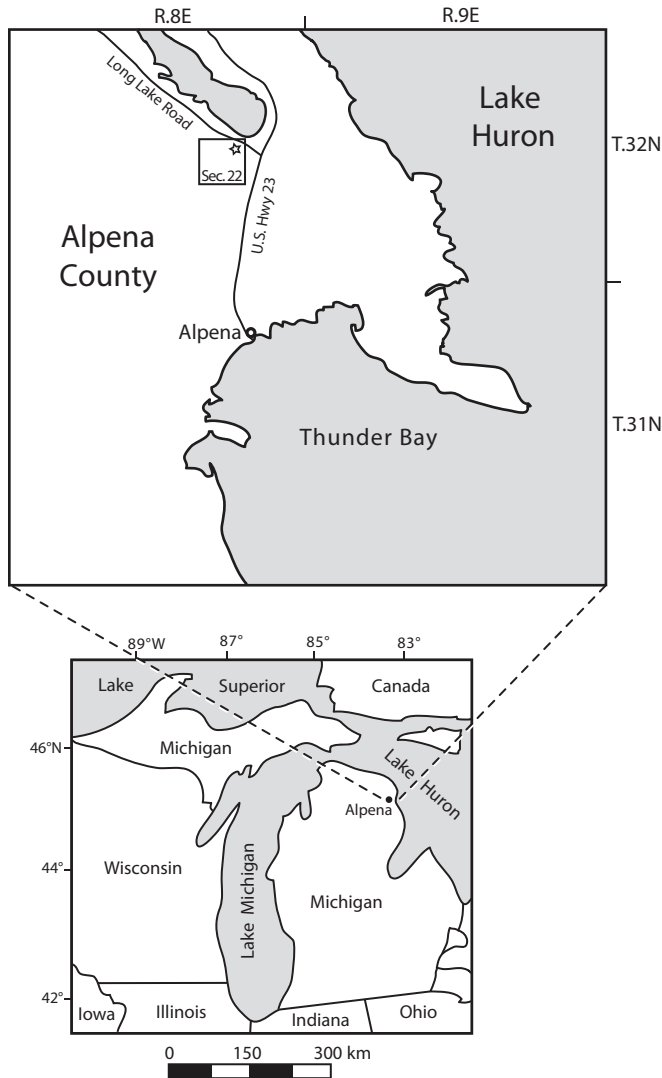


FIGURE 2 — Map showing the general location (star) of University of Michigan Museum of Paleontology taxonomic collection specimen UMMP 57602, accession number 1950/D-1, and University of Michigan Museum of Paleontology stratigraphic collections 1934/D-9, 1950/D-1, and 1957/D-21. These collections are the same as Locality 32-8-22 NE of Ehlers and Kesling (1970). Michigan base map modified from Wicander and Playford (2008). Placement of Locality 32-8-22 NE modified from Ehlers and Kesling (1970).

SYSTEMATIC PALEONTOLOGY

The classification and morphologic terminology used herein follows Williams and Brunton (1997), Williams et al. (1997; 2000a, b, c), and Copper (2002).

Phylum BRACHIOPODA Duméril, 1806

- Subphylum RHYNCHONELLIFORMEA Williams, Carlson, Brunton, Holmer, and Popov, 1996
- Class RHYNCHONELLATA Williams, Carlson, Brunton, Holmer, and Popov, 1996
- Order ATRYPIDA Rzhonsnitskaia, 1960
- Suborder ATRYPIDINA Moore, 1952
- Superfamily ATRYPOIDEA Gill, 1871
- Family ATRYPIDAE Gill, 1871
- Subfamily VARIATRYPINAE Copper, 1978
- Genus *Pseudoatrypa* Copper, 1973

Pseudoatrypa, a genus created by Copper (1973, pp. 492-493), is most closely related to *Desquamatia*, from which it evolved. It differs from *Desquamatia* by its more closely spaced growth lamellae, less tubular ribs, a tendency in maturity for a significant reduction in the size of its interarea, pedicle opening, and deltidial plates, and by a more flattened pedicle valve and strongly arched brachial valve. It differs internally from *Desquamatia* by its typically small dental cavities. It is distinguished from *Atrypa* by its tiny interarea and small dental cavities, as well as its lack of deltidial plates.

The geologic range of *Pseudoatrypa* is upper Givetian–Frasnian, and its known geographic distribution is North America, Eurasia, and Australia (Copper, 1973, 2002; Day, 1998; Day and Copper, 1998).

Pseudoatrypa “is most common in Iowa and Michigan where it is locally extremely abundant and can be collected by the bucketful” (Copper, 1973, p. 492). This statement is certainly an accurate reflection of its abundance in the Genshaw Member in Alpena County, Michigan.

Copper (1973, p. 493) also stated that “*Pseudoatrypa* was a soft muddy bottom inhabitant favoring quieter water.” Based on our experience collecting this species, its occurrence in the University of Michigan stratigraphic collections, and its abundance in unit 7 (grey, calcareous, fossiliferous shale) of the lower part of the Genshaw Formation (Ehlers and Kesling, 1970, p. 63), this is a factual observation of the paleoecology of *Pseudoatrypa keslingi* n. sp.

***Pseudoatrypa keslingi* n. sp.**

Figs. 3, 4

Atrypa sp. Ehlers and Kesling, 1970, pp. 50-51, pl. 18, figs. 1-8.

Holotype.— UMMP 57602, accession number 1950/D-1, (Ehlers and Kesling, 1970, pp. 50-51, plate 18, figures 1-5; Figure 4A-D). Shell 33.5 mm long, 32.4 mm wide, 21.1 mm thick. The stratigraphic and collecting information associated with the holotype designated herein is as follows: “*Atrypa* sp., Middle Devonian, Traverse Gp., Lower Genshaw Fm. Ditch along new Long Lake Rd. about 1/3 to 1/2 mi. NW of Hwy. 23, Alpena County, Michigan. Coll: G. M. Ehlers, R. V. Kesling, P. Kier. Id: R. V. Kesling.”

Paratypes.— UMMP 57598, accession number 1960/D-18, (Ehlers and Kesling, 1970, pp. 50-51, plate 18, figures 6-8; Figure 4E-H). Shell 38.8 mm long, 38.7 mm wide, 25.7 mm thick, 47 radial, tubular ribs, evenly spaced growth lamellae (3 mm),

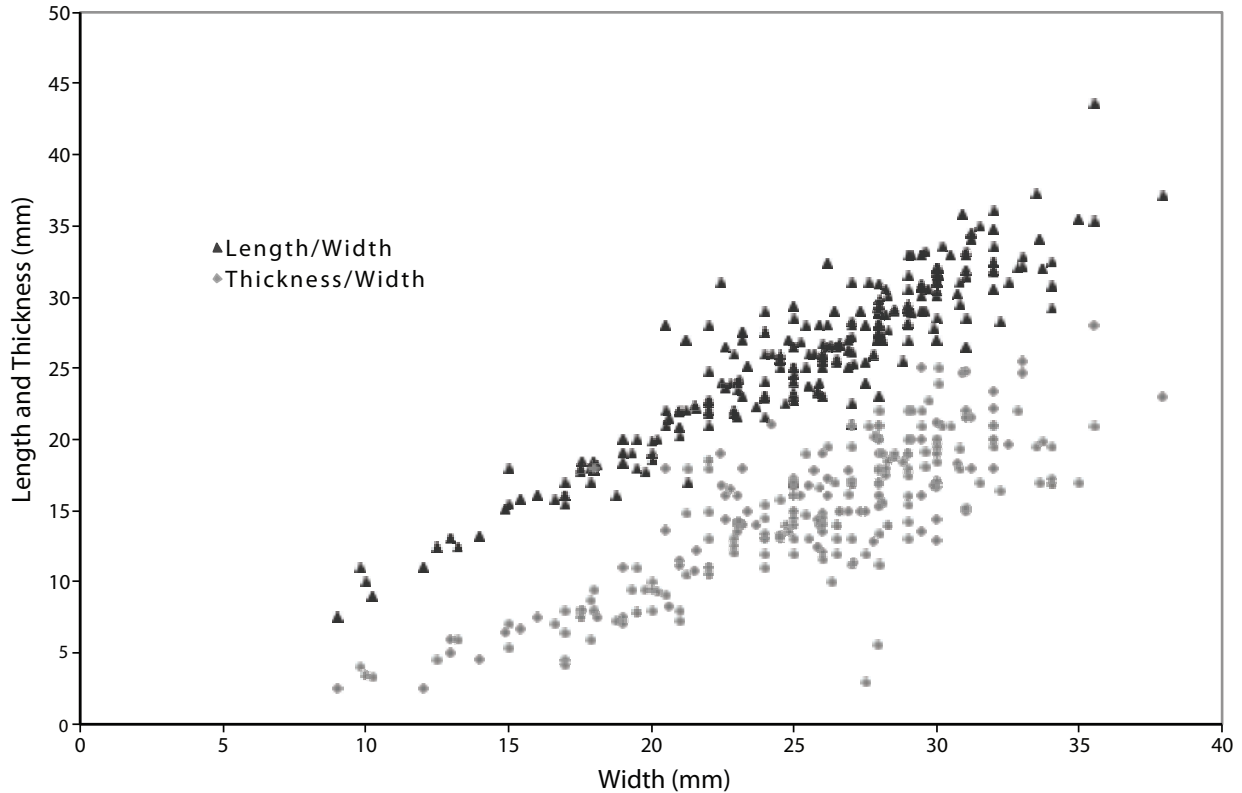


FIGURE 3 — Plot of shell measurements of *Pseudoatrypa keslingi* n. sp. from the Middle Devonian Genshaw Member of the Long Lake Limestone, Michigan. Note that the plot indicates a linear trend of the ratio of shell length versus shell width from juvenile through adult, as well as a linear trend of the ratio of shell thickness to shell width, which is to be expected as the individuals age.

becoming somewhat crowded anteriorly (≤ 1 mm), with very short frills.

The stratigraphic and collecting information associated with this paratype (UMMP 57598, accession number 1960/D-18) is as follows: “*Atrypa* sp., Middle Devonian, Traverse Gp., Genshaw Fm. Ditches beside Co. Hwy. 634, about 1/3 mi. N. of boundary between Alpena & Presque Isle Co., Mich. Coll: G. M. Ehlers & E. Driscoll 1962, Id: R. V. Kesling.”

UMMP 74080 (Figure 4I-L). Shell 32.0 mm long, 31.9 mm wide, 21.2 mm thick, 61 radial, tubular ribs, evenly spaced growth lamellae (2 mm), becoming somewhat crowded anteriorly (< 1 mm). This paratype is from the 1957/D-21 stratigraphic collection, accession number 1957/D-21.

UMMP 74081 (Figure 4M-P). Shell 37.0 mm long, 32.9 mm wide, 21.0 mm thick, 44 radial, tubular ribs, evenly spaced growth lamellae (1-2 mm), becoming somewhat crowded anteriorly (< 1 mm). This paratype is from the 1934/D-9 stratigraphic collection, accession number 1934/D-9.

Diagnosis.— Globose dorsibiconve with hemispherical dome-like dorsal valve. Ventral valve plano to slightly convex and somewhat resupinate anteriorly, inflated near the umbo, and gently sloping anteriorly into a shallow, broad sulcus that is widest and deepest along the anterior shell margin. Outline is subrectangular and widest just slightly anterior to the hingeline. Very narrow ventral interarea. Apical foramen not extending

into ventral umbo region. Commissure weakly plicate. Thirty-nine (39) radial, tubular ribs with evenly-spaced growth lamellae (2.5-3 mm), becoming somewhat crowded anteriorly (≤ 1 mm) with no noticeable frills.

Distribution.— Currently, *P. keslingi* has only been reported in the literature from the Middle Devonian Genshaw Member of the Long Lake Formation of Michigan, but we have also collected it from the Middle Devonian Ferron Point Formation of Michigan.

Etymology.— Named in honor of Dr. Robert V. Kesling, who made major contributions and advancements in the field of Michigan Devonian paleontology.

Description.— Medium to large (25.8 mm long, 25.5 mm wide, 15.0 mm thick, on average). Globose dorsibiconve to convexoplane shell, with hemispherical dome-like dorsal valve. Ventral valve plano to slightly convex, and weakly to distinctly resupinate anteriorly, which is most commonly expressed in adult shells. Ventral valve inflated near the umbo, sloping gently anteriorly into a shallow to distinct sulcus that frequently produces a slight extension of the anterior shell margin in adult shells. Outline is subrounded to subrectangular, with a somewhat extended anterior medial margin in most adult shells. Shells are typically widest at approximately mid-length, with shell length generally exceeding shell width in nearly all growth stages (273 specimens measured). Narrow interarea. Apical-transapical

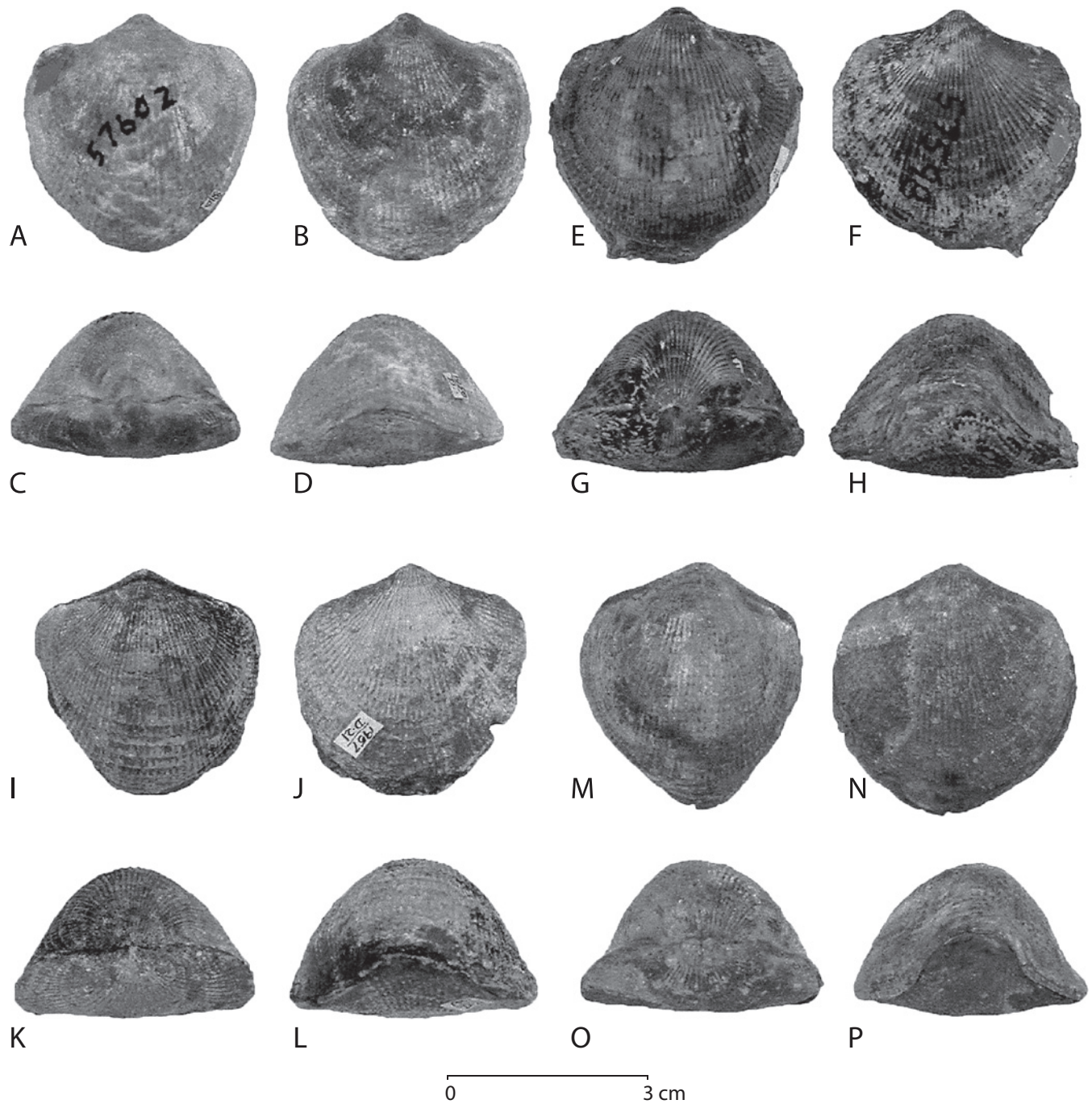


FIGURE 4 — Holotype and paratypes of *Pseudoatrypa keslingi* n. sp. A-D, dorsal, ventral, posterior, and anterior views of holotype UMMP 57602, accession number 1950/D-1, from the UMMP 1950/D-1 taxonomic collection. E-H, dorsal, ventral, posterior, and anterior views of paratype UMMP 57598, accession number 1960/D-18, from the UMMP 1960/D-18 taxonomic collection. I-L, dorsal, ventral, posterior, and anterior views of paratype UMMP 74080, accession number 1957/D-21, from the UMMP 1957/D-21 stratigraphic collection. M-P, dorsal, ventral, posterior, and anterior views of paratype UMMP 74081, accession number 1934/D-9, from the UMMP 1934/D-9 stratigraphic collection.

foramen, frequently slightly expanding into ventral umbo. Small deltidial plates, typically reduced or lost in adult shells. Small, delicate teeth and opposing dental sockets. Commissure is weakly to moderately plicate. Numerous radial, tubular ribs (38 on average), with closely and evenly-spaced growth lamellae, sometimes becoming crowded anteriorly, and with nonexistent to very short frills.

Measurements.— Measurements of shell length, width, thickness, anteriorly developed fold width, and number of ribs are 'high (average) low' for the number of specimens measured. Shell length 7.5 (25.8) 43.6 mm (273 specimens measured). Shell width 9.0 (25.5) 40.0 mm (273 specimens measured). Shell thickness 2.5 (15.0) 28.0 mm (273 specimens measured). Anteriorly developed sulcus width 33.9 (18.2) 4.0 mm (271 specimens measured). Number of ribs (dorsal valve) 16 (38) 66 (244 specimens counted). Figure 3 shows plots of length/width and thickness/width for the 273 measured specimens of *Pseudoatrypa keslingi* n. sp.

Discussion and comparison.— *Pseudoatrypa keslingi* n. sp. is a very abundant and easily recognized brachiopod species from Middle Devonian outcrops in Michigan, and is similar to only two other atrypid species, both of which are common in Iowa.

P. keslingi superficially resembles *Desquamatia (Independatrypa) scutiformis* (Stainbrook, 1938) Day and Copper, 1998, in that it has a medium to large dorsibiconvex shell. However, the shell length (33.5 mm), shell width (32.4 mm), and shell thickness (21.1 mm) of the holotype of *P. keslingi* are greater than the holotype of *D. (I.) scutiformis* (28.3 mm shell length, 29.9 mm shell width, and 15.9 mm shell thickness), as are the shell lengths, shell widths, and shell thicknesses of the three paratypes figured herein (shell length 38.8 mm, 32.0 mm, 37.0 mm; shell width 38.7 mm, 31.9 mm, 32.9 mm; and shell thickness 25.7 mm, 21.2 mm, 21.0 mm) compared to the two figured paratypes (shell length 21.7 mm, 20.4 mm; shell width 23.3 mm, 22.5 mm; and shell thickness 12.1 mm, 11.6 mm) in Stainbrook (1938). Furthermore, the dorsal valve of *P. keslingi* is typically highly inflated and dome-like, and its outline is more subrounded to subrectangular, compared to being shield-shaped in *D. (I.) scutiformis*.

P. keslingi most closely resembles *Pseudoatrypa lineata* (Webster, 1921) Day and Copper, 1998 in terms of shell shape (dorsibiconvex to convexoplane with inflated hemispherical dome-like dorsal valve), shell outline (subrounded to subrectangular), and regularly spaced concentric lamellae. The shell length and shell width measurements are also similar with a range of 8 mm to 44 mm in length and 9 mm to 40 mm in width for *P. keslingi* (Figure 3 and Appendix 1), compared to 9 mm to 37 mm length and 9 mm to 35 mm in width for *P. lineata* (Day, 1992; Day and Copper, 1998). On average, however, *P. keslingi* is slightly larger than *P. lineata*. In addition, *P. keslingi* has finer and less prominent radial ribs, and lacks the distinctive attachment sites of frills seen in the early growth stages of *P. lineata*.

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APPENDIX

Measurements of 271 specimens from the three stratigraphic collections (1934/D-9; 1950/D-1; and 1957/D-21) discussed in this paper. Measurements are: width (maximum shell width), length (maximum shell length), thickness (maximum shell thickness), fold width (width of fold), and ribs (count of number of ribs). All measurements are in mm.

Box no.	Specimen	Width	Length	Thickness	Fold width	Ribs							
							1	41	28.0	29.5	17.8	19.0	40
							1	42	26.6	26.7	15.0	15.1	44
							1	43	21.2	26.9	14.9	19.7	40
Collection 1934/D-9 (118 specimens measured, two boxes)							1	44	32.0	32.5	19.5	23.0	52
1	1	31.0	33.0	21.5	19.0	44	1	45	29.0	28.1	19.0	20.9	38
1	2	35.5	43.6	28.0	24.0	36	1	46	26.0	25.5	11.6	18.0	32
1	3	30.1	32.0	25.0	19.0	40	1	47	28.0	29.0	22.0	19.0	44
1	4	28.0	27.0	13.4	18.0	30	1	48	27.8	25.9	12.8	15.4	34
1	5	29.7	30.5	22.8	20.6	32	1	49	32.2	28.3	16.4	21.6	42
1	6	28.2	28.7	18.0	17.1	30	1	50	25.4	28.0	19.0	18.4	38
1	7	32.0	33.6	21.0	22.0	—	1	51	31.5	35.0	17.0	16.5	50
1	8	26.0	26.0	12.1	16.0	46	1	52	28.0	29.0	16.9	20.0	34
1	9	26.8	24.0	13.0	16.0	—	1	53	28.0	27.0	17.0	18.9	28
1	10	25.0	26.5	15.0	14.0	36	1	54	24.5	25.5	15.8	14.0	32
1	11	26.5	26.5	14.0	16.0	40	1	55	30.0	27.0	14.4	24.0	32
1	12	28.0	28.0	16.0	19.3	40	1	56	28.5	29.0	19.0	18.3	32
1	13	29.0	29.2	20.0	21.0	38	1	57	30.8	29.5	18.0	22.0	40
1	14	29.0	30.6	15.4	24.7	46	1	58	24.0	27.6	15.4	17.3	44
1	15	29.0	31.5	14.2	20.8	36	1	59	24.5	25.0	13.2	17.0	32
1	16	32.0	34.7	22.2	25.0	36	1	60	29.6	33.2	18.1	20.0	30
1	17	33.0	32.8	25.5	26.6	66	1	61	23.1	24.2	14.3	18.0	28
1	18	29.1	33.0	22.0	19.5	36	1	62	22.0	21.8	10.5	13.4	32
1	19	24.0	29.0	13.4	19.0	28	1	63	24.0	25.3	14.5	16.0	—
1	20	28.8	25.5	18.4	21.9	44	1	64	19.8	17.7	9.4	13.0	26
1	21	31.0	28.5	22.0	22.2	—	1	65	25.0	23.2	12.0	17.0	16
1	22	26.9	26.2	17.8	22.1	34	1	66	22.0	22.8	11.0	15.1	32
1	23	28.0	28.9	21.0	20.4	36	1	67	26.3	26.6	10.0	19.1	32
1	24	27.1	25.3	11.4	19.4	38	1	68	26.9	27.0	15.0	19.7	28
1	25	29.9	27.8	16.8	20.2	30							
1	26	26.2	32.3	19.5	17.8	32	2	1	21.0	20.2	8.0	13.9	36
1	27	27.8	26.0	20.2	18.0	36	2	2	10.0	10.0	3.5	7.0	40
1	28	28.1	27.0	19.0	20.3	32	2	3	10.2	9.0	3.3	6.5	30
1	29	25.8	27.0	15.0	16.5	—	2	4	12.9	11.9	4.0	10.0	—
1	30	22.6	23.6	16.0	17.0	32	2	5	12.0	11.3	6.5	11.0	—
1	31	32.0	32.0	21.0	23.0	—	2	6	14.9	15.1	6.5	13.0	46
1	32	27.6	31.0	21.0	20.0	—	2	7	16.6	15.8	7.0	14.5	48
1	33	28.1	27.0	15.6	18.9	32	2	8	19.0	18.3	7.5	16.0	48
1	34	21.0	20.8	11.1	13.8	42	2	9	17.0	16.0	8.0	13.0	36
1	35	26.4	29.0	17.0	18.0	50	2	10	18.0	18.0	8.0	13.8	28
1	36	30.8	31.0	19.4	18.6	40	2	11	20.5	21.0	9.1	13.0	50
1	37	22.0	28.0	18.5	17.2	—	2	12	19.0	20.0	11.0	16.0	28
1	38	27.0	26.1	13.0	19.8	36	2	13	20.0	19.9	9.5	14.5	34
1	39	29.0	28.0	18.0	20.0	32	2	14	20.6	21.4	8.2	16.7	44
1	40	28.0	27.4	15.3	18.2	30	2	15	22.9	21.8	12.1	18.5	32

2	16	23.0	21.5	13.5	17.4	26	1	13	24.0	21.5	13.0	23.0	58	
2	17	20.5	22.0	13.7	16.1	22	1	14	24.0	23.0	12.0	19.0	56	
2	18	22.0	22.0	15.0	15.0	24	1	15	25.5	23.7	13.0	23.5	50	
2	19	23.2	23.0	14.0	18.0	48	1	16	27.0	22.5	17.1	24.0	46	
2	20	33.7	32.0	19.9	24.0	30	1	17	22.5	24.0	16.8	20.0	36	
2	21	23.2	26.9	14.0	19.5	30	1	18	27.0	21.1	16.9	23.7	44	
2	22	27.0	28.0	21.0	23.9	36	1	19	28.3	30.1	18.5	25.7	46	
2	23	28.2	30.6	17.5	18.5	26	1	20	34.0	30.8	19.5	27.0	40	
2	24	29.0	29.5	18.9	19.4	46	1	21	33.5	37.2	19.5	29.5	54	
2	25	30.0	31.1	12.9	21.0	42	1	22	32.0	31.9	20.0	26.3	40	
2	26	25.9	24.0	14.0	21.9	46	1	23	34.5	32.5	26.7	31.0	—	
2	27	27.9	27.0	5.6	19.0	—	1	24	28.0	27.0	17.0	26.0	50	
2	28	25.0	23.9	14.5	18.7	30	1	25	30.2	33.5	21.0	26.0	50	
2	29	25.0	23.0	16.0	19.0	30	1	26	35.5	35.3	21.0	29.5	44	
2	30	23.0	24.0	14.3	17.8	32								
2	31	30.0	31.8	18.4	23.2	42	2	1	29.0	29.2	19.0	21.0	28	
2	32	29.5	29.0	16.0	22.0	38	2	2	22.4	31.0	19.0	18.4	30	
2	33	29.5	33.0	21.0	22.0	44	2	3	29.1	28.9	20.0	18.2	32	
2	34	28.0	29.0	20.0	17.0	40	2	4	27.9	29.2	20.2	18.7	28	
2	35	30.0	32.0	19.0	22.8	44	2	5	24.8	27.0	13.5	16.0	—	
2	36	30.0	32.0	20.0	23.2	40	2	6	30.0	31.0	21.2	23.0	34	
2	37	29.5	30.1	25.0	19.5	38	2	7	30.0	30.4	20.0	17.8	36	
2	38	32.0	31.8	21.0	20.0	24	2	8	23.0	23.4	9.2	14.0	—	
2	39	33.0	32.1	24.7	26.8	52	2	9	22.6	26.5	14.4	16.0	—	
2	40	25.9	28.0	16.7	18.7	46	2	10	24.8	25.0	14.0	17.0	—	
2	41	34.0	32.5	16.9	26.1	32	2	11	28.0	28.2	20.0	16.3	—	
2	42	26.6	26.6	15.0	22.0	28	2	12	25.0	28.5	17.3	16.0	24	
2	43	26.9	25.0	16.2	18.7	46	2	13	25.0	29.4	17.0	21.0	34	
2	44	26.5	25.6	13.0	19.7	42	2	14	25.0	24.1	16.0	20.1	34	
2	45	24.2	26.0	21.1	18.0	40	2	15	25.2	26.8	16.0	20.1	32	
2	46	31.2	34.0	18.0	25.0	34	2	16	29.0	31.4	18.0	22.0	—	
2	47	29.5	30.8	22.0	26.0	42	2	17	40.0	40.3	17.0	25.0	—	
2	48	31.0	31.9	24.8	24.9	34	2	18	29.0	28.0	17.5	22.0	36	
2	49	31.0	33.2	21.5	24.8	50	2	19	25.5	26.0	16.8	23.4	38	
2	50	25.0	24.5	15.0	20.0	46	2	20	27.0	27.2	21.0	21.0	34	
							2	21	27.3	29.0	15.0	17.0	26	
							2	22	24.0	24.3	13.2	16.0	—	
Collection 1950/D-1 (94 specimens measured, two boxes)								2	23	23.7	22.3	14.0	19.4	32
1	1	30.1	31.5	24.0	21.2	47	2	24	32.5	31.0	19.6	22.6	36	
1	2	37.9	37.1	23.0	33.9	48	2	25	28.0	30.9	21.0	20.0	40	
1	3	22.8	24.0	16.5	21.0	56	2	26	27.0	28.3	11.3	21.2	32	
1	4	32.8	32.1	22.0	28.0	60	2	27	32.0	36.0	18.0	22.1	32	
1	5	30.9	35.8	24.7	26.0	52	2	28	29.0	33.0	16.0	17.6	30	
1	6	24.0	26.0	13.0	19.0	—	2	29	28.0	23.0	11.3	19.6	54	
1	7	15.4	15.8	6.7	10.0	52	2	30	30.0	30.1	17.0	18.2	42	
1	8	17.9	17.9	6.0	13.0	40	2	31	23.0	23.0	16.0	16.9	—	
1	9	18.1	18.2	7.5	14.6	32	2	32	27.5	24.0	15.0	19.0	36	
1	10	19.3	19.0	9.5	18.1	32	2	33	24.0	22.9	13.0	14.0	46	
1	11	19.5	20.0	11.0	11.9	40	2	34	25.0	26.5	16.6	17.1	56	
1	12	17.9	17.0	8.7	16.8	42								

2	35	15.0	15.5	5.4	9.9	30	1	13	21.6	22.1	12.2	16.0	36
2	36	15.0	18.0	7.0	9.0	20	1	14	23.0	23.5	14.0	18.0	34
2	37	26.0	23.0	14.1	15.0	26	1	15	23.4	25.2	15.0	19.0	44
2	38	23.0	24.0	16.0	16.3	30	1	16	22.0	24.8	18.0	14.0	46
2	39	22.9	26.0	13.0	16.0	—	1	17	29.0	29.0	22.0	23.5	28
2	40	31.4	27.0	16.0	18.0	—	1	18	28.0	27.5	18.0	21.5	32
2	41	24.5	26.0	13.3	16.0	—	1	19	22.0	21.0	11.0	17.0	36
2	42	20.5	28.0	18.0	16.9	36	1	20	35.0	35.5	17.0	27.0	46
2	43	29.6	29.0	19.2	19.2	—	1	21	34.0	29.2	17.3	24.8	28
2	44	19.5	18.0	7.9	9.9	22	1	22	30.0	31.5	17.1	23.9	50
2	45	33.6	34.0	17.0	21.0	48	1	23	27.5	25.4	12.0	20.0	48
2	46	26.0	25.8	19.0	15.0	38	1	24	30.5	33.0	21.0	18.0	46
2	47	31.0	31.4	15.0	16.8	38	1	25	29.0	27.0	13.0	20.5	46
2	48	14.0	13.2	4.5	7.0	20	1	26	32.0	30.5	20.0	24.0	44
2	49	28.5	29.1	18.8	18.1	32	1	27	25.7	26.0	17.8	16.0	42
2	50	25.4	25.0	14.7	16.0	28	1	28	18.0	18.4	18.0	17.0	32
2	51	26.0	26.0	13.5	16.2	34	1	29	25.0	25.0	14.0	15.5	44
2	52	21.3	17.0	17.9	14.0	32	1	30	25.0	25.0	17.0	17.0	34
2	53	27.0	31.0	19.5	18.4	28	1	31	25.8	23.3	14.4	17.0	—
2	54	28.3	27.7	14.0	18.3	46	1	32	24.7	22.5	14.0	16.9	32
2	55	31.0	26.5	15.2	17.0	22	1	33	27.5	28.0	3.0	21.0	46
2	56	21.0	22.0	7.3	13.0	26	1	34	24.0	23.0	14.5	16.0	60
2	57	20.0	18.5	10.0	12.3	26	1	35	21.5	22.4	10.8	16.0	42
2	58	18.0	17.8	8.0	9.0	32	1	36	26.5	25.4	12.0	15.0	42
2	59	23.2	27.5	18.0	17.0	38	1	37	24.0	24.1	11.0	16.5	40
2	60	27.0	28.0	18.7	18.1	—	1	38	21.0	21.9	11.5	14.0	30
2	61	30.0	32.0	16.6	20.0	34	1	39	21.2	22.0	10.5	15.0	40
2	62	25.0	22.8	13.0	15.1	26	1	40	19.0	19.0	7.0	13.0	48
2	63	25.8	23.2	12.5	15.0	34	1	41	20.2	20.0	9.3	15.9	—
2	64	27.0	26.8	16.0	17.4	—	1	42	20.0	19.0	8.0	13.0	36
2	65	25.0	17.0	14.0	15.3	44	1	43	18.0	18.0	9.5	11.2	48
2	66	26.0	26.7	14.8	19.3	32	1	44	22.0	22.5	13.0	14.0	36
2	67	26.0	25.0	14.5	17.0	30	1	45	17.5	17.7	8.0	11.0	38
2	68	26.2	28.0	17.2	16.2	44	1	46	16.0	16.0	7.5	13.5	34
							1	47	17.6	18.4	8.0	13.0	30
							1	48	17.5	18.0	7.5	11.8	30
Collection 1957/D-21 (59 specimens measured, one box)													
1	1	22.9	22.0	12.6	15.5	48	1	49	13.0	13.0	5.0	7.0	34
1	2	29.5	30.9	20.0	20.0	50	1	50	17.0	16.0	4.5	12.0	34
1	3	26.2	26.5	16.0	17.0	52	1	51	17.0	15.5	6.5	11.0	28
1	4	31.2	34.5	21.6	24.0	52	1	52	17.0	17.0	4.2	11.0	36
1	5	29.5	30.7	13.5	17.8	44	1	53	18.8	16.0	7.3	9.5	36
1	6	30.7	30.2	18.3	21.0	38	1	54	13.0	13.0	6.0	8.0	30
1	7	32.0	32.5	23.3	25.0	48	1	55	12.5	12.5	4.5	8.0	28
1	8	30.0	28.5	19.5	25.9	34	1	56	9.8	11.0	4.0	4.0	26
1	9	26.0	23.0	14.0	17.8	32	1	57	12.0	11.0	2.5	5.5	24
1	10	24.5	25.6	13.0	17.0	52	1	58	9.0	7.5	2.5	5.0	20
1	11	28.0	29.8	19.0	22.0	36	1	59	13.2	12.5	6.0	8.0	24
1	12	27.3	29.5	3.0	17.3	40							