

Nomenclatural review of *Polyptychoceras* and 18 related taxa (Ammonoidea: Diplomoceratidae)

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Abstract The nomenclature of *Polyptychoceras*, a Late Cretaceous heteromorph ammonite genus, and 18 related taxa is examined with a view to clarifying their nomenclatural availability, authors, dates of publication, and name-bearing types, on the basis of the *International Code of Zoological Nomenclature (Fourth Edition)*. It is concluded that one family-group name, four genus-group names, and 12 species-group names are currently available. In contrast, the names *Po. subundatum* and *Po. jimboi* are unavailable. We also showed that *Po. yubarense* had been established by Shimizu (J Shanghai Sci Inst, Sect II, 1(11):159–226, 1935a).

Keywords Heteromorph ammonites · Late Cretaceous · Nomenclature

Introduction

Polyptychoceras is a genus of heteromorph ammonites from the Upper Cretaceous, a member of the family Diplomoceratidae Spath, 1926. Due in part to its unique paper clip-like shell (Fig. 1), many studies have examined the paleoecology, taphonomy, and shell morphology of this genus (e.g., Matsumoto and Nihongi 1979; Okamoto and Shibata 1997; Okamoto and Asami 2002; Kruta et al. 2009; Ifrim et al. 2013; Okamoto et al. 2013). However, several pieces of nomenclatural information for each name in this genus remain unclear. For example, the name *Po. yubarense*, which has been attributed to Yabe (1927) or Jimbō (1894), was not established in these works. As a result, the true author and date of publication of this species are unknown.

Hayakawa and Tashiro (1994) and Okamoto and Shibata (1997) have identified taxonomic issues within *Polyptychoceras*. For instance, several individuals that had been initially described as distinct species were later interpreted as different ontogenetic stages of the same species by Okamoto and Shibata (1997). Most such problems remain unresolved today. Owing to this, restudying the taxonomy of *Polyptychoceras* in the future will contribute to revising the diversity of heteromorph ammonites in the Late Cretaceous.

In the present study, we examined the nomenclature of members of the genus *Polyptychoceras* and related taxa and clarified their nomenclatural availability, authors, and dates of publication according to the current *International Code of Zoological Nomenclature Fourth Edition* (International Commission on Zoological Nomenclature 1999; partly amended in ICZN 2003, 2012), hereafter referred to as the *Code*. In addition, we treat name-bearing types of each taxon.

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Fig. 1 A well-preserved specimen of *Polyptychoceras pseudogaultinum* (Yokoyama, 1890), UMUT-MM19881a from Hokkaido Island, Japan, coated with ammonium chloride. In this individual, the paper clip-like shell is composed of four straight shafts running almost in

parallel connected with U-shaped tubes. Scale bar represents 10 mm. The repository of this specimen is the University Museum, University of Tokyo. For detailed locality, see Okamoto and Shibata (1997)

Polyptychoceratinae Matumoto, 1938

Subfamily Polyptychoceratinae was originally proposed by Matumoto (1938) as the family “Polyptychoceratidae”. This name is not accompanied by a description, definition, bibliographic reference, or proposal for a new replacement name, but it is assumed to have formed from an available generic name, *Polyptychoceras* Yabe, 1927, by inference from its stem and the context of the original publication. Although this name does not satisfy the provisions of the *Code’s* Article 13.1, as mentioned above, it is available from its original publication because (1) Polyptychoceratinae was used as a valid taxon name before 2000 (e.g., Wright et al. 1996) and (2) it has not been rejected by an author who, after 1960 and before 2000, expressly applied Article 13 of the then current edition of the *Code* (Art. 13.2.1).

The type genus of this family-group taxon is *Polyptychoceras* Yabe, 1927 (Art. 63). Moreover, the rank of this name was changed from family to subfamily by Wiedmann (1962).

***Polyptychoceras* Yabe, 1927**

Polyptychoceras was originally proposed by Yabe (1927) as a subgenus of the genus *Hamites* in a list of fossils from Hokkaido Island, Japan. The name *Polyptychoceras* is available, though it is not accompanied by a description or definition. This is because, from context, the specific names listed can be unambiguously assigned to nominal species (e.g., “*pseudogaultinus* Yok.”: *Ptychoceras pseudogaultinum* Yokoyama, 1890), though no bibliographic references were provided (Art. 12.2.5).

Shimizu (1935a, p. 178) reported that *Polyptychoceras pseudogaultinum* (Yokoyama) had been designated as a “subgenotype” [type species of subgenus] of subgenus *Polyptychoceras* by Yabe (1927); however, this designation has not been confirmed. In the same year, Shimizu (1935b, p. 271) stated that the “genotype” [type species] of the genus *Polyptychoceras* is “*Anisoceras pseudogaultinum* Yokoyama, *Palaeontographica*, XXXVI, 1890, 181, pl. XX, Figs. 1–3”. He states that the species is the type species and clearly accepts the species as the type species; thus Shimizu (1935b) is deemed to have subsequently designated *Ptychoceras pseudogaultinum* Yokoyama, 1890 as a type species (Art. 69.1.1).

According to Wright et al. (1996), the genus *Polyptychoceras* is subdivided into three subgenera: *Polyptychoceras* (*s. s.*), *Subptychoceras*, and *Phylloptychoceras*. In contrast, Jagt et al. (2006) treat *Phylloptychoceras* as an independent genus because of its characteristic ornamentation and suture line (see also Shigeta and Nishimura 2013). In the present study, we follow Jagt et al. (2006) and exclude *Phylloptychoceras* from *Polyptychoceras*.

***Polyptychoceras vancouverense* (Whiteaves, 1879)**

Polyptychoceras vancouverense was originally proposed by Whiteaves (1879) as “*Ptychoceras Vancouverense*”. This name is available because it is accompanied by a description (Art. 12.1). The spelling of the specific name was emended by Usher (1952) as “*vancouverense*” (Art. 32.5.2.5).

Usher (1952) designated one of the illustrated specimens in the original publication of this name (Whiteaves 1879, pl. XIV, Fig. 3) as the lectotype (Art. 74). The specimen

illustrated in Whiteaves (1879, pl. XIV, Fig. 3a), is a paralectotype (Art. 74.1.3).

***Polyptychoceras pseudogaultinum* (Yokoyama, 1890)**

Polyptychoceras pseudogaultinum was originally proposed by Yokoyama (1890) as “*Ptychoceras pseudo-gaultinum*”. This name is accompanied by a description of the denoted species and is available (Art. 12.1). The spelling of the specific name was emended by Jimbō (1894) as “*pseudogaultinum*” (Art. 32.5.2.3).

Because neither a holotype nor a lectotype has been fixed for the species, the specimens illustrated in Yokoyama (1890, pl. XX, Figs. 1–3) are syntypes.

***Polyptychoceras subquadratum* (Yokoyama, 1890)**

Polyptychoceras subquadratum was originally proposed with a description by Yokoyama (1890) as “*Anisoceras subquadratum*”. Therefore, this name is available (Art. 12.1). The illustrated specimen (Yokoyama 1890, pl. XX, Fig. 4) is the holotype fixed by monotypy (Art. 73.1.2).

Okamoto and Shibata (1997) interpreted this species as a junior subjective synonym of *Po. pseudogaultinum*. They acted as First Revisers and gave precedence to the name *Po. pseudogaultinum* (Art. 24.2.1).

***Polyptychoceras haradanum* (Yokoyama, 1890)**

Polyptychoceras haradanum was originally proposed by Yokoyama (1890) as “*Anisoceras Haradanum*” based on several specimens. This name is available because it is accompanied by a description (Art. 12.1). The spelling of the specific name was emended by Yabe (1927) as “*haradanus*” (Art. 32.5.2.5) in which the ending was changed because of an agreement in gender.

Matsumoto et al. (1963) designated the specimen illustrated in the original publication of this name (Yokoyama 1890, pl. XX, Fig. 5) as the lectotype (Art. 74.4).

***Polyptychoceras subundulatum* (Yokoyama, 1890)**

Polyptychoceras subundulatum was originally proposed by Yokoyama (1890) as “*Anisoceras subundulatum*”. This name is accompanied by a description and is available (Art. 12.1).

Matsumoto et al. (1963) designated the specimen illustrated by Yokoyama (1890, pl. XX, Fig. 6) as the lectotype.

This designation is invalid because it was conducted for an unavailable name as mentioned in the next section (Art. 74.3). The specimens illustrated in Yokoyama (1890, pl. XX, Figs. 6–7) are, therefore, syntypes.

***Polyptychoceras subundatum* (unavailable name)**

In Matsumoto et al. (1963, p. 30), the above species (*Polyptychoceras subundulatum*) was spelled incorrectly as “*Polyptychoceras subundatum*” more than once. Because this change in the spelling of the specific name can be interpreted as “demonstrably intentional” (Art. 33.2.1), the latter name is an “unjustified emendation” (Art. 33.2.3). If the unjustified emendation meets the other requirements for availability, this name is itself an available name (Art. 19.1). However, this name was also written as “*Anisoceras subundatum*”. The generic combination of this “species” is ambiguous and this name is thus unavailable (Art. 11.9.3.4).

***Polyptychoceras obstrictum* (Jimbō, 1894)**

Polyptychoceras obstrictum was originally proposed with a description by Jimbō (1894) as “*Hamites obstrictus*”. Therefore, this name is available (Art. 12.1).

Matsumoto (1963) designated a specimen illustrated in the original publication of the species (Jimbō 1894, pl. VII [XXIII], Fig. 2) as the lectotype. This designation is invalid because it was conducted for the incorrect subsequent spelling “*Hamites obstrictum*” (unavailable name), which is without agreement in gender. All specimens of the type series are syntypes and collectively constitute the name-bearing type (Art. 73.2), because neither a holotype nor a lectotype has been fixed for the species. Therefore, the specimen illustrated in Jimbō (1894, pl. VII [XXIII], Fig. 2) is a syntype.

***Polyptychoceras yabei* (Nagao, 1931)**

Polyptychoceras yabei was originally proposed by Nagao (1931a) as “*Hamites yabei*”. This name is accompanied by a description of the characters purported to differentiate the species and is available (Art. 13.1). The same name was used by Nagao (1931b, c) in a description of an aptychus from Hokkaido Island, Japan. In Nagao (1931b), the name is not accompanied by a description, definition, bibliographic reference, or proposal for a new replacement name. Thus, the name does not satisfy the provisions of Article 13.1. In Nagao (1931c), the name is accompanied by a description of the characters purported to differentiate the

species and satisfies the provisions of Article 13.1. However, Nagao (1931c) was published in September 1931, whereas Nagao (1931a) was published in April 1931. Therefore, the name *Hamites yabei* is attributed to Nagao (1931a) (Art. 50.1).

Neither a holotype nor a lectotype has been fixed for the species. Accordingly, the specimen illustrated in Nagao (1931a, p. 168, Figs. 1, 1a) is a syntype.

***Polyptychoceras mihoense* Shimizu, 1935**

Polyptychoceras mihoense was originally proposed by Shimizu (1935a) as a species of the genus *Polyptychoceras*. This name is accompanied by a description and is available (Art. 13.1). The name was also proposed by Shimizu (1935b), but this publication does not satisfy the provisions of Article 13.1 in terms of listing only the species name.

No holotype or lectotype has been fixed for the species.

***Subptychoceras* Shimizu, 1935**

Subptychoceras was established by Shimizu (1935a), with a description and *Subptychoceras yubarensis* Shimizu, 1935, fixed as the type species by monotypy (Art. 68.3). The name was also proposed by Shimizu (1935b) in the same manner. However, Shimizu (1935b) was published in July 1935, whereas Shimizu (1935a) was published in February 1935. Therefore, *Subptychoceras* is attributed to Shimizu (1935a).

***Polyptychoceras yubarensis* (Shimizu, 1935)**

Polyptychoceras yubarensis was established by Shimizu (1935a) as “*Subptychoceras yubarensis*”. Shimizu (1935a) incorrectly attributed this name to Yabe (1927); however, the name “*Hamites yûbarezis*” [sic][*recte yûbarensis*], proposed by Yabe (1927, p. 44 [18]), is a *nomen nudum* (with no original description, or indication). In contrast, *Hamites* sp. in Jimbō (1894), which is referred to in the explanation by Shimizu (1935a), is accompanied by a description of the species denoted by the name. For this reason, *Subptychoceras yubarensis* proposed by Shimizu (1935a) is available (Art. 13.1.2).

Because neither a holotype nor a lectotype has been fixed for the species, the specimen illustrated in Jimbō (1894, pl. VII [XXIII], Fig. 6) is a syntype.

***Polyptychoceras jimboi* (nomen nudum)**

Polyptychoceras jimboi was originally proposed as a species of the genus *Polyptychoceras* by Matumoto (1938) in a table of stratigraphic distributions of Cretaceous fossils without a description. Therefore, *Po. jimboi* is unavailable (Art. 13.1).

***Dihamites* Matsumoto, 1977**

Dihamites was originally proposed by Matsumoto (1977). This name is accompanied by a description, diagnosis (Art. 13.1), and fixation of a type species (Art. 13.3). Therefore, *Dihamites* is available. The type species of the genus-group taxon is *Dihamites obiraensis* Matsumoto, 1977, fixed by Matsumoto (1977) by original designation (Art. 68.2).

***Polyptychoceras obiraense* (Matsumoto, 1977)**

Polyptychoceras obiraense was established by Matsumoto (1977) as “*Dihamites obiraensis*”. The specimen illustrated in Matsumoto (1977, pl. 59, Fig. 2; text-Fig. 12) is a holotype fixed by original designation (Art. 73.1.1).

***Heteroptychoceras* Matsumoto, 1977**

Heteroptychoceras was originally proposed by Matsumoto (1977). This name is accompanied by a description that is purported to differentiate the genus (Art. 13.1) and is further accompanied by the fixation of a type species (Art. 13.3). Hence, the name *Heteroptychoceras* is available. The type species of the genus-group taxon is *Heteroptychoceras obatai* Matsumoto, 1977, fixed by Matsumoto (1977) by original designation (Art. 68.2).

***Polyptychoceras obatai* (Matsumoto, 1977)**

Polyptychoceras obatai was originally proposed by Matsumoto (1977) as “*Heteroptychoceras obatai*”. This name is accompanied by a description that is purported to differentiate the species and is therefore available (Art. 13.1). One of the specimens illustrated in Matsumoto (1977, pl. 58, Fig. 4) is a holotype fixed by original designation (Art. 73.1.1). The specimen illustrated in Matsumoto (1977, pl. 60, Fig. 1) is a paratype (Art. 72.4.5).

Table 1 Summary of the nomenclatural availability of the genus *Polyptychoceras* and 18 related taxa

Name, author(s), date of publication	Availability	Remark
Family-group name		
Polyptychoceratinae Matumoto, 1938	Available	
Genus-group names		
<i>Polyptychoceras</i> Yabe, 1927	Available	
<i>Subptychoceras</i> Shimizu, 1935	Available	
<i>Dihamites</i> Matsumoto, 1977	Available	
<i>Heteroptychoceras</i> Matsumoto, 1977	Available	
Species-group names		
<i>Polyptychoceras vancouverense</i> (Whiteaves, 1879)	Available	
<i>Po. pseudogaultinum</i> (Yokoyama, 1890)	Available	
<i>Po. subquadratum</i> (Yokoyama, 1890)	Available	Junior subjective synonym of <i>Po. pseudogaultinum</i>
<i>Po. haradanum</i> (Yokoyama, 1890)	Available	
<i>Po. subundulatum</i> (Yokoyama, 1890)	Available	
<i>Po. subundatum</i>	Unavailable	Unjustified emendation by Matsumoto et al. (1963)
<i>Po. obstrictum</i> (Jimbō, 1894)	Available	
<i>Po. yabei</i> (Nagao, 1931)	Available	
<i>Po. mihoense</i> Shimizu, 1935	Available	
<i>Po. yubarensis</i> (Shimizu, 1935)	Available	
<i>Po. jimboi</i>	Unavailable	<i>nomen nudum</i> proposed by Matumoto (1938)
<i>Po. obiraense</i> (Matsumoto, 1977)	Available	
<i>Po. obatai</i> (Matsumoto, 1977)	Available	
<i>Po. sakhalinum</i> Alabushev and Wiedmann, 1997	Available	

Seventeen names are available, whereas two names are unavailable

***Polyptychoceras sakhalinum* Alabushev and Wiedmann, 1997**

Polyptychoceras sakhalinum was established by Alabushev and Wiedmann (1997). One of the specimens illustrated in Alabushev and Wiedmann (1997, pl. 4, Fig. 4) is a holotype fixed by original designation (Art. 73.1.1). Therefore, all specimens of the type series other than the holotype, such as that illustrated in Alabushev and Wiedmann (1997, Figs. 5–7 in pl. 4 and text-Fig. 4D), are paratypes (Art. 72.4.5).

Conclusion

Toward a taxonomic revision, we examined the nomenclature of the genus *Polyptychoceras* and 18 related taxa on the basis of the current *Code* to clarify their nomenclatural availability, authors, dates of publication, and name-bearing types. We conclude that one family-group name, four genus-group names, and 12 species-group names are available, whereas two species-group names are unavailable (summarized in Table 1).

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