



# Review and revision of the West Timor Permian *Graphiocrinus* species of Johannes Wanner

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## Abstract

In a series of papers published between 1916 and 1949 Johannes Wanner assigned or reassigned more than 1700 crinoid specimens to 26 species or subspecies of *Graphiocrinus*. Nine of the 26 species were subsequently transferred to other cladid genera by Wanner or other authors. Study of the amalgamated Netherlands collections of the West Timor crinoids in Naturalis Biodiversity Center in Leiden, resulted in recognition that few of the West Timor *Graphiocrinus* species unquestionably belonged to the genus. Review of these species and subspecies resulted in reassignment of 12 species to other genera, whereas other species and individual specimens are considered indeterminate members of several families because they lack the arms preventing positive generic identifications. This study also resulted in significant revision of the Erisocrinoidea.

New taxa introduced are: Graphiocrinoidea n. superfam., *Rautscholdticrinus* n. gen., and *Ekmelocrinus* n. gen. Reassigned taxa are: *Rautscholdticrinus indicus* (Wanner, 1916) n. comb.; *Rautscholdticrinus weidnerii* (Wanner, 1937) n. comb.; *Graffhamicrinus? crassus* (Wanner, 1924) n. comb.; *Neocatocrinus? depressus* (Wanner, 1916) n. comb.; *Ekmelocrinus amplior* (Wanner, 1924) n. comb.; *Ekmelocrinus subamplior* (Wanner, 1949) n. comb.; *Ekmelocrinus ovoides* (Wanner, 1949) n. comb.; *Ekmelocrinus verbeeki* (Wanner, 1916) n. comb.; *Ekmelocrinus vermistriatus* (Wanner, 1916) n. comb., nomen correctum; *Permiocrinus pumilus* (Wanner, 1916) n. comb.; *Permiocrinus quinquelobus* (Wanner, 1916) n. comb.; and *Apographiocrinus? rugosus* (Wanner, 1916) n. comb.

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## 1. Introduction

The world famous Permian crinoids and blastoids (among other fossils) from West Timor were acquired on expeditions in the first half of the 1900s. Specimens were collected by J. Wanner in 1909 and 1911, G. A. F. Molengraaff in 1910–1911, J. Weber in 1911, H. G. Jonker in 1916, and scientists on the Snelius expedition of 1929. In addition, students in the Geological Institute of Amsterdam University collected specimens during field class expeditions in West Timor in 1934–1937 led by Professor Brouwer. The crinoids and blastoids were described in a

series of monographs and papers by Wanner between 1916 and 1949. His classic works on these fossils are the primary references for amateurs and professional paleontologists identifying the abundant specimens still found in West Timor today.

The various early collections of the West Timor echinoderms that were housed in the Geological Institute of Amsterdam University, Technical Highschool in Delft, and Rijks Geologisch Museum in Leiden were assembled and are all now repositied in the Netherlands Center for Biodiversity, Naturalis Biodiversity Center (NBC hereafter) in Leiden (Meijer et al., 2009) along with other fossils of all ages. The West Timor Permian collections contain several thousand echinoderm specimens, dominantly crinoids and blastoids.

In 1974, while on sabbatical leave, Webster sorted and identified part of the unidentified crinoids from the 1937 Amsterdam University field class expedition. At that time he recognized that there were problems with some of the generic assignments of

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Wanner, especially among the cladids. He also visited the University of Bonn and looked at West Timor crinoids that are now part of the Goldfuss Museum, Institute of Paleontology collections in the University of Bonn (IPB hereafter), Bonn, Germany. Many of the problems that he recognized involve modern cladid revisions based on newer discoveries in North America (e.g., Moore and Plummer, 1940; Knapp, 1969; Strimple and Watkins, 1969; among others). These problems became more obvious and diverse while compiling the Bibliography and Index of Paleozoic Crinoids (Webster, 1977, 1986, 1988, 1993, 2003; Webster and Webster, 2014), investigating the Permian crinoids of Australia (Webster, 1987, 1990; Webster and Jell, 1992, 1999), and studying the West Timor collections in NBC in 2011.

Within the NBC collections are numerous specimens from the Geological Institute that were from the early expeditions to West Timor and identified by J. Wanner, a 1948 student project of C. J. Mulder identifying part of the 1934–1937 field class collections, and part of the 1937 field class collection identified by Webster in 1974. A number of specimens lack locality information and some have lost the labels that had the locality information. However, overall, the collections are in good condition and provide an immense amount of general locality information (rarely very precise) and other data for future investigation, but lack specific stratigraphic occurrence. The lack of stratigraphic information reflects the absence of a recognized stratigraphic column for the Basleo area where most of the specimens were found (Barkham, 1993; Webster, 1998). Many of the identifications have not been reviewed to include the newer generic name to which some species have been transferred and several bags of unsorted specimens remain to be identified. Although the emphasis of our study was species of *Graphiocrinus* in NBC it reinforced the conclusion of Webster's investigation in 1974 of the West Timor crinoids in the University of Amsterdam Geological Institute collections that species of some other dendrocrinids (e.g., *Stuartwellerocrinus*) and some flexibles (e.g., *Cibolocrinus*) need detailed analysis.

The purpose of this paper is to review the West Timor *Graphiocrinus* species of Wanner (1916, 1924, 1937). It also includes *Graphiocrinus* species described and discussed by Wanner (1949) that are housed in the Goldfuss Museum, IPB.

## 2. Review and comments on NBC “*Graphiocrinus*” specimens

*Graphiocrinus de Koninck and Le Hon, 1854*, was named with *G. encrinoides de Koninck and Le Hon, 1854*. The monotypic species, for a crinoid crown from Tournaisian strata of Belgium. More than a half century later, while describing the West Timor Permian crinoids Wanner (1916, 1924, 1937, 1949) assigned 26 species or subspecies to *Graphiocrinus*, *Delocrinus*, *Ceriocrinus*, or *Basleocrinus* (Appendix 1). Several species initially assigned to *Delocrinus*, *Ceriocrinus*, or *Basleocrinus* were transferred to *Graphiocrinus* by Wanner or later investigators. The original generic designation of some of the species assigned to *Graphiocrinus* was questioned by Wanner (1916, 1924). When some of the later transfers were made by Wanner (1949), the recombined generic assignment was questioned,

such as *Graphiocrinus? beyrichi* (Wanner, 1916). The West Timor species of *Graphiocrinus* were referred to by Moore and Plummer (1940) as a group, when they suggested that the generic assignment should be investigated. All of the above generic names will be referred to in the following sections as “*Graphiocrinus*” unless otherwise specified.

Overall, the “*Graphiocrinus*” specimens in NBC are free of matrix and well preserved. However, most specimens are cups; crowns are rare and some specimens are fragmentary, as might be expected. Located in small trays in a series of larger trays in open-end cabinet stacks within one general area, specimens are distributed through the collections separated by the original repository. That is, Delft collections are separate from the Amsterdam University specimens and both are separate from the Rijks Museum materials. They are not in systematic order. In general, trays contain specimens from the early expeditions to West Timor (mostly Delft collections) and the 1934–1937 field expeditions (Amsterdam University collections). Some trays contain boxes or bags of specimens of only one particular genus or species, where they are in extreme abundance or were previously part of a particular investigation. Type specimens are individually boxed and marked with red tags, but again, not in systematic order, or a single tray or cabinet. Species of a single genus, as well as multiple specimens of a species, may be, and commonly are, in more than one tray. This separation appropriately reflects a difference in locality, collector, and year of collection.

During October 2011 an attempt was made to verify to species all “*Graphiocrinus*” specimens with previous identifications and sort some small unidentified lots containing several “*Graphiocrinus*” specimens in the NBC collections. Species and generic identifications were corrected as appropriate. Because of time constraints, no attempt was made to sort or identify “*Graphiocrinus*” specimens in the few unsorted bulk collections. Thus, the number of specimens for each of the species in Section 5 will not include those few specimens in the unsorted bulk samples. However, the relative number of specimens of each species provides an approximation of the relative species abundance within the collections.

Variation is common in the West Timor species assigned to “*Graphiocrinus*” and was recognized in most species known from as few as five specimens. The most common variation is in the small to large size of the primanal and its relationship to the posterior basal. The position of the primanal plate evolves from directly above and in contact with the posterior basal to separated from the posterior basal, but still mostly within the radial circlet, to positioned in a notch within the distal mutual edges of the C and D radials, and, ultimately, to above the radial summit visible on the exterior and distally enclosed within the adjacent primibrachials. In addition, the primanal enclosed on the interior, not visible on the exterior, may occur with the previously mentioned variations within a single species. It is obvious from the bulk numbers of the more abundant species from the various localities that the Timor “*Graphiocrinus*” species were in the process of evolving the primanal plate out of the cup to form a more perfect pentamerous symmetry. This is an evolutionary process common in other late Paleozoic cladids as

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