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**Phanerozoic-Cryptozoic and Related Transitions: New Evidence**

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## Phanerozoic-Cryptozoic and Related Transitions: New Evidence

**Abstract.** *The fossil Pteridinium, a distinctive component of a worldwide early metazoan (Ediacaran) assemblage, is provisionally recorded from probable early Cambrian strata in eastern California. In context with other evidence, this finding implies a Cambrian age for the Ediacaran fauna and approximate coincidence of limits between Phanerozoic-Cryptozoic, Paleozoic-Precambrian, and Cambrian-Precambrian.*

Recent study of markings of biologic origin in rocks near the base of the Paleozoic in the White-Inyo Mountains of eastern California reveals similarities between one of these markings and the problematical genus *Pteridinium* (1), which occurs at the base of the Nama System in South West Africa. The Nama fauna has been correlated with the Ediacaran fauna of South Australia (2) on the basis of their mutual inclusion of *Pteridinium* and also another problematical organism, *Rangaea*, both provisionally assigned to the Pennatulacea (3). From other fossils at Ediacara this correlation has been extended to strata in the Charnwood Forest of England (4) and in northern Russia and Siberia (5).

Thus the elements of worldwide correlation of a very early Metazoan fauna are suggested. The immediate problem is the relation of this fauna to other early metazoan faunas; and that is quite uncertain, except for the fact that the type Ediacaran fossils occur several hundred feet below a Lower Cambrian archaeocyathid assemblage in a different stratigraphic unit. This bears ultimately on the question of metazoan origins and on the vexing question of where and how to define a boundary between the major divisions of geologic time known as Paleozoic and Precambrian.

This discussion is further complicated by the historical evolution of the term Precambrian. For many years the Cambrian was considered to mark the base of the decipherable historical record, and rocks older than this were thought to represent a subordinate part of earth history not susceptible to world-wide subdivision, hence known only as pre-Cambrian. The use of the term Precambrian as a single word with a capital P was only recently introduced to dignify its present treatment as a major formal grouping of the rock succession and geologic time, and not merely something that wasn't Cambrian.

Increasingly in recent years some geologists and paleontologists have entertained the notion of recognizing a

boundary between the Paleozoic and Precambrian eras that would take into consideration factors epitomized by the use of the terms Phanerozoic and Cryptozoic. The relatively late appearance of the metazoan grade of evolution probably marks and is related to some great episode in earth and atmospheric history that offers operationally practical and philosophically satisfying grounds for the division of geologic time into two major if unequal parts (6).

Under such a concept the era boundary between Precambrian and Paleozoic becomes independent of the Cambrian, and one thinks of the possibility of pre-Cambrian rocks of Paleozoic age. Precambrian then signifies pre-Paleozoic, and the time may come when this awkward term (Precambrian) will disappear from our language altogether. In fact, it must disappear to resolve the absurdities inherent in trying to discuss the very legitimate question of pre-Cambrian rocks of post-Precambrian age, as well as the awkward but now widely used reference to post-Precambrian in other connections. Meanwhile we can continue to talk about the problem as some have done in terms of Phanerozoic and Cryptozoic eons (perhaps eventually with more felicitous eon terms for still more ancient rocks with no animal life at all or without life).

The object that precipitates these and other reflections (Fig. 1B) is an unimpressive but nevertheless distinctive imprint which can hardly be of nonvital origin and which compares among fossils known to us only with *Pteridinium* (Fig. 1A, C), for which we have ample reference material collected by Cloud in 1965 and also loaned to him for study by P. S. Swart of the State Museum of South West Africa at Windhoek. Were there any question about the age of the California specimen (Fig. 2), one might hypothesize that it was the imprint of an annulately ribbed, orthoconic cephalopod or sipuncle, but it occurs far below the position in the geologic sequence where such fossils are known.

As can be seen by comparing Fig. 1B with known *Pteridinium* to right and left, they compare closely in their slat-like ribbing, dimensions, and spacing of ribs. Nothing else is yet known at this general stratigraphic level which the California fossil resembles even faintly, and it seems likely that it is in fact a *Pteridinium* or closely related form. This fossil was found by a University of California student in the middle member of the Deep Spring Formation (locality 6, Fig. 3B) slightly more than 2000 feet below the lowest occurrence of the early Cambrium trilobite *Fallotaspis*, about 3000 feet below a zone (locality 2, Fig. 3A) containing relatively abundant *Fallotaspis* and *Daguinaspis* (7), and 350 feet below a zone of trace fossils including representatives of the arthropod sitz-mark *Rusophycus* and crawl-track *Cruziana* (localities 1, 3, Fig. 3A; locality 7, Fig. 3B). These relations are shown in Fig. 2, and Fig. 3 shows the location and local geologic relationship.

If the reader accepts the probable presence of *Pteridinium* in California, its relation to other organisms in the same section becomes of great interest.

First let us consider the presumably arthropodan sitz-mark to crawl-track sequence *Rusophycus-Cruziana* from the beds 350 feet above *Pteridinium*. Both forms are shown to be attributable to a single organism by certain

Fig. 1. (A, C) *Pteridinium simplex* Gürich 1930, emend. Richter 1955. Kuibis Quartzite, base of Nama System, Aar, between Kuibis and Aus, southeastern South West Africa. Locality P.I. 16 of State Museum of South West Africa. (B) Compare *Pteridinium*. Close to middle of Deep Spring Formation, NE $\frac{1}{4}$ , NW $\frac{1}{4}$ , SE $\frac{1}{4}$ , sec. 16, T7S, R35E, Blanco Mountain Quadrangle, California. Locality 6 of Fig. 3. (D) *Rusophycus* (upper left) and *Cruziana* (continuous below *Rusophycus* at left and also on right). Obviously the two names apply to the same organism (and *Rusophycus* has priority), but it is convenient to use both names here, Tapeats Sandstone, Middle Cambrian, Chuar Valley, Grand Canyon, Arizona. U.S. National Museum No. 66148. (E, G) Arthropod (? trilobite) scratchings of *Cruziana*-type from base of upper member of Deep Spring Formation, Lower Cambrian, center E $\frac{1}{2}$ , NE $\frac{1}{4}$ , SW $\frac{1}{4}$ , sec 18, T6S, R35E, Blanco Mountain Quadrangle, California. Locality 1 of Fig. 3. For comparison with Fig. 1D and also with *Cruziana* and other scratchings attributed to trilobites by Walcott (10, plates 37 to 40). (F) *Rusophycus* from base of upper member of Deep Spring Formation, Lower Cambrian. Same locality as E and G. (All illustrations are approximately natural size.)