Dipleurozoa from Lower Silurian of North America

Abstract. *In a problematical fauna discovered in Australia, 152 meters below diagnostic Lower Cambrian species, are fossilized remains belonging in the phylum Coelenterata. These jellyfish-like fossils were defined as a new class (Dipleurozoa) by Harrington and Moore because of their strong bilateral symmetry and differentiated extremities. The class was not reported elsewhere before many specimens were discovered recently in the Shawangunk (Tuscarora) formation at Delaware Water Gap, Pennsylvania. Three new species belonging to a new genus can be recognized, the indication being that the class ranges stratigraphically from the infra-Cambrian to at least the Lower Silurian, and geographically from Australia to eastern North America.*

Since the discovery of exotic soft-bodied animals in the infra-Cambrian of the Ediacara section of South Australia, paleontologists have had difficulty in relating many of the forms to known taxa; they had considered that all had become extinct before the appearance of the more diagnostic forms indicative of Lower Cambrian life on a worldwide basis. Included in the original assemblage, and among the first to be described (*1*), were several species resembling jellyfish in form. Because of the marked bilateral symmetry of the body, they were later assigned (*2, 3*) to a new class, Dipleurozoa, in the phylum Coelenterata.

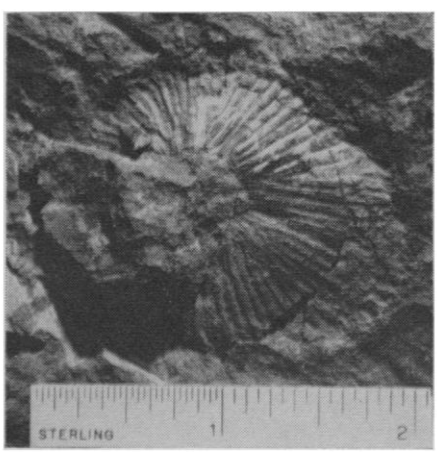

Fig. 1. *Rutgersella truexi,* new species. Rule in inches (× 1).

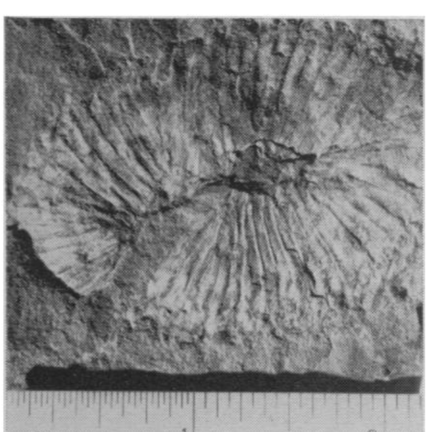

Fig. 2. *Rutgersella delawarensis,* new species. Rule in inches (× 1).

Many specimens that may be referred unquestionably to Dipleurozoa have been collected recently from the lower part of the Early Silurian Shawangunk (Tuscarora) formation in exposures at Delaware Water Gap, Pennsylvania. Individuals representing at least three species are herein referred to a new genus *Rutgersella* in the the family Dickinsoniidae Harrington and Moore. All specimens occur approximately 150 m above the base of the formation in thin silty-shale lenses between beds of quartzite and quartzite conglomerate. The new fauna also contains many fragments of eurypterids in what was apparently an intertidal environment.

Rutgersella, new genus

Diagnosis: Bell-shaped, varying from body varying in size from 5 to 10 cm. elliptic to nearly round; strongly bilateral Median dorsal ridge is prominent, dividing the umbrella into equal halves, and surmounted by an anterior (?) hump or mound. Segments are well defined, convex, radiating from dorsal ridge, and fewer in number (40 to 52) than in the only other known genus *Dickinsonia*; they are generally wider and irregularly dichotomous. Lappets occur along margins, but there is no indication of marginal tentacles. Compared with five described fossil genera assigned to Siphonophorida only *Discophyllum* Hall (*D. peltatum*) bears a resemblance to *Rutgersella*, especially *R. kittatinnyensis* one of three new species in the *Rutgersella* faunule. The latter, however, lacks the concentric markings so prominent on the dorsal surface of the pneumatophore. Because of the apparent segmentation of the envelope it is possible that *Discophyllum* should be included with Dipleurozoans. The genus is named in honor of the recent celebration of the bicentenary of the founding of Rutgers University.

Remarks: This genus, so widely separated in time and space from *Dickinsonia*, resembles the infra-Cambrian genus but differs in many respects. It has a fairly thick peridermal layer and dorsal mound surmounting a dividing ridge which is probably a reflection of the digestive cavity. Segments are fewer in number than in *Dickinsonia*. The new genus probably belongs in the same family and order as the Australian forms which (*4*) have recently been referred to the phylum Annelida. The specimens from Pennsylvania are clearly coelenterate in character.

Rutgersella truexi, new species
(Fig. 1)

Diagnosis: Body ovoid, slightly longer than wide; dorsal mound anterior (?) of center. Segments well defined, strongly convex, and 40 to 46 in number; they radiate from central mound and are generally oblique to dorsal ridge. They are intermediate in width between those of two other new species, *R. delawarensis* and *R. kittatinnyensis*. There is clear evidence that some segments divide into irregular dichotomous branches.

Holotype: Sp. No. 68:5:1, Rutgers Museum Collection; length, 5 cm; width, 3.75 cm. This species is designated the genotype and is named for Paul Truex, Rutgers Class of 1970, who discovered it.

Horizon and locality: Lower Shawangunk (Tuscarora) formation (Early Silurian), Delaware Water Gap, Pennsylvania.

Rutgersella delawarensis, new species
(Fig. 2)

Body relatively large, elongate, elliptical, 6.25 to 10 cm in length. Dorsal ridge surmounted by centrally located mound. Segments are convex and separated by furrows; those in the central lateral area parallel each other and extend outward from the dorsal ridge. The periderm on each segment is minutely crenulated. Lappets are prominent, slightly flared, and separated from each segment by an infold of the peridermal layer. If tentacles were present, none have been preserved.

Holotype: Sp. No. 68:5:2, Rutgers Museum Collection; length 6.25 cm; width, 3.75 cm.

Horizon and locality: Lower Shawangunk (Tuscarora) formation (Early Silurian), Delaware Water Gap, Pennsylvania.

Rutgersella kittatinnyensis, new species
(Fig. 3)

Diagnosis: Body relatively small, subcircular in outline. Dorsal ridge is not pronounced. Segments are rather narrow

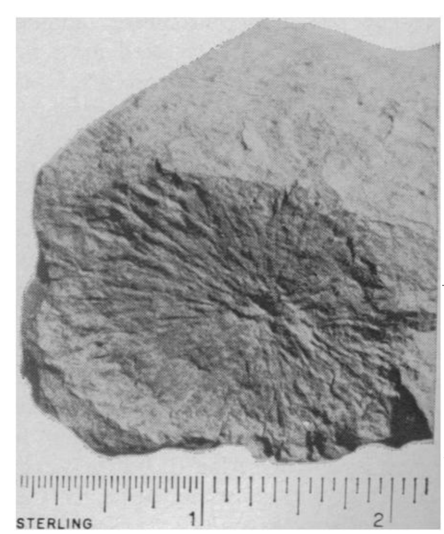

Fig. 3. *Rutgersella kittatinnyensis,* new species. Rule in inches (× 1).

and separated by furrows that are not deeply indented. All segments radiate from dorsal mound which is slightly anterior (?) of center. Lappets are not distinct. Periderm seems to be preserved as carbonaceous film at least 0.5 mm in thickness.

Holotype: Sp. No. 68:5:3, Rutgers Museum Collection; length 4.7 cm; width, 4.1 cm. Named for Kittatinny Mountain at Delaware Water Gap.

Horizon and locality: Lower Shawangunk (Tuscarora) formation (Early Silurian), Delaware Water Gap, Pennsylvania.

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Atmospheric Aerosols: Increased Concentrations during the Last Decade

Abstract. *Atmospheric turbidity values calculated each month from solar radiation observations at Mauna Loa Observatory, Hawaii, show an increase of aerosols from 1958 through the present. These data indicate that either the effects of the Mount Agung eruption are still being observed or a longer-term trend of increasing turbidity is in evidence.*

The possibility of climate modification resulting from increased concentrations of atmospheric aerosols has been a popular topic of discussion in meteorology. McCormick and Ludwig (*1*) explored this idea from the viewpoint that man-made pollutants are the source of increasing numbers of aerosols. By contrast, violent volcanic eruptions which inject large quantities of aerosols into the atmosphere have also been suggested as a mechanism for large-scale climate change (*2*). We report here on variations in the solar radiation data from Mauna Loa Observatory, Hawaii (which has been in operation for 10 years) by considering the influence of both these aerosol sources on the radiation measurements.

A measure of the concentration of atmospheric aerosols is provided by surface observations of the total amount of direct solar radiation, which are made on a routine basis at several United States localities, including the Mauna Loa Observatory. This station is particularly well suited for such measurements and for their application to estimates of aerosol densities on a global scale. At an elevation of 3398 m, the observatory is above much of the atmospheric water vapor. Most of the days each year are clear or partly cloudy, and it is remote from local sources of pollution (*3*). Four observations of direct solar radiation are made at Mauna Loa, in the morning and in the afternoon, providing that the sky is cloud-free near the sun, at prespecified times so that the solar angle is the same for corresponding observations on each day. These measurements began in November 1957, and, except for June 1958 and March 1964, the data have been published monthly through December 1967 (*4*). However, these observations (on which our report is based) are tentative and subject to future correction.

For our study, monthly averages of the Linke turbidity factor were computed according to the method outlined by Fritz (*5*) for each of the eight observation times. These were averaged to yield a single turbidity value for each month. Linke turbidity, T, is defined by

$$T = (\ln I_0 - \ln I)/(\ln I_0 - \ln I') \quad (1)$$

where I_0 is the solar constant, I is the observed direct solar radiation, and I' is the amount of direct radiation which would be transmitted through a clear, dustfree atmosphere with 1 cm of precipitable water vapor. Thus, each unit on the Linke scale corresponds to the depletion of the direct solar beam which would result from passing vertically through one such atmosphere. Particulate attenuation and water vapor absorption are the primary factors affecting variations of the Linke turbidity. If the water vapor concentration is assumed to be relatively constant from year to year, then large, longer-term changes of turbidity will be the result of variations of particulates.

Since the observed monthly values of turbidity had an annual variation, the average monthly turbidities were expressed as departures from the normal values for each individual month, the normal values being calculated from the data on the entire period through 1967. The results were subjected to three-point binominal smoothing (Fig. 1). The average turbidity for the entire 10-year period is 2.98.

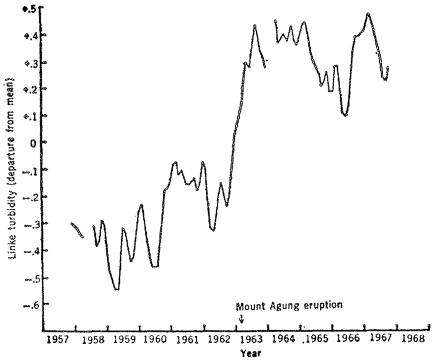

Fig. 1. Trend of monthly anomalies of Linke turbidity factor calculated from published normal incidence radiation data for Mauna Loa, Hawaii. Three-point binomial smoothing has been used.

The rapid increase in turbidity during mid-1963 (Fig. 1) was detected in many other parts of the world. This increase was the result of the eruption of Mount Agung in the East Indies in March 1963 (*6*). By considering this event as the major factor influencing large-scale changes of turbidity during the last decade, Fig. 1 can simply be interpreted as representing pre-eruption and post-eruption levels of turbidity.

If the Mauna Loa data are seen from this viewpoint, their unusual aspect is that by the end of 1967 (nearly 5 years after the eruption) the turbidity had not decreased to pre-eruption levels. Such a long period of reduced radiation after such an event has not previously been reported. For example, even after the very violent eruption of Krakatoa in 1883 the direct solar radiation returned to normal within 3 years, and for other, less intense eruptions the period of decreased radiation was even shorter (*7*).

We support an alternate interpretation of these data—that the Mount Agung effect is superimposed on a longer-term trend, a trend of increasing turbidity, which could have man-made pollution as its origin. Bryson (*8*) discussed various climatic aspects of such a contemporary turbidity trend. Examined from this viewpoint, Fig. 1 shows generally increasing turbidity during the decade despite the considerable scatter of the data, such as the positive departures during 1961 and from mid-1966 through mid-1967. Thus, the effect of the eruption can be seen as gradually diminishing during most of 1965 and the first half of 1966. By mid-1966, however, the long-term trend, which was also evident during the pre-eruption