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A fossil insect egg on an Early Cretaceous conifer shoot from the Wealden of Germany

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ABSTRACT

Macerated carbonised leaf material of a scale-leaved conifer from the Lower Cretaceous German Wealden yielded a portion of a fossil insect egg chorion (eggshell). The morphology and anatomy of the external and internal surfaces are described from SEM studies. It is postulated that this egg could belong within the terrestrial hemipterans with characteristics recognisable in extant members of the Pentatomomorpha. It is the first description of detailed architecture of the chorion of an Early Cretaceous insect egg and is probably the earliest known fossil insect egg displaying chorionic features in fine detail. A new genus and species has been erected: *Merangia horricomis*.

1. Introduction

The fossil egg described here was discovered accidentally in the course of an ongoing revision of the scale-leaved conifers in the Lower Cretaceous German Wealden Flora. Samples for routine cuticle preparations were taken from shoot specimens, preserved as compressions, in the collections of the Museum für Naturkunde, Berlin. The egg was recovered during the chemical maceration of a leaf sample from an un-described specimen which is now to be diagnosed as a new *Pagiophyllum* species. As the maceration progressed, a small, resistant, unidentified body separated from the coaly plant tissues. Thinking it to be a small seed or large megaspore we mounted it for viewing in the SEM but found it was clearly a portion (somewhat less than half) of the resistant chorion of an arthropod egg, with exquisite preservation, perfectly cut in a vertical plane (Fig. 2A).

Having questioned and accepted that the egg is contemporaneous with the fossil conifer host (see Discussion below), we have since studied details of the wall section together with both the inner and outer surfaces by SEM.

2. Material and methods

The conifer sample was removed from Specimen 1984/378 in the Museum für Naturkunde, Berlin, by means of a new surgical scalpel blade, hence obtaining an extremely clean cut. This, fortuitously, renders visible both inner and outer surfaces of the chorion (eggshell) as well as vertical sections of the lateral walls, the position of the missing operculum in the flattened apex and a basal plate.

The original sample, thought to be only compressed, carbonised conifer leaf material, was macerated in Schultze's solution and observed at intervals over a period of nearly 24 h, somewhat longer than the anticipated time for obtaining leaf cuticle from material of this provenance. It became obvious that the sample was macerating unevenly and, unfortunately, with the decision to prolong the Schultze treatment, no leaf cuticle was obtained from this preparation. However, the resistant specimen described here remained at the end and, as usual, was cleared in very dilute ammonia and washed in distilled water, with the expectation that it was plant in nature. After viewing in the light microscope showed it to be opaque, it was mounted on a brass stub using nail varnish and sputter-coated with gold for SEM examination. The use of nail varnish for mounting has been routinely adopted with Wealden plant cuticles because it allows the specimen to be removed easily in acetone, turned over and remounted for study of both sides.

Our first SEM view of the specimen (Fig. 2A) initially seemed to suggest it was seed-like. However, closer examination soon revealed the layered nature of the anterior pole (Fig. 3A–C) and the basal plate (Fig. 4F) at the posterior pole, closely resembling the lamellate structure in exoskeletons of both fossil and living arthropods. This is generally referred to as the integument, which becomes heavily mineralised in some arthropod groups. Despite lacking cutin in its composition, the term cuticle is also employed

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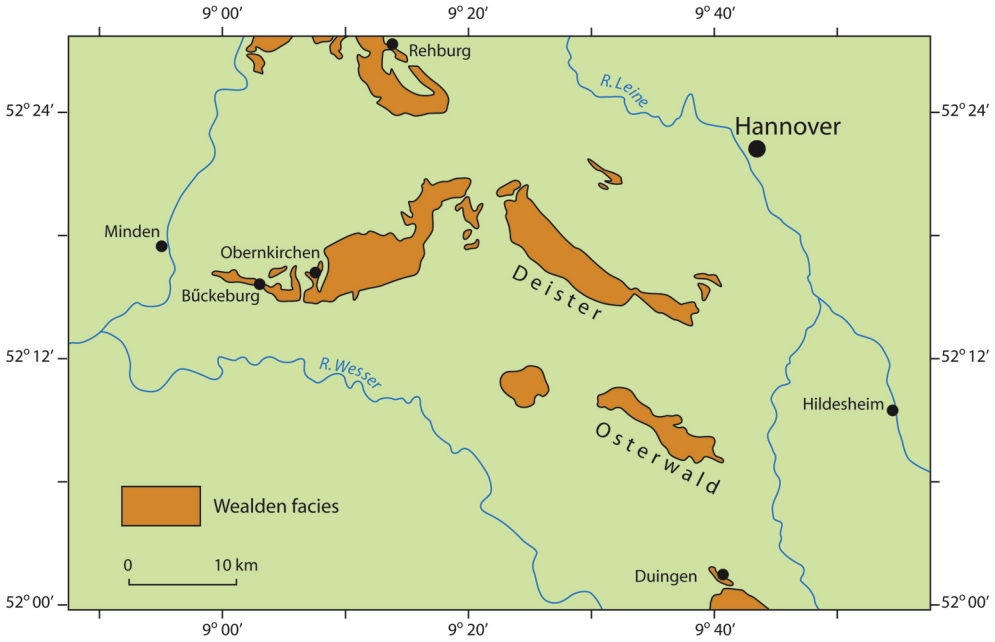

Fig. 1. Map showing northwest German Wealden outcrops and localities mentioned by Dunker (1846), Ettingshausen (1852) and Schenk (1869, 1871, 1876). See Pelzer et al. (1992), Hornung et al. (2011) and Pott et al. (2014) for details of the old localities and stratigraphy.

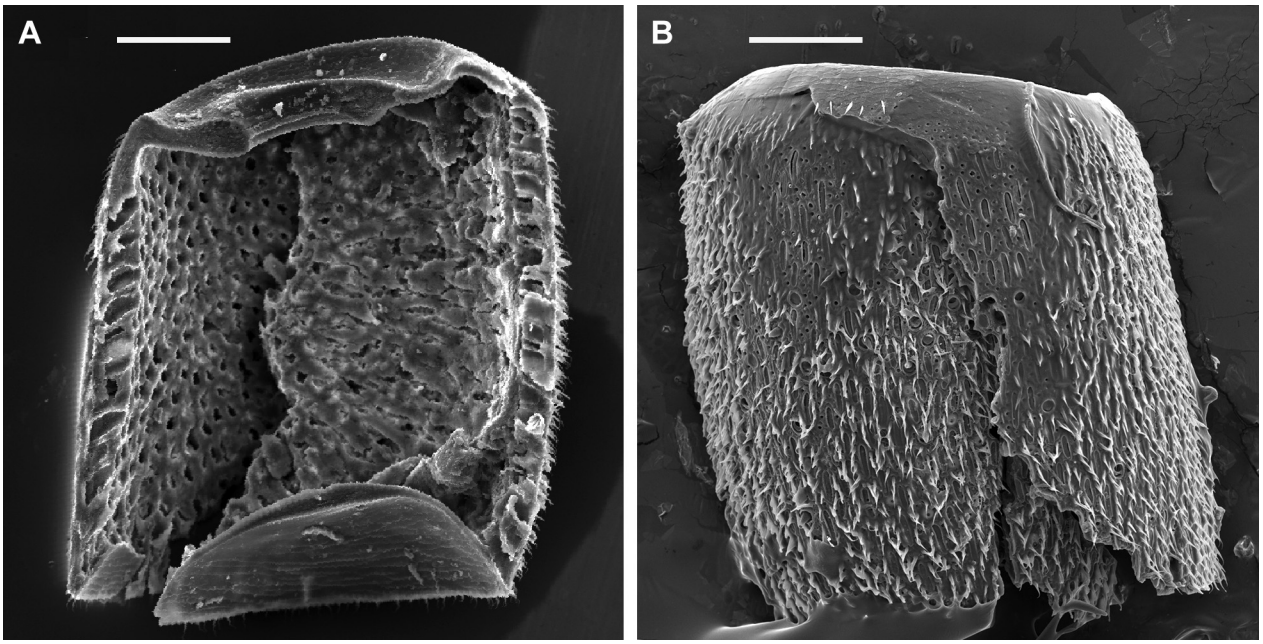

Fig. 2. *Merangia horricomis* gen. et sp. nov. A, B, Scanning electron microscope images showing inner and outer views of insect egg from specimen 1984/378, Museum für Naturkunde, Berlin. A, vertically oriented sagittal view of chorion, displaying longitudinal section and inner surface of lateral wall; profile section and outer surface of anterior polar area (top) with portion of opercular rim; outer surface of basal plate at posterior pole (bottom) also cut to show thickness. B, egg turned over to display outer surface of egg in same orientation showing two spine-free areas contrasting with strongly spinose lateral wall elsewhere and sloping shoulder of the un-sculptured anterior polar area. Scale bars = 100 μm.

by zoologists to describe the un-mineralised, organic integument which comprises a complex mix of chitin and proteins secreted in various layers. Insect eggshells, which our specimen proved to be, are also layered in structure and are largely proteinaceous.

3. Terminology used for insect eggshell

There has been considerable variation, even in recent years, in the terminology used to describe the morphological and anatomical details displayed by developing and mature insect eggs. As the largest group of animals on Earth, the Insecta produce immensely varied mature eggs but detailed studies of egg architecture remain relatively few, often emphasising the physiological aspects of egg and embryo development. The works of Southwood (1956), Hinton (1981) and Margaritis (1985) stand out as influential in the evolution and stabilising of egg terminology.

Known occurrences of fossilised insect eggs are extremely rare and examples showing detailed morphology and anatomy are