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Forewing of a cockroach (Blattodea).

The insects of the Winterswijk Muschelkalk

U vindt een samenvatting aan het eind van de tekst.

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Abstract **| This article describes the insect fossils found in the Muschelkalk of Winterswijk. Amongst these finds is a beetle elytron, which constitutes the oldest known beetle fossil from the Netherlands. The other insect fossils from the Muschelkalk of Winterswijk that are also briefly discussed, include a dragonfly wing fragment and a complete cockroach wing. These finds make Winterswijk unique amongst Muschelkalk outcrops, no other Muschelkalk site has yielded so many insect fossils. These insect fossils also help us to better reconstruct the depositional environment at Winterswijk: these finds indicate more terrestrial influx in the top section of the Winterswijk quarry.**

The first insect remains from the Winterswijk quarry were described by Oosterink (1987). A completely preserved wing was first described as a cockroach (Blattidae) (Oosterink, 1987), but then later more accurately described as a dragonfly (Oosterink, 2012). Recently, several additional insect remains were described by van Eldijk *et al.* (2017). The aim of this small summary is to first discuss all the different insect remains uncovered, to subsequently briefly describe the more general impact of these findings.

FIGURE 1. | *Part of a fossilized Odonata wing, possibly the cubito-median area of a member of the Triadophlebiomorpha. This wing was originally described by Oosterink (1987). Picture courtesy of Tonko Oosterink.*

Initially, the re-examination of the photographs in Oosterink (1987), indicated that the fossilized wing could represent the cubito-median area of a member of the Triadophlebiomorpha (van Eldijk *et al*., 2017). An examination of a more recent high resolution colour photograph of the specimen (Fig. 1) was consistent with this putative identification, yet it did not provide any greater degree of certainty, as some of the taxonomically important structures (i.e. those at the base of the wing) are unfortunately not preserved. Regardless, the Triadophlebiomorpha are an extinct order of Odonata (dragonflies & damselflies), that due to their basal placement in the Odonata phylogeny have the potential to elucidate the evolutionary relationship between the Palaeozoic griffinflies (Meganisoptera) and the modern Odonata taxa (Grimaldi & Engel, 2005; Zheng *et al*., 2017).

Another noteworthy insect find from Winterswijk is a single isolated beetle elytron (see Figure 2A). Due to the lack of characters of this elytron, a taxonomic assignment beyond Coleoptera (beetles), is simply impossible. However, this elytron is remarkable as it represents the oldest known beetle fossil from the Netherlands (van Eldijk *et al*., 2017). Additionally, van Eldijk *et al*. (2017) described three more insect fossils from Winterswijk: a forewing of a cockroach (Blattodea, Fig. 2B), a wing fragment perhaps of orthopteran (crickets & grasshoppers) affinity (Fig. 2C), and an undetermined fragment of a grylloblattid (ice-crawlers) forewing (Fig. 2D). Whilst modern ice-crawlers are rare and relict wingless extremophiles, Triassic Grylloblattidae had wings and are quite abundant in Triassic insect faunas (Grimaldi & Engel, 2005). For those unfamiliar with ice-crawlers; their body shape superficially resembles modern earwigs (Grimaldi & Engel, 2005).

The insect fossils currently known from Winterswijk are too few in number to form a complete picture of the terrestrial ecosystem surrounding the Winterswijk intertidal area. Yet, these findings are unique since Winterswijk is the only Muschelkalk locality from which an assemblage of fossil insects has been described (van Eldijk *et al*., 2017). In addition, the Triassic in general represents a key time for insect evolution during which many modern orders first arose, further highlighting the importance of the Winterswijk locality (Grimaldi & Engel, 2005; Misof *et al*., 2014). Finally, it is important to state that insect fossils have only been found in the upper section of the Winterswijk quarry (i.e. layer 33 and above). Thus, these findings are consistent with the view that more terrestrial influx is present in the upper part of deposits at Winterswijk (Oosterink, 1986; van Eldijk *et al*., 2017). This view is further supported by the presence of fossilized plant material and pollen grains in the upper section of the quarry (Herngreen *et al*., 2005a, 2005b). A layer of particular note here is the quite recently uncovered layer 43, which has yielded three out of the five insect specimens known (van Eldijk *et al*., 2017). The authors hope that additional exploration of layer 43 in particular will yield more insect specimens, which may provide a further glimpse into a tantalizing ancient insect fauna.

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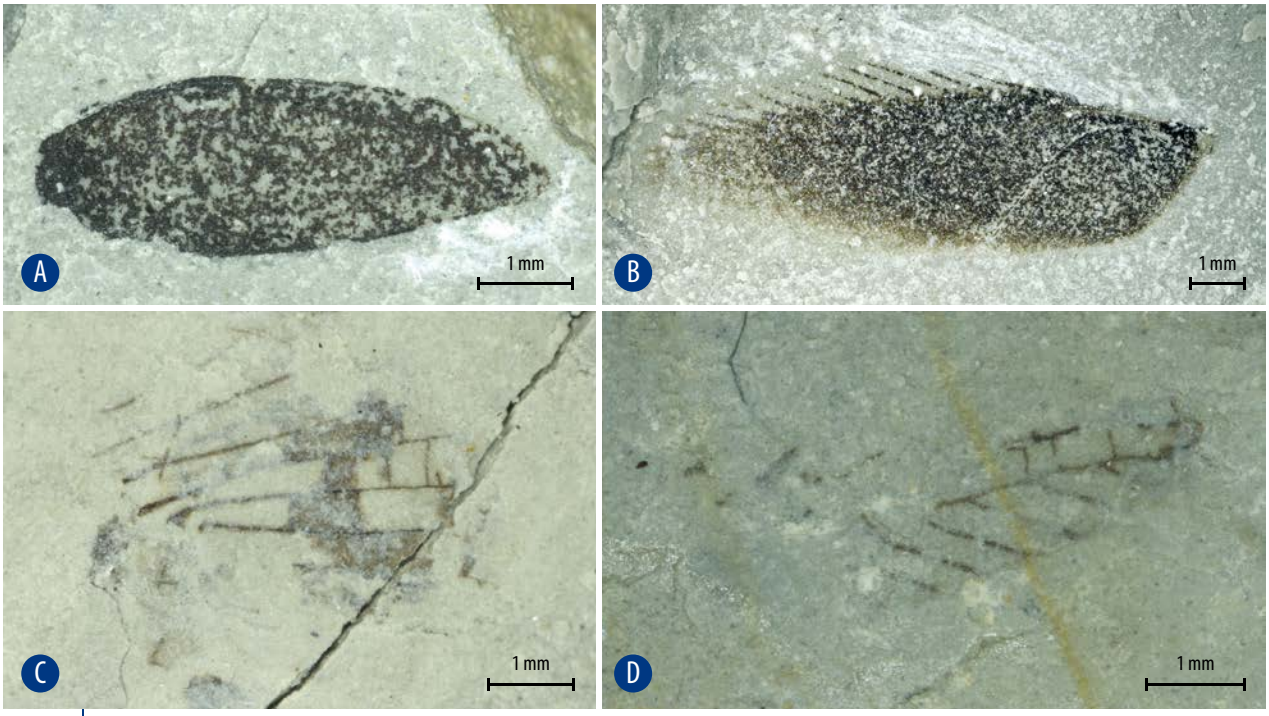

FIGURE 2. | *The other insect fossils from the Winterswijk quarry, described by van Eldijk* et al. *(2017). A. Beetle elytron, the oldest beetle fossil from the Netherlands; B. Forewing of a cockroach (Blattodea); C. Wing fragment possible orthopteran affinity; D. A wing fragment of a grylloblattid. Pictures courtesy of Dr. Torsten Wapppler.*

Samenvatting

Dit artikel omschrijft de insectenfossielen die zijn aangetroffen in de Winterswijkse Muschelkalk. Het betreft onder andere een dekschildje van een kever. Dit dekschildje is het oudste keverfossiel van Nederland. De overige insectenfossielen uit Winterswijk worden ook kort besproken, waaronder een vleugel van een libel en een vleugel van een kakkerlak. Deze vondsten maken de groeve van Winterswijk uniek, in geen enkele andere Muschelkalk-afzetting zijn zo veel insectenfossielen aangetroffen. Ook helpen deze vondsten ons om een beter beeld te vormen van het afzettingsmilieu te Winterswijk: zij duiden op meer terrestrische invloeden in de het bovenste stuk van de Winterswijkse Steengroeve.

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