Fleas and bites in armadillo's bones.

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Fact: Females of the flea *Tunga perforans* penetrate the epidermis over an armadillo's carapace, are fertilised by males, when their abdomen swells enormously to form a ~3mm diameter discoid 'neosome' which perforates bone and forms a cavity. But fleas are blood suckers and you need good teeth to chew bone.

Material: We examined bony lesions in animals which had died in the wild to look for clues as to how they may be generated – greater hairy armadillo *Chaetophractus villosus* and southern three-banded armadillo *Tolypeutes matacus.*

Methods: 3D Back-Scattered Electron mode Scanning Electron Microscopy (BSE-SEM) and X-ray MicroTomography (XMT, µCT).

Results: Lesions involved both sutures between adjacent bones and their central regions. The cavities show resorption pit complexes typical of those made by osteoclasts. They show numerous extra blood vessel canals. They eventually repair by infilling with new bone.

We conclude that the *Tunga perforans* neosome creates a local host inflammatory response which causes the bone resorption, creating the space in which it can grow. Fleas are known to inject anticoagulant(s) – which cause local osteoporosis.

Insect Bio-Inspiration speculation? The lesions are superficial. They would easily be studied by vital confocal microscopy. This might constitute a valuable experimental observational model for future cell and tissue level osteoporosis and osteoarthritis research.

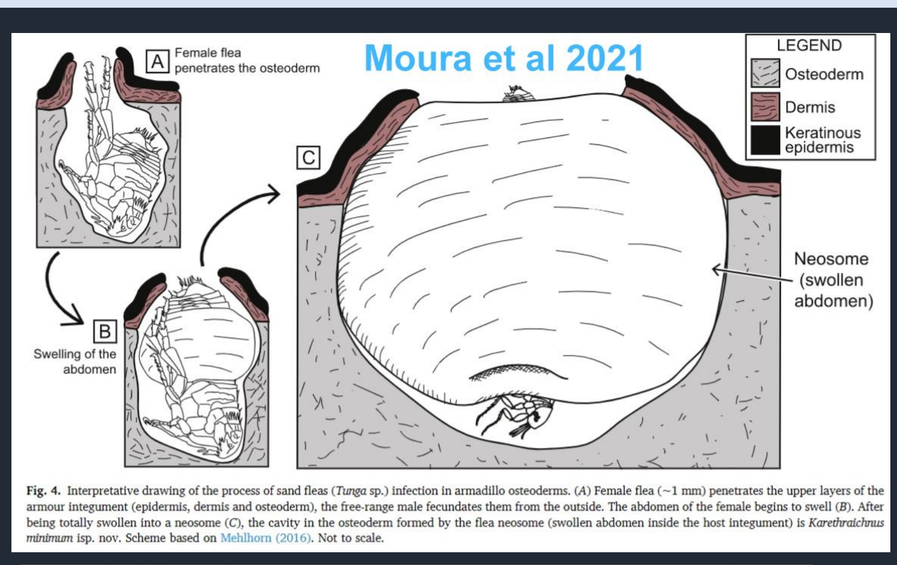
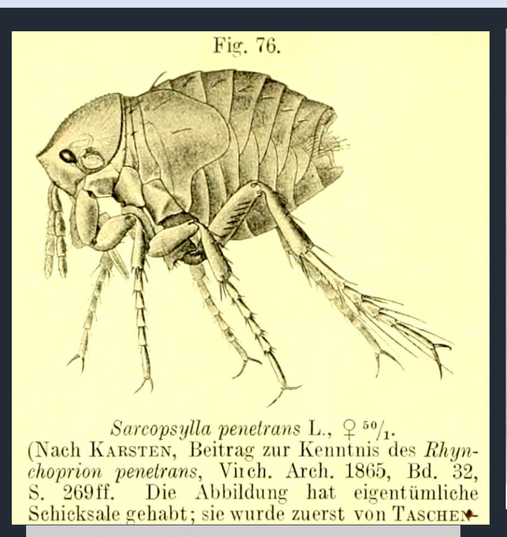
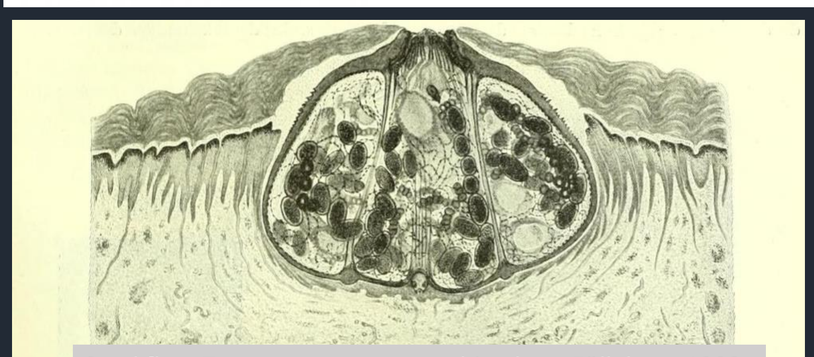


Fig. 4. Interpretative drawing of the process of sand fleas (*Tunga* sp.) infection in armadillo osteoderms. (*A*) Female flea (~1 mm) penetrates the upper layers of the armour integument (epidermis, dermis and osteoderm), the free-range male fecundates them from the outside. The abdomen of the female begins to swell (*B*). After being totally swollen into a neosome (*C*), the cavity in the osteoderm formed by the flea neosome (swollen abdomen inside the host integument) is *Karethraichnus mintmum* isp. nov. Scheme based on Mehlhorn (2016). Not to scale.



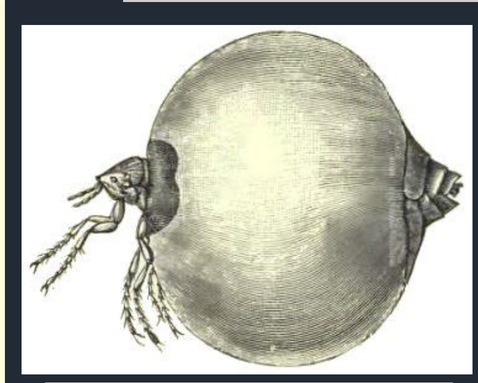
Female sand flea, *T. penetrans*, 1865

Dog flea SEM

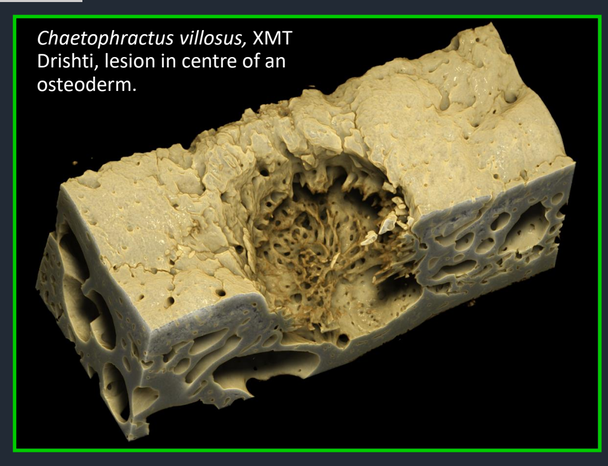


Sand flea, *T. penetrans*, neosome histology, Fülleborn 1908

Ausgereiftes Sandflohweibchen in der Sohlenhaut eines Negers. 10:1. Man sieht, daß der Parasit innerhalb des bruchsackartig vorgewölbten Epithels und zwar im Stratum lucidum sitzt, die Schweißdrüsenausführungsgänge sind aus ihrer normalen Lage gezogen. Das Hinterende des Flohs mit den ausmündenden Tracheen befindet sich an der Hautoberfläche, der Kopf an der tiefsten Stelle. Im oberen Abschnitt des Parasiten greifen Chitinzähnchen in das stark verdickte Stratum lucidum, den Floh verankernd, ein. Kräftige Muskeln inserieren am Kopfe und an im Durchschnitt buckelartig vorspringenden Chitinleisten. (Nach Fülleborn.)



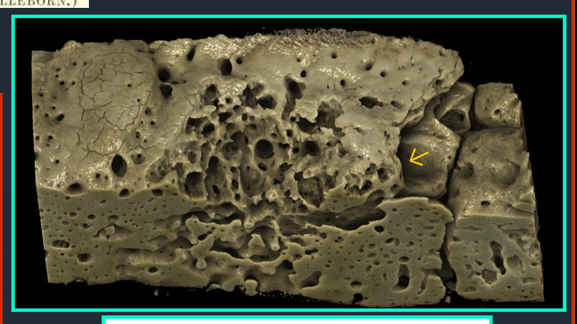
Sand flea, *T. penetrans* neosome. Image © Wikipedia



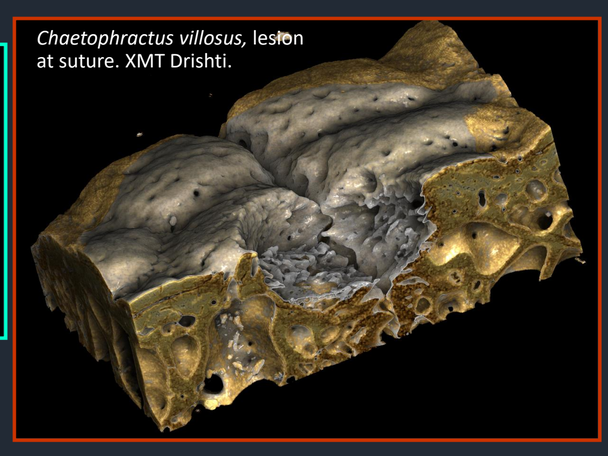
Who digs the holes? The flea? Or the host?

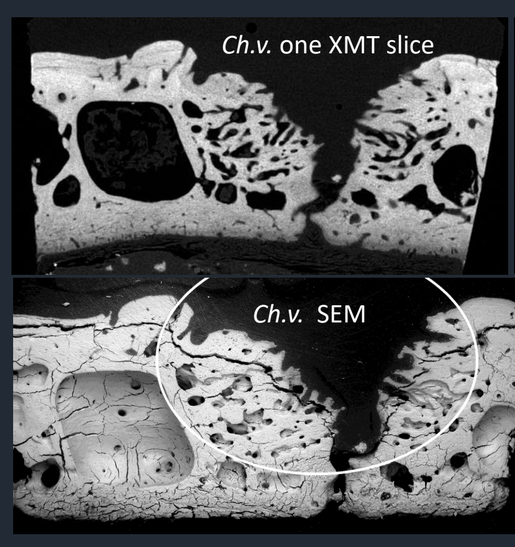
Ch. v. From video. ↘ Red arrow, neosome being removed with a stick. Green ↗↗↗ other sites

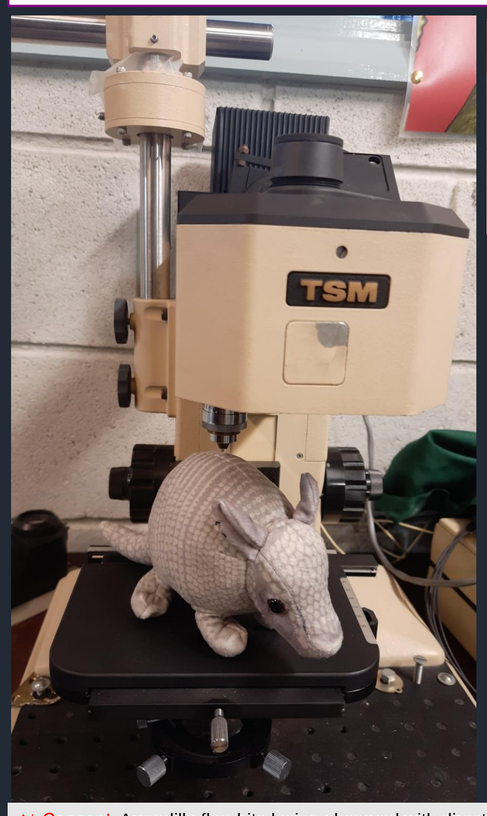
Tolypeutes matacus, southern three-banded armadillo, junction between osteoderms with a 3 mm diameter 'flea bite' hole. Anorganic. SEM. 20kV Field height = 5.14mm.



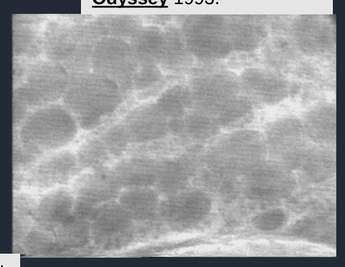
Chaetophractus villosus, lesion at 'suture'. XMT. Drishti. Note porosity and large number of blood vessel canals ← hair follicle cavity.







↑↓ Reality. Optical window implant in Ti frame, Rabbit medial tibial plateau. **Odyssey** 1993.



↑↓ Concept. Armadillo flea-bite lesion observed with direct view real time spinning disc confocal. **Tracor TSM 2024?**