Microkarren

A field classification

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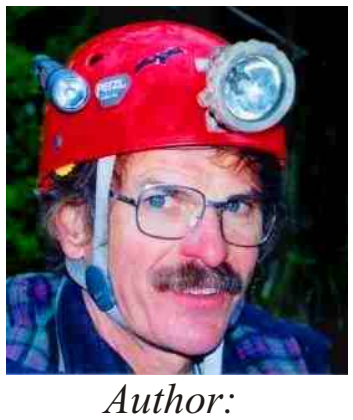
Introduction

Microkarren are the smallest class of visible karren. They are finely-sculptured solutional forms, typically recognisable within a one centimetre grid. They form best on gently-sloping surfaces of bare (algae-free) pavements and cobbles [2,3], of fine-grained limestones and are also found on the undersides of loose cobbles.

This poster aims to stimulate interest, and provide and illustrate a terminology for field use.



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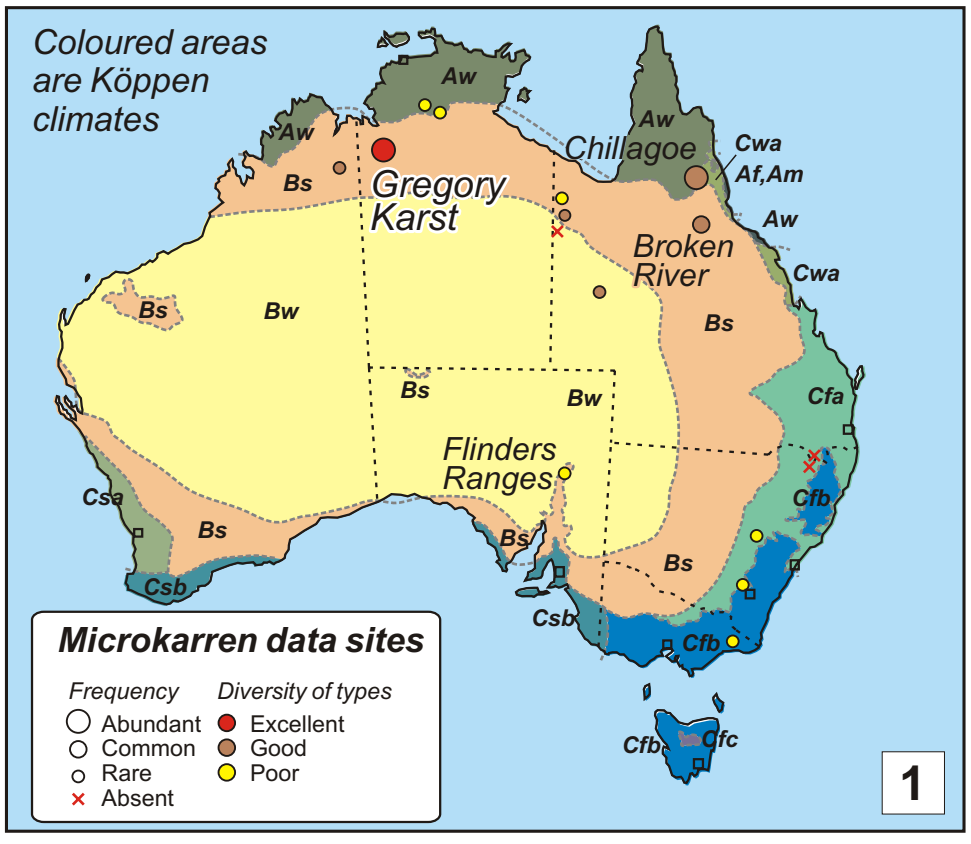


Terminology

Laudermilk & Woodford (1932, *Amer. J. Sci.*, **23:** 135-154.) listed four types of *rillensteine*, but their descriptions are confusing and don't cover the full range of forms, so a broader terminology is suggested.

Genesis

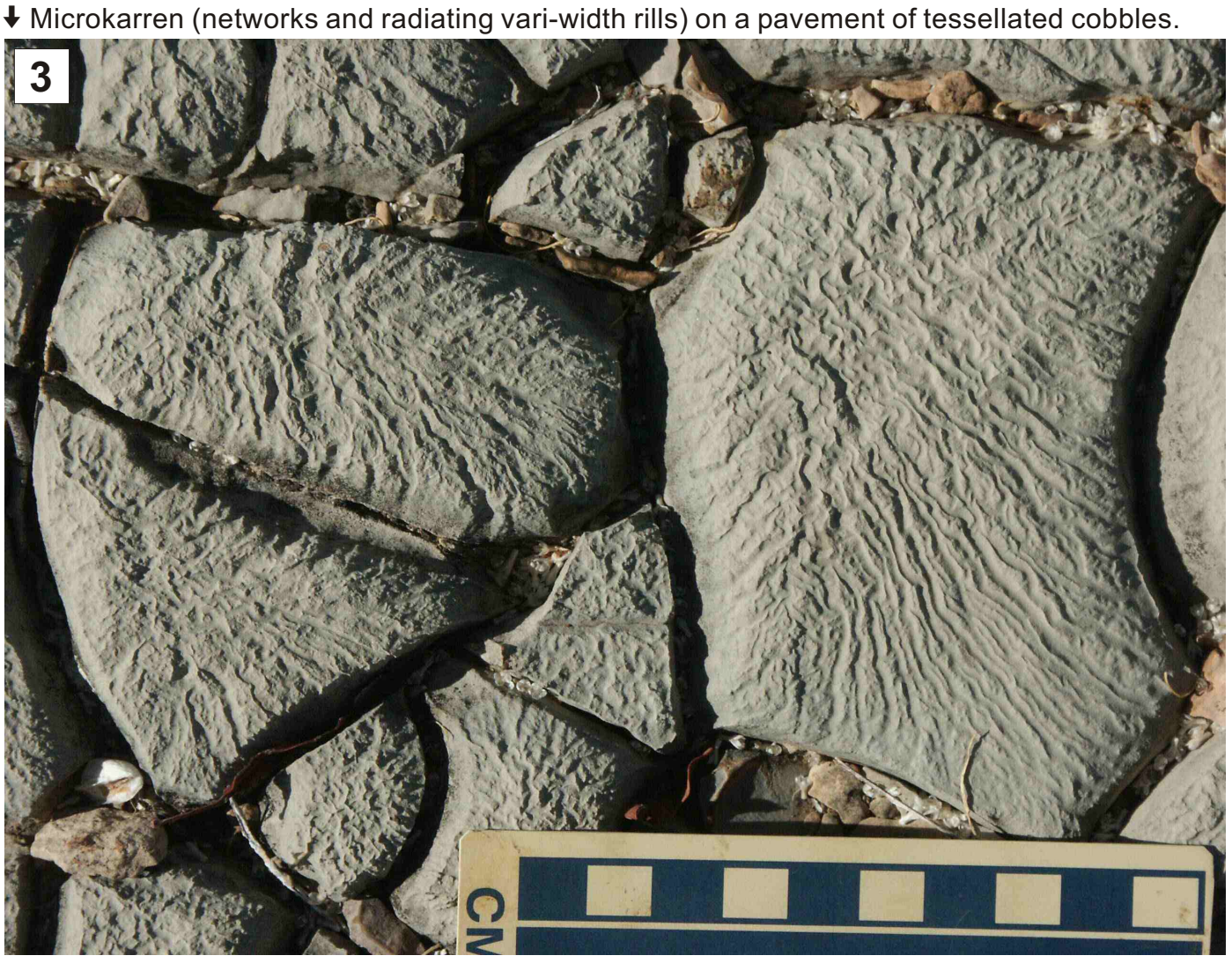
Theories of genesis generally involve solution by thin films of water (dew, sea-spray or light rain) with surface tension effects (Ford & Lundberg, 1987). Some forms, e.g. micro-pits, may be polygenetic and not always associated with other types of microkarren.

Distribution

In Australia their best development seems to be in tropical monsoon (seasonally dry) and arid areas [1]. They are particularly well-developed in the Gregory Karst, NT. Elsewhere, they have been recorded from the arctic (Greenland) to the tropics (Philippines) and from dry to humid (2500 mm) rainfalls. See bibliography on page 6.

⬆ Microkarren (micro-rills, -pits and -networks) superimposed on shallow rain-pits and rillenkarren.

⬇ Microkarren (networks and radiating vari-width rills) on a pavement of tessellated cobbles.



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Micro-rills

These are the most common type, also known as *Rillensteine*. They are narrow grooves, running down gentle slopes; typically 1 mm wide, and less than 1 mm deep, and a few decimetres long (up to 60 cm long in the Gregory Karst). They vary from straight, to sinuous [4] to tightly meandering [8]. There may be some branching, both contributory and distributary depending on whether the slope is spreading or focusing the rills. As the density of branching increases microrills grade to micronetworks (see page 3).

The surfaces can be polished, dull or frosted. The ridges between the rills can be sharp [4] or rounded [5], and some may be bleached [6]. Some break up into chains of elongate teeth [7].

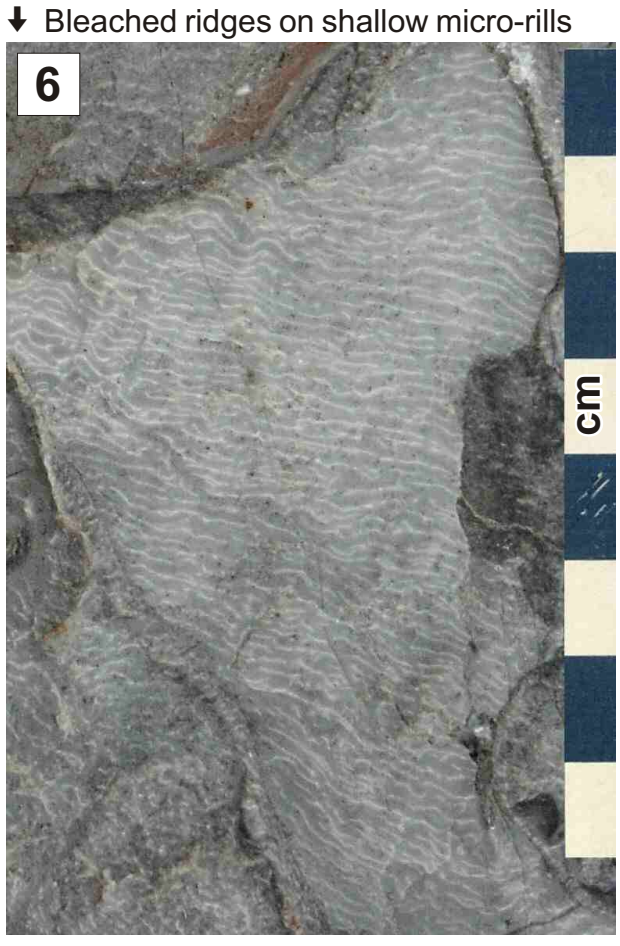
There are (at least) two main sub-types of micro-rill: The most common type are regular in width, sharp-ridged, with parallel sides, and can be straight, sinuous or meandering [2, 4, 8]. A less common type, mainly found on the gently domed surfaces of cobbles, is variable in width (fanning out and widening downslope) with either sharp or rounded ridges [3, 5, 13].

Occasionally, microkarren can be superimposed on rillenkarren splitkarren or rainpits, and may modify their form [2, 7, 8]. They are also found on the underside of some cobbles, but generally in a subdued or rounded form (see page 6). Other cobbles show dense micro-pitting on the underside – presumably from solution in contact with damp soil.

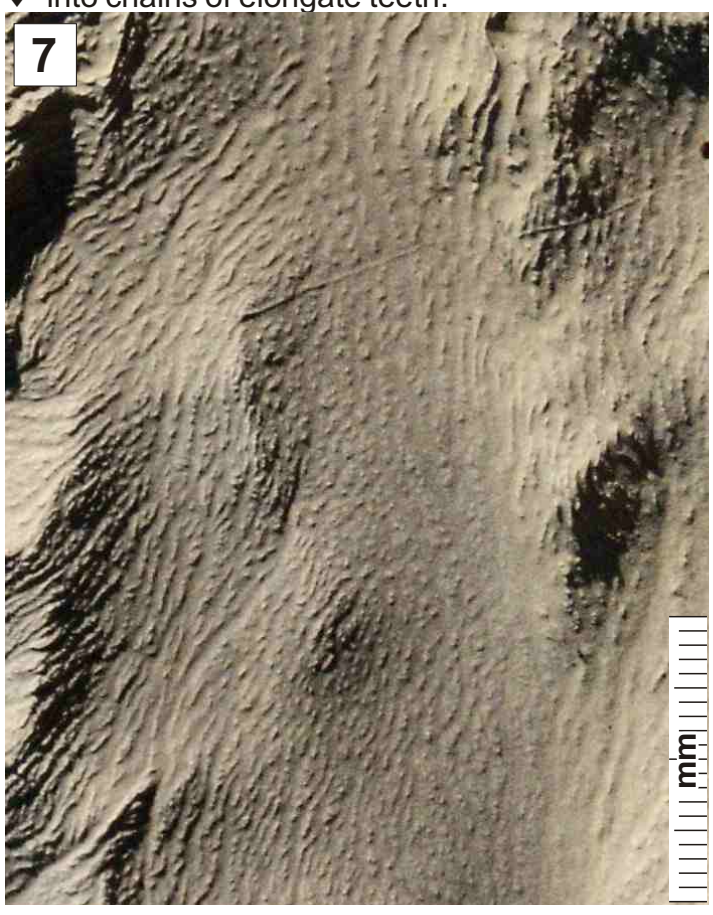
⬆ Sharp-ridged, sinuous and moderately-branching micro-rills

⬆ Round-ridged, radiating, vari-width rills.

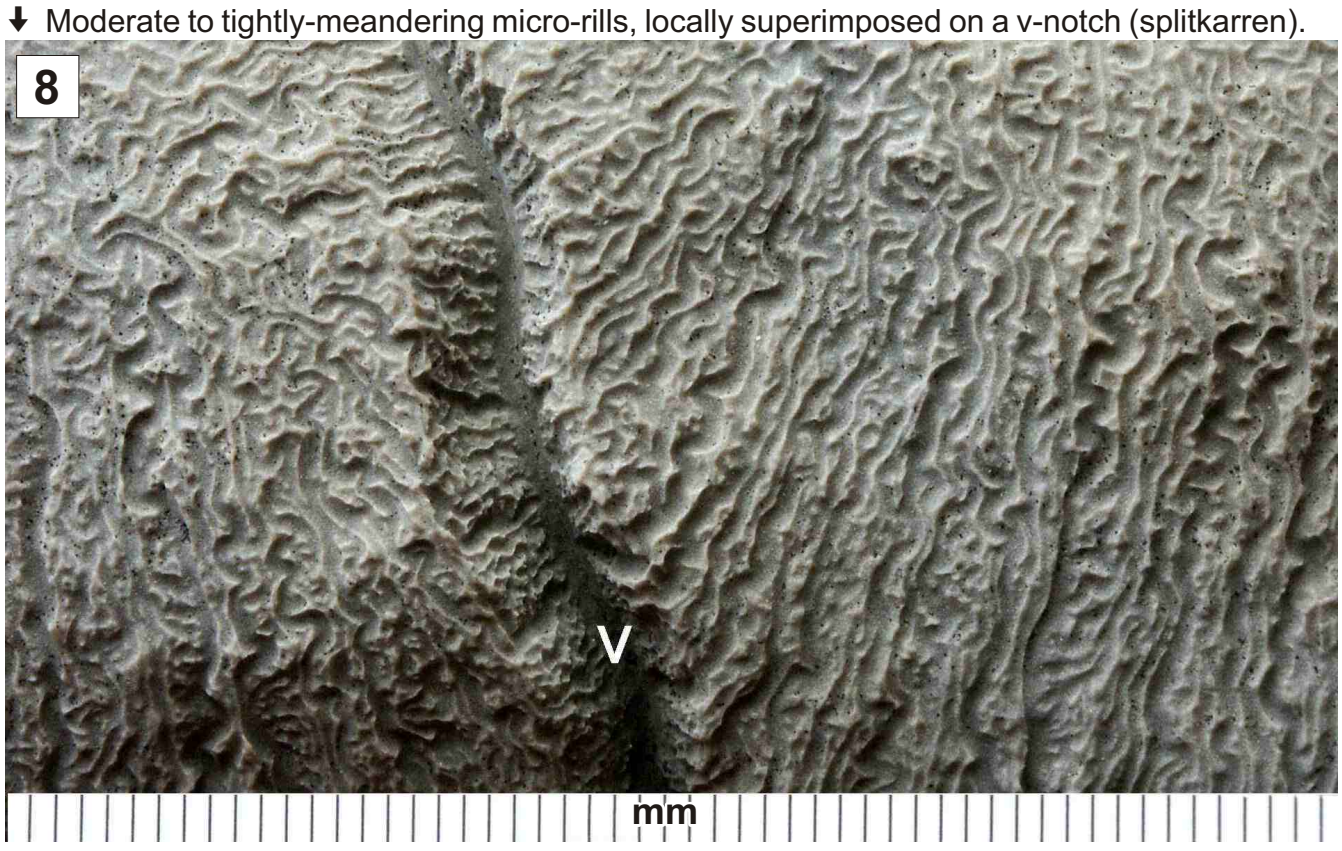
⬇ Bleached ridges on shallow micro-rills



⬇ Toothy-rills. The sharp ridges have broken up into chains of elongate teeth.



⬇ Moderate to tightly-meandering micro-rills, locally superimposed on a v-notch (splitkarren).



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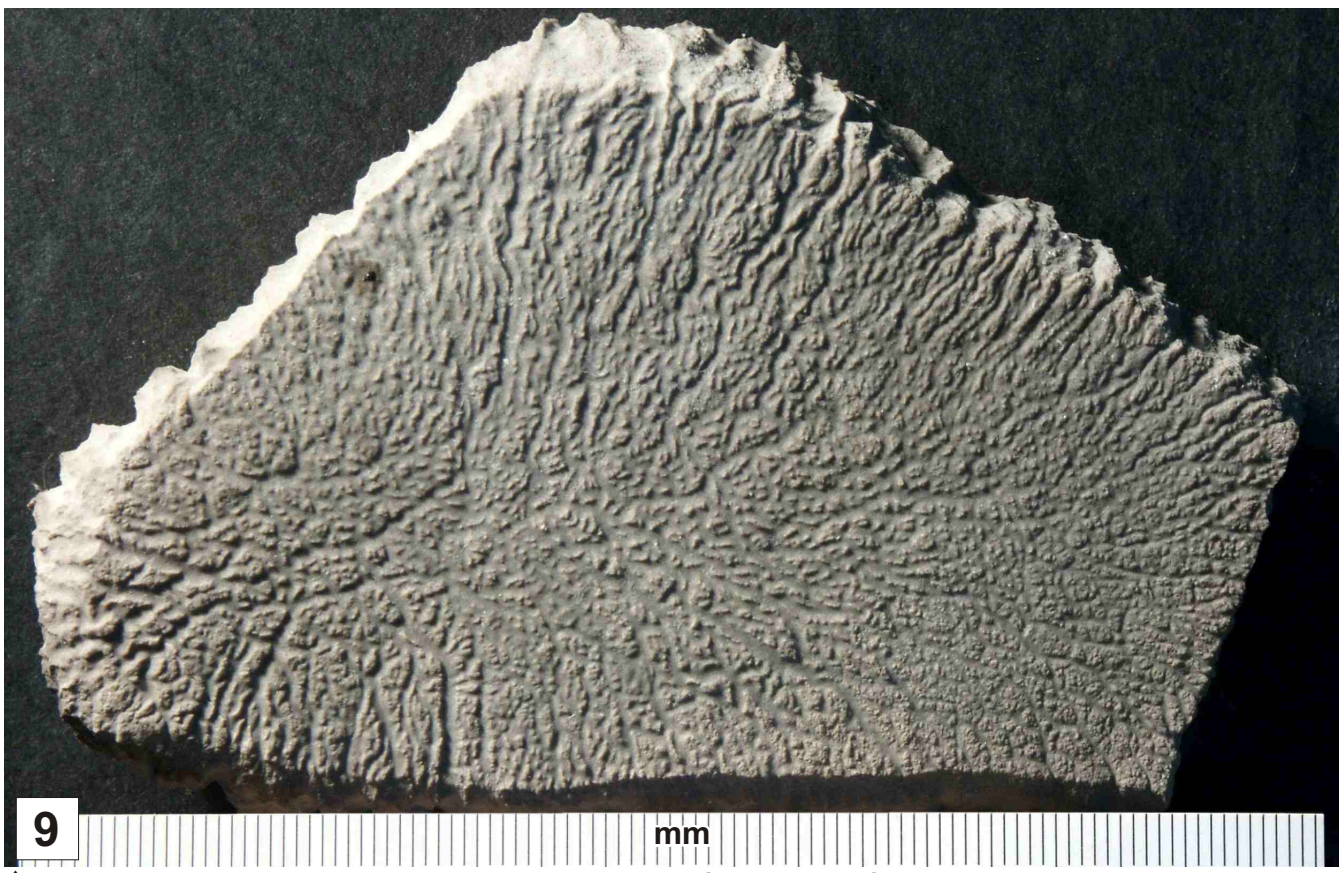
The rill–-network–-teeth gradation

As the density of branching increases micro-rills grade to micro-networks [10] and then to micro-teeth [11]. A typical pattern on cobbles is for the crest to have pits or teeth that grade out through a narrow network zone to radiating rills [9,13].

Micro-networks: Are similar to micro-rills, but more densely branched to form an irregular or elongate network rather than long linear runs [10,2,3]. With increasing branching of the grooves they grade to micro-teeth.

Micro-teeth: In these the network of grooves has become so densely branched that the interfluves have been reduced to isolated sharp, rasp-like, conical or faceted teeth about 1 mm wide and less than 1mm high [11,12,22]. The ridges between micro-rills can also break up into chains of elongated teeth – a type I refer to as "toothy rills" [7].

Micro-pits also can grade to micro-rills [13, and see page 5].

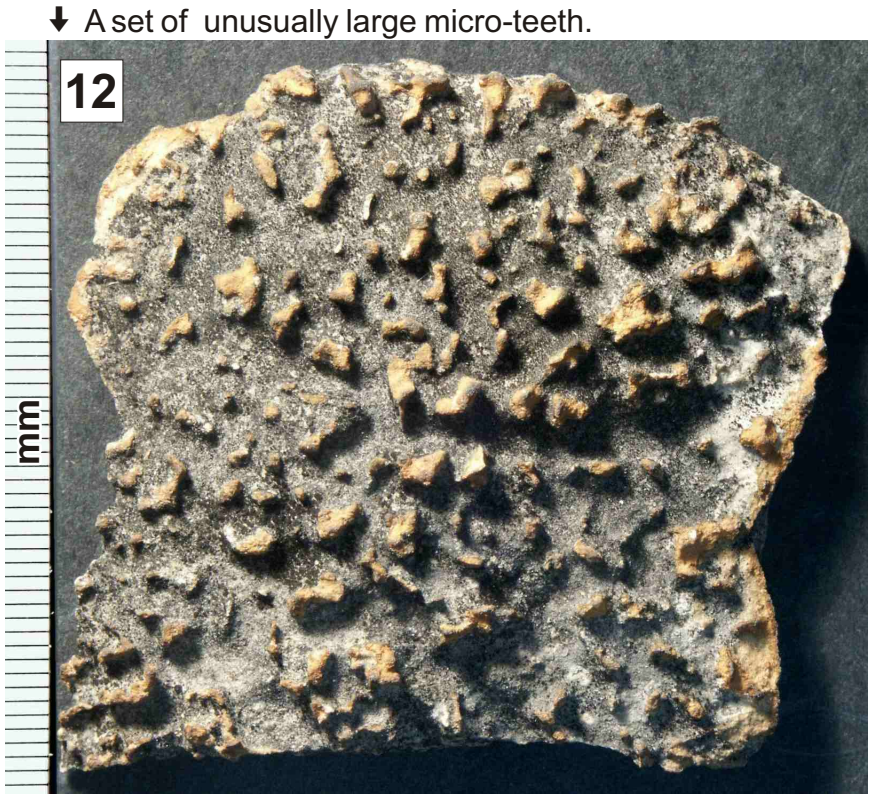


⬆ Micro-teeth grade via networks to rills at edge of a cobble. Coarser decantation rills on edge.

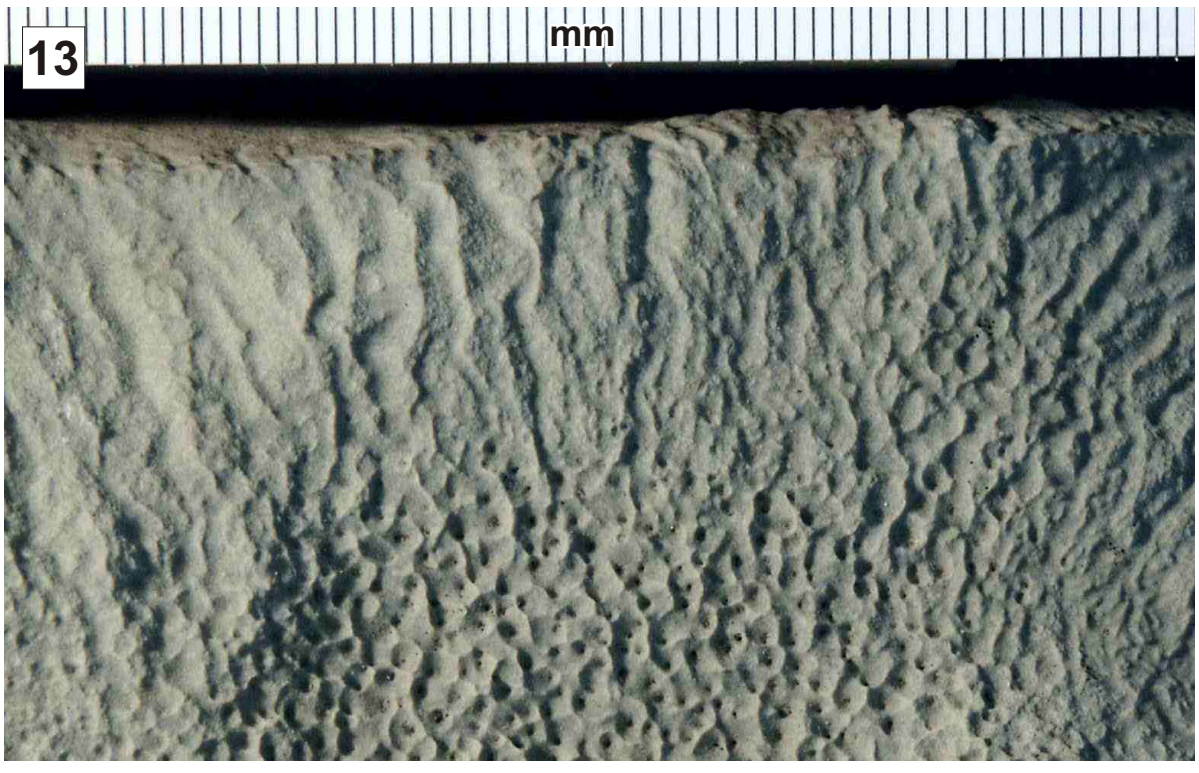
⬇ Micro-network of densely branching grooves

⬇ Faceted micro-teeth

⬇ A set of unusually large micro-teeth.



⬇ Micro-pits on crest of a cobble grade to radiating, vari-width, sharp-ridged rills



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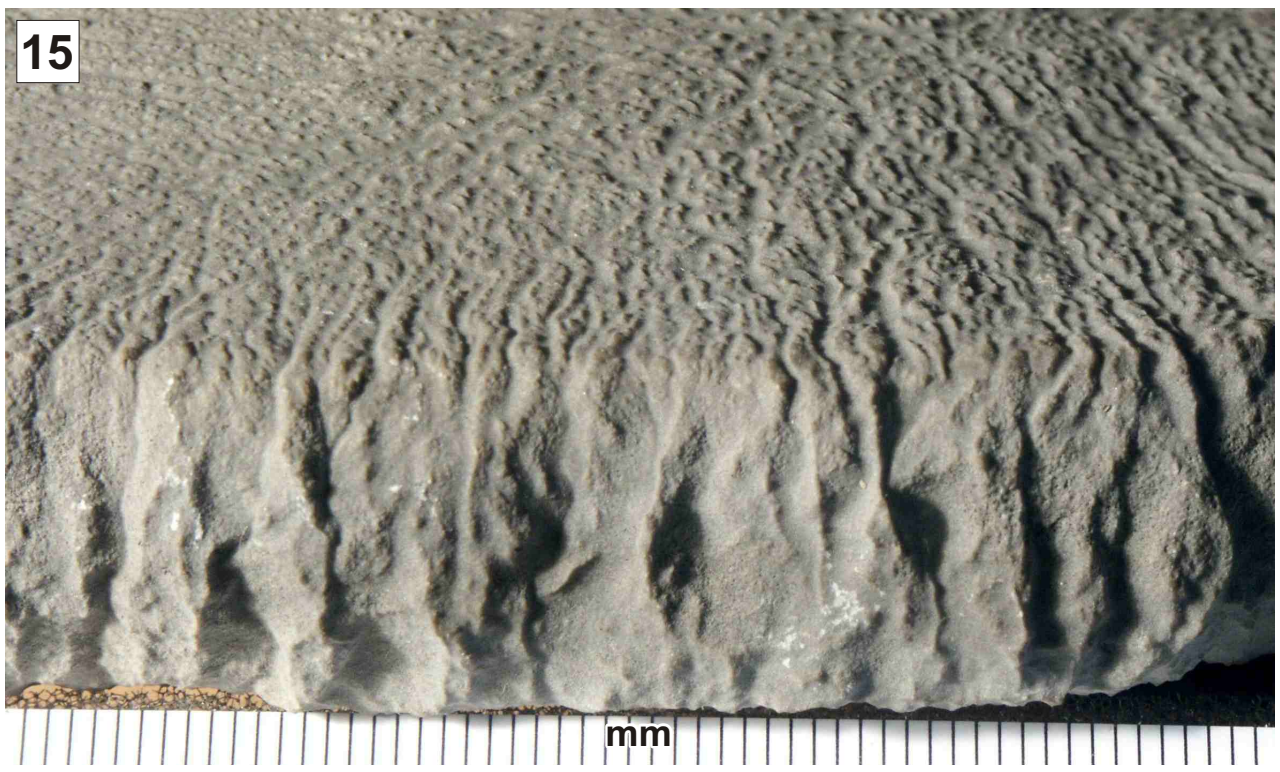
Other Linear Types

Micro-decantation-rills: These run down the vertical sides of a cobble [14, 15], sometimes becoming shallower as they descend – implying a loss of aggressiveness as they descend from their source at the top. They are frequently coarser than the rills that feed them [15].

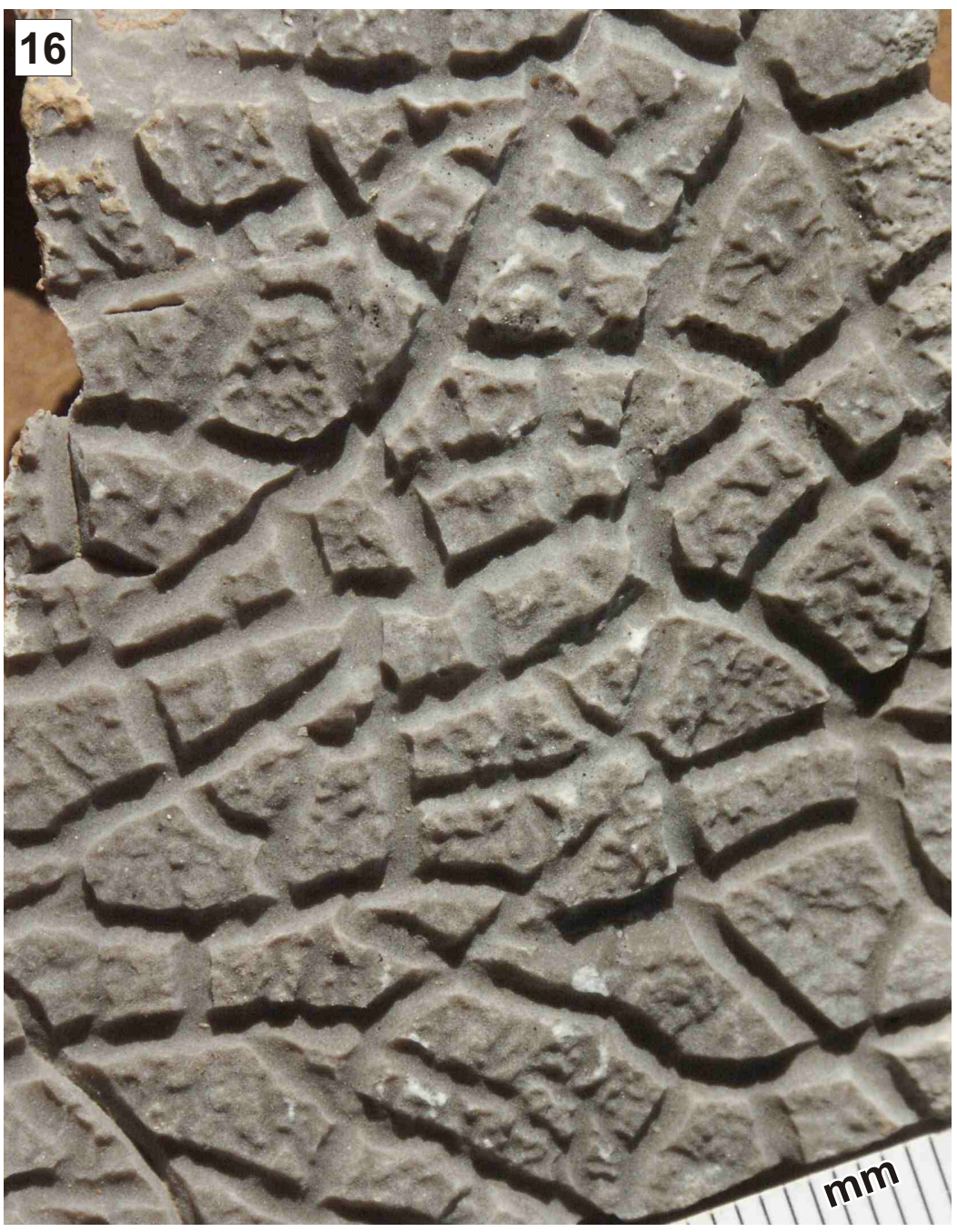
Micro-tessellations: Open networks of U-section notches [16]. They commonly disrupt other pre-existing microkarren and appear to be following a cracking or crazing pattern which is superficial, not deep as in joints. Shallow, barely recognisable, versions are also seen.

Micro-notches: Straight V-section notches that follow cracks, joints or bedding in the rock (a micro version of splitkarren). They have a broad range of sizes [17]. These are an etching of the rock structure, and may not be genetically related to the other (surface-tension) microkarren.

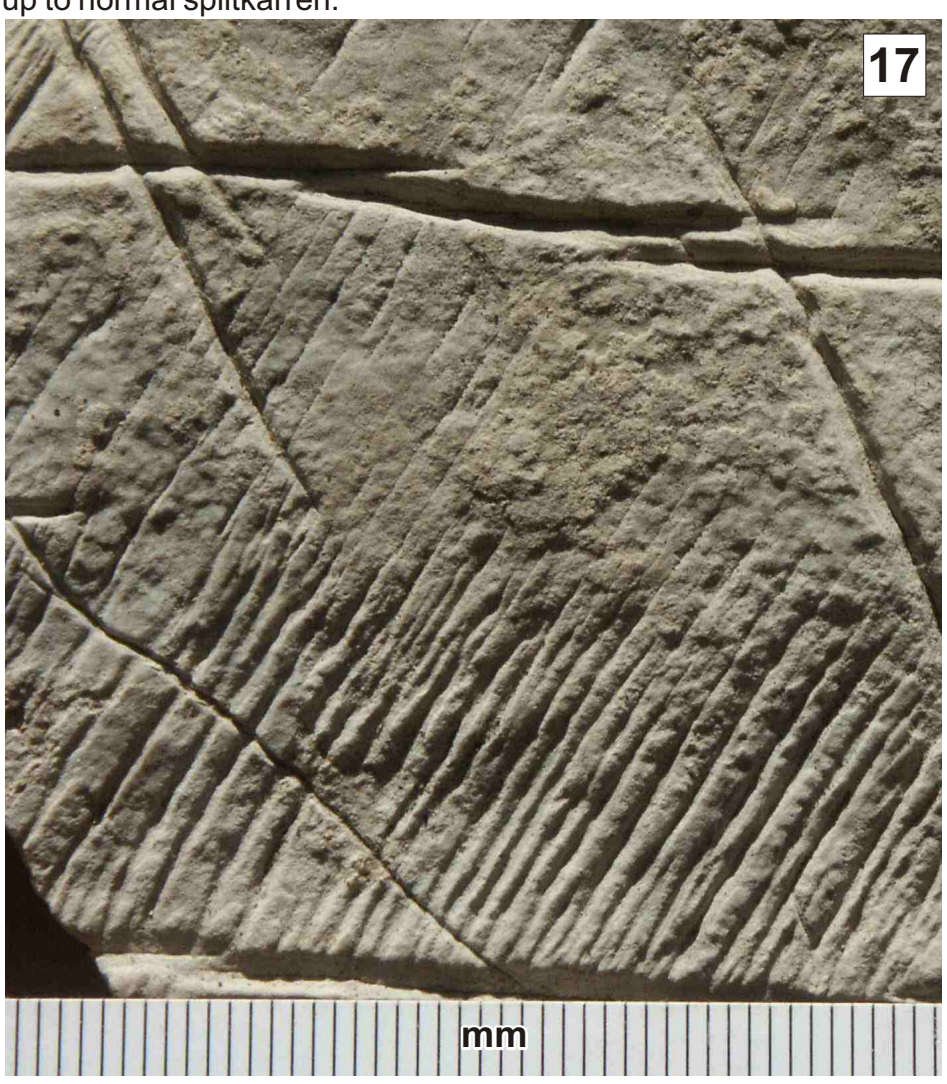
↑↓ Micro-decantation-rills run down vertical sides of cobbles.



Micro-tessellations cut a pre-existing surface of micro-teeth. ➔



↓ Micro-notches range in size up to normal splitkarren.



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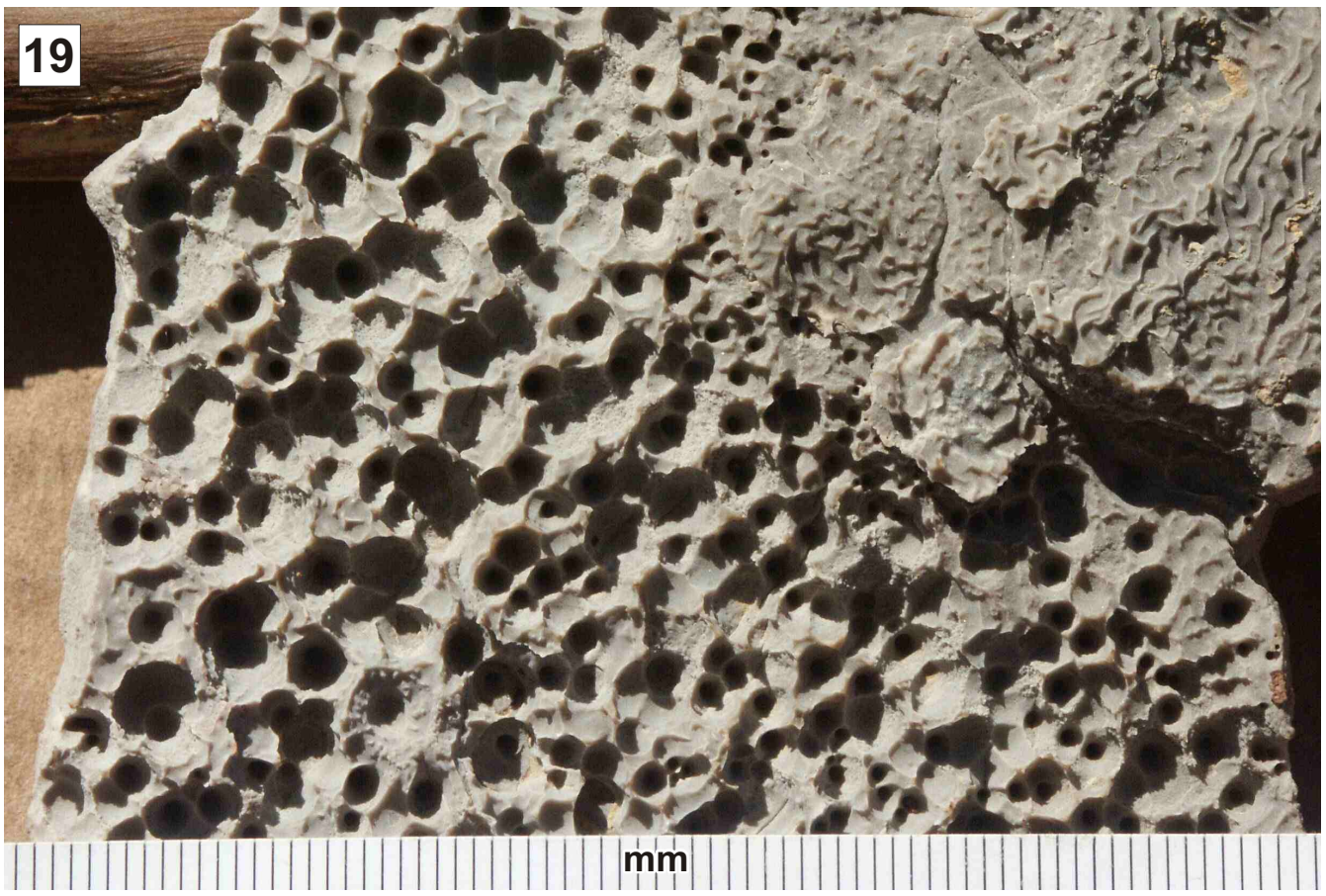
Non-linear Types

Micro-pits: Hemispherical to conical pits occur in a wide range of sizes from 1 mm wide and deep up to 20 mm (i.e. grading to normal "rain-pits") [13, 18-20]. A broad range of sizes can occur within a single outcrop [18]. Possibly there are several modes of formation for these and only some would be related to microkarren of surface-tension origin. On gently-domed surfaces there is a tendency for micro-pits to occur on the crest and grade to micro-rills on the slopes [13].

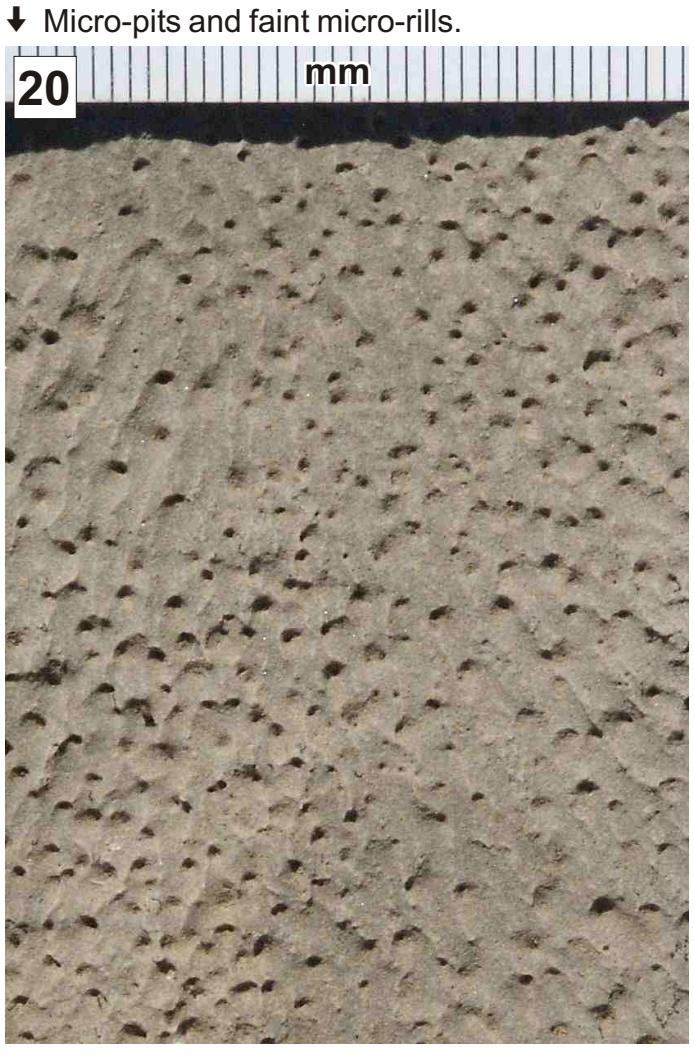
Micro-pans: Shallow pits, 5-10 mm wide, but only 1-2 mm deep [21]. They have flat to slightly concave floors with fine micro-pits or teeth [21]. They are commonly superimposed as scattered clusters on other microkarren – which suggests that they formed later. A possible, but unconfirmed, origin might be concentrated solution beneath pellets of wallaby dung.

⬆ Pits of various sizes

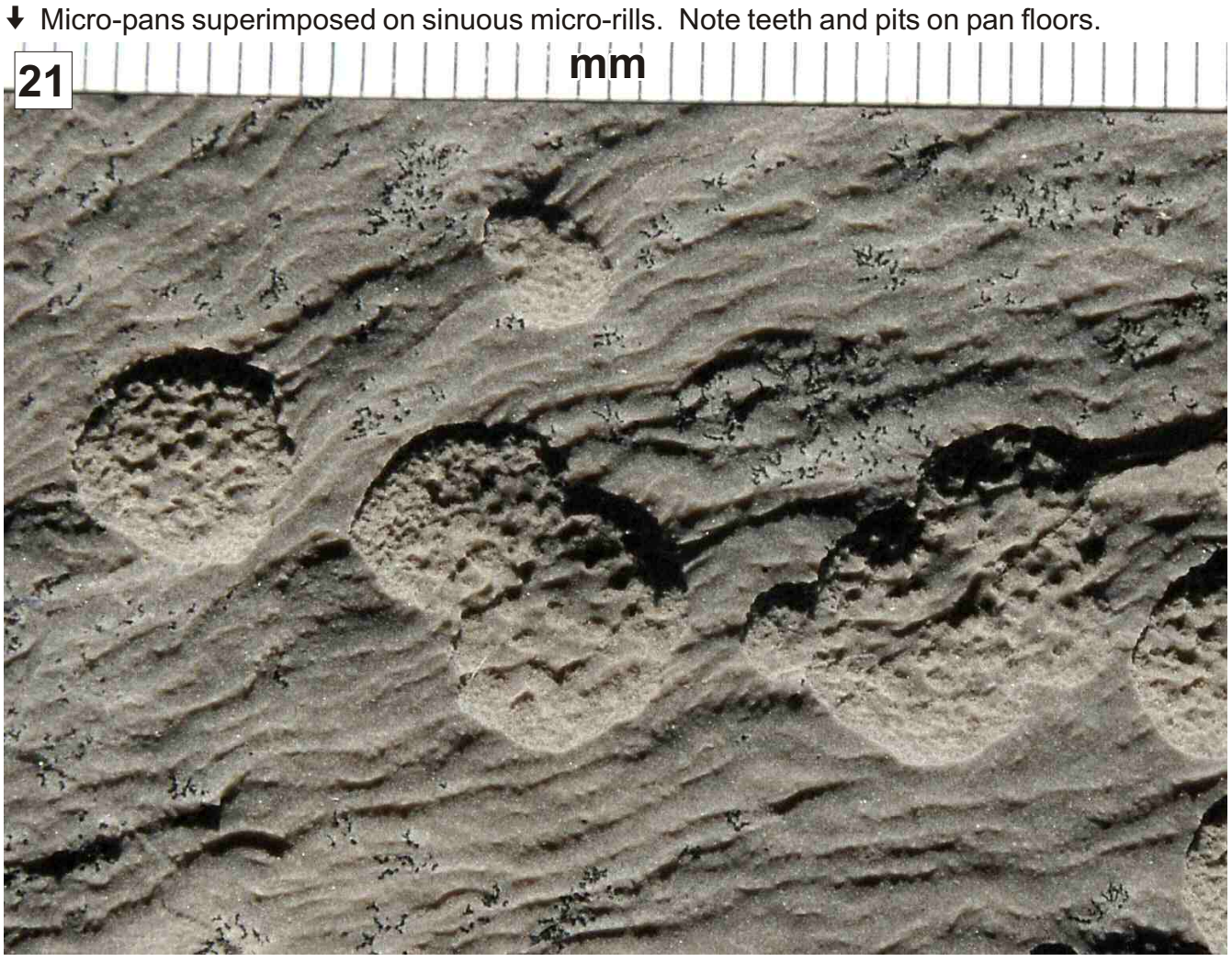
⬇ Deep conical pits restricted to a specific bed (overlying bed at top-right has rills & nets)



⬇ Micro-pits and faint micro-rills.



⬇ Micro-pans superimposed on sinuous micro-rills. Note teeth and pits on pan floors.



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Miscellanea

Etched rock structures: Various structures of fossils, grains, crystals, joints [17], cracks [16] or bedding may be etched out; negatively or positively and sharply or more rounded. These effects are ubiquitous, and just as common beneath soil as on the surface. Etching is not restricted to microkarren processes.

Double-sided cobbles: The underside of cobbles is usually smooth or pitted, but it is not uncommon to find ones with rills and other microkarren [22]. These tend to be more rounded and more shallow. Possibly the cobbles have been kicked over by animals and the initial sculpture smoothed against the soil. However, Lauritzen (1981) demonstrated that 1-2 mm wide rills could form in contact with silt, so these could form directly on an underside against damp soil.

Lithological effects: Microkarren seem to form best on fine-grained (lutite) limestone. However, there is an exception at Chillagoe where (poorer-quality) microkarren occur on coarser-grained marble ("sugar-stone") as well as on finer-grained sparry limestone. Occasionally one sees a local preference for a particular bed, or a variation in microkarren style between adjacent beds [19, 23].

Slopes: Microkarren are most common on gentle slopes, but I have seen rills on slopes up to 60°.

Relationship to meso-karren: Microkarren do not compete well with mesokarren (rillenkarren etc), but the two can co-exist, typically with microkarren superimposed on shallow rillenkarren and rainpits on the flatter crests [2].

In the Gregory Karst they are found where the limestone surface has just emerged from beneath a cover – as the surface becomes dissected by mesokarren the microkarren are mainly lost, but examples still occur on spitz-karren crests. However, the best development is on a thin-bedded fine-grained unit above the main karren-field where mesokarren are rare (Grimes, 2009).

⬆ Double-sided microkarren pebble has sharp teeth on one side (the top?) and rounded teeth on the other (bottom?). Photos by Rudy Frank of a specimen from the Flinders Ranges, SA.

⬇ Thin steep-dipping beds show an alternation of pitted beds and ones with rills.

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