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Cover: Points, Tennant Creek. Photo: Attila Péntek, by courtesy of the Ethnographic Museum in Budapest, Hungary.

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RESEARCH ARTICLE

Stone assemblages from the surroundings of Tennant Creek (Northern Territory, Australia) Part I - Flaked stone assemblage

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Abstract

A large part of the Australian collection of the Hungarian Museum of Ethnography in Budapest, 766 stone artefacts altogether, was donated in November 1977 by László Pintér, a Hungarian citizen who had immigrated from his hometown Tata to Sydney. The stone artefacts have been processed by the author. The results of the processing are presented in two parts. This first part contains the description of the 731 flaked stone artefacts, while the planned second part will describe 15, partly macrolithic, partly edge-ground artefacts. Twenty artefacts will not be described. Most of these are grinding, polishing and smoothing stones with macroscopically undefined functions, for which only a formal description would be possible. In addition to the descriptions of the finds, the papers include detailed descriptions of specific Australian stone tools, based on the available archaeological and ethnographic literature.

Keywords

Australia, Northern Territory, flaked stone tools, Warramunga and Walbiri tribes, Museum of Ethnography in Budapest

Cite as

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"*Sometimes you gotta run before you can walk.*"
~ Tony Stark (Iron Man)

1. Introduction

We have very little accurate biographical data on László Pintér. What does seem certain is that he immigrated to Sydney in 1969 and lived and worked in Australia for about 26 years. He worked in a variety of jobs as a miner and prospector in the Tennant Creek region (Northern Territory), where he collected wealthy ethnographic and archaeological material. Most of these artefacts come from the Warramunga and Walbiri tribes and most of them are stone tools (stone blades, spearheads, stone knives, scrapers, etc.) found as surface finds and would therefore be considered to be archaeological artefacts without archaeological context. However, since the indigenous people of this part of Australia understood and still understand how to make flaked/knapped stone tools up to a few decades ago, and in some places even today, there is virtually no difference between objects 100 and 1,000 years old. These surface finds are therefore a good representation of the culture of the Australian Aborigines and, together with the other raw materials donated with them (kangaroo nails, Spinifex resin, braided human hair, etc.), allow to demonstrate the technology of the Aborigines. The various tools and weapons (boomerang, wooden shield, wooden bowl), musical instruments and ritual objects (didgeridoo, churinga, boomerang, etc.) also provide a good parallel to the material from Central Australia collected by Géza Róheim, a Hungarian psychoanalyst and anthropologist in 1929 (Vargyas, 2000).

2. Ethnohistorical and archaeological background

The town Tennant Creek is located in the middle of the Northern Territory of Australia, in the Barkly

Region, 376.5 metres above sea level. John McDouall Stuart (7 September 1815 — 5 June 1866), a Scottish explorer, was the first European who passed through the region. On his unsuccessful first attempt to cross the continent from north to west, on 6th June 1860 named a creek north of the town "Tennant Creek", after John Tennant Esq. of Port Lincoln, a financier of his expedition (Hardman, 1865, p. 197). The Warumungu (or Warramunga; other synonyms are listed in Tindale 1974, 237 with numerous ethnographic references) people, who lived in the region surrounding Tennant Creek and Alice Springs for thousands of years, called the creek north of the town traditionally Jurnkurakurr. There, the Carpet Snake or Carpet Python (*Morelia spilota*) waterhole is a place of great spiritual significance, one of the most important "dreaming" sites. It is a centre of sacred sites and a place to conduct trade and ceremonies. The Warumungu language belongs to the Pama-Nyungan language family and is similar to the Warlpiri language spoken by the Warlpiri people, who are living northwest of Alice Springs and west of Tennant Creek (see, for example, Simpson, 2017). Walter Baldwin Spencer (23 June 1860 — 14 July 1929), British-Australian evolutionary biologist, anthropologist and ethnologist, and Francis James Gillen (28 October 1855 — 5 June 1912), Australian anthropologist and ethnologist, spent two months amongst the Warramunga. Their account of their lifestyle, their weapons and everyday tools, and their religious rituals and ceremonies is certainly the most complete ethnographic record of the Warumungu people (Spencer & Gillen, 1912, pp. 364–439).

In Fig. 1, some archaeological sites closest to Tennant Creek can be seen from which stone assemblages have been published. As one can see, even the nearest sites are located at a distance of 150 to 260 km (ca. 93 to 162 mi) as the crow flies.

The Helen Springs sandstone quarry is situated within the Ashburton Range, on the edge of the Barkly Tablelands, within the Northern Territory, at a distance of 150 km (ca. 93.2 mi) from Tennant Creek. The site is called Kurutiti (or Kuratiti) and is associated with the tradition concerning two quiet snake sisters known as Milywaru (or Milwayi, especially by Warumungu speakers). The Milywaru Dreaming track with its associated mythological tradition is extensive, passing through among others Warlpiri and Warumungu countries (Ellwood, 2019, p. xvi). Kenneth J. Mulvaney (1997), in his doctoral thesis, investigated the nature of production and distribution of prehistoric sandstone artefacts produced at the quarry. He was concerned principally with those implements used in milling of seed but reviewed a very rich, varied flaked stone assemblage as well (Mulvaney, 1997, pp. 87–109). The flaked stone artefacts were made of a range of raw materials, such as quartzite and silcrete, chalcedonic chert, chert, and banded chert (Barkly Tablelands variant), as well as the basic igneous rocks, basalt and coarse-grained dolerite. The assemblage included both unifacial and bifacial points. Of the unifacial points, the so-called pirri points failed. The trimming of the butt is a distinct character of the bifacial points. Points made up about 43% of the entire flaked formal implement classes. For the manufacture of points, silcrete and quartzite were the more frequently used raw materials. Within the symmetrically formed bifacial points, having usually well-rounded, thin butts, the use of pressure flaking is evident. It is characterised by the narrow extended flake scars, commencing from a relatively small negative cone of pressure point (Mulvaney, 1997, p. 92).

The Renner Springs silcrete quarry is located 20 km (ca. 12.4 mi) north of Kurutiti. The first recorded information related to the silcrete quarries was conducted by Spencer & Gillen (1904, 641). They also described the knapping of leilira blades by Warramunga (Warumungu) craftsmen (see, also, Spencer & Gillen, 1912, pp. 375–375). These large-sized blades were used, trimmed or untrimmed as knives or spear-points (Akerman, 2007).

Lake Woods is an ephemeral freshwater lake in the Central Northern Territory, close to the small town of Elliott. It is situated at a distance of about 70 km (ca. 43.5 mi) to the northwest of Renner Springs. In 1985 Mike Smith (1986) carried out a series of excavations. He tried to identify the provenance of lithic artefacts recovered 19 years earlier by James M. Bowler. The excavation revealed an assemblage of lithic artefacts situated in situ in the dune sediments, which on typological criteria are less than 6,000 years old. Recently, Ceri Shipton and colleagues (2021) reported on a project intending to explore the archaeological potential of the area further and to conduct archaeological, geochronological and geomorphological investigations at the locations, which were localised by Smith. Besides the field surveys, which yielded surface collections of diverse stone artefacts, test excavations were also undertaken at three sites on the western side of the lake basin in 2019. At the site of Gully Mouth, OSL age estimations indicate human occupation spans ~5–1 ka. In the surface collections, there were unifacial and bifacial points as well. The points included some particularly finely made Northern Territory Triangular Points, with

Figure 1. Some archaeological sites in Northern Territory. Figure: Attila Péntek, basemap: World Imagery, WGS 84.

plano-convex profiles (i.e., one flat and one domed surface). According to Kim Akerman & Peter Bindon (1995, p. 91), these points appear to be prehistoric, there being no known ethnographic record existing.

Robert Paton (1994) carried out a research project in an area around the centre of the Northern Territory. The Mudburra and Jingili Aboriginal groups, who live at the small settlement of Elliott (situated at a distance of about 260 km or ca. 161.6 mi from Tennant Creek), retained considerable knowledge of an extensive exchange system of large-sized quartzite artefacts commonly named leilira blades. These were manufactured at four local quarries. The selected quartzite cobbles and boulders were subjected to heat treatment to crack the rock and break it up and at the same time remove any faults which may affect knapping. Flaking properties of certain rocks could be enhanced by controlled heating of the raw material (see, for example, Crabtree, 1970, p. 5; Domanski & Webb, 1992, 2007; Webb & Domanski, 2008). The evidence of the heat treatment process was reported in numerous regions, including the Kimberley (Akerman, 1979), central Queensland and the northeast (Cochrane et al., 2012). From a technological point of view, it is worth mentioning that core preparation is minimal. The cores usually possess an unmodified striking platform with an edge angle of about 90 degrees. If it was necessary, the edge of the platform was rubbed with another rock to remove any minor overhang. The hammer was made traditionally of chert. The prime reason for making the lithic artefacts was trade. Debitage by-products or broken blades were likely used to manufacture tools for local everyday usage.

3. The flaked lithic assemblage from the surroundings of Tennant Creek

All data, concerning the natural alteration process of lithic artefacts, the necessary technological remarks on the lithic assemblage, the typological and morphological remarks, and the detailed description of specific Australian tool types will be summed up in the SI001 Supporting Information file.

4. The raw materials in the assemblage

For reasons of space, it is not possible to describe the complex geology of the Tennant Creek region. It has been documented by Nigel C. Donnellan and colleagues (1995; see also Donnellan, 2013) and a chronological framework was independently developed by David M. Compston (1995). Given that determination of rocks macroscopically, with the naked eye is almost impossible without proper petrographic analyses, the author used a somewhat arbitrary classification system during processing. The geological formation of individual rocks could not be consistently validated during classification. Taking it as a general framework, the author relied basically on the work of Swapan K. Haldar & Josip Tišljar (2014). It was a rather great difficulty that there were quite a few publicly available publications about the study area, Tennant Creek (see, for example, Cozens, 1992; Crone et al., 1992). Since quartz is one of the essential constituent minerals of the vast majority of the rocks present in the assemblage, it is necessary to make some descriptive remarks in this regard. Quartz is silicon dioxide (SiO_2), a hard but brittle mineral, a significant component of many igneous, sedimentary, and metamorphic rocks, such as sandstone, quartzite etc. (Bons, 2001). Quartz can be broadly divided into cryptocrystalline (or microcrystalline; extremely fine-grained dense and compact forms) and macrocrystalline forms (varieties that develop visible crystals or are made of large intergrown crystals). The modern classification scheme of quartz, taking into consideration the structure and physical properties creates two types: quartz (macrocrystalline quartz) and chalcedony (cryptocrystalline quartz) (e.g. Götze, 2010, pp. 166, Fig. 2). The "grainy" varieties of cryptocrystalline quartz include flint, chert, and jasper, and are described as rocks instead of minerals (as they have less SiO2 in their composition). Macrocrystalline forms include vein quartz and rock crystal, while the artefacts made of them will be referred to as "lithics" in archaeological parlance, they are in fact minerals.

The raw material classes defined by the author are the followings:

4.1. Raw material class 1 (RMC-1)

Quartzite. It is a compact, hard, non-foliated, medium to coarsely crystalline metamorphic rock. It has a typical equigranular texture, that is, the grains mutually adjust their boundaries to achieve textural equilibrium. Pure quartzite is metamorphosed from quartz-rich sedimentary rocks, such as, for example, pure quartz sandstone (Haldar & Tišljar, 2014, p. 286). The quartz content exceeds 90 per cent in most quartzites. The extreme toughness of quartzite made it a favourite rock for use as an impact tool. Its conchoidal fracture allowed it to be shaped into large cutting tools, but its coarse texture makes it difficult for producing tools with fine edges.

Orthoquartzite. Generally, in terms of metamorphism, there are two varieties of quartzites, metaquartzite and silicified sandstone, known as orthoquartzite, although it is often difficult to distinguish them. Orthoquartzites have not undergone a metamorphosis. Quartz grains are interlocked and hardened by a cementing process in orthoquartzites, and fracture happens along the internal cement interstices between the individual quartz grains.

Silcrete. According to the definition of Médard Thiry & Anthony Milnes (2017), along the lines of that proposed by Richard A. Eggleton (2001), silcrete is "Strongly silicified, indurated regolith, generally of low permeability, commonly having a conchoidal fracture with a vitreous lustre. Represents the complete or near-complete silicification of regolith by the transformation of precursor silica or silicates and/or the infilling of available voids, including fractures. On a macroscopic scale, some silcretes are dense and massive, but others may be nodular, columnar, blocky, or cellular with boxwork structure. On a microscopic scale, the fabric, mineralogy and composition of silcretes may reflect those of the parent material, but also indicate the changes experienced by, as well as the general environments of, silicification." Sandstone and quartzite that have formed specifically as a result of secondary silification of the regolith are silcretes. The quartzitic silcrete types are typically formed in sands by cementation of the detrital quartz grains or other forms of silica.

4.2. Raw material class 2 (RMC-2)

This class contains several siliceous sediments (silicites), and sedimentary rocks, which are known under the general name of "chert". Cherts appear as layered rocks or as nodules, lenses and irregular clumps and include all solid-silicon rocks, disregarding the origin of silicon minerals. Bedded cherts appear in the form of thin layered or tens of meters thick chert deposits within, among others shale or fine-grained greywacke sandstone. Most bedded cherts occur mainly by processes of recrystallization of diatomite, radiolarites and spiculite or acid tuffs and volcanic glasses. Nodular and lenticular cherts occur within limestones and dolomites and consist of microcrystalline and/or cryptocrystalline quartz. Cherts vary in colour, expressing the present trace elements in the rock. In the lithic assemblage, only two types of sedimentary rocks could be identified with more or less certainty. One is chalcedony, a microcrystalline fibrous variety of quartz, and may be semi transparent or translucent. The other is jasper, an opaque variety of cryptocrystalline chalcedony, containing a significant proportion of Fe-oxides. The reddish colour comes from hematite and the brownish colour from goethite (Haldar & Tišljar, 2014, pp. 121–212).

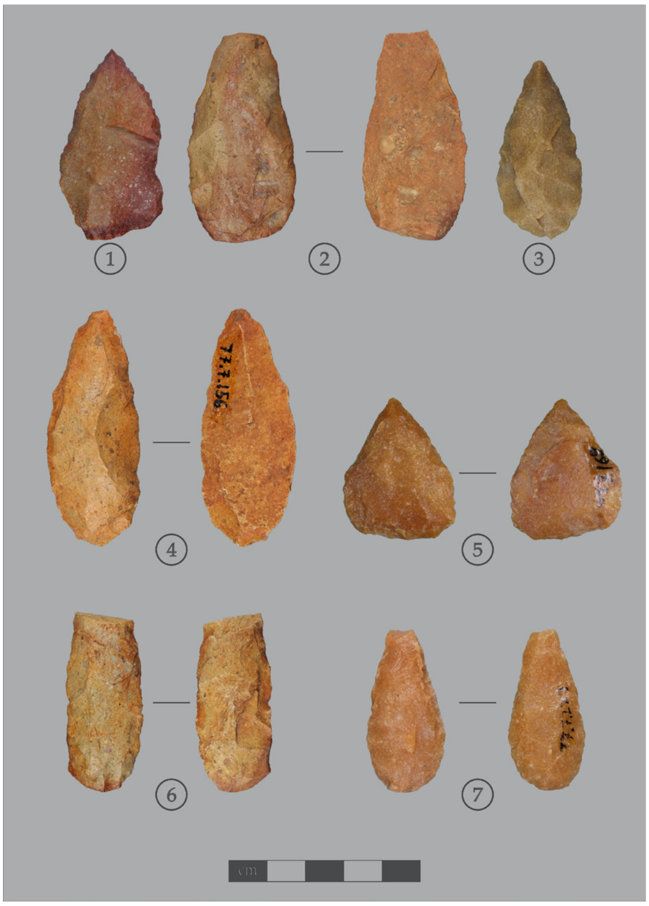
4.3. Raw material class 3 (RMC-3)

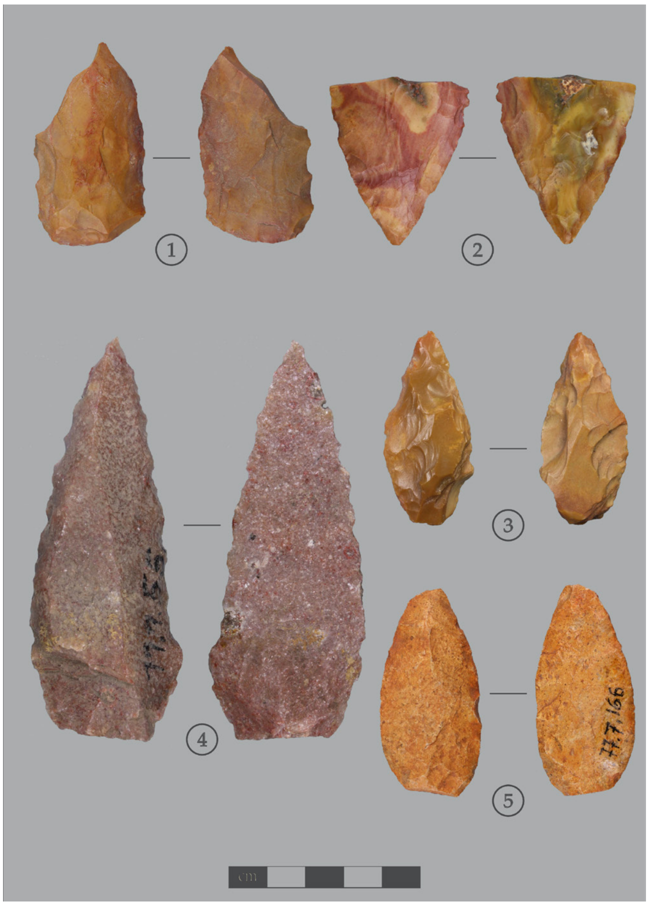
This class contains several clastic (detrital and mechanical) sediments and sedimentary rocks, which are composed of particles, grains, and fragments that resulted from physical and chemical weathering. Macroscopically, without having a good deal of experience, the different types are hardly distinguishable. Silt is loose pelite (clayey fine-grained clastic sediment or sedimentary rock) sediment and siltstone is a pelite rock, containing >66% silt grain size. The dominant component of siltstone is angular quartz. Shales are thinly laminated fine-grained pelite clastic rock composed predominantly of siliciclastic materials. Shales can be grouped as clay and mud shale based on the mutual sharing of particles of clay and powder. Mudstones (or poorly lithified argillites) are, unlike the shale, homogeneous, solid lithified rocks that contain a mixture of clays and particle size of powder (Haldar & Tišljar, 2014, pp. 145–162).

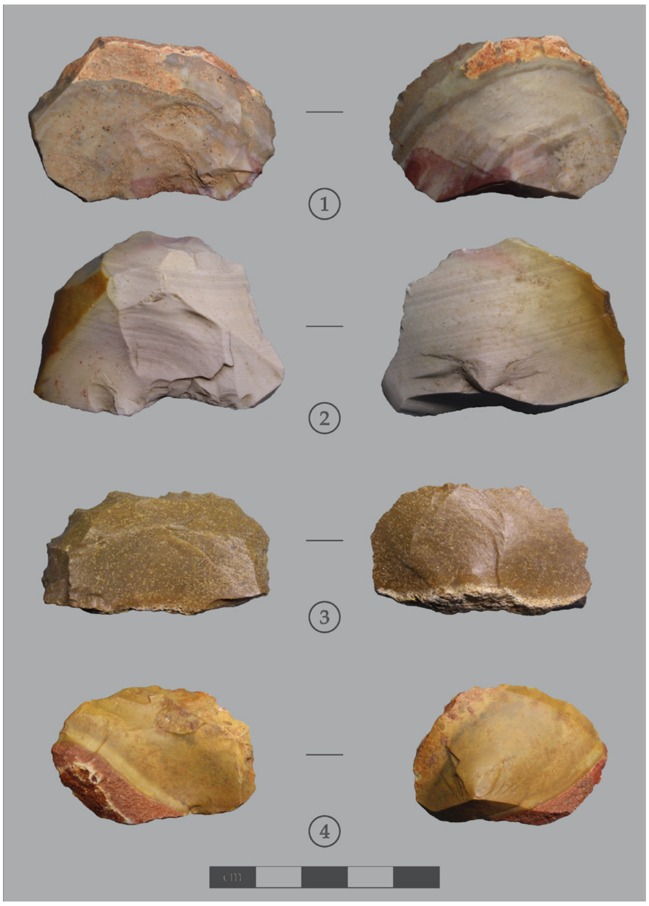
As regards the raw material utilisation of the 731 artefacts, the raw materials of the RMC-1 raw material class (406 artefacts; 55.54%) dominate those of the RMC-2 raw material class (302 artefacts; 41.61%). The RMC-3 raw material class is represented by 23 artefacts (3.15%; there is a single artefact of nummulitic sandstone, a rather peculiar raw material). In RMC-1 the 331 artefacts made of quartzite (81.53%; 45.28% of the total) dominate over the 75 artefacts made of silcrete (18.57%; 10.26% of the total). In RMC-2, there are 224 artefacts made of "chert" (74.17%); 30.64% of the total, 73 artefacts (24.17%; 9.99% of the total) made of chalcedony. The amount of three jasper artefacts (0.99%; 0.41% of the total) and two opalite artefacts (0.66; 0.27% of the total) is negligible.

5. Technological remarks on the flaked stone assemblage

From a technological point of view, during the flaking, generally, the "direct percussion with a hard hammer" technique was used. The "direct percussion with a soft hammer" technique was used to manufacture chiefly the unifacial and bifacial points and the bifacial tools. It is likely that at Tennant Creek, at least a part of







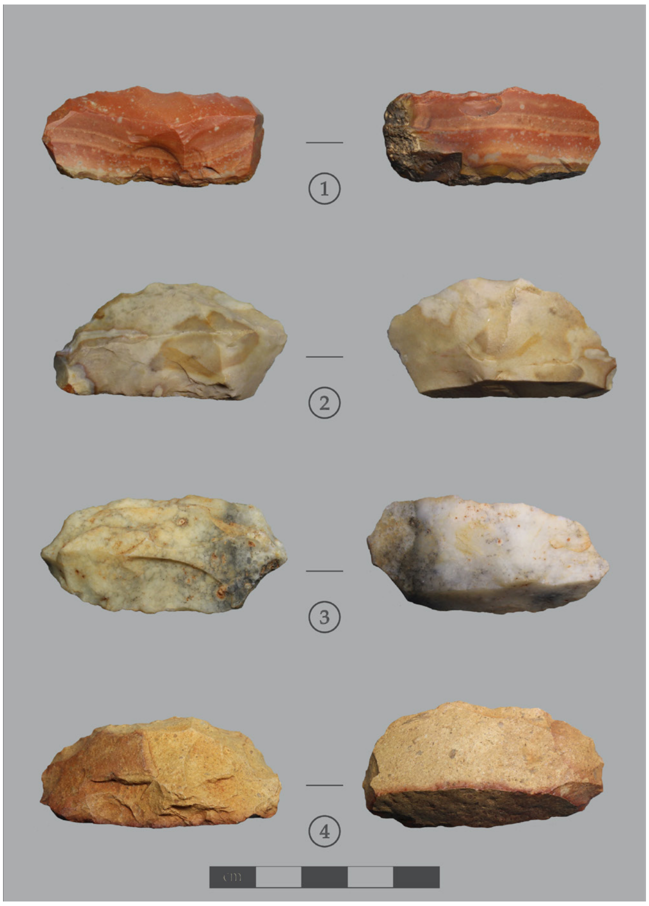


Figure 2 (upper left). Points. **Figure 3** (upper right). Points. **Figure 4** (lower left) Tulas. **Figure 5** (lower right) Tula adzes. Figures: Attila Péntek, by courtesy of the Ethnographic Museum in Budapest, Hungary.

the unifacial and bifacial points was made by pressure flaking. Only a detailed technological analysis could identify the applied retouching technique. Particularly, the differentiation between the percussion flaking technique and the ”rolling pressure technique” (*sensu* Tindale, 1965) requires a good deal of experience. Some end-scrapers, especially those, which were made of small-sized pebbles and adzes or slugs, bear the incidental evidence of the application of the bipolar-on-anvil technique.

The butt of 543 artefacts could be identified. The plain butts have a clear dominance (365 artefacts; 65.38%) over the cortical butts (131 artefacts; 24.13). The number of winged butts is 27 (4.97%); there are 15 faceted (2.76%) and 11 crushed (2.03%) butts. The two punctiform (0.18%), one dihedral (0.18%) and one linear (0.18%) butts are rather negligible.

The preparation of the striking platform is not common, only 427 artefacts (58.41%) show evidence of overhang removal. In the case of the remaining 304 artefacts (41.59%), there is no recognizable preparation at all.

Classifiable cores are practically absent in the assemblage. There are altogether four non-hierarchic flake cores of irregular shape. Two cores were made of “chert”, one of them is a very small-sized specimen. There is a quartzite core and there is a small-sized core made of nummulitic sandstone.

6. The main characteristics of the discussed flaked stone assemblage

First of all, it should be emphasised that it was not possible to rigidly apply Valoch’s type list when processing the assemblage (Valoch, 1979). The transition between the individual subtypes is relatively continuous and subjective judgement is given a lot of space during the classification of individual artefacts. At the same time, the collection also contains a large number of atypical, often ad hoc, spontaneous tools that can be practically not fitted into any typology. Below, the order of Valoch’s type list will be followed. If necessary, Valoch’s comments on the tool type will be referred to.

6.1. Points

Valoch (1979, p. 116) defined points as “blades or pointed flakes, either completely untrimmed or partly trimmed, either only marginally or uni- or bifacially, flat. They are as a rule symmetrical to the axis of formation, they have straight edges or convex ones and the angle of the point should exceed 45°”.

Jared Brindley & Chris Clarkson (2015, p. 12) pointed out that a strict definition that requires a deliberately fashioned sharp point, overlooks numerous elongated flakes with a natural pointed tip. They can be referred to as “convergent flakes”. Such artefacts appear to have been systematically manufactured in Wardaman Country (Northern Territory) and were used for various activities. For the sake of simplicity and to avoid confusion, during the analyses of the assemblage from Tennant Creek, the more general definition of Clarkson & David (1995, p. 22) was applied. According to this definition, “points are defined as any flake tapering to a point at the distal end for more than half of its length, irrespective of retouch.”, that is, actually all pointed artefact, which cannot be classified otherwise, fall into the category of points. The degree of skewness was for all artefacts recorded. In general, an off-axis deviation of fewer than 10 degrees was considered a “slight skewness”.

In Tennant Creek, there are 263 points, which represents 35.98% of the total flaked assemblage of 731 pieces (Table 1). The raw material class 1 (RMC-1) dominates with 199 pieces (75.95%), followed by RMC-2 (64 pcs., 24.34%). In RMC-1, there are 157 quartzite artefacts (78.89%) and 42 silcrete (21.11%). In RMC-2, there are 39 “chert” artefacts (60.94%), 24 chalcedony artefacts (37.5%) and a single jasper artefact (1.56%). The dominating point type is that of the bilaterally trimmed points (Type Nos. 1.4.1, 1.4.1 var, 1.4.2, 1.4.3, 1.4.5., 1.4.6; 109 pcs., 41.44% of the points), the untrimmed points (Type No. 1.1; 79 pcs., 30.04% of the points) and the bifacial points (Type Nos. 1.6.1, 1.6.2; 55 pcs., 20.91%). Interestingly enough, the number of the unifacial points, that is the pirri points is rather low (Type Nos. 1.5.1, 1.5.2; 10 pcs., 3.8%).

Among the 10 unifacial points, four specimens were made of RMC-1 raw material, one piece of RMC-2 raw material (chalcedony) and five points of RMC-4 raw material. The base is intentionally broken in one case, there are three points with a trimmed base and four specimens have plain butts. Five points are centred, three points are slightly right-oriented, one specimen is slightly left-oriented and a piece (the one made of chalcedony) is right oriented (the orientation angle is greater than 10 degrees). There are only three undamaged unifacial points, there are five proximal fragments, a distal fragment with an intentionally broken base and there is a point with a broken tip.

Among the points, the bifacial points are undoubtedly the most interesting, also because of

Table 1. Type and raw material distribution of the points

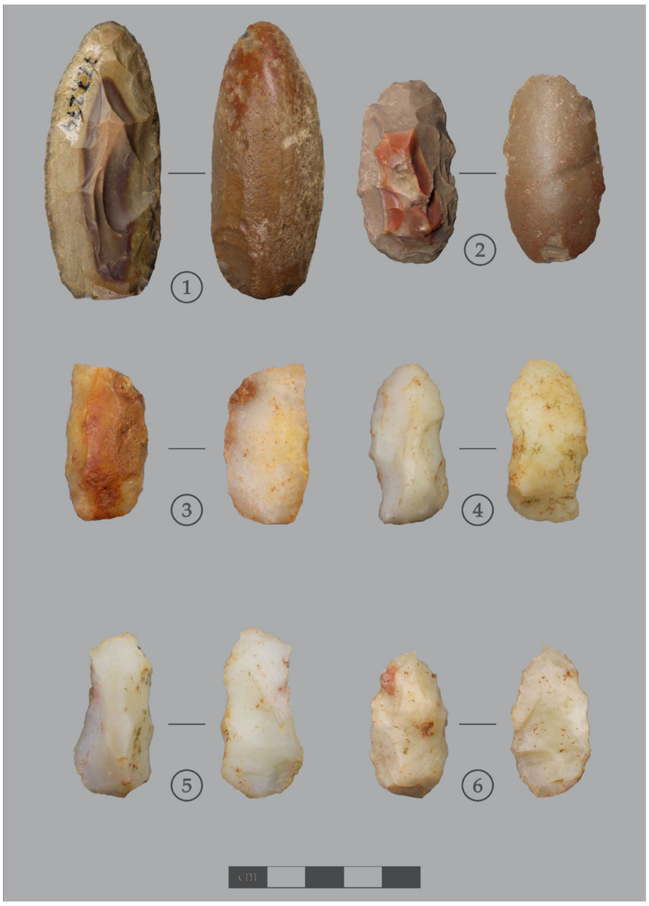
	Type No.	Type	RMC-1		RMC-2			#	%
			Quartzite	Silcrete	Chert	Chalcedony	Jasper		
Points	1.1		52	4	17	6	0	79	30.04
	1.2		8	0	0	1	0	9	3.42
	1.3		1		0	0	0	1	0.38
	1.4.1		36	5	2	3	0	46	17.49
	1.4.1 var.		20	3	5	5	0	33	12.55
	1.4.2		1	0	0	0	0	1	0.38
	1.4.3		0	1	0	1	0	2	0.76
	1.4.5		9	1	5	2	0	17	6.46
	1.4.6		5	2	2	1	0	10	3.80
	1.5.1	Unifacial point	4	5	0	0	0	9	3.42
	1.5.2	Unifacial point	0	0	0	1	0	1	0.38
	1.6.1	Bifacial point	12	9	1	3	0	25	9.51
	1.6.2	Bifacial point	9	12	7	1	1	30	11.41
	#		157	42	39	24	1	263	
	%		59.70	15.97	14.83	9.13	0.38		100.00

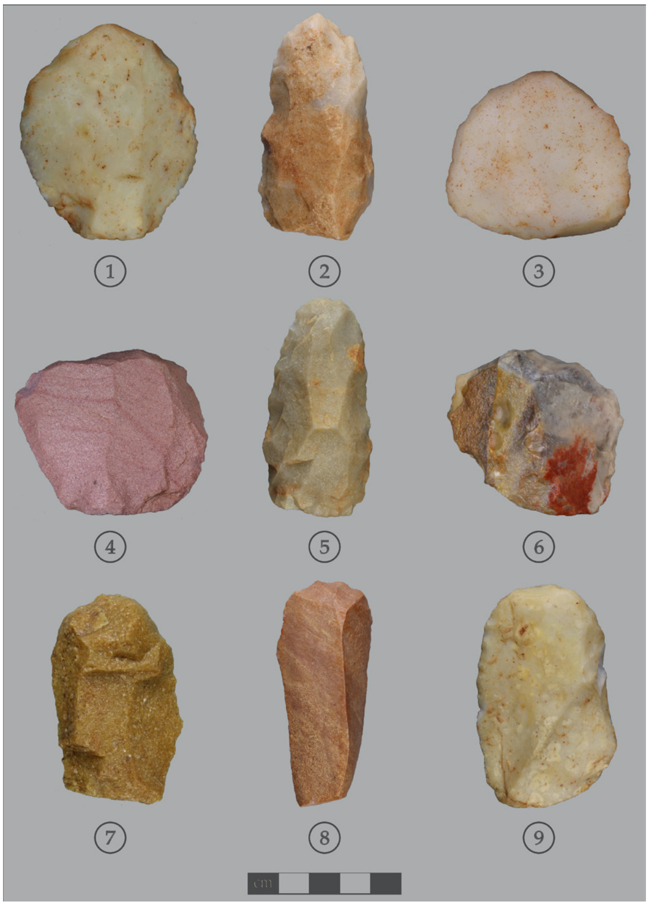
their quantity. There are altogether 55 bifacial points (Type Nos. 1.6.1, 1.6.2; 20.99% of the 262 points). Almost half of them (27 pcs., 49.09%) are undamaged points. Among the 28 broken artefacts, relatively high is the number of the proximal fragments (20 pcs., 36.36%), there are only six distal fragments (10.91%) and two mesial fragments (3.64%). Due to the presence of step-terminating bending fracture at their distal extremity, the majority of the proximal fragments can be identified as potential hunting weapons (projectile points). The distribution of the used raw materials is rather balanced, 21 specimens of each (38.18%) were made of RMC-1 and RMC-2 raw material and 13 specimens of RMC-2 raw material (23.64%; eight pcs. of "chert", four pcs. of chalcedony and one piece of jasper).

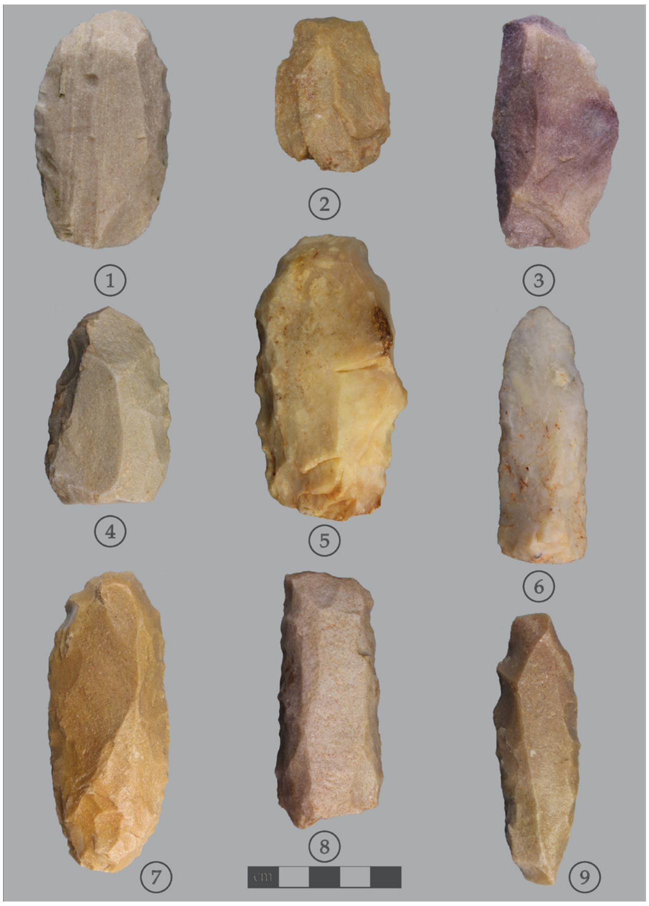
As regards the orientation of the bifacial points, there are 34 (61.82%) centred (symmetric) points. Four specimens (7.27%) are left-oriented; eight specimens (14.55%) are slightly left-oriented (the orientation angle is less than 10 degrees). The number of slightly right-oriented specimens is nine (16.36%). Concerning the base and type of the butt, 10 points have an intentionally broken base, 20 points have a trimmed base and in nine cases the points lack a clear classifiable butt for reasons unknown. Sixteen points have plain butts, and there is a single crushed butt.

For 27 undamaged bifacial points, morphometric and weight measures were carried out. Although the dimensions are varying in broad intervals (length: 29.2–52.1 mm, mean value is 37.9 mm; width: 14.6–28.2 mm, mean value is 21.09 mm; thickness: 6.1–18.0 mm, mean value is 9.37 mm; weight: 3.4–18 g, the mean value is 7.94 g), the standard deviation values are relatively low (length: 5.91 mm, width: 3.54 mm, thickness: 2.12 mm, weight: 3.41 g). Since there are only two undamaged unifacial points, no detailed morphometric data will be given. But it should be emphasised that the unifacial points emerged on average as longer, broader and thicker and heavier. Especially striking is that the average length of the unifacial points exceeds that of the undamaged bifacial ones, with 10.84 mm (48.74 vs. 37.9 mm). As a result of this, the unifacial points are rather elongated, having an L/W ratio of 2.12. The corresponding ratio of the undamaged bifacial points is 1.83.

For the point assemblage from the Yarar rock shelter, Flood (1970, tbl. 3) published an extensive statistical analysis. The statistical values established by Flood for the 181 bifacial points made almost entirely of quartzite are very similar to those of Tennant Creek. Peter Hiscock (1994a) was the first to deal with the issue of the use of a bipartite division, between bifacial and unifacial points and examined the evidence for these points being successive forms in a continuous process of shaping, use, and reshaping, rather than discrete end products. Concerning the points analysed by Flood, Hiscock concluded that "*... bifacial points that are smaller and more reduced than unifacial points would be the precise expectation of the sequence model, which implies specimens losing mass as they are retouched on the second face*". But as a counter-example, after Harry Allen & Gerry Barton (Allen, 1989), Hiscock mentioned the point assemblage from Ngarradj Warde Djobleng







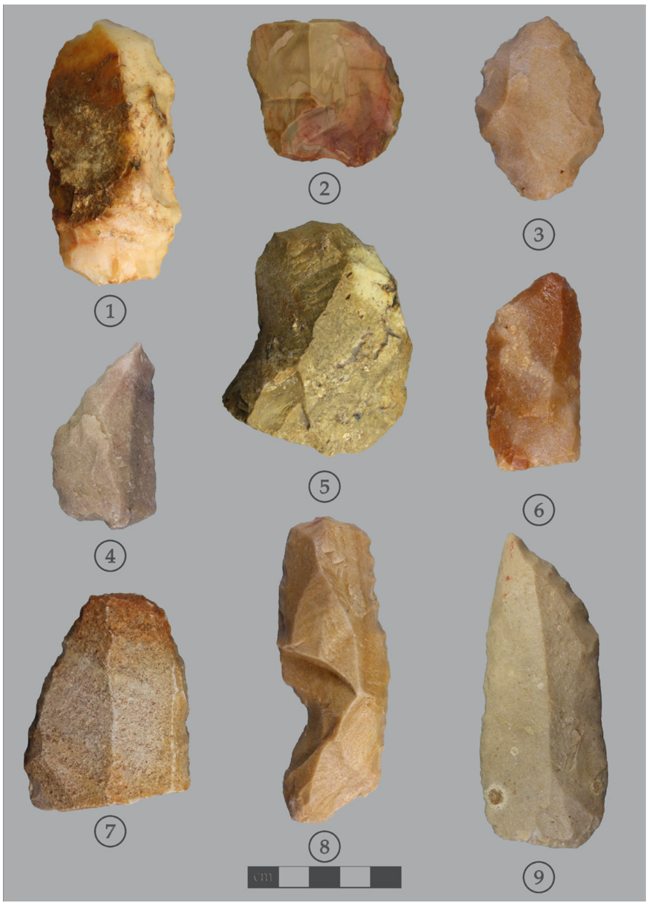
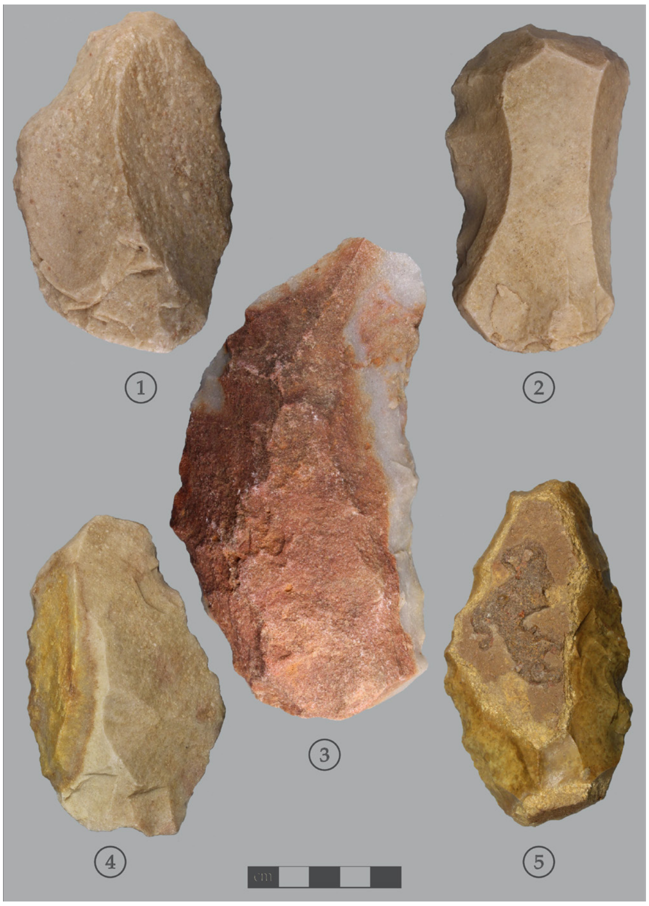


Figure 6 (upper left). Burren adzes and eloueras. **Figure 7** (upper right). End-scrapers. **Figure 8** (lower left) Selected tools. **Figure 9** (lower right) Selected tools. Figures: Attila Péntek, by courtesy of the Ethnographic Museum in Budapest, Hungary.



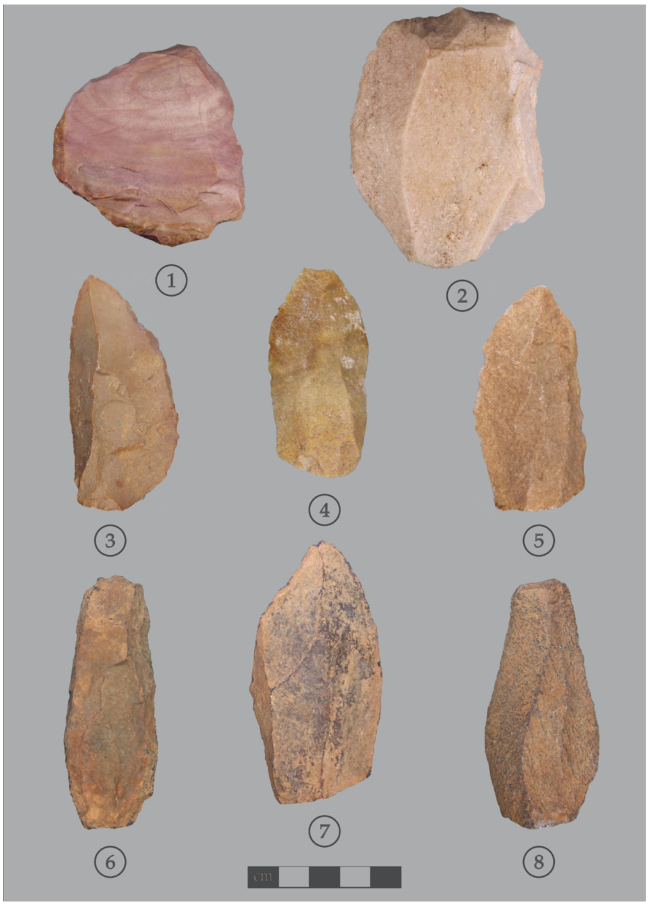


Figure 10 (upper left). Selected tools. **Figure 11** (upper right). End-scrapers and blades. Figures: Attila Péntek, by courtesy of the Ethnographic Museum in Budapest, Hungary.

(on the East Alligator River in western Arnhem Land). The average length and width of 38 bifacial points exceed that of 10 unifacial points, which implies that the two forms are distinct. As sample material for his analysis to explain point variability, Chris Clarkson (2006, 2007) took a population of 456 complete unifacial and bifacial points from the excavated lithic material of four rock shelters close to each other in Wardaman Country (eastern Victoria River Region, Northern Territory). During his analysis, he identified two reduction pathways for points and demonstrated that unifacial and bifacial points share a common reduction trajectory. In the represented constructed reduction model (Clarkson, 2006, fig. 9), the flexibility to either take enough large points into the bifacial stage or continue with unifacial reduction is visible.

Some of the points from the Tennant Creek assemblage need to be highlighted.

In Fig. 3: 2, there is the distal fragment of a bifacial point. It is centred and has a bi-convex cross-section. The fracture may have been caused by a knapping accident due to the inhomogeneity of the raw material (larger-scale inclusion). Both faces are very finely elaborated.

The slightly curved lateral edges are zigzaggy. Especially on the upper face, there are several rather invasive removals. The application of some kind of pressure flaking method cannot be excluded. The raw material is “chert” (RMC-2). The dimensions are 42.7 × 35.2 × 8.7 mm. The weight is 11.4 g. The dimensions and morphology suggest that the point may have been a leaf-shaped one. Tindale (1965, fig. 23) illustrated a highly decorated bifacially pressure-flaked resin-hafted circumcisional knife, which is known to have originated west of Tennant Creek. According to Tindale, the specimen seems to be a general indicator of the eastern spread of results of Kimberley blade-making (Tindale, 1985, p. 23).

In Fig. 3: 3, there is a bifacial point. The artefact was made on a blade or an elongated flake with an irregular bi-convex cross-section. It is symmetrical to the flaking axis. The distal end is tapering; it is sharpened on the lower face with fine removals. The base is trimmed in a straight line, thinned on the lower face, and the bulb was removed. On the right part of the upper face, there is the remnant of the patinated raw material outer surface (cortex). The thinning of the upper face and the removal of the prominent cortex have failed.

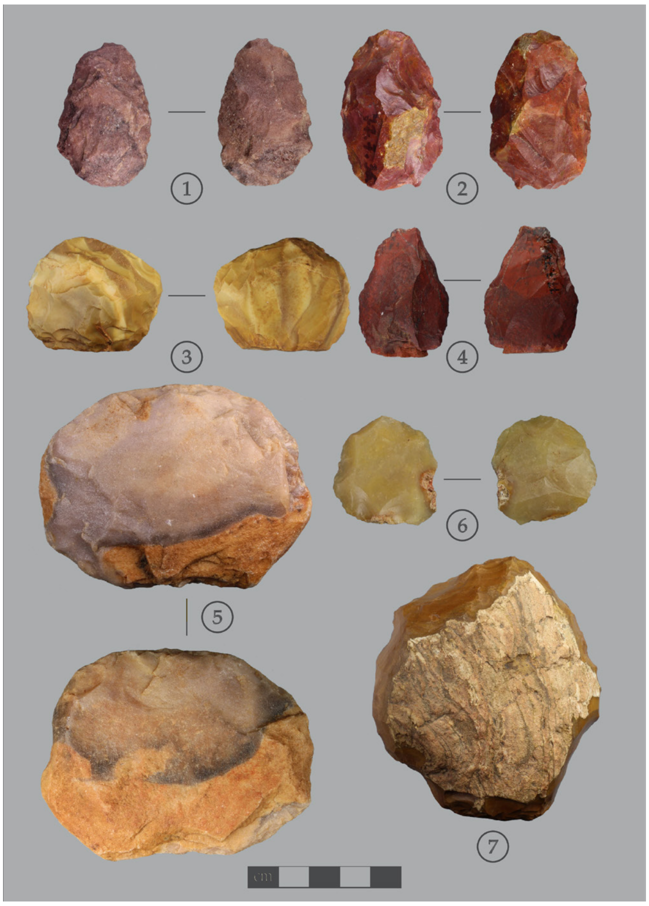


Figure 12 (lower left) Selected tools. Figures: Attila Péntek, by courtesy of the Ethnographic Museum in Budapest, Hungary.

Along the curved left side with a wavy profile, a fine invasive retouch can be found. At the centre of the curved right lateral edge with an irregular profile, a steep stepped retouch is visible. The edges are thinned on the lower face. The dimensions are 47.9 × 22.1 × 8.2 mm. The weight is 8.3 g.

The raw material is a unique one in the assemblage; it is likely the so-called "Anthony Lagoon chert (ribbon stone)" (RMC-1). Anthony Lagoon is a cattle station on the Barkly Tableland in the Northern Territory (see, Fig. 1). It is situated approximately 215 km (134 mi) east of Elliott and about 240 km (149 mi) northeast of Tennant Creek. From a morphological point of view, this artefact is rather an "alien" in the assemblage. It has a striking resemblance to the small bifacial points from Brunette Downs, which are common as surface finds. These artefacts comprise leaf-shaped bilaterally symmetrical points made on fine-grained siliceous stones, which were made by freehand hard-hammer percussion (Brumm & Rainey, 2011, Fig. 9).

In Fig. 3: 4, there is the largest point made on a chunky blade of middle fine-grained quartzite (RMC-1). It is very slightly right-oriented, almost centred, and has an asymmetrical sub-triangular cross-section. The side profile of the blade is straight-lined. The butt is a natural surface and has an irregular sub-trapezoid form. The maximal platform length is 24 mm; the maximal platform width is 12 mm. The interior platform angle (flaking angle; the angle between the butt and the lower (ventral) face) is about 100 degrees. On the upper face, there are flaking scars visible from previous flake removals. The presence of some abrupt clean breaks (step-fracture) refers to knapping accidents (hinged flakes). Overhang removal is also visible. Except for their proximal end, both lateral edges are somewhat irregularly treated. The treatment on the left edge is of a stepped, abrupt character; the treatment on the right edge is semi-abrupt. On both edges, there are small splintering and chipping, probably caused by work. The dimensions are 99.0 × 37.8 × 14.3 mm. The weight is 56.9 g.

In Fig. 9: 9, there is a large point made on a chunky blade of middle fine-grained quartzite (RMC-1). It is very slightly left-oriented, almost centred, and has a triangular cross-section. The side profile of the blade, especially at its distal end, is slightly curved. The butt is plain and has an elongated ellipsoid form. The maximal platform length is 26.1 mm; the maximal platform width is 8.8 mm. The interior platform angle (flaking angle; the angle between the butt and the lower (ventral) face) is about 100 degrees. Overhang removals are visible. The left lateral edge is almost straight-lined; the right lateral edge is somewhat broken-lined, convexly curved. Both edges bear a semi-abrupt scaled retouch. The dimensions are 97.7 × 42.0 × 13.2 mm. The weight is 61.6 g.

6.2. End-scrapers

Valoch (1979, p. 118) defined the end-scrapers as "Blades or flakes having the distal edge (in the direction of the axis of formation), i.e. the edge opposite the bulb of percussion, worked in such a way that a convexly curved head is formed, usually symmetrical to the axis of formation. They are worked more or less steep, usually with parallel (lamellar) trimming, often converging in a fan shape." The differences among named end-scraper types involve the overall shape of the tool and the number of retouched edges (Shea, 2013, pp. 131–132). It should be noted that the definition entirely disregards the dimensions of the tool.

In the flaked assemblage from Tennant Creek, with 96 specimens, the end-scrapers are the fourth-richest tool category (13.13% of the flaked assemblage) (Table 2). Although some studies on end-scraper morphology

Table 2. Type and raw material distribution of the end-scrapers

	Type No.	RMC-1		RMC-2			#	%
		Quartzite	Silcrete	Chert	Chalcedony	Jasper		
End-scrapers	2.1.1	8	0	6	3	0	17	17.71
	2.1.2	16	1	27	7	0	51	53.13
	2.1.3	3	0	2	2	0	7	7.29
	2.2	1	0	0	0	0	1	1.04
	2.3	8	0	4	4	0	16	16.67
	2.4	0	0	3	0	0	3	3.13
	2.5	1	0	0	0	0	1	1.04
	#	37	1	42	16	0	96	
	%	38.54	1.04	43.75	16.67	0.00		100.00

Table 3. Type and raw material distribution of the side-scrapers

	Type No.	RMC-1		RMC-2			#	%
		Quartzite	Silcrete	Chert	Chalcedony	Jasper		
Side-scrapers	4.1..3	8	1	2	1	0	12	31.58
	4.3	13	3	3	2	0	21	55.26
	4.5	1	0	1	0	0	2	5.26
	4.7	0	0	0	1	0	1	2.63
	4.8	2	0	0	0	0	2	5.26
	#	24	4	6	4	0	38	
	%	63.16	10.53	15.79	10.53	0.00		100.00

and related topics have been investigated (see, for example, Swader, 2009; Comstock, 2011), here only some elementary statistical data will be reviewed. Thirty-eight specimens were made of quartzite (RMC-1; 39.58%). Fifty-eight specimens were made of sedimentary rocks of the RMC-2 class (60.42%), among them 16 pieces of chalcedony. Somewhat more than half of the end-scrapers have their lengthwise edges trimmed (Type No. 2.1.2; 51 pcs., 53.13%). There are 17 simple end-scrapers whose remaining edges are not trimmed (Type No. 2.1.1; 17.71%). In the case of 20 specimens, the butt could not be determined; 50 specimens have a plain butt. The number of cortical butts is 20; there are four specimens with a faceted butt. One specimen has a wing-shaped butt, and in one case the butt is crushed. Almost half of the end-scrapers (45 specimens) show evidence of striking platform preparation (overhang removal). Sixty-five end-scrapers are centred; 12 are slightly right-oriented; 11 specimens are left-oriented. In eight cases, the orientation could not be determined. There are 16 (16.67%) end-scrapers made on large and usually thick flakes. The presence and the polymorphic nature of this type were emphasised also by Valoch. There are among them some specimens completely similar to the European Aurignacian carinated end-scrapers or microblade cores.

As regards the morphometric data and weight, all measures vary in a very broad range. The length varies between 18.5 and 104.1 mm, the width between 16.1 and 74.1 mm, the thickness between 5.1 and 30.6 mm and the weight varies between 2.2 and 201.4 g. The mean values are 42.91 mm, 35.11 mm, 14.67 mm and 30.5 g, respectively. The relating standard deviations are 17.84 mm, 11.88 mm, 5.33 mm and 35.55 g. Since most of the large-sized end-scrapers were made of quartzite, which has a greater specific weight than “chert”, the standard deviation for the weight is larger than the mean. The L/W ratio varies between 0.71 and 2.61; it has a mean value of 1.25. It indicates that the end-scrapers were made generally on sub-circular tool blanks.

The statistical term median is the number found in the exact middle of the set of values, which is the numeric value separating the higher half of a sample from the lower half. It is for all measures lower than the mean. This phenomenon alludes to a right-skewed (positively skewed) distribution, having a long right tail in the positive direction on the number line. Based on the median of the length, by dividing the sample into two parts, an interesting observation can be made about the use of raw materials. Among the 48 end-scrapers belonging to the lower half, 11 specimens were made of quartzite (RMC-1), and the remaining 37 specimens of RMC-2 raw material (among them four of chalcedony). On the contrary, the raw material utilisation concerning the upper half is more balanced; 27 specimens were made of RMC-1 raw material (except for a single one of silcrete, all others of quartzite) and 21 specimens of RMC-2 raw material (among them 12 of chalcedony).

From a technological point of view, it is important to note that most of the end-scrapers of the lower half of the sample were made by the bipolar-on-anvil technique by setting a suitable small-sized pebble on a stone anvil and striking it with a hard stone hammer to break open the pebble and split it up. The manufactured working edge of the end-scraper is retouched or denticulated. The latter describes more or less regularly spaced projections that are separated by notches. These small-sized end-scrapers have an almost circular form, having an L/W ratio of 1.05. The end-scrapers of the upper half of the sample are rather elongated, having an L/W ratio of 1.46.

Below, some end-scrapers will be highlighted.

In Fig. 7: 1-9, there are several rather large-sized end-scrapers of different shapes and forms made of different raw materials. The specimens in Fig. 7: 1 and Fig. 7: 9 were made of chalcedony, Fig. 7: 6 of "chert" and all the others of quartzite.

In Fig. 8: 1, there is one of the most finely manufactured end-scrapers. It is centred, symmetric to the flaking axis and has a sub-trapezoid cross-section. The side profile of the blade blank is straight-lined. The butt is plain and has an elongated ellipsoid form. Traces of overhang removal are visible. The curved distal end and the lateral edges are semi-abruptly retouched. The raw material is quartzite. The dimensions are 66.7 × 55.7 × 17.3 mm. The weight is 61.3 g.

In Fig. 10: 2, there is an end-scraper made on a large, high, elongated flake. As regards the flaking axis, the tool is slightly right-oriented and has a sub-trapezoid cross-section. On the curved distal end, a semi-abrupt, rough-and-ready working edge was created. The left lateral is irregular, wavy-lined and elaborated by larger removals and semi-abrupt retouch. The straight-lined right lateral edge is untrimmed but due to some working activity, there is sporadic splintering visible. The raw material belongs to RMC-1 (quartzite). The dimensions are 102.4 × 56.6 × 20.7 mm. The weight is 161.6 g.

In Fig. 11: 1, there is one of the largest end-scrapers made on a chunky flake. The tool is slightly left-oriented, has an irregular cross-section, and the side profile is somewhat twisted. On the butt, there is the remnant of the outer surface of the raw material. The distal end and the distal end of the convexly curved right lateral edge are abruptly retouched and several times renewed. The raw material belongs to RMC-2 ("chert"). The dimensions are 76.1 × 74.1 × 18.5 mm. The weight is 129.7 g.

In Fig. 12: 7, there is an atypical end-scraper made on a chunky flake or raw material piece of sub-circular form. From the upper face, the eroded, patinated outer surface of the raw material was not removed. Along the circumference, continuous, abrupt, many times renewed retouch. The raw material belongs to RMC-2. The dimensions are 80.1 × 71.7 × 22.8 mm. The weight is 176.6 g. This tool has a great resemblance to the "karta", the fossile directeur of the Kartan industry of South Australia (see, for example, McCarthy, 1943) and the "árapia", depicted by Norman B. Tindale & Brian G. Maegraith (1931, p. 287, figs. 10–11) and described by Tindale (1937, p. 48) as a discoidal block trimmed around most of its circular perimeter (Lampert, 1981, p. 49, fig. 27: a).

6.3. Side-scrapers

In the flaked assemblage from Tennant Creek, there are 38 side-scrapers (Type Nos. 4.1.3, 4.3, 4.5, 4.7, 4.8; 5.2% of the flaked assemblage) (Table 3). Three-quarters (28 specimens) were made of RMC-1 raw materials (73.68%; 24 of quartzite and four of silcrete). Ten specimens were made of RMC-2 raw materials (26.32%; six of "chert" and four of chalcedony). Thirty-four side-scrapers were made on flake. One specimen was made of a raw material lump; one specimen was made on an elongated flake (or blade). In two cases, the nature of the tool blank could not be determined. The 21 double side-scrapers (Type No. 4.3) dominate over the 12 simple, convex side-scrapers (Type No. 4.1.3). The role of the two convergent side-scrapers, one ventral side-scraper and two alternate side-scrapers are negligible. In the case of 16 specimens, the butt could not be determined; 15 specimens have a plain butt. The number of cortical butts is four, and there are two specimens with a faceted butt. Almost half of the side-scrapers (18 specimens) show evidence of striking platform preparation (overhang removal). Eighteen side-scrapers are centred; seven are slightly right-oriented; six specimens are left-oriented. In six cases, the orientation could not be determined.

As regards the morphometric data and weight, all measures vary in a very broad range. The length varies between 33.5 and 109.1 mm, the width between 20.3 and 63.2 mm, the thickness between 6.3 and 26.1 mm and the weight varies between 7.3 and 160.8 g. The mean values are 50.42 mm, 30.84 mm, 13.03 mm and 28.63 g, respectively. The relating standard deviations are 17.19 mm, 10.59 mm, 4.39 mm and 36.64 g. The L/W ratio varies between 1.16 and 2.71; it has a mean value of 1.67. It indicates that the end-scrapers were made generally on elongated tool blanks. As in the case of the end-scrapers, the median is for all measures lower than the mean. This phenomenon alludes to a right-skewed (positively skewed) distribution, having a long right tail in the positive direction on the number line.

In Fig. 8: 5, there is a somewhat atypical tool made on a large flake. It can be classified either as a double side-scraper or possibly as a backed tool. The tool is symmetric to the flaking axis of the flake blank and has an irregular cross-section. On the right part of the upper face, there is a small remnant of the eroded, patinated original raw material surface. The slightly curved lateral edges are backed (retouched abruptly) in their entire length. Both edges were several times renewed. The raw material is chalcedony (RMC-2). The dimensions are 88.0 × 47.1 × 24.3 mm. The weight is 117.7 g.

In Fig. 10: 4, there is an alternate side-scraper made on a flake of asymmetric sub-triangular cross-section. The tool is centred, and symmetric to the flaking axis. The slightly curved left lateral edge is roughly retouched. On the irregularly lined right lateral edge, there is a partially inverse retouch. The raw material is quartzite (RMC-1). The dimensions are 98.4 × 63.2 × 21.2 mm. The weight is 131.2 g.

In Fig. 10: 5, there is a double side-scraper or combination tool, made on a raw material lump of elongated ellipse form. On the middle part of the upper face, there is a partial remnant of the eroded outer surface. On the lower face, there are numerous, large-sized thinning removals to be seen. The convexly curved left lateral edge is semi-abruptly to abruptly, partially stepped retouched. The slightly curved right lateral edge is zigzaggy, bifacially trimmed. The raw material belongs to RMC-2 ("chert"). The dimensions are 109.1 × 59.1 × 26.1 mm. The weight is 160.8 g.

6.4. Miscellaneous types

6.4.1 Pièces esquillées (splintered pieces)

Valoch (1979, p. 41) applied the original definition (Bardon & Bouyssonie, 1906); that is, pièces esquillées are bifacially chipped flakes with one or two opposite working edges. Although according to Valoch, the splintered piece is a normal element in Australian lithic industries, the meaning of the term "fabricator", usually used for this type in Australia, is rather confused. For example, according to the definition of Peter Dixon Hiscock (1988b, p. 321), a fabricator is "*Any object used to apply force to a piece of stone in the knapping process.*" It was defined in the South African Late Stone Age for objects morphologically and technologically quite different, typically coroid hammering or trimming stones (see, for example, Brien, 1935, p. 502). It should be briefly noted the issue of the possible distinction between splintered pieces and bipolar-on-anvil-cores (see, for example, Leblanc, 1992; Shott, 1989, 1999). The paper of J. Peter White (1968) is related to Australian lithic artefacts and discussed this tool also from an ethnographical point of view. According to McCarthy (1941, p. 263), besides hammerstones, "*Another type of fabricator is a flake which bears a slightly concave and battered edge, due to its use*" [for chipping the edges of flakes]. White discussed thoroughly the more detailed subsequent definition, "*Fabricators and trimming stones are flakes or blades with one, and usually both, facets of the working edge battered and splintered from use. The working-edge is frequently gouge-like ...*" (McCarthy et al., 1946, p. 34) and gave many examples in Australian archaeological assemblages. At the same time, White stated that implements similar to the Australian fabricators were usually called "outils écailles", "*lames écailles*", "*lames ésquillés*" or squamous flakes (see, also Wright, 1970, pp. 89–91).

Foni Le Brun-Ricalens (2006), studied the issue of the tool type *pièce esquillée* both from a typological and a technological point of view. Following the paper of Pierre-Yves Demars & Pierre Laurent (1992, p. 94), the tool has flexible been defined as an "*artefact that generally has a quadrangular form and is frequently splintered, sometimes bifacially, on its two opposing extremities, and more rarely on one or four of them. The shock wave lines of the 'splinter' are often marked and closely spaced. The splinters on one or two faces (inferior, superior, other) can be short, hinged, invasive, or even overshot. The edge, particularly the one that has been struck is generally bevelled.*"

In the assemblage from Tennant Creek, there are two tools, which fit relatively well into the above-cited definition of Le Brun-Ricalens.

The artefact in Fig. 12: 3, is a splintered piece made on a flake. It is symmetrical to the flaking axis and has a vaulted cross-section. The flake has a double, diffuse bulb. On the curved distal end, on both faces, there is intensive splintering. Along the lateral edges, there are sporadic edge treatments. The raw material is siliceous rock (RMC-2). The dimensions are 35.0 × 41.3 × 17.5 mm. The weight is 24.7 g.

The artefact in Fig. 12: 6 is a splintered piece (very similar to an atypical, partly bifacially elaborated tool), which was manufactured on a flake, symmetrical to the flaking axis and having a flat, irregular cross-section. The base of the tool was trimmed to eliminate the bulb of percussion. A significant part of the lower (ventral) face is thinned. Along the entire perimeter, there is partially bifacially elaboration. The raw material is chalcedony (RMC-2). The dimensions are 34.3 × 32.2 × 11.0 mm. The weight is 13.2 g.

6.4.2. Tula adzes and tula slugs

In the assemblage from Tennant Creek, with 98 specimens, this group is the third-richest tool category (13.41%). There are only six tula adzes, the remaining 91 artefacts are tula slugs. Among the tula slugs, there is a broken piece and five atypical specimens. The overwhelming majority of the tulas were made of RMC-2 raw material (90 specimens of "chert", 6 specimens of chalcedony and a single one of opalite) and only a single specimen was made of quartzite (RMC-1).

Concerning the base and type of the butt, among the 97 tulas, there are 45 specimens with wholly or partly cortical butts (eroded and/or patinated natural raw material outer surface), 31 specimens have plain butts, 10 specimens have winged butts. In twelve cases, since the tools were resharpened and reversed in their hafts, the nature of the butt could not be determined. There are altogether 29 tula adzes (29.59%), of which, due to the reversal, both the distal end and the proximal end were intensively used.

Based on the reproduction of the manufacturing process of tulas made by Moore (2003a), it is somewhat surprising the relatively low number of artefacts with winged butts. Of course, it can be assumed that other free-hand flaking techniques than that proposed by Moore were also used in the manufacturing of the tool. On the other hand, it seems to be very likely that among the artefacts with indeterminable butts, there were some with winged butts. Another very convincing explanation would be the fact that at the same time the number of artefacts with cortical butt is rather high. Some blanks of which the tula adzes were manufactured bear the incidental evidence of the application of the bipolar-on-anvil technique. A typical characteristic is that the interior platform angle (flaking angle; the angle between the butt and the lower face of the artefact) is close to 90 degrees. The bulb of force, if present, is flattened and the striking platforms are often small and/or damaged (see, for example, Knight, 1991; Kobayashi, 2011). In any case, at least some tula adzes were manufactured of small-sized pebbles, where the application of freehand knapping was not suitable at all.

The length of the tula adzes varies between 21.2 and 29.7 mm, the width between 40.9 and 51.2 mm, the thickness between 9.3 and 17.4 mm and the weight varies between 13.5 and 33.3 g. The mean values are 25.28 mm, 46.83 mm, 12.9 mm and 20.22 g, respectively. The relating standard deviations are 3.69 mm, 4.79 mm, 3.26 mm and 7.14 g. The L/W ratio varies between 0.42 and 0.61; it has a mean value of 0.54. That is, the width of the tula adzes is about twice the height (depth).

The length of the tula slugs varies between 6.0 and 22.7 mm, the width between 26.3 and 51.9 mm, the thickness between 5.4 and 17.8 mm and the weight varies between 2.2 and 18.2 g. The mean values are 13.58 mm, 36.14 mm, 10.06 mm and 6.47 g, respectively. The relating standard deviations are 3.85 mm, 6.33 mm, 2.35 mm and 3.24 g. The L/W ratio varies between 0.16 and 0.74; has a mean value of 0.39. That is, the width of the tula adzes is about two and a half times the height (depth).

Ron Hewitt (1976) described a stone adze hoard from Lake Hanson on the western edge of the Arcoona Plateau near Woomera, in South Australia. All 105 items of the cache were found within a one square metre area, some still neatly piled up and partially covered by sand. Hewitt documented the raw materials and typologies of the artefacts. John Hayward (2011) studied thoroughly a total of 1,364 artefacts, which were collected also by Hewitt at four nearby sites at Mungappie. Statistical analysis was done to test the hypothesis of Hewitt's toolkit as a recurring discrete item at these sites. A comparison of the results with the Lake Hanson cache was also made. The average volume was calculated using the length, width, and thickness data, which indicated comparative volumes between artefacts. Based on this information, a reduction index was calculated for tula blanks and other tula types according to the classification of Hewitt. As Hayward noted, "*Knowing how much an artefact has been reduced indicates the amount of use it has had, and how much potential use an artefact has (Shott and Nelson 2008; Shott 2009).*"

To calculate the reduction index (or Utility Unit Index), Hayward took the average volumes of all tulas from blanks ("G. tula blank" *sensu* Hewitt) and subtracted from them the average volume of a fully utilized tula ("A. tula slug" *sensu* Hewitt). He followed the theoretical approach of Steven L. Kuhn (1994) and defined the potential utility of a tula as "*its ability to be resharpened a number of times, until it becomes unusable. Tula slugs were used as the minimal usable, or irreducible, artefact size to calculate utility.*" (Hayward, 2011, p. 60). Hayward (2011, tbl. 5.4), gave the volumetric averages of tula types of all Mungappie sites in cubic centimetres (cc; although the artefacts were measured in millimetres, the volumes had been converted into cubic centimetres).

On the 97 specimens from Tennant Creek no such detailed analysis was made, only the average volume for the tula adzes (G. tula blank) and the discarded tula slugs (A. tula slug) was calculated. The volume of the G. tula blanks of Mungappie averaged 22.34 ccs (cubic centimetres), with a range of 14.2 ccs to 35.42 ccs. The tula slugs had a volumetric average of 5.34 cc, with a range of 1.56 cc to 13.57 cc. The average volume of the six tula adzes from Tennant Creek is 15.53 cc, ranging between 9.83 ccs and 26.36 ccs. The average volume of the 85 tula slugs is 5.09 cc, ranging between 1.83 ccs and 13.43 cc. Although the average volume and range values of Mungappie are almost identical to those values of Tennant Creek, the tula blanks were significantly larger. The difference in tula blank size is most probably raw material dependent. In the Mungappie assemblages common quartzite, which is to be found in gibber desert pavement form across most of the Arcoona Plateau, was dominant (57.32%). Quartzite, especially the fine-grained variant, was possibly suitable to manufacture larger tula blanks. The similarity, the almost identity of the values for the tula slugs can be explained by the fact that the tulas made from quartzite at Mungappie were either resharpened more times than the tulas made almost exclusively of "chert" at Tennant Creek or the occasional resharpening of the quartzite was a more intensive reduction process than that of the fine-grained "chert" raw material.

It should be noted that besides the Lake Hanson cache of Hewitt, there is only one cache of 50 tulas from the Boulia District of Queensland, excavated by Peter Hiscock (1988a). Both caches fulfil the scenario of Banks (2009, pp. 84–86) of being cached hoards that contain unused artefacts, and therefore reveal stages of the manufacturing process.

In Fig. 4: 1-4 tula adzes and in Fig. 5: 1-4 tula slugs can be seen.

6.4.3. Burren slugs

In the assemblage, there are eleven burren slugs (1.5%). In the little sample, it is rather problematic to make a distinction between adzes and slugs, especially because generally both lateral edges were intensively used and renewed. Four burrens were made of "chert", six specimens were made of chalcedony and a single specimen was made of quartzite. Most artefacts have convex or somewhat irregular cross-sections. Concerning the base and type of the butt, one specimen has a cortical butt, four specimens have plain butts. In six cases, the type of the butt could not be determined.

As regards the morphometric data and weight, they all vary in a rather broad range. The length varies between 29.3 and 67.5 mm, the width between 15.1 and 28.1 mm, the thickness between 7.7 and 15.5 mm, and the weight varies between 3.9 and 31.3 g. The mean values are 38.43 mm, 19.65 mm, 10.01 mm and 9.03 g, respectively. The relating standard deviations are 11.34 mm, 4.25 mm, 2.86 mm and 8.21 g. The L/W ratio varies between 1.68 and 2.41 and has a mean of 1.94. That is, the burren adzes were made on very elongated tool blanks.

In Fig. 6: 1, there is an atypical burren adze made on an elongated segment of a "chert" pebble. It is centred in respect to the flaking axe and has an approximately bi-convex cross-section. The upper face of the tool is the patinated cortex of the pebble. The entire surface of the lower face is trimmed. The convexly curved lateral edges are finely retouched and renewed several times. The dimensions are 67.5 × 28.1 × 15.2 mm. The weight is 31.3 g.

In Fig. 6: 2, there is an atypical burren adze, very similar to the previous. It was made on an elongated segment of "chert" pebble. It is centred in respect to the flaking axe and has a high, irregular cross-section. The upper face of the tool is the patinated cortex of the pebble. The entire surface of the lower face is trimmed. At the proximal end, the base was thinned, and the incidental bulb was removed. The convexly curved, abrupt lateral edges are finely retouched, renewed many times and show signs of deterioration. The dimensions are 46.9 × 25.6 × 15.5 mm. The weight is 16.3 g.

6.4.4. Bifacial tools

In the assemblage from Tennant Creek, there are only two small bifacial tools (0.41%).

The artefact in Fig. 12: 1 is a bifacial tool made on a flake. It is symmetrical to the flaking axis and has a bi-convex cross-section. The tool has an elongated, ovaloid shape, tapering towards the distal end. The base is rounded, and the bulb was eliminated. On the distal end, there are tiny removals. Most of the upper face is elaborated; on the lower face, there are long, invasive removals for thinning purposes. The curved, zigzaggy lateral edges are retouched bifacially. The raw material is quartzite (RMC-1). The dimensions are 46.4 × 29.8 × 12.2 mm. The weight is 16.8 g.

The artefact in Fig. 12: 2 is a rather chunky bifacial tool made likely on an exhausted small-sized flake core. It is symmetrical to the flaking axis and has a bi-convex cross-section. The tool has an ovaloid shape. Both faces are rough and ready-made. The curved, zigzaggy lateral edges are bifacially elaborated. The raw material is jasper (RMC-2). The dimensions are 50.4 × 31.1 × 21.7 mm. The weight is 31.0 g. The artefact is broadly comparable with the relatively small bifacial cobble cores mentioned by Moore (2003b, pp. 29–30, fig. 8).

6.4.5. Diverse combination tools

In the assemblage, there are six tools, which were classified as combination tools (0.82%). Except for a small-sized tool made of jasper, all others were made of quartzite. The quartzite tools are large-sized, and four of them were made on blade blanks. Their length varies between 68.5 mm and 98.0 mm, their width varies between 27.1 and 52.0 mm, their thickness varies between 12.1 and 19.3 mm, and their weight varies between 39.5 g and 86.4 g.

In Fig. 8: 7, there is a combination tool made on a large, high blade. The tool is symmetric to the flaking axis of the blade blank and has an asymmetrical sub-triangular cross-section. On the curved distal end, a working edge was created through fine laminar removals. The slightly curved, convex left lateral edges are retouched semi-abruptly in their entire length. The slightly curved, convex right lateral edge is backed (retouched abruptly). Both edges were several times renewed. The raw material belongs to RMC-1. The dimensions are 94.6 × 38.3 × 19.3 mm. The weight is 86.4 g.

In Fig. 8: 8, there is a backed tool made on a large, high blade. The tool is symmetric to the flaking axis of the blade blank and has a sub-trapezoid cross-section. The proximal end of the tool was broken intentionally long ago. The distal end is formed by some removals, creating an approximately straight-lined working edge. The straight-lined, parallel lateral edges are backed (retouched abruptly) in their entire length. Both edges were several times renewed. The raw material belongs to RMC-1. The dimensions are 81.0 × 34.0 × 17.2 mm. The weight is 67.8 g.

In Fig. 8: 9, there is a backed tool made on a large, high blade. The orientation of the tool is arbitrary since the direction of the removal cannot be determined unambiguously. The tool is symmetric to the flaking axis of the blade blank and has a sub-trapezoid cross-section. The slightly curved, convex lateral edges are backed (retouched abruptly) in their entire length. Both edges were several times renewed. The assumed proximal end is formed wedge-like by somewhat larger lateral removals. The raw material belongs to RMC-1. The dimensions are 84.3 × 27.1 × 13.4 mm. The weight is 39.5 g.

In Fig. 9: 8, there is a combination tool made on a large, high blade. As regards the flaking axis, the tool is slightly right-oriented and has an irregular cross-section. On the curved distal end, a working edge was created. The lateral edges are slightly curved convex and retouched semi-abruptly. Both edges were several times renewed. On the left lateral edge, near the proximal end, there is a somewhat larger longish unretouched notch. The raw material belongs to RMC-1. The dimensions are 98.0 × 34.6 × 14.7 mm. The weight is 58.5 g.

6.4.6. Elouera

Only four artefacts could have been classified as rather atypical eloueras (0.55% of the total flaked assemblage). All of them were made on elongated chalcedony flakes. Unlike the burren adzes and slugs, these pieces have a relatively high, sub-triangular cross-section. It is the only distinguishing attribute from the burren adzes.

The artefact in Fig. 6: 4 is a borderline case between a tula slug and an elouera. The tool blank, a chalcedony flake with a sub-triangular cross-section with 45 degrees, is strongly right-oriented. The entire circumference of the tool is semi-abruptly/abruptly retouched (backed). The renewals and the edge deteriorations allude to intensive working activity. The dimensions are 25.6 × 41.2 × 16.2 mm. The weight is 12.0 g.

Table 4. Type and raw material distribution of the Tennant Creek assemblage

Type	Subtype	Type No.	RMC-1		RMC-2				RMC-3	#	%
			Quartzite	Silcrete	Chert	Chalcedony	Jasper	Opalite	Others		
Points		1.x	157	42	39	24	1	0	0	263	35.98
End-scrapers		2.x	37	1	42	16	0	0	0	96	13.13
Side-scrapers		4.x	24	4	6	4	0	0	0	38	5.20
Splintered pieces		6.1.1	0	0	1	1	0	0	0	2	0.27
Denticulate		6.3	2	1	0	0	0	0	0	3	0.41
Atypical biface		6.5	1	0	1	0	0	0	0	2	0.27
Atypical tool		6.6	3	1	1	0	0	0	0	5	0.68
Tulas		6.7.x	1	0	90	6	0	1	0	98	13.41
Burrens		6.8.x	1	0	4	6	0	0	0	11	1.50
Atypical adzes		6.9	1	1	1	1	0	0	0	4	0.55
Bifacial tool		6.10	1	0	1	0	1	0	0	3	0.41
Combination tools		6.11	5	0	0	0	1	0	0	6	0.82
Elouera		7	0	0	0	4	0	0	0	4	0.55
Backed tool		8	0	0	0	1	0	0	0	1	0.14
Knives	Untrimmed blades	9.1	14	2	3	0	0	1	8	28	3.83
	Partly trimmed blades or flakes	9.2	1	0	2	1	0	0	1	5	0.68
	Blades trimmed uni- or bilaterally	9.3	0	0	0	1	0	0	0	1	0.14
Fragments	Trimmed fragments	10.1-10.2.3	2	2	1	0	0	0	0	5	0.68
	Untrimmed fragments	10.3	3	0	0	0	0	0	1	4	0.55
Pebbles and coroids		11.x	2	0	2	0	0	0	1	5	0.68
Flakes	Untrimmed flakes	12.1	59	18	21	4	0	0	11	113	15.46
	Trimmed flakes	12.2	17	3	9	4	0	0	1	34	4.65
#			331	75	224	73	3	2	23	731	
%			45.28	10.26	30.64	9.99	0.41	0.27	3.15		100.00

The elouera in Fig. 6: 5 was made on a high flake with a sub-triangular cross-section. The base is thinned on the lower face and the bulb was removed. On the concavely curved left lateral edge, there are deteriorations due to use. The irregularly lined right lateral edge is thinned on the lower face. It is abruptly retouched (backed) and renewed morefold. The dimensions are 41.2 × 20.1 × 17.8 mm. The weight is 13.1 g.

The elouera in Fig. 6: 6 was made on a high flake with an irregular cross-section. The base is thinned on the lower face and the bulb was removed. The slightly curved lateral edges are abruptly retouched (backed) and renewed morefold. The dimensions are 36.2 × 20.0 × 12.5 mm. The weight is 9.1 g.

6.4.7. Backed tools

There is only one artefact, which could be classified as a backed tool. In fact, in the assemblage from Tennant Creek, this artefact is the only one that fits relatively well into the tool category of "backed blade". "*Backed blades are flakes with steep retouching along one margin, the backing sometimes removing the platform and distal end. Their distinguishing feature is the near-90°, bidirectional retouch that has often been accomplished with the use of bipolar techniques on an anvil.*" (Hiscock, 1994b, p. 270; see also Flenniken & White, 1985, p. 143; Hiscock, 1993). The specimen is a small-sized backed microblade of a sub-trapezoid cross-section. The base and the distal end were broken intentionally. The straight-lined lateral edges are backed in their entire length. The raw material is chalcedony (RMC-2). The dimensions are 31.0 × 11.5 × 5.6 mm. The weight is 2.3 g.

6.4.8. Knives

In the assemblage, there are 34 knives (4.65%). Most of them (28 specimens) are untrimmed blades of various sizes. As regards the raw materials, the RMC-1 raw material class is dominant (14 quartzite and 2 silcrete specimens). There are three "chert" pieces and a single piece made of opalite.

As regards the morphometric data and weight, they all vary in a rather broad range. The length varies between 32.7 and 80.1 mm, the width between 12.7 and 36.4 mm, the thickness between 3.1 and 16.1 mm and the weight varies between 2.6 and 38.7 g. The mean values are 54.34 mm, 21.23 mm, 8.9 mm and 11.27 g, respectively. The relating standard deviations are 12.39 mm, 5.55 mm, 3.23 mm and 8.71 g. The L/W ratio varies between 2.09 and 5.08 and has a mean of 2.62.

There are five partly trimmed or worn blades. One blade was made of quartzite, two blades were made of "chert", one of chalcedony and there is one specimen made of an unknown raw material.

In Fig. 8: 6, there is the sole bilaterally knife present in the assemblage made on a large, high blade of chalcedony (RMC-2). It is symmetric to the flaking axis and has a triangular cross-section. The straight-lined, parallel lateral edges are retouched semi-abruptly in their entire length. Both edges show sporadic signs of renewals. The dimensions are 80.3 × 28.6 × 18.2 mm. The weight is 39.8 g.

6.5. Fragments

Among the nine fragments, there are five fragments of partly trimmed flakes or blades (0.68%) and there are four untrimmed raw material fragments (0.55%). One tool fragment was made of "chert", two specimens of quartzite and two of silcrete. The raw materials of three untrimmed specimens belong to the RMC-1 raw material class (quartzite) and there is one specimen of the RMC-3 raw material class.

6.6. Pebbles and coroids

There are five pebbles and coroids in the assemblage (0.68%). Two pieces each were of quartzite (RMC-1) and chert (RMC-2) and there is a specimen of the RMC-3 raw material class.

In Fig. 12: 5, there is a large pebble tool, made on a relatively flat ovaloid pebble. The orientation is arbitrary. The cross-section of the pebble is lenticular. The convexly curved right lateral edge has a wavy profile. It is bifacially worked and shows the traces (splinterings) of intensive working (likely cutting and/or scraping) on hard material such as bone or wood. The irregularly lined left lateral edge is rough-and-ready and shows also the traces of some working activity. The raw material is a kind of foliated (layered) quartzitic sandstone (RMC-1). On the left side and the very distal end of the upper face and, respectively, on the right side of the lower face, the two different layers are visible. The dimensions are 83.9 × 63.7 × 22.9 mm. The weight is 167.8 g.

6.7. Flakes

There are 113 untrimmed flakes of various sizes (15.46% of the total flaked assemblage). Most of them

(77 artefacts) were struck from RMC-1 raw materials (59 of quartzite and 18 of silcrete). Twenty-five were struck of RMC-2 raw materials (21 of "chert" and 4 of chalcedony) and eleven of RMC-3 raw materials. There are many elongated, almost "blade-like" flakes. The upper quartile of the L/W ratio is 1.7 and there are 30 flakes with a greater L/W ratio. There are 34 trimmed flakes of various sizes (4.38% of the total flaked assemblage). Most of them (20 artefacts) were struck from RMC-1 raw materials (17 of quartzite and 3 of silcrete). Thirteen were struck from RMC-2 raw materials (9 of "chert" and 4 of chalcedony) and one from RMC-3 raw materials. There are not so many elongated flakes. The upper quartile of the L/W ratio is 1.72 and there are ten flakes with a greater L/W ratio.

7. Some statistical remarks

The range of a set of data, which is the difference between the extreme values in the set, is the "most robust" characteristic of the variability of the data. The disadvantage of the range is that it is very sensitive to outliers, to extremely high or low values. As was mentioned above, the morphometric attributes for the end-scrapers and the side-scrapers vary in a very broad range, and the median of all measures is lower than the mean. The data distribution is right-skewed (positively skewed), having a long right tail in the positive direction on the number line.

To find the outliers in a set of data, there is a commonly used statistical method based on the quartiles and the interquartile range. To compute quartiles, the data must be ordered from smallest to largest. The first quartile (lower quartile; Q1) is defined as the middle number between the minimum value and the median of the data set; the second quartile (Q2) is the median of the data set and the third quartile (or upper quartile; Q3) is the middle value between the median and the maximum value of the data set. The lower and upper quartiles provide information on how big the spread of the data is and if the dataset is skewed toward one side. If introduced the interquartile range (IRQ = Q3 − Q1), the presence of outliers in the data can also be observed as follows. Outliers are defined usually as data values that fall below Q1 – 1.5 * IQR or above Q3 + 1.5 * IQR.

Having the above formulas, among the 96 end-scrapers, based on the length data, there are two outliers. The first one can be seen in Fig. 10: 2 (102.4 × 56.6 × 20.7 mm), the second one has the dimensions of 104.1 × 71.5 × 30.6 mm. And similarly, among the 38 side-scrapers, based on the length data, there are also two outliers. The first one can be seen in Fig. 10: 4 (98.4 × 63.2 × 21.2 mm), the second one is in Fig. 10: 5 (109.1 × 59.1 × 26.1 mm). It should be noted that among the combination tools, there are also several large-sized specimens (see, for example, the above-described specimens in Fig. 8: 7-9 and Fig. 9: 8).

Although Valoch did not give concrete morphometric values for the delimitation of the macrolithic tools, Graph 1 (Valoch, 1979, p. 145) shows that the length of most of the macrolithic tools at the Wilton River XXII site varies between 100.0 and 120.0 mm. Graph 1 is expressly right-skewed.

8. Discussion

As Hiscock stated, the three-phase archaeological sequence for mainland Australia developed by Derek J. Mulvaney (1969), is "*defined primarily in terms of the presence or absence of the typologically regular and finely made flaked implements, such as points, backed blades, and tulas.*" (Hiscock, 1994b, p. 270; but *cf.* Lampert, 1971, p. 65). As regards the characteristics of typical assemblages, the early industries, covering the period from the initial colonisation of Australia by prehistoric people until approximately the mid-Holocene, are generally labelled as the "Core Tool and Scraper Tradition" (Bowler et al., 1970, p. 52). The dominance of horse hoof core tools and steep edge scrapers is perceivable within many Pleistocene and early Holocene assemblages. For Lake Mungo in the Willandra lakes system in western New South Wales, there are a series of radiocarbon dates (Bowler et al., 2003; Polach et al., 1970). The following phase, beginning about the mid-Holocene, is commonly called the "Small Tool Tradition". It was defined by Richard Gould (1969, p. 235). This tradition includes but is not limited to, backed blades. Other tool types include such items as pirri points, small end-scrapers and adzes and micro-adzes. Assuming that points, backed blades, and tulas were all hafted tools, elements in composite tools, Gould argued that they "*may belong to a common historical tradition*". He mentioned that the Australian evidence also suggests that the presence of small tools in an assemblage does not mean the absence of large, hand-held tools in that same assemblage. The assemblages of the third phase, covering approximately the last two millennia and has been called the "Lesser Retouched Tradition", contain few points and backed blades.

In Table 4, the artefact composition of the Tennant Creek assemblage will be shown. The "small tools" (points, various adzes and end-scrapers) dominate the assemblage with 65.12%. However, the almost complete absence of the backed tools is conspicuous, and this fact needs to be examined thoroughly. According to the distributional map of backed artefacts and bifacial points across Australia, backed artefacts are found across most of the continent, but appear to be absent from the northwestern regions of the Kimberley and Arnhem Land (Hiscock, 2002, p. 167, fig. 11.3).

On the other hand, Clarkson (2007, pp. 3–4), wrote that bifacial points are found only in the central northern tip of the continent and there is only little geographic overlap between the two types. Hiscock (2008, p. 150) also stated that fully bifacial points are restricted to Arnhem Land and northwestern Australia and their distribution overlaps slightly with the southern distribution of backed artefacts. In the tool assemblage from Arnhem Land studied by Valoch, the surprising lack of backed implements was also mentioned (1979, p. 151). Narrow blades, backed on one or both edges, occurred comparatively often, which are similar to the European "*lamelles à dos*". There were also some quite large steeply trimmed blades and a single instrument of geometrical shape, a largish triangle. Neither microlithic tools of geometrical shape nor Bondi points were found on any site. Mulvaney (1997, pp. 94–95, Fig. 6.2, 5) described a single backed artefact in an assemblage of some 200 retouched classified artefacts recorded at the site of Kurutiti at Helen Springs. This backed blade was made of chalcedonic chert (probably a locally derived source) and has the dimensions of 29 × 11 × 5 mm. The artefact was produced on a segment of a blade, with retouch (backing) applied to the thicker margin and extending along the transverse break of the distal end of the blade. Mulvaney noted that "*The appearance of only one or two backed blades on a site within northern Australia is not unique.*" Michael Pickering (1990, pp. 84–85, fig. 2) described two backed blades from Borroloola on the McArthur River in the southern Gulf of Carpentaria (see, Fig. 1). Both specimens were made of fine-grained chert-like raw material. Their dimensions are 14.0 × 7.8 × 3.3 mm and 14.3 × 8.4 × 3.9 mm. Both artefacts display evidence, in the form of flake scars and crushing, of having been produced through bipolar techniques. It is of interest to mention three backed artefacts (similar to geometric microliths) from Pleistocene sediments at two excavated sites adjacent to the Gregory River at Riversleigh in northwestern Queensland (Slack et al., 2004, p. 135, fig. 7).

It is consequently very likely that the above-mentioned "small tools", that is two-thirds of the whole flaked assemblage, at Tennant Creek are part of the "Small Tool Tradition". Among the other formal tools, only the side-scrapers are somewhat important with a ratio of 5.2% in the total assemblage, all others are negligible. Large, hand-held tools are to be found in relatively small numbers among the side-scrapers and the combination tools as well.

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