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The Ellerslie Meteorite: Description and correction to historical find site

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Abstract

The 10.2 kg Ellerslie meteorite was donated to the National Museum of Victoria in May 1905 by Mr Henry Crawford, who informed the curator at that time that it had been found on the Ellerslie Estate in August 1900. The Ellerslie Estate, which Mr Crawford co-owned, is some 40 km east of Enngonia in northern New South Wales, adjacent to the Queensland border. In an unexplained historical error, the official find site for the Ellerslie meteorite has been recorded as "Tego, Maranoa, Queensland" in the 2000 Catalogue of Meteorites. This paper provides the first formal description of the meteorite, confirming it as an L5 ordinary chondrite showing mild shock features. It also investigates the source of the error in the historical record of the find site.

Keywords: Ellerslie meteorite, find site, historical error, L5 ordinary chondrite, Tego.

Introduction

Historical background

On 27 May 1905, Mr Henry Crawford paid a visit to the National Museum of Victoria (NMV) in Melbourne. He had a gift for the museum, a large and heavy (10.2 kg or 22.5 lb) brown rock that he'd carried all the way from the Ellerslie Estate, which was about 25 miles (40 km) from Enngonia and about 80 miles (130 km) from Bourke, in far-north New South Wales. The Museum's curator, Richard Walcott, recognised the rock as a meteorite at the time, but it wasn't registered in the collection until March 1916, when it was given the unofficial name Ellerslie and catalogue number M7336. The date of discovery, August 1900, had been supplied by Mr Crawford after he'd received a note from Walcott on the day after the donation. Locality information was later provided to Thomas Hodge-Smith, Curator at the Australian Museum in Sydney, who was compiling a list of Australian meteorites. In the resulting paper, published in the Australian Museum Memoirs in 1939, Hodge-Smith stated that the meteorite was "known 1905" from the Ellerslie Estate, "about 80 miles north of Bourke, New South Wales," which was the locality as entered in the NMV's register. To this information, and without providing a source, Hodge-Smith added the clarification that "the locality is across the Queensland border." Ever since, Ellerslie has been listed officially as a Queensland meteorite, but as the original record clearly indicates, it came from New South Wales.

History of investigation

At the time of its registration in the NMV collection, the Ellerslie meteorite was a complete stone measuring approximately 26.7 × 17.3 × 12.2 cm with a mass of 10.2 kg (Figure 1). The meteorite probably remained intact until December 1962, when a 28.7 g piece was sent to Brian Mason at the Ameri-

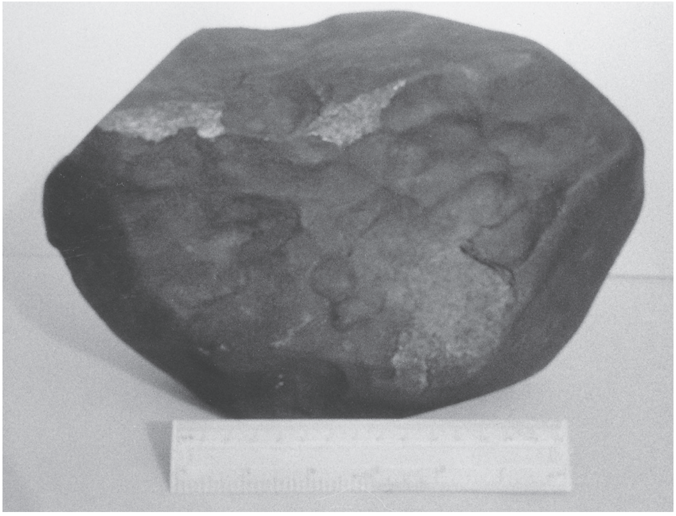

Figure 1: The Ellerslie meteorite photographed in 1972. Note the prominent regmaglypts and the near complete fusion crust. MV specimen E11444; photographer unknown.

can Museum of Natural History to support his study of olivine compositions in chondritic meteorites. He classified Ellerslie as an olivine-hypersthene chondrite based on its olivine composition falling within the range Fa_{24-25} characteristic of this large group (Mason, 1963). In June 1967, Ray Binns, at the University of New England in New South Wales, was provided with 31.7 g for comparison with other stony meteorites he was studying from the Dirranbandi district in southern Queensland, which is several hundred kilometres to the northeast of Ellerslie. In return, he donated a thin section of the meteorite to the NMV. Later in 1967, Binns submitted reports on two of the so-called "Dirranbandi" meteorites, Wynella (H4) and Hamilton (L6), in the form of letters to the Commission on Meteorites of the International Geological Congress, with preliminary information published in *The Meteoritical Bulletin*, no. 42, in February 1968 (subsequently republished in *Meteoritics*, 1970, volume 5, page 96). However, until this paper, no formal description of Ellerslie appears to have been prepared and published. Brian Mason was supplied with another 28.2 g in October 1972 to enable him to undertake microprobe analyses as part of a comprehensive study of Australian chondrites, but no results were published.

The meteorite

Description

The remaining mass of the Ellerslie meteorite is now on display in Melbourne Museum (formerly the NMV) (Figure 2). It clearly shows a fusion crust that is largely intact, with some well-developed "thumb prints" (regmaglypts). The thin section of Ellerslie donated to the Museum by Ray Binns in 1968 has a cover slip, thereby preventing a complete description and the gathering of microprobe data on the main minerals, including the metallic phases. However, a small sliver of the meteorite was donated for this study by Rainer Bartoschewitz, who had obtained material by exchange in 1984

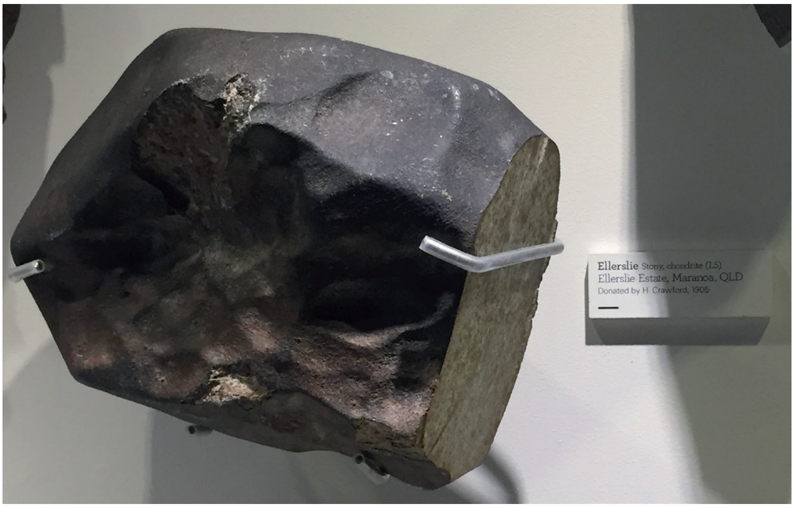

Figure 2: The Ellerslie meteorite on display in Melbourne Museum. Note the label repeats the incorrect site details. Photograph from Anthony Abell.

(see later). This enabled a polished section to be prepared for the description and microprobe analysis.

Microscopic examination shows poorly defined chondrules up to 1 mm across, with indistinct edges. Discernible chondrule varieties include radial and porphyritic pyroxene (RP, PP), barred and porphyritic olivine (BO, PO) and porphyritic olivine pyroxene (POP) types (Figures 3, 4). The matrix and the chondrule mesostases are fully recrystallised and plagioclase grains are up to 100 μm across but mostly less than 20 μm. Subhedral grains of chromian ferroan spinel to 0.3 mm also occur, in places in contact with metal phases. These are dominated by taenite, kamacite and troilite, which are commonly in contact and in places show textures with troilite blebs included in the metal and associated with grains of native copper (Figure 5). As discussed by Tomkins (2009), such textures are indicative of low-temperature, post-impact metamorphism in ordinary types 3 to 6 chondrites.

Evidence for moderate shock is also present, in the form of undulose to mosaic-like optical extinction in olivine grains, characteristic of shock classification S3–S4 (Stöffler et al., 1991). Shock-melted metal (quenched metal droplets in silicate glass) and sulfide melt veins are also observed. While oxidation crusts occur around some of the metal grains, overall rusting appears to be low, consistent with the preservation of a near-complete fusion crust.

Mineral compositions

Representative mineral analyses were obtained using a JXA-8530 field emission electron microprobe in the School of Earth Sciences, University of Melbourne. Olivine analyses are extremely uniform and give an average composition expressed as $Fo_{74.7}Fa_{24.7}Te_{0.5}$, consistent with Mason's determination (Mason, 1963). Orthopyroxene analyses are also uniform, giving rise to an average composition expressed as X_{En}=77.5, X_{Fs}=21.0, X_{Wo}=1.5. Only one plagioclase analysis, expressed as $Ab_{64}An_{28}Or_{9}$, was obtained

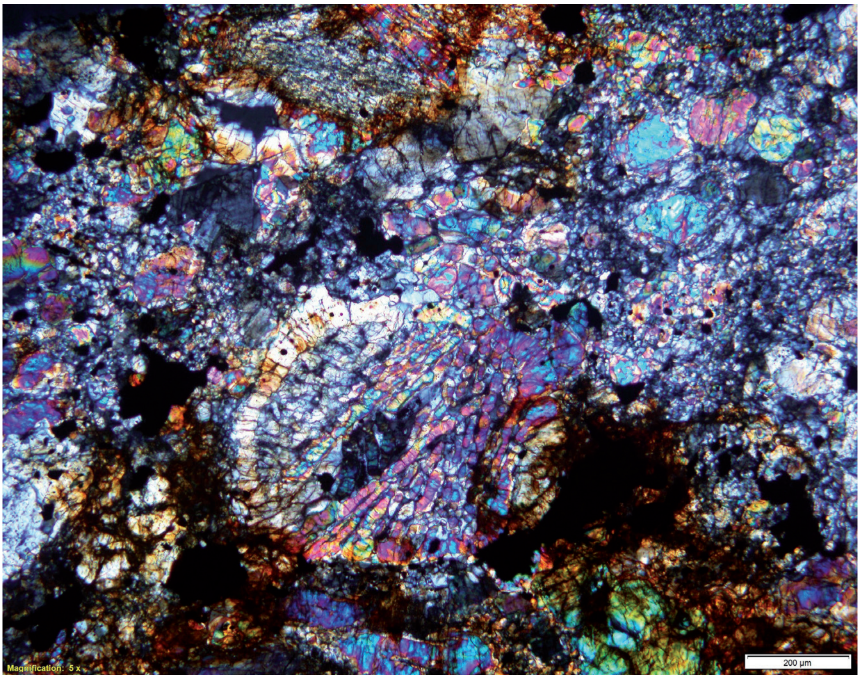

Figure 3: Transmitted light image showing barred olivine chondrule 0.7 mm across.

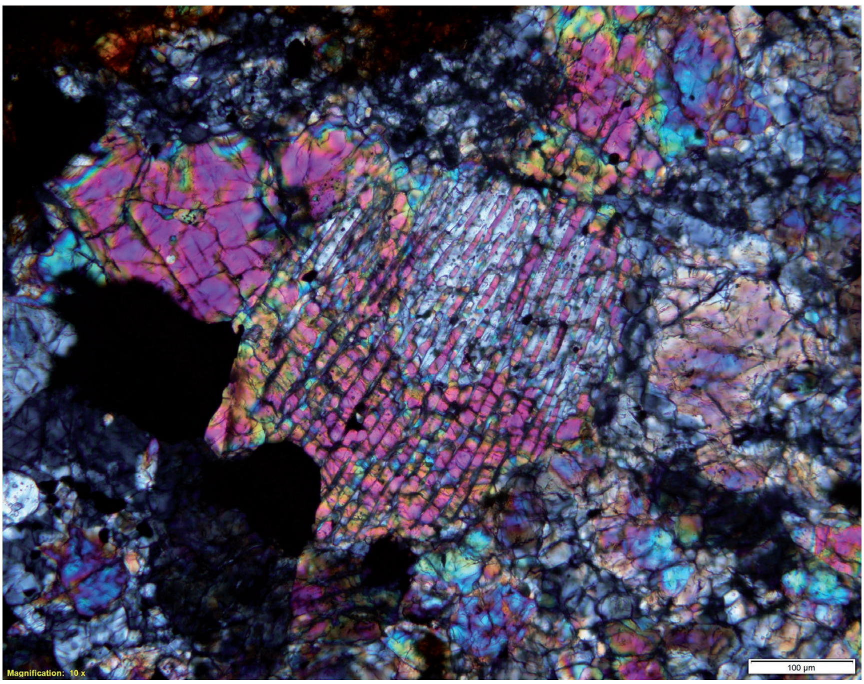

Figure 4: Transmitted light image showing barred olivine chondrule 0.7 mm across.

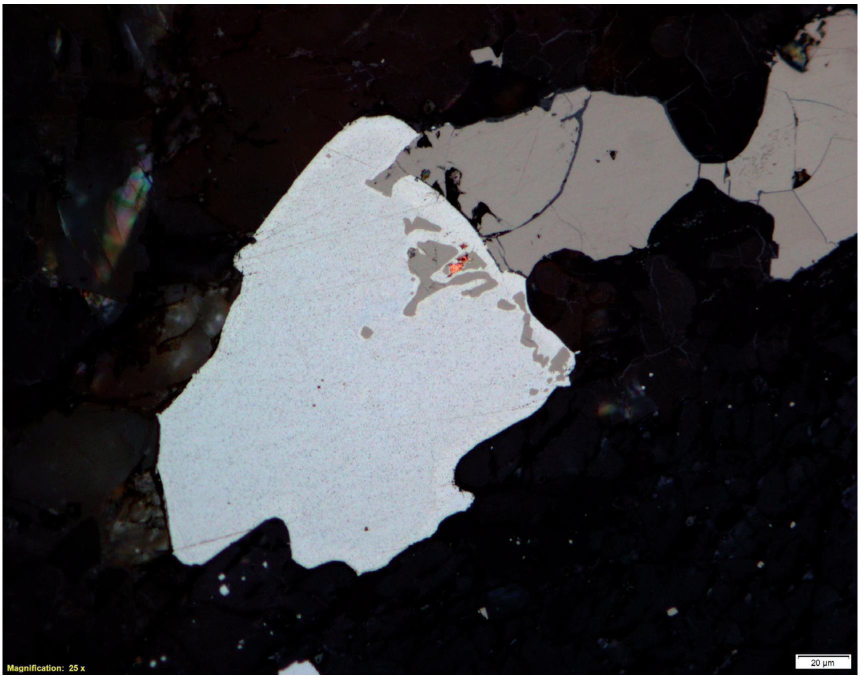

Figure 5: Reflected light image showing taenite grain (white) in contact with troilite (pale brown) and an inclusion of native copper (orange) in the taenite. Note also the troilite inclusions in the taenite. Image is 0.3 mm across.

and no phosphates were detected. The Ni contents of kamacite average 6.4 percent and Co contents average 0.9 percent (*n*=22). The relationship between the Co content of the kamacite and the Fa content in olivine is consistent with values determined for ordinary types 3–6 chondrites (Rubin, 1990). The taenite averages 24.5 percent Ni (*n*=14); no tetrataenite was detected.

Classification

Petrographic features and mineral compositions can be used to distinguish between Types 4, 5 and 6 ordinary chondrites, as the degree of recrystallisation increases with increasing thermal metamorphism (Huss et al., 2006). While the presence of tiny Ca-pyroxene grains in the matrix is diagnostic of Type 5 chondrites, the necessary diligent search with the microprobe to find these was not possible in this study. Instead, other criteria have been used to classify Ellerslie. Orthopyroxene compositions in Type 4 show considerable variation, whereas those in Ellerslie are invariant, typical of Types 5 and 6. Little significance can be attached to the single plagioclase analysis, given that equilibrated L chondrites may contain a wide range in feldspar compositions and exsolution features (Lewis & Jones, 2016). However, plagioclase grain size is more diagnostic, with distinction between Types 5 and 6 made on the basis of plagioclase grain size in the recrystallised mesostases around chondrules (Huss et al., 2006). In Ellerslie, grains are primarily around 10–50 microns across, characteristic of Type 5, whereas those in Type 6 are more typically 50–>100 microns. These features, together with the olivine composition $Fa_{24–25}$ determined by Mason (1963), support Ellerslie's classification as an L5 ordinary chondrite.

The presence of thin oxide mantles on some of the metal grains is characteristic of grade W1 on the weathering scale of Wlotzka (1993).

Distribution

The mass of the remaining portion of Ellerslie is 9.2 kg (Figure 2), so approximately 1 kg has been removed for distribution to other institutions. Up until 1984, 89 g of that can be accounted for by the pieces sent to Ray Binns and Brian Mason. Since then, some 628 g has been distributed, mainly to meteorite collectors, with all transactions involving exchanges for other meteorites. This means that Museums Victoria has provided a total of around 717 g for research and exchange purposes. According to the 2000 *Catalogue of Meteorites* (Grady, 2000), some 656.5 g of Ellerslie was held by other institutions around the world at the time of its publication (Grady, 2000, Table 1). This list is incomplete; for example, the Australian Museum in Sydney holds 5.5 g of Ellerslie obtained by exchange in 1973 (Ross Pogson, pers. comm.) and the University of New England holds 24 g remaining from Ray Binn's research (Malcolm Lambert, pers. comm.). There are no records of Museums Victoria exchanging directly with these listed repositories other than the Natural History Museum in Paris, which received 114 g in 1986, and the Rainer Bartoschewitz collection, which received a total of 262 g in

Table 1: Distribution of portions of the Ellerslie meteorite

Location	Weight
US National Museum, Washington, USA	26 g
Natural History Museum, Paris, France	114 g
Max Planck Institute, Mainz, Germany	83 g
Monnig Collection, Texas Christian University, Fort Worth, Texas, USA	35.7 g
Western Australian Museum, Perth, Australia	12.5 g
American Museum of Natural History, New York, USA	0.6 g
Arizona State University, Tempe, Arizona, USA	209 g
Field Museum of Natural History, Chicago, Illinois, USA	9.4 g
Du Pont Collection, Palatine, Illinois, USA	120.7 g
Bartoschewitz Collection, Germany	37.3 g
Institute of Theoretical Physics, Münster, Germany	8.3 g
Total:	**656.5 g**
Other depositories	
University of New England, Australia (left over from Ray Binn's studies)	24 g
Australian Museum, Sydney, Australia (obtained by exchange in 1973)	5.5 g

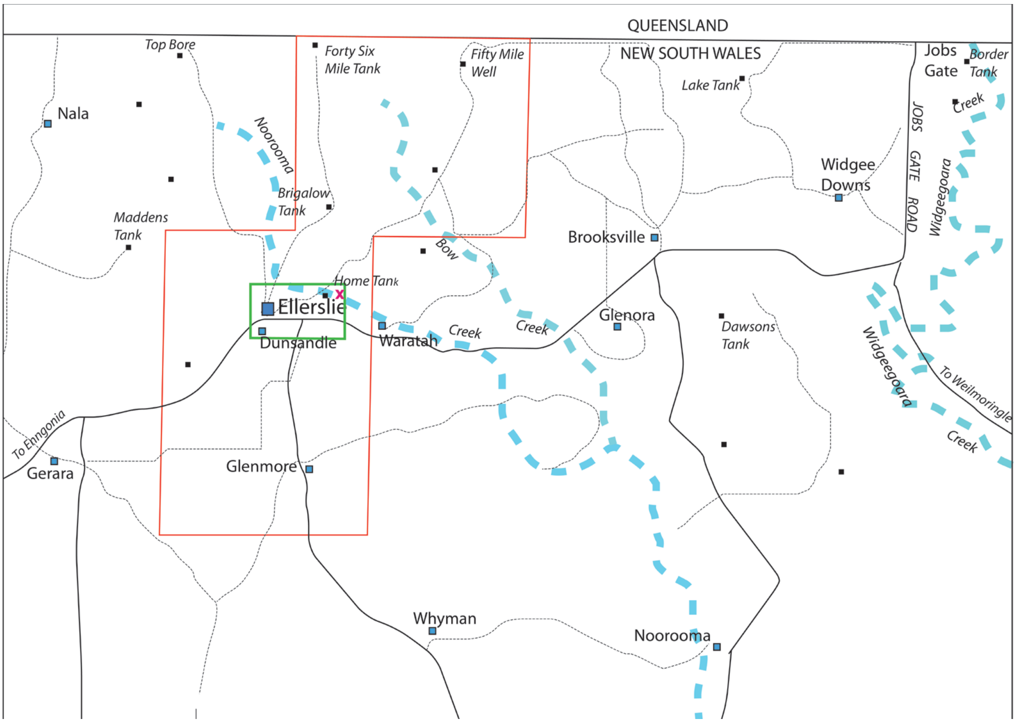

Figure 6: Simplified map of the region around Ellerslie Station, whose present-day boundary is indicated by the red border (as indicated by Mrs Robinson). The inset bordered in green coincides with the Google Earth image shown in Figure 8. The red cross marks the likely find site of the Ellerslie meteorite, on a small claypan within the broad drainage channel of the Noorooma Creek (see Figure 7). The gate (Jobs Gate) through the border into Queensland is near the top right corner of the map.

1984. These figures indicate that most of the latter has been exchanged to organisations on the list in Table 1, and that there are about 280 g unaccounted for, some of which probably arose from loss during slicing.

The find site

Anyone checking the official *Catalogue of Meteorites* (Grady, 2000) would read that Ellerslie was found at "Tego, Maranoa, Queensland," a puzzling change in the find site. Perhaps this had come about in an attempt to set a more accurate location than just "about 80 miles north of Bourke" and at the same time placing it "across the Queensland border." Just to be clear about the location of the Ellerslie Estate, the author approached Mrs Nancy Robinson, who has lived on Ellerslie, now known as Ellerslie Station, for over 50 years. She confirmed that the station is and always has been entirely within New South Wales, with its northern boundary coinciding with the border with Queensland (Figure 6). The property now covers 31,000 acres (12,545 hectares), but it should be noted that its boundaries have changed considerably over time, as various neighbouring "paddocks" were absorbed or lost through purchases and sales.

Figure 7: Claypan typical of those in the area near the find site (photo from Nancy Robinson).

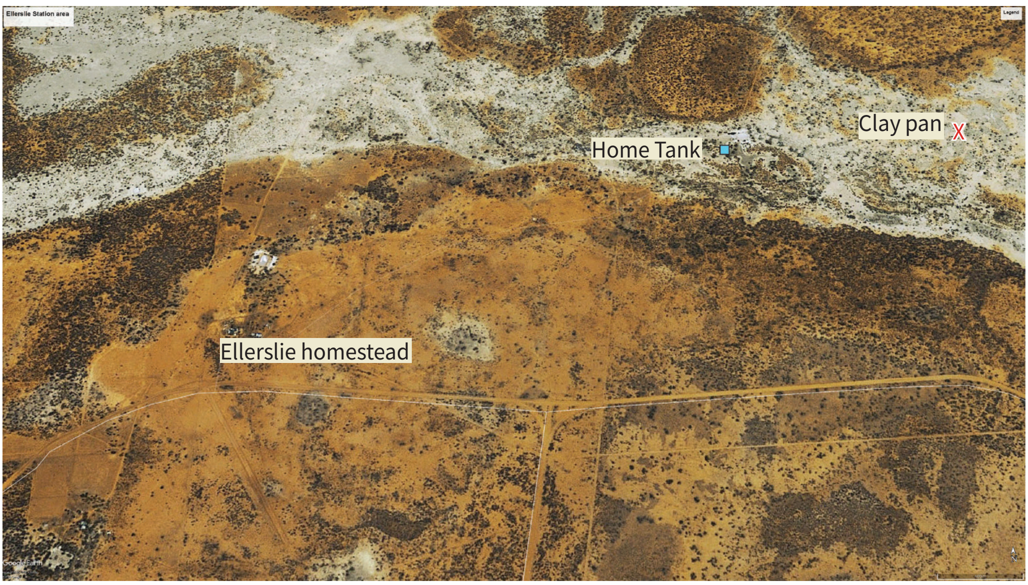

Figure 8: Google Earth image showing the location of Ellerslie homestead, the Home Tank and the find site of the meteorite (refer to Figure 6).

The Ellerslie district is within the Glenmore Land System, which is a region of stony and sandy plains supporting open mulga and areas of woody shrubs, spinifex and grasses (Hunter, 2015). In such a landscape, a large meteorite on the surface might be conspicuous, but Mr Crawford did not provide any specific information about where on the property he found it. However, according to Mrs Robinson, some long-time residents of the district recall that the meteorite was discovered on a clay pan to the east of the Home Tank (Figures 7, 8).

But where or what is Tego? Amongst the earliest appearances of the name is on a plan of runs or blocks shown in the *Atlas of Bundaleer Plains and Tatala*, produced by Frederick Montague Rothery between 1877 and 1878. Tego and Tego North runs are situated to the west of Nebene Creek and north of Widgegoarra Creek in the southernmost portion of the Bundaleer Plains, then a large pastoral property within Queensland's Maranoa district, as it was then constituted (Figure 9). The history of these blocks is complicated, mainly because leaseholders came and went, and names changed frequently (Butlin & Jennings, 1970). On the Maranoa Run Map of 1883, the Tego run is renamed Tego Springs in reference to an intermittent natural spring found within its boundaries. In 1899, a Tego township was gazetted on the site of a former settlement adjacent to the springs but was never built. A parish with that name has existed through the 20th century in the County of Nebine and is now included in the Shire of Paroo. Tego is also the name of the springs, or an artesian bore, in the Culgoa Floodplain National Park (Figure 10). This region can be reached via Jobs Gate Road, about 20 km north of Job's Gate on the State boundary fence some 60 km northeast from Ellerslie (see Figure 6).

While this history records the name Tego, it doesn't explain how or by whom the name was attached to the meteorite site. The most likely explanation is that it was an attempt to locate it "across the Queensland border" and, for unknown reasons, Tego was chosen as the most appropriate name. Tego was in use, possibly informally, by 1967, when Ray Binns, then at the University of New England, New South Wales, wrote to the NMV requesting a sample for study. By then, the meteorite had been reregistered as E11444 in May 1968.

The finder

The meteorite's finder, Henry Crawford, is a mysterious figure. Research has revealed that he was born in the early 1860s in Castlemaine, in central Victoria, one of nine children born to parents who emigrated from Glasgow in 1857. It appears that Henry moved to New South Wales in his mid-teens, probably on his own, and eventually reached the Bourke district by the 1890s. He married Ann Cowan during a brief visit to Melbourne in 1902–3, and the couple went back to Ellerslie, living there until the property, which they co-owned, was sold in 1914. Henry had returned several more times to Melbourne, delivering the meteorite in May 1905, then to donate more samples of rocks and minerals from Ellerslie to the NMV in December 1906. After Ellerslie's sale, Henry and his wife returned to Melbourne, where they lived in a rented house in Nicholson Street, Carlton, with two of his sisters. After living briefly

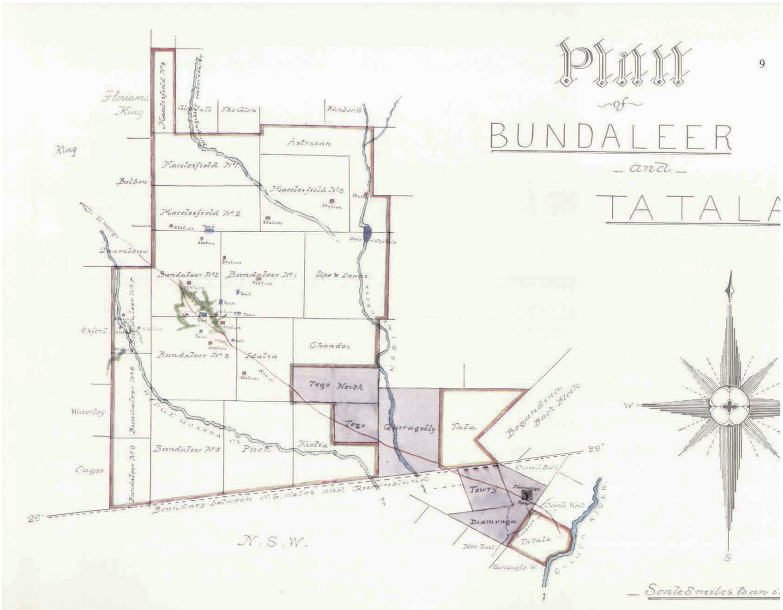

Figure 9: Plan of the Bundaleer Plains and Tatala showing positions of the Tego and Tego North runs in 1878 (see text).

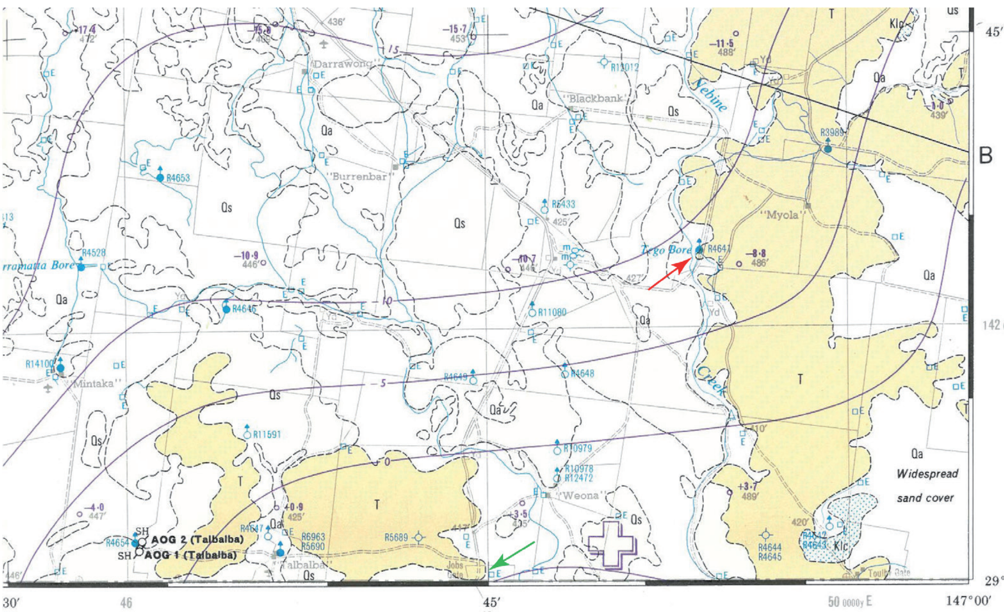

Figure 10: Part of the Cunamulla 1:250,000 geological map (Bureau of Mineral Resources 1968) showing the location of Tego artesian bore (red arrow) and Jobs Gate (green arrow) on the Queensland border (see Figure 6).

in Burke Street in the city, Henry died in Prahran in February 1925 from a form of lymphatic cancer, for which he'd been treated for years. Bearing in mind that the journey from Ellerslie to Melbourne in the early 1900s involved taking a coach from Enngonia to Bourke, then trains through central New South Wales to connect to Albury, then on to Melbourne, it might be expected Henry had good reason to travel so far other than to donate geological specimens, especially when a 10-kg meteorite would have imposed logistical difficulties. There are no records of any business interests he had in the city; instead, it's more likely his visits were for medical treatment. He left his estate, worth £3386, to his widow, who died in 1934; they had no children.

Summary

This investigation of the history of the Ellerslie meteorite has confirmed that it was discovered in August 1900 on the original Ellerslie Estate on the New South Wales side of the border with Queensland. The finder, Henry Crawford, was a co-owner of Ellerslie and made several visits to Melbourne in the early 1900s, during one of which, in May 1905, he donated the meteorite to the National Museum of Victoria. The official record of its find site being "Tego, Maranoa district, Queensland" is based on an historical mistake whose origin this investigation has sought to trace, but ultimately without success. Despite pieces of Ellerslie being widely distributed in international institutions, this paper provides the first known formal description of the meteorite, which is classed as an L5 ordinary chondrite showing mild shock features. A preliminary summary of this information has been added to the *Meteoritical Bulletin*'s online database.

Acknowledgements

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