Notes

The suitability of the fuel used for motor-sledging on Scott's last expedition, 1910–1913

Cameron P. McIntyre and Herbert Volk
CSIRO Petroleum, PO Box 136, North Ryde, NSW 1670, Australia

Barry D. Batts
Department of Chemistry and Biomolecular Sciences, Macquarie University, North Ryde, NSW 2109, Australia

Simon C. George
Department of Earth and Planetary sciences, Macquarie University, North Ryde NSW 2109, Australia

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ABSTRACT. The fuel used for motor-sledging during Scott's 1910–1913 expedition has been reanalysed to assess its suitability for that task in Antarctica. A research octane number of 65 and volatility were low compared with modern fuels but probably suitable when considering the design of the flathead engine. The findings are consistent with view that engine design was the primary cause of the mechanical failings.

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Introduction

On Scott's 1910–1913 expedition to Antarctica three newly developed motor sledges where taken to assist with haulage of supplies. One fell through the ice shortly after arrival and the other two were plagued by mechanical failures and were abandoned on route to the South Pole. The failure of the big ends was the primary mechanical problem and this was attributed to overheating of the air-cooled engine and inadequate lubrication producing excessive mechanical stresses (Day 1912; Dibbern 1976; Anon. 1991). The intense dryness of the air combined with the positioning of the cooling fan meant that only the first two of the four cylinders of the engines were cooled effectively. The constant over-heating of the third and fourth cylinders was suggested to have resulted in the excessive oil consumption of the engine and hence inadequate lubrication (Day 1912).

One of the more minor issues was that the engines were difficult to start due to poor volatilisation of the petrol. As a consequence, either at the start of the day or after a break to let the engine cool, a blow-torch was required to heat the carburettor for up to half an hour. A wooden box constructed around the motor to keep it warm while starting may also have disrupted the cooling airflow and contributed to the overheating and subsequent failure.

Fuel analysis

The fuel for the motor-sledges was donated by Shell and retrieved from a petrol canning factory in Melbourne, Australia (Wilson 1972: 50). Fuel from metal tins in wooden crates labelled 'Shell Motor Spirit' at a fuel-dump besides Scott's hut has been sampled and analysed for composition and geochemical properties (Gardner and others 1984; Dougherty 1985; Volk and others 2005). It was a straight run-gasoline produced from southeastern Asian crude and is consistent with fuel production at that time (*Encyclopædia Britannica* 1911). The simulated distillation by gas-chromatography indicated that the fuel had a boiling range of 2–176 °C with 22% *n*-alkanes, 37% *iso*-alkanes, 15% cycloalkanes and 7% aromatics by weight. Dougherty (1985) notes that the composition would be markedly different from modern fuels as the initial boiling point is about 20 °C higher, because it was produced before modern refinery processes such as catalytic cracking, alkylation, naphtha hydrofining, reforming and hydrocracking processes were available. A modern Australian gasoline, for example, will contain approximately 12% *n*-alkanes, 32.4% *iso*-alkanes, 6.4% cycloalkanes, 42.9% aromatics and 6.3% olefins. Dougherty (1985) goes on to suggest that an octane rating should be determined so that it can be compared to the compression ratio of the engine. The fuel was re-analysed to obtain an octane number for comparison with published engine designs (Anon. 1910) and to consider its suitability for the task in the Antarctic. Details of the fuel used are given in Volk and others (2005). 100 mL of fuel was analysed by Intertek, Caleb Brett, Australia. Bulk hydrocarbon group-type composition (PONA) and a research octane number (RON) were calculated from data for individual compounds obtained using gas-chromatography (ASTM 2001). The fuel has a density of 0.73 g/cm^3 (15 °C) and a vapour pressure of 24 kPa (37.78 °C). The average molecular weight was 96.2 and the elemental composition was Carbon = 85.2%, Hydrogen = 14.8% and Oxygen = 0%. Eighty peaks were identified (99.2%) ranging from C_5 to C_{11} and the RON was calculated to be 65. The density is normal for a fuel of that time which ranged from 0.70–0.74 g/cm^3 (*Encyclopædia Britannica* 1911). The vapour pressure is lower than for modern gasolines that have a range from 50–80 kPa. However, although the fuel was stored under Antarctic conditions some loss of volatile components may have taken place. The RON of the fuel is normal for a fuel of this composition and for that time, although considerably lower than that of modern fuels that are typically around 85–95. The text with the engine diagrams indicates that the valves were mounted on the side of the engine, indicating that it had a flathead or side-valve configuration (Anon. 1910). A major disadvantage of flathead engines is that the exhaust follows a more complicated path through the block to leave the engine leading to overheating under sustained heavy use. No cylinder volume is given and from the diagrams it is not possible to calculate one. Therefore, no compression ratio can be calculated. No piston or cylinder damage has been reported, suggesting that no pre-ignition or detonation occurred and that the compression ratio was correct for the fuel.

In conclusion the information presented here suggests that for the period the fuel was probably suitable for the purpose of powering the motor sledges and did not contribute to any major failings. Volatility may have been low, but not such that the motor could not be operated, and the octane rating appears suitable for the engine. Fuel composition is therefore not likely to have added significant stresses or contributed to failure of the big ends. These findings support the explanation that inadequate engine design was the primary cause of the failings.

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The frozen continent: an Antarctic play

Jason Kendall Moore (script) and Consuelo León Wöppke (preface)

Centro de Estudios Hemisféricos y Polares, Balmaceda 37-121, Recreo Viña del Mar, V Región, Chile

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ABSTRACT. This one-act play was recently presented at an Antarctic workshop held at Universidad Marítima de Chile, Viña del Mar, Chile. Apart from being entertaining, it provided an example of how theatre can be used to generate or reinforce interest in polar studies. The script has been translated from Spanish by the playwright.

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Preface

Many historians have dealt with the Antarctic sovereignty dispute of the 1940s and 1950s, and they concur that it motivated the U.S. internationalisation proposal that served as the basis of the Antarctic Treaty of 1959. It is understandable that most Antarctic specialists dwell on contemporary issues related to the treaty's maintenance, yet the sovereignty dispute entailed a number of more dramatic issues: jingoistic declarations, provocative gestures, and the risk of war. These issues are encapsulated