

Flickering lamps - from beeswax to gas

The need for improved lighting led to many interesting inventions, from safety matches to chandeliers. Fortunately we no longer have to kill a muttonbird or a whale to have oil for our lamps!

By Nigel Isaacs, BRANZ Principal Scientist

The light from wood fires probably offered the first artificial illumination, with sticks of a suitably resinous wood being used as portable torches. Even so, animal or vegetable oils or fats offered a more controllable source of fuel.

Liquid vegetable or animal oils could be held in a regularly replenished plant or clay container, feeding the wick which required regular removal of the 'snuff' (or trimming) as it turned to carbon. Maritime people in many parts of the world developed a lamp made from a seashell containing fish oil. Maori used fish (shark or whale) or muttonbird oil in a lamp, based on a shell or hollowed stone with a flax wick.

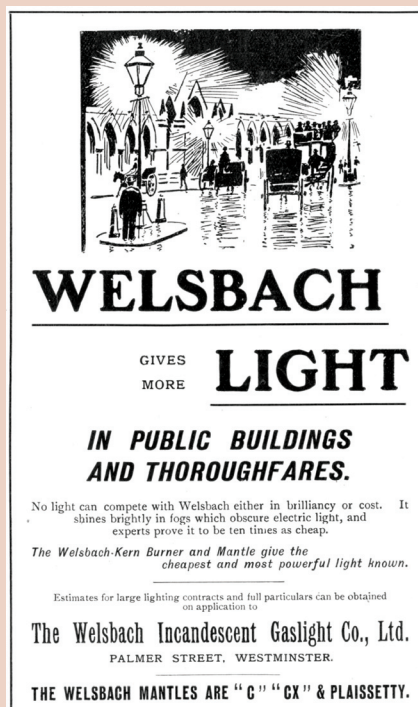
Homemade lamps and candles

Animal fats (notably tallow) were commonly used by early European settlers to make soap, but they could also be used for candles.

Wicks – whether from local reeds, or store-brought cotton or linen thread – were mounted on a frame, and repeatedly dipped in the melted tallow until they were of the required thickness. The 1883 Brett's *Colonists' Guide* suggested keeping tallow candles through the winter to improve their condition.

Homemade candles were cheaper and also avoided the government taxes that applied in the UK. Tallow and vegetable fat candles could even be eaten in times of severe hardship – Captain Scott took 2,300 lb (1,043 kg) of 'Price's Belmont stearine candles' on his ill-fated Antarctic expedition of 1910–11.

Other fats – notably beeswax – gave better quantity and quality of light but at a greater cost than tallow. John A. Lee (born in 1891) reflected that in his youth you 'could nearly



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Figure 1: Advertisement for Welsbach light. (Source: *The distribution of gas* by Walter Hole, 1912.)

determine the income standing of people by the candles they used. Poorer folks used tallow candles, the better-off could afford wax'.

Accidents with a portable light, whether using liquid or solid fuel, could have disastrous consequences. A major fire in Wellington in November 1842 caused much loss of property. Consequently, a resolution 'That fires, candles and all lights should be extinguished in raupo houses immediately after sunset on the pain of a heavy fine for neglecting to do so' was considered by Council, but never passed.

Sperm whale made finest candles

Until 1783, oil lamps gave a weak, flickering light. Swiss inventor, Genevois Aimé Argand, found that surrounding the wick by a glass chimney steadied the flame and provided a good air supply. The wick was fed from a reservoir below. His design was also later used with gas.

The need for improved lighting led to many other inventions – the safety match, plaited and borax impregnated wicks, the chandelier (from chandelles, the French for tallow candles) and chambersticks.

But the search was also on for improved fuel – and it was found in the sea. The finest candles were made from the spermaceti found in the sperm whale. Spermaceti candles lasted longer and burnt more clearly, brightly and with less odour than the same sized tallow candle. This led to their selection as the basis for standardisation of light levels. In the English-speaking world, the candle-power (c.p.) was defined by the London Metropolis Gas Act of 1860 as the light given by a sperm candle, of which six weighed 1 lb and each burned 120 grains an hour – equivalent to the candle lasting 9.75 hours. The source of light was replaced in 1909 by an electric lamp, and ultimately the SI unit became the candela (equal to 1.019 c.p.).

Crude oil gives other options

The discovery of oil in Pennsylvania, USA, in 1859 resulted in the ready availability of paraffin wax. Extracted from crude oil after refining, it could be moulded into candles of higher quality and lower cost.

Kerosene (called 'paraffin oil' in the UK) was also extracted from crude oil. It was

stable, produced a good flame and had little smoke or smell.

Kerosene lamps provided better light than candles but were expensive. They replaced candles in wealthier houses, particularly in remote areas.

Kerosene lamps were used in cities for street lighting. In 1863 Christchurch boasted three kerosene lamps. The lamplighter was paid 7 shillings a week for each lamp and to supply chimneys, wick and kerosene (£18 4s per year). In 1864 the Council let a contract for a further 17 kerosene lamps, but the next generation of lighting was already on the way.

Town gas from the 1860s

Town gas was first provided commercially from the heating of coal in London in 1812. In New Zealand, street lighting was the first initiative for gas companies. By Christmas 1864 the Christchurch Gas, Coal and Coke Company replaced the kerosene lamps with gas – costing £20 per year. Auckland's gas company supplied 43 street lights and most leading stores in April 1865. The Wellington Gas Company was supplying 24 gas street lamps in 1871.

Once the piping was in the street for gas lighting, domestic use quickly followed – including lighting, cookers, water heating and space heating.

Coal gas was noxious and smelly, even before combustion. A good level of background ventilation was essential (perhaps life saving) – the ornate ceiling rose often being used to provide both ventilation and removal of burnt gas. Among the English middle class it was

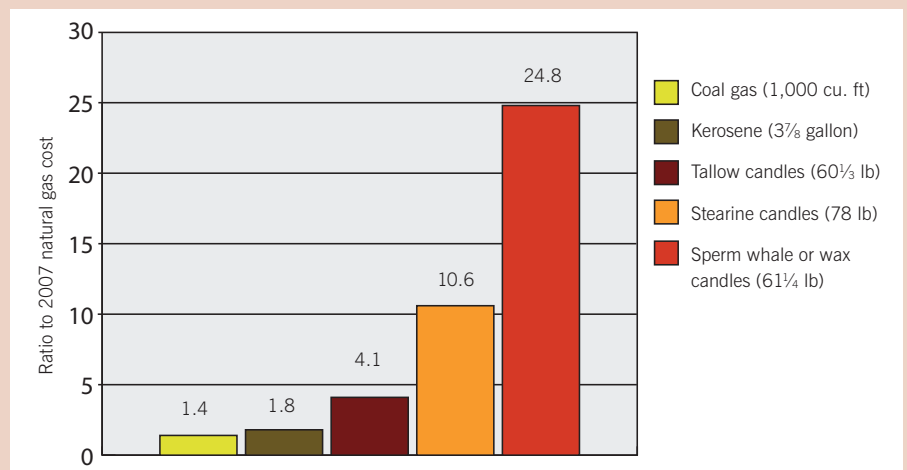


Figure 2: 1888 Auckland Gas Company lighting fuel cost compared to 2007 cost of residential natural gas.

said that each £100 of a family's income was proven by a leaf on the parlour aspidistra – a plant with little to recommend it beyond its ability to survive the town gas fumes.

The flickering gas flame continued the problems of candles and kerosene. Many different burners were invented, such as the cockspur, fishtail and batwing – largely named after the appearance of the flame. It was found that playing a flame on a piece of limestone (calcium oxide) created an intense, stable light – leading to its use in theatres for spotlights (and hence being 'in the limelight').

Ultimately it was the 1885 patent of the incandescent mantle for gas lamps, by Viennese Dr. Auer von Welsbach, that solved the problem. A mixture of rare earths was put on a cotton mantle that burnt away with the first flame, leaving a shell to give a steady glow

of greenish tinted light. In 1890, Welsbach produced a mantle with the more thermally-stable thorium oxide (99%) combined with cerium oxide (1%), which was more robust and produced a whiter light (see Figure 1).

In 1888, the Auckland Gas Company showed that town gas was the most economic option. Interestingly, after allowance for inflation and the higher energy in today's natural gas, but not for the environmental impacts, town gas would be still a cheaper option in 2007 (see Figure 2).

But by the late 1890s the competition with electricity was becoming fierce. Gas suppliers and equipment manufacturers fought back, developing gas lighting systems that could be controlled from a wall-mounted switch, but it was not enough. The invention of the electric incandescent lamp proved to be the death knell for gas lighting. ♦