

INTRODUCTION TO SOLAR WATER HEATING

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Neville S Billington & Brian M Roberts, 1982

12.6 SOLAR ENERGY UTILISATION

Heywood has given an outline history of solar energy utilisation up to *ca.* 1950 (*Engng.* 1953 176 (4573) 377). There has of course been considerable research and development work in the following 30 years, and solar heating is now a commercial proposition.

Many of the early devices sought to concentrate the sun's rays by means of a mirror; this enabled quite high temperatures to be attained at the focus, so that steam could be generated. According to Heywood, Güntner in America made the first experiments between 1854 and 1873. He, and Mouchot in France (1860-1880) and Adams in Bombay (1876) generated steam. Bessemer was able in 1868 to melt copper at the focus of a 3.3-m diameter mirror. Abel Pifre demonstrated a modified Mouchot device to the French Association for the Advancement of Science in 1879. This had a steerable semi-parabolic reflector, and raised steam at 400 kPa. An efficiency of 80% was claimed. Harding used a solar still to distil water in Chile (1883) and obtained about 5 kg of water per day per m² of receiver. Willsie and Boyle (USA, 1902) used a two-fluid system, with ammonia, ether or sulphur dioxide as the secondary fluid, whose vapour was employed to drive an engine. In the same year, the first English-language text-book on solar energy was published

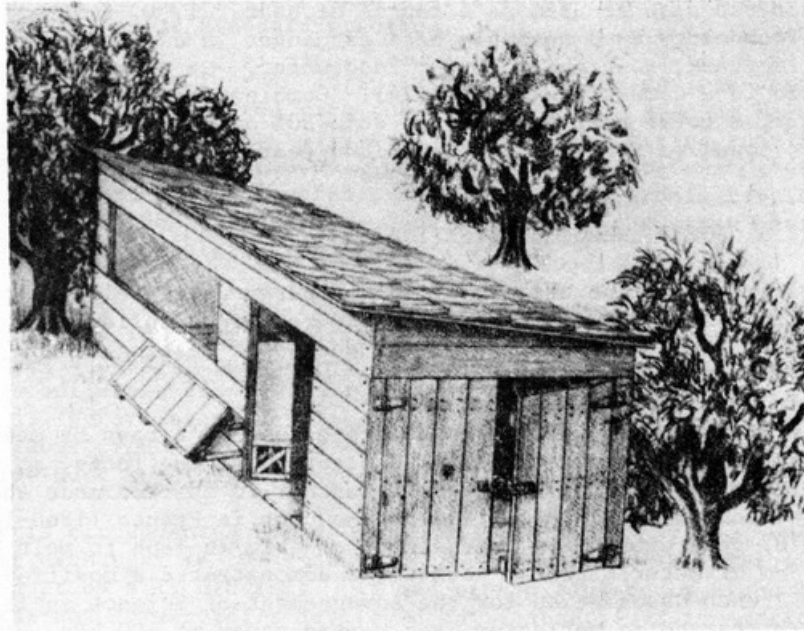
The earliest use of flat collector plates for heating water is not known, though it is recorded⁽¹⁶⁾ that in the USA:

"Early settlers had heated water in the sunlight for many years. A tank, usually painted black, was put in the sun and by late afternoon the water in it was hot enough for washing."

In 1891, C. M. Kemp of Baltimore patented the "Climax" water heater — four tanks, of about 30 l capacity each, arranged side by side in a glass-covered box, which was mounted on a slant so that one tank was above another. By 1900 some 1600 "Climax" heaters were in operation throughout the southern states.

In 1898, Frank Walker of Los Angeles designed "an improved heater, with better water flow and a back-up provision". In 1905, Charles Maskell introduced the "Improved Climax", described as having broader, shallower tanks (which heated faster), with further improved water circulation and with a back-up. The Walker and Climax devices could heat water to 50°C by late afternoon; the "Improved Climax" by early afternoon.

The cast-iron or galvanised-iron tanks in these first solar heaters had themselves to warm up before transferring heat to the stored water, and then they were not particularly efficient at doing that. These problems were tackled by William J. Bailey of Monrovia, Cal, around 1909 (Fig. 12.7):⁽¹⁶⁾



WHERE IT STARTED—Sketch made in early days shows shed at Linwood and Myrtle Aves, Monrovia, where William J. Bailey developed

first 24-hour solar water heater in 1908-9. Collector panel can be seen angled against wall at left, with storage tank visible inside door.

Fig. 12.7. Bailey's solar water heater (1908).

"Bailey ran the water through copper (a better heat transfer medium) pipes soldered to a copper sheet, both painted black. The smaller quantity of water exposed to the sun at any one time also heated faster.

Secondly, the water stored in the same tanks in which it was heated, cooled off at night and had to warm again the next day. Bailey removed the storage from the heater and kept the hot water in an insulated tank, mounted on the rooftop or in the attic... .

The final step came when the disastrously cold winter of 1912-13 froze solar heaters right and left, bursting the pipes. The flood of complaints forced him to create a new device in which a non-freezing solution was heated in the solar panel and then used to warm the tank water by being passed through an immersed coil."

It has been estimated that about 25000 solar water heaters were in use in Southern California during the 1920's and 30's. In 1923, Bailey licensed the use of his patent to an entrepreneur in Florida, where the solar water heater probably made its greatest impact, for by 1941 at least 60000 were in use there.

The solar industry diminished with the discovery of ample supplies of natural gas in California in the 1930's. The restrictions on the use of copper in World War II destroyed the industry, while after the War cheap electricity prevented its revival. Nevertheless, solar water heating remained in use in some parts of the world: the British Army used it in the Mediterranean and the Middle East in 1954. Considerable research was carried out in Australia from the 1950's, and in Israel, where solar water heating became established practice.