

Tar distillation at Crew's Hole

Raymond Holland

Crews Hole, just over two miles upriver of Bristol Bridge, is both downwind of the city and on cheap land so it is not surprising to find early industry where there was, for example, stone available for quarrying, coal from both opencast mining and pits at nearby Conham and Hanham and clay suitable for fireclay works. Clay from the Isle of Wight and Poole was used by Anthony Ammatt to make pottery in Crews Hole between 1812 and 1819. The river provided the means for moving raw material in from coastal and inland sites and finished products out. There was also a barge-building slipway near the Lamb Inn (now Technigraphic). There was a lead works in the 18th century run by Hares and Somers. Prior to 1843 Stone and Tinson produced sulphuric acid and soda ash. It is known that there had been a bottle-glass works in Crews Hole before 1766, for in the Bristol Journal of 4th October 1766 it was offered for sale by auction. The earliest known industrial works in the area was in about 1710 when copper smelting was started by the Bristol brass company. The flue up the hillside to the chimney at the top of Troopers Hill is believed to have been built later to give good draught conditions for the furnaces. Thus, there have been industrial and chemical works here for over two and half centuries.

The origin of coal tar as the name suggests is from one of the by-products when coal is heated to produce gas and coke. The tar condenses from the gas stream. Coal itself is of vegetable origin. Bitumen – the 'other black stuff' – is the residue from the distillation of crude oil which is mainly of animal origin. In 1807 gas lighting was introduced in London and soon every town up and down the country had its gas plant. The benefits of the lighting were rather dimmed by the massive pollution of the rivers by the black tarry by-products which nobody wanted. Manchester was the first gas works to use the tar as a fuel. The alternative, distillation, did not become common practice until uses had been found for the products, naphtha, creosote and pitch.

In 1819 a Scot named Macintosh discovered that the light distillate forerunnings from the distillation of tar was a solvent for rubber and he rubberised fabric, making it waterproof. We still remember the name, albeit misspelt, calling our rain coats 'mackintoshes'. John Bethell of West Bromwich took out a patent, No.7731 in 1838, describing the use of creosote distilled from tar as a wood-preservative. This patent came to the knowledge of Isambard Kingdom Brunel, who, wanting a preservative for his wooden railway sleepers, took out a licence for the use of the process. Based on technical advice from John Bethell and financed by Roberts and Daines of Silverthorne Lane, a tar distillery was erected at Crews Hole and managed by William Butler, who had worked with Brunel on the Bristol and Exeter Railway.

In the early days at Bristol Works creosote and pitch were the only saleable products. Creosote, as a result of Brunel's early experiments with railway sleepers, became the pre-

eminent wood preservative. Pitch was used by the patent fuel industry in South Wales to bind unusable coal and anthracite dust into a first-class fuel briquette.

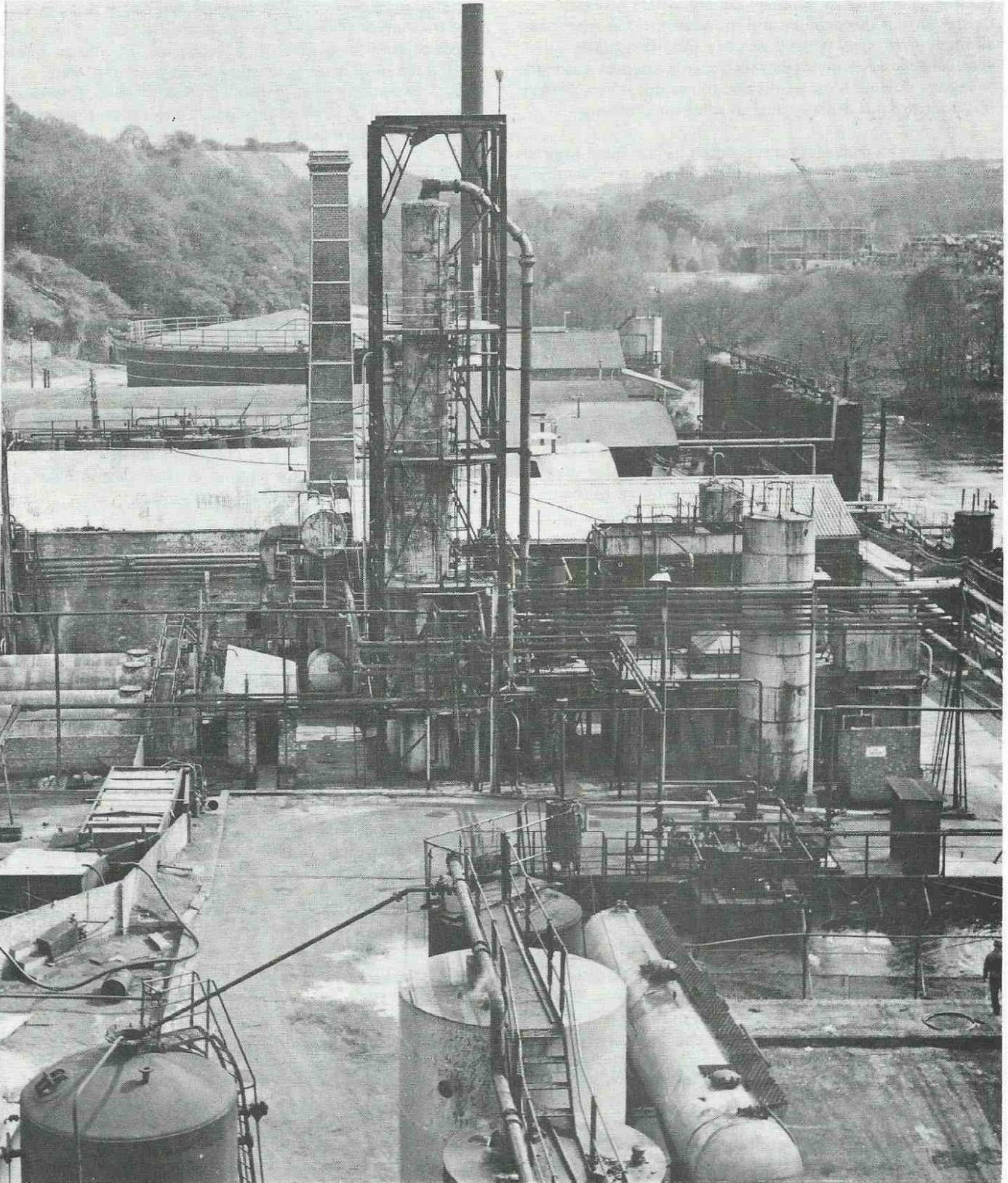
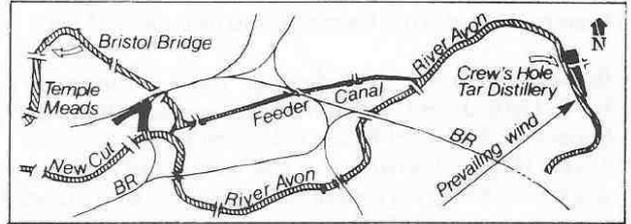
In 1863, following a great fire at Crews Hole, Roberts and Daines sold their interest to William Butler, who then both owned and ran the works. In 1871, Roberts and Daines leased to William Butler part of their Silverthorne Lane premises, which eventually became the railhead at Bristol, storage depot and Head Office.

In the meantime many new uses had been discovered for the products of tar distillation. In 1849, phenol was being extracted from the creosote distillate and, when nitrated to make trinitro phenol (picric acid), was used as a yellow dye for wool, cotton and silk. This was the first artificial dye. In 1856, William Perkin, attempting to make quinine, oxidised aniline with potassium dichromate and obtained a black precipitate, which was soluble in alcohol giving the colour which he called 'mauve'. A year later he set up the first dyestuffs factory in the world at Greenford Green, Middlesex. As aniline was obtained from benzene there was a rise in the demand for benzene from the tar industry. Phenol became prominent again in 1865, when Lister introduced his antiseptic surgery. To this day anyone who has been in hospital knows how keen they are to wash beds, lockers etc. with 'carbolic acid' solution!

The artificial dye industry was becoming established when, in 1869, Caro, Graebe and Liebermann in Germany, and Perkin in England, independently devised methods for producing alizarin, the essential dye of madder, from anthracene. The tar industry extracted the anthracene from its heavy creosote to meet the new demand. This resulted in the cultivation of madder - the natural source of Turkey Red dye, used from the time of the ancient Egyptians - coming to an end. In 1880 Adolf Von Baeyer synthesised indigo from naphthalene but it was not until 1897 that it was produced on a commercial scale in Germany. Tar distillers extracted the naphthalene from their oils and the growing of indigo plants in India ceased.

At Crews Hole all distillation was in pot stills, that is batch distillation, until 1899, when William Butler and Company set up a continuous pipe still, only the second one in this country, the first being at Greenwich. This method of distillation gave a greater throughput than the batch process, there was no recharging and no warming up period. As everyone looked to greater prosperity, and the new introduction coincided with the gold strike in 1897, the Lennard Still was christened '*Klondyke*'. After much modification over the years, it was eventually demolished in 1977. With the invention of the internal combustion engine and the horseless carriage, the tar industry started separating motor benzole from the light distillate as a fuel. The name 'Petrol' was coined by Carless, Capel and Leonard in 1893. The Bristol Works was at the forefront

Crew's Hole "Klondyke", the Lennard still set up in 1899 and shown here in its modified form before demolition in 1977.



photograph by John Cornwell

of this development since a benzole distillation plant had been purchased from Germany and installed in 1890.

Bristol had the first 'macadamised' roads in the country, for in 1815, John Loudon McAdam was appointed General Supervisor of Bristol Roads belonging to the Turnpike Trust. He gave his name to a new method of roadmaking when he evolved the idea of using small carefully graded stones to make the foundations, and is commemorated by the plaque outside 23 Berkeley Square, where he lived. By the turn of this century and the advent of the motor car, all roads were dusty when it was dry and often slippery or even very muddy when it was wet. Some attempt was made to lay the dust with gas-works tar, and as this is very sticky it is doubtful if it did anything to solve the problem.

As a result of a competition sponsored by the Road Improvement Association, first dehydrated tar and then refined tar, (the residue left after the distillation of crude tar to a point before it becomes pitch) was tested. Road Board Specifications were introduced during the 1920s and by 1930 the British Standards institute BS76 was in use, defining the limits for viscosity, the type of oil to be used to 'thin' road tar and limiting the naphthalene and phenol content. Both the latter were considered to be injurious to good road surfacing. This suited the tar distillers very well for they wanted the maximum extraction of naphthalene and phenol, since if road tar was its 'bread and butter' then the extracted chemicals were the 'jam'. Tar was sold in the summer months for surface dressing and throughout the year to the quarries to mix with stones to produce tarmacadam for road construction. One of the earliest thermo-setting plastics can be attributed to the tar industry for in 1907 Baekeland discovered a plastic, later called 'Bakelite', made from phenol and formaldehyde.

Both the 1914-18, and the 1939-45 wars brought the tar industry into considerable importance in the production of chemicals for wartime uses. Motor benzole was produced as a fuel - the famous National Benzole Mixture. Toluene gave trinitro toluene (TNT) and saccharin. Refined tar acids (phenol, cresols, xylenols and high boiling tar acids) gave rise to plastics, synthetic resins, weed-killers and disinfectants. In particular phenol gave acetyl salicylic acid (aspirin) and picric acid, which as well as being used as a dye was an explosive known as 'lyddite' (the name being taken from a testing site at Lydd in Kent). Pyridine, a tar base, which was used to denature alcohol became, in the Second World War, a starting point for the sulphonamide drugs. Road tar was diverted to making aerodrome runways and perimeter tracks, while pitch and creosote were blended to make coal tar fuel at a time when the fuel oil supply to this country was in grave danger.

During the 1930s petrol and gas oil were being made by ICI at Billingham by the hydrogenation of creosote. The production of aviation spirit continued until the end of the war in 1945, when it became uneconomic compared with petrol from the oil refineries. With current fuel and energy shortage, it may become viable yet again!

After the war in 1947 the gas industry was nationalised and following protracted negotiations a long term contract, on a co-operative basis, led to the formation on 1 January 1952

of Bristol and West Tar Distillers Limited, owned 75% by Butlers and 25% by the South West Gas Board. In 1962 Butlers sold their share to the Gas Board, so that Bristol and West Tar Distillers Limited became a private company wholly owned by the Gas Board. Butlers moved all the non-tar side of their business to the new Rockingham Works at Avonmouth between 1962-65.

During the 1960s the replacement of the old town gas by both gas produced from petroleum and North Sea gas, led to the demise of coal-based gasworks and resulted in a large reduction in the availability of crude tar. Finally on 1 April 1970 the ownership of Bristol and West Tar Distillers Limited passed to the British Steel Corporation, Chemical Division and in 1974 British Steel Corporation (Chemicals) Limited was formed.

The present-day tar distillation plant at Bristol is one of the most modern in Europe following renewals and modifications over recent years. Bristol has a primary distillation unit receiving tar by road tanker mainly from geographically close South Wales BSC coke ovens at Port Talbot and Llanwern. It operates continuously 24 hours a day, 7 days a week only shutting down for overhaul and repair. The crude tar is heated to approx 350°C to drive off the light fractions leaving a pitch residue which is used for briquetting coal and making electrodes for the aluminium industry. The light material is separated by the fractionation column giving a gaseous 'overhead' product and five useful side-streams. The lowest boiling liquid product, from the top of the column, is recirculated. The progressively heavier fractions, descending the column, are called naphthalene oil, wash oil, light and heavy anthracene oils.

There are three subsidiary plants manned by day workers - naphthalene, creosote and pitch tar blending. Naphthalene is refined by crystallisation to produce a grade suitable for transfer to another BSC (Chemicals) Ltd works where phthalic anhydride is made. Creosote is blended for sales as a wood preservative, as flux oil for road tars and as a feed-stock for carbon black production. Light anthracene oil is transferred to another BSC (Chemicals) Ltd works for anthracene extraction. Pitch is blended with creosote to produce various grades of road tar to meet BS76, which are either used for surface dressing, during the summer months, or sent to the quarries to be mixed with stones to make tarmacadam for road construction.

Thus from small beginnings in 1843 tar distillation at Crews Hole has developed to the modern continuous distillation plant which can be seen on a present-day tour of the works.

References

Butler Howard T, *The History of Wm Butler & Co (Bristol) Ltd.* 7843- 1943.

Wm Butler & Co (Bristol) Ltd, *Tar Distillation in Bristol*, post war pamphlet.

Janson S E, A Science Museum illustrated booklet *Chemistry 4; Making Chemicals*

Marochan K, Crews Hole Pottery, paper 1960.