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## THE HOUSE OF WATER

R. Harker

Water has always been one of the greatest problems faced by miners in the course of their work. It has always been necessary to drain mine workings, even in the days of bell-pits and surface workings, where only the backs of veins were worked to a shallow depth.

In the early surface workings, the water was probably disposed of by bailing with buckets or, where possible, by digging a drainage ditch from the lowest part of the workings.

It was necessary to get rid of water in the early workings to prevent flooding, this problem grew as the mines went deeper. Thus, "the chief exercise of ingenuity required by the miner at his work has always been in getting rid of the water" (Hamilton-Jenkins).

Water has always been costly to raise to the surface as can be seen from the following extract from a letter by Ulrick Frosse, a German in charge of the Perin Sand mine in 1584. "Mr. Carnsewe was here to see our workes and mine at Perin Sand and went down with me into the bottom of the worke and so up alongst the new audiet we made which is at this present about fifty fathoms long under all the old workes. Great springs of water we light on still in going up which will put us to great charge in the end, I fear me."

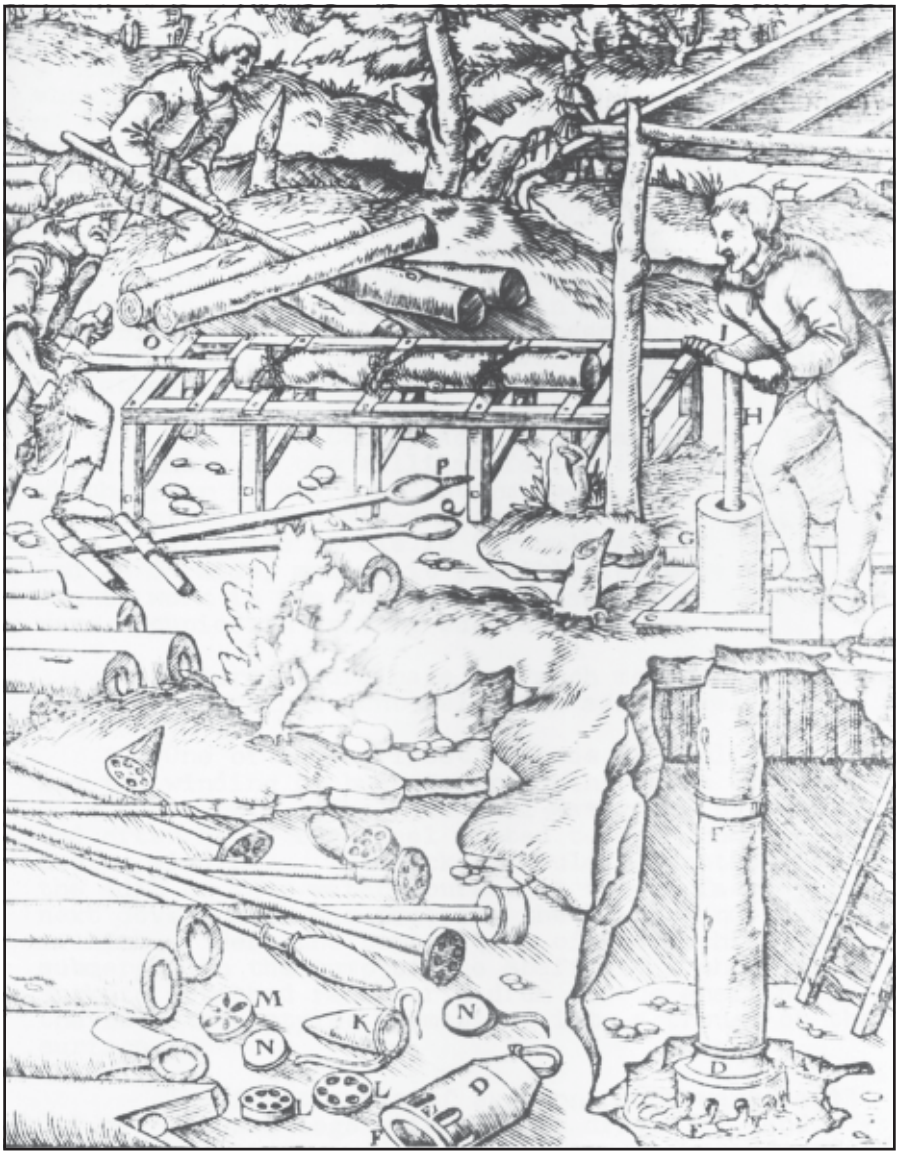
The later deeper workings in Cornwall were very expensive to drain as they often required large numbers of men working round the clock to keep them free from water. Evidence of this is given by a traveller in the St. Austell district in 1695. "I went a mile further on to the hills where there were at least twenty mines, all in sight, which employ a great many people at work almost night and day, including the Lords day, which they are forced to, to prevent their mines being overflowed with water.



More than a thousand men and boys are taken up with them; they have great labour and expense to drain the mines with mills that horses turn, and now they have mills or water engines that are turned by the water".

In some mines, where water was very abundant, it proved so costly to drain the workings that they had to be abandoned. "100 mines some of which were at work, others that were at work, others that were lost by the waters overwhelming them". This was in the Redruth area in 1695.

Much thought was applied to the drainage of mines and many of the early contrivances for this were invented by Germans. Evidence of this lies in




Before the steam engine: making and using elm-tree pumps to drain mines, from Agricola's *De Re Metallica*, 1556.

Agrico1a's "De Re Metallica", (see woodblock Book VI 177) where particular reference is given to the early mines in Germany. However, the Cornish miners were not entirely dependent on the Germans. "In Cornwall" wrote Carew, "they pray in aide of sundry devices, as Addits, Pumps and Wheeles driven by a streame, and interchangeably filling and emptying two Buckets with many such 1ike: all which notwithstanding, the springs do so incroche upon these inventions as in sundrie places they are driven to keepe men, and somewhere horses also at worke bothe day and night without ceasing, and in some all this will not serve the turne".

Great store was set, even up to the present day in some places, on the use of adits for the drainage of mine workings. Even as early as the 14th century special levels or adits were being driven for the sole purpose of drainage. This was the case at "Byr1ande" in 1303 where the Royal silver-lead mine had recourse to an adit. An extract from a letter to the Lord Treasurer states, "for whereas we could to nothing before this time in winter by reason of the abundance of water, except it was by drawing off the water by leather buckets, which was done at very great expense, now we shall be able, thanks to God, to do as much and win as much in Winter as in Summer, because the water will have its full course out of the mines through the adits down as far as the deepest part of the mine, without our drawing off any of the water in the manner aforesaid."



In some cases it was less costly to drive a level for drainage than to drain the mine by pumps and, moreover, an adit was often more efficient than a pumping engine even as late as the 18th century when steam power was available. This was the case at Wheal Rose mine about 1725 where one of Newcomen's early engines proved so expensive to run that the mine owners had a drainage adit driven for a mile and a half, which proved cheaper than running the engine.

Adits were used in Cornwall during the 18th century to such an extent that in many places where formerly a shaft could not have been sunk to a depth of 15 fathoms, without being overwhelmed with water, 50 fathoms could be reached without meeting water.

The Great County Adit was started in l748 (by a member of the Williams family in Gwennap) which after 50 years of intermittent driving, ran for 30 miles and drained 46 mines. The average size of drainage levels in Cornwall was 6 ft 0 ins high and 2 ft 6 ins wide, making it possible for only one man to work in the end at a time and often many years were occupied in driving such a level.

Naturally drainage was much more of a problem where the workings went below the adit level.

One of the earliest methods of hauling water was the winding of buckets or leather bags by means of a jack-rowl. The jack-rowl was wound by hand and often had a fly-wheel fitted to the drum for easier winding. The buckets would be emptied into the adit or into water courses at the surface. The next development was probably the bucket and chain machine. Here the bottom drum of the machine was submerged in the sump of the shaft and a chain with buckets attached ran over a drum at the shaft head, the buckets emptying themselves into a trough on the surface.

The first types of suction pumps were made out of hollowed logs with pistons driven by hand, horse or water powered crank shafts. The ends of the bottom suction pipes were submerged in the sump [25] surrounded by wicker baskets acting as filters. Water was sucked up the first pipe and discharged into a trough in which the second stage of the pump rested, this in its turn lifted the water to the surface or the next lift as the case may be. This kind of pump might have been used as early as 1480, when account has it that Beer Ferris silver-lead mine was drained partly by jack rowls and partly by suction pumps powered by water wheels. These pumps gradually developed in lifting power, being built in banks and were capable of lifting water a great distance. This meant that greater power was required to drive the pumps, this problem being not altogether solved by the introduction of the steam engine. The early engines consumed a great deal of coal for the power they gave.

The water-wheel at Cooks Kitchen Mine in Cornwall was 48 ft 0 ins in diameter and could raise water through 9 inch bore pipes, for 80 fathoms. The rag and chain type pump which was used over a great period was gradually abandoned in Cornwall, “On account of the great expense and the destruction of the men” (Pryce) and recourse was taken in many cases to winding with water barrels. The largest barrels drawn by a horse whim contained 120 gallons and had to be powered by four horses and work at a rate of not less than two barrels a minute to make it pay.

During the 18th century steam power was being developed and applied to the mines for both haulage and pumping, although the early Newcomen engines left much to be desired. The Newcomen engine was introduced in about 1714, but due to the great quantities of coal it used there was only one of these engines still working in the whole country by 1742. The clack valves of these engines were constantly giving trouble, being made of sewn leather. On the many occasions of these failures, every man in the mine was bound under penalty of a fine to man the capstans. When Boulton and Watt began to build their engines, they opened up a new era for mining. Until these engines appeared, fifty fathoms below the adit had been about the maximum depth that the old Newcomen engines could drain. In the year 1780 a set of adventurers started to work the Con- [26] solidated Mines in Cornwall and in 1782 they had five Boulton and Watt engines working which consumed only 2,030 weys of coal in a year. This compared very favourably with the 6,362 weys used by seven Newcomen engines in one year. The saving by

using the new type of engine amounted to £10,830. From this time, pumps and engines were developed as one culminating with the final 90 inch diameter cylinder engine of which fortunately a few are still preserved.

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