

COAL THROUGH THE AGES

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Occasionally it is interesting, and sometimes useful, to review the past for early references to our industry, and to learn of the trials and travail passed through before it arrived where it now is—and the results of such a review follow.

Some time ago one of our modern playwrights and poets, Arthur Guiterman, turned to coal, with the following result:

Afar in the Carboniferous time
I grew in Paleozoical slime,
A lepidodendron with boughs on my stem
And lepidostrobuses grew out of them.
My roots in the mud of the ages I spread
And up to the heavens I vaunted my head,
I thrive in the heat of tropical sun,
And now I am coal at two dollars a ton

Behold from my bed on the primitive shale
How quickly they raise me; the stead of the rail
Is mine, yea, mine are the ships of the sea
And shivering multitudes clamor for me
As chariot borne through the sleet and the snow
Of winterbound cities in triumph I go,
In honor and dignity second to none,
For now I am coal at two dollars a ton.

The millions of years between the time first mentioned, when the sunshine and chlorophyl were transforming the hydrogen, oxygen and carbon of the air and soil into cellulose and lignin, which later became the complex chemical coal, and the present era of its use has been a far cry, and it has been only during the last several thousand years of this time that mankind has known anything about coal, only about two thousand years during which it has been of any commercial importance and only a few hundred years since it has become indispensable in our economy.

It is generally agreed that the use of fire was the first great discovery that differentiated man from the animal. For thousands of years the fuel used was mainly wood, charcoal derived from it, dried dung and straw, which were ample for the limited heating requirements and the fabricating of metals

for hunting and warfare. It is possible, but hardly likely, that small amounts of bitumen, or petroleum, may have been used in western Asia for fuel, as its occurrence was well known as early as 1500 B.C., and it is mentioned many times in ancient literature.

With the single exception of China, all of the early civilizations developed in warm countries, in which very limited quantities of coal exist. It is not surprising, therefore, that the references to coal in the writings of the ancients are meager. It is generally conceded that where it is mentioned in the Bible the references are to charcoal and not to mineral coal.

REFERENCES IN LITERATURE

Perhaps the first reference to coal is found in Aristotle's "Meteorology." Speaking of the combustible bodies, he says, "Those bodies which have more of earth than of smoke are called coal-like substances."

Theophrastus was a pupil of Aristotle, and in his "History of Stones," about 371 B.C., he says:

Some of the more brittle stones there also are, which become as it were burning coals when put into a fire, and

continue so a long time; of this kind are those about Bena, found in mines and washed down by the torrents, for they will take fire on burning coals being thrown on them, and will continue burning as long as anyone blows them; afterward they will deaden, and may after that be made to burn again. They are therefore of long continuance, but their smell is troublesome and disagreeable. But the Lipara stone empties itself, as it were, in burning, and becomes like the pumice, changing at once both its colour and density; for before burning it is black, smooth, and compact. Certain stones there are about Tetras, in Sicily, which is over against Lipara, which empty themselves in the same manner in the fire. And in the promontory called Erineas, there is a great quantity of stone like that found about Bena, which, when burnt, emits a bituminous smell, and leaves a matter resembling calcined earth. Those fossil substances that are called coals, and are broken for use, are earthy; they kindle, however, and burn like wood coals. These are found in Liguria, where there also is amber, and in Elis, on the way to Olympia over the mountains. These are used by smiths.¹

This reference includes the word lithanthras, from which anthracite is derived. The coal mentioned here was mainly of the brown coal variety, coming from Thrace in northern Greece, and Liguria in northwestern Italy.

Several other Greek authors² refer to a series of

References are on page 58.

substances which burned, contained earth and which, no doubt, comprised coal. Generally, however, these references are only to the material and not to its use. Coal cinders are found among the ruins of Roman villas and towns in England, especially in Northumberland along the Roman wall, near which well-known seams outcropped. The Romans, in Britain at least, were familiar with its use before 400 A.D. In France, however, some Roman aqueducts uncovered coal outcrops without any mention being made of them, and with no evidence of familiarity with the use of the fuel.

Coal, like so many other things, was probably used by the Chinese on a commercial scale long before it was so used in Europe. Dr. T. T. Read has found large iron castings in China that were made as early as 900 A.D. and cast-iron coins made about the first century B.C., and in his opinion—which he has not yet been able to confirm—these were made by the use of a coal very high in phosphorus, in the same manner that castings are now being made there. The first mention of coal he found in Chinese literature is by Liu An, who died 122 B.C., who calls it “ping-t’an,” literally “ice charcoal” or “frozen charcoal.”

It is also referred to in early Chinese works as "earth charcoal" or "rock charcoal" and seems to have been widely known quite early, but nothing indicates its extensive use. Since wood fuel is scarce and expensive in many parts of China, and has been so for centuries, he suspects that coal was used as fuel to evaporate brine in saltmaking as early as the second century B.C. Macgowan, in 1850, stated that:

the earliest notice of coal is in the history of the Hán dynasty, B.C. 202 to A.D. 25, where the remark occurs that Kiangsi produced stones, which were used as fuel.

Marco Polo, once considered the greatest liar of all time—and this statement of his was not believed in Europe about 1310—said:

Throughout this province there is found a sort of black stone, which they dig out of the mountains, where it runs in veins. When lighted, it burns like charcoal, and retains the fire much better than wood; insomuch that it may be preserved during the night, and in the morning be found still burning. These stones do not flame, excepting a little when first lighted, but during their ignition give out a considerable heat. It is true there is no scarcity of wood in the country, but the multitude of inhabitants is so immense, and their stoves and baths, which they are continually heating, so numerous, that

the quantity could not supply the demand. There is no person who does not frequent a warm bath at least three times in the week, and during the winter daily, if it is in their power. Every man of rank or wealth has one in his house for his own use; and the stock of wood must soon prove inadequate to such consumption; whereas these stones may be had in the greatest abundance, and at a cheap rate. (Surely a prophetic statement.)

The Fu-shun mine, in Manchuria, by far the largest producer in China, has no authentic record, but "it is said that the coal was used as fuel for a porcelain factory about 600 to 700 years ago, and for copper smelting in times as remote as 2000 or even 3000 years ago".³ If the latter statement is correct, undoubtedly this was the earliest commercial use of coal. The first period puts China ahead of any country, with the possible exception of England, in industrial use of coal, and coal was undoubtedly used for this purpose, from this mine, between 1230 and 1330 A.D.

The earliest worked coal field in Germany is considered to have been that of Zwickau, in Saxony, where mining probably began about the tenth century.⁴ Coal was first discovered⁵ near the community of Kirchroth, province of Wormrevier, Belgium, in the year 1113.

Agricola, early in the sixteenth century, mentions coal as being in general use in Europe, but probably its development there was later than it was in England. Because our mining practice has followed generally that of England, most of the following material has been taken from English sources.

Although in England in 852 the Abbot of Peterborough leased some land with wood, fagots and "graefa" as part of the rent, it is certain that the last term referred to peat and not to coal, as has sometimes been supposed. Peat is plentiful in that locality, but it is a long way from any coal. No mention is made of coal or coal mining in the Domesday Book (1085) which was a complete record of everything of economic value in the country at that time, although mention is made of lead and iron mining. The records of Holyrood and Newbattle Abbeys, about 1200, mention the digging of coal on the shore of the Firth of Forth at Carriden, and also at Linlithgow.

DISCOVERIES AND USE OF COAL IN ENGLAND

It is difficult nowadays to understand that in the England of the early thirteenth century no free man had a right to dig or break ground in any

forest, or uncultivated land, and that the digging of marl pits in cultivated lands adjacent to a forest was sometimes severely punished, because it might interfere with hunting. Magna Charta, in 1215, increased his rights, and the Forest Charter, in 1217, granted liberty to every freeman "to erect a mill in his own wood, or upon his own land, which he hath in the Forest, to make a marl-pit, or ditch," etc., and conceded the right to dig or break ground. No mention was ever made of digging coal, as mills and marl-pits were more important then, and coal passed into the hands of the subjects as a mere surface material, included in the simple right to dig. Common law extended this right from the forest, or uncultivated land, to all land in later years.⁶

The Fife and Northumberland coal fields border on the North Sea, and denudation resulted in lumps of coal being found in large quantities on the shore. Women and children gathered this "sea coal" (whence the name used for all coal for several centuries) and it was sold for fuel to replace wood. The monks of Tynemouth were among the first to mine coal in the north of England and shipped coal from that port in 1269. Several of the other coal

fields began working before 1250, and in 1257 Queen Eleanor was forced to leave Nottingham Castle, where she was staying, on account of the objectionable smoke from the sea coal. Most of the other coal fields began mining in the latter part of the thirteenth century. Coal reached London during the first half of that century; there was a lane there called "Secole Lane" in 1228.⁷ Coal then, however, was used only by humble artisans, such as smiths, lime burners and brewers, and in 1306 Edward I compelled all but smiths to cease using this obnoxious fuel and return to the use of wood.⁸

In those days, chimneys as we now know them existed in few, if any, buildings. The fireplaces were usually in the centers of the rooms, or in one or more corners, and the smoke found an outlet in the center or side of the ceiling. In the great castles the thick walls allowed space for flues, or vents, into which the smoke found its way. In the fourteenth century the use of coal for domestic purposes began in monasteries and castles. Movable iron chimneys were first used to convey the smoke from the fire to the outlet and later the present type of fireplace and chimney was developed.

In 1354 an entry in an inventory of the monks of Finchale, on the Wear River, of two coal picks and two iron wedges is the earliest reference to coal-mining implements.⁹

The standard measure of coal was the chaldron, a basket-shaped vessel, holding about 2000 lb., in which the coal was drawn from the mines to the staiths, where the keels lay. The keels, or boats, into which the coal was loaded held 20 chaldrons and for some time the keel was regarded as the standard measure in the Tyne coal trade.

In the fifteenth century, as the domestic consumption increased and the salt industry required more fuel, coal mining grew rapidly, and in order to evade the King's tax of 2d. per chaldron, the size of the chaldron increased until finally it held 5300 lb. instead of 2000. The capacity of the keel finally was standardized by driving nails into the bow and stern of the boat, which was the first known instance of fixing the load line on a vessel.

In 1492-93 an entry in the roll of the stockkeeper of the bishopric of Durham records the payment of 40s. "for two great iron chains for drawing coals and water out of the coal pit"—the earliest mention

of the employment of machinery at the Tyneside collieries for raising water.¹⁰

A cargo of coal was sent from the Tyne in a French vessel as early as 1325, and on account of the exhaustion of wood used for fuel, coal mining increased rapidly in the sixteenth century and frequent shipments to France began. During this century, too, the size of the keel became 10 chaldrons instead of 20, as the chaldron had doubled in weight. In the latter half of the century, the Grand Lease near Newcastle, which had been owned by the Earl of Leicester and later by Queen Elizabeth, was bought by the first combination of coal owners, the Society of Free Hosts, an old established society founded in 1404 to entertain merchants and aliens resorting to Newcastle to buy coals or grindstones. During Elizabeth's reign the ladies of the land supported the Queen in her dislike of sea coal, and many would not enter houses in which it was burned, or partake of a meal cooked over a sea-coal fire, and thus to the end of her reign coal was used mainly by artisans and the poor, who could not afford to buy wood. During King James' reign its use extended to all classes, as he had used it in Scotland and soon introduced

it into Westminster. Queen Elizabeth laid a tax of 1s. a ton on coal exported from Newcastle, and later this became known as the Richmond shilling, when Charles II granted it to his son the Duke of Richmond. This tax continued until 1831.

The wage rates for men during the sixteenth century were about 3d. to 4d. per day. Picks were so dear, because of the difficulty of obtaining iron, that often they were rented annually. It is on record that about this time in the Wear district a capital outlay of £200 for a mining property yielded a clear annual profit of £200.

The Society of Free Hosts of Newcastle had effected a monopoly of the Tyne coal trade and in 1622 were forced by Parliament to rectify the abuses then in practice. Charles I attempted to make himself the sole vendor of all coal loaded into English or foreign ships, but before his plan could be put into practice the Civil Wars began and the scheme was dropped. About this time the increasing number of chimneys attracted the attention of the tax experts and a tax was laid not only on the chimneys but also upon the coal burned on the hearth. In the reign of Charles II Parliament attempted to force the Newcastle coal owners to

sell their coal at a fixed price, so in the summer of 1665 they shut down all the mines, with the result that the increased price of coal in London caused Parliament to repeal its law.

In the seventeenth century the "charking" or coking of coal began for iron and copper smelting; much money was spent and many patents were taken out in the search for a commercial process, and in 1708 or 1709 a successful process was developed.

DEVELOPMENT OF MINING IN BRITAIN

In England alone of the western European countries, all minerals except gold and silver belonged to the owner of the soil. Prior to 1744 this was also the case in France,

but exploitation by numerous landowners had led to waste of resources, inefficiency, and endless litigation; and since the small proprietors had neither the knowledge nor the capital adequately to develop the mineral wealth of their lands, the growing need of fuel led to a decree restricting mining to those obtaining concessions from the Crown. Though wealthier than the peasant cultivators, these concessionaires did not usually control sufficient capital to work the mines unaided, and hence the typical form of mining enterprise in France—as in most other countries of Western Europe where like causes were operative—was the joint-stock company.¹¹

In Britain the land was generally held by large owners, and the judicial decision of 1568, on which the landlord's right to the minerals is said to depend, resulted in an organization of coal mining similar to that of the surface, and led British land proprietors to take a close personal interest in the development of the minerals under their estates, and that condition has existed to the present time. This concentration of economic and political power accounts for much in the history of the coal industry; in part for the freedom of the coal owners from state control; it helps to explain the growth of combinations for the fixing of prices, and it has a bearing on the labor relations between operators and men.

While many of the large landowners preferred to lease rather than to work their coal holdings, the lessees often were from the same class of society. The Church had a large interest in many lands as lessor, and in one instance at least, in Yorkshire, a curate, described as a "man of rough manners, great resolution and much personal strength," abandoned caring for souls to become the manager of a coal mine. Several similar instances occurred later. As the pits grew deeper and more capital was

required, partnerships were formed to operate them, and by the end of the eighteenth century several corporations were engaged in coal mining. While shares in these were sometimes offered for sale by advertisement, most of them were family concerns, and there never was anything in English coal mining that paralleled the great companies engaged in metal mining—particularly copper mining—of that period.

In South Wales, the Midlands, Lancashire and Yorkshire, and in Scotland, the growth of manufacturing had important effects on coal mining. By the early seventeenth century coal had taken the place of charcoal in brewing and distilling, the making of bricks, tiles and pottery, the boiling of soap, sugar and salt, in the making of glass, nails, hardware and cutlery, as well as in the smelting and casting of brass.

Between 1708 and 1784, when the process of puddling and rolling was discovered, many iron manufacturers became interested in coal mines, and what we now know as "captive mines" evidently date from this period.

In Britain, where most of the seams pitch much more sharply than do most of our bituminous

coals, conditions for rapid development were not so favorable as with us. Openings were first made along the outcrops, of course, and in most places the early mines were very small—usually as small as our wagon mines. Quite soon resort to shafts for openings was necessary. The smallest undertakings were those near Bristol, where in 1684 there were 70 mines with only 123 colliery workers, including those carrying the coal. Some of the names of mines are reminiscent of our own West—Made for Ever, Strip and At It, and Starve-all are typical. In the Forest of Dean in 1741 a regulation was in effect prohibiting any miner from working more than two pits at one time. In this field, in early times the limits of a pit were set by the distance to which a miner could throw the rubbish from his pit, later commuted to 12 yards all around, and though later pits were larger, they could usually be managed by four working colliers. In 1778 the 90 pits at work produced an average of not more than 20 tons of coal each per week.

In the central parts of England the collieries were much larger, some employing a hundred men or more, but the average pit had rarely more than 20 men. In Northumberland, Durham and Cum-

berland the getting of coal was one of the main businesses. The surface of the country was dotted over with pit shafts and lined with wagon roads, extensive levels drained the water away from hundreds of acres of coal, and the colliery buildings were permanent structures; in fact, one colliery office in Whitehaven is said to have been designed by Sir Christopher Wren. Piers projected into the rivers and sea to load the coal into keels, which filled the holds of vessels taking the coal to Dublin, London and the ports of western Europe.

Early in the eighteenth century the deepest shaft in this area was 400 ft. and the average depth less than half that. In 1765 a depth of 600 ft. was reached and in 1794 a shaft at Hebburn was 774 ft. deep. Curiously enough, as we look at it now, the increase of depth in the shafts grew more rapidly than the size of the area worked. In Durham, about 1700, pits might extend 150 yards north, south, east and west of the shaft bottom—an area of about 19 acres—and in 1773 the 17 pits of South Birtley colliery appear to have worked only about 30 acres each. Opening headings and maintaining them, providing fresh air to the men and hauling the coal to the shaft bottom cost

much more than sinking new shafts. The putters, or barrow men, who transported the coal, were paid piece rates, which increased rapidly with the distance over which the coal moved. At Long Benton colliery, in 1745, the life of a pit was only about three years, and almost every year saw an old one abandoned and a new one worked out. Until 1835 the coal supply may be said to have been produced by mines not exceeding a depth of 1000 ft. As recently as 1830 it was considered doubtful whether coal could be profitably mined at a greater depth than 1200 feet.

At this time, for inland mines, marketing depended upon the condition of the roads and practically ceased during the winter, as it largely did at the mines served by water shipments for a few months, on account of ice and storms in the North Sea. It was not until the development of canals and railroads that coal mining was able to expand rapidly. The output of Great Britain for 1660 is estimated to have been about 2,250,000 tons, in 1700 about 2,500,000 and in 1800 over 10,000,000 tons.

In sinking the shafts a four-sided pit was first cut in the surface soil, but as the sinking proceeded

toward the rock it was changed to an octagon shape, and in the rock the shaft was circular. Timbers were used for lining through the earth, and in sand it was usually held back by ramming clay between it and the wooden tubing. In wet strata the sinkers sometimes packed undressed sheepskins between the timbers and the stone and sometimes the sides were lined with brick, behind which channels carried the water to the bottom. Gunpowder was first used in Staffordshire by some German miners, as early as 1638, and it was slowly adopted by lead and copper mines elsewhere, but there is no record of its use in coal mining before 1719. The early workings were all on the bord-and-pillar system, which has now been largely superseded in England, except in Durham and Northumberland.

In the north of England each hewer worked alone in his place, although later he was assisted by a marrow, or companion:

In the process of hewing the coal from its bed, the hewer first digs as far as he can into the bottom of the stratum; then he nooks or corners off the part measured out, and afterwards the great coals come away by a wedge or mallet.¹²

The hewer prepared the coal only, usually doing a certain stint or suffering loss of wages; when his task was done he was free to go home. The marrow man, or putter, filled the coal into baskets called "corves," loaded these on wooden sledges or trams, and dragged, pushed or hauled them to the pit bottom. Later in the century the putters worked in pairs, one youth pulling the tram by cords, the other pushing behind. At the pit bottom an onsetter hung the corves on the rope, a brakesman or windsman drew them to the pit eye and delivered them to two banksmen, who carried them on a sledge to the coal heap, where they were exposed for sale. One of these banksmen kept account of the number of corves and saw that they were properly filled. That there was some need for this may be gathered from the statement:

for otherwise both the Hewers and Barrow-Men will confederate under ground, and they will be sometimes so Roguish as to set those big coals so hollow at the Corfe bottom, and cover them with some small coals at the top of the Corves.¹⁸

For these services this prototype of the modern weighman received an addition of 2d. to the 14d.

a day that was the pay of the ordinary banksman in the early years of the century.

In this coal field specialization of labor was carried to a high degree:

Boys enter the subterranean workings at the age of 7 or 8, sometimes as early as 6 (wrote a colliery viewer in 1800).¹⁴ They are first Trap doorkeepers, being employed to open and shut doors fixed for conducting air round the works while the coals are passing through them from the Workmen to the Shaft; their Wages are 6d. a day; they continue in this situation 4 or 5 years when they become what are termed lads or foals, supplying the inferior place at a machine called a Tram, where two are employed, and made use of to convey the Coals from the workmen to the Pit's mouth; their wages from 9d. to 12d. per day according to the earnings of the Tram, which is paid a certain price for every score or 20 baskets of Coals in proportion to the distance of the workings from the Shaft.

After two or three years in this subordinate position a youth became a half-marrow, when he received half the earnings of the tram, or 14d. to 16d. a day. Later he became a headsman, putting the tram with a lad or foal and taking two-thirds of the earnings of the tram. The next step up the industrial ladder was to the position of put-and-hewer, when half the day was spent at the tram and the other half in working coal. During the period in which the young man occupied this place he was learning the technique of hewing, and was paid

2s. to 2s. 6d. a day. He rarely continued as put-and-hewer for more than a year, for besides the inducement of the higher earnings which full-time getting obtained, there was the incentive of fewer hours of labour; whereas during this long apprenticeship from the age of 6 or 7 he had worked 12 to 18 hours a day, when he became a finished collier (a hewer) his working day was of 8, or, at the most, 10 hours' duration.

WOMEN CARRIERS IN SCOTLAND

In Scotland the classes of labor were about the same as those in Northumberland and Durham, the main difference being the more extensive use of women and girls. The hewing was always done by men, who engaged to deliver the coal to the pit bottom. In many pits, because of heavy pitches, dikes, etc., this required much carrying, and in the opening years of the nineteenth century this was done as described below. It was customary for the man, accompanied by his sons, to go to work about eleven o'clock at night.

In about three hours after, his wife (attended by her daughters, if she has any sufficiently grown) sets out for the pit, having previously wrapped her infant child in a blanket, and left it to the care of an old woman who, for a small gratuity, keeps three or four children at a time, and who, in their mother's absence, feeds them ale or whisky, mixed with water . . .

The mother . . . descends the pit with her older daughters, when each, having a basket of a suitable form, lays it down, and into it the large coals are rolled; and such is the weight carried, that it frequently takes two men to lift the burden upon their backs; the girls are loaded according to their strength. The mother sets out first, carrying a lighted candle in her teeth; the girls follow, and in this manner they proceed to the pit bottom, and with weary steps and slow, ascend the stairs, halting occasionally to draw breath, till they arrive at the hill or pit top, where the coals are laid down for sale; and in this manner they go for eight or ten hours almost without resting. It is no uncommon thing to see them, when ascending the pit, weeping most bitterly, from the excessive severity of their labour; but the instant they have laid down their burden on the hill, they resume their cheerfulness, and return down the pit singing.

Some conditions, where the hewer had no women in his family, were worse than this. Allowing for considerable exaggeration, we surely are all thankful that conditions such as these can no longer exist. It was 1843 before all women were excluded from the coal and iron mines.

Ashton and Sykes, in "The Coal Industry of the Eighteenth Century," from which much of this information is obtained, make the following statement:

The creel or basket had a supporting strap that passed around the forehead. It would hold as much as 170 pounds of coal, and a woman might bear such a load a distance of 150 yards underground, then ascend with it 117 feet to the surface, and finally carry it 20 yards farther to the pit hill. And this she might do as often as twenty-four times in the course of the day. When the

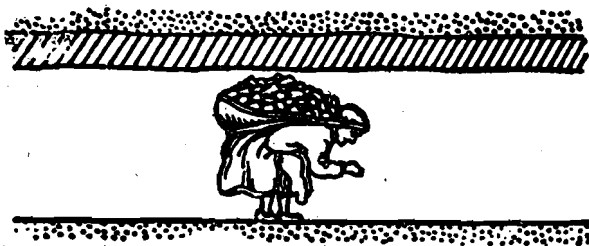


FIG. 1.—FEMALE COAL BEARER. (*From Historical Review of Coal Mining.*)

hewers had no female relatives, they would secure from the overman of the pit the services of women. (Fig. 1.)⁸

EARLY MINING PROBLEMS

Shaft development meant water to be handled and the early shafts were usually sunk on hilly ground to allow the water to drain away through "soughs" or channels driven from the shaft bottom to the side of the hill. In 1678, in the Forest of Dean, it was ordained that if anyone had made such a sough no other pit should be sunk within

100 yards of it, and by 1754 this was increased to 1000 yards. Numbers of these soughs were constructed in the seventeenth century, some draining several square miles; in 1807 there was published a list of 33 of these water courses, some two or three miles long, draining the coal and lead mines of the county of Derby, and they were numerous in other fields.

When these soughs could not be used, machinery had to be installed to handle the water. The first one consisted of a series of buckets attached to a chain and operated by a windlass, similar to a modern dredge. The wastage of water in discharging led to the substitution of a series of flat circular plates in a pipe. When the lift was over 180 ft., it was customary to sink a second shaft to about half this depth; the water was raised up the main shaft as far as convenient, allowed to run to the second shaft and lifted to the top there. The windlasses were replaced by treadmills operated by men, gins turned by horses, windmills, and, where available, by water wheels. (See Fig. 2.)¹⁵

The invention by Savery of the atmospheric steam engine, and its application to a mine pump about 1705, bade fair to cure most of the troubles

experienced with the crude devices named, but it was not until a few years later and the changing of the condenser by Newcomen that the pump was successfully applied to mining. The machine was exploited by a company called "The Proprietors

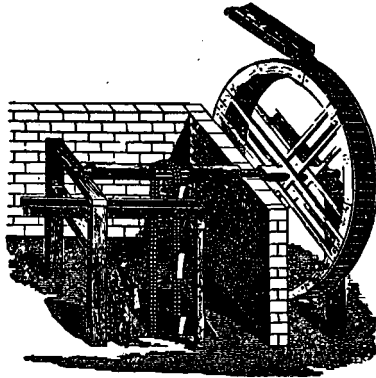


FIG. 2.—WATER WHEEL AND CHAIN OF BUCKETS. (*From Galloway. Annals of Coal Mining.*)

of the Invention for Raising Water by Fire," and from 1715 to 1725 many of these machines were installed in collieries, usually on a purchase of the cylinders and other parts and an annual rent. In 1763 the Walker colliery installed a cylinder having a diameter of 72 in. and a length of stroke of $10\frac{1}{2}$ ft., the largest in the north of England. By 1769, when Watt and Boulton introduced the steam engine,

more than a hundred of the Newcomen machines had been erected about Newcastle. The introduction of the steam engine was much slower, largely because the superior economy did not appeal to the colliery owners.

From the earliest times both black damp and fire damp were known to the miners and explosions were of frequent occurrence, as no system of ventilation was known. Before the invention of the safety lamp it was an old practice to burn out the fire damp by igniting it from a light on a pole, carried by a fireman, who was wrapped in wool or leather and who lay on the bottom while he extended his light toward the face. In 1931, Prof. Henry Briggs, in the *Colliery Guardian*, called attention to the oldest reference to this practice that he had seen. One Nicander Nucius traveled widely in Europe on certain diplomatic missions, and in Liége, Belgium, about 1554 he became acquainted with coal. His account of it is as follows:

In this city (Liége) and all the neighbouring country, they are accustomed to burn a certain black substance, stony and shiny, and producing hot embers without smoke. But when the coal has been consumed it yields no cinders, but a very fine dust is scattered through the

air. These stones they dig out of the deepest recesses of the earth, finding certain veins from which they extract them; but a peculiar prodigy takes place when they are being dug out. For the miners are accustomed to excavate, at a distance of eight or more stadia (nearly one mile) from the city, below the river, about thirty cubits (45 ft.) or more. When they meet with this mineral, they form a spacious cavern; but they are not able to throw out the stones immediately, for fire on a sudden bursts forth, and encompasses the whole cavern.

When the miners are desirous of extracting the coal, they put on a linen garment, which has neither been bleached nor dipped in water. This covers them from head to foot, leaving only certain apertures for the eyes, that they may be able to see through them; they also take a staff in their hands, which serves to guide and direct their steps in the passage leading to the cave. The miner then draws near to the fire, and frightens it with his staff. The fire then flies away, and contracts itself by little and little; having then expended itself, it collects itself together in a surprising manner, and becoming very small, remains quite still in a corner. But it behoves the man who wears the linen garment to stand over the flame when at rest, always terrifying it with his staff. Whilst he performs this service, the miners extract the stones, but as soon as they have left the cave the dormant fire on a sudden bursts forth, and environs the whole cave. No one then ventures to enter without the above-mentioned garment and staff, for he would inevitably be consumed. And this we ourselves have beheld. For we were desirous of ascer-

taining the fact by actual experience, being admirers of the operations of nature.

For we were unable to discover the cause of this, whether these things take place through a spiritual agency; and we were aware that linen possesses a certain mysterious power, tending in a remarkable degree to expel fire; since fire will not touch it, though it burns and consumes everything it lays hold of in a wonderful manner. Whence also this is accounted a prodigy by the beholders. But the most surprising thing is, that when the fire has retired, and the violence of the flame is quenched, instead of being exceedingly hot, it renders the cave of a gentle heat, and capable of being approached. And they call these stones, in the language of the country, "Oulleis" (houille). And whilst they are burning, no great or bright flame is emitted, but red and blue; and this lasts for about eight hours, and possesses somewhat of a sulphureous nature.

After this experience Nucius visited England, in Henry VIII's reign, 1546, but makes no other reference to coal except that "the stone used for fire and black is found in most places." His account shows that the fireman was a valued member of the mine personnel, and that the method of dealing with fire damp underwent no substantial change for nearly 300 years.

While furnaces for ventilation were used as early as 1732 and stoppings to regulate the course

of the air in 1759, it was not until 1830 and a few years later that the use of furnaces began to be general. The favored location of the furnace was at the foot of the shaft; some mines had two, and at least one plant three furnaces burning all the time, and temperatures in these shafts ranged from 122° to 168° F. A volume of air as great as 190,000 cu. ft. per min. was used at one mine in 1850. At this same time 10,000 cu. ft. per min. was considered enough ventilation for any mine in Scotland, except one.

Steam jets were used for ventilation in some mines about 1846-50, to avoid the dangers incident to furnaces, but had no general application. A few small ventilating fans had been used prior to 1840, but at that time there was probably not a single mechanical ventilator in regular and constant use in Great Britain, and it was not until after 1850 that the use of ventilating fans began to be common.

The safety lamp was invented by Davy in 1815 and was soon used in many mines to a limited extent. As late as 1841, except in the pillar districts of the Northumberland and Durham coal fields, however, nearly all of the mines used these

lamps only for testing purposes, naked lights being used elsewhere.

HOISTING AND TRANSPORTATION

At the early shafts the hoisting was done by a simple windlass turned by hand; then the cog-and-rung gin, which consisted of a drum mounted over the top of the shaft, was used. See Fig. 3.¹⁵

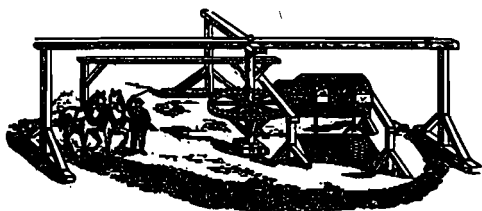


FIG. 3.—COG AND RUNG GIN. (*From Galloway: Annals of Coal Mining.*)

Cogs on one end of the drum engaged with others on a horizontal wheel, to the axle of which a stern pole was fastened and to this a horse was harnessed. The position of the drum over the shaft gave trouble and towards the end of the seventeenth century the practice rose of fixing a simple pulley at the top of the shaft and leading the rope to the drum a few yards away. See Fig. 4.⁸ As shafts became deeper two and then four horses were used, and while

greater numbers were tried, four remained the maximum for convenient working. In 1801, at Whitehaven, coal was hoisted 600 ft. by four horses at the rate of 42 to 44 tons in nine hours, the horses working in relays of three hours.

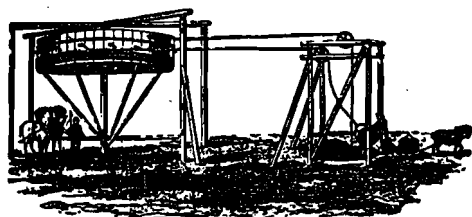


FIG. 4.—MODEL OF WHIM GIN. (*From Galloway: Annals of Coal Mining.*)

Men were lowered in the coal baskets at times, but usually by putting a leg in a loop at the end of the rope, holding the rope above with one hand and using the other to keep away from the sides of the shaft. About 1750 water tubs were used to raise the coal, the water was let out at the bottom and the descent of empty corves brought up the empty tubs. Small steam winding engines were first introduced about 1872. See Fig. 5.¹⁵ The first hoisting by cages was done about 1841, in the north of England.

Transporting the coal to the shaft by putters and barrow men has been mentioned. Apparently the first reference to the use of horses underground was in 1667. The first tracks were two parallel lines of planks, with a pin projecting from the

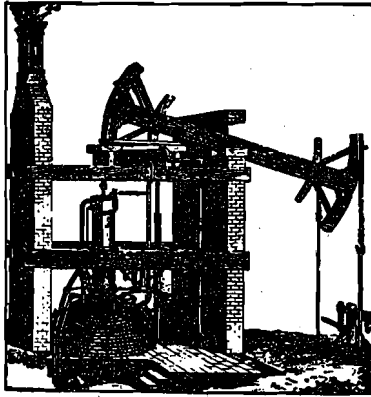


FIG. 5.—ENGINE AT GRIFF COLLIERY, WARWICKSHIRE. (*From Galloway: Annals of Coal Mining.*)

bottom of the wagon into the space between the planks to keep the wheels on the planks. These were used as early as 1610 near Nottingham and the usage soon became general. Cast-iron rails having a flange to keep the wheels in position were first used about 1753 and wrought-iron rails were substituted for the cast ones about 1780, these

being in the form of straps fastened to the timbers. Thomas Wilson in "The Pitman's Pay," says of this:

God bless the man wi' peace and plenty,
That first invented metal plates.
Draw out his years to five times twenty,
Then slide him through the heevenly gates.

For if the human frame to spare,
Frae toil an' pain ayont conceivin',
Ha'e aught te di wi' gettin' there,
Aw think he mun gau strite to heeven.

Wheeled corves, which could be raised up the shaft without changing the contents, were first used about 1787 and these were the predecessors of our present mine cars.

There were many tramways from mines to docks, some of them several miles long, and these mine railways were the predecessors of our present railway system. In England, the standard gage of today is the distance between the wheels of the coal wagons used in the north 150 years ago. It was in the fields of South Wales, and the Tyne also, that Trevithick's first attempts at steam locomotion were made—and George Stephenson was engineer at a colliery.

LABOR CONDITIONS

Coal miners have always been different from other classes of labor, much of the difference being due to the physical isolation of the mines. In early times it was usually several days journey to any center of urban life, and only within the present generation, with the coming of automobiles and good roads, has this isolation of the mines largely disappeared. This geographical separation had a profound effect upon the habits of living and thought of the miners, much of which has not yet passed away.

In the north of England and in Scotland, where the mines probably were more remote than elsewhere, the owner of a mine was almost entirely dependent upon the local supply of labor; if his workers left him they could not easily be replaced and his investment in plant might be ruined. As a safeguard against such loss the employer sought to bind the workers by a long-time contract, with more or less drastic penalties for breaches of its provisions. In the north of England these agreements were in effect as early as 1636, usually for a period of one year, the laborers usually being given

a bonus for signing, which occasionally was as large as one-half guinea, as at one colliery in 1787. One contract is in existence, made at Durham, Oct. 22, 1763, in which 110 hewers and 55 drivers agree not to combine, strike or absent themselves from work and to present one corf gratis every fortnight to the employer; they assent to a fine of one shilling for every corf insufficiently filled and undertake to replace every corf rejected because of intermixture of stone with the coal. The time was one year, the hiring money sixpence per man and £18 was to be the penalty for each man for noncompliance. During a later period of high prices, the operators agreed that no employer should take on any man who was unable to show a certificate of leave from the master he had last served; owing to the scarcity of labor, no master would have given such a certificate, so that the men would become practically slaves—as they actually were in Scotland. A long strike resulted and the men finally won their point. During later years binding for shorter terms became general, but there was little opposition to the practice itself until the eighteen thirties. A strike in 1844 virtually ended the bond in Northumberland, although it lingered for nearly thirty years more in some other fields.

In Scotland, this system became one of slavery, as was stated in the preamble of an act of Parliament. There is doubt as to whether it was a survival of the agrarian serfdom of the Middle Ages or was the result of legislation. In 1579 a law gave a vagrant who had been sentenced the option of servitude to anyone who would undertake to keep him in employment, and his children might be seized and kept in lifelong bondage. An act of 1672 specifically conferred on coal-masters the right of apprehending vagabonds and their children without the necessity of a trial in a court of law. The expansion of the salt industry, and the coal mines furnishing the fuel for it, caused a shortage of labor and in 1606 an act was passed prohibiting the employment of anyone without a certificate from his previous master; if workers were so employed they could be reclaimed by their previous employer within a year and a day of leaving him and be punished as thieves; if the new owner refused to surrender them within 24 hours he was liable to a fine of £100 Scots. Somewhat similar, but less drastic, provisions applied to some other industries. By simply withholding a testimonial the master could bind a man for life, and the worker's only

remedy was to escape to England for a year and a day. In practice, serfdom was hereditary and whole families were attached to a colliery estate, but wages—sometimes high ones—were paid, their property after maintenance was their own and in at least one locality they voted for burgesses. This system continued in effect until 1775, and to the credit of the coal-mine owners be it said that it was abolished solely on their own initiative, and was not associated with any public campaign or any politician.

Data about wages in the early days are too meager to allow much generalization. During the early years of the eighteenth century a collier's wages generally were between 12d. and 18d. per day. About 1760, in Durham, wages were about 1s. 6d. per day. About the end of the century they were about 2s. 6d. to 3s. per day. About 1811 wages were 3s. 2d. to 4s. per day. Even at these figures the coal miner was usually better off than most other workers. An old Lancashire song says:

Collier lads gets gowd and silver,
Factory lads gets nowt but brass.

In 1702 one mine went on double shift, one being 10 hours and the other 14 hours. The average of

12 hours was the same time worked in that same field 140 years later. In 1809 on the Tyne the drivers were working 14 hours a day, and 12 hours was the common period of work in most fields in 1843.

Data about outputs per man are scarce. In 1800 an agreement with six colliers required an output of 75 tons per week, or 2.8 tons per man per day, with a penalty and bonus provision.¹⁶ In that year in Cumberland, 570 men raised an average of 1.29 tons per day.¹⁷ In Scotland the annual produce of a collier may be estimated at 400 tons per year,¹⁸ and the weight of coals brought to the top by a woman in a single day amounts to 4080 lb. with frequent instances of 4480 lb.¹⁹ In 1810, in Durham, an average of 177 tons per year per man employed was produced at 34 collieries.²⁰

LIGHTING DEVICES

The invention of the safety lamp has been mentioned.

In the early days of mining the lamps used by the miner were of the same type as those used in dwelling houses. With slight modification of construction, adapting it for carrying on the cap, the lamps used by Scottish

miners in open light mines remain the same in essential features as those used by the most primitive miner. Where open lights are used in English mines candles have displaced the lamp.⁸

At some of the early mines reflecting mirrors were used to illuminate the workings from the surface, but naturally this system soon became useless. The first method of avoiding the dangers of open lights in fire damp was the use of flint and steel, and as early as 1733 the steel mill was apparently in use. This consisted of a small toothed wheel, which was made to turn a larger wheel of steel, the edge of which revolved against a piece of flint, producing a shower of sparks that gave a light just sufficient to enable work to be carried on.

The sparks gave indications of inflammable gas by increase in size and luminosity, on approaching the firing point they assumed a liquid appearance, and adhered more than usual to the periphery of the wheel, giving off a bluish light. When the quantity of fire damp present was in excess of the explosive limit, or in carbonic acid gas, the sparks were of a bloody red color.⁸

This machine required one boy in operation for each collier, and of course did not eliminate the danger of explosions. In some of the fiery mines of the Tyne the colliers sometimes tried to carry

on their work by the feeble light of phosphorus and putrescent fish. When the safety lamps were invented, their use rapidly spread in these mines, and their introduction was at least as great an advance in illumination as it was in safety.

COAL IN NORTH AMERICA

The first reference to coal being found in North America appeared in an article published in Paris in 1672 by Nicholas Denys, who had been appointed Governor of Eastern Acadia in 1637. He obtained a concession in 1654 of the whole island of Cape Breton, from the King of France, with the right to search for and work all minerals, paying one-tenth of the profit to the King. He made no attempt to mine coal and in 1672 returned to France and left his sons in charge of his property. He referred to "mines of coal within the limits of my concession and upon the border of the sea."* Some unauthorized persons began taking coal from the cliffs, and in 1677 the Intendant of New France recognized Denys' right to exact a duty of 20 sous per ton. The concession was canceled in 1690. Admiral Sir H. Walker commanded an unsuccessful expedition against Quebec in 1711, and spoke of the excellent

* Mines, as used in this connection, and for more than a century later, meant deposits, or outcrop showings.

quality of coal his sailors obtained from the cliffs with crowbars in Spanish Bay, now Sydney Harbor. In 1720 some coal was shipped from what is now Port Morien to Boston. After that date coal was mined continuously from various parts of the province and after 1749 a small coal trade was carried on with New England ports for about a century and a half. Breaking the coal from the cliffs was soon succeeded by regular mining, which has been carried on now for about two hundred years.²¹

In our own land one of the Jesuit missionaries has recorded the fact that he saw the Algonquins "making fire with coal from the earth"²² as early as 1660, but the first definite reference to the discovery of coal by Europeans is due to Joliet and Marquette in 1673, as follows:

That he had set down in his Journal an exact Description of the Iron-Mines they discovered, as also of the Quarries of Marble, and Cole-Pits, and Places where they find Salt-Petre, with several other things.

Joliet's map of 1674 shows the location of "Charbon de terre" (coal) near the present city of Utica. LaSalle in his letter to Frontenac (1680) referring to the Illinois River²³ says:

We have seen no mines there though several Pieces of Copper are found in the Sand when the River is low. There is the best Hemp in that Country I have

seen anywhere, though it grows naturally without culture. The Savages tell us, that they have found near this Village some yellow Metal; but that cannot be Gold, according to their own relation, for the Oar of Gold cannot be too fine and bright as they told us. There are Coal-Pits on that River.

Marquette's Journal was first published in France by Thévenot in 1681.²⁴ Accompanying the narrative was a map copied by Thévenot from one made by Marquette. Both original and copy show the same location of "Charbon de terre" as does Joliet's map.

Father Louis Hennepin, a Recollect priest, accompanied LaSalle's expedition to the Illinois country in 1680 as chaplain and in his "A New Discovery of a Large Country in America," published in English in 1689, says with reference to the country along the Illinois River from its source to the site of the present city of Peoria:²⁵

There are Mines of Coal, Slate and Iron; and several pieces of fine red copper, which I have found now and then upon the surface of the Earth, makes me believe that there are Mines of it; and doubtless of other Metals and Minerals, which may be discovered one time or another. They have already found Allom in the country of the Iroquoise.

Hennepin's map accompanying this narrative located a "cole mine" on the Illinois River above

Fort Crevecoeur (Peoria) copied from Joliet's map or Marquette's.²⁶

Other early mention of coal in Illinois is made by Patrick Kennedy in his journal of an expedition undertaken in the year 1773 from Kaskaskias Village in the Illinois country in search of a copper mine. Under the date of August 6, 1773, he writes:²⁷

At sun-set we passed a river called Michilimackinac (Mackinaw River in Tazewell County). Finding some pieces of coal, I was induced to walk up the river a few miles, though not far enough to reach a coal mine. In many places I also found clinkers, which inclined me to think that a coal mine, not far distant, was on fire, and I have since heard there was.

The next reference to coal in the United States is near Richmond, Virginia. At Manakin, about 14 miles above the present city, coal was found by Huguenot settlers early in 1701. On May 10 of that year Col. William Byrd and some companions "went up to ye Cole, w'ch is not above a mile and a half from their settlement," where, due to high water washing away the banks of a creek, "the coal lyes bare, otherwise its' very deep in the Earth," and he so wrote to the Colonial Council of Virginia.^{28a} In May, 1702, one of the French settlers, a blacksmith, petitioned the Governor for leave to use the coal in his forge, and it was so used locally

from that time. No records exist now to show the date of opening of the first "pit," as they were called, but a deed dated Feb. 6, 1746, refers to a "Place Cald the Cole Pit."^{28b} Coal was sent from this district to New York and the West Indies as early as 1758.^{28c} On June 13, 1766, in the *Virginia Gazette*, published in Williamsburg, Samuel DuVal advertised "any quantity of COAL, for 12d. a bushel, not inferior to the Newcastle coal" for sale at Rocket's landing, about a mile below the falls of James River.²⁹

These mines enjoyed a trade with Philadelphia, New York and Boston as early as 1789; while it had been used pretty extensively in the vicinity of the mines as early as 1775, and, during the War of Independence, was used at Westham, on the James River, five miles above Richmond, for the manufacture of shot, shell, etc., or until destroyed by the traitor Arnold in 1781.³⁰

The early records of output are missing, but in 1822 production was 54,000 short tons,³¹ in 1824 it was 67,040 and in 1828 it had increased to 100,280.

A memorial to the 24th Congress, January 20, 1837, signed by 18 coal companies operating in the Richmond, Va., field, protesting against the removal of the tariff on coal, says:

It is sufficient to say that by far the greater part of the coal exported from the James River is employed in the

manufacture of iron. If the production of coal in Virginia should be put down, that manufacture, as an object of national importance, would be placed in absolute dependence on Great Britain for its existence; the whole supply of bituminous coal, without which it could not be carried on in many of its most important branches, is derived from Virginia, Great Britain, or her colony in Nova Scotia.³²

The next record of coal is in the latter part of 1736, in a survey of the upper Potomac River to determine the boundaries of the Fairfax Grant. Benj. Winslow, in his map of the survey, shows "cole mine" in two places on the river above the mouth of Savage River, evidently where the outcrops showed in, or along, the river bed.* Coal was taken from there to Hagerstown for use in an iron-works as early as 1789.

The first record of coal in what is now southern West Virginia is:

One John Peter Salley, a German living in Augusta County, Virginia, with three other men, set out on March 16th, 1742, to explore the country west of the mountains. They struck the upper part of Wood's River, now the Kanawha, but could not navigate it in the buffalo skin boat they had made. Leaving the stream they went by land eighty-five miles southwest-

* A Plan of the Upper Part of the Potomack River, 1736. Maryland Historical Society.

wardly to a small stream where they built another boat and went down the river. He says, 'where we came to this river the country is mountainous, but the farther down the plainer, in those mountains we found great plenty of coals, for which we named it Coal river.'³³

These hardy souls were later captured by the French on the Ohio, taken to New Orleans and kept there some time, then were allowed to go to Charleston, S. C., by ship and thence overland to home.

Eight years later, in what is now southeastern Kentucky and the Pocahontas field of West Virginia, Dr. Thomas Walker with some companions had a memorable trip. He was the first white man to leave a record of a visit to Kentucky, part of which was as follows:

April 13th, 1750—At the foot of the hill on the North West Side we came to a Branch, that made a great deal of flat land. We kept down it 2 miles, several other Branches coming in to make it a large creek, and we called it Flat Creek. (Yellow Creek near Middlesborough). We camped on the Bank where we found very good Coal.

April 23rd, 1750—We travelled about 12 miles and encamped on Crooked Creek. The mountains are very small hereabouts and here is a great deal of flat land. We got through the Coal today.

May 5th, 1750—We got to Tomlinson's River, which is about the size of Powell's River. Here is plenty of

Coal in the South Bank opposite to our Camp. (Near Livingston and Pine Hill.)

June 19th, 1750—We got to Laurel Creek early this morning and met so impudent a Bull Buffalo that we were obliged to shoot him, or he would have been amongst us, we then went up the Creek six miles, thence up a North Branch of it to the Head, and attempted to cross a mountain, but it proved so high and difficult, that we were obliged to Camp on the side of it. This Ridge is nigh the eastern edge of the Coal Land. (Outcrop of Pocahontas seam on Flat Top Mountain.)

A year later, in 1751, Christopher Gist, who later was to accompany Washington on his first trip across the mountains, was sent by the Ohio Company to select suitable land for it on the waters of the Ohio River.

Gist went from Cumberland to Pittsburgh, thence into Ohio and nearly to the falls of the Ohio River at Louisville, then went south to the Kentucky River and up it into Virginia and thence home. On March 27, 1751, he wrote in his journal 'Our Horses and Selves were so tired that We were obliged to stay this Day to rest, for We were unable to travel—On all Branches of the little Cuttaway River (North Fk. of Kentucky River) was great Plenty of fine coal some of which I brought in to the Ohio Company.'

Thursday 28. 'Set out S E 15 M crossing several Creeks of the little Cuttaway River, the Land still full of Coal and black Slate.'

Monday, April 1.—'Set out the same Course about 20 M. Part of the way we went along a Path up the

Side of a little Creek, at the head of which was a Gap in the Mountains, then our Path went down another Creek to a Lick where Blocks of Coal about 8 to 10 In. square lay upon the Surface of the Ground, here We killed a Bear and encamped.' Undoubtedly this was the first time a white man went through Pound Gap.³⁴

Upon his return home Gist was again instructed to select lands in what is now West Virginia and set out November 4th. In 1752, he made the following entry—'Sunday March 1 and Monday 2.—Set out N 30 E 10 M to a little Branch full of Coal then N 30 E 16 M to Nawmissipia or Fishing Creek.' This little branch was probably the head of the middle fork of Tygarts Creek, in Wood Co., W. Va.³⁵

The writer has been over most of this country when it was fairly accessible by roads and trails, and has the profoundest respect for the hardihood and courage of those men who blazed the way through that country when it was almost entirely unknown.

In western Pennsylvania, the first record of coal is on a manuscript map in the Library of Congress, untitled, not dated and with no name of maker. Along the Kiskiminetas River is marked "Sea Coal here," and the same notation is on the head of Hocking River and one place in Kentucky. The map was made prior to 1753, and the information about coal is probably as of the early part of 1750, at the latest. The first reference to the Pittsburgh

Seam is in May, 1754, when Capt. Adam Stephen saw it along the Monongahela, near Redstone, and wrote to a friend in London of his experience.^{35a} Col. Mercer, in command of the garrison at Fort Pitt^{35b} and James Kenny, a young trader, both reported Pittsburgh seam coal in April, 1759.^{35c} Col. James Burd, in his diary, under date of Sept. 21, 1759, states that his detachment "moving westward camped at Coal run, that the bottom of the run was entirely paved with stone coal, and on the south of it there was a rock of the finest coal he ever saw, of which he burned a bushel on his fire." This place was about 2½ miles from the Monongahela River, on Redstone Creek and Coal Run.

Thomas Hutchins, Captain in the 60th Regiment of Foot, who was in Fort Pitt when it was besieged by the Indians during the Pontiac war, in a description of Virginia, Pennsylvania, Maryland and North Carolina, printed in 1778, said:

Most of the hills on both sides of the Ohio are filled with excellent coal and a coal mine was in the year 1760 opened opposite to Fort Pitt on the River Monongahela, for the use of the Garrison.³⁶

In his Journal of a Tour to the Ohio River, 1770, George Washington made the following entry:

October 14th. At Capt. Crawford's all day. Went to see a coal-mine not far from his house on the banks of the river. The coal seemed to be of the very best kind, burning freely, and abundance of it.

This opening was near what is now Connellsville, Pa., near the heart of the Connellsville region, and the description of the quality of the coal was fully borne out by subsequent developments. Captain Crawford was later captured by the Indians and put to death by torture. It is probable that this was Washington's first visit to this vicinity since the bloody day of Braddock's defeat.

In November, 1768, the Penn proprietaries purchased from the chiefs of the Six Nations the whole of the bituminous coal field of Pennsylvania except that portion which lies northward of Kittanning, which was not purchased until 1784.³⁷

In 1769 Thomas Penn, in a letter to Lieutenant Governor Penn, advises the latter to lay out 5000 acres of land about Pittsburgh, which, he adds,

I think, from its situation, will become considerable in time. I would not engross all the coal hills, but rather lease the greater part to others, who may work them."³⁸

In 1793, André Michaux, in his Journal of a trip west of the Allegheny Mountains, said:

On the 6th of August I saw on the bank of the Monongahela River opposite Pittsburgh a coal mine at the

entrance of which there seems to be a thickness of 15 ft. of that mineral without admixture.

Michaux was a botanist and evidently was very liberal in his estimate of thickness.

A Mr. F. Cuming made a trip from Philadelphia through Pittsburgh and down the Ohio and Mississippi, starting early in 1807. On reaching Greensburg he wrote:

On entering Habach's tavern, I was no little surprised to see a fine coal fire, and I was informed that coal is the principal fuel of the country fifty or sixty miles round Pittsburgh. It is laid down at the doors here for six cents a bushel.³⁹

Later he comments on the smoke and dirt in Pittsburgh, caused by burning the coal in grates—two fires at least to each house.

Coal was shipped from Pittsburgh down the Ohio River to Fort Washington, now Cincinnati, as early as 1794.^{37a} In 1820 coal mining began at other points on the Monongahela. In 1837, there were 10 collieries working in Coal Hill, just across the river from Pittsburgh.

From the fact that in each of the divisions of the anthracite coal field there are numerous outcropping beds, and since the region is traversed by streams, many of which cut across the measures and expose the beds of

coal, it is probable that the existence of coal was known to the Indians prior to the advent of the whites.

The first authentic date in connection with anthracite coal is 1762, when Parshall Terry and a company of Connecticut pioneers found coal at the mouth of Mill Creek, on the banks of the Susquehanna near the site of the present city of Wilkesbarre. In 1769 Obadiah Gore, a blacksmith, used anthracite for fuel in his forge. The presence of coal in the Mahanoy and Shamokin basin of the Schuylkill region was known in 1770, but the beds were not developed until 1834. In 1775, the proprietary government of Pennsylvania had coal floated down the Susquehanna from Wilkesbarre to Harris Ferry (Harrisburg), whence it was hauled by wagon to the arsenal at Carlisle for use in the manufacture of munitions of war. This was the first shipment of anthracite ever made in this country. Similar shipments were made annually during the Revolutionary War. In 1788 Jesse Fell used this coal in his nailery.

In 1791, coal was discovered near Mauch Chunk by Philip Ginter, who, according to tradition, on returning home at night kicked a black stone in his path, which proved to be anthracite. The Lehigh Coal Mine Company was formed in 1792, and secured a large tract of coal land, and in 1793 a road was built to the Lehigh River above Mauch Chunk.

Coal was used locally by blacksmiths immediately after each of the above discoveries, and numerous attempts were made to float coal-laden arks down the Lehigh and Susquehanna, but people would not believe that the black stones would burn, and no progress was made for some years in the development of coal trade.

Oliver Evans burned anthracite in a grate in Philadelphia in 1802. So also did Frederick Groff, chief of the water company in Philadelphia in 1802.

In 1805-6 John and Abijah Smith, from Derby, Conn., settled in Plymouth, Pa., bought coal lands, and immediately began shipping coal by arks to points along the lower Susquehanna River. Fifty-five tons were shipped in 1807 to Columbia, Pa., and thereafter 400 to 500 tons yearly to points on the lower Susquehanna and to Baltimore where \$10 per ton was received, and to New York, where \$12 was the price. It was necessary to create a demand for anthracite coal and to instruct people in its use, so the Smith brothers accompanied their arks and took with them suitable grates, which were set up in public houses to demonstrate the use and value of this fuel.

In 1804 coal was discovered at Carbondale by Samuel Preston; in 1814 William and Maurice Wurtz began its development, and in 1815 they succeeded in sending an ark load to Philadelphia by the Lackawaxen and Delaware rivers, but this experiment was not repeated until 1823.⁴⁰

In 1785, Samuel Boyd patented a tract of bituminous coal in Clearfield Co., Pa., and in 1804 William Boyd shipped the first ark load of Clearfield coal down the Susquehanna River to Columbia, a distance of 260 miles. We are informed that it occasioned much surprise.

In 1804, Lewis and Clarke made the first reported discovery of coal west of the Mississippi River, along the banks of the Missouri and Yellowstone Rivers.⁴¹

In 1804 also, coal was first discovered near Frostburg, Md.⁴⁰ In 1816 coal was being mined near Frostburg and used in Cumberland for glass

making, and in 1820 the first shipment of a few thousand tons was sent down the Potomac River in boats. The first shipment by rail was in 1842, the tonnage for that year being 1708 tons.⁴¹

Coal was discovered in Center County, Pa. near Snowshoe, in 1819, but shipments were small until the railroad was built in 1857-59.⁴¹

In 1828 the first cargo of semibituminous coal ever shipped to Philadelphia from a Pennsylvania mine was sent from Karthaus, in Clearfield County. The coal was taken down the Susquehanna to Port Deposit, at the head of Chesapeake Bay, and thence by vessel to its destination.⁴¹

The Blossburg, Pa., coals first attracted attention in 1832 and the first shipments from the Broad Top field were in 1856. In 1834, Dr. Alexander Jones, of Mobile, discovered coal in Alabama.⁴¹

FUTURE FOR COAL

We have briefly traced the known discoveries of coal and the development of its mines in both England and the United States to the beginning of the era of railroad development about a century ago, and time does not permit later references to the many fields not mentioned which have been found and developed since then, and whose story is generally well known.

It will be seen that the use of coal everywhere has been largely a matter of transportation and its first important development, both abroad and here, was in those districts from which water transport was available. The growth of railroads increased the demand for coal, as did the manufacturing industries of which the products could now reach more markets, and these industrial developments, coupled with the fact that cheap and excellent coal was available for outbound ships bringing back the needed raw materials, have built up under British rule the greatest and most far-flung dominion the world has ever seen. In our own land the abundance of coal over a wide-spread area, coupled with the spirit of the people, has resulted in an industrial nation whose might we only began to realize during the World War.

During the last few years the abundance of other fuel supplies, oil and natural gas, have greatly interfered with the development of coal. From a national point of view—necessarily a long one—we can glimpse a time when the exhaustion of these fuels will restore King Coal to his former eminence, and when his products will be the raw material from which will be derived many chemicals and substances now no more than dreamed of by our

research men. Then, even more than now, those nations having an abundance of coal will be the most favored and powerful, and with reasonably intelligent use of our opportunities we should produce a civilization at least equal to any that has yet existed.

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