PART II

PAPERS, ETC.

"TO MENDIP FOR COAL"—A STUDY OF THE SOMERSET COALFIELD BEFORE 1830[1]

BY JOHN A. BULLEY, M.A.

Part 1 : OUTPUT, MARKETING AND TECHNIQUES OF MINING

PRODUCTION FIGURES

Various assessments have been made of coal production in Somerset prior to the nineteenth century. J. U. Nef's estimate of the combined production of Kingswood Chase and Somerset, based on a rough annual average of ten years, is as follows :[2]

1551-1560..... 10,000 tons annually
1681-1690.....100,000 tons annually
1781-1790.....140,000 tons annually

He has given no indication of how these figures were arrived at. In the last decade of the eighteenth century Billingsley reckoned output in Somerset alone at between 2,300 tons and 3,000 tons weekly, or an annual output of between 120,000 and 150,000 tons.[3] He was a shareholder in Smallcombe colliery and his intimate knowledge of the area lends more authority to his statement. Greenwell and McMurtie's figure of 140,000 tons for the year 1800 seems to have been reached on the basis of an average output of 20 tons a day for the 29 pits known to them, less 40,000 tons for summer inactivity.[4] Official statistics are not available until the mid-nineteenth century ; and they frequently do not separate the records of the Somerset and Gloucestershire coalfields ; but in 1867, for example, Somerset pits alone landed 413,678 tons of saleable coal.

[1] Considerable use has been made in this essay of MSS. records in the possession of Lord Hylton of Ammerdown, Mr. E. F. Rees-Mogg of Temple Cloud (Cholwell MSS.) and Mr. R. J. Lawrence of Clutton (Timsbury Minute-books and notebooks), to whom grateful acknowledgement is made. Research has also been assisted by the University of London Central Research Fund.

[2] *Rise of the Coal Industry*, i, 19-20.

[3] *Agriculture of Somerset*, (2nd Ed. 1798), 27-9.

[4] *The Radstock Portion of the Somerset Coalfield* (1864) 8-9.

No really accurate figures of production exist for the centuries before 1800. The working collier would occasionally give a rough estimate of the total value of coal raised from, say, a seventeenth century pit. For example, Richard Fenner said in 1677 that two pits at Stratton raised between them about £30 to £40 worth of coal, which at current prices would have been between 150 and 250 tons.[1] Simon Fussell and his partners at Perthill, living in the same generation, raised coal worth about £100 (equivalent to about 500 tons) from one pit. Thomas Plummer of Holcombe worked at a pit where £60 worth of coal (about 300 tons) was landed within the space of one year. Such workings were often exhausted after a couple of years ; but the suggestion is that the typical unit of production in mid-seventeenth century Somerset was responsible for an annual output that could best be measured in tens or hundreds, rather than in thousands, of tons.

A more satisfactory and detailed picture is forthcoming from an examination of the royalty income of two estates in the coalfield—the Kilmersdon accounts for the years 1679-92[2] and the Hunstrete accounts for the years 1705-1833.[3] Even here calculations depend upon a knowledge of the fraction taken in royalties over a period of years, the variations in the selling price of coal in the locality and an assumption that the colliery owner was always playing fair with the landowner. Moreover, the royalty did not usually reflect the amount of the miner's free allowance of coal, nor the coal used for engines and other work in and about the mines. However, the accounts serve to illustrate the growth in the demand for coal in Somerset from the last quarter of the seventeenth century to the first quarter of the nineteenth century.

The Kilmersdon figures covered the freeshare returns entered in Thomas Feere's account books from up to seven pits that were in production between 1679 and 1692. Years for which there are complete returns were 1679, when receipts were £215 8*s.* 6*d.*, 1681—£229, 1682—£227 18*s.* 9*d.*, 1683—£312 2*s.* 9*d.*, 1685—£130 17*s.*, 1688—£297 0*s.* 5*d.*, 1689—£112 3*s.* 1½*d.*, 1690—£201 11*s.* 11*d.*, 1691—£267 16*s.* 9*d.* and 1692—£256 0*s.* 2*d.* Individual

[1] *P.R.O.* E.134/30 Chas. II/Mich. 11.

[2] Contained in the notebook kept by James Twyford, the most energetic and enlightened mining adventurer in the Somerset of the later Stuarts. (*Ammerdown MSS.*).

[3] Extracted from the Popham Estate records (Somerset Record Office) DD/PO, 32-35.

pits made widely varying contributions to these totals ; thus in 1679 the smallest pit paid 6*s.* 9*d.* in royalties, another £37 1*s.* 3*d.*, a third £56 15*s.*, and the largest £76 18*s.* The selling price at that time was on an average 3*d.* per bushel and the bushel at Kilmersdon was roughly a hundredweight. The freeshare[1] was one eighth, so saleable coal landed on the Kilmersdon estate was, on this reckoning, nearly 7,000 tons in 1679, nearly 10,000 tons in 1683 and about 3,600 tons in 1689. The smallest amount from a single pit in 1679 would have been 10½ tons and the largest amount from a single pit (Sheere's Close) would have been over 2,400 tons. We know that at this time there was a considerable output from the neighbouring pits at Stratton Common ; Twyford records that on one occasion about 70 tons were laden there in a day and a night. There were, too, a number or workings in the other mining parishes, such as Timsbury, Farrington Gurney, Clutton, High Littleton and Pensford. Total annual production in Somerset, therefore, may well have approached 50,000 tons in a good year, though it may not have exceeded 10,000 tons in a poor year.

The Hunstrete accounts extend over a much longer period, and they serve to stress two main points, firstly, the existence of a number of small separate enterprises in the years before 1750, and secondly the development of a single enterprise after 1750 with a considerably greater production than the combined output of all the smaller concerns in the earlier period. The following royalty receipts for the years 1705 to 1710 help to illustrate the first phase of this area's mining history.

Year	*Coalpits*	*Receipts* £ *s.* *d.*	*Totals* £ *s.* *d.*
1705	Birchwood	4 3 0	
	Sutton	5 8 4	9 11 4
1706	Chew	6 5 6	
	Birchwood	4 3 0	
	Chelworth	8 8	10 17 2
1707	Chew	10 14 0	
	Birchwood	3 0 0	
	Chelworth	2 18 4	16 12 4
1708	Chew	12 4 0	
	Birchwood	1 5 0	
	Houndstreet	3 0 0	16 9 0
1709	Farnborough	24 7 1½	24 7 1½
1710	Chew	6 8 0	
	Houndstreet	15 3 3	
	Farmborough	63 7 0	84 18 3

[1] Freeshare meaning royalty appears to be a term peculiar to Somerset.

The freeshare was one eighth in these years, except at Chelworth, where it was possibly still one-tenth ; and the selling price was still 3*d.* per bushel. On this basis the total output for the six years would have been just over 5,000 tons, of which more than half was landed in the year 1710. As for individual undertakings, Chelworth seems to have produced less than 20 tons in 1706, whereas Farmborough produced about 2,000 tons in 1710.

Prior to 1753 the only single enterprises on the Popham estate which exceeded an annual output of 1,000 tons were those at Timsbury and Farmborough. The former was paying freeshare over a short period, from 1749 to 1753, that represented an annual production of about 3,500 tons, while the latter, after many fluctuations, seems to have stopped working altogether by 1749.

In 1753 a new Farmborough enterprise came into existence under the management of John Bush, who was superseded in 1771 by the partnership which called itself the Heighgrove Coal Company. Its fortunes are recorded in the freeshare payments it made half-yearly to the Pophams.

Oct. 1753 to Mar. 1754	£131 0*s.* 6*d.*
Mar. 1754 to Oct. 1754	£196 10*s.* 2*d.*
Oct. 1754 to April 1755	£254 14*s.* 11¾*d.*
Apr. 1755 to Oct. 1755	£236 9*s.* 0*d.*
Oct. 1755 to Apr. 1756	£279 7*s.* 4¾*d.*
Apr. 1756 to Nov. 1756	£213 1*s.* 5*d.*
Nov. 1756 to May 1757	£234 18*s.* 4½*d.*
May 1757 to Dec. 1757	£253 2*s.* 7*d.*
Dec. 1757 to Nov. 1759	(no figures available).
Nov. 1759 to May 1760	£239 0*s.* 5*d.*
May 1760 to Nov. 1760	£168 13*s.* 8½*d.*
Nov. 1760 to June 1761	£252 6*s.* 9¾*d.*
June 1761 to June 1762	(no figures available).
June 1762 to Dec. 1762	£160 13*s.* 2*d.*
Dec. 1762 to July 1763	£147 8*s.* 2¾*d.*
July 1763 to Dec. 1763	£132 10*s.* 11½*d.*
Dec. 1763 to July 1764	£106 2*s.* 8¼*d.*
July 1764 to Dec. 1764	£70 3*s.* 4*d.*
Jan. 1765 to July 1765	£55 5*s.* 2½*d.*
July 1765 to Mar. 1766	(no figures available).
Mar. 1766 to Dec. 1766	£250 18*s.* 2*d.*
Dec. 1766 to July 1767	£225 17*s.* 8¼*d.*
July 1767 to Nov. 1768	(no figures available).
Nov. 1768 to Mar. 1769	£147 19*s.* 5*d.*
Mar. 1769 to Dec. 1769	£328 17*s.* 5¼*d.*
Dec. 1769 to Oct. 1770	£473 12*s.* 10*d.*
Oct. 1770 to Apr. 1771	£325 12*s.* 9*d.*
Apr. 1771 to Apr. 1806	(no figures available).
1806 (full year)	£361 14*s.* 0*d.*
1807 (full year)	£298 13*s.* 0*d.*
1809 (full year)	£383 6*s.* 10¼*d.*

1810 (no coal landed between 14 July and 8 September)	£157 12*s.* 1½*d.*
1811	£255 16*s.* 5*d.*
1812	£258 0*s.* 0¼*d.*
1813 to 1816 inclusive	(no figures available).
1817	£264 19*s.* 10*d.*
1818	£394 1*s.* 2*d.*
1819	£25 14*s.* 1*d.*

During the third quarter of the eighteenth century the Heighgrove Company[1] was paying one-eighth freeshare and the selling price of coal at the pithead in this area was then 4*d.* a bushel. Thus in the late 1750's and the late 1760's saleable tonnage would have been between 9,000 and 13,500 tons a year. Daily average output would then have been between 30 and 45 tons, though this does not necessarily give us an idea of how much coal was landed from a single pit, since there were three of four pits operated by the Company at Farmborough and more than one of them may have been in production at different times. In contrast to these years of greater activity, there were periods of relatively low output—notably 1761 to 1766, 1810 to 1813, and 1819 onwards, when the mines had ceased to be a profitable concern.

Nevertheless, the increase in the scope of colliery undertakings became general throughout Somerset by the last quarter of the eighteenth century. At Mearns Pit, High Littleton, in 1792 it was expected that an average of 20 tons a day would be landed for 300 days in the year, giving a total annual output of 6,000 tons ;[2] and most of the pits in the coalfield seem to have been financed and planned on similar lines. At Radstock 840 bushels could be landed in a day in 1792,[3] but it is doubtful whether this amount (about 40 tons) could be consistently maintained.

Prices

Differences in measurements of quantity are a factor which renders an assessment of production and prices a difficult task. The most frequently mentioned unit of quantity used in Somerset was the bushel. This was according to Twyford larger than the bushel in London Pool, which he described as 19½ inches in diameter and 7½ inches deep. The bushel at Kilmersdon was 19½ inches diameter

[1] The mining leases of the Company are contained in the Popham Estate Records (*Som. Rec. Off.* DD/PO 12).
[2] William Smith MSS, preserved at University Museum, Oxford (Dept. of Geology and Mineralogy).
[3] *Bath Chronicle*, 10 Oct. 1792.

and 11¼ inches deep, at Hallatrow 20½ inches diameter and 9⅛ inches deep and at Farrington 19¾ inches diameter and 8⅛ inches deep. It would not be far wrong to describe the Somerset bushel as equivalent to a hundredweight. Other measurements are more variable. A sack of coal, for instance, often meant 2 to 3 cwts., but obviously on occasions refers to much more than this. The horseload was another indefinite term ; it was sometimes about 2 cwts. and sometimes much more. The plough had a capacity of about half-a-ton and the cart and wagon load often contained 5 or 6 quarters of coal, or 2 to 2½ tons. The use of measurements of weight did not become general in the Somerset coalfield until the middle of the nineteenth century.

With these limitations in mind it is possible to suggest the trend of coal prices for part of the period under review. The following table of prices summarises the relevant evidence.

Year	*Place*	*Quantity*	*Estimated price per bushel.*	
			Retail	*Pithead*
1458	Glastonbury	13 weys—£4 3*s.* 11*d.*	2*d.*	
1471	Yatton	2 weys—10*s.*	1½*d.*	
1500-1	Wells	4 quarters—2*s.* 4*d.*	½*d.*	
1588	Bath	11 sacks—7*s.* 10*d.*	2*d.*-3*d.*	
1610	Clutton	3*d.* per horse load		1*d.*-1½*d.*
1683	Wells	6 sacks—4*s.* 6*d.*	3*d.*	
*c.*1700	Mendip pits	2*s.* 8*d.* per quarter		4*d.*
*c.*1700	Farrington	1*s.* 8*d.* to 2*s.* per quarter		2½*d.*-3*d.*
1709	Hunstrete	21 horseloads—£1 1*s.*	3*d.*	
1717	do.	29 sacks—£1 9*s.*	3*d.*	
1719	do.	52 sacks—£2 16*s.* 4*d.*	3*d.*	
1720	do.	52 sacks—£2 16*s.* 4*d.*	3*d.*	
1751	do.	5 quarters—10*s.* 6*d.*	3*d.* (plus carriage)	
1753	do.	5 quarters—10*s.* 6*d.*	3d. (plus carriage)	
1756	do.	13/4*d.* per load (5 quarters)	4*d.*	
1762	do.	do.	do.	
1773	do.	do.	do.	
1791	Timsbury (v. Collinson ii, p.111)			3*d.*
1791	Midsomer Norton (v. Collinson ii, p.149)			4*d.*
1791	Paulton (v. Collinson ii, p.152)			4*d.*
1792	(Sept.) Bath	6/- per quarter	9*d.*	
1795	Northern part of coalfield (Billingsley p.28)			5*d.*
1795	Southern part of the coalfield (Billingsley p.29)			3¾*d.*

Year	*Place*	*Quantity*	*Estimated price per bushel.* *Retail*	*Pithead*
1795	Midsomer Norton	1 load—£1 6*s.* 2*d.*	6½*d.*	
1796-9	do.	6 quarters—£1 6*s.* 2*d.*	6½*d.*	
1800-2	do.	1 load—£1 6*s.* 2*d.*	6½*d.*	
1803	do.	1 load—£1 10*s.*	7½*d.*	
1804-7	do.	2 loads—£3	7½*d.*	
1808-10	do.	2 loads—£3 8*s.*	8½*d.*	
1811	do.	2 loads—£3 10*s.*	8¾*d.*	
1812-17	do.	2 loads—£3 12*s.*	9*d.*	
1818	do.	2 loads—£3 4*s.*	8*d.*	
1819-29	do.	2 loads—£3 12*s.*	9*d.*	
1830	do.	2 loads—£3 17*s.*	9½*d.*	

The figures for Midsomer Norton, taken from the accounts of the Ann Harris Charity School, are of particular interest, in that they cover the period of the French wars with its rapid changes of price level, while the quantities involved remain constant either as one load of six quarters or two loads of twelve quarters per annum. The retail price was 6½*d.* a bushel in 1795, and it will be seen that Billingsley quotes the pithead price in Midsomer Norton for that year as 5*d.* a bushel, so that the cost of carriage over a distance of about a mile would have then been about 1½*d.* a bushel. No increase in price is noticeable until 1802, but then a steady rise takes place until 1812, when 9*d.* a bushel is paid. The 1812 level level is maintained with scarcely any variation until 1829, but in 1830 there is a further rise of one halfpenny a bushel.

As a whole, these figures reflect a fairly steady level of prices from the end of the seventeenth century down to 1750. An increase takes place in the 1750's but little further change occurs until the outbreak of the Revolutionary Wars. There is no unusual feature about the sharp upward movement of prices during the war years, but the maintenance of the high level after 1815 does not accord with the general trend of prices for the fifteen years after Waterloo. Two possible explanations present themselves. One is that an increased demand for coal for industrial and domestic uses kept coal prices up. The other possible explanation is that combinations of employers within the coalfield were adopting a deliberate policy of controlling production and prices.

Classification of coal according to quality was not a common practice in Somerset before the end of the eighteenth century, although lime coal was invariably sold a few pence a bushel below the pithead price of hard coal. The development of sale by weight in place of sale by measure was a feature of the early nineteenth century, but does not appear to have been completed until the 1850's.

CARRIAGE OF COAL BY ROAD

The slow development of the Somerset coalfield was due in part to the limitations imposed by lack of transport facilities. The Radstock area was essentially a land-sale area and suffered from the double disadvantage of having within six or seven miles of the main collieries neither a navigable river nor a Bristol Channel port. The trade that existed in 1797 in lime coal carried from Portishead to South Wales related only to the Nailsea collieries.[1] Between 1747 and 1765 only 55 tons of coal reached London by sea from Somerset[2]—45 tons shipped from Bristol and the remainder from Bridgwater—and there is nothing to prove that this came from the area around Radstock. The tributaries of the Avon that traverse the coalfield from west to east were not large enough to connect the pithead with the wharf ; and even so, competition from the Forest of Dean, South Wales and the Shropshire coalfields seems to have deterred the Somerset proprietors from extending their trade northwards in the direction of Bristol ; and there are scarcely any references in the period before 1800 to Bristol being even a potential market.

Deprived of obvious opportunities for sea or river transport, the coalfield had three main ways of carrying the coal from the pithead to the user ; these were by sack, by pannier and by cart or waggon. None of these methods was in any sense adequate for the transport of large quantities for any appreciable distance. The loads carried at a time could best be measured in bushels and the largest waggons were limited to a load of about three tons. The problem created by this was rendered far worse by the state of the roads in Somerset, which was notorious down to the middle of the eighteenth century. Parishes in the area sometimes neglected, or refused, to repair those roads which were used heavily by coal carts. Thus in 1617 the inhabitants of Stoke St. Michael, on the road from Coleford to Shepton Mallet, complained that ' of late by reason of many coalmines which are set to work in the country near there adjoining, there is so much travelling that way that the highways there are much in decay and grown very founderous '.[3] Sixteen years later the inhabitants of Brislington made a similar complaint, to the effect that their roads were becoming ' very founderous and

[1] Billingsley *op. cit.* p.29
[2] *Report of the Coal Commission* (1871) iii, 21.
[3] Quarter Sessions Records, *Somerset Record Society*, (James I), 227.

in decaye by meanes of the great resorte of colliers with their horses to certain cole pittes there of late yeares found out '.[1] In the mid-eighteenth century John Wesley asserted that Midsomer Norton was probably so called because formerly it was only possible to reach it at mid-summer.[2]

As late as 1819 Skinner remarked on the state of the Priddy road ' rendered bad by farmers' carts going to Paulton from this part of the country for coal '.[3] But generally speaking there was a great improvement taking place in the condition of Somerset roads after 1750. This was due to various factors. but not least were the activities of the turnpike trusts, despite the hostility they caused, and the growth of the stone-quarrying industry which provided an abundance of road-metal. The Bath and Wells turnpike trustees were very active in the 1750's and the 1760's, and one thing they did was to improve the road at Dunkerton, the main outlet for the east-bound coal traffic. Moreover, the coalmasters came to realise that money spent on road repairs and maintenance was money well spent, and the Timsbury proprietors, for instance, made frequent payments towards the upkeep of the Bath road which ran from Timsbury through Dunkerton.[4]

Nevertheless, land carriage was dear and this inevitably meant a certain restriction on the extent of the markets. Ironically enough, this dearness was in part the result of improving the roads, for turnpike tolls had to be paid. A letter in the *Bath Chronicle* in May, 1789, referred to an increase in the turnpike tolls for the Bath area, which had led the proprietors of collieries at Camerton, Timsbury, Paulton, Radstock, Stratton, Welton, Midsomer Norton, High Littleton, Clutton and Farmborough to present a petition, pointing out that the increased tolls would lead to higher prices and ' encourage the consumption of inferior coals brought from distant parts by water carriage '.[5] In 1792 the cost of carrying a bushel of coal from the pithead in the coalfield to the consumer in Bath was 3*d.* or 4*d.* With the cheaper grades of lime coal this came to more than the pithead price of the coal itself.

[1] Do. (Charles I), 203.
[2] *Journals*, (Everyman Ed.), iii, 304.
[3] B.M. Add. MS. 33653, fol. 97.
[4] Minute Books of the Timsbury Collieries.
[5] *Bath Journal*, 27 Jan. 1766.

WATER CARRIAGE

It was not surprising, therefore, that thought should be given to the utilisation of alternative means of transport. Already in 1766 a scheme had been put under way for the extension of the Avon navigation from Bath to Melksham and one writer at this time pointed out the dual advantage of carrying this extension further to Chippenham, so that corn and other farm produce could be sent to Bath instead of to the south Midlands as heretofore, while coal could be sent in return by water from the Bath and Bristol areas.[1] In 1794 the coalmasters became involved in two separate schemes of canal building and they managed to secure the support of most of the local landowners as well.

The first of these schemes resulted in the construction of the Somerset Coal Canal. The original committee of management for this enterprise was under the chairmanship of James Stephens of Camerton and included the following people who were directly or indirectly connected with the coal industry :—Thomas Jolliffe, James Tooker, Jacob Mogg, Francis Whalley, James Savage, John Billingsley, Samborne Palmer, Richard Perkins, John Crang and James Flower. They employed a Mr. Bennett and then William Smith as engineers, the latter being engaged on the work for four years, until a difference of opinion over policy led to his resignation. The Canal was planned in two branches and the routes followed are shown on several contemporary maps.[2] One branch began at Hallatrow and passed eastwards through or near Timsbury, Camerton, Dunkerton, Combe Hay and Midford, joining the Kennet and Avon Canal not far from the Dundas Aqueduct. It was built in sections roughly two miles in length, each of which was the subject of a separate contract ; the first of these sections was from Paulton Engine pit to Hopyard in the parish of Camerton, and the second from Hopyard to the Dunkerton turnpike. Both were planned to be begun in 1795.[3] The whole branch was completed in the early years of the nineteenth century and used continuously down to 1902, when it was classified as derelict and taken over by the Great Western Railway, which constructed a light railway to serve the same area. The second

[1] *Felix Farley's Journal*, 3 June, 1794.
[2] For example, those by Taylor and Meyler (1800) and Day and Masters (1803) in the Bath Municipal Library collections.
[3] *Felix Farley's Journal*, 26 April and 3 June 1795.

branch was originally planned to go from Radstock through or near Writhlington, Foxcote and Wellow to join the other between Combe Hay and Midford Bridge. This was under construction in September, 1799, when Warner visited Radstock and noticed that ' a canal terminating at this place is now cutting and in great forwardness, intended to convey the produce of the mines to Bath and more distant places '.[1] Whether or not the unfinished part of the canal was ever used is a matter of some dispute, but if it was, the transference of load at Midford must have been a very clumsy business. However by 1814 there was a tramroad running the whole distance from Radstock to Midford and this continued working until 1873-4, when the Somerset and Dorset Joint Railway was opened as far as Bath. Such tramroads were used to connect the pitheads with the canal along its route and as early as 1795 tenders were invited for seven miles of track, using ' 7,000 best oak sleepers four feet six inches long, eight inches to nine inches broad and three inches thick '.[2] Iron founders were asked to supply specifications of rails, with models if possible.

The financial success of the Somerset Coal Canal helps to illustrate the part it played in the growth of the coalfield. In 1828 it carried 113,442 tons of coal, for which it received £14,809 in revenue or a rate of 2.61 shillings per ton.[3] In August, 1829 the value of the shares was 109½ and the dividend paid was 7%. In August, 1846 the profits of the canal were £9,181 and of that £8,800 was paid out in dividends, equivalent to 8%.[4] The main branch of the canal served a dozen collieries between 1825 and 1850, and the Radstock-Midford tramway served a similar number.

The second scheme of canal building was associated with that pathetic failure, the Dorset and Somerset Canal. The main part of the project was never begun, but in 1796 a branch was cut, and only partly completed, from Stratton Common, passing eastwards through Coleford, Newbury, Vobster and Mells towards Frome. The aim of this was to send coal northwards *via* Bradford-on-Avon to connect with the Kennet and Avon, and southwards *via* Wincanton to the Stour Valley. The engineering obstacles were greater than had been originally thought and although hopes had run high at first, when it was believed that this route could be used to reduce

[1] *Walk through some of the Western Counties*, (1800) 10.
[2] *Felix Farley's Journal*, 3 June, 1795.
[3] C. Hadfield, *British Canals*, 197. [4] Note-books of the Timsbury Collieries.

the cost of coal carriage from the collieries to Frome from about 5*s*. per ton to about 2*s*. per ton, the work was never finished.[1] The significance of the introduction of canal transport may be measured by comparing the increased production of the area served by the Somerset Coal Canal and its associate tramway with the decline after 1800 in the output of the collieries in the southern part of the coalfield. which had still to rely upon horse and waggon. By 1795 the production of this area was estimated by Billingsley to have been 800 to 1,000 tons per week, and he suggested that there could be an increase of 100% ' if sale can be found '. But by 1867 total production from the pits in the same neighbourhood was less than 20,000 tons annually,[2] representing less than 5% of the total for the whole of the Somerset coalfield and a weekly average of less than 400 tons. The coal seams were not exhausted yet, since the late arrival of the railway in this district helped eventually to revive activity.

On the other hand, the development of the northern and central sectors of the coalfield cannot altogether be explained by the introduction of canal transport, because the canals were not finished until the early nineteenth century, and the Kennet and Avon, the most important link in connecting the mines with more distant markets, was not open to Bath until 1810. There must be other reasons why mining adventure in Somerset quickened after 1750. How is it that the main nineteenth century mining enterprises in the county nearly all have their origin in the pre-canal era ? No one obvious solution to this problem presents itself, but the following factors are worth consideration :—

i. A general improvement in road and river communications.
ii. An increasing demand for coal being made by a growing population.
iii. The spread of new techniques, such as steam power for drainage, facilitating exploitation of the coalfield's resources.
iv. The organisation of wealthier partnerships of coalmasters whose incentive to investment had been stimulated by the operation of the first three factors.

[1] Phelps wrote (*Hist. & Ant. of Som.*) I, 59 : ' By some injudicious management the subscriptions were expended before the work was near completion ; the further progress was suspended and after the useless expenditure of a large sum of money the whole was abandoned.'
Coal Commission Report (1871) iii, 126.

THE ORGANISATION OF SALE

Evidence of the organisation of sale before 1800 is very scanty. What records there are suggest that the collieries did a certain amount of direct sale to consumers at the pithead. For example, farmers from Mendip commonly brought their carts to the collieries for coal. Sometimes the mineowners, acting as distributors as well as producers, had their own carts and waggons. Much of the marketing was done by the small merchant or dealer who lived in the neighbouring town or village. One Holcombe miner in the seventeenth century had been employed in his youth helping his father with his horse and cart on trips with coal to Wells. At that time there was an expression, ' to go to Mendipp for coles ', which had common currency amongst the dealers of the area. Some of the trade was for ready money, but the colliery accounts made allowance for credit to ' trusted ' buyers and dealers. In such a small coalfield large trading concerns had little place ; the stock of one Bath coal merchant in 1795 consisted of ' one broad-wheeled waggon, two narrow-wheeled ditto, and a cart and five horses and harness for seven ditto '.[2]

Once the canal traffic, and later the railway traffic, had come into existence, a more elaborate organisation of sale was necessary. In the first part of the nineteenth century it became customary for the coal companies to employ their own agents, salesmen and travellers. For example, the Timsbury and Grayfield proprietors in 1844 had platforms constructed at Swindon, Oxford, Twyford and Slough railway stations and sent their own agents to establish trade there. The Timsbury collieries had a financial interest in the Bath Coal Company, a firm of coal factors, up to 1847.

Before 1830 there is evidence of occasional co-operation by the Somerset coalmasters to protect their markets. They combine to protest against the increase in the Bath turnpike tolls, they combine to raise the price of coal on 1792, they join in the petition of 1818 aimed at preventing the increasing threat of duty-free privileges being granted to all the Severn ports, and they combine to oppose the Bill of 1828, which authorised the building of a tramway from the Gloucestershire coalfield to the River Avon at Bitton.[3] However, no record has been found of a definite employers' organisation

[1] P.R.O. E.134/30 Ch. II/Mich. 11 (Evidence of A. Chivers).
[2] *Felix Farley's Journal*, 12 May, 1795. [3] Cholwell MSS.

existing before 1843. The events of the 1840's and 1850's are not within the scope of the present review, but brief reference to them is justified by the fact that the policies followed then were quite possibly a feature of the earlier period.

By 1843 a production quota was enforced by the Coal Masters Annual Meeting, which represented the Somerset area. In that year the Timsbury proprietors sought to get sanction from this body for an ' increase of ten score (200 bushels) per day for the Old Grove works and five score (100 bushels) for Withy Mills '.[1] The quota was known as the ' tale ' ; and in 1845, when the Hayeswood colliery was flooded, permission was granted by the ' Chairman of the Somerset Coal Masters Society ' to get the Hayeswood ' tale ' transferred to the other Timsbury coal works. In October, 1849, the Timsbury shareholders resolved to make ' the same arrangements for the proportionate sale of coal of various kinds for the ensuing quarter as shall be made by the Radstock and other works '.

The second function of this employers organisation was the control of prices. Meetings of colliery agents and owners were held from time to time at Stone's Cross Inn, Midsomer Norton, and complaints of unauthorised changes in prices were sometimes dealt with. This form of collective action was regularly adopted in the coalfield by the middle of the century ; thus, when the Paulton coalworks (Engine, Hill and Ham pits) increased the amount of credit to traders and began giving gratuities to canal boatmen in 1855 it was considered equivalent to a reduction in the price of coal and a contravention of the Stone's Cross agreement of October, 1854.

The Extent of the Market

Nef has estimated the extent of the land-sale market in Britain prior to 1700 to have been an area not more than ten to twelve miles in radius from the centre of the coalfield. Somerset markets reached by land carriage seem to have been somewhat more extensive than this. To the west Wells, Glastonbury and the farming communities on the Mendip Hills were served with coal from the Somerset mines ; but the journey from Midsomer Norton to Glastonbury and back by horse and cart even in the days of the

[1] Timsbury Minute-books (see above). The coalmasters had their own solicitor in the labour troubles of 1817 (P.R.O., H.O., 42, 161).

turnpikes took two days[1] and the part of Somerset which lay west of the Mendip Hills was mainly supplied by sea-borne coal brought to Bridgwater, especially from the South Wales coalfield.

South of Brislington the Somerset pits do not seem to have been considered as a source of supply for the city of Bristol. Bristol had her own coalfield in Kingswood Chase and to supplement it there was an important water-borne trade from South Wales and the Forest of Dean. Indeed, it was something of a novelty for the Timsbury Company, as late as 1851, to establish a Bristol trading connection by renting a wharf at Hotwells and employing an agent there to sell the coal that came *via* the Canal and the Avon ;[2] and this enterprise was proved a failure by 1860.

To the east the main market was at Bath and in the western part of Wiltshire, extending to Warminster and Maiden Bradley. In 1824 there was a track between Stourhead and Maiden Bradley which ' had been cut out for the coal carts passing to the pits for a supply of that commodity '.[3] Warminster was mentioned in 1808 as being on the boundary of the land-sale area.[4] Frome and Shepton Mallet were the largest centres of population directly to the south ; and in times of distress at Frome it is recorded that some of the unemployed were harnessed to carts and obliged to draw loads of coal into the town.[5] Beyond these places there was a further market in the northern part of Dorset, a district where there was least competition to be expected from other coalfields and from water-borne coal.

Even without the developments in transport and leaving out of account any increase in industrial demand, it must be remembered that there was a substantial growth in population within the land-sale area of the coalfield during the first part of the nineteenth century. Taking the 1801 and 1831 census figures as illustrations of this,[6] the population of Frome increased in thirty years from 8,748 to 12,240, of Glastonbury from 2,095 to 2,984, of Wells from 4,505 to 6,649 and of Bath from 27,686 to 38,063. Even without a corresponding increase in the number of new houses built to accommodate a larger population, this could represent a big increase in demand for coal for domestic consumption. Although accurate figures do not

[1] This was, of course, still true of the Glastonbury coal trade at the beginning of the present century.
[2] Timsbury Minute-books (see above).
[3] B.M. Add. MS. 33675, fol. 12.
[4] B.M. Add. MS. 33625, fol. 1-2.
[5] *Bath Chronicle*, 29 April, 1830.
[6] *V.C.H. Somerset*, ii, 338 ff.

exist for the years before 1801, this trend may well have begun before then.

Once the canal traffic was developed the eastward trade expanded, particularly along the line of the Wilts and Berks Canal (which in 1868 took 26,058 tons of coal from the Somerset area) into the White Horse Vale.[1] Other sales were facilitated at Bradford-on-Avon, Devizes, Newbury and Reading. A portion of the Bath trade now was water-borne, though in 1858 a man was still employed by the Radstock collieries to help the carts of the Bath traders up the hill at Dunkerton.[2]

The Nature of the Demand

The bulk of this coal was destined for the domestic market. The quality of it varied greatly, but certain seams produced good house coal—for example, the Globe, Garden Course, and Firestone veins in the Lower Series, the Farrington Top and Middle veins in the Farrington Series and the Great, Middle, Slyving and Bull veins in the upper or Radstock series. Much of the small coal was used in the lime kilns. Some of the earliest references to the use of coal in Somerset appear in the Churchwardens' Accounts, when lime was used in the building of parish churches. Following the agricultural improvements of the eighteenth century, there was a steady demand for coal by the farmer who used lime, and it was estimated that a kiln might use 15 quarters or 120 bushels of refuse coal a week.[3] The manufacturer or iron wares used coal. In Tudor times Camden had remarked that the Stratton Common coal was 'made use of by smiths, as most proper to soften iron'.[4] There were iron works at Mells before 1800—possibly belonging to Fussell's, manufacturers of agricultural implements,[5] who in the 1820's had iron mills at Nunney, Mells and Little Elm.[6] Paulton Foundry, adjoining Paulton Engine Pit, was in existence at least as early as 1828,[7] and under the management of William Evans its main products were used to meet the requirements of the collieries of the district. Some of the coal from the Bishop Sutton pits went for lead-smelting ;[8] these coalworks were the nearest to the Mendip

[1] *Coal Commission Report* (1871), iii, 129.
[2] Radstock Colliery records, held by the National Coal Board.
[3] Billingsley (*op. cit.*) 90.
[4] *Britannia* (3rd Ed. 1753) I, 87.
[5] Collinson, ii, 462.
[6] B.M. Add. MS. 33703, fol. 27.
[7] B.M. Add. MS. 33702, fol. 197.
[8] *Coal Comm. Rep.* (1871) i, 59

leadmines, though the latter industry was already in decline by the eighteenth century and there was in Somerset none of the integration of the coalmining and metalliferous enterprises that was a common feature of some other British coalfields. Coke is mentioned occasionally in the eighteenth century—for instance in the Farmborough lease of 1771[1]—but this is more likely to have been used at that time for brewing rather than for metal-smelting. There were two pits at High Littleton about 1745, of which it was reported that only the surface coal was fit for sale and that the rest was burnt for coke to dry malt with. In 1798 at Writhlington William Smith found coke being burnt in the open air, the method producing only about one-third of the quantity of the new coal, though the coke made this way was 'firmer and better for drying malt than that burnt in the oven, but the latter method is the most profitable to the coakmaker as the coaks burnt this way measure as much as the new coal'.[2]

Gas lighting, introduced in Bath in the 1820's and locally at Midsomer Norton in 1840, provided a fresh outlet for the product of the Somerset mines, and as transport improved more distant markets found a greater variety of use. By the mid-nineteenth century the customers of the collieries included the Westbury Iron Works (which built a light railway from Newbury pit to Mells Road station), Whiteways of Newton Abbot, breweries as far distant as Birmingham and other firms at Newbury and Martock. In 1851 and 1852 free supplies of coal were given to two steamboat companies at Bristol to test its suitability as bunker fuel.[3] This phase of expansion, however, belongs more properly to the age of the railway.

Summing Up Production and Sale

The Somerset coalfield, therefore, was supplying a limited market, mainly domestic in character. The extent of the market was determined by the mode of transport available and by the existence of competition from other coalfields. The extent of the demand was such that up to 1750 it encouraged the development of mainly small enterprises, but after 1750 there is a marked increase both in the size of the undertakings and in the quantity of saleable coal produced, a trend that is further assisted by the growth of the water-borne

[1] *Som. Rec. Off.* DD/PO 12.
[2] Notes on High Littleton and Writhington (William Smith MSS.—see above).
[3] Timsbury Minute-books.

trade after 1800. The coalmasters themselves played a large part in the distribution of the coal, with their own or hired conveyances, with their sponsorship of the Somerset Coal Canal and with the activities of their agents and travellers, though most of the retail trade was carried out by small independent dealers. Before 1830 the mineowners took occasional collective action to protect their interests and in particular to maintain their markets against the threat of external competition ; but it was not until the period after 1830 that we find evidence of a definite prices and production policy, controlled through an organised employers association.

The Techniques of Mining

Surveying for Coal and Sinking Shafts

In Somerset the need for coalpits arose in the fifteenth century —that is to say the need for shafts and underground workings as opposed to the surface workings of the outcrop areas which belong to the first years of the coalfield's history. Robert Horner's ' colepytte ' at Kilmersdon was deep enough in 1437 to have an adit or drainage channel ;[1] and John Welley's pits at Stratton were established coalworks that can be accounted for during most of the century following the year 1453.[2] There was a coalpit at Kilmersdon in 1489 which was said to be ' deep and dangerous ' ;[3] and the ' wark ' (rubbish) from these ' old men's pits ' in the outcrop areas still remains to-day in mounds of considerable size as a tangible record of early mining activity.

As soon as shafts had to be sunk, there was a need to evolve methods of surveying for coal. This was often done by following the line of the outcrop seams. ' Forepitch ', wrote James Twyford, ' is sometimes made, which is by sinking pits, ten, twenty, thirty or forty yards before the place the coal outed and near on the same point of the compass either east or west '. Sometimes the less scientific method of dowsing was used. Twyford has a word of advice to give about this. According to him a forked rod of one year's growth of hazel, coventry or witch-hazel would, in certain persons' hands, bend down when held over any coal or mineral. He even gives a table showing the most suitable times for its use.

[1] *P.R.O.* Court Roll, 198/50.
[2] *P.R.O.* Ministers' Accounts, 1123/1, 1095/7, 1123/3.
[3] *P.R.O.* Court Roll 198/51.

After 1700 geological knowledge was increasing. Twyford, who showed an intelligent interest in the formation of the coal measures, listed twenty seams (or, in Somerset, ' veins ') of coal in the Stratton area.[1] John Strachey of Sutton Court, another pioneer of amateur geology, in 1719 described for the benfit of the Royal Society the seams of coal in the vicinity of his own home.[2] Yet it was not until the very end of the century that expert knowledge was brought to bear on these problems, and the important date in this connection is 1792, when William Smith came to Rugbourne Farm, High Littleton, as surveyor for the local colliery proprietors. The enthusiasm he developed in studying the strata of the area, starting with that of Mearns Colliery, was the beginning of a career that was to lead him to be regarded as the father of English geology. By 1824, when Buckland and Conybeare published their findings on the structure of the Somerset coalfield,[3] the obligation that the industrialist owed to the geologist was becoming increasingly patent, and many of the ' unknown ' factors that previously hindered enterprise had been eliminated. This was particularly important in Somerset, where the disturbed nature of the coal measures has hindered production at least as much as it has done in any other British coalfield, whilst ignorance of the extent of the coal deposits diverted capital in fruitless quests and delayed useful speculation.

By the beginning of the nineteenth century the colliery proprietor was using boring rods, screwed together in different lengths, ' the ends being furnished with chisels to cut the stone met with in the progress of the work '.[4] (This method had been developed in other coalfields much earlier than this).

No early accounts exist of the actual sinking of shafts in Somerset. By the early nineteenth century this had become a highly specialised job and was invariably undertaken by a firm under contract to the colliery owner.[5] The cost of sinking Springfield, near Paulton,

[1] These, with their romantic names, were South and North Perink, Hard and Soft Callais, Stone-ragg, Verne-ragg, Blew-pott, Standing Coal, Catt, Butterrakes, Catt, Wild Drift, Red Axen Coal, Branch, Foot Coal, Hard Coal Drift, Foot Coal, Dungy Drift, Stone Coal and Ireland.

[2] These were (a) Stinking Vein (with sulphurous smell) ; (b) Cathead Vein (5½ fathoms below (a)) ; (c) Three Coal Vein (5½-7 fath. below (b)) ; (d) Peaw or Peacock Vein (with coal figured with eyes likes a peacock's tail) ; (e) Smith's coal Vein (a yard thick) ; (f) Shelly Vein ; (g) Ten inch Vein (not worked). (*Phil. Trans. Royal Society* VI, 421-4).

[3] *Proceedings of the Geological Society*, 1824.

[4] *B.M.* Add. MS. 33656, fo.. 45.

[5] Several accounts of contracts are found in the Timsbury Note-books (see above)

was £7 2*s.* per fathom. The men drew 2*s.* 6*d.* each for eight hours and after the first fifty fathoms had been completed they had a bonus of £40 to share amongst them. The sinking of the New Welton or Welton Hill pit in 1813 may be taken as a fair example of practice and experience in Somerset. It was started on 24th February with the driving of a Level through the ' red ground ', which was so soft that the use of gunpowder was unnecessary. Not until nearly two years later was the Great Vein discovered, 45 fathoms below the level, and to celebrate the occasion the workmen were given a supper at the Greyhound Inn, Midsomer Norton. In 1815 three more veins were found—the Little, Middle and Slyving—but when the Under Little Vein was reached the pit came down on a fault and a branch was begun. In May, 1816, the Slyving Vein was found again 51 yards from the pit, and at intervals between then and April, 1819 the three upper veins were again proved, the Great Vein being 346 yards from the shaft. At one time Mr. Kelston, one of the proprietors, ' who then took a considerable share in the management of the work, became so alarmed at the probable expense and at the state of the work altogether ' that the project for one roadway was abandoned. The work only began paying freeshare (royalty) in March, 1816, three years after the sinking had commenced.

Quite deep pits existed in Somerset before 1700. The three pits at Clutton which were surveyed in 1610 had been comparatively shallow—four, six and eight fathoms respectively.[1] In 1678 Simon Fussell, a coalminer, described ' certain ancient cole pitts ' at Perthill on Stratton Common which had been originally sunk more than twenty yards and had been deepened during his lifetime.[2] In the 1690's George Stedman worked a pit at Stratton Common 140 yards deep, though this might have been exceptional.[3] The pumps of that time mostly drew water from working between 30 and 50 yards deep. According to Billingsley, writing a century later, the depth of pits in the northern area of the coalfield varied from 60 to 80 fathoms and in the southern area from 30 to 60 fathoms. In 1817 the deepest pit in Somerset was Clandown, a sinking of just over 400 yards.[4]

[1] *Hist. MSS. Comm. Rep.* (12th Rep.) app. i, 71.
[2] *P.R.O.* E. 134/30 Chas. II, Mich. No. 11, Som.
[3] *Ammerdown MSS.*
[4] *P.R.O.* H.O. 42, 161.

Techniques of Winning the Coal

In the sixteenth and early seventeenth centuries the usual method of working in English coalmines was ' bord and pillar ', or ' pillar and stall ', or some variant of this ; and an interesting description of this is found in a report on the Clutton manor pits, dated 1610.[1]

' They cut their lanes about four feet high and broad. They need no great store of timberwork for support. The lane we crept through was a good quoit cast in length, wherein we found but two cross lanes, whereby it may appear that the mine is newly entered into . . . At the end of every lane a man worketh and there maketh his Bench (as they call it) and according to the vent they make more or fewer benches '.

The advantage of ' pillar and stall ' is stressed in the above passage; it did away with the need for much timber and thereby reduced expense. But disadvantages also appeared in Somerset ; for example, sometimes as much as half of the coal had to be left underground in the form of supporting pillars, and often considerable danger arose when the more unscrupulous miners overworked the pits and removed or ' rubbed out ' the pillars on which the safety of the pit depended. John Plummer's comment on the Holmes pits in 1641 was that they were worked ' in such a manner as Mendipp men did use to worke their colepitts, but if (he) had had an estate for some long tyme in the said pitts he would not have wrought the same in such manner but would have bestowed some chardges in the mending thereof, the timber being broken and in decay '.[2]

The most detailed account of early mining methods in Somerset is contained in James Twyford's ' Observations on Coleworkes '. He describes how, once the shafts had been sunk, lanes were cut, ' which they call branching ' and a tip, or cut, was sunk.

' They break into the coal with a mattock, which they call Benching and with wedge work through and break into coals of great bigness.' To support the sides of the lanes wooden posts were fitted as props and ' woodes ' were placed overhead to stay the roof ' with two tails which come into the posts '.

By this time earlier methods were being modified in the coalfields of the Midlands, and a letter written by Strachey in 1725 infers that

[1] *Hist. MSS. Comm. Rep.* (12th Rep.) App. i, 71.
[2] *P.R.O.*, L.R. 2/207, ff.138-46.

the pillar and stall techniques he had seen in the Northern coalfields were no longer being operated in Somerset.[1] The new idea, that of longwall working, necessitated more timber, but nearly all the coal could now be removed and the rubbish was used to pack the passage made. It was particularly suited to the thin seams and abundance of rubbish encountered in the Radstock area and was a more economical way of winning the coal in the long run. However, pillar and stall was still being used in the neighbouring Nailsea coalfield in 1869.

One other technical development mentioned by Strachey in 1719 was the use of gunpowder.[2] It was then used, not in the actual extraction of the coal, but in blasting the ' clives ' or hard rock that lay between the miner and the coal seam. This was undoubtedly one of the few things that were copied by the Somerset coalminers from the leadminers of Mendip. Already in 1683 John Beaumont of Stone Easton had described the use of explosives in leadmining,[3] and this corresponds very closely with the methods practised by the shot-firers in Somerset collieries right down to the introduction of the first ratchet-boring machine at Braysdown in 1886.

Greenwell and McMurtrie collected some information about Somerset mining at the beginning of the nineteenth century.[4] Methods naturally varied according to the position of the coal measures. Where the seam dipped roads were driven forty yards apart and carting boys had to haul the coal in their ' puts ' from thirty yards on the high side of the road and ten yards on the deep side. Where the seams were level, roads were driven off right and left and the coal was hauled thirty yards each way to the horses in the main roadway. The heads (the coal face) were rarely above thirty yards in width and the number of hewers working in each was restricted to two or three. There was an abnormal amount of rubbish to be disposed of, consequent upon the working of thin seams and in places the hewer would have to take out four or six inches of bottom and top waste material in order to have a minimum of about two feet height in which to work. Some of the rubbish was used to build pack-walls and the remainder had to be sent to the surface. A great deal of timber had to be used.

[1] *Phil. Trans. Roy. Soc.* VII, 119. [2] *Do.* VI, 421-4.
[3] Lowthorp, *Phil. Coll.* II, 368.
[4] *Radstock Portion of the Somerset Coalfield*, (1864), 9-14. The authors apparently relied on the evidence of the older mine workings and of the older miners.

At Vobster, where there was an inversion of the strata, some of the seams were vertical and here another device of the lead-miner was used. That is to say, the workman removed about six feet high of coal for a distance of twenty to thirty yards in length, then returning and getting on top of the timber to remove another layer, and so proceeding as far upwards as the coal extended.

In later years the width of the heads increased from thirty to something like three hundred yards, so that several dozen men could be employed in them at once ; and the distance of the coal face from the shaft increased (at Timsbury and Camerton it exceeded 600 yards with certain seams by the 1830's). However, in general these conditions of working persisted in Somerset throughout the first half of the nineteenth century.

Ventilation

Twyford had a great deal to say about the difficulties of ventilation in Somerset pits about the year 1700. Usually one shaft was sunk first, but if the air was bad ' they sink another pit about six yards distant on the same course as near as can and cut a line of communication from one pit to another to give air or else . . . they put down trunks . . . to let the air to the nose of the shides or pipes and so carry the air into the lanes '. If the air of the pit was still poor, an iron basket was filled with burning coals and lowered about ten yards into the mine to ' draw the stenched or stagnant air from the bottom and lanes '. Sometimes the air shaft was regulated by ' a board and turfs '. ' To their grass turf they have two doors—they shut that which the wind bloweth against and open the other and they change their turfs over the air-pits against the wind '. Another method was to use fans and force the wind into the trunk-holes, but this was ' not well approved of '.

Just before this time, certain members of the Royal Society had begun to take an interest in the phenomenon of fire-damp in mines ; and the characteristics of the pits in the southern part of the Somerset coalfield were the subject of an account by Mr. John Beaumont of Stone Easton—surgeon, geologist and explorer of Mendip.[1] According to him the pits most subject to ' fiery damps ' were those in the vicinity of Coleford, Vobster and Mells.

1 Lowthorp—*Phil. Coll.* II, 381-2.

' There is much working in this running and Fire Damps continually there happen, so that many men of late years have been there killed, many others maimed and a multitude burnt ; some have been blown up at the pit's mouth ; the turn-beam (which hangs over the shaft) has been thrown off its frame by the force of it ; and those other effects, whereof you had an account from other places, are generally found '.

In addition to the precautions mentioned by Twyford to ' keep the air quick ' Beaumont quotes another expedient of the Somerset miner to reduce the risk of an explosion. ' They use candles in their works but of a single wick, and those of 60 or 70 to the pound, which nevertheless give as great a light there, as others of 10 or 12 to the pound in other places ; and they always place them behind them and never present them to the breast of their work '. It must be remembered that until the advent of the safety lamp each miner was given an allowance of candles at the beginning of each shift and he was also equipped with a simple candleholder consisting of a small metal cylinder with a long spike projecting from one side of it, so that the holder could be wedged into a rock crevice while the miner was at work.

Should explosions cause burns, and this was a frequent occurrence at the beginning of the seventeenth century, ' the usual method they observe in their cure is this ; they presently betake themselves to a good fire, and sending for some cow's hot milk, they first bathe the burnt places with that ; when they have done this awhile they make use of an ointment proper to such burnings which the Masters of the works have always in readiness for such chances, being furnished therewith at the cheap rate of 12*d.* a pound by a good old woman living near the works '.

It is interesting and perhaps unusual to find a coalmaster at this time showing such concern for the physical welfare of the workmen in his employment.

Firedamp was discovered to be most prevalent in the winter, especially when there was a ' black ' frost, and this was the season when the mines were worked most. Fatalities were frequent, but the smallness of the pits prevented them from reaching large-scale proportions. In December, 1773, four men were killed at Vobster when a ' vaporous damp suddenly broke forth ', and eleven men were killed at Old Breach, Vobster, in 1800 ; but the newer collieries in the northern and central sectors of the coalfield were relatively

free from the perils of gas. Nevertheless, after 1800 the presence of ' foul air ' was increasingly noticed and commented upon in the Somerset area. The Report of the Child Employment Commission in 1842[1] pointed out that there was only one hewer at Coal Barton over sixty years old and very few over fifty, attributing the fact that miners were not long-lived to their aptness ' to get asthmatical from the gas and foul air '. Miners' asthma or ' tight breath ' as it was commonly described in those days was undoubtedly the same disease as pneumoconiosis, a particularly serious problem in this coalfield to-day.

Drainage

The invention of elaborate machinery to assist underground working was originally connected, not so much with the extraction of the coal, as with the difficult problems of drainage and haulage. The first of these, which like the second became more acute with the increasing depth of the mines, was eventually the spur responsible for the most important technological advance in the history of the industry—namely the introduction of steam power.

In the earliest times, a ditch or drainage channel was adequate for ridding the workings of water ; for example, Robert Horner had an ' unscoured ditch ' at his coal-pit in Kilmersdon in 1437.[2] As long as the veins worked were above the level of the valleys in the neighbourhood, adits or levels could be driven from the mine into the nearest valley bottom. The longest and most ambitious level constructed in Somerset was driven in 1791-2 from the Grove and Tyning works at Timsbury to Radford Bridge, at an initial cost of £1,200.[3] It was later extended to serve the Hayeswood pit and in all was about a mile and a half in length.

Pumps were employed from the early years of the seventeenth century. In 1610 it was recorded that the miners at the Holmes at Stratton had ' latelie found meanes with much facillitie to exhaust the water though with great charge, namelie with pumpes, whose wheeles are moved by the fall of a streame conducted to the same which cannot be brought to the service of the Barrowe so far surmounting the level '.[2] The Barrow was a nearby pit not in production at that time ' by reason that the springs are soe superfluente '.

[1] Vol. III, 47ff.
[2] *P.R.O.* Court Roll 198/50.
[3] Society of Genealogists—Timsbury deeds.
[4] *P.R.O.* L.R. 2/207, fol. 9-10.

In 1617 at Benter the problem of drainage was solved less expensively, and less legally, by James and Clement Huish.[1] They, with some partners, conspired to take advantage of a mill (*i.e.* a pump) that had already been set up in the vicinity by Richard Burke to draw water from his own workings ; and they ' soe worked underneath the earth that they caused the water to run into (Burke's mine) whereby the mill wheel might draw the water of both '. Unfortunately for all concerned Burke's mine was ' utterly drowned ' and litigation ensued.

In 1641 Richard Coysh, a carpenter of Stratton, alleged that William Long had felled one hundred oaks on some of the lands of the parish—timber that had been used for repairing the pump wheels of the Holmes pit.[2] Not long afterwards Long seems to have diverted the course of a surface stream ' out of its ancient course into his own land ', enabling him to drive a pump mill to draw the water away from his coal-works.

Sometimes several pumps were necessary for the drainage of one pit ; at the Breach, Vobster, for instance, there were four mills, two at the east end of the working and two at the west end.[3] These drew about 50 yards deep, but despite this there was so much water to be disposed of that the ' mills could not discharge and so Mr. Sallmon that had a lease for lives on it was forced to quit the work '. At Cornish's mill the water was carried away by means of ' shutes made of elm board stood upon trees about ten feet high as the ground was '.

The manufacture of pump wheels was a skilled local craft and in Twyford's time men like Tyler of High Littleton had a reputation for skill at this work.[4] The dimensions of the pump wheel used at Mr. Brewer's work at Paulton in 1700 were 8 feet diameter, with two cranks and water troughs 20 inches broad and ten inches deep It drew water from a depth of about 17 fathoms. On a larger scale there was the wheel at Stowey, where the head of the water came into troughs about 80 yards distant from the wheel. The troughs or shutes were 16 inches wide and 13 inches deep and the diameter of the wheel was 30 feet. On the other hand there was a hand pump in operation at Stratton in a pit called Atkin's Gout, which drew ' 15 to 16 yards with one hand at a time but another stood by

[1] *P.R.O.* Chanc. Proc. Jas. I.B.20/72.
[2] *P.R.O.* L.R. 2/207 fol. 138-46.
[3] v. Twyford.
[4] v. Twyford.

whilst one pumped 100 or 200 or 300 strokes and as they could agree they exchanged and took by turns '.

In 1800 and after similar pumps, worked by manpower, horse-power or waterpower, were still employed in various parts of the coalfield. The lease of Welton Hill Colliery in 1813 gave permission to the lessees to use streams ' for the purpose of driving any wheel or wheels or for draining or drawing the water from any pit or pits hereafter to be made '.[1] In the 1850's there was a bucket-chain, driven by a fall of water, still used at Coal Barton ; and as late as 1867 there was one waterwheel left in the Nettlebridge valley.[2]

Loss of life occasionally accompanied the menace of ' drowned workings '. The worst disaster of this kind in Somerset occurred in 1845 at the Hayeswood pit, Timsbury, when an irruption of water from old workings cost the lives of eleven workmen.[3] In the same decade water broke into Newbury pit,[4] again from old workings (which at that time were uncharted and often unknown) and completely flooded it, though fortunately no hands were underground to face the danger. Loss of production was frequent, and in some instances led to the closing down of relatively prosperous pits. Water was the cause of the closing of Dunkerton, Amesbury's and Sweetleaze collieries, all in the first half of the nineteenth century.

Nevertheless, even in the early part of the eighteenth century the inadequacies of the pumping machinery then in use were driving British engineers to evolve new means of power capable of dealing with the drainage problem ; and the successful outcome of these experiments was the Newcomen atmospheric engine. According to Greenwell and McMurtrie the first atmospheric installed in a Somerset pit was that at Paulton Engine in about 1750 ; but they do not give the source of their information and there are no records of this engine's structure, performance or working life. However, there are passages in Twyford's notebooks, written in the first years of the eighteenth century (though the actual date is not clear from the context) which reveal that he, at any rate, had recognised the possibilities of the use of steam power, although he does not specifically mention the existence of any atmospheric engines in Somerset during his lifetime. In a section devoted to the description of pumping engines he notes : " There are fire

[1] *Cholwell MSS.* [2] Brice—*The Coalfield of N. Somerset*, 70-1.
[3] Timsbury Minute-books (see above). [4] 1871 *Comm. Rep.* I, 43.

engines to force water and some like smoaky Jacks ', and again, ' Engines now invented by Fire as a smoaky Jack so contrive in some places (to) draugh water and clear the stanch air '. One part of his notebook is given up to drawings of various kinds of contemporary engines, including one ' that beats the piles at London Bridge ', another ' to draw silk wire ', several hand-driven or horse-driven pumps ' neer Mr. Strachey ' (at Bishop Sutton ?) and belonging to Mr. Holland at Amesbury (Timsbury), and one entitled ' an Engine to force by Fire and draugh water allso '. This last-named drawing bears no relation to anything that was produced by Newcomen or Savery, but might well be a copy of an earlier experimental type, such as the unsuccessful high pressure engine invented by Sir Samuel Morland somewhere about 1685.

After 1780 steam pumping engines came gradually into general use in Somerset. One of the most noteworthy was that erected by Jonathan Hornblower at Radstock in 1782. This was the first full-scale engine built by this former employee of James Watt on a compound engine principle. It had two cylinders—one 19 inches in diameter by 6ft. stroke and the other 24 inches in diameter by 8 ft. stroke. After various teething troubles it was got to work in the autumn of 1782 and was the prototype of nine or ten more erected later, mainly in Cornwall. Watt complained that it was an infringement of his patent of a double-cylinder engine and an agent was sent to Radstock to investigate. He found it closely guarded, but later Watt reported that it was ' obliged to stand still once every ten minutes to snore and snort ' and that ' when they have got a very strong steam it will make twenty-one strokes in three minutes, but then comes to rest, and must stand five minutes before it gets strength enough to make another stroke, and all the while they must fire away as hard as ever they can, otherwise it will not work at all '. He informed the colliery proprietors at Radstock that he considered the engine to be an infringement of his patent and the whole matter later became part of the lengthy litigation that involved the Hornblowers, Boulton and Watt in the last years of the eighteenth century.[1]

The New Tyning work at Timsbury, begin in 1791, was equipped with a steam engine and in 1793 a proposal was accepted ' that a

[1] Descriptions of this engine are contained in the standard biographies of Watt, by S. Smiles, Muirhead and H. W. Dickinson.

communication should be made in the Great Vein and also in the Little Vein under the same from the New Tyning Engine Pitts to the New Grove Pitts in order to draw what water may be found in the New Grove Colliery by means of the Steam Engine at the New Tyning work '.[1] In this way one pumping engine was used to drain two neighbouring pits. A pumping engine was erected at the Upper Writhlington work by J. Nash in 1805 and another was started by J. Bond at Huish in September, 1821 (though two years later it was used to haul coal).[2] Lower Writhlington originally had three pumps—the top one, a 12-inch pump, drew 20 fathoms, the middle one, 10-inch, drew 32 fathoms and the bottom one, 10-inch, drew 37 fathoms. Paulton Foundry, adjoining the Engine Pit, was in the first half of the nineteenth century the source of much of the pumping equipment and of one or two engines (including the water engine at the Conygre work, Timsbury).

Underground Haulage

The development of underground haulage reflects the reluctance of the Somerset collier to replace the methods current before 1800 with labour-saving devices and with steam power. Up to 1800 the coal was brought from the coal-face to the main roadway in ' puts ' by carting boys. The ' put ' was comparable to the Northern corf —simply a sledge frame with iron pins fixed at regular distances round the upper edge, and the pins were wreathed with hazel rods. Empty it weighed about 60 lb. and according to size and the nature of the workings in which it was used it carried a load of from three to six hundredweights.[3] Hauling the put was physically exhausting and not without an element of danger. Drawn over rough and uneven ground, with no more light than the flicker of a candle and no mechanical help over a route sometimes 70 to 80 yards in length, the put was a clumsy and primitive contrivance. The carting boys were harnessed to their load by the ' guss and crook '. The ' guss ' was a heavy rope or leather belt that fastened round the waist ; unless it was fitted absolutely skin-tight, discomfort could be unbearable. To it was attached an iron chain (the ' tugger ') and hook, which was connected to the put. The boys worked barefoot,

[1] Articles of Partnership for Timsbury works (*Cholwell MSS.*).
[2] Survey notebooks (Timsbury—see above).
[3] Greenwell and McMurtrie describe early haulage equipment in their pamphlet, and the life of a Somerset miner is summarised in another pamphlet, Jonathan Presto's ' Five Years of Colliery Life ' (Manchester, 1884).

for although the hardening of the soles of the feet might take a month or two, this was the best guarantee of a sure foothold on the rough and loose surface of the underground passage. The danger of falling stones (' bell-moulds ' in local parlance) encouraged the wearing of a padded basin-shaped hat made of thick material. If clothes were worn at all, they consisted of canvas trousers with two buttons to secure them at the waist.

In the main roadway the coal might then be transferred to a larger container, called a ' wreath-cart '. This was circular, about two feet in diameter and two feet deep. It had a strong wooden base with iron pins bolted at regular intervals through the rim. These were interlaced with hazel rods and on top of them was rivetted an iron rim, to which a strong iron hoop could be attched. This could then be hooked to the pit rope. Haulage was done by boy-power, manpower or horsepower. An average-sized pit such as Middle Pit, Radtsock, which in the mid-nineteenth century employed about 150 men and boys, kept between ten and a dozen horses underground.

After 1800 the ' hudge ' gradually took the place of the wreath-cart ; this can best be described as an iron barrel, orignally holding little more than three hundredweights of coal, but later increased in size to hold between half a ton and a ton. Wheeled tubs, conveyed along " bridge-rails " made of wrought iron, eventually ousted the hudge and the put, but this was not until the middle of the nineteenth century.

William Smith made a plan of Mearn's Colliery, High Littleton, after his first tour of the pit in 1792, and his notes on the arrangement of the underground haulage are worth reproducing in full.[1]

> " 1. The pit, 100 yards deep, where the coal is landed by a machine turned by a horse which consists of a large upright axle (and braces) . . . feet high on the upper part of which is fixed a drumwheel . . . feet in diameter and . . . feet thick at the circumference, having a rim or board on its upper and lower edge projecting out and another round the middle which divides it in two parts, round which coils two ropes running over two rollers and two little wheels, . . . feet diameter just over the pitt. To the ends of these two ropes the baskets (called bushells) are hook'd on and as the empty one goes down on one rope, the full one comes up on the other to the top, when the full one is unhooked at the top and the empty one at the bottom and the horse turns and drives the machine the contrary way.

[1] William Smith MSS. (see above). The comments in brackets after the words ' Standing ' and ' Twinway ' are those of the present writer. An inclined plane (' gugg ' when it was self-acting and using two sets of carts) was known in Somerset as a ' stipe ' when it used only one set of carts.

2. A Standing (there were four of these at Mearns at this time) is a place by the side of the bottom of the pitt at the top of the gugg about 8 or 10 feet high where is fixed a windlass (turned by man) with a large balance wheel on it, round the axle of which coils two ropes, to the ends of which are hooked two 3-bushell carts on four low wheels which run up and down the guggs, the empty one going down and the full one coming up at the same time, which is pitcht down in the standing and loaded into the bushell baskets that come down the pitt.

3. A Gugg is a comon road about four feet high and wide and 55 yards long, pitches about 9 inches in a yard. In the bottom lies timber framed together down which are two roads of four rutts made for the wheels of the carts to run in so as to pass one by the other going up and down.

4. A Twinway (between way)—a common road from the bottom of the first Gugg to the standing at the top of the second about four feet high, . . . feet wide and 30 yards long and nearly level. The three bushel carts that are wound up the second Gugg are drawn along here to the bottom of the first by a man down on his hands and feet, bare with a cord round his waist to which is fastened a chain that comes between his legs and hooks to the forepart of the cart.

Employed :— Surface—Haunt loader and veerer (two adults, the latter to unload the baskets and the former to load the waggons).
Coal Hole—One man loading bushel carts.
Windlass—Boy winding and man to unhook and empty carts.
Twinway—One boy bringing carts and hooking on to guggs.

As far as haulage up and down the shaft was concerned, the Somerset mines appear to have been backward in development compared with those of the North of England. The shafts themselves were very narrow—five feet diameter was a maximum in 1800, and the first shafts wide enough to take two cages, those in the Countess of Waldegrave's pits at Radstock, did not appear until after 1850.[1]

Before cages were introduced there were two main methods used by the workmen for descending and ascending the shaft ; these were by ' man-hudge ' and by ' hooker '. The former was the hudge described above with a covered top and a hole at one side. The hooker was merely a loop of rope with a hook attached to it, which could be fastened in the chain at the end of a pit rope. The loop was wide enough to go around a man's thigh and by hanging on to the rope with one hand, ten to twelve miners could descend at one time, strung up almost in the same way as a string of onions. The free hand was used to avoid being dashed against the side of the shaft.

Before about 1850 flat hemp ropes were used, consisting usually of four to six cables, five to six inches wide and one and a quarter inches thick. In 1830 the breaking of such a rope at Paulton

[1] Greenwell and McMurtrie *op. cit.* 10.

Engine Pit was responsible for the deaths of four men and a boy.[1] On 24 March in that year nine men and boys were ascending the shaft when the rope broke. They fell about 50 feet and had about 100 fathoms of flat rope fall on top of them, some part of it from a height of 900 feet. In 1839 at Wells Way Colliery, Radstock, another calamity occurred, when the rope was maliciously cut by an unknown person, and twelve men and boys, the youngest eleven years of age, were precipitated to their deaths at the bottom of the 756 feet deep shaft.[2] The wire rope was introduced about the same time as cage working. For example, a flat rope was used at Conygre until 1854, when arrangements were made to substitute cages for hudges and a wire rope was ordered.[3]

The introduction of guides was another slow process. As early as 1794 William Smith was impressed by what he saw of ' Mr. Cur's sliding rods ' at Hisley Wood and Whitelane Collieries in Yorkshire;[4] but he seems to have brought no influence to bear on the Somerset coalmasters when he returned to High Littleton in order to get this invention introduced there. A generation later Mr. Hollwey experimented with wooden guides at Welton Hill Colliery,[5] yet for some reason or other the idea was abandoned and not revived until 1850, when wooden guides were successfully introduced at Welton Hill and Old Pit, Radstock. The reluctance of some of the colliery proprietors to spend money on such improvements is revealed by the resolution passed at Timbury in 1854, when cages and guides instead of hudges were proposed, ' provided expense does not exceed £250 '.[6]

Until about 1790 the windlass and the ' drum ' (as described above by William Smith) were the only pieces of apparatus used for winding. The latter was commonly worked by two horses and two boys ; the horses, not the boys, were changed every two hours. The efficiency of the process can perhaps be compared with the native Indian's bullock-and-bucket method of irrigating his fields. Waterpower was used occasionally ; and in 1798 Billingsley wrote approvingly of a new water wheel at Old Welton which drew the coals up, ' the use of horses being entirely superseded and consumption of fuel saved '.[7] The latter comment is no doubt a reference

[1] *Bath Chronicle*, 1 April, 1830.
[2] *do.* Nov. 1839.
[3] Timsbury Minute-books (see above).
[4] Phillips—*Memoirs of William Smith*, 12.
[5] Greenwell and McMurtrie, 9.
[6] Timsbury Minute Books (see above).
[7] Billingsley (2nd Ed. 1798) 27.

to the existence of steam engines being used for hauling coal, as distinct from draining water out of the pit workings. Another thing that impressed William Smith on his trip to the Northern coalfields in 1794 was the sight of quite a large number of haulage engines worked by steam power ; for he knew of only one in Somerset at that time, and that was badly constructed.[1] Unfortunately he did not say where it was, but it may have been the engine erected at Old Pit, Radstock, ' about 1800 ', according to McMurtrie. This was inefficient and soon fell into disuse. About 1804 another engine was erected at Middle Pit, and this worked for many years. The Welton Hill lease of 1813 mentioned ' coal employed for any fire engine or steam engine (used either for working of, landing of, draining or drying the coal) '.[2] The use of the Huish engine for hauling coal from 1823 has already been mentioned. But until this time we may assume that the rotatory steam engine, used for hauling coal, was the exception rather than the rule in Somerset collieries.

Summary of Technical Development

The story of technical development in the Somerset coalfield follows the pattern of gradual evolution which a study of the general history of English coalfields down to the nineteenth century would lead us to expect. There are no short cuts to prosperity, no revolutionary inventions, and no quickly-adopted new ideas to disturb the slow progress that takes place. From outcrop to deep working, from pillar and stall to longwall, from forepitch to boring-rod and geological survey, from waterwheel to steam-pump, from put to tub, from hooker to cage—all these changes can better be related to the work of generations than to any one year or decade.

If, however, any comparative judgment is to be made, then it must be that the Somerset mines were technically backward at the end of the eighteenth century and the beginning of the nineteenth century. The opportunity for such comparison occurred for William Smith in his tour of 1794 and his opinion is endorsed by such facts as the narrowness of the shafts, the slower-than-usual adoption of the steam engine, the late introduction of wheels, cages, guides and iron rails, and the reluctance of the coalmaster to risk his limited capital in those improvements which ultimately increase production and reduce costs.

[1] Phillips, *op. cit.* 12.

[2] *Cholwell MSS.* (see above).