

RUNNING OUT OF SUSTAINABLE ENERGY

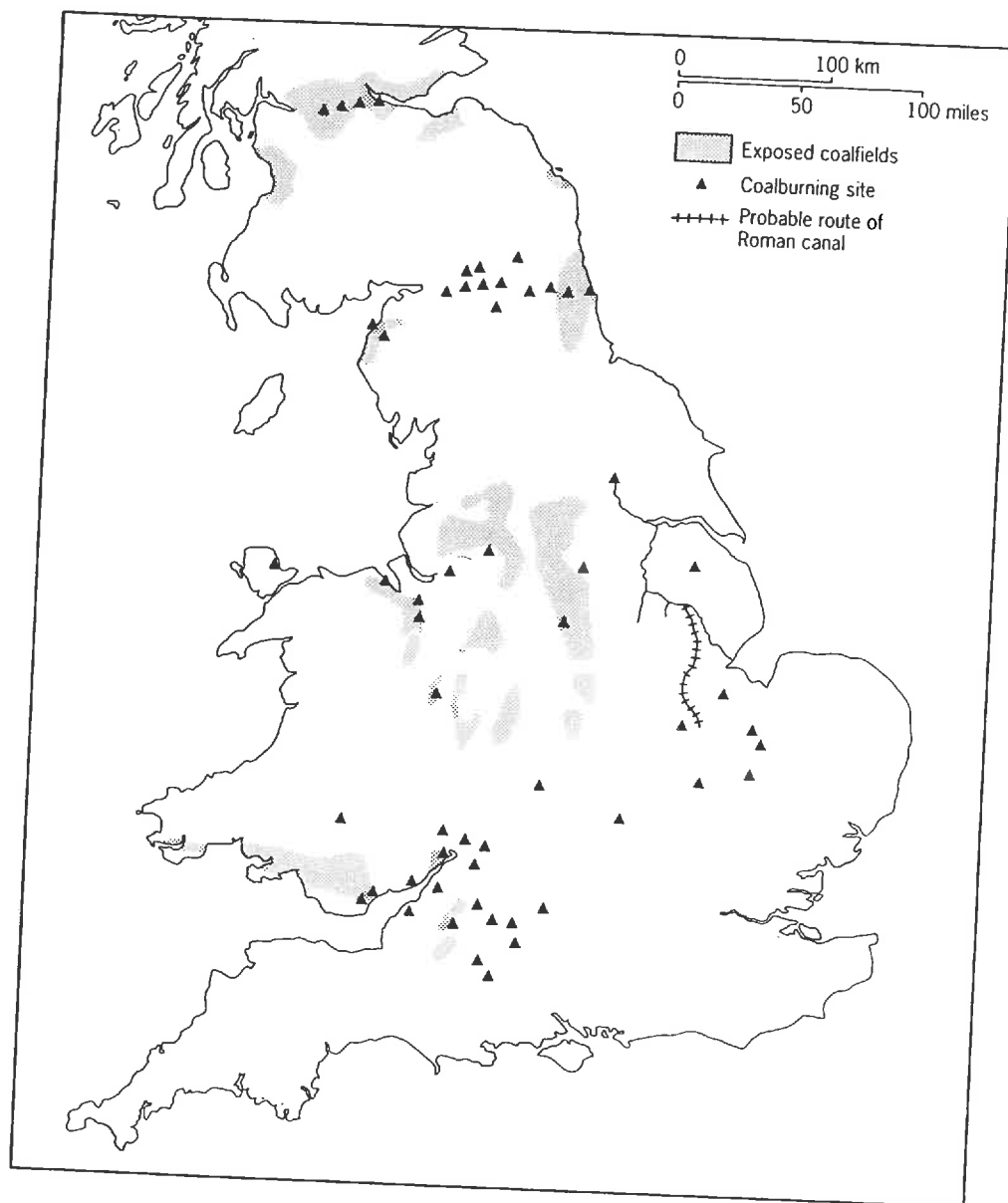
*A History of the Winning and Supply of Coal and
their Role In the Industrial Revolution*

Lecture Notes

Dr David Williams

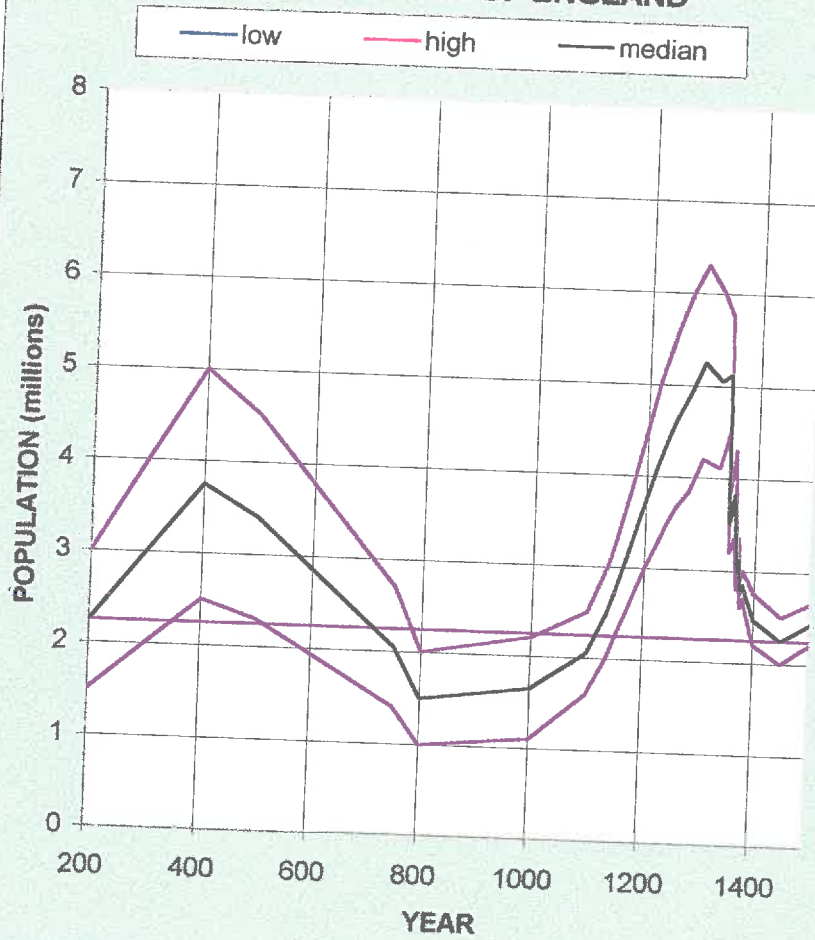
CSIRO

Div of Energy & Technology



Map 2.1. Romano-British coal-burning sites

POPULATION OF ENGLAND



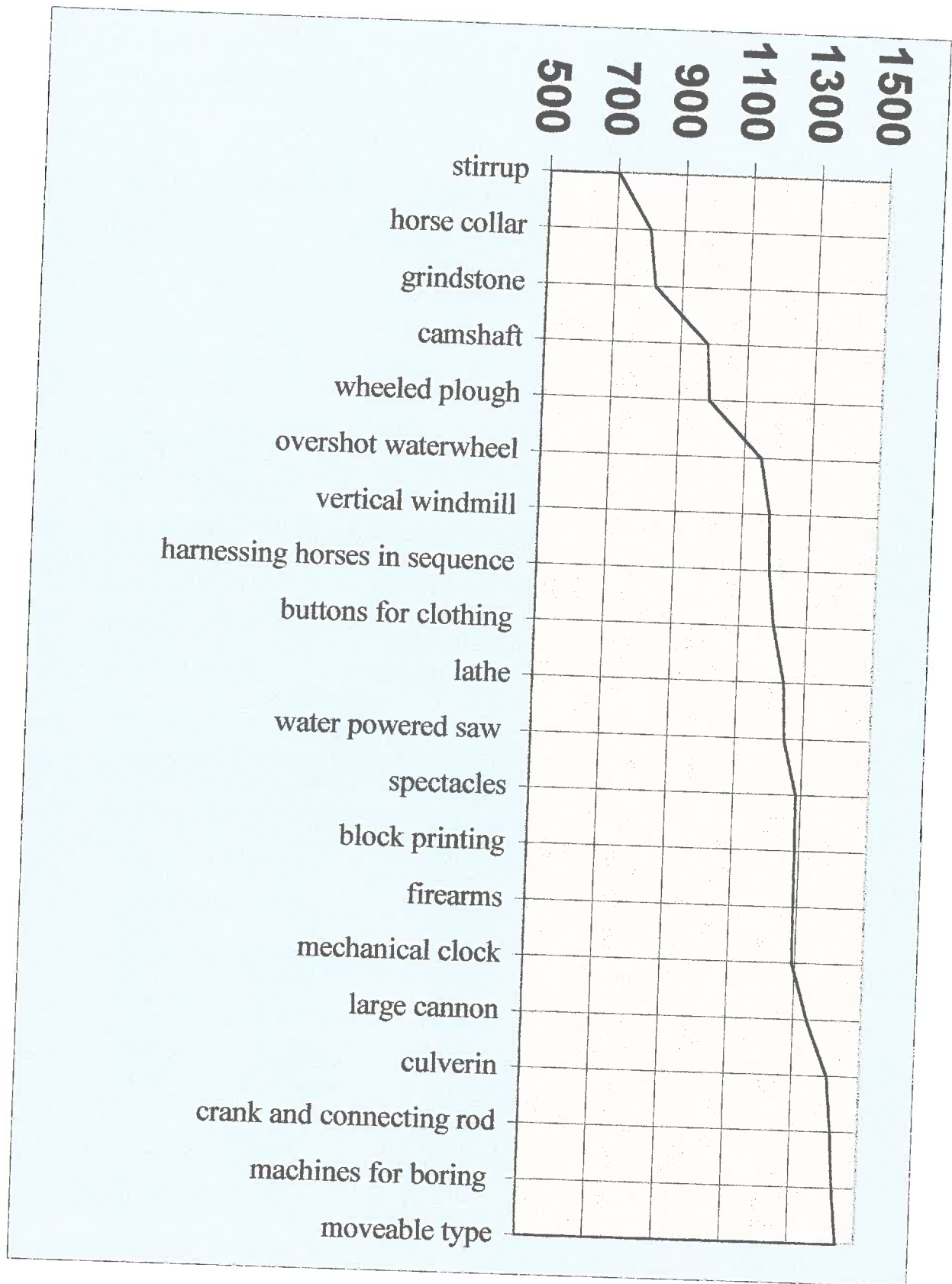
The Demand for Fuel Wood

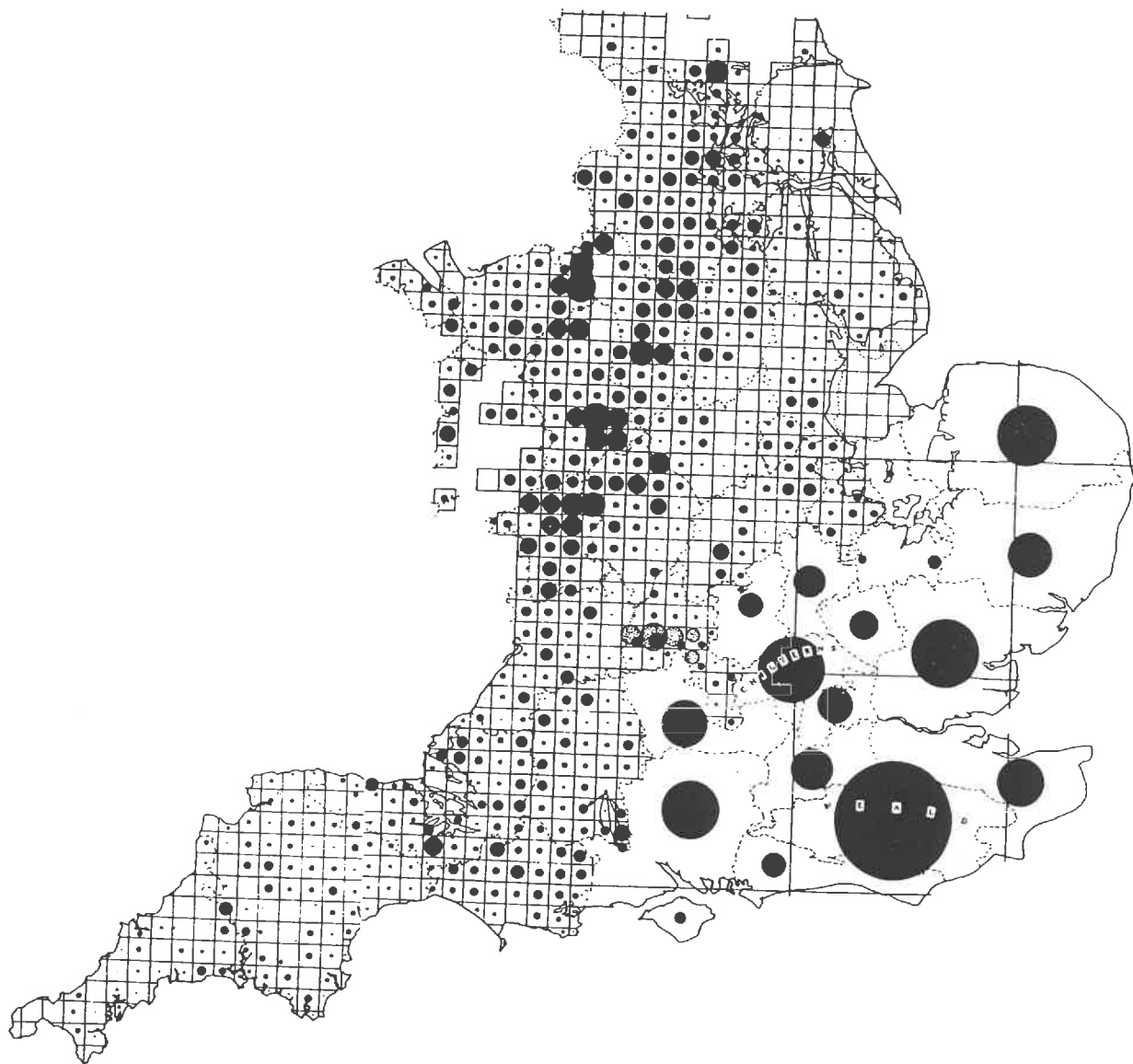
Domestic heating and cooking **1000 kg / annum / capita**
(offset by use of peat)

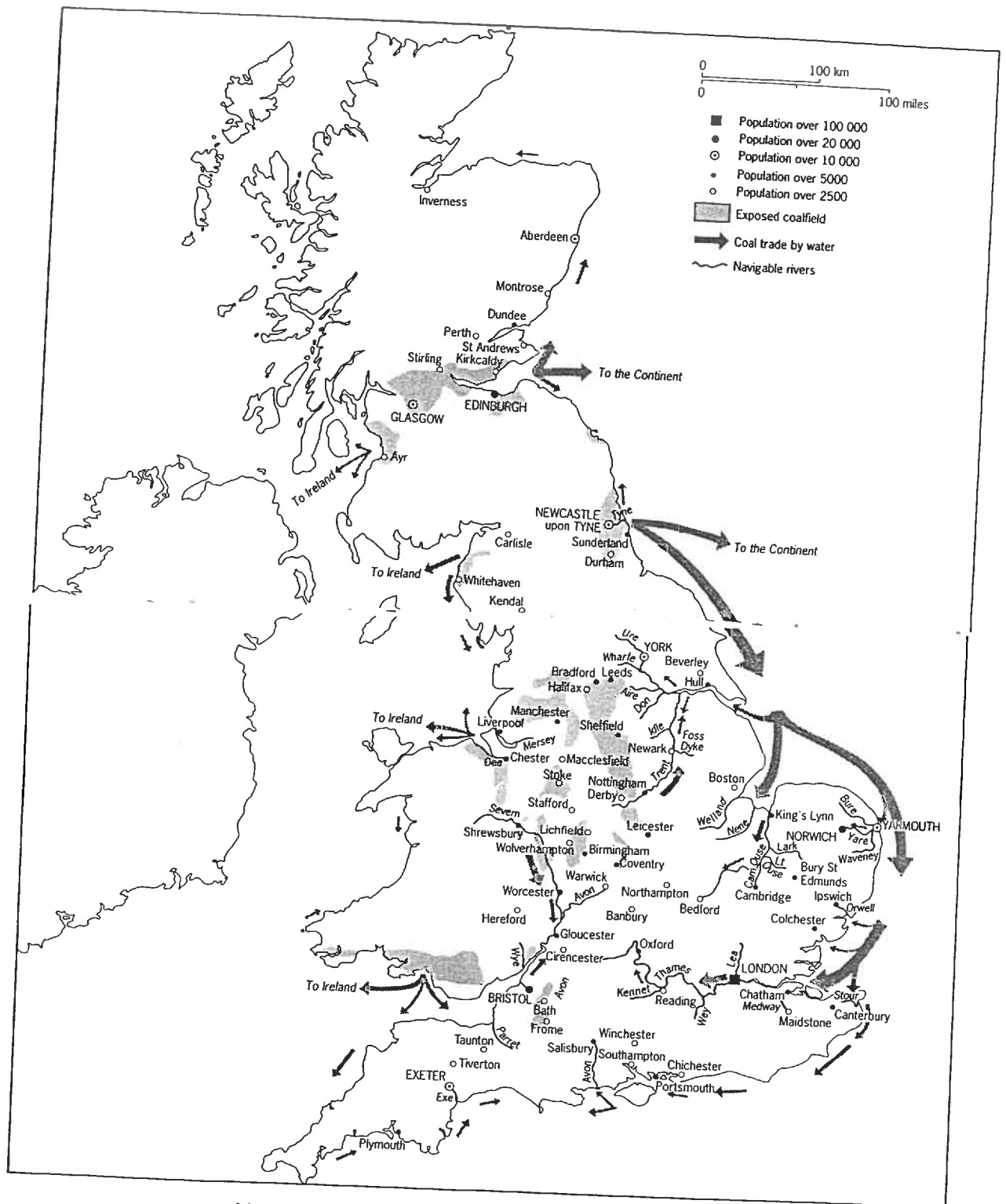
Ironmaking **40 t / t iron**
(could be sustained by 20 ha coppice woods)

Lime cement for castles **20,000 t / castle**

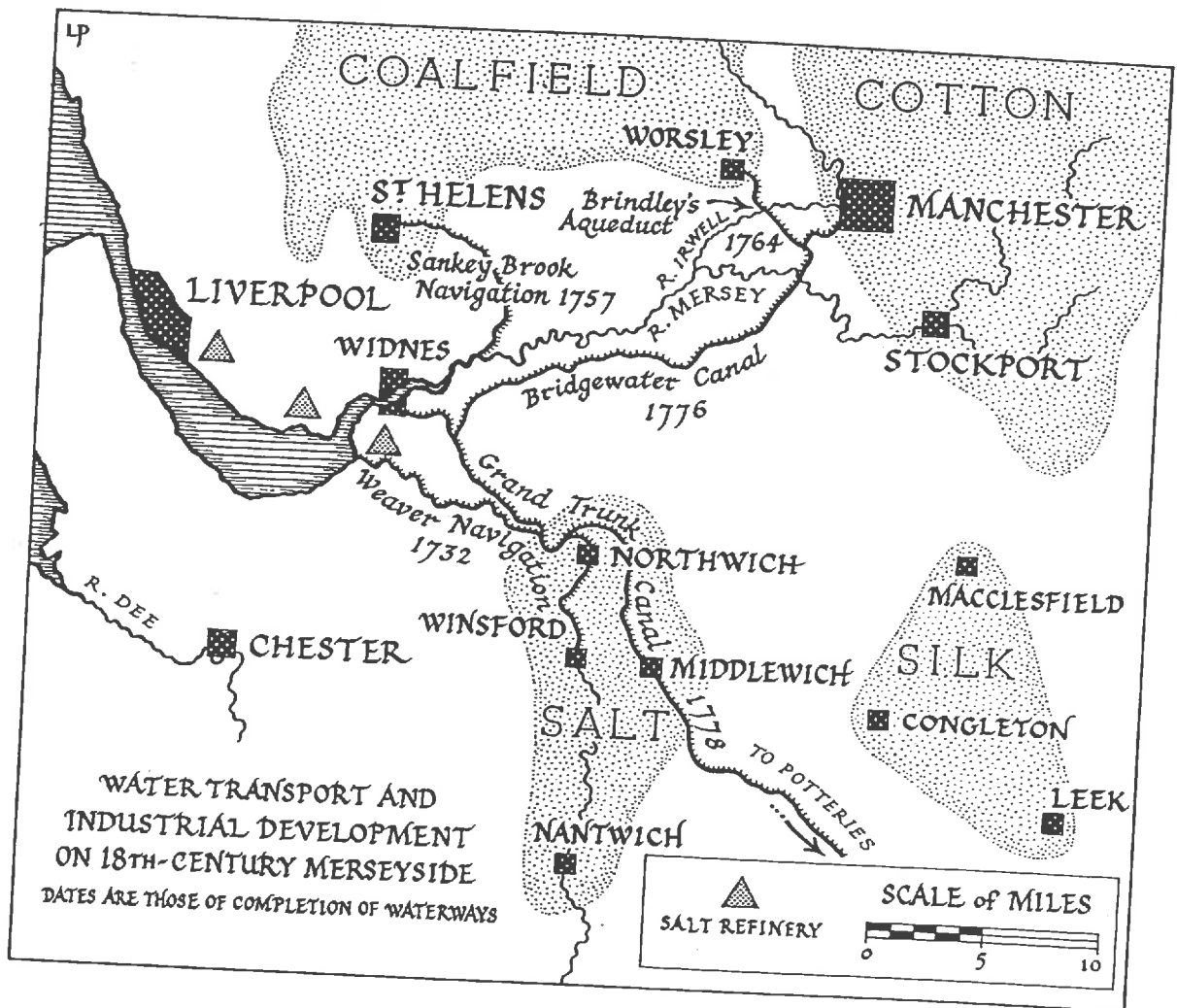
Salt-boiling **15 t / t salt**

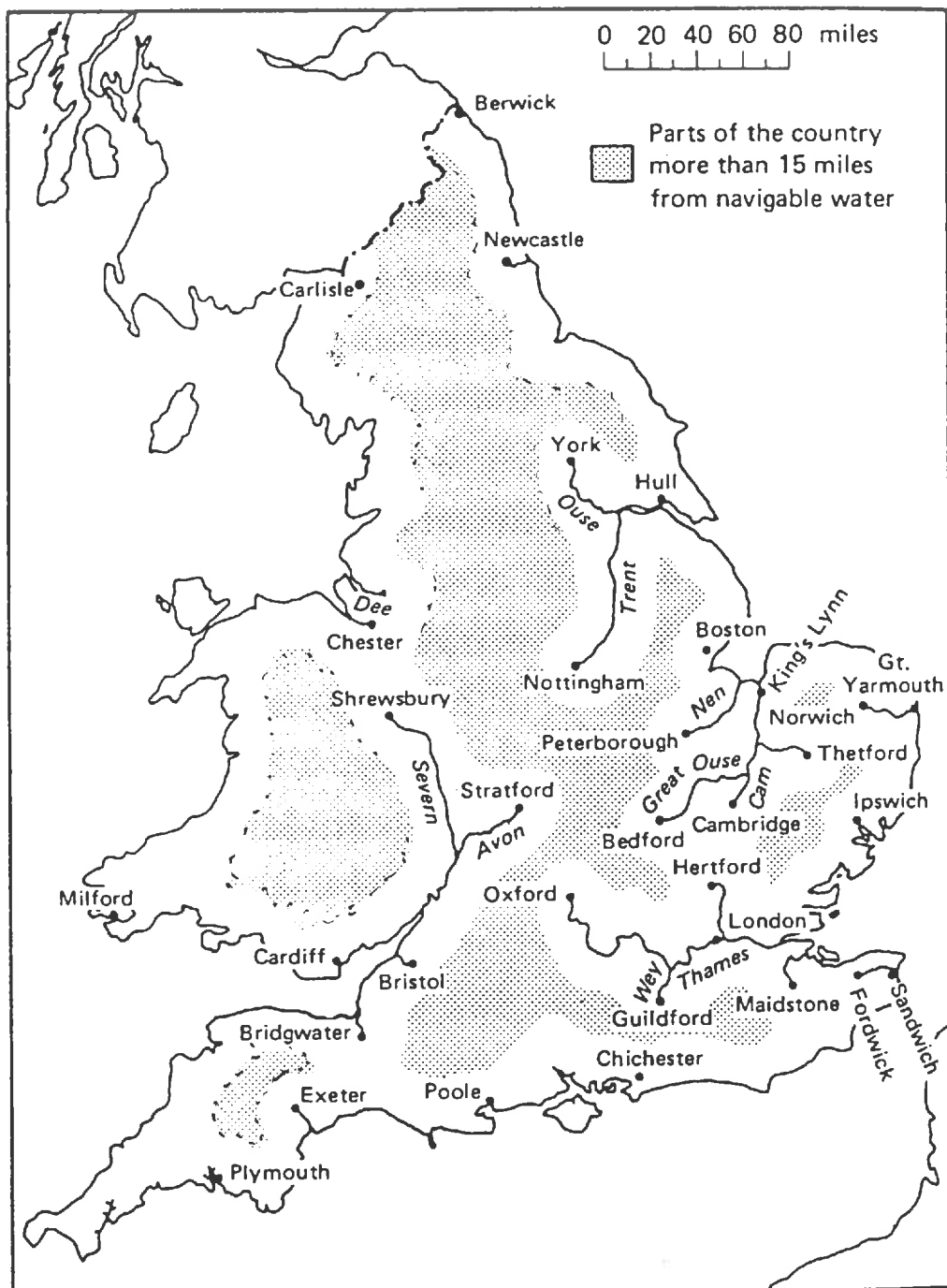






Map. 1.1. Coalfields, principal towns, and navigable rivers, c. 1700

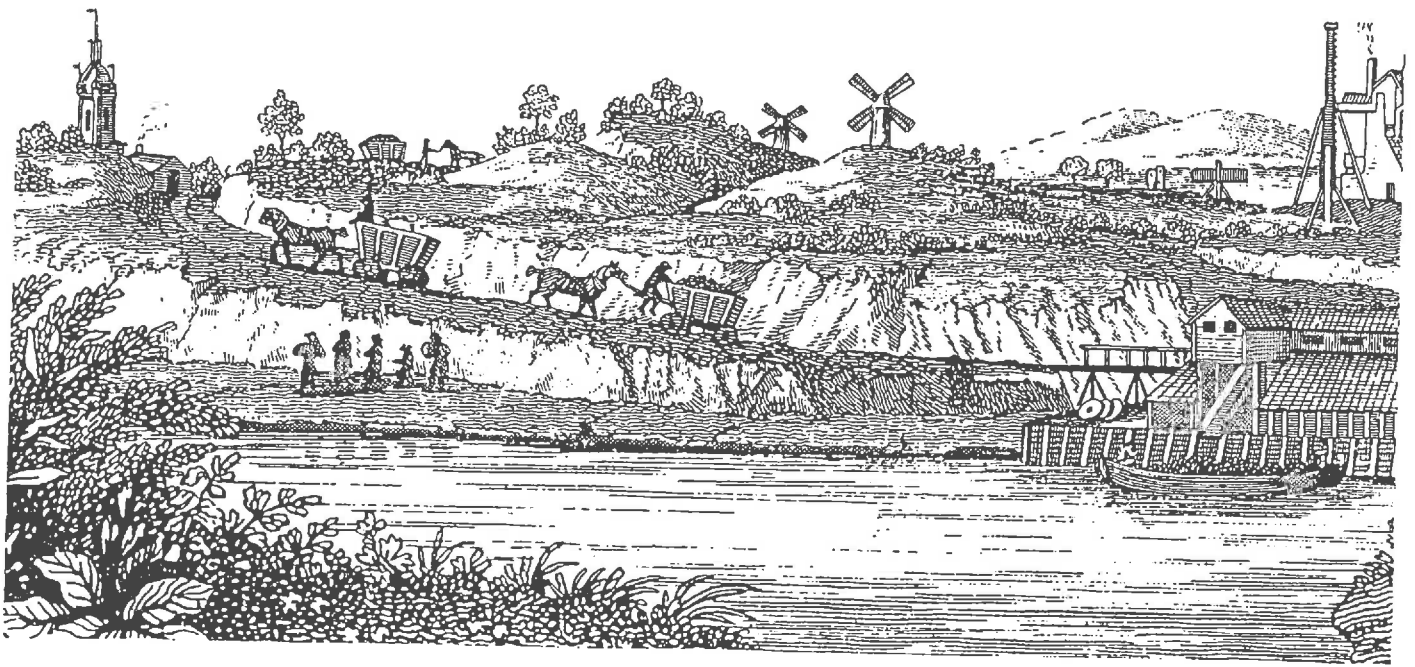




Navigable rivers of England and Wales 1600–60, showing the areas more than fifteen miles from navigable water



*Navigable rivers of England and Wales 1724-7,
showing the areas more than fifteen miles from
navigable water*



A double-track wagon-way shown on part of the engraved title to a "Plan of the Collieries on the Rivers Tyne and Wear," published in 1788 from surveys by John Gibson

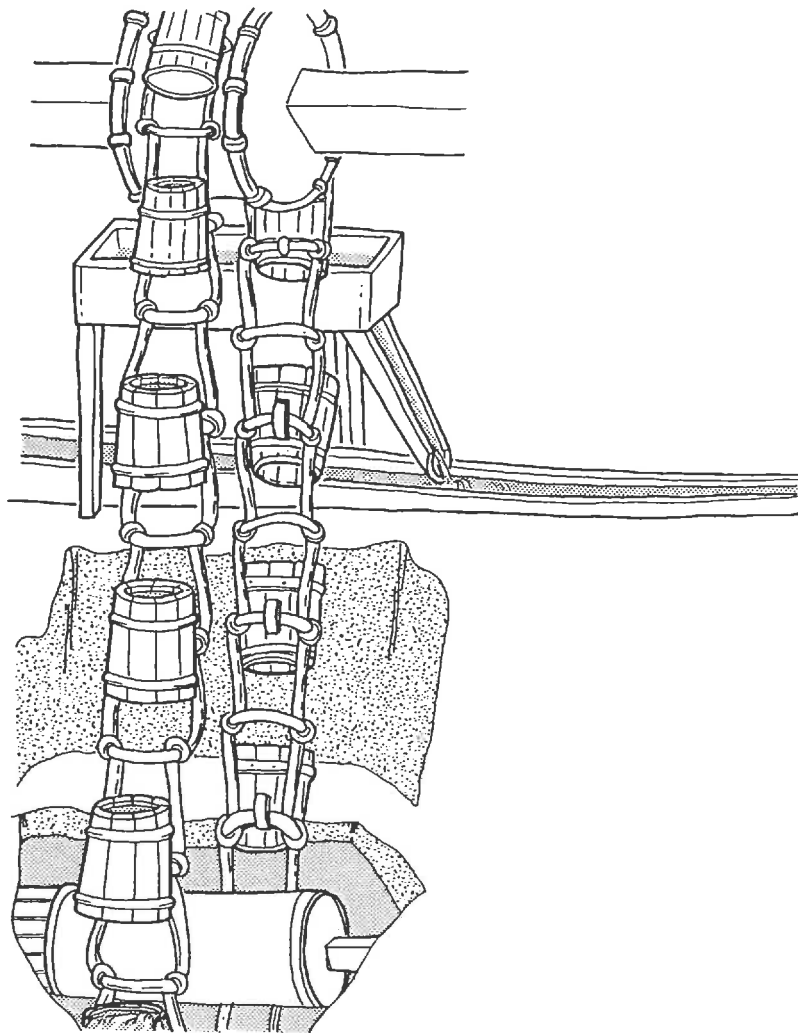


Fig. 6.6. Bucket-and-chain pump (after Agricola, *De Re Metallica* (1556))

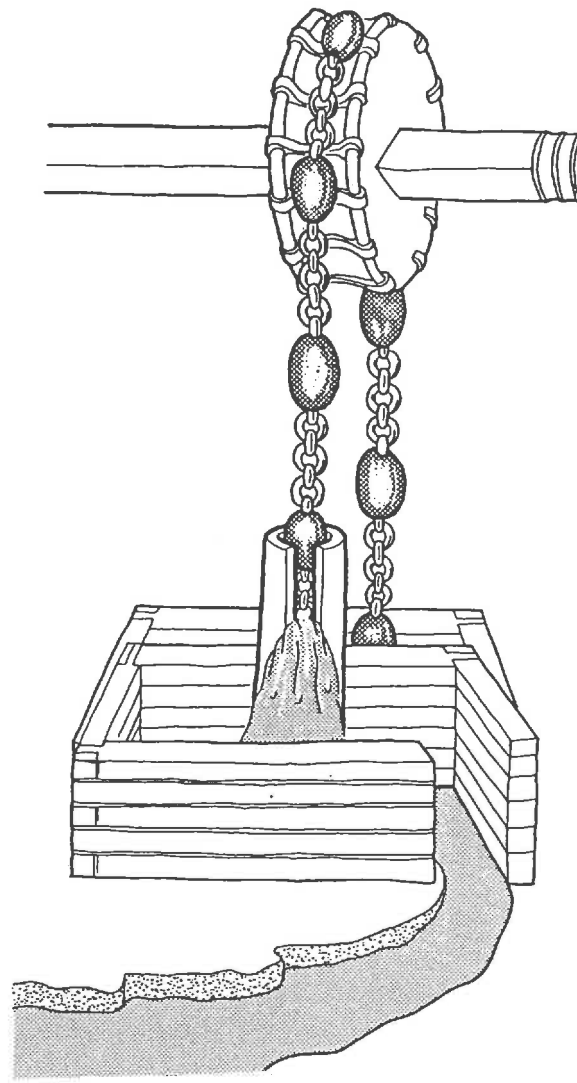
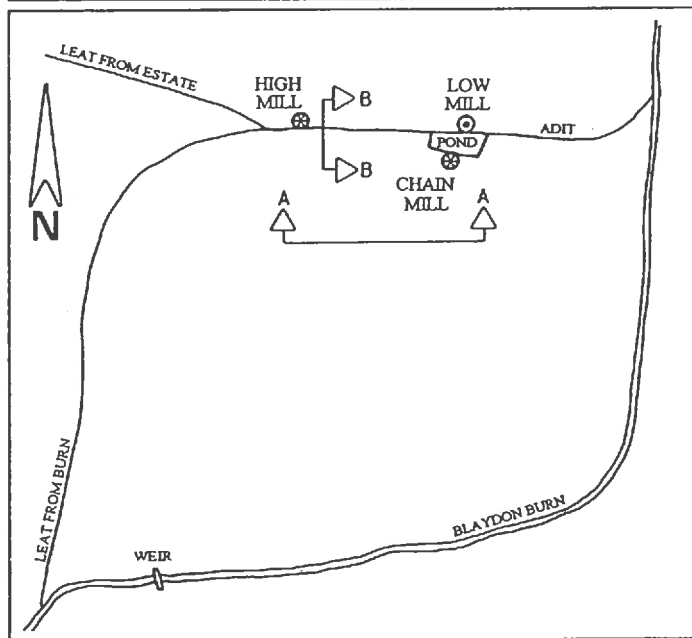
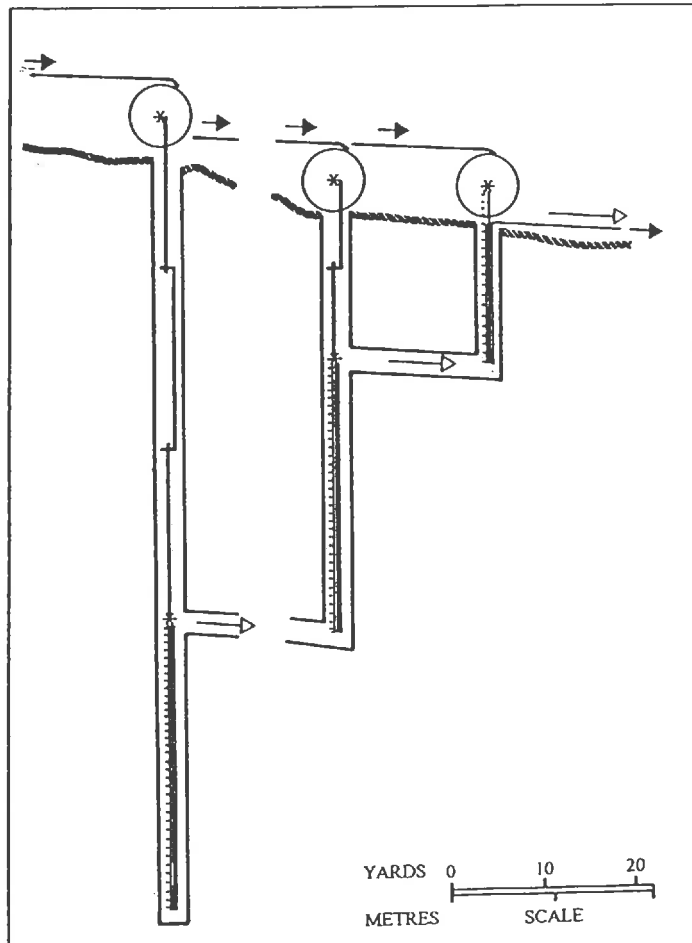


Fig. 6.7. Rag-and-chain pump (after Agricola, *De Re Metallica* (1556))



THE TREBLE-WHEEL COMPLEX
1650-1690

Sir Thomas Liddell,
redevelopment of

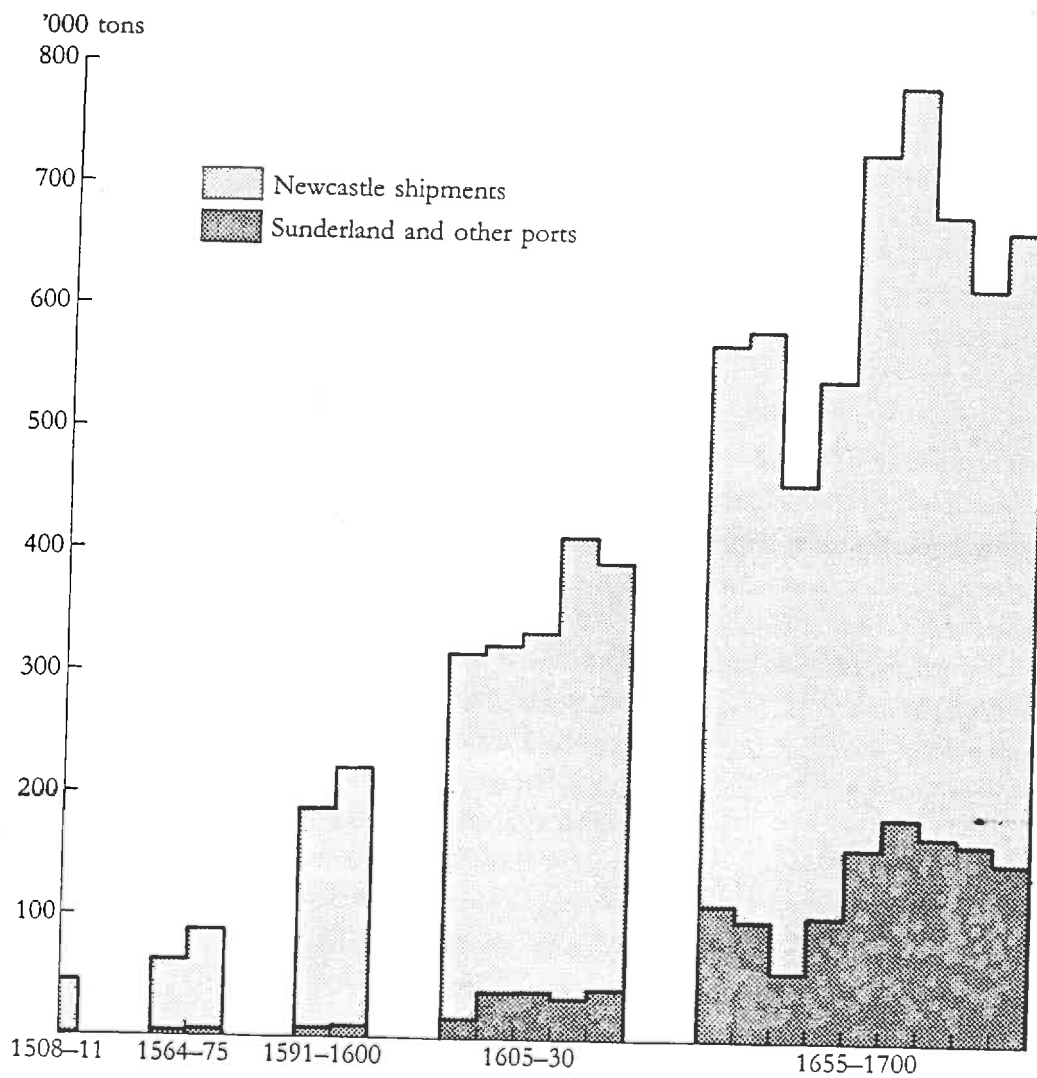


Fig. 3.3. Coal shipments from north-east England, 1508-1700 (in quinquennial averages)

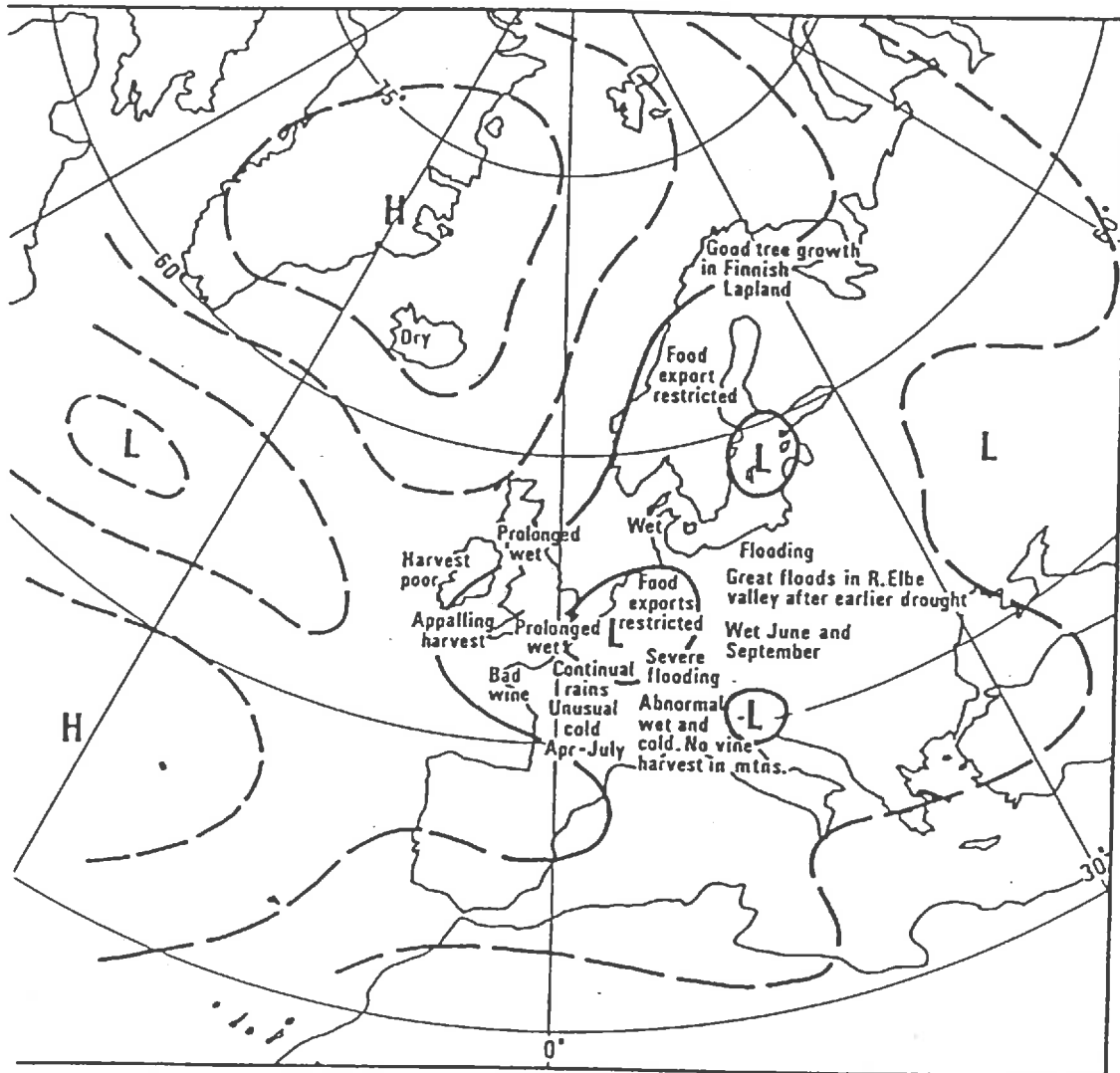


Table 15.1 *The freight and prices of a London chaldron*

	1601	1606	1698-1700
Price on Tyneside	5s. 3d.-6s. 4d.	5s. 3d.-6s. 4d.	4s. 9d.-5s. 9d.
Freight and Newcastle duties	6s. 10d.	—	6s.
Break-even sale price for shippers in London	12s. 1d.-13s. 2d.	13s. 4d.	10s. 9d.-11s. 9d.
London duties	[nil]	[nil]	5s. 10d.
Lighterage, wharfage, and metage	1s. ^a	1s. ^a	4s. ^b
Minimum cost price to London merchants	13s. 1d.-14s. 2d.	14s. 4d.	21s. 7d.-22s. 7d.
Average price paid by Westminster College, including delivery	13s. 10d.	18s. 9d.	23s.-30s.
(Minimum delivery charge to Westminster College)	1s	1s.	2s. 6d.

Table 4.1 *The estimated output of British coalfields from 1560s to 1690s*

Area	1560s (tons)	c. 1700 (tons)	Growth rate (fold)
North-east	90,000	1,250,000	14
Scotland	30,000	300,000	10
Cumberland	2,000	40,000	20
Lancashire	7,000	80,000	11
Staffordshire	15,000	150,000	10
Shropshire	12,000	230,000	19
Warwickshire	3,000	45,000	15
Forest of Dean	5,000	50,000	10
Bristol	5,000	60,000	12
Somerset	3,000	30,000	10
Leicestershire	5,000	40,000	8
Nottinghamshire/Derbyshire	15,000	75,000	5
Yorkshire	15,000	150,000	10
South Wales	15,000	100,000	7
North Wales	5,000	40,000	8
TOTAL	227,000	2,640,000	12

Note: Output figures are of necessity estimates of coal produced for sale, and do not include small-coal waste, colliers' allowances, coal burnt at the colliery, etc.

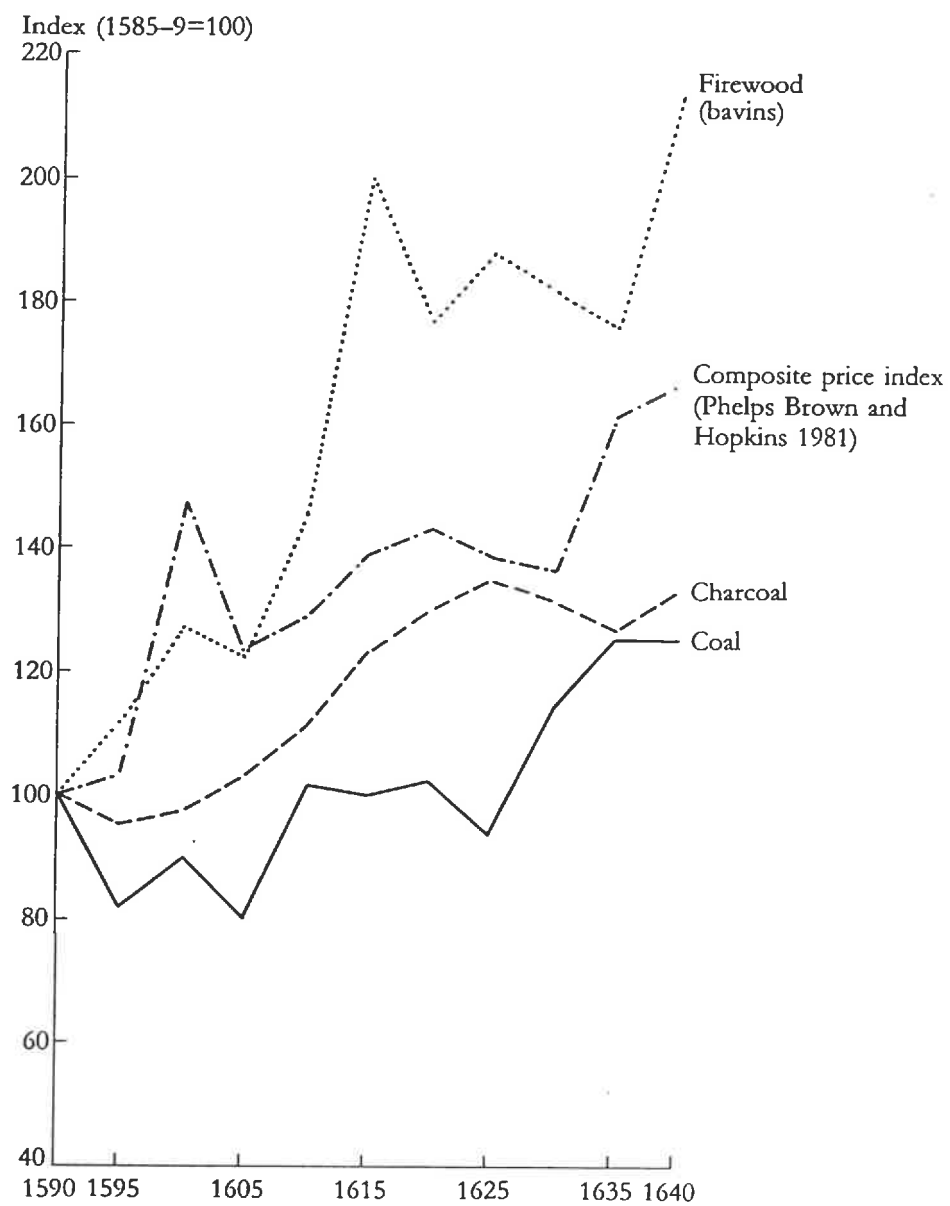
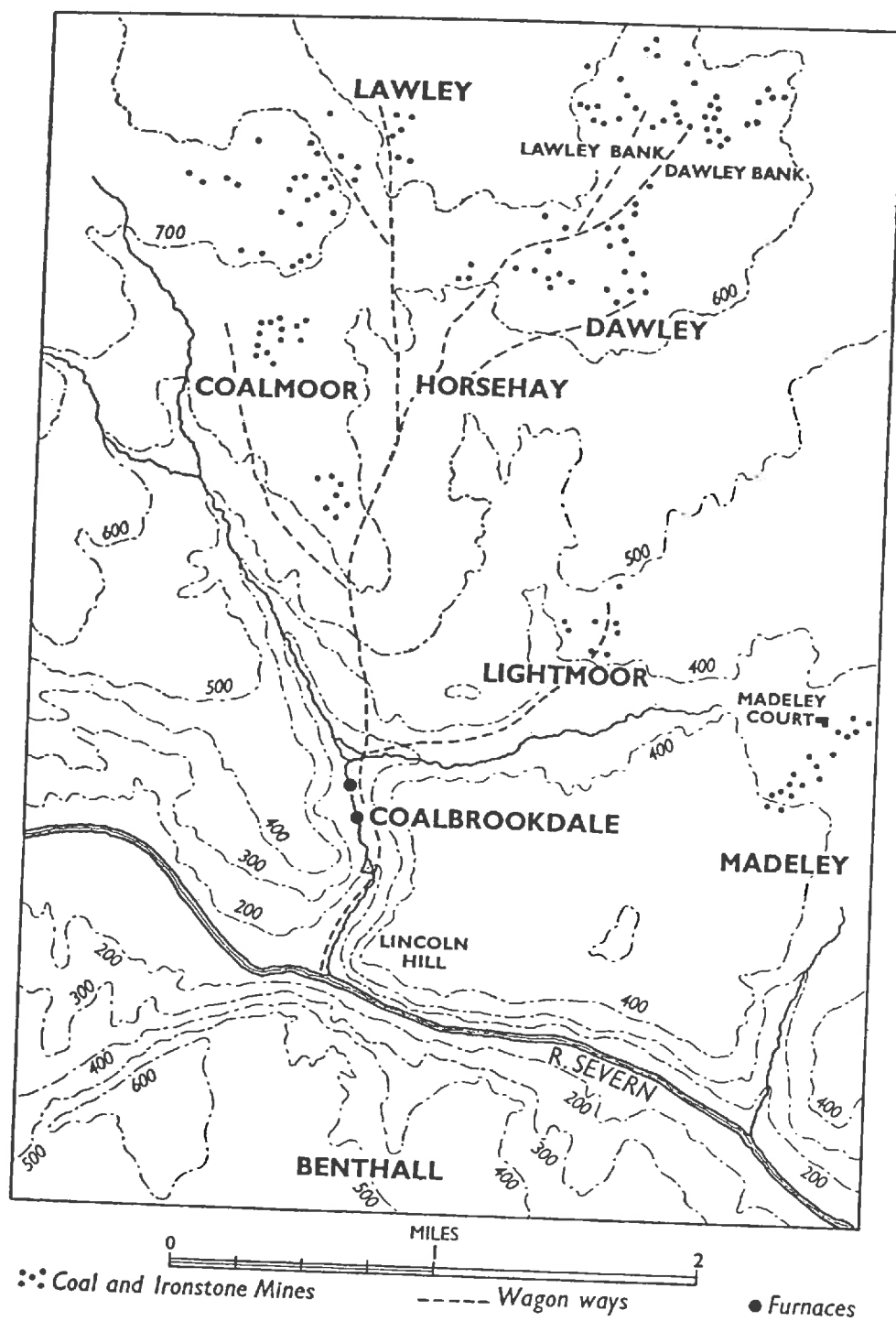
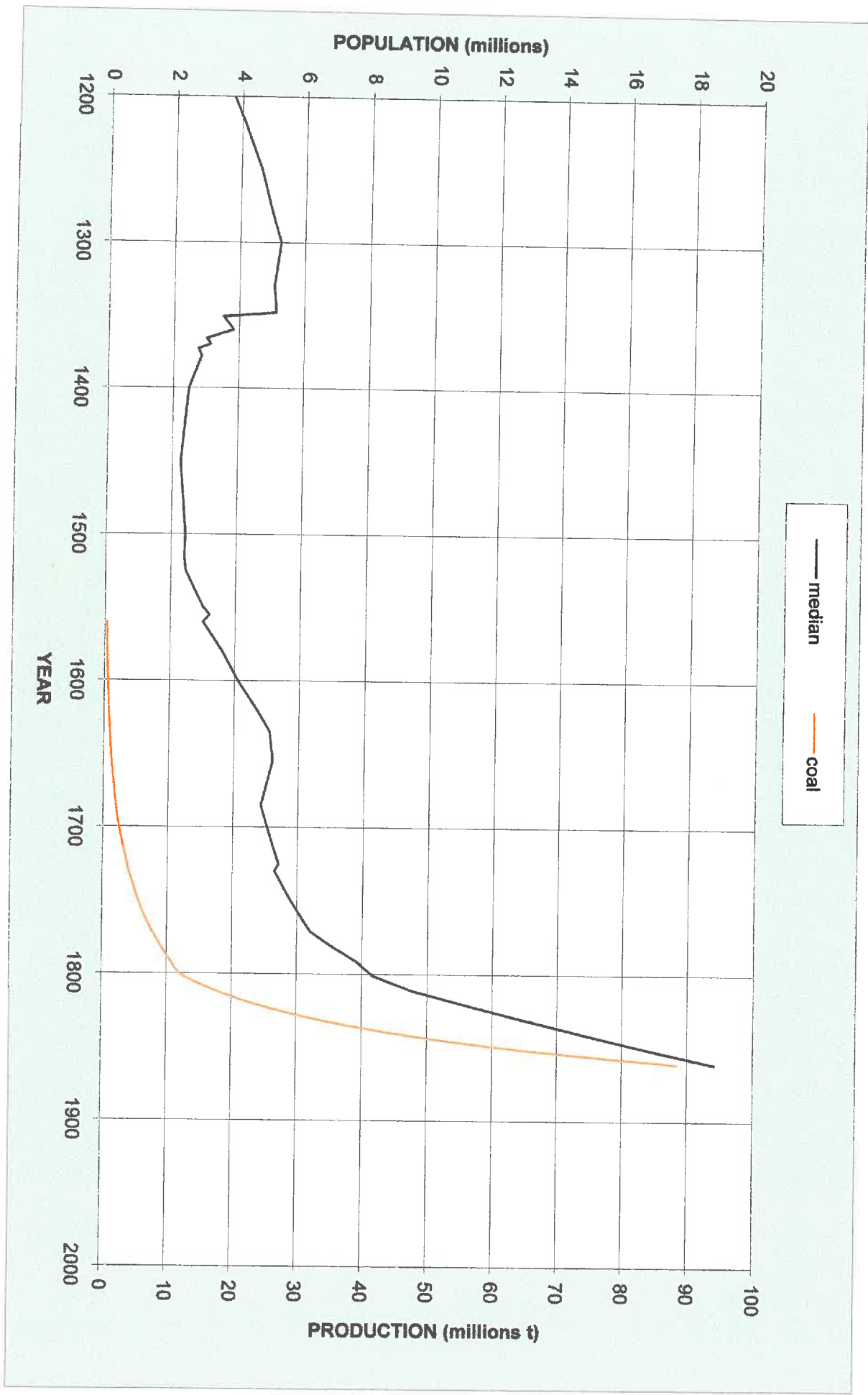


Fig. 3.1. The prices of fuels purchased by Westminster College, 1585-1640
 Sources: Beveridge 1939, 193-4; Phelps Brown and Hopkins 1981, 28-30.



Map showing relation of Coalbrookdale Works to Mines, about 1760.



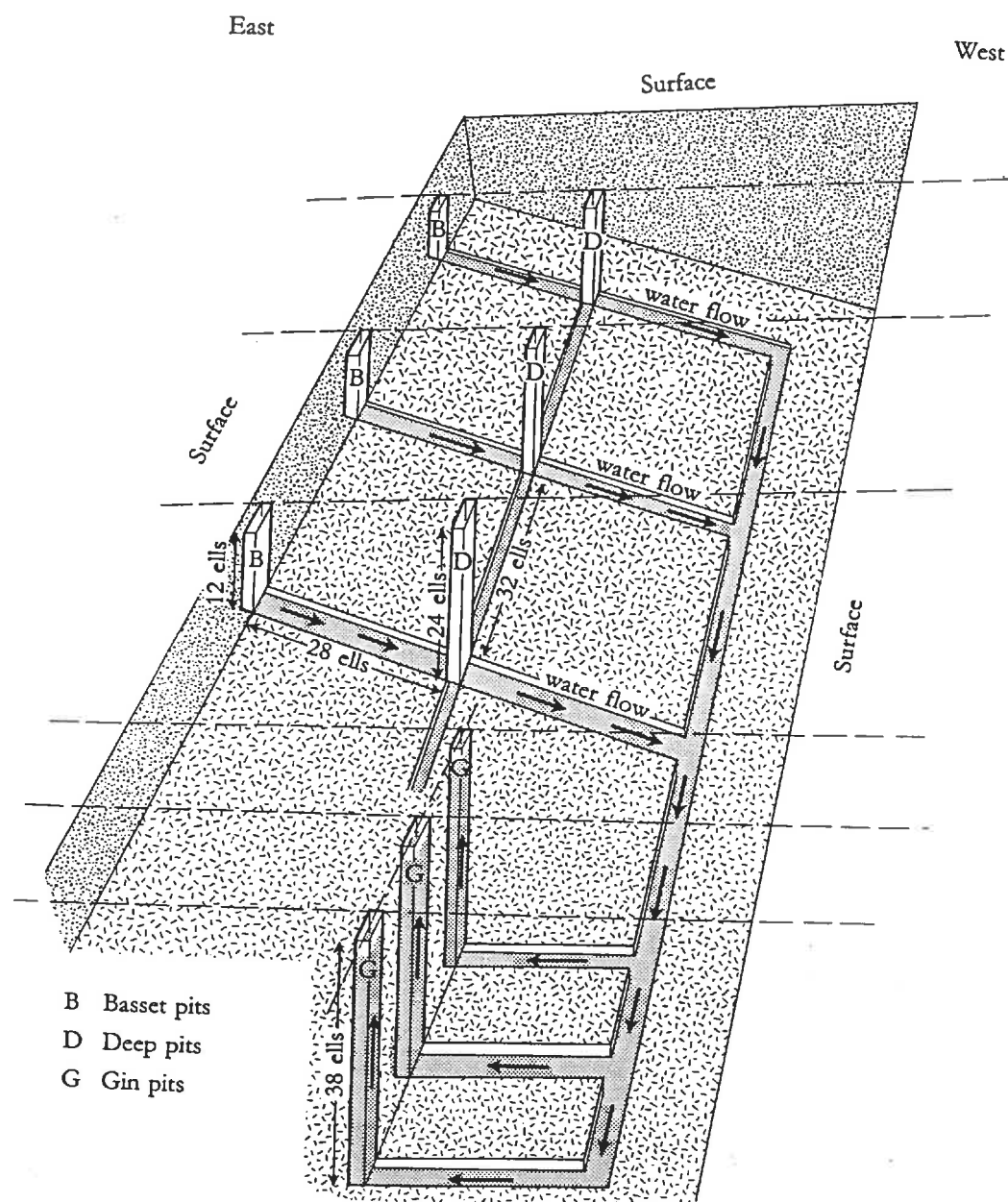


Fig. 6.2. Idealized reconstruction of Griff colliery, 1701
 The coal-seam at Griff had a dip of approximately 30° . The coal was worked up the dip, from the deep shafts to the basset shafts, so that the coal-face was drained. Sketch based upon information and drawing in White thesis 1969.

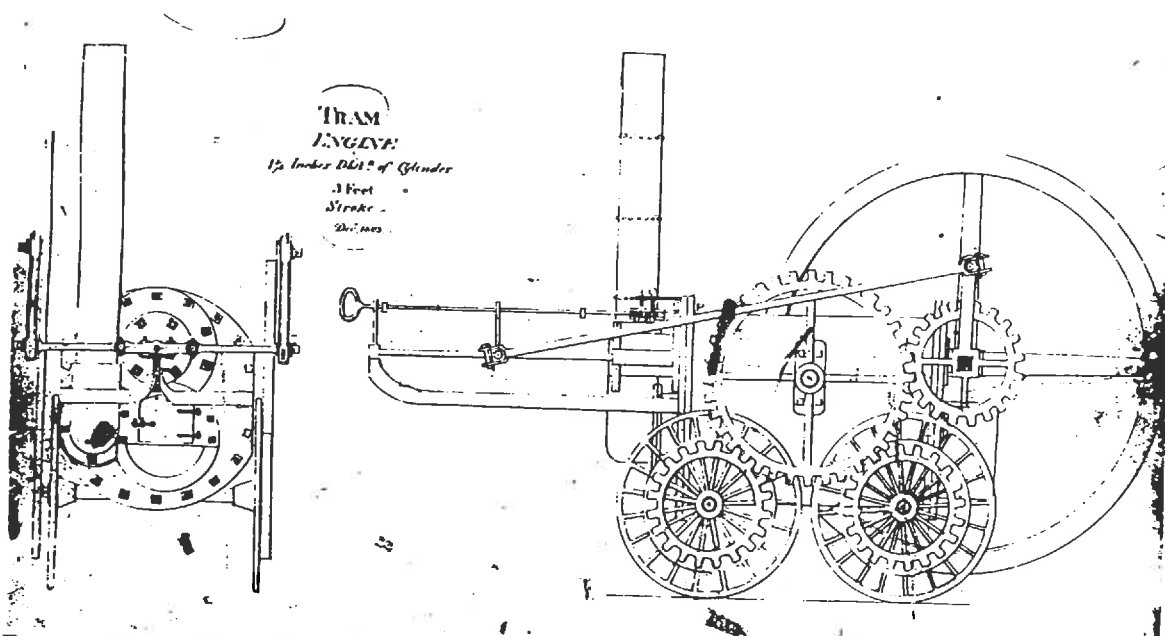
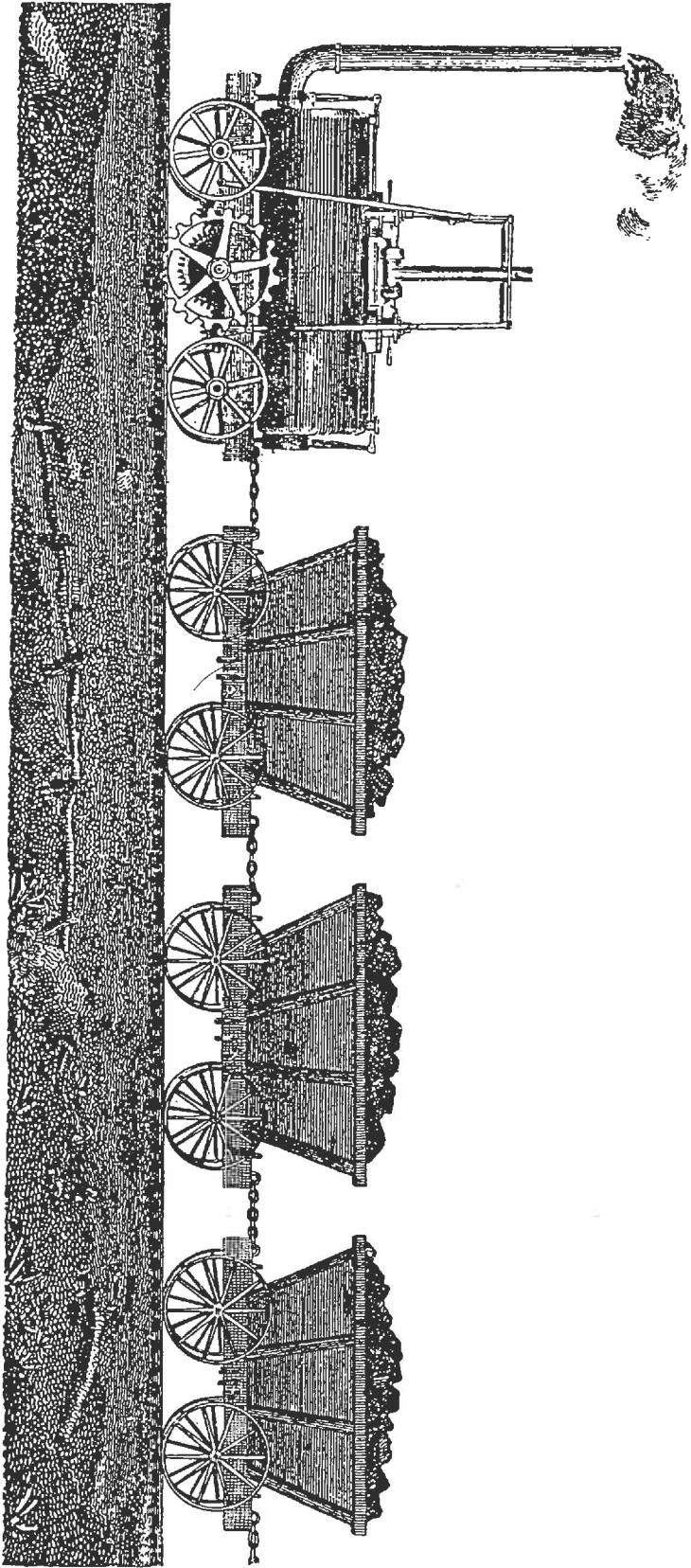
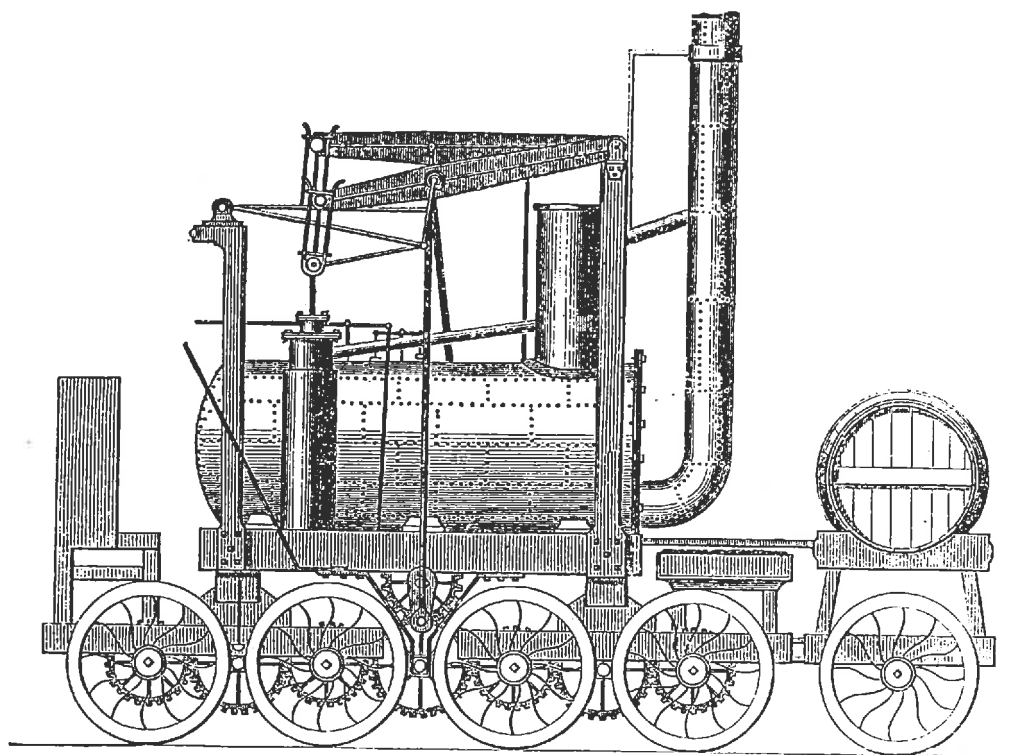
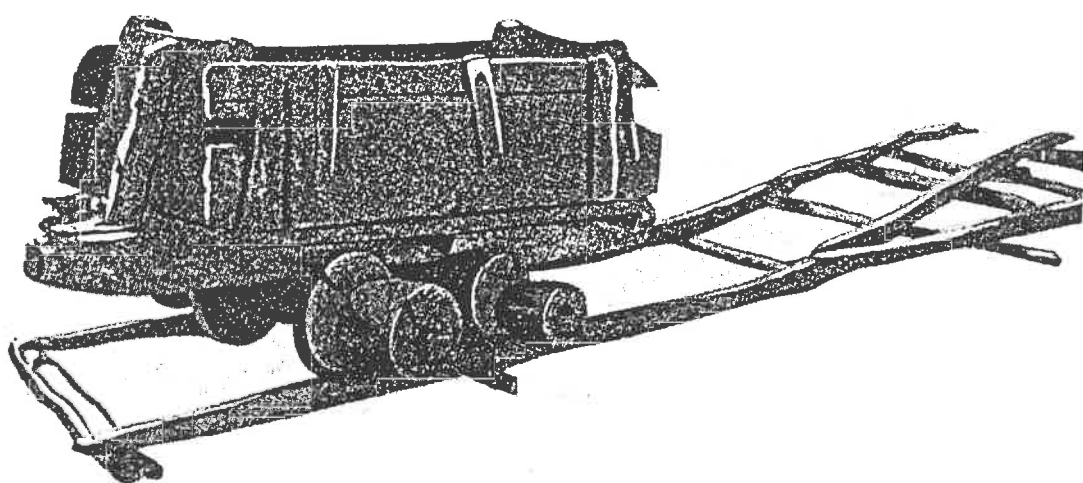


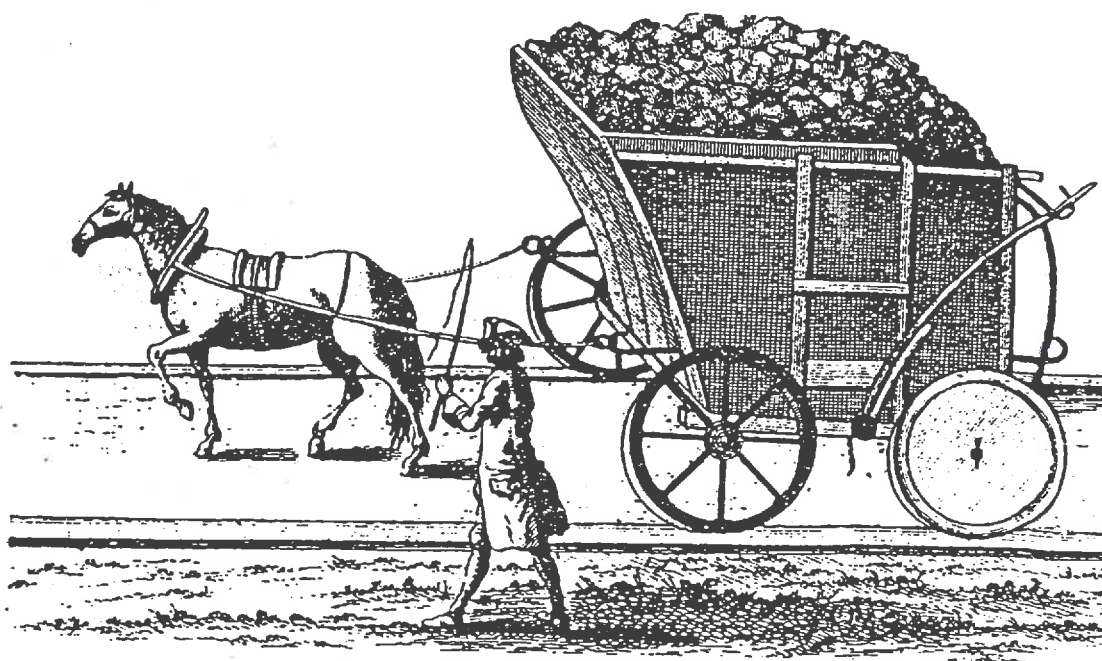
PLATE XV The World's first steam locomotive designed by Richard Trevithick and built at Coalbrookdale in 1802 with support from William Reynolds. For many years this drawing was believed to depict the Penydarren locomotive, but closer examination showed that the gauge matched some of the larger plateway used in the Gorge at this time, which was nevertheless much smaller than those used in Wales.



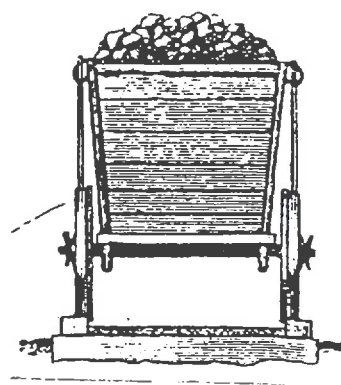
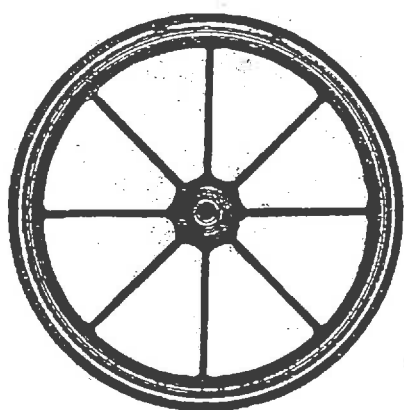








Echelle de 12 Pieds



*Coal wagon on a 4-ft. wagon-way in County Durham
(with enlarged details of the flanged iron wheels) from
"Voyages Metallurgiques" by Gabriel Jars (1765)*

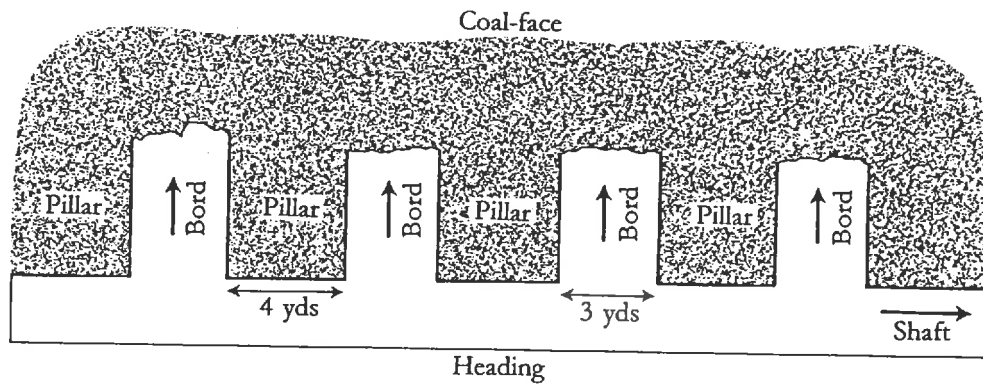


Fig. 6.3. Bord-and-pillar or pillar-and-stall mining in early stages

Source: dimensions specified in J.C., *The Compleat Collier*.