ART. V.—*An Early Tudor Coiner's Mould and the Working of Borrowdale Graphite.* By GEORGE C. BOON, F.S.A., F.R.N.S.

Read at Appleby, April 3rd, 1976.

THE bivalve mould of "pure Cumberland plumbago" in Carlisle Museum was published by R. S. Ferguson a century ago.[1] In reverting to it I may at once correct the identification of two of the three types of coin imitated, which are demonstrably all of Henry VII, not later than 1500. The importance of the mould, however, lies less in a criminal direction than an industrial, for it is the earliest evidence for the working of the celebrated Borrowdale deposits. We shall see below that Borrowdale "wad" was used as early as 1412, but was probably not then dug. On the other hand, if — as was presumably the case — the mould was fashioned from a single nodule, this must have been considerably upwards of 12 by 7 by 4 cm. and unlikely to have been obtained except by mining.

According to the Revd. T. Paitson, Ferguson's informant, the mould was found during April 1865 by a labourer seeking stone for a wall, in a small cairn near the R. Irt about ¼ mile outside the village of Strands in Netherwasdale (NY 124040). There it had obviously been hidden. No signs of metal-working were perceived. Each valve consists of a subrectangular tablet of fine graphite about 7 by 6 by 2 cm. (Plate I). One has a damaged corner, probably the result of attempting to drill a peg-hole whereby the valves could be kept in register: the spacing of the engravings avoids this corner, and the existing neat hole (not quite a piercing in one case), very close to the edge in the opposite corner, has spoilt one of the

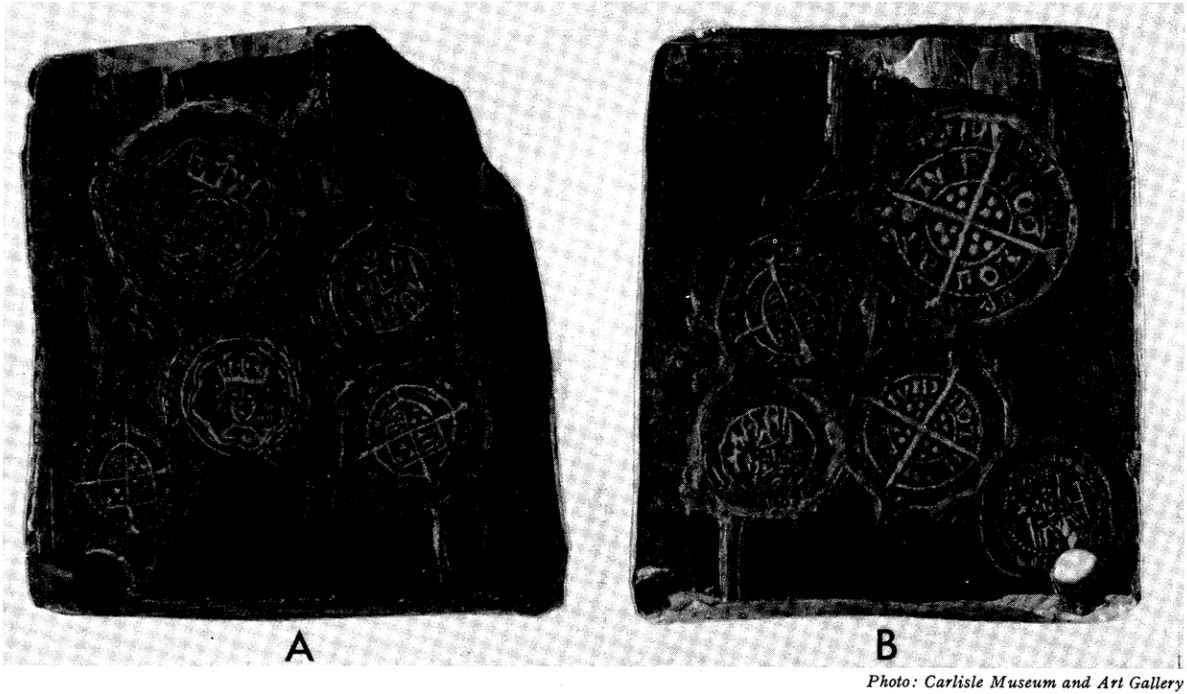


Photo: Carlisle Museum and Art Gallery

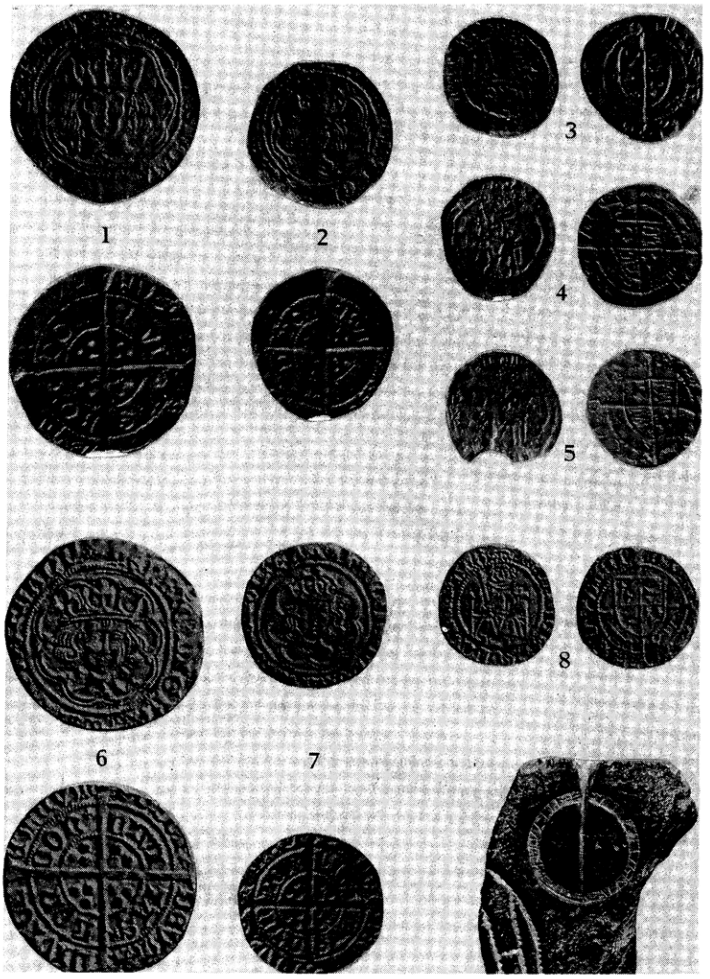
PLATE I.—Graphite mould from Netherwasdale, for the production of counterfeit coins of Henry VII, *c.* 1500. Full size.

engravings. In use, the two parts would have been carefully adjusted by means of this peg, tightly bound, and luted at the edge to prevent the escape of metal.

As Ferguson observed, the faces of the engravings are not merely sunk into the surface of the tablets. They are very slightly recessed, to obtain casts of requisite thickness, but around them the graphite has been cut away so that "the casting comes out a solid sheet, the coins . . . being surrounded by a thicker mass of waste . . . the coins are so excessively thin, that the molten metal would not run into the mould were not this device adopted". With a friend's help, he tried the mould, and soon found that it was necessary to heat it to a fairly high temperature if success was to be obtained: "a cold mould chills the metal as fast as it is run in." None of the original products survives to show what metal was used: analogy suggests that an old pewter vessel or two, or a few old spoons, would have sufficed.

The Counterfeiter.

Ferguson entertained a high opinion of the mould, going so far as to aver that it was probably the work of a literate — an ecclesiastic, possibly a monk of Furness Abbey, to which Borrowdale had belonged. But it is clear from a comparison of impressions with genuine coins (Plate II) that the products were barbarous. Even allowing for the rubbing-down and staining which snide coins often undergo to acquire the appearance of long-circulated and therefore easily acceptable pieces, the Netherwasdale coins would at once have been detected upon scrutiny. Only at crowded markets and fairs, where money changed hands quickly and where attention was distracted by novelty, could there have been much chance of passing them successfully, and then only when well mixed in



Photos: National Museum of Wales

PLATE II.—1-5. Impressions from the Netherwasdale graphite mould, 6-8. Originals for comparison (London groat; Canterbury half-groat; York penny). Full size. Bottom right: slate mould for a buckle, etc., 15th century. Found near Llandysul, Dyfed. Half size.

small numbers with the King's coin. The counterfeits which have survived from the late medieval and early modern periods are not very numerous, less because coining was then punished as treason without benefit of clergy,[2] than because coins were carefully scrutinised, and few forgeries were good enough to elude detection and so pass into a merchant's store or hoard. Such as did so, plated in the main, were necessarily of good technical quality and appearance, die-struck like their originals.[3] The postcard thinness of medieval coins made reproduction by casting, as in the Netherwasdale case, difficult.[4] The modern casts exhibited with the mould in Carlisle Museum, for instance, are far too thick.

Setting aside the barbarous character of the mould and turning to its other aspects, it seems clear that its maker was a man to whom some experience in minor casting-work can colourably be attributed. It seems that no other types of mould exist in graphite; but for badges, buckles and the like they are fairly common in fine-grained stones of various kinds (Plate II, bottom right; Plate III).[5] Here we have a case where a material excellent for the purpose, being highly refractory yet easily worked, and very fine-grained, was adopted; and its disadvantage of an extremely high thermal conductivity overcome in the ways discovered by Ferguson. Furthermore, if we look closely at the casts (Plate II), we notice isolated letters or groups which conform very well to the style of the lettering of the originals. Experiment shows that good graphite will receive something of the outline of coins hammered into its surface. There can be little doubt but that this was the method taken to mark the designs upon the tablets. Subsequent engraving emphasized the details and augmented them clumsily where no impression had been made, and perhaps renewed what had become degraded by wear.

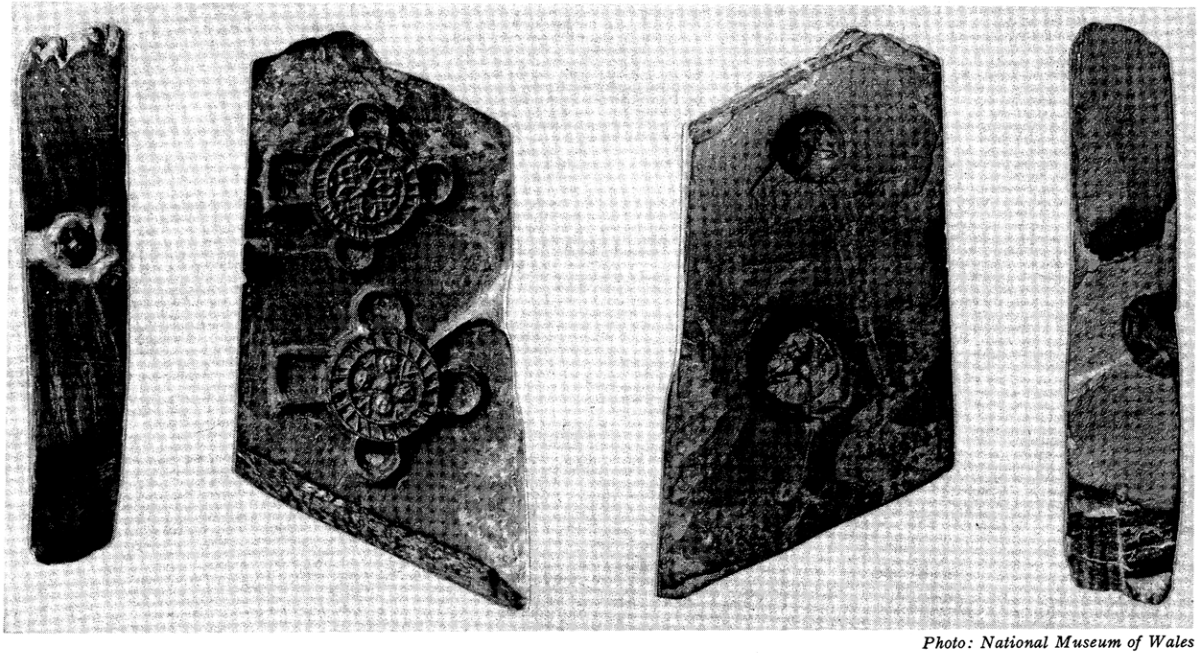


Photo: National Museum of Wales

PLATE III.—Dark brown silt-stone mould for belt-fittings, etc., 16th century. Found at Low Lightburn near Ulverston. Full size. Furness Museum.

Particularly clear examples of impressed letters are DI.GRA. on the obverse, and the last letter of POSVI on the reverse, of the groat. In short, it would not be surprising if other graphite moulds for castings of of perfectly innocuous type turned up, for we can be almost certain that forgery in this was only a side-line to the manufacture of gew-gaws for sale by travelling pedlars at the markets and fairs of the region. Such men were notorious for deceit and disreputable dealing,[6] and the experimental production of snide might well have recommended itself to one of them.

Schedule.

The standard obverse and reverse legends for the groat and half are HENRIC. DI.GRA.REX ANGL. S.FRANC (S being an abbreviation for ET), and POSVI DEVM ADIVTOREM MEVM ("I have set God as my Helper", from Psalm 54 v. 4), variously abbreviated, together with the mint-name CIVITAS LONDON or CANTOR. The obverse legend of the penny is much shortened and the reverse has only the mint-name, CIVITAS EBORACI.[7] In the following descriptions, letters without brackets are carefully-worked impressions; in round brackets, similar but faint (by use?); in square, badly engraved; and the oblique lines stand for formless crude scratches. *A* and *B* mark the valves so designated in Plate I. Despite the peg provided for registration, the two sides of each coin do not precisely coincide.

1. Plate II, 1, cf. 6. LONDON GROAT. (*A*) *Obv.* Facing bust wearing open crown. Quatrefoil to right of neck visible. [⁝ HENR]IC.DI.GRA.(RE)X.[ANG]L[.S.]FR(A)[NC.]. (*B*) Long cross with pellets. [POSV]I[+/E](VM)[ADV]TORE [ME] *sic* — [C](I)[V]I(T)AS[LO]ND[ON]. Copied from the earliest class of Henry VII's groats: the arched crown came in *c.* 1490. The reworked initial-mark may be intended for a *rose,* 1489-90 (the cinquefoil mark is later).

2. Plate II, 2, cf. 7. CANTERBURY HALF-GROAT. (*A*) *Obv*. Similar but with arched crown (only one arch of two shown) with tall orb-and-cross. (O)[HENR]I [/](D)I.GRA.(RE)X.A(N)G[///]. (*B*) *Rev*. Similar. (O POSVI)[DE/M](AD)IVT(ORE MEV) — [CIVI](T)AS C(A)[NTOR]. Faint traces of the *tun* initial-mark of Canterbury: with an M centrally on the long cross, it referred to Archp. Morton, ob. September 1500, when the coinage ceased; but by that date the King was in partial control of the mint, and the M was no longer applied.
3. Plate II, 3, cf. 8. YORK PENNY. (*A*) *Obv*. Seated figure of the King holding orb and sceptre; on his right, pillar-like side-piece of throne. [/////](CV) [/CVS REX] *sic*. (*B*) *Rev*. Shield of royal Arms imposed on long cross; a key obliquely on either side below [//////// ////ADI] *sic*.
4. Plate II, 4. Similar. (*B*) *Obv*. (*A*). *Rev*.
5. Plate II, 5. Similar. (*B*). *Obv*. damaged by peg-hole. (*A*) *Rev*. Keys very faint. (ACI) of original *Civitas Eboraci* faintly legible.

Ferguson recognised these three as copies of a York penny of Henry VII. The keys, from the Arms of the See, denote Archbp. Rotherham's mint, continuing to his death in May 1500. This "sovereign" type of penny, so-called from the obverse which is modelled on that of the 20s. gold coin of 1489, shows typological development from throne with no side-pieces, to one (as here) and then to two. All are known for the archbp.'s mint at York before Rotherham's death. Pennies were not again struck here until *c*. 1531 when a few of distinctive design appeared. In 1534 all ecclesiastical coinages ceased.

Date.

The originals were and are common. This fact, when taken with the circumstances of discovery and the barbarous quality of the workmanship, proves that we are not dealing with any modern attempt to foist Henrician forgeries upon collectors. Nor is there any possibility that the mould was prepared in 1544, when Henry VIII embarked upon the second stage of his debasement of the currency:[8] after that date, there

were few of the older coins of the full standard of England (92.5% fine) in circulation,[9] and any surviving into the time of Mary or Elizabeth would have been subjected to careful scrutiny which the casts could not support.

On the basis of the coins copied, *c.* 1500 is the latest date to be put on the mould; but other considerations obtrude. Firstly, since groats and halves with a new profile portrait had been introduced in 1504, the nearer we approach the end of the reign in 1509, the greater the chance that a profile coin would have been available as a model; and conversely, the less likely the actual choice. Secondly, however, it has been suggested that the profile coins met little welcome in the North;[10] and if there was discrimination against them, the mould may have been cut after 1504 without bearing any sign of the fact. The argument, nevertheless, is weak because the coins from the Norham Castle hoard, upon which it was based, run some years later than those attested by the mould, and include specimens with the same initial-mark as appears on early profile issues. Against the *prima facie* date, therefore, there is only the third point, which from analogy must be allowed some weight, namely that the coiner may have chosen old coins because worn, clipped and discoloured pieces were more easily imitated and passed than bright new coins. But I think that some validity attaches to the rather close date of the coins actually copied, and it seems unlikely that the mould was made as late as the reign of Henry VIII.

The Mines.

The plural is apposite, for there were throughout the period which we shall be studying two distinct workings (Fig. 1), known as the upper (or high) and lower (or low) wad-hole or wad-mine. The mines are situated on the south-east side of Seatoller Fell opposite

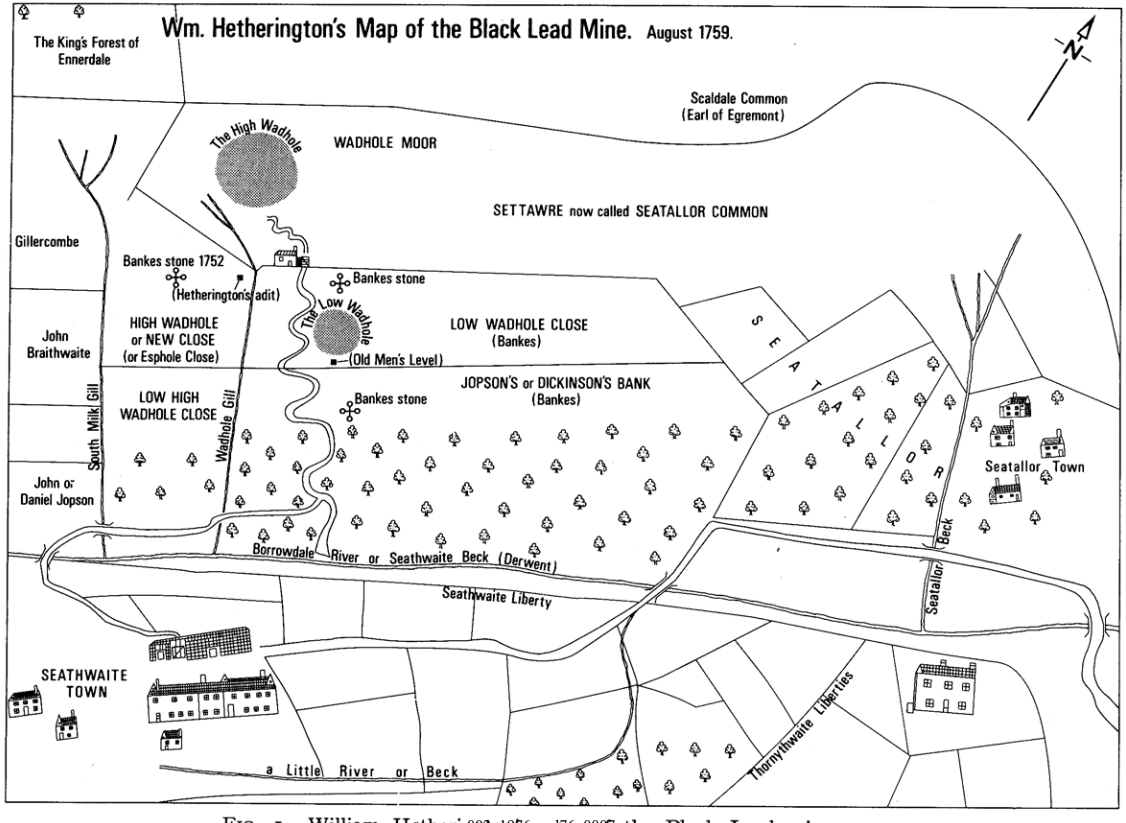


FIG. 1.—William Hetherington's map of the Black Lead mine, 1759.

the hamlet of Seathwaite, lying thus in the upper reaches of Borrowdale (NY 232124). Molly Lefebure has given an excellent description of the site as it is today;[11] but the reader is referred to Ward's monograph of 1876 and to Postlethwaite for the geology and mineralogy of the deposits.[12] Suffice it to say that the graphite occurs associated with an igneous dyke, confined within pipe-like formations of considerable size, in which the mineral is commonly found in nodular form. Two, known as the grand pipe and Gorton's, outcrop about 190 yds. apart, the first in enclosed ground (Wadhole Close, Fig. 1), the second upon Seatoller Common. At these spots the early workings were developed. There have been several brief accounts of the mines, mostly derived from Ward; Mrs Lefebure has added some details in *Cumberland Heritage,* but all accounts are highly defective in their coverage of the early phases of working which we wish to examine here, and which may be regarded as ending with the sale of the former Furness Abbey manor of Borrowdale by the Crown in 1613.[13] Documentary evidence for this period lies mostly in Duchy of Lancaster papers in the Public Record Office, because the manor was administered as part of the Duchy after the Dissolution.

As Charlotte Kipling first pointed out in her study of the salt-well at Manesty, Grange, near the mouth of Borrowdale, royal commissioners were sent in August 1555 to enquire into any metals or ores, any salt-well, or any wad-hole "for the colouring or uring of shepe" within the lordship.[14] The outcome was that in December one Ambrose Dormer of Ascote (Ascot in Great Milton, Oxon.) was granted a lease of the mineral rights for 21 years.[15] The commissioners had been able to discover nothing as to metals and ores, and little as to the salt-well, which they valued at only 2s. rent per annum: the great prize, thus, was the graphite, for which 13s. 4d. was the recom-

mended rent. These figures remained unchanged until 1614, indeed later in the case of the wad-holes.[16] Ambrose Dormer, son of Sir Michael Dormer, Lord Mayor of London 1541-2, and father of a High Sheriff of Oxfordshire, died in 1566;[17] it is unknown what work was done under the lease, and what became of it.

In 1578, a new lease of the wad-holes, salt-well, and property elsewhere was taken out by one Roger Robinson, of whom I have found nothing.[18] The interest passed to one Mathewe Buck, who renewed the lease in his own name in 1594.[19] The last Crown lessees, Edward Boraston and Thomas Fanshaw, seem to have acquired the Buck lease, for their grant of 1607 was to run from its expiry, i.e. until 1636.[20] Like the other lessees, they were primarily businessmen, for in 1607 they sub-let to Emanuel and Daniel Hechstetter (and their London partner, John Masefield "citizen and armourer"), sons of the great Augsburg mining-engineer who had been the guiding force of the Mines Royal at Keswick (*ob.* 1581).[21] Thus when James I, by letters patent of 12 March 1613/14, granted extensive lands in Lincolnshire and the Furness Abbey manor of Borrowdale to William Whitmore and Jonas Verdon of London for an undisclosed sum,[22] the mines were subject to an existing lease. Whitmore and Verdon recouped their purchase by selling off each of the tenancies to its occupier by bargains-and-sales of 23 November 1614, and drew the whole matter together under the terms of "the great deed of Borrowdale" of 28 November,[23] whereby the manorial rights were assigned to the former tenants, who thus became seised of the freehold and inheritance of their properties, and were to share various unapportionables such as common rights, and also the salt-well, divorced for the first time from the wad-holes. These meanwhile had been bought by William Lamplugh and Charles Hudson of Bowtherbeck in a separate transaction of

Photo: National Portrait Gallery

PLATE IV.—Sir John Bankes, born at Keswick 1589. died at Oxford 1644, Chief Justice of the Common Pleas 1640-44. From a portrait by an unknown artist, *c.* 1641, in the National Collection.

23 November.[24] To round off this part of the story, the mines thereafter descended as distinct moieties. One remained in the Hudson family until acquired in two parts (1697, 1706) by the father of the John Shepheard who figured with John Bankes in the petition to Parliament for the severe protective Act of 1752;[25] the other was bought on 9 March 1622 by the rising London lawyer Sir John Bankes (Plate IV: great-grandfather of the above, a man of Keswick birth, destined to become Chief Justice of the Common Pleas, 1640-44), together with his father-in-law Ralph Hawtrey of Ruislip, Middlesex.[26] It remains to add that Sir John Bankes bought the Hechstetter lease for £150 in September 1625,[27] when it still had eleven years to run, and was thus enabled to mine on his own account — a very different matter from receiving a moiety of the annual pittance of rent. The surface ownership was, of course, quite separate.

26 August 1555 is the earliest reference, so far recorded, to the wad-holes. The commissioners, Thomas Legh and Nicholas Bardsey, repaired to Borrowdale on 16 September (or October),[28] and duly reported:

> Item astouchyng the Wad hole or Cauke pyt wherwith the[y] Color shepe lyeing in the Comon of Setower . . . they which heretofore hath gotten any of the same hath bynne accustomyd to pay to the Lord For brekyng the grownde or soyle one pennye at the first entre[;] that notwithstandyng it is worth by the yere xiijs iiijd of rent which wolde be gy[ve]ne unto ther highnes[,] for the same lyeing upon the comon of the Kyng and the Quenes Ma^{ts} [is] not hurteful to any of ther highnes tenants nor in ther occupacons but alwais at the disposition of the Lord, the said wad beyng very dangerus to get by reason of habundance of waters. . . .

It may be concluded that the digging of wad in the upper mine was already long established, because a manorial royalty had been imposed, and because the pit itself had been carried to such a depth that flooding

constituted a danger. Not yet, nor possibly for a century or more, was any sough or adit cut to drain the workings here or at the lower mine.[29]

We return to the problem of the lower mine later (p. 114). Let us here notice that "wad" is not the only term applied to the mineral. "Cauke" is also used; "black cawke" occurs in the Dormer lease, in the expression *tot(a) ill(a) lez Wadhole[s] et le wadde communiter vocat(um) black cawke*;[30] and "calke" and "vayne of calke" appear in the court record of the first of the many lawsuits — 1597 — which were to vex very nearly the whole history of the mines.[31] These words are equivalent to "chalk" in the sense of "marking-stone", sometimes qualified as to colour, sometimes not. In another context altogether, "black chalk" was the name of a carbonaceous clay used for marking and drawing.[32] These synonyms lend significance to a neglected entry in the Ministers' Accounts for the dissolved monastery of Furness, 1540-1, long in print, if only in a very imperfect translation.[33] Here we read of *vjs viijd de p(er)qu(is)-it(ione) miner(ie) petre vocat(e) calkstone al(ias) Shepe Oodde lucrat(e)[?] infra unu(m) montem vocat(um) close Edge ib(idem) in Borowdale*, "6s. 8d. from the profit of a mine of stone called calkstone otherwise sheep-wad worked (?) under a mountain called Close Edge there in Borrowdale". Given the known rustic use of graphite for marking sheep, "oodde" is clearly a variant spelling for "wad".[34] Whether the mountain was in fact called Close Edge seems doubtful. The name seems to apply better to the location of the workings near the boundary of the enclosed ground, cf. Fig. 1.

The Netherwasdale mould encourages a search for an even earlier *terminus ante quem*; and I have therefore acted upon the prompting of Mr Fred Barnes, F.S.A., to inspect at the Public Record Office

and the British Library "the sole example of the work of Furness Abbey scriptorium",[35] namely the two great folio volumes of the cartulary or Coucher Book, written by the monk John Stell in 1412.[36] It was considered likely that the monks would have known of the substance even then employed, no doubt, by their tenants to mark sheep; and that in consequence the rulings and other lineations in the manuscript would display the characteristics of graphite.[37] The Coucher is a highly accomplished and beautiful document, perfectly legible and with numerous illuminated initials containing portraits and coats of Arms; but the rulings setting out the columns and guidelines for the text are on the whole somewhat coarsely drawn, and many are erased. A peculiarity of the lines is that they are sometimes black and sometimes brownish-red: in one case, a black line crosses a brownish-red one, and so disposes of the notion that partial oxidation has taken place. In many cases, the same line changes colour.[38] Some of the black lines contain shiny specks consistent with graphite;[39] but of a "typical" graphite streak there is no sign in these rulings, if we look for the brilliant gleam produced by best-quality mineral. But graphite varies considerably: kinds too poor to be used in pencils are flaky, stony, or else soft to greasy in texture, and a "typical" gleam is by no means always produced. Furthermore, graphite commonly contains iron — at Borrowdale, up to 18%.[40] If iron-oxide was present in veins or lumps within a poor-quality piece used for ruling, the varying colour of the lines would be explained, for the surface abraded by contact with the vellum would at times be graphite, and at other times the oxide. I have made very similar lines with a specimen of poor graphite heavily intermixed with iron-oxide.

Besides the ordinary rulings, there are lines in a much finer point, used here and there, particularly

near the initials, where spacing was important, and in outlining the initials themselves: one or two unfinished initials may show traces of graphite lineation,[41] but I am by no means certain that an ordinary metallic lead stylus was not employed for all this secondary work. The only appearance of a good graphite streak in either volume is unhappily quite undatable, though of course very old. It occurs, strangely enough, in a blank column at the end of the entries relating to Borrowdale itself,[42] and is a scrawl about 20 cm. long, which has been converted in pen-and-ink to the traced outline of a left hand laid flat on the page, fingers spread.

Even if the rulings have been correctly identified as having been produced by a fragment of heavily iron-impregnated graphite, it seems highly unlikely that wad was being mined upon Seatoller Fell as early as 1412. The very fact that only the poorest sort was available almost precludes the possibility that a mine had then been opened, for a mine would inevitably have struck mineral of far better quality. Natural erosion, particularly by the stream which rises near the high wad-hole, would have scoured nodules from the outcrops and deposited them in the stream-bed or more widely still along the foot of the slope, where indeed they have been ploughed up.[43] Through some servant of the monastery, or some monk staying at the grange, stray material of this kind may easily have come into Stell's possession. In sum, it is reasonable to suppose that the first wad-hole was begun after 1412. The site of the deposits was obvious as late as the 18th century, for Bankes remarks that "the surface of the earth in general about the High Wad Mine, where it is not rock, is of a sandy colour, but upon the veins themselves it is of a dirty mahogany colour"[44] arising, no doubt, from the presence of iron in oxide form.

The penny royalty which Legh and Bardsey mention perfectly reflects the simple, workaday, and strictly local use to which the mineral was first applied. It is when we come to the payment of 6s. 8d. in 1540-1 that the first hint of larger operations is gained. It is scarcely credible that there should then have been no fewer than eighty separate "breakings" by local farmers: the sum is a round one, of half-a-mark, half what Legh and Bardsey were to propose. We may venture the guess that some unknown person had obtained permission of the ministers for exploratory digging: the question is whether this activity concerned solely the upper mine, or whether the lower mine had already been brought to light.

Legh and Bardsey refer to only one wad-hole, that on the common. This coincides with the tradition that the other was "discovered in Queen Elizabeth's time by reason of the Wadd appearing in the holes where the roots grew of a large Ash tree blown down and in the same place where the shaft of the Low Wadd Mine now is".[45] Two wad-holes were certainly being worked by 1597, when operations in the upper mine were the subject of ill-informed dispute.[46] The question is whether tradition, in its circumstances quite unexceptionable, had up-dated the event from 1540-1. The wording of the entry in the accounts (p. 111) is not very precise, and could apply either to the upper mine or to prospecting on the site of a new discovery lower down. To my mind, the sum of half-a-mark suggests the latter; and in this case the local farmers could still have dug wad, at a penny a time, in the upper mine, until the first Crown lease was granted. As an isolated occurrence, exploratory digging in the lower deposit may not have come to the notice of the commissioners, who took their information from local residents and probably did not consider it necessary to inspect the site.

Early Uses of Graphite — the Passau Mines.

By 1555 there must have been wider uses of graphite in prospect; but to identify them is not easy. It is not until 1565, for example, that we meet the first reference to "English antimony" in pencils, or rather stylus-points (Fig. 2);[47] but since that reference is continental, it need not furnish a close *terminus ante quem* for home production. How far back the medicinal uses of graphite go, beyond their first mention by Samuel Dale, as an afterthought, in 1693,[48] is obscure: in any case, a small amount met apothecaries' demands.

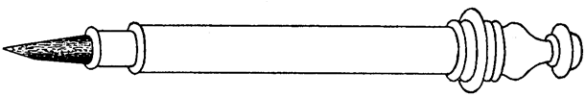


FIG. 2.—"Stylus for writing," after Gesner, 1565.

The industrial applications, however, will bear looking into. Borrowdale is often accorded a primacy among the graphite sources of the world, but this can truly apply only to the superb quality of the best mineral, which was used in its natural state (as no other graphite could so be used) by the pencil-trade as late as 1906, and for 150 years at least had been the chief and most profitable destination of the substance.[49] But the deposits east of the Bavarian town of Passau, lying at the confluence of the Danube and the Inn, close to the Austrian frontier, were certainly worked much earlier. Had Borrowdale but possessed the extensive deposits of Passau; had it but enjoyed the easy communications by river available in that case; undoubtedly the development and history of the undertaking would have been very different. The Passau and other central European sources, for example, were exploited in antiquity, when the mineral was used in pottery, and even a few crucibles are known:[50] but there is not the slightest sign that the same could be said of Borrowdale or any other British source.[51] Pottery, and above all crucibles, were to emerge again as the chief

products of Passau; and the same region produced the fine white clay which was later to be used for the Nymphenburg and other German porcelain as well as crucible-bodies. The incorporation of graphite into ceramics is shown by the expressions *Eysendachtein* and *eysnen . . . hevenwerch* ("iron-tiles" and "iron . . . pottery") found in the ordinances of the Vienna potters' gild as early as 1431: "iron" refers to the metallic sheen. Other references include *Eysenfarb* ("iron-colouring") in 1518, and *Eysentahen* ("iron-earth") in 1524; and Rudolph, from whose survey these details are taken,[52] also mentions duty paid upon *Schmelzdegl* (crucibles) worth 10 gulden — a considerable quantity — by an Ingolstadt skipper at Neustadt-am-Inn, in 1532. He is also prepared to accept a reference of 1496, if not others of 1470, as likewise referring to graphite-ware crucibles. Some doubt, I think, must attach even to the 1532 date, for the crucibles could as well have been composed of the pure porcelain-clay, as will become apparent from our further discussion below (p. 118). Nevertheless, the medieval exploitation of Passau graphite certainly began long before this period, even if it was not used for crucibles; it was well-established in the mid-thirteenth century, when a royalty was imposed; and the use of central European graphite for ruling manuscripts dates from about the year 1100.[53]

By 1565 we have the authority of Kentman that Bavarian graphite was used for another of its chief purposes, to polish iron and render it rust-proof, especially stoves: *Eisen Than, damit man die eisern öfen fein eisenfarb anstreicht.*[54] Thus, knowledge of the commercial applications of graphite could well have reached London by 1540; and if so, we have a key to the mysterious operations of that year in Borrowdale, and to the otherwise scarcely explicable decision of Ambrose Dormer to take out a lease on the deposits.

That some such circumstances lay behind the Dormer lease can hardly be doubted; and we may guess that stylus-manufacture and iron-blacking were the most important destinations of wad raised under its terms. The nature and extent of other uses at this period are obscure. Pottery, however, can certainly be ignored as far as home manufacture goes: graphited ware was not made. Possibly the ordinary Dutch word *potlood* ("pot-lead") may be taken to imply that Borrowdale graphite was exported to Holland for this purpose; it seems likely, for members of the Newcastle Merchant Adventurers' Company were handling graphite by 1602 (p. 119); and Newcastle, like other important east-coast towns, had had extensive trading links with Flanders since at least the 14th century.[55]

Of other applications, the use of graphite as a separator in foundry-castings is first clearly described in 1752, but was probably an invention of that man of many parts, Prince Rupert.[56] As to the antiquity of graphite as a lubricant, its use was small or unknown, probably, in the 16th century.[57] Thus we come again to crucibles. English manufacture cannot be traced back anything like as far as the middle of the 16th century; such evidence as I have found is to the contrary. Thus, in 1565, London potters were unable to supply an alchemist with "one pott to content him. They know not how to seasson their stuff to . . . susteyne the force of his great fiers"; and as late as 1662, the Royal Mint was still using plain earthenware crucibles for melting gold, and iron for silver.[58] Although the Mint was scarcely an institution in the forefront of technical change, a century's familiarity outside the Tower with the refractory advantages of graphite-ware crucibles would surely long since have led to some effect within; and for this reason it seems unlikely that a patent of 1636, which mentions *inter alia* that the applicants had "found out the Arte and Skill

of Makeinge and Dryeinge of all sorts of Panne Tyles, Stone Juggs, Bottles . . . , Meltinge Potts for Gouldsmyths, and other Earthen Comodityes . . . which nowe are made by Straungers in Forraigne Partes", could have a bearing upon the problem.[59] The earliest reference to Borrowdale wad in connexion with crucibles seems to be no earlier than 1700, and moreover implies foreign rather than home manufacture.[60] The development of this trade is unquestionably bound up with the prohibition placed by the Bavarian authorities upon the exportation of graphite of crucible-making quality; and since this was imposed in 1613 — to remain until 1805[61] — the English trade may well have grown to substantial proportions in the 17th century, and left records which I have not found.

In view of the early development of the Passau deposits, it is curious that there is no reference to the region, or to graphite, on the part of Georgius Agricola, whose *De Re Metallica* (1556) and annexed monographs are a treasury of information upon 16th-century mining and metallurgy. In the section upon crucibles, he writes merely of earthenware tempered with sand, etc., and otherwise only of the special ash-composition cupels used, for the sake of their absorptive properties, in assay-work.[62] Another writer to make no overt mention of graphite-ware crucibles is the great Daniel Hechstetter of Augsburg himself, who has left some notes on assay, in which three sorts of crucibles, including cupels, appear.[63] These notes, however, scarcely required details of the fabric. Whether graphite-ware crucibles were among the cupels and other special equipment imported to Keswick by the Mines Royal is uncertain. The question depends on the extent to which Bavarian production had spread by mid-century — not only in the spatial sense, by river-highway as far, say, as Augsburg; but also in the technical sense, from the area of secondary metal-working as practised,

say, at Nuremberg, into that of primary metal-production. Here Agricola's silence cannot but be taken as significant; and its significance is perhaps further increased by the fact that when the Mines Royal came, in 1573, to buy bone and bone-meal locally, either for making cupels or for lining the bottoms of full-sized cupellation-hearths, they made no parallel purchases of the local graphite for crucibles, or indeed for any other purpose.[64]

Early Marketing Arrangements.

Upon this essential subject, little is known from the period of the Crown leases, and that little falls late. The lawsuit of 1597 concerned seven tons of superior wad worth £13. 6s. 8d. by the ton, and about 25 cwt. of inferior wad, worth £5. 6s. 8d. by the ton.[65] These figures, low as they are by later standards, show that a good market existed for the mineral, and explain why the right to work the deposits was so bitterly contested. The only detail so far traced regarding the mode of marketing the graphite occurs in the records of the Company of Merchant Adventurers of Newcastle upon Tyne. In 1602, a new schedule of commodities upon which imposts were levied by the Company "for divers urgent and necessarie causes and reasons" was drawn up, and in it black-lead is listed at the rate of one farthing per hundredweight, among cloth, lead, hides and the like, all staple articles of trade.[66] Black-lead was therefore commonly handled by Newcastle merchants. Later in the 17th century, it was customary for bargains to be struck at intervals between particular merchants and the proprietors of the mines, as we show below; and this early reference implies that the same system operated in the Crown lease period, at least from the date of Buck's lease in 1594 if not at a still earlier time. At the risk of stretching the evidence

a little, further confirmation of the arrangement may perhaps be seen in the limited facility given to the manorial tenants under the court's judgement of 1597, whereby they were to be allowed to work in the upper mine "from tyme to tyme hereafter at such tymes as the said Wad holes shall bee opened by her Maties fermors . . . and not at any other tyme or tymes . . . ;" for, under the terms of the 17th-century agreements, a period of closure was imposed upon the proprietors of the mines, so that the market would not be flooded with further supplies of graphite, and a high re-sale price could be maintained. What the re-sale price was, at any period, we have no knowledge.

One of the most prominent Merchant Adventurers and dealers in black-lead during the 17th century was Robert Ellison of Newcastle upon Tyne.[67] The first record of a bargain is of 14 July 1642, barely five weeks before the outbreak of the Civil War.[68] Ellison and his then partner, Ralph Lomax, also of Newcastle,[69] wrote to Charles Hudson, as joint proprietor of the mines with Sir John Bankes, concerning a consignment of 20 tons of graphite priced at £400, divided into three grades. It appears that another 50 tons, probably in the barn at Bowtherbeck, had been the subject of negotiation, for the Newcastle merchants explained: "The reason why we dare not venture at the whole bargain is that within 7 miles of Salem in New England is a myne found of [. . .] which is good of which Mr Paters the Minister there shewed me a very good piece and proffers to me 400 Tons." This reference to New England graphite, possibly the first in England, is very interesting;[70] but in this context seems to have been a gambit, for, in sending on the letter to Sir John Bankes, Hudson added that the merchants "desire 6 score to the hundred being 8 lb. more than I delivered into the Barn which will amount to £25 in 20 tons and if we

[act] according as they desire I think Michaelmas next come a year a sufficient time to bar us from selling But I do also refer to your Lordships consideration. . . ."

Lord Chief Justice Bankes died on 24 December 1644 at Christ Church College, Oxford.[71] Thus the next record of a sale is of 6 March 1646/47 between Lady Bankes, as executrix of his Will, and Charles and John Hudson his son of the one part, and Stephen Boulton and John Brett grocers (i.e. wholesale merchants) of London of the other part.[72] The articles covered 80 tons, 50 tons at £18 and 30 tons at £10, averaging therefore only £15 per ton as against the pre-war £20.[73] Of the 50 tons, 20 were to be of nodules "of the bigness of a hens egg", 20, "of the bigness of an Hazel Nut", and 10, "of the bigness of a White pea" (i.e. an ordinary small pea); the 30 tons of inferior wad were to be of the third size. "The pitts not to be opened for the space of 7 years upon pain of Three Pounds for every hundredweight."

The third record is of 2 April 1655, between Lady Bankes and John Hudson of the one part, and Robert and Benjamin Ellison of Newcastle and John Brown "citizen and grocer of London" of the other part.[74] 50 tons of superior, and 17 tons of inferior quality of white-pea size down to dust, were covered. The prices are not given; but the proprietors undertook "not to open within 7 years upon pain of £20 Stirling for every hundredweight (except the sale thereof)". The extremely high penalty may reflect a continuance of mining during the previous period of closure, either by the proprietors' workmen or, more probably, by unauthorised persons, which had led to further quantities being placed on the market, to the detriment of the Ellisons and Brown. The relevance of the proviso seems obscure.

Lady Bankes died in 1661; and the fourth record,

of 27 March 1662, is between her son Sir Ralph Bankes and John Hudson of the one part, and Robert and Benjamin Ellison and Stephen Boulton of the other part.[75] Seventy tons were to be delivered to them "at the House called the New House of Sir Ralph Bankes in Keswick" by 1 May 1663, to be composed of 6 tons "of the large", 9 "of the second", 18 "of the third", 33 "of the fourth", and 4 "of the rough"; the price was £1,600, more than restoring the pre-war position, and was to be paid, one moiety to Sir Ralph Bankes, and the other to John Hudson. The period of closure was six years; and not surprisingly, in view of the £20 per cwt. previously fixed, the proprietors were able to state that they had sold no mineral since the 1655 bargain.

A final record is of 6 April 1671, between Sir Ralph Bankes, George Hudson "of London, gent." and Thomas Lamplugh of Gray's Inn on behalf of widow Susan Hudson of Bowtherbeck and Susan Hudson [*sic*] spinster, and Henry Crackplace of Crackplace Hall, Cumberland, and Eleanor his wife, all of the one part (presumably reflecting the division of John Hudson's estate), and David Lelong, merchant of London, of the other part.[76] Sixty-four tons, priced at £1,800 (giving an average of just over £28 per ton, a substantial rise, doubtless mainly in the best grade), were to be delivered to Lelong at Sir Ralph Bankes's house in Keswick. There were 6 tons of the largest sort, at £100 per ton; 6 of the second, at £45; 16 of the third, at £30; "of the rock or fourth sort" also at £30; and 30 of the fifth sort, at £15.[77] Since 1647, therefore, two new grades had been added to the lower end of the range, which reflect the increasing uses being found for the poorer mineral.

These figures give us an inkling of the value of the deposits, which was later to increase very much further. Some later prices can be found in works already

cited,[78] and we may content ourselves with one other. In 1761, Henry Bankes concluded an agreement with James Stone, colourman, of Bishopsgate-st., London, for the sale of nearly 5 tons (96 cwt. 1 qr. 27½ lb.) for £3,217. 10s., the best fetching 12s. a pound, and even the worst, 2s. — amounting respectively to £1,344 and £224 by the ton, or nearly 13½ times and 15 times the prices ruling ninety years before.[79] The development of the pencil-trade since the invention of deal or cedar cases for the leads, recent in 1683,[80] and the extension of industrial applications for the mineral, are seen here to have had their effect.

The 17-century bargains involved London merchants only in 1646 and 1671, Newcastle merchants only in 1642, and London and Newcastle merchants together in 1655 and 1662; and in 1662 and 1671 it is made clear that the responsibility of the proprietors of the mines ceased when the mineral had been handed over in Keswick. On one of these occasions, Newcastle and London merchants were involved, and in the other, only Lelong of London. We may conclude that even if no Newcastle partners were concerned in 1671, the route taken by the mineral would almost certainly have been the same; and in short on all these occasions it would have been transported by pack-horse to Newcastle, for onward shipment — some or all to London, some possibly directly to the continent, where the Newcastle Merchant Adventurers had well-established connexions going back to medieval times.[81] Whether any graphite was taken, at this period, directly by road to London seems very doubtful. Until the turnpike era, when a regular carrier's wagon plied upon improved roads between Kendal and the capital, pack-horse transport would hardly have been an economic proposition, unless managed by a third party who could expect to pick up a sufficiency of return loads.[82] The consignment of only 5 tons or so,

mentioned above, was conveyed in 156 firkins weighing between 72 and 76 lb. apiece; and supposing that each animal carried four, there would nevertheless have been a requirement for a train of 39 or 40 animals, or rather for two trains of 20, perhaps a double journey for a single train of 20.[83] When as much as 70 tons was to be transported, as in 1662, we reach the figure of 530 loads, 26 or 27 journeys for a team of twenty beasts. The advantage of the overland route to Newcastle, doubtless via Appleby, Barnard Castle, and Durham, and conveyance by sea to London, was very considerable. In 1569, it cost £1 to ship eight tons of iron from London to Newcastle, and £20 (plus nearly £2 handling costs, tolls, etc.) to complete the journey to Keswick by road, about 120 miles.[84] The shortest route to London, via Preston, Lichfield, Coventry and Dunstable, as shown by Bowen, was 286 miles,[85] and at the same rate this load would have cost nearly £50.

Although the periodic closure of the mines worked to the advantage of both contracting parties, the position of the proprietors was far from easy. As the value of the mineral soared to around 30s. a pound in the 18th century, illicit working became ever more grave a danger. A particularly cunning attempt took place in 1749/50, when one William Hetherington, who had a lease from the surface owner of High Wadhole Close (Fig. 1), Daniel Jopson, opened an adit ostensibly in search of copper — not without small success — driving it well away from the graphite deposits. In the timber lining of the gallery, however, a secret door was contrived, to give admittance to a branch which ran direct for the vein of wad.[86] Here, too, tools were kept for less discreet pilferers to borrow when working over the spoil-tips (an occupation, we are told, which brought them as much as 6s. or 8s. a day).[87] John Bankes solved the problem by buying

the ground concerned, and appointing Hetherington as his steward, in 1754 — a post which he held, at the salary of £20 per annum, until his death in 1766.[88] The 1759 plan, of which Fig. 1 is a simplified version, is his or at least contains his corrections: it is a curious piece of work, laterally compressed, and vertically distorted, as if based on a prospect taken from high up on the opposite fell above Seathwaite.[89] For the far more dangerous affray of December 1750, which resulted in the death of one of the "rogues" during an exchange of gunshots, and more than anything else precipitated the petition for the Bill of 1752, the reader may be referred to the account in the *Gentleman's Magazine*.[90]

Notes and References.

1 R. S. Ferguson, CW1 iii (1878) 27-30; acc. no. OM 103-4. I am much obliged to Mr Robert Hogg, B.Sc., F.M.A., for permission to publish the mould and for photographs and an impression.

2 25 Edw. III 5 cap. 2 (1351-2), *Statutes of the Realm*, I (London, 1820) 320; cf. Rogers Ruding, *Annals of the Coinage* (London, 1819), I 214-220, with reference to the drawing and hanging of the Abbot of Missenden for such offence not long after the passing of this Act.

3 Two gilt base-metal nobles of Hen. VI were among 2,000 coins in the Fishpool (Notts.) hoard and seven plated groats and pennies of Hen. VI and Edw. IV were among 219 coins in the Wyre Piddle (Worcs.) hoard: M. M. Archibald, *Num. Chron.* ser. 7 VII (1967) 144, pl. 11; ser. 7 X (1970), 160-1, pl. 12. See *Letters & Papers Foreign and Domestic, Henry VIII* (London, 1883), 477, for attempts to coin with dies in Wales, 1534.

4 A much overweight cast crown-of-the-rose (Hen. VIII) from a reworked mould was found on an old fair-site at Woodhouse Moor (Yorks.): J. P. C. Kent, *Brit. Num. Journ.*, XXXII (1964) 162, pl. 11. *L. & P. loc. cit.* also refer to unsatisfactory casting of groats at Strata Florida Abbey; cf. further S. W. Williams, *The Cist. Abbey of Strata Florida* (London, 1889), App., lxxvii-ix — I owe this ref. to Mr Peter Humphreys.

5 The mould shown in Plate II is in a poor dark blue slate and was found near Llandysul (Dyfed); National Museum of Wales. The circular buckle bears an illiterate inscription and is suggestive of a 15th-century date. The mould shown in Plate III is in a dark brown mudstone and was found at Low Lightburn, Ulverston (published by permission of Furness Museum, acc. no. 1115). The objects cast are studs and girdle-attachments, 16th century. The fragment was later used as a whetstone, one edge being polished.

6 L. F. Salzman, *English Trade in the Middle Ages* (London, repr. 1964), 198-202.

7 Hen. VII's coinage: G. C. Brooke, *English Coins* (London, 1966 ed.), 162-173, 260; last ecclesiastical coinage of York, *ibid.*, 185.

8 J. D. Gould, *The Great Debasement* (London, 1970), 57-58.

9 Cf. M. M. Archibald in *Coins and the Archaeologist* (Oxford, British Archaeological Reports No. 4, 1974), 262.

10 S. E. Rigold, *Brit. Num. Journ.*, XXVI (1952) 348-350. The groats ranged in date from Edw. III (1), Edw. IV (6), Rich. III (1) to Hen. VII (12 — open crown (1), double-arched crown (9), single-arched crown (2 with *cross-crosslet* initial mark); Burgundian double-patards of Charles the Bold *c.* 1467-77 (3)).

11 M. Lefebure, *Cumberland Heritage* (London, 1970), 79-82.

12 J. C. Ward, *The Geology of the Northern Part of the English Lake District* (Memoirs of the Geological Survey. London, 1876), 60-67; J. Postlethwaite, *Mines and Mining in the (English) Lake District* (Whitehaven, 1913 ed.), 113-114; also J. Otley, *Manchester Lit. & Phil. Soc. Mems.*, ser. 2 III (1819), 168-175, and id., *Descr. Guide to the English Lakes* . . . (Keswick, 1843 ed.), 179 ff. (a ref. owed to Dr Alan Harris). I am grateful to my colleagues in the Geology Dept. of the National Museum of Wales for guidance in the matter of the occurrence of the graphite and in other ways.

13 Granted to Furness Abbey by Alicia de Rumeli in 1209 in return for £150 and 10 marks in lieu of two horses: Coucher Book, ed. J. Brownbill, *Chetham Soc. Remains Hist. & Lit.*, N.S. LXXVI (1916), 568, 577. Fountains Abbey also had a Borrowdale manor. Details are well distinguished by Mr B. C. Jones, in notes kindly supplied, with much other help, by the Record Office, Carlisle. 1613 sale: Patent Roll 10 Jac. I pt. 21 no. 7; trans., CRO DL 294/3.

14 CW2 lxi (1961) 55-70. "Uring" is dialect, cf. *Surtees Soc. Pubns.*, XCIII (1894) 59, "a foother of leed ure" ("a fother [2352 lb] of lead ore").

15 PRO DL 42/32 f. 218. Trans. in Furness Public Library with other relevant papers of which Mr Fred Barnes, F.S.A., kindly sent Xerox copies which I checked with the originals in the PRO.

16 It has been said that the rent for the wad-holes was 15s 4d. in 1613, but this includes the 2s. rent for the salt-well, as the letters patent show.

17 *VCH Oxfordshire*, VII (London, 1962) 127. Dormer family, M. Maclagan, *Oxon.*, XI/XII (1946-7) 91-101, with slip as to the date of Ambrose Dormer's death: I am obliged to the Revd. E. P. Baker, F.S.A., for a copy of the parish register entry of 23 June 1566.

18 PRO Index 17596, 423. The Robinson lease is not copied in DL 42/35 where it ought to be. The Buck lease (next note) rehearses its contents and mentions the wad-holes, the salt-well, ironstone mines (?) at Plumpton Moor and some property at Ulverston. The general mineral rights enjoyed by Dormer in the Furness manor of Borrowdale are not included, because the monopoly of the Mines Royal under its Charter of 1568 (and already its articles of indenture of 1561) forbade it. It is curious that the latest lease known to the chancery, when the letters patent of 1613 were prepared, was Robinson's.

19 PRO DL 42/36, f. 201; cf. DL 5/22, p. 41 (lawsuit of 1597).

20 PRO Index 17596, 424, and Henry Bankes, "A State of the Wad Mine upon Settaure or Seatallor Common . . . and of the Wadd in the Lower Wad Mine . . ." MS. of 1771, copy of *c.* 1890 with new pagination, CRO DX 294/11, 82 [hereafter cited as "Bankes"].

21 Bankes, 83. The lease had nothing to do with the Mines Royal. On the Hechstetters, see W. G. Collingwood, *Elizabethan Keswick* (CW Tract Series, VIII, 1912), 124-125; 201-202.

22 Patent Roll 10 Jac. I pt. 21, no. 7. The Lincolnshire lands had formerly belonged to the monastery of Swineshead, as it happened a daughter-house of Furness, and chiefly remarkable as the place where K. John stayed after his disastrous passage of the Wash.

23 CRO has three copies made at different times, and also a 23 November 1614 bargain-and-sale between Whitmore and Verdon of the one part and Charles Hudson of the other part: he also purchased a moiety of the mines (CRO D/Ben Crosthwaite Tithes I). The question of the surface ownership is far too complicated to enter into in this paper. Most was in Bankes' hands by 1752, except for the common.

24 Bankes, 9. Lamplugh: on this branch of an extensive family see A. Jabez-Smith, CW2 lxvii (1967) 81-92. Charles Hudson was, I presume, the son of the John Hudson co-defendant with Tolson in the 1597 case.

25 25 Geo. II cap. 10, *Statutes at Large,* VII (London, 1764) 415-416. The purpose of this Act was to increase the punishment for breaking and entering the mines, stealing and receiving wad, and aiding and abetting such offences. An interesting feature of the Whole House committee-stage was a call for the reading of the preamble of the Statute 1 Edw. VI cap. 12 (*Statutes of the Realm,* IV (London, 1819) 18) which deals with the variation of punishment according to the climate of the time (*Journals of the House of Commons,* XXVI, January 1750-April 1754, 419). Under it, many offences were reduced from treason or felony to misdemeanour, the reverse of what was here intended, and quickly enacted to be effective from 24 June 1752. As felony, the offences were punishable by a public whipping and a year's imprisonment with hard labour; or by up to 7 years' transportation. As in the case of other hard measures, the effect of the Act was far from total: as late as 1771, Bankes records (p. 99) that "gunpowder was used by rogues in the night-time".

26 Hawtrey died in 1638, so that the whole moiety fell to Sir John Bankes (Bankes, 10, 12). On the family, see J. Hutchins, *Hist. and Antiq. of Dorset,* III (Westminster, 1868) 239-342, a ref. owed to Mrs J. Hudson of Dorset CRO. For Sir John and Lady Bankes, see also *DNB*. She was the heroic defender of Corfe Castle in two sieges against the Roundheads. The family usually found Tory M.P.'s for one of the two seats in their borough of Corfe. John Bankes (after 1691-1772) who was co-proprietor of the wad-mines with John Shepheard of Betty's Town (Co. Meath) when the 1752 Act was obtained, sat 1722-41; his brother Henry (1700-76), who succeeded to the moiety, having guided that Bill through Parliament, and was the compiler of the "history" of the mines in 1771, sat 1741-62, when he accepted the Commissionership of Customs. See R. Sedgewick, *The History of Parliament : the House of Commons 1715-54* (London, 1970) I 432. A certain "J. Banckh" of Keswick, mentioned in the Mines Royal accounts (*Eliz. Keswick,* 183) may have been Sir John Bankes' father.

27 CRO DX 294/4 is a copy of a receipt from Joseph Hechstetter (cf. note 21), son of Emanuel, dated 8 September 1625 and witnessed by two illiterates named Bankes, probably relatives of Sir John Bankes and in one case a purchaser of a tenement in 1614.

28 PRO DL 3/81, R10 (commission of Philip & Mary); DL 3/80, R10, R10a (certificates dated 16 September and 16 October, R10a being quoted here).

29 The earliest sough or adit in the Keswick region was cut by the Mines Royal in 1569 and later, and others *c.* 1600 (Goldscope, *Eliz. Keswick,* 40-41; Caldbeck, M. B. Donald, *Elizabethan Copper* (London, 1955), 172-173). Such adits were earlier very rare in Britain. Until the late 17th century at the earliest, all the work of cutting was done by hand, by gad and sledge with or without the help of fire-setting (on which see B. W. Holman, *Trans. Inst. Mining and Metallurgy,* XXXVI (927) 219-234). The adoption of gunpowder depended for success upon the invention of a tool capable of sinking a good cylindrical hole which could be plugged with a special metal tampon in two wedge-shaped pieces, one containing a hole for the fuse, which jammed in place under the force of the explosion and so caused the rock to burst asunder. See Thos. Birch, *History of the Royal Society of London,* I (London, 1756) 335, for the method, reported by Sir Robt. Moray from Prince Rupert; it was the invention of one M. du Son, who had used it in Germany, and is described at greater length by Moray in *Phil. Trans.* I (1665-6) 82-5, illus. facing 95. Thus as W. G. Collingwood noted in *Eliz. Keswick,* 114, cf. 145, a small barrel of gunpowder supplied to the Mines Royal people in 1571 was not for blasting, but for firearms. The only adit in the upper mine at Borrowdale, as late as 1771, was that extended by and named after the Gorton brothers in 1735-6 (Bankes, 101-102); and in the lower mine, Old Men's, prior to 1678, cf. a 1710 letter of Bp. Nicolson of Carlisle, quoted e.g. by Otley, *loc. cit.,* note 12, 170, and Lefebure, *op. cit.,* 85, which refers to the opening of this old level in that year after 32 years' closure of the mines.

30 PRO DL 42/32, f. 218.

31 PRO DL 5/22, p. 41. Briefly, half the 7 tons of wad valued at 20d. per stone, laid up on Buck's behalf in Wm. Braithwaite's barn at Seathwaite, had been seized on colour of a writ of replevin by the under-sheriff, Richard Tolson, acting upon the procurement of John Hudson, who went on to mine in the upper wad-hole and extracted about 200 stone more valued at 8d. a stone. It was alleged that the Crown "had not right" to let more than one wad-hole, namely the lower, since the other had been available as of right to the manorial tenants, who "have used to digge and carry awaie to their owne use all the Wadd there found". Furthermore, Buck had falsified the Robinson lease by adding an *s* to *wad-hole*, so working both at the rent applying to one. The case was brought by William Gale and his wife, Buck's widow. Judgement was for the plaintiffs with costs of £3. 6s. 8d. Tolson and Hudson were both fined £5, and Hudson was ordered to pay for wad still in his possession and not now restored — Buck himself had recovered some — at the stated rates. As to forgery, the court reserved its opinion; but the copy of Buck's lease (note 19) repeats the clerical error *les wadhole* in the first mention, and gives the correct plural form in the second. The plaintiffs therefore were to be allowed to continue working according to the terms of the lease, and there was to be no interference with them. On the other hand, a valuable concession was made to the tenants, who were in future to be allowed to dig in the upper mine when the mines were opened by the lessees (see p. 114), and to "take so much wadd as will only serve for the markinge or smuttinge of their sheepe and other their necessary use as they have done and not to sell the same or to dispose of it in any other sort. . . ."

32 R. D. Harley, *Artists' Pigments 1600-1835* (London, 1970), 146-147. *OED* cites *Howard Household Books 1481-90* for "blak chalke": the Howard connexion with Cumberland unfortunately comes too late for us to be able to suggest that graphite was in that case meant.

33 PRO DL 29/159/2508; 2509 for 1542-4 mentions the mine again with "nil return"; the account for 1541-2 is missing. The printed translation, *Chetham Soc. Remains Hist. & Lit.*, N.S. LXXVIII (1919) 653-654, uses "quarry" instead of "mine", omits the location in 2508, and has "at" for "al." in 2509. I am obliged to Mrs Patricia Moore of Glamorgan CRO for help in reading certain words in 2508, but the responsibility for the transcription is my own.

34 It would be interesting to discover when the use of wad for sheep-marking died out. "Red [ruddle] and wad marks" are mentioned in a petition of 1752 by the High Sheriff of Cumberland and others against complaints received by the House of Commons regarding dirt and foreign matter in wool, *Journals of the House of Commons*, XXVI 414. Bankes, 3, refers to the use of sludge from the washing of graphite for the same purpose "still", in 1771. The use of wad-marks probably declined with production in the 19th century. The last attempt to work the mines was between 1887 and 1891, cf. CRO DX 294/23-25, but whether sheep were marked with wad as late as this I do not know.

35 S. B. Gaythorpe's phrase, CW2 liii (1953) 98. [He states that no other book from Furness Abbey Library survives. An early 14th-century Geoffrey of Monmouth, presented by Abbot Dalton, is, however, recorded by N. R. Ker, *Medieval Libraries of Gt. Britain* (London, 1964 ed.), 89, now in the Bodleian Library.]

36 PRO DL 42/3 (first vol.), BM Add. MS. 33244 (second vol.).

37 C. Ainsworth Mitchell, *Nature*, CV (March-August 1920), 12-14, discusses the character of streaks made by natural and reconstituted graphite and metallic lead. Unfortunately he pays no attention to the very wide variation possible with natural graphite of different qualties.

38 Lines crossing, vol. ii, f. 86v; black to brownish-red, e.g. vol. ii, f. 199, but *passim*. Gaythorpe *loc. cit.*, figs. 1-2, shows typical rulings near initials, brownish-red, from vol. i, f. 7 and ii, f. 2.

39 E.g., vol. i, ff. 47v, 51v, 55.

40 Ward, *op. cit.*, 65-66.
41 E.g., vol. i, f. 117; ii, f. 185.
42 Vol. ii, f. 225.
43 Bankes, 93.
44 Bankes, 44.
45 Bankes, 3.
46 Note 31.
47 Conrad Gesner, *De Rerum Fossilium, Lapidum et Gemmarum Figuris Liber* (Zürich, 1565), f. 104: *Stylus inferius depictus, ad scribendum factus est, plumbi cuiusdam (fictitii puto, quod aliquos Stimmi Anglicanum vocare audio) genere, in mucronem derasi, in manubrium ligneum inserto.* "The stylus illustrated below [our Fig. 2 is enlarged from the tiny woodcut] is made for writing, from a kind of lead of some sort (artificial, I think; I hear that others call it English antimony) scraped to a point, inserted into a wooden handle." Since the nature of graphite was unknown, the identification with antimony is not disturbing: there are superficial likenesses. Only the adjective is significant.
48 S. Dale, *Pharmacologia seu Manuductio in Materiam Medicam* . . . (London, 1693), 650, addendum to p. 50. Early identifications of graphite with antimony colour the entry, cf. *ibid.*, 71 (Trans.) "Virtues: cools, dries, repels. Uses: esp. against strumas, and cold and phlegmatic tumours." The Revd. Thos. Robinson, however, says it is a remedy for cholic, and for the pain of gravel, stone, and the strangury; and gives the country people's mode of taking it, *Essay towards a Natural History of Westmorland and Cumberland* (London, 1709), 74-76.
49 Lefebure, *op. cit.*, 98.
50 I. Kappel, *Die Graphittonkeramik von Manching* (Manching II. Römisch-Germanische Kommission, Wiesbaden, 1969), with good account of occurrence. Crucibles, *ibid.*, Abb. 13.
51 R. P. Greg and W. G. Lettsom, *Manual of the Mineralogy of Gt. Britain & Ireland* (London, 1858), 2, mention a possible source "lately found" in Bannerdale, dismissed, however, by Ward, *op. cit.*, 67, and J. G. Goodchild, *Trans. Cumb. & West. Assn*, VII (1882) 104. Another supposed deposit, at Coniston, was inspected in 1666, cf. W. Rollinson, *Hist. of man in the Lake District* (London, 1967), 125 note. Greg and Lettsom mention other British sources in Cornwall, the Isle of Man, and Scotland, of which only the last has been profitable.
52 W. Rudolph, *Verhandlungen des historischen Vereins für Niederbayern*, LXXII (1939), 45-90.
53 In the Codex Theophili in the Wolfenbüttel Library; cf. F. M. Feldhaus, *Zeitschrift für angewandte Chemie*, 1918, 76, with vague allusion to other medieval MSS. Mitchell, *loc. cit.*, note 37, also refers to this codex and others through the medium of C. T. Schönemann's *Versuch eines Systems der Diplomatik* (Leipzig, 1818), II 108 [not seen by me], but dismisses the notion that graphite was used (on which Feldhaus, *loc. cit.*, is emphatic) on the erroneous grounds that the mineral was unknown "until about 1560".
54 J. Kentman, *De Omni Rerum Fossilium Genere . . . Libris aliquot* [publ. by Gesner in *op. cit.*, note 47], f. 5., Abr. Rees, *The Cyclopædia; or Universal Dictionary* . . . (London, 1819), XXVI, s.v. "Plumbago", gives a receipt of 1699 describing the preparation and application of the graphite. A little was mixed with melted lard, etc., and applied hot on the heated iron, which was then wiped.
55 *Lapis Flandriae* is mentioned by Andrea Caesalpino, *De Metallicis Libri Tres* (Rome 1596, Nuremberg 1602), 186, and is certainly graphite, presumably imported Borrowdale mineral. The name was given "because it is brought out of Belgium". It was used by painters in the form of "little whetstones cut to a point". Caesalpino is aware of German graphite, but mistakenly assumes it is the same as bismuth used with antimony in casting printer's type. In the 17th-18th century three English writers refer to the exportation of graphite in large quantities: Thos. Fuller, *Worthies of England* [1662] ed. J. Nichols, London, 1811, I 232;

Charles Leigh, *The Natural History of Lancashire, Cheshire, and the Peak* . . . (Oxford, 1700, 90-91; Thos. Robinson, *loc. cit.* The preposterous notion that graphite was used in glazing stuffs or as a mordant for dyes, which Fuller and Robinson repeat, probably cloaks exportation for crucible-manufacture, cf. note 60. Fuller's reference to the use of graphite by felt-makers, for colouring hats, seems to be sensible enough.

56 1752: in evidence to the Commons committee enquiring into the Bankes-Shepheard petition: "Mr Richard Gilpin said that he contracts with the Board of Ordnance for furnishing Iron Shot and Bomb Shells; and that Black Lead is used for washing the Inside of the Moulds, to prevent the Metal from burning and mixing itself with the Moulds; and that it answers this Purpose better than any thing yet found out." The petition itself says that the moulds were of iron: *Journals of the House of Commons,* XXVI 339, 365. Prince Rupert: T. Birch, *History of the Royal Society of London,* III (London, 1757), 8 (January 1672): "Dr [Chr.] Wren intimated, that his highness Prince Rupert had a way of making black lead run like metal in a mould, so as to serve for black lead again." This seems nonsensical as it stands, and is probably to be interpreted as suggested here, unless his highness was making pencil-leads from dust.

57 The greasy feel of some graphite must early have suggested this use, but I have found no reference prior to R.-J. Haüy's statement, *Traité de Minéralogie* (Paris, 1801), 103, that the powder was mixed with grease for lubrication. Rudolph, *loc. cit.,* 51, reports a letter of 1821 in which it is stated that graphite had been used instead of cart-grease, and was still exported widely to the North Sea, the Baltic, and the South Sea, where ships' rigging and cables were lubricated with it. Ottley, *loc. cit.,* 173, indicates a wide use in "anti-attrition compounds" by 1819.

58 K. Quinn, *Trans. Eng. Ceramic Circle,* VIII. 1 (1971), 61, quoting PRO SP 12/37, letter from Armigil Waade to Cecil; Sir John Craig, *The Mint* (London, 1953), 161.

59 Quinn, *loc. cit.,* 78; Ll. Jewitt, *The Ceramic Art of Gt. Britain* . . . (London, 1878), I 91.

60 Leigh, *loc. cit.,*; Robinson, *loc. cit.,* implies English manufacture by 1709. German black-lead destined for crucible-making arrived in London from Rotterdam aboard the *Queen Charlotte* in December 1769. The two casks containing some 43½ cwt were taken to the Customs House warehouse and were inspected by Henry Bankes, who, as Commissioner for Customs, was well-placed to do so. The mineral was in pieces from about 8 lb down to 2 or 3 oz, small pieces and dust, "but . . . none were capable of being made into pencils by reason of the Brittleness of the lead which would not bear to be cut to a point. It looked very well & in colour and appearance was very like the true Cumberland Lead. But the only uses it was fit for were after it was ground into a powder to clean Iron and Grates with and to be made up into bad pencils with a large blunt point such as the Jews sell in Reeds in the London Streets & to make crucibles with for which purpose only it is imported into this Kingdom. A pound of this dust is worth about four pence". (Bankes, 100-1). While on the subject of foreign graphite, it is of interest to record that "pens of Spanish lead", presumably graphite and from Mexico (true Spanish was highly pyritic and unsuitable for this purpose, cf. Haüy, *op. cit.,* IV 100) were recorded as part of a knight's equipment in 1595, cf. Feldhaus, *loc. cit.,* note 53, with ref.; and graphite from the East Indies was known by 1693, cf. Dale, *op. cit.,* 650, described as "the worst" sort. For New England graphite offered in Newcastle, 1642, see p. 120. For English sources other than Borrowdale, see note 51.

61 Rudolph, *loc. cit.,* 68, 86 note 84. The *Queen Charlotte's* cargo, see prec. note, was doubtless exported not as crucible-graphite but as blacking (*Ofenfarb*).

62 Georg Bauer, called Agricola, *De Re Metallica* Basel, 1557 ed.), 181-183.
63 Donald, *op. cit.*, 369-373.
64 *Ibid.*, 232, for importation of 200 assay-cupels and other gear in 1566; more "crucibles", 1568, *Eliz. Keswick*, 26; bone and bone-meal, *ibid.*, 141.
65 Note 31.
66 *Surtees Soc. Pubns.*, XCIII (1894), 58-59.
67 On the Ellison family see *Harleian Soc. Visitations*, XVI (1881), 110 (1563-4); J. Foster, *Pedigrees recorded at the Heralds' Visitations of Northumberland in 1615 and 1666* (Newcastle, n.d., *c.* 1890), 42. Robert Ellison, Benjamin Ellison and Ralph Lomax, to whom later reference is made in the text, are mentioned *passim* in *Surtees Soc. Pubns.*, XCIII (1894) and CI (1899). Members of the Ellison family not including this Robert are in C. H. Hunter Blair's list of mayors and sheriffs of Newcastle, *Arch. Aeliana*, ser. 4, XVIII (1940, extra volume).
68 Bankes, 81. Apparently dated 1624, but a note of Henry Bankes' says "it should be 1642 for Sir John Bankes was not a Judge in 1624". For 6 score lb to the cwt mentioned in this letter, note PRO DL 5/22, p. 44, where it is stated in the record of the court hearing of 1597 that such a figure "is affirmed by the Plaintiffs to be the rate that is accompted in that Countrey for a hundred of that matter or stuffs". In retrospect, therefore, the dealers were not asking anything unusual.
69 Note 67.
70 Note 59 for other foreign graphite known in the 17th century.
71 Bankes, 13.
72 Bankes, 24, cf. 86.
73 At first sight, it seems strange that so notable a Royalist lady should have been allowed to go about her business during the Rebellion and Interregnum. But *DNB* informs us that she was not molested after surrendering Corfe; and although Sir John's property had been sequestrated by the Parliament, Cromwell returned it after large payments had been made by Lady Bankes and her children.
74 Bankes, 24-25.
75 Bankes, 87-88.
76 Bankes, 88-89.
77 The figures are in some way corrupt: 64 tons as stated, but the total is £1,920.
78 Note 12; cf. R. F. Smithwick, *Art-Journal* 1866, 349-351, in an interesting account of pencil-manufacture at Keswick.
79 Bankes, 72.
80 Sir John Pettus, *Fleta Minor* . . . (London, 1683), as quoted by E. H. Voice in his paper on the history of pencil-making, *Trans. Newcomen Soc.* XXVII, 1949/51 (1956), 134, states that "of late, [black lead] is curiously formed into cases of deal or cedar, and so sold as dry pencils. . . ."
81 *Surtees Soc. Publns.*, XCIII (1894), xxiii; CI (1899), xi-xii.
82 There was of course a pack-horse trade, or service, between Keswick and London, and it was often used by the Mines Royal people for small loads and luxuries, as recorded in *Eliz. Keswick, passim.* D. and S. Lysons, *Magna Britannia*, IV: *Cumberland* (London, 1816), cxxv, describe the mode of transportation by carrier's wagon, the proprietor of which was "bound in a considerable sum for its safe delivery". The graphite was taken by pack-horse under armed guard from Keswick to Kendal, *Art-Journal, loc. cit.*; J. Fisher Crosthwaite, *Trans. Cumb. & West. Assn.*, I (1875-6), 68. By this time none was sold locally, except shepherds' gleanings from the abandoned tips (*Art-Journal, loc. cit.*): John Bankes had decided *c.* 1750 that local sales gave "a handle and opportunity to the Rogues and buyers of Stolen Black Lead to cover under the pretext of having bought it of the proprietors". (Bankes, 98.) Even the legitimate pencil-manufacturers of Keswick had to send to London for their supplies (Otley, *loc. cit.*, 173).
83 A. Raistrick and B. Jennings, *A Hist. of Lead Mining in the Pennines* (London, 1965), 271, give two to three cwt as the load of packhorses carrying ore.

84 *Eliz. Keswick*, 79, etc. The rate varied with the goods, but I have chosen iron as being a reasonable equivalent to wad for the present purpose.

85 Eman. Bowen, *Britannia Depicta or Ogilby Improv'd* (London, 1720), ed. J. B. Harley (Newcastle upon Tyne, 1970), 50, 90, 259.

86 Bankes, 90, and details on the 1750 plan of the adit, CRO DX 294/7. Hetherington could mine for copper because the Bankes-Shepheard rights covered only the graphite, and because the monopoly of the Mines Royal as to base-metals had been terminated by the Statutes 1 Wm. & Mary cap. 30 and 5 Wm. & Mary cap. 6, 1688 and 1693. Thereafter, ownership of such minerals was vested in the ownership of the ground. On the Jopson ownership and John Bankes' acquisition of the ground, see Bankes, 40-41 and 91-92.

87 *Gent. Mag.*, XXI (1751), 53.

88 Bankes, 92.

89 CRO DX 294/9, copy *c.* 1890. I have inserted the sites of Old Men's and the Hetherington adit. I have no information as to the exact site of Gorton's adit, which approximately lies towards the lower edge of the great spoil-tip, marked in the figure at the high wad-hole. The name, Gorton, is so given by Bankes. Other sources have Goaton's, etc., by error.

90 *Gent. Mag.*, XXI 40; *Journals of the House of Commons*, XXVI 339, 364-365 for other details.