ART. XVIII.—*The Nent Force Level.* By PAUL N. WILSON.

Read at Carlisle, April 6th, 1963.

THE Nent Force Level is a mine drainage level nearly five miles long which was driven from Alston to Nenthead in east Cumberland during the latter part of the 18th and early 19th centuries. It was an outstanding mining venture, started at a time when lead-mines throughout the country were entering a period of great prosperity, and although we do not know what estimate of time was given for its completion, there can be little doubt that those who planned it realised that they would not live to see it finished. Comparable works were being carried out during the same period in Derbyshire and Cornwall, but for the boldness of its conception the Nent Force Level must take a high place in the mining history of the times. It failed in one of its main objects, namely to discover ore deposits in the unexplored strata below the bed of the river Nent, but as a drainage level it proved invaluable. If it had not been driven, many thousands of tons of lead ore would never have been raised, and a number of the mines of Alston Moor would have closed long before their lower seams were worked out.

The search for facts about its history has not been easy. Many of the early records of the Greenwich Hospital Estates have been dispersed, and a fire at the offices of the Vielle Montagne Zinc Company at Nenthead in 1930 destroyed much valuable material. Metalliferous mining in the area ceased some ten years ago, but most of the mines had closed long before. My information about the Level is far from complete, but because this great work may soon be forgotten by future generations, or, perhaps

worse, only a few vague myths may continue to be recorded, I think that it is worth setting out as much of its history as I have been able to discover. I hope that interested readers of the paper will be able to fill in gaps and, above all, draw attention to any inaccuracies.

The Historical Background.

Lead and silver were mined in Alston Moor from the 12th century and possibly for many years before.[1] By the beginning of the 18th century the methods of mining and of leasing mining areas were becoming established, though the system of paying royalties on the ore raised and payment to the working miners varied considerably. On Alston Moor small groups of "Adventurers" or companies with considerable financial backing took up leases from the owners of the land, and paid a royalty on the ore they extracted. Development was, in the main, on a small scale, and every effort was made to obtain a quick return with the minimum of capital expenditure. Shallow shafts were sunk, or narrow adits (tunnels) were driven into the hillside to follow the mineral vein, and exploration for new veins was often carried out by the crude but effective method of "hushing".[2]

At this time the Manor of Alston Moor belonged to James Radcliffe, Earl of Derwentwater, who threw in his lot with James Stuart in the Jacobite rising of 1715 and was beheaded in the Tower of London on 24 February 1716. His northern estates were taken over by the Crown, and were transferred to the Commissioners of Greenwich

[1] R. S. Ferguson, *Why Alston is in the Diocese of Durham, and in the County of Cumberland,* CW1 viii 23. This paper refers to the *Silver Mines of Carlisle* — accepted as the Alston Mines, many of which recovered a fair amount of silver from their lead — mentioned in the Pipe Roll of 31 Henry I, 1130-1.

[2] "Hushing" was carried out by building a temporary dam high up on a hillside above an area where it was known or expected that there was an outcropping vein below the surface soil. When the dam was full the wall was broken, and the rush of water, helped by men with picks and bars, would wash away the earth and expose the bare rock. Pieces of ore could often be recovered with little trouble or cost when the "hush" subsided. Many of the scars left by "hushes" can still be seen in the district and are named on the Ordnance Survey map.

Hospital in 1734. Local administration was carried out by two "Receivers", at least one of whom lived on the estate, and a "Moormaster" was responsible for the mine properties.

The London Lead Company, controlled by the Quakers, had considerable interests in the mines, and held a number of leases in the Nenthead and Garrigill areas. When the Commissioners took over, this Company increased their holding, and by the middle of the 18th century they had extensive mining rights in the upper Nent and South Tyne valleys.[3]

Thus, early in the second half of the 18th century, the mines of Alston Moor were owned by the Commissioners, administered by the Receivers, and worked at the head of the Nent valley by the London Lead Company, and from Nenthead to Alston by a number of "Adventurers" who had taken leases from the Commissioners.

The Mining Problem.

It does not come within the province of this paper to attempt to describe the detailed geology of Alston Moor. Very briefly it may be said that the formation comprises alternate layers of limestone, sandstone, and hardened clay. These vary in thickness and are faulted due to the movement of the earth's crust: they are tilted at a slight angle to the horizontal. The lead veins outcropped on both sides and at the head of the Nent valley, and as mining progressed it was found that others, approximately at right angles, lay deep in the hillsides. There appeared to be — and indeed there was — great potential wealth, and we must assume that the miners had little idea how deep the veins went below the valley bottom.

In following a vein downwards the miners sunk

[3] A. Raistrick, *Two Centuries of Industrial Welfare*, Friends Historical Society (1938), deals largely with the London Lead Company's work at Nenthead. Also by the same author, "The London Lead Co.", *Trans. Newcomen Society* xiv (1933-4) 119-162.

"sumps" or shafts from their adits, and immediately water became a problem. As long as they drove horizontally on a slight up-grade the water would drain out, but water collecting in a sump had to be cleared with buckets or a pump and this could soon set a limit to the extent of the working. Mining machinery was still primitive, and the small streams flowing down the sides of the Nent valley would have provided little power.

This dual problem of exploring for deeper veins and draining the lower workings must have been very much in the minds of the London Lead Company, the "Adventurers" and the Commissioners from about 1770 onwards, and between them they decided that the solution lay in driving the Nent Force Level.

The Commissioners of Greenwich Hospital and the Receivers.

The Receivers at this time were Richard Walton and John Smeaton (1724-1792). Smeaton was one of the most famous engineers of the 18th century. He built water-mills, pumping and blowing engines, "fire" (steam) engines and windmills, and acted as a consultant for many important harbour, drainage and inland navigation works. He is best remembered for building the Eddystone lighthouse which was completed in 1759. He was appointed a Receiver in 1764 and resigned the post in 1777.[4] During this period of 13 years he was busily engaged on engineering works all over the country. These included repairs to London Bridge and the design of a new water-wheel driven pump for the waterworks, the building of blowing engines for the newly formed Carron Ironworks, the bridge over the Tay at Perth and many river improvement schemes and harbour works. Most of his reports were made from his home at Austhorpe, near Leeds, and only occasionally does one find a letter

[4] Samuel Smiles, *Lives of the Engineers* ii (London, 1862) 3-89.

written from Newcastle when, it may be assumed, he was actively engaged in his duties as a Receiver.[5]

I think that there can be little doubt that Walton was the man on the spot who was responsible for the day-to-day running of the Northern Estates, and that Smeaton acted mainly as a consultant. Nowhere in the records of Smeaton's work have I been able to find any suggestion that he advised on mining methods, although he did design pumping and haulage engines driven by steam and water for use in a number of mines.

I stress this point because future generations linked Smeaton's name with the Nent Force Level to an extent which I consider quite unjustified. If he earned a credit which may be undeserved it is, perhaps, only rough justice that the Level should still be referred to by some of the older inhabitants of Alston as "Smeaton's folly"!

The activities of the Commissioners are recorded in the Minutes of the General Court and Minutes of the Directors preserved in the Public Record Office.[6] At a meeting of the General Court on 10 March 1774 they decided that although they had complete confidence in the ability and integrity of the Receivers, it would be as well if some of

[5] *Reports of the late John Smeaton, F.R.S.* (London, 1797), 4 vols. The *Reports* do not contain a complete record of all Smeaton's work, but it is notable that neither here, nor in such of his letters as are held by the Institution of Civil Engineers, is there any reference to the Nent Force Level. Several designs for mechanical equipment made for the Commissioners, e.g. machinery for Scremerston Mill, 1776, Derwentwater Smelt Mill, etc. are available in the library of The Royal Society.

[6] The Minutes are indexed under "Admiralty" at the P.R.O., and there is an excellent *Digest Ref.* ADM. 67-7846. This has a complete index, but this is so large and heavy that it is difficult to handle in a crowded reading-room. The distinction between *Minutes of the General Court* and *Minutes of the Directors* can be confusing. In general the earlier records will be found in the *General Court* and the later ones with which we are concerned *Minutes of the Directors* were bound annually, ADM. 67-24 being for the year 1774-5, ADM. 67-25 for 1775-6 *et seq.*

Relatively few of the *Minutes* deal with mining or the Northern Estates, but sandwiched between a mass of detail about the running of Greenwich Hospital itself anyone interested in the history of Northumberland and east Cumberland from the mid 18th to the mid 19th centuries may find a considerable amount of information of social importance.

There are also parcels of *In Letters*, not indexed, dealing with the work of the Receivers, Ref. ADM. 65-78. Glancing quickly through these I could find no reference to the Nent Force Level, but here again they probably contain much useful material.

the Directors visited the Northern Estates to see for themselves how things were going on, and to make recommendations aimed at improving the revenues. They were to go up that summer, accompanied by the secretary and a surveyor.[7]

The report on this visit was considered by the General Court at their meeting on 2 March 1775 and the resulting minute states that ". . . the Estate is capable of great improvement . . .". Although there is no mention of the proposal to drive the Nent Force Level we may reasonably assume that this was one of the matters discussed, and that the visiting Directors agreed that a plan should be prepared.[8]

The Level Planned and Approved.

Walton and Smeaton prepared a report on the proposed Level and submitted it to the Commissioners. It was evidently regarded as so important that consideration of it was deferred until one of the Receivers would be available to answer questions. Unfortunately I have not been able to find this report, and we must piece together what we can from the *Minutes* and the Plan of 1775. (Unfortunately it is not possible to reproduce this Plan in the *Transactions*.)

It has the following title:

PLAN of
NENT RIVER
Profile of its bed & Section of the Strata
under the same; as also
A PLAN of the proposed LEVEL for unwatering the SILLS and discovery of all Veins which intersect the Course of the said LEVEL from NENT FORCE near the town of ALSTON to NENT HEAD. Designed by
Mss^rs Walton and Smeaton
1775[9]

[7] ADM. 67-11, *General Court,* 10 March 1774.
[8] *Ibid.,* 2 March 1775.
[9] Mr E. C. Hamilton-Russell, F.R.I.C.S., M.I.Min.E., senior partner of William Armstrong & Sons, Newcastle upon Tyne, went to great trouble to find this plan amongst his firm's records.

From the minute of the General Court held on 16 February 1776 it will be seen that Walton (not Smeaton) came to London, and the undertaking was approved in the following terms:

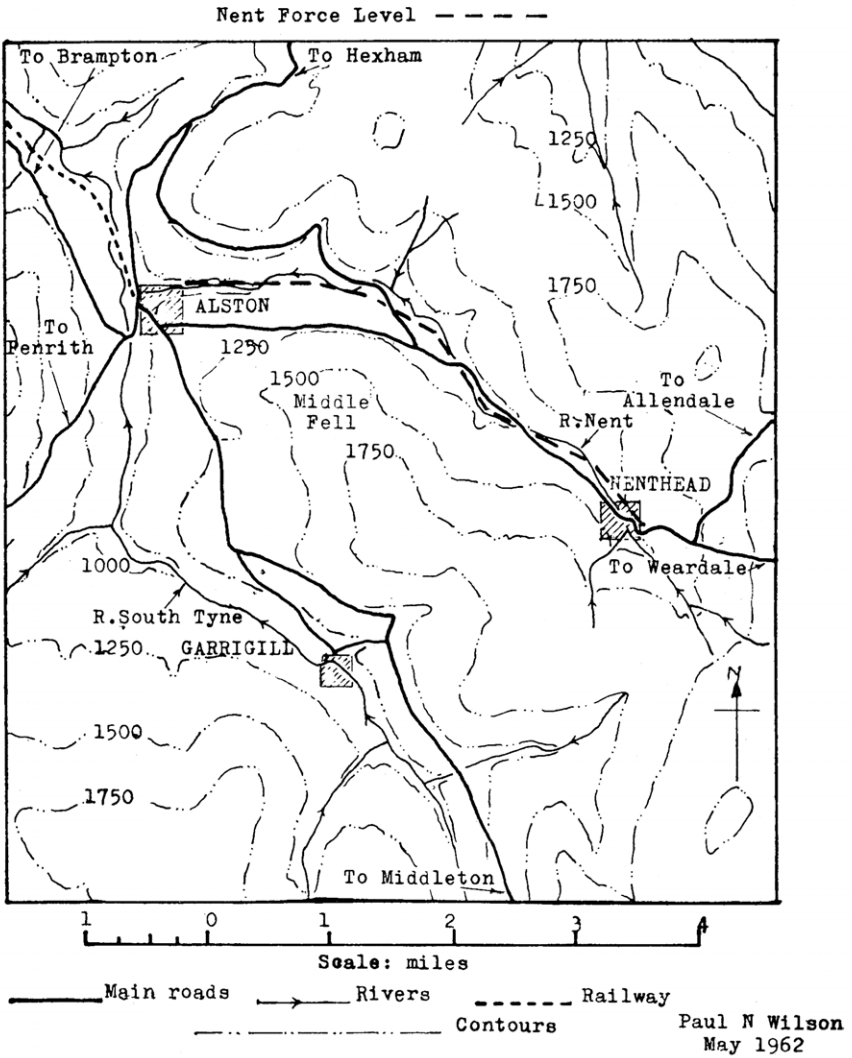
"The Secretary laid before the Court the Receivers Letter of the 24th May last upon the subject of the Level proposed to be begun and carried forward from the foot of Nent Force or Waterfall near the town of Alston to Nenthead by the general course of the Valley of Nent River, has hitherto delayed til one of the Receivers should be present, and at the same time observed that Mr Walton one of the Receivers who was come to Town to answer any questions The Court may have to propose to him relative to the said Level, — And the Court having taken the abovementioned Letter with the Plan and papers which accompanied the same into consideration, and being satisfied of the great Benefits which in all probability will result to the Hospital therefrom:

Res[d] That the said Level be begun and carried on in the manner proposed with all the dispatch and good Husbandry the nature of the undertaking will admit, and that a copy of the plan and section be left with the Moormaster for the inspection of the several Adventurers and Agents in Alston Moor as proposed."[10]

I have prepared Plan 1 largely from information obtained from the Plan of 1775. It is interesting to note that two lines of the Level are shown. The first is marked: "Course of the Proposed Level" and the second, bearing no description, is clearly the line as it *was* driven.

The original portal is shown on the *south* side of the river Nent at the foot of Nent Force. The line then ran straight to a point below Lovelady Shield bridge, then straight again to a point below Middle Cleugh Burn nearly a mile beyond the village of Nenthead. The length is 27,900 ft. ($5\frac{1}{4}$ miles) and it was apparently intended to drive *on the level,* and not with the usual upward grade of about 1 ft. per 100 ft. A number of named veins are shown by full double lines crossing the Level, and others, unnamed, are indicated by dotted lines close to it. Of

[10] ADM. 67-11, *General Court,* 16 February 1776.



MAP 1.

Alston, Nenthead and Garrigill, showing the area and the line of the level.

those shown in full, Blagill, North Grain and Farnberry veins lay between the portal and Lovelady Shield. It was presumably expected that the Level would cut these proved veins at a depth impossible to work economically without the drainage it would provide, and hence bring in some revenue at an early stage. The Level would have run at about 900 ft. above ordnance datum (A.O.D.) and no ventilation shafts are shown. This seems strange, as it must have been known that ventilation would become a major problem, and beyond Lovelady Shield ventilation or haulage shafts would have been from 300 to 800 ft. deep. Possibly it was hoped that the connections to existing and new mines on either side of the valley would provide an adequate supply of air. If this line had been taken, the first two ventilation shafts would have been some 50 to 100 ft. deeper than those actually sunk. This fact may have influenced the change in the plan.

The second line on the Plan may have been drawn as the work progressed or have been added at a much later date when a report was called for by the Commissioners. The main difference is in the section from the portal to Lovelady Shield. The portal is located about 300 ft. downstream of the point originally proposed, and on the *north* bank of the river at an elevation of 890 ft. A.O.D. The line follows very closely the bed of the river, as can be seen from Plan 1 and Plates I and II, and the change was presumably made before the work was started on 10 June 1776.

The Level as an Underground Canal.

Before dealing with the history of the Level from its start in 1776 until its final closure and sealing off early in the 20th century, I would like to examine the evidence available to see whether or not it was intended to be used as an underground canal for carrying out the rubbish in boats as it was driven and also, possibly, the

ore from some of the workings which it was hoped it would open up.

It was planned at a time when great industrial development was taking place, particularly in the north. Road transport was proving quite inadequate to deal with the movement of raw materials, and only the crudest of "rail ways" were coming into use. The canal suddenly appeared as the answer to all major transport problems, and it is significant that the Duke of Bridgewater's canal from his colliery workings at Worsley to Manchester, opened in 1761, started far inside the mines.

John Farey, describing and listing the long drainage levels (called "Soughs") in Derbyshire in the 18th century states about several of them: "Boats were used in it".[11]

Nellie Kirkham, writing of Hillcarr Sough which was started in 1766, is more specific in her information:

"Underground places were excavated for loading boats, as they boated the rubbish out. In the Reckoning Book one reads that they boated pipes up to the face, and in the 1780's they were boating ore down at the cost of 1s. 4d. a load, as much as thirty boatloads occurring in a reckoning . . . But boating was not without its troubles, there are a number of entries on the lines of 'setting a sunk boat at liberty'."[12]

C. Le Neve Foster, in his article on "Mining" in the 9th edition of the *Encyclopaedia Britannica,* 1878, says of underground transport in mines in Germany:

"A few instances of transport by boats may still be met with. The boats used in the underground canal at Klausthal are 31ft. long by 4 ft. 6 in. wide, and 2 ft. 11 in. deep. Each boat carries 5 or 6 tons."[13]

These references show that underground transport by

[11] John Farey, Sen., *Agriculture & Minerals in Derbyshire* i (London, 1811) 328. Particular soughs mentioned are: Hill-car, 3 miles long, Meerbrook, 1½ miles long, and Hollingwood Common.

[12] Nellie Kirkham, *The Draining of the Alport Lead Mines, Derbyshire.* Paper to the Newcomen Soc., London, 1 February 1961. It will be published in Vol. XXXIII of that Society's *Transactions.*

[13] *Encyclopaedia Britannica,* 9th edn. (1878), reprinted 1899, Art. "Mining" 455.

water was very much in the minds of mining engineers at this period, and W. Wallace, in his book: *Alston Moor: Its pastoral People: Its mines and miners,* throws some light on the ideas of people connected with the Alston mines. He first refers to the fact that John Gilbert, 1724-1795, who almost certainly did more for the Duke of Bridgewater's canal works than the more famous Brindley, and was a very good engineer, took shares with the Earl of Carlisle and others in a mining venture which involved taking up a number of leases on Middle Fell, between the rivers Nent and South Tyne, in 1771. Wallace says:

"They proposed to Messrs. Walton and Smeaton to make two navigable canals, one below the Tyne and the other on the west side of Nent river. On 30 May 1778 they obtained this lease. Mr Gilbert's plans of these proposed works were once in my possession. On these plans the underground lough or canal on the Tyne was drawn to begin on the east side of the river, a little below Middle Craig farmhouses and continued . . . to a point on the east side of High Lee house, and to 20 fathoms north of the Priorsdale boundary. The other lough or canal was shown to commence at the junction of Gallygill Well syke with Nent River, and continued in a straight line through Greengill veins, at their intersection with Greengill Moss veins, with other veins."[14]

He goes on to state that an attempt was made to drive the South Tyne "Canal", a shaft being sunk at Beldy Gin near Garrigill. The section was 9 ft. square which was the approximate *revised* size of the Nent Force Level. Hard basalt was struck at the required depth, and only 180 to 200 ft. were driven before the venture was abandoned.

A minute of the Directors shows that although the Nent Force Level was to be driven "on the level" it was intended, in accordance with contemporary practice, to be as narrow and as low as possible. It is an *alteration* in the dimensions which indicates a significant change

[14] W. Wallace, *Alston Moor,* etc., Newcastle upon Tyne (1890) 124-127.

in thought. The minute, of 11 June 1777 (a year after the Level was started) reads as follows:

"That they [the Receivers] be directed to cause a quantity not exceeding 50 fathoms [300 ft. This, at the rate of progress which will be discussed latter, would represent about 9 months work] of the Level carrying on from Nent Force to be made 10 ft. wide instead of 3 ft. 6 in. the present width, and also somewhat higher as recommended to them by Mr Gilbert the principal Agent to the Duke of Bridgewater's Works, that it may serve as a navigable Canal; in order that it may be seen whether the expense of making the said Canal will not, as he represents, be greatly different from that of making the said Level of the size already begun."[15]

The next minute, of 11 February 1778, suggests that the Directors were in favour of carrying on at the larger size, and there is general agreement amongst future writers that the average dimensions — though they varied considerably in different rock formations — were 9 ft. square. The minute reads:

"A letter of the 30th of last month from the said Mr Walton and Mr Smeaton was read containing the result of the Trials which have been made with respect to Nent Force Level, and their sentiments concerning the further prosecution of that work.

Ordd That the said letter be laid before the next General Court for their information and direction."[16]

Fortunately not all the "Reports" from the Receivers were lost, and Mr A. Holden, Receiver and Agent of the Greenwich Hospital Estates at Greenwich in 1960 has been able to quote me an extract from one of 1805 which seems to clarify the situation. At this date the Level had reached a point 11,472 ft. from the portal, between Foreshield and Lovelady Shield shafts, and the Directors had called for a full report on the cost of the work, and the time and expense required for its completion. The Receivers pointed out that wages were rising and it was difficult to make a forecast, but they had found a new way of keeping down costs. They state:

[15] ADM. 67-25, *Directors*, 11 June 1777.
[16] *Ibid.*, 11 February 1778.

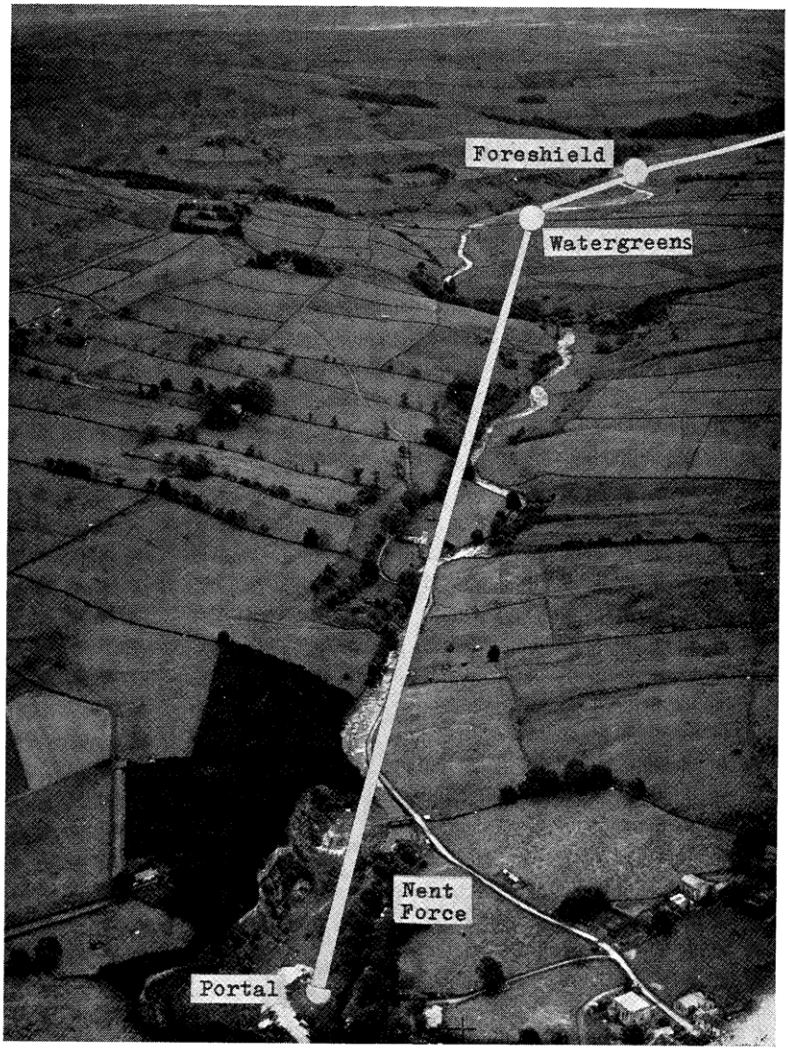


Photo: Dr J. K. St Joseph

PLATE I.—Nent Valley, looking east from above Alston. The white line indicates approximately the position underground of the Nent Force Level. The circles are ventilation or haulage shafts.

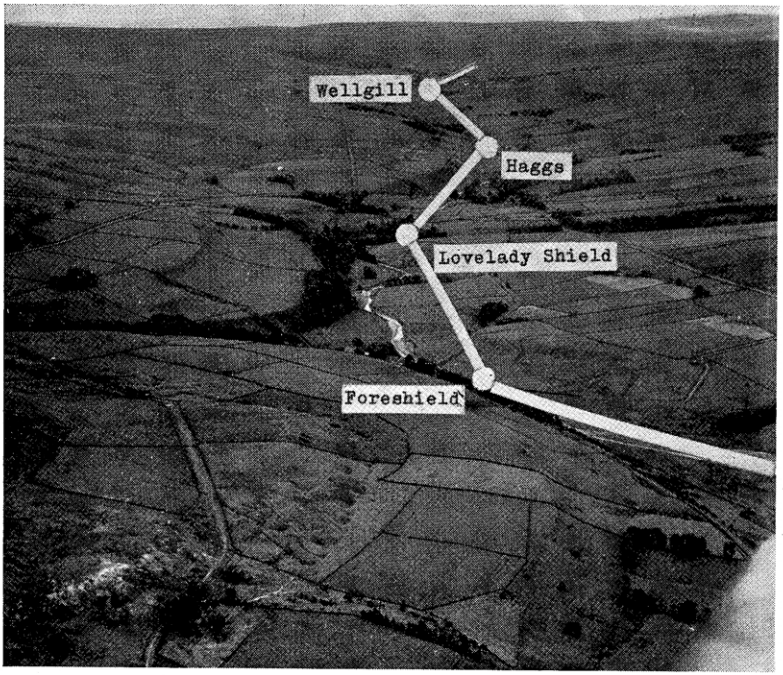


Photo: Dr J. K. St Joseph

PLATE II.—Nent Valley, looking south-east from Blagill. The white line indicates approximately the position underground of the Nent Force Level. The circles are ventilation or haulage shafts.

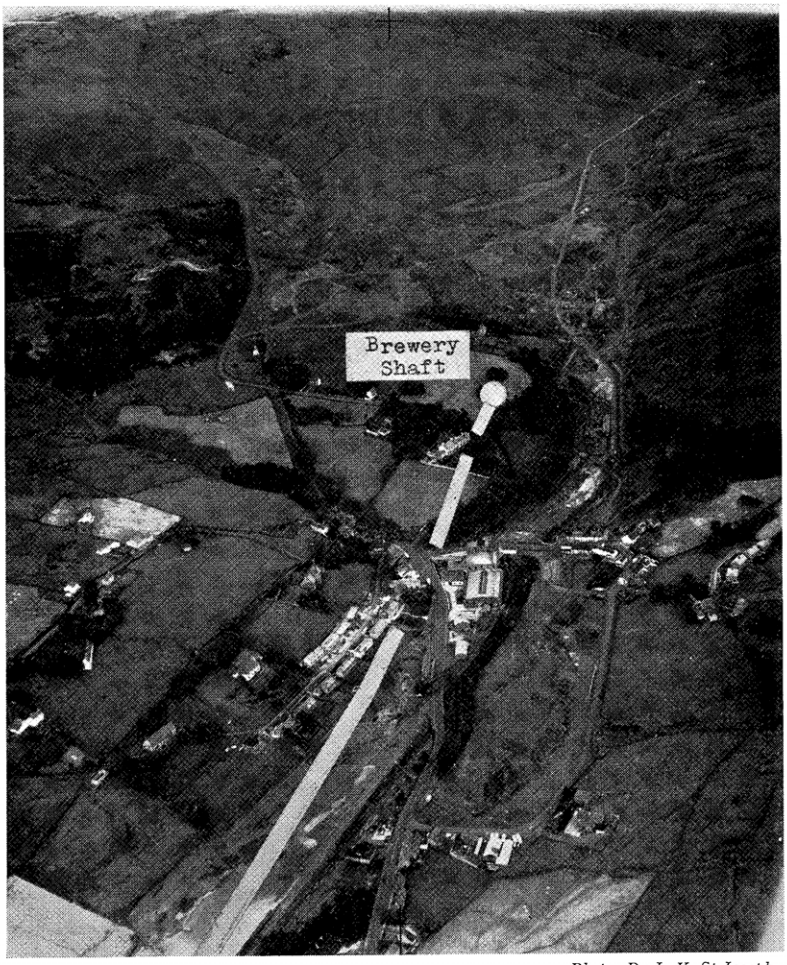


Photo: Dr J. K. St Joseph

PLATE III.—Nenthead, looking south-east. The broken white line indicat s approximately the position underground of the Nent Force Level, terminating at Brewery Shaft, Rampgill.

PLATE IV.—Portal of Nent Force Level, *circa* 1900. Reproduced from a lantern slide in the possession of Mr Fred Kearton of Alston.

"... the conclusion naturally to be drawn would be that the expense must be increased in proportion [to the length of the Level and the time taken to complete it] and so it undoubtedly would but for an ingenious, and useful alteration which has been recently made in the level, namely, by converting the bottom of it from a road into a canal, and using boats, instead of carriages and horses, to carry out the rubbish. The advantages to be derived from this alteration may reasonably be expected to be great ..."[17]

Lovelady Shield shaft, reached about 1810, was 13,325 ft. from the portal. It is difficult, from the sources of information available to be exact, but it appears that in five years only 1,850 ft. were driven, an average of 370 ft. (123 yds.) per annum. This was below the average rate from 1776 to 1805, and unless other factors slowed the work, it looks as though "boating out" showed no material advantage.

I think we must assume that the idea of using the Level as an underground canal was in the minds of the Receivers from the start, and that in 1777 it was approved in principle. Then the men on the spot decided that it was better to cart out the rubbish in the conventional way, and it was only when the cost of transport became a major factor that "boating out" was adopted. When Lovelady Shield shaft was reached there was a complete change of policy. A new section, starting at an elevation of 1,100 ft. A.O.D., and rising on a slight grade was driven, and there was no further thought of using the Nent Force Level as an underground canal.

The Driving of the Level.

At about the same time as authorisation to increase the width and height of the Level was given in 1777, a vein was struck. A minute of the *General Court* reads:

"To be leased to Thomas Bates:

All that N & S running Lead Mine lately discovered in Nent Force Level and in future to be called Nent Force Cross Vein."[18]

[17] Captain M. L. Hardie, D.S.C., R.N., of the Royal Naval College, Greenwich, sent me this information from Mr Holden.
[18] ADM. 67-11, *General Court*, 27 June 1777.

The next entry in the *Digest of Minutes* is rather surprising. It reads briefly:

"14 December 1782. £180. 1s. 0d. to be paid for drink for the Men at Nent Force Level, but nothing similar to be allowed in future."[19]

This sum, nearly two hundred years ago, would have bought an enormous quantity of drink. We think of the men almost swimming in a tunnel flowing with rum and brandy! It may have been at this time that a drinking-glass was blown, round the rim of which is engraved: TO NENT FORCE LEVEL SUCCESS. This glass, a plain tumbler holding about half a pint, is in the possession of Mr Hugh Kearton of Alston.[20]

The true story appears to be less jovial, but we only have the Director's side. The minute is much the longest in the whole history of the Level; it reads as follows:

"A letter of the 15th of last month from the Receivers was read, representing that they are again constrained to move the Board upon the subject of the improvident Behaviour of Mr Joseph Walton [not to be confused with Richard Walton, the Receiver] the late Moormaster, who died some time ago insolvent in having ordered the Nent Force Level Workmen, Drink and Victuals to the amount of £180. 1s. 0d., as more particularly set forth in their letters of 26 December 1778 and 12 March 1779; and at the same time stating, that though the Parties to whom the money is due now think they cannot recover it of the Hospital by Law, yet, as they consider they have just demands which ought to be satisfied; never cease teazing them [the Receivers] when they go into Alston Moor upon the Hospital Business; and will most undoubtedly conclude, if they are not paid, that there is a want of confidence of the Commissioners and Governors of the Hospital in their Agents, which would bring discredit upon the Agency and consequently upon the Hospital affairs; it seems, independent of the wish which must arise in the Breast of the Board to relieve the distressed, to be a matter in which it would be good policy to discharge the Bills and particularly so, as the expenses were contracted by a man,

[19] ADM. 67-7846, *Digest of Minutes*, 14 December 1782.

[20] Kirkham, *op. cit.* "Mr D. Wild of Winster (Derbyshire) possesses a beautiful glass, engraved with a design and the words 'success to Hillcarr Sough'. The period is *c.* 1787."

who, though extremely improvident, had, by his Advice, been the means of getting many thousand pounds worth of Lead Ore which would, in all probability have remained untouched in the Manor of Alston Moor for years to come, had it not been for his attention to the Mines and the communication of his Opinion and Observations to the Adventurers, the Effect of which, in some degree, continues to the present time in the works now carrying forward.

And the Board having weighed well all the abovementioned circumstances, whereby it appears that the Debt, though unwarrented by any authority, was contracted by a person who was a very useful Servant to the Hospital, and probably with a view of promoting its Interests, by encouraging the workmen employed on the abovementioned Level to proceed with more alacrity and Vigour, in carrying out that great and useful work; and that, if the Parties to whom the Money is due and has been so long owing, are not paid, it may occasion much discontent and uneasiness in Alston Moor, and ultimately prove very detrimental to the Hospital's Concerns there, by bringing discredit upon its Agents and therefore

Res^d That the Receivers do forthwith cause the whole of the said Debt to be paid to the persons to whom the same is respectively due; and charge the amount of it in their Contingent Account, taking care to make it publickly (*sic*) known, that no debt of the same kind will be allowed hereafter, on any account whatever."[21]

I must admit that I was mystified by this business until I read Miss Kirkham's paper. This clarifies the position. There was undoubtedly a close connection between the miners of Derbyshire and Alston Moor. John Gilbert (see p. 263) had shares in some of the Alport (Derbyshire) mines,[22] and Wallace says:

"It was talked in our family when I was a boy that my grandfather, William Thomason, and John Gilbert were both employed in the construction of the Bridgewater canal and that they both came into Alston Moor about the same time."[23]

The inscriptions on the drinking glasses relative to Hillcarr Sough and Nent Force Level are almost identical, and it is only reasonable to assume that traditional

[21] ADM. 67-31, *Directors,* 14 December 1782.
[22] Kirkham, *op. cit.*
[23] Wallace, *op. cit.* 127.

practices in Derbyshire were imported to Alston Moor. Miss Kirkham makes several references to special payments or gifts in kind to miners doing work under difficult conditions, and the following one is particularly interesting:

"As in other reckoning books, there are many entries of gifts to the men, such as 'Ale to the men when the cut was made larger' and 'allowed the Masons and men Ale to encourage them at different times', and '8 gallons of rum at 10s.'. A sheep was given to the miners, and meat and bread and ale, especially when sludging . . ."[24]

It will be recalled that the widening of the Level was authorised in June 1777, and the first letter from the Receivers upon the subject of the unpaid bill was dated December 1778. Presumably during this period of 12 to 18 months the original small section was being widened and heightened, and the men, knowing what was the normal practice in Derbyshire, felt that they were entitled to special perquisites. The unfortunate Joseph Walton, not realising the enormity of his offence, granted their requests without obtaining permission from the Directors or General Court. The soughmasters of Derbyshire were private individuals who undertook to drive soughs for the profit they expected to gain, and were clearly prepared to pay extra to get on with the work. The Directors, however, like everyone connected with the Admiralty, lived in constant fear of the Treasury auditor, and this unauthorised expenditure on victuals and drink must have filled them with horror. It is a pity that we have no tape-recording of the discussions which took place before the minute was reluctantly passed!

There are no further minutes until June 1791 when the Receivers are instructed to give:

"An account of what money has been expended on Nent Force Level since it was first begun; to what length it has already been carried; what advantage has been derived from such expenditure; the further extent to which it is proposed to carry

[24] Kirkham, *op. cit.*

it; the probable time and expense which will be necessary to complete it, and the advantages ultimately to be expected from it."[25]

This suggests that the Directors were getting a little worried about the venture. No good veins had been struck (Nent Force Cross vein does not appear to have produced very much) and some of the Directors may have been in favour of giving up.

However, in 1795 the prospects were more cheerful.

"A letter of the 26th Instant, from the Receivers, was read, representing that they had the satisfaction to announce the discovery of a Vein of Lead Ore, by carrying forward Nent Force Level; that in September 1793 the said Vein was cut by that undertaking and in October following the Governor and Company for smelting &c Lead Ore, made a proposal to take the said Vein by the name of Hudgill Cross Vein and the Blagill Company by the name of Blagill Foot Cross Vein; that, ever since Grants had been made to them respectively, they had been making Trial for Lead Ore without effect til (*sic*) about Midsummer last, when the Vein was met with somewhat promising, and Ore, to the value of £1,200 and upwards had already been raised; that though such kind of appearances were not to be absolutely depended upon, yet by the testimony of Gentlemen of knowledge, the prospect was exceedingly flattering . . ."[26]

We move again to a personal note. In 1803 we learn that one of the workmen, Thomas Lee, suffered an accident:

". . . in the operation of blasting the rock [he] drew out the Pricker too suddenly, by which Fire was produced and he had the misfortune to receive a severe contusion in his Forehead and to lose an eye . . . to prevent similar accidents happening in future, they had caused the Hospital Workmen to be supplied with Copper instead of Iron Prickers which they hoped the Board would approve."[27]

The workman was sent to Newcastle Infirmary at the expense of the Hospital, and every care was taken of him.

[25] ADM. 67-40, *Directors*, 29 June 1791.
[26] ADM. 67-44, *Directors*, 31 October 1795.
[27] ADM. 67-52, *Directors*, 29 January 1803.

We now return to the Report of 1805, referred to on p. 264. This first gives a résumé of the purpose of the Level and continues:

"This work was begun on 1st of July 1776 [the memorial stone placed at the portal gives the date as 10th June] and from the accounts exhibited to us, made up to April last [1805], a period of nearly 29 years, it appears that two miles and 304 yards or 3,824 yards were then completed, at an expense of upwards of £26,000; the progress made has therefore been on an average, rather more than 130 yards in length each year, the annual average expense about £900, and the medium cost per yard in length about £6. 18s. 11d. should the undertaking be carried on to the extent at first proposed, a line of 4,976 yards remains to be executed, and supposing the future progress to be like the past, 36 years more, at least, will elapse before the work is completed, making altogether from the commencement in the year 1776 to the computed conclusion, a period of about 65 years."[28]

I have already quoted most of the remainder of the report dealing with the reduction in cost anticipated by boating out the rubbish. The estimate of time to complete was remarkably accurate: the Level took 66 years and not 65, and did not go quite as far nor at such a low level as was originally intended. What is surprising is that there should apparently have been so little improvement in the rate of driving over a period of 66 years, during which vast technological changes had taken place in all other forms of engineering.

In 1809 another promising vein — this time not named — was cut, and in December the Receivers were instructed to pursue the Level in such direction as they thought fit in order to cut mineral veins, and also to prepare a plan showing the veins ". . . which have been or may be discovered there."[29]

Some very serious re-thinking was evidently going on after 34 years of work which had produced singularly little reward. I am indebted to Mr Holden for a reduced

[28] See footnote 16.
[29] ADM. 67-58, *Directors*, 9 December 1809.

scale reproduction of the Plan of 1809. The title is as follows:

PLAN
of the
RIVER NENT
with the THICKNESS of the STRATA under the same
down to the present WATER LEVEL
and DISCOVERY of all LEAD ORE VEINS
which intersect the direction or Course thereof from
NENT FORCE near the town of ALSTON to NENTHEAD
May 1809

This plan indicates — not too clearly — that the forehead on 29 April 1809 was some 540 ft. north-west of Lovelady Shield shaft and had just cut Lovelady Shield north vein. The next minute, 9 June 1810, reads:

"A letter of the 1st Instant from the Receivers, was read, recommending that Messrs. Lowry & Co. may be released from any further expense in sinking Lovelady Shield shaft into Nent Force Level, in consequence of their having offered to the Hospital their Moiety of the Machinery erected for that purpose, and to lay out the money which would be expended by them in sinking the remainder of the said shaft, in making discoveries for Lead Ore on the East side of the River."[30]

At Lovelady Shield shaft the original policy of driving *on the level* was abandoned. No good veins had been struck, and we must assume that it was decided to continue it only as a drainage level and give up the idea of deep exploration. It was later connected to Hudgill Burn Mine[31] and to most of the other mines up to and above Nenthead. The second section was continued at an elevation of 1,100 ft. A.O.D. rising to 1,160 ft. at Haggs Mine, Nentsberry, and 1,170 ft. at Brewery shaft, Nenthead.[32] The Directors appear to have taken little

[30] ADM. 67-59, *Directors*, 9 June 1810.

[31] Hudgill Burn Mine plan, lent to me by Mr Hugh Kearton, Alston, states "Deep level [connecting to Lovelady Shield shaft] begun May 1829."

[32] K. C. Dunham, *Geology of the Northern Pennine Orefield* (H.M.S.O., 1948) 165 *et seq.* Most of the distances and elevations on Plan 1 are based on information obtained from this work.

interest in its progress, and the remaining minutes may be briefly summarised:

27 March 1817.	The Nent Force Level to be carried Southward from Nentsberry Haggs shaft.
18 June 1817.	A labourer, John Walton, who earned 19/- per week in the Level to be granted a pension of 1/- per week for life.
21 December 1822.	A statement of account of the expenditure on the Level and the return received from the Adventurers was presented.
29 June 1825.	The purchase of a piece of land for £40 to erect an Engine for Nent Force Level was approved.[33]

Westgarth Forster, who published the 2nd edition of his book on the geology of the area in 1821 makes the following reference to the Level:

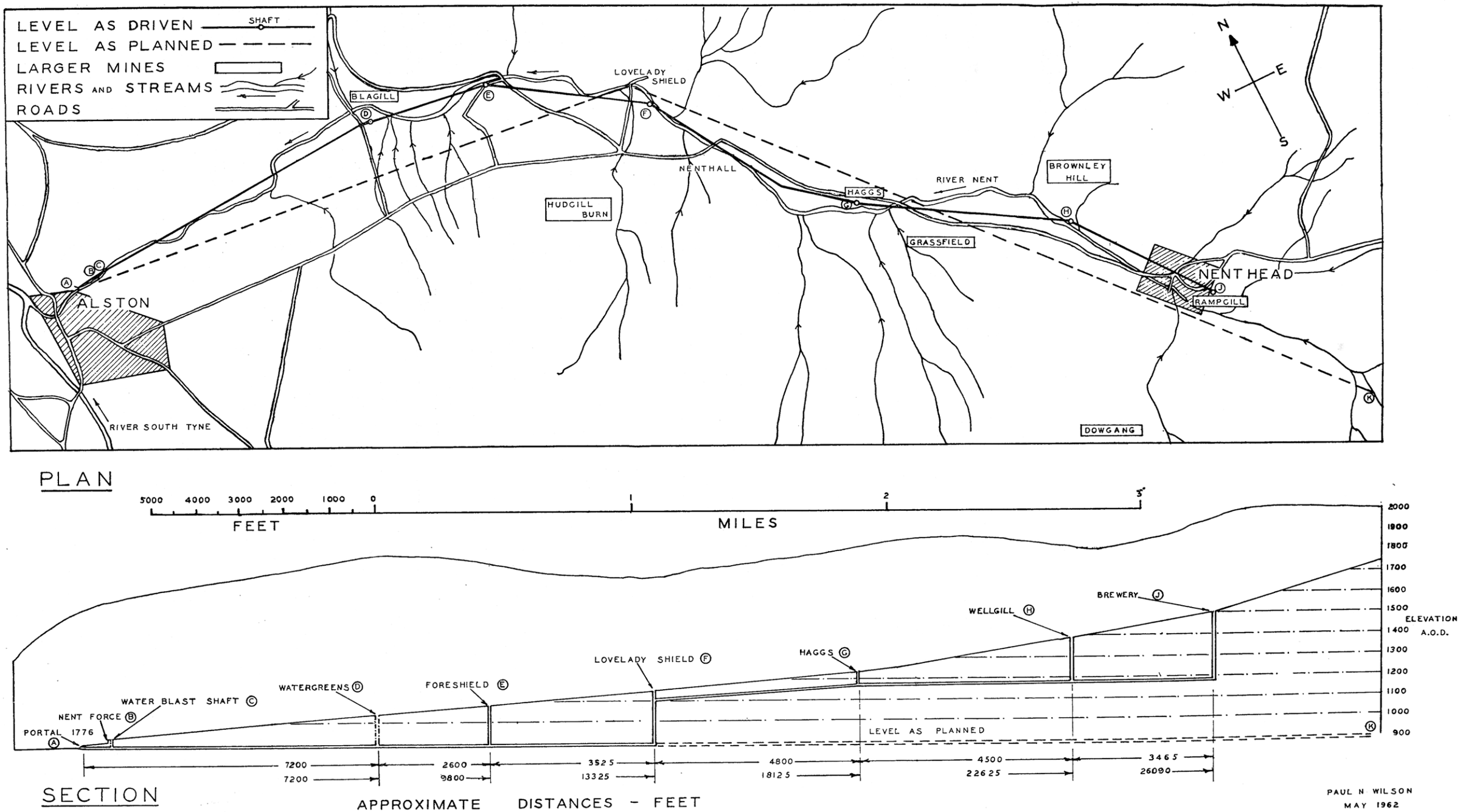
"The Acqueduct level of Nent Force, which is now driving down from Old Haggs engine shaft (sunk by the Commissioners and Governors of Greenwich Hospital for the double purpose of an air shaft and forwarding this Stupendous work) will very probably, be holed through to a drift in the course of two years and will then exceed two miles in length . . . The above shaft is the largest that has been sunk in Alston Moor; and the machinery is admirably adapted for the purpose there being a water-wheel for pumping the water from the works and a double-bucketted water-wheel for drawing the stone etc."[34]

The Commissioners completed the Level to Wellgill shaft near Nenthead (Ref. "H", Plan 1) in 1842, and erected a memorial stone at the portal engraved as follows:

[33] ADM. 67-66. *Directors*, 18 June 1817, and ADM. 67-7846.

[34] Westgarth Forster, *A Treatise on a Section of the Strata commencing near Newcastle upon Tyne, etc. . . .*, 2nd edn., Appendix II, 108 (Newcastle, 1821). The "double-bucketted" water-wheel was presumably of the reversing type as illustrated by Agricola.

Agricola, *De Re Metallica*, translated by H. C. and L. H. Hoover, from the original printed in Basle, 1556, *The Mining Magazine* (London, 1912). This illustration on p. 199 has been reproduced in many books dealing with the history of technology.



Plan and section of the Level, showing the position of shafts and other relevant information.

facing p. 272

NENT FORCE LEVEL
COMMENCED 10th JUNE 1776 and COMPLETED IN THE YEAR 1842
LENGTH 4¼ MILES
COST £81,000
PROJECTED BY MR JOHN SMEATON AND EXECUTED BY ORDER OF THE COMMISSIONERS OF GREENWICH HOSPITAL
THIS GREAT WORK WHICH BEARS THE NAME OF NENT FORCE LEVEL HAS BEEN SET FORWARD WITH THE APPROBATION OF THE WHOLE COUNTRY WHO SEEM IN A MANOR UNANIMOUS IN THEIR GOOD WISHES THERETO
REPORT OF RICHARD WALTON AND JOHN SMEATON RECEIVERS 21st JULY 1776

[35]

The second paragraph of the inscription is presumably an extract from a report submitted by the Receivers immediately after the work had started. It will be noted that, fifty years after his death, the work is credited to Smeaton, but I have already pointed out that there appears to be little evidence to justify this. It is an interesting example of how myths are born!

The final section of the Level to Brewery shaft (Ref. "J" on Plan 1 and Plate 3) was carried out later, but it is generally accepted as forming a part of the Level, making its total length 26,090 ft. or 4.94 miles.[36]

Engineering Features.

One of the greatest problems encountered when driving long levels, if not *the* greatest, was that of ventilation. This is put clearly by Agricola, writing in the mid-16th century:

[35] This stone was removed from the portal when it was demolished by quarrying operations early in the 20th century. It is now (1962) in the store of the Greenwich Hospital Estates at Alston.
[36] Dunham, *op. cit.* 165.

"If a shaft is very deep and no tunnel reaches to it, or no drift from another shaft connects with it, or when a tunnel is of great length and no shaft reaches to it, then the air does not replenish itself. In such a case it weighs heavily on the miners, causing them to breathe with difficulty, and sometimes they are even suffocated, and burning lamps are also extinguished."[37]

He illustrates a number of ingenious methods of ventilation, including bellows worked by men and horses, fans, and cowls to catch the prevailing wind.

Farey, dealing with the same problem at the beginning of the 19th century, makes the following observations:

"The driving of long Soughs, is apt frequently to be Interrupted or stopped, by want of fresh Air, or not being able to carry the wind with them: this, in Soughs and Gates where Boats are not used, is effected by laying a close floor of Boards, and stopping the cracks carefully with Clay, as the Sough proceeds, at a few inches above the stream of water in its bottom; along which *Wind-gate*, or Air-gate, the cold fresh air flows into the fore-field of the Sough, as the hot and impure air passes the contrary way, near to the roof of the Sough, and escapes. In some Instances, Air-trunks or Pipes are supported along the roof of a Sough while driving, and large Bellows are resorted to, to force fresh Air, or Bellows are used, or fire-places constructed, over the pipe's mouth, to draw foul air out of the Sough; such Pipes however seldom prove effectual in long Soughs, as is now experienced in Meerbrook Sough, above, but Air-shafts, which will next be mentioned, are forced to be sunk."[38]

It will, I think, be evident from the records I have quoted, that the Commissioners were not interested in the practical problems involved in the driving of the Level, except from the financial aspect. We must revert to the plans to determine how this all-important question of ventilation was tackled.

Professor Dunham quotes the first shaft as Lovelady Shield (Ref. "F", Plan 1) over 2½ miles from the portal. Mr Eric Richardson[39] told me that he had always regarded Foreshield shaft (Ref. "E", Plan 1 and Plates

[37] Agricola, *op. cit.* 200.
[38] Farey, *op. cit.* 329.
[39] Mr Eric Richardson of Nenthead has an intimate knowledge of the mines of Alston Moor and his help has been invaluable.

1 and 2) some 2,600 ft. from the portal as the first ventilation shaft, and it was only after he and I had studied the Plan of 1775, to which the line of the actual driving of the Level had been added, that we agreed that Water Greens shaft (Ref. "D", Plan 1 and Plate 1), 7,200 ft. from the portal, must have been sunk for ventilation purposes.

A further point of interest arises from a note on the Plan of 1809 which marks "Water Blast Shaft" about 300 ft. from the portal, just above Nent Force. Mr Richardson tells me that water from the river would be diverted down this shaft or bore-hole, and falling into a tub or box would help to force pure air up the Level and foul air out. He knows of other water blast shafts on Alston Moor.

The first use of cast iron rails *underground* has been credited to Nent Force Level,[40] but this must be accepted with some reserve as I have been unable to find any supporting evidence and similar claims have been made elsewhere.[41]

The statement that:

"Mr Thomas Dickinson, the present [*c.* 1830] agent or Moor Master of Alston, has made use of lead pipes for the same purpose in ventilating Nentforce Level."[42]

has also been interpreted by later writers as meaning that lead pipes were *first* used for ventilation in the Level.[43] Here again there appears to be no additional evidence to support the claim.

[40] Tom Sopwith, *An Account of the Mining Districts of Alston Moor*, etc. . . . (Alnwick, 1833) 118.

[41] James H. Rieuwerts, "Connections between the Pioneers of Civil Engineering and Mining Practice", *Peak District Mines Historical Soc.*, Vol. 1, no. 4, p. 11.

"He [John Curr] is given credit for laying the first cast iron rails underground [*c.* 1774] and this was probably at the Deep Pit Colliery, Bassett Pit, Sheffield."

[42] Sopwith, *op. cit.* 119.

[43] *The Industrial Resources . . . of the Tyne, Wear and Tees, etc.* (London and Newcastle, 1864) 135. The subject matter for this book was prepared by Sir W. G. Armstrong and others for the meeting of the British Association at Newcastle upon Tyne for their meeting in 1863. The quotation reads:

". . . Mr Dickinson first used lead pipes for the purpose of ventilation in Nent Force Level."

The Level as a Tourist Attraction.

By 1810 the "canal" section of the Level to Lovelady Shield was complete, and the forehead, 210 ft. higher up, was steadily moving away to the south-east. The age of tourism was starting, and a trip up the Nent Force Level became one of the attractions of Alston. Sopwith gives a good description:

"From the entrance near Nentforce [the Level] extends under the course of the river Nent for a distance of three and a quarter miles to Nentsbury (*sic*) engine shaft. Its dimensions are 9 ft. in height and the same in width, but in many places, owing to the nature of the beds, it is considerably larger, and in a few places is so much as from 16 to 20 ft. in height. It is navigated in boats 30 ft. in length, which are propelled in four feet water by means of sticks projecting from the sides of the level; and thus may be enjoyed the singular novelty of sailing a few miles underground, and beholding with perfect safety the various rocks which it passes through, owing to the rise or inclination of the strata, and also the numerous mineral veins which it intersects. The hanging rocks supended over the entrance with the romantic scenery adjoining, and the neighbouring waterfall, render a visit, even to the exterior, highly interesting; but this is much increased by a subterraneous excursion, which is frequently undertaken by strangers, and not unfrequently by parties of young persons resident in the neighbourhood. The old and often grotesque dresses worn on such occasions add to the mirth and cheerfulness which prevail — while the fine effect of vocal or instrumental music, and the exercise of propelling the boat, add to the singular feeling which is excited by the idea of so bold an adventure.

A voyage of about a mile in length, with the return, occupies as much time as will generally be devoted to such an excursion. More than this becomes tedious — the spirits flag, and the current of air, which is sometimes up the level and sometimes down, might prove unpleasant by a longer stay. As a number of candles are usually taken up, a variety of beautiful effects may be produced by leaving short pieces of them burning at intervals; the reflection of them in the water presents a fine spectacle, and, by this means also, some idea is afforded of the vast extent of the level by the receding vista of the lights. In the day-time the levelmouth is seen from upwards of a mile up the level; in sunshine seeming like a brilliant star with radiating beams."[44]

[44] Sopwith, *op. cit.* 30-32.

In those days the gorge below the Nent Force did not look as it does now. On the south bank there was a corn-mill for which, in about 1785, Smeaton designed a fine water-wheel 30 ft. in diameter.[45] The opposite side of the gorge was blasted out by the Nent Force Quarry Company, and is now being filled in by the Alston Foundry Company Ltd.

Walter White, describing a visit to Alston in 1859, refers to the Level, but did not himself take the trip up as he had already:

"... voyaged along a water level deep down in the Peak of Derbyshire and had no desire to repeat the adventure in Cumberland."[46]

Arrangements for the expedition were made by the proprietor of the Lowbyer Inn (now the Lowbyer Manor Hotel) which stands on the east side of the road from Alston to Hexham over Nent Bridge.[47]

Although the novelty of the underground adventure wore off for tourists it never did for boys, and the following descriptions given to me by Mr Fred Kearton combine the recollections which he and his brother, the late Mr Tom Kearton, have of the level.

"I can remember the entrance to the Level, when the walk to the waterfall was one of the most picturesque in the district before the Nent Force Quarry Co. started and the rock face was removed. From the Force cottage past the bridge with its iron gate leading to the factory there was a broad road built up from the river bed, protected from the river by a wooden post and rail fence. There were seats placed here and there and it was a sheltered and beautiful walk, much frequented by visitors. The entrance to the Level was at the bottom of the cliff. It was an opening about five feet high above the water line. There was a small dock or enclosure to accommodate the boats.

As boys we were thrilled by the stories told to us by our elders, and our imagination was fired by the idea of this under-

[45] Paul N. Wilson, "The Waterwheels of John Smeaton", *Trans. Newcomen Soc.*, xxx (1955) 25-48. Smeaton's original drawings for Alston Mill are preserved in the library of The Royal Society, London.

[46] Walter White, *Northumberland and the Border* (London, 1859) 40.

[47] Westgarth Forster, *op. cit.* 108.

ground level filled with water, which subsequently finished at Nenthead. We were already familiar with, and had explored the secret passage behind the waterfall, where, after removing a stone, which hid the opening, one boy at a time could crawl through and join the level some 50 yards from the entrance. At that point there was a narrow ledge where they could moor the boats which were used. I remember the pleasure we had when a small boat was brought by the Nenthead Mining Company to explore the waterway. Though the boat was supposed to be securely locked we soon found a way of borrowing it and embarking on a voyage of exploration.

The waterway was 9 ft. by 9 ft. with about 5 ft. of water. It was started in soft shale, which lies under the Scaur limestone, but as the strata is not perfectly level and rises to the south and east it was found necessary to enter other rocks and keep it level The water appears almost motionless with a very slow rate of flow. The air was fresh and still, and your voice echoed strangely if you shouted. For long distances it is quiet, but there are places near the upper end where falling water makes a great noise."[48]

"The level varies a good deal in width and height. In some places it is necessary to be flat in the boat and we had to propel it with our hands on the roof. In other places the roof was so high that when standing in the boat and shining a light you could not see the top. The boats were propelled by stakes driven into the right hand side of the wall.

We had often heard older people talk of the adventures and lovely nights they had spent in Nent Force Level dancing in Jennie's Dancing Loft.

The Dancing Loft is near the south end of the canal section of the waterway. (It may have been used for loading the boats to bring surplus spoil down the Level.) It is a platform cut out of solid rock, just above water height. The floor is smooth rock, a lovely dancing floor, and parties of young people used to go up the Level in boats, with good supplies of candles, taking their music with them. It must have been exciting and very romantic to hear the music and voices echo and to see the lights twinkling on the water."[49]

A hundred years after it was started the Level was fulfilling a function which can hardly have been visualised by Messrs Walton and Smeaton!

[48] Manuscript notes of the late Mr Tom Kearton, Alston.
[49] Additional notes by Mr Fred Kearton, 1960 and 1962.

The Useful Years.

From the early years of the 19th century until mining virtually ceased on Alston Moor in 1951, the Nent Force Level played a valuable part in keeping the mines clear of water. The Commissioners spent money on its maintenance, and Mr Hamilton-Russell has found several references to it in a mutilated Mineral Agent's record book covering the years 1882-1884. These include clearing the Level, repairing the roof with masonry, buying a new boat, and paying a reward of 10/- each to six men:

> ". . . for proceeding up the Level to rescue the miners engaged in repairing it."

An underground power-station was excavated in Brewery shaft by the Vielle Montagne Zinc Co., and two pelton wheels made by Gilkes of Kendal, one of 80 and the other of 140 horsepower were installed in 1903 and 1905.[50] They drove air compressors and an electric generator, and both discharged into the Level. As a method of prospecting for new mineral veins the Level was disappointing, but it certainly did much to keep an important mining area prosperous at a time when powerful centrifugal pumps and cheap electricity were unknown.

Conclusion.

All signs of the portal of the Level have now vanished. It is little wonder that I was baffled and disappointed when I first scrambled up the river-bed in August 1954 and could see no trace of "This Great Work"! The waste heaps of the mines it drained are sinking into the landscape, and what remains of the buildings are crumbling into decay. Sooner or later this must happen in every mining area, but I hope that this paper may help to keep

[50] *Records,* Gilbert Gilkes & Gordon Ltd., Kendal. Mr Richardson tells me that early in the 19th century the offices of the Vielle Montague Zinc Co. and some of the staff and workers' cottages at Nenthead were lit by electricity, and six electric street lights were put up in the village, the curent coming from the power-station in Brewery Shaft.

alive some memory of one of the most memorable features of the mines of Alston moors.

Acknowledgements.

My greatest helper in preparing this paper has been Mr Eric Richardson of Nenthead. He it was who took me over the ground and pointed out the tops of the shafts, and helped me to locate them with reasonable accuracy on Plan 1. He also lent me a number of books and maps, and provided much local information. Mr Holden and Captain Hardie of the Royal Naval College, Greenwich, provided me with the map of 1809, and put me in touch with Mr Hamilton-Russell to whom I am more than grateful for the original plan of 1775. The contributions made by Mr Fred Kearton and Mr Hugh Kearton speak for themselves; it is a matter of great regret to me that I met them too late to have a chance of talking to Mr Tom Kearton.

To all these, and to others at Alston and elsewhere who have assisted me directly or indirectly I tender my grateful thanks.