

NEIMME-ZB-14 Transcription

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The Water Gauge

Finding that great diversity of opinion as to the practical utility of the water gauge exists amongst running engineers the following short paper is brought before you with the view of clearing up in the minds of many the real use of this little instrument and also in the hope of raising a discussion on the subject of ventilation generally which may be both interesting & instructive.

The water gauge it need hardly be said is a V shaped tube with a double column of water in it, acted upon when in use by a different atmospheric pressure in either column.

The difference of these pressures as indicated by the difference of length of the column of water in inches is called the water gauge. It will therefore be seen that the water gauge is simply & purely a weighing machine, showing the difference of density between any two unequal atmospheres.

In practical application in collieries the water gauge is used in the following positions : in connection with the fan or fan drift showing the difference of open air or the inside of the fan or fan drift. This of course under normal conditions is the greatest water gauge obtainable on the colliery. Again it is used in furnace pits to show the difference of pressure between the intake & the return air at the furnace. It is also often placed at the bottom of pits in a cabin in the position showing the difference between the intake & the return air at the.....

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...immediately upon leaving and entering the shafts. And lastly it is placed upon the preparation (?) doors of different districts and it there shows the difference of densities between the 'intakes' and returns in those districts.

Let us now take into consideration the object with which the water gauge is placed in these various positions and discuss whether the results obtained agree with the expectations.

In the first place the water gauge generally placed on the fan Engine House is supposed in some mysterious way to be an indication of the state of ventilation of the Colliery. If the water gauge is standing at 3 inches, it is the custom to look (?) and remarks are made, on the quiet, as to the state of that particular Colliery. But if it stand an inch, everything is supposed to be in good order, the ventilation admirable, and the returns remarkably roomy. Now nothing could be more erroneous than any such conclusions, all the water gauge tells us is that either in one case the fan is running at a high velocity and erecting a large amount of ventilation power, with a result that the air drawn from the pit by it is proportionately ... or that in the other case, the fan is working well within its capability and expecting air so slowly that it is not in its passage round the mine to the same extent.

With a water gauge standing at say 2 inches and a speed of 50 revolutions of the Fan now matter how great the alterations in the course of the ventilating current, provided the temperature of the two currents be the same the water gauge will be....

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...the same with the same speed. The speed of the fan being maintained but of course with the shorter airway the velocity and also the quantity of the current will be immensely increased until the function of the two currents become equal.

Of course with a shorter current the indicated horsepower of the Engine will be greater because the power required to raise the larger volume to the same density will be greater.

But give the temperature of the currents as fixed the water gauge is simply an index to the Engineman of the speed of the fan.

With the object of testing whether this is carried out in practice the following experiments were made:-

The fan was run at a speed of 25 revolutions the indicated horsepower was..... The water gauge at the fan stood at.....inches, on fan drift.....inches, on fan drift inches the temperature of the external atmosphere was : F and in the fan drift F and the quantity of air in the fan drift measure....ft. per min.

During the experiment the ventilating current was passing in the ordinary course round the Colliery though at reduced speed.

A second experiment was then made with the top of the upcast shaft opened and two sets of separation doors at the pit bottom opened, so as to allow the air to take its shortest possible course through the fan drift.

The indicated horse power of the Engine was the water gauge on the fan stood at....inches on the fan drift the temperature of the external atmosphere was % and in the fan drift % it will therefore seem that the difference.....

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...of the water gauge in the two experiments was only.... Inches, which may be accounted for by the difference of temperature in the 'return' air as the following calculation as the return air will show.

In the next position that of near the furnace the gauge performs a very useful service to the furnaceman by indicating to him the state of efficiency on his fire. In this case the fire being burned down or too 'green' is exactly the same in reduction of the speed of the fan and a consequent increase in the density of the 'return' air; owing to a lower velocity and reduction of friction. In no position can a water gauge be of more service, than in this, for while it is possible to apply governors to fan engines to maintain a regular speed of the fan and a consequent regular ventilation, the water gauge is the only guide to a furnaceman to enable him to maintain a constant and uniform current of air, for although this could be done by use of anemometer it would be too difficult an instrument for a common workman to use, and not nearly so handy.

A water gauge placed immediately at the bottom of the pit connected with the bottom of the shafts, (as is frequently done) for the use of the underground officials, and to be recorded by them is of a practical value at all excepting as a check upon the fan or furnaceman in the execution of their duty. A water gauge placed here....

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.....must record an exact counterpart of that in the fan, or at the furnace, with the exception of the difference due to the friction of the shafts or length of road and the probable difference of the temperature.

The last position in which water gauges are placed viz: upon separation doors is one upon which greater misconceptions exist than upon any other.

It is generally supposed that a water gauge placed upon a separation door of any district will show the state of the 'return' of that district and compared with another from a , separate split, and it is commonly assumed that if a fall take place in a return the water gauge on a separation gauge will immediately rise. I will endeavour to show that as long as the ventilating power, whether fan or furnaces remain the same , no difference will be made upon the water gauge. It has already been shown that the variations of the water gauge are produced by exactly similar causes, whether with a fan or furnaces and therefore for the sake of argument a fan will be spoken of as the action of a machine can be more clearly brought home to mind.

It has already been shown by argument and experiment that the density of the air in the fan drift remains the same with the same speed of fan, no matter what quantity of air is passing along it.

If this is the case in the fan drift it must be the same in the bottom of the upcast shaft, and if at the bottom of the upcast shaft in each and every....

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...road delivering from that shaft, providing the distance from that shaft be equal and the temperature the same. Let us therefore suppose the pit is divided into three districts having three separate 'intakes' diverging at the same spot from the downcast shaft and return to the upcast at the same place . Three cross cuts are driven between each 'intake' and 'return' respectively at equal distances from the shaft and separations doors placed in them with water gauges upon each set of doors. Let the course of the air in one case travel 1 mile in another 2 miles and in the third 3 miles and first of all place regulations in the shorter returns on the wind side of the separation doors that is to say not between them and the shaft, and regulate the quantity of air passing around each district, until they are equal. This it will be conceded by everyone to cause the water gauges on all doors to be the same because the friction of the air in each case, and consequently the density of the air would be the same. But take away the regulations and what would be the result. Most people would say there would be a greater water gauge along the longest split, but such would not be the case. The fact is that the quantity of air passing round each district, would so adjust itself and form an equal rising until the densities in each would be the same.

In the long split a smaller quantity would pass with a slower velocity over a greater surface and be as rarefied by friction, whilst in.....

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...the short split a large quantity would pass with such an increase in velocity that it would also be rarefied to the same degree, such being the case a fall in the return has exactly the same effect on the above making a short return practically longer with a reduced quantity of air but with air in the same density.

It will be seen therefore that as in index as to the state of a driveway the water gauge is only a snare (?), and a delusion and the only efficient mode of ascertaining a change in the quantity of air is by frequent measurement of the quantity by such instruments as the anemometer.

The Water Gauge

Remarks on Mr Wright's paper on the above subject

Certainly the water gauge is a measure of the difference between two unequal atmospheres, but at the same time it must also be a measure of friction, for according

to (Atkinson page 40) the friction is greater or less in the same proportion that the density or weight of each (?) of air is greater or less, as that of each cubic foot of air had a double weight it would have a double amount of friction etc. and again (page 41) the friction in fact, increased or decreased in just the same proportion that the volume of a given weight of air increases or decreases, whether the change of density arises from changes of temperature or pressure. As.....

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...one of the laws of friction is that it varies as the normal pressure that friction of air on the rubbing surfaces of the airways of a mine, must vary according to the density and weight and consequently the pressure of the air, so that the water gauge is a measure of the amount of pressure required to overcome the friction or resistance to the air in the mine.

First position. I do not see how the water gauge in this position can be expected to be an indicator as to the state of workings, for it merely shows according to your argument the difference of density between the external atmosphere and the air in the fan which has been rarefied by it, but this air is rarefied to such an extent (apart from difference of temperature of workings and shaft) after having passed round the workings.

Therefore the greater the speed of the fan and consequently the more rarefied the greater the water gauge because the pressure of the external atmosphere remaining the same, whilst the air in the fan is being rarefied, the water in that leg the gauge exposed to the external atmosphere must be driven into the other leg exposed to the rarefied air, as the pressure on that leg is being decreased by the air being as rarefied. According to Atkinson 'the friction increased or decreased as the square of the velocity. How when the speed of the fan is increased so is the velocity, with the quantity so for double the velocity we should....

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... have a four folded resistance, therefore the water gauge. For it is apparent that the greater the velocity (the airways on the periphery of the fan remaining the same) the greater the quantity and the greater quantity of air pressing on each foot of area, the greater must be the friction. Therefore this increase of friction, together with the rarefying of the air in the fan I consider gives rise to the increased water gauge, so should I see a large water gauge on a fan, I should not condemn the airways, nor should I at once on the water gauge of the separation doors underground were large, but I should take warning at a sudden rise, the speed of the fan remaining the same. As an illustration of a large water gauge take Newport Abercain where the airways as you know were all very roomy, yet the water gauge was 3.10 inches with 163,000 cubic feet of air circulating.

Provided the speed and airways remaining the same. B yes but if you shorten the length of airways A now also lessens the friction which would greatly reduce the water gauge but this would be modified by the increased quantity of air for of course there being an increased quantity there would be an increased resistance as already shown. But perhaps the reduce friction due to the shorter airway might be greater than the increased friction due to the greater quantity and in this case the water gauge would less than before.

Second position. Therefore with increased velocity & reduction of friction....

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... the water gauge would be less exactly.

Third position. I consider it would be of use here were the underground officials in the habit of recording it, for they knowing that the fan would be kept at a regular speed. (excepting in case of an accident in which case word would be immediately sent down the pit, and the men withdrawing from the workings). Noticing a rise in the water gauge the sign might then be a sign that the cause was due to a fail in the airway or some other means of causing extra friction for Atkinson distinctly says that the water gauge may be increased by falls of material or other obstructions in the airways, even while they lessen the quantity of air circulating, because of the air. And why not? for even though they lessen the quantity, so do they lessen the airway, the increase (the friction I believe increasing as the square as the area is decreased) more in proportion to the lessened quantity than it would be with the larger quantity and airway because the velocity is increased the friction increasing as the square of the velocity. Therefore I take it, that for a smaller airway and a smaller quantity but an increased velocity the friction would be greater (and therefore the water gauge) for we all know that it is preferable to have a large airway to a small one, even though the quantity remains the same for by doing so we should lessen the friction as the square of the velocity. On your argument as to the splits you say that by removing the regulator from the short split, that most.....

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...people would say that the large split on the water gauge would be increased. I do not see this for of course the quantity and velocity would be reduced and as I have shown so would the friction and consequently the water gauge would be decreased not increased. You also say that within a long split a smaller quantity would pass with a smaller velocity is but it would be over the same rubbing surface as the larger quantity was lessening ever with a greater velocity, therefore the friction must be reduced. And again whilst in the short split a larger quantity would pass with such an increased velocity.

Therefore the water gauge would be increased according to my argument.

But placing water gauges on the separation doors of different splits I take to be intended any different light to what you do. You say that a water gauge placed on a separation door of any district will show the state of the return of that district compared with another from a separate split. I should place a water gauge on a separation door of any district to ascertain the resistance due to friction and also to observe if the water gauge constant, the spread of the fan being manufactured.

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Report of Walker Colliery December 9th 1882

Schedule A sinking and boring

Schedule B Mr Simpson's letter

Schedule C Estimated and recent cost of working

Schedule D Valuation of plant

Schedule E for sinking

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Castle Eden Colliery Offices December 18th 1882

Thomas Bell Esq.
Newcastle Upon Tyne

Dear Sir,
Walker Colliery

In obedience to instructions received from you bearing date November 20th 1882 I have viewed the Walker Colliery making a full and complete inspection of its present underground workings which are confined solely to the Low Main Seam (see plan 2) and have also made a careful examination of the plant including shipping staithes etc. and have secured data relative to the output and cost of working the Colliery with future prospects which I now have the honour to lay before you.

I find the Colliery to consist of one leasehold royalty of 1108 acres held on lease by the present owners from the City & Corporation of Newcastle, which lease I am informed expires in May 1883. On this Royalty there have been such numerous shafts two only of which.....so the present working seam and these are known as the Anne & Jane Pits both of which are situated in the township & local Board district of Walker being 3 miles east of Newcastle having a private railway from the pits to the shipping staithes at Walker (see p (?)) at staithes all coals vended from London market are shipped. The two pits mentioned were originally sunk for the purpose of working the famous Tyne High Main Seam but on this seam being partially exhausted or flooded with water the 'Anne & Jane'

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....pits were hibbed off and such to the Low Main Seam (see schedule A the former sinking it will be seen was continued to a point 26 fathoms below the present working or Low Main Seam when the Beaumont Seam was reached given as I am informed the following section—

Coal 2ft 4 in

Band 3ft 2 in

Coal 0ft 8 in

From this point you will observe (see schedule A) where a bore hole was put down at 15 fathoms below the Beaumont, the Brockwell Seam was bored into given the following section—

Coal 2 ft 11 in

Band 0ft 5in

Coal 0ft 6in

(see schedule A also Mr JB Simpson's letter to myself). Of the two shafts the Anne pit is the only pit fitted up, and at which coals are drawn. The Jane pit being used exclusively as the upcast or fan shaft and second outlet (see plan 2) . This Royalty is divided into two natural divisions by a Whin Dyke and other faults. The Jane has formerly been used in that part of the coal drawn shaft for that part of the Low Main Seam which lies to the South of the Whin Dyke, all available coal there in the Low Main Seam has been exhausted. The only available coal of this seam being on the north side of the Dyke, which is being worked at the present time and drawn to the surface at the Anne pit, nearly all of which coal is pillar working except a small tract between the south of that shaft between the Whin Dyke and a series of step faults against the Whin and over towards the Tyne. (see plan2). From careful measurements I found the sections of the seam to be in the several....

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.....districts as follows (see plan 2)

North Way

Good Coal	1ft	7 ³ / ₄
Slate Band	0	1 ¹ / ₄
Good Coal	0	11
Coarse coal	1	6
Good coal	1	4
	5	6

North West Flat

Good coal	1ft	3
Black stone	0	1 ¹ / ₄
Good coal	1	1
Black stone	0	8 ³ / ₄
Grey coal	0	3
Black stone	0	4
Good coal	1	0
	5	2

Main West from Byker Hill 600 yards from Main

North Line

Good coal	1ft	8
Black stone	0	1
Good coal	1	1
Black band	0	8
Grey coal	0	4
Good coal	1	6
	5	4

(5)

Good coal	1ft	8
Black stone	0	1
Good coal	1	1
Grey coal	0	4
Good coal	1	6
	5	2

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South East Flat of Shaft

Good coal	2ft	11
Band	0	11
Good coal	3	6
	5	8

From this I estimate from the plan attached that the coal which may be worked after the expiration of the present lease to be 400,000 tons, this would give for 4 years 100,000 tons per annum or 400 tons per day and if my information be correct (see schedule A & Mr Simpson's letter) I estimate that in the Brockwell seam which gives a workable section there will be (see schedule B as per allowings 15% for loss bt barriers and faults etc. 411.0.650 tons which for an output of 600 tons per day or 150,000 tons per annum reckoning 250 working days, would have a duration of 26 years. In this calculation I have only taken into account 2ft 11ins of coal neglecting the 6 ins. Beneath the Band, which may very probably be good coal. (see schedule A & Mr Simpson's letter). You will observe that the Beaumont Seam gives only a moderate section but which to some extent might be worked along with the Brockwell. I have not however calculated the quantity of coal available in that seam. This seam shows a very favourable section at the Wallsend pits which are in one of the adjacent Royalties. Then according to Schedule A & Mr Simpson's letter the Bensham Seam which is 24 fathoms above the Low Main Seam, gives a workable section of 3ft in the Jane Pit but only 1ft 8 in the Anne Pit, showing that south of Whin Dyke when the lower seams are exhausted the Bensham Seam may be available to some extent.

From my observations underground and on the surface my estimates of the cost of working the Low Main seam for.....

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.... 10 days per fortnight at 400 tons per day is 4/5.63 per ton which if we add 5/- for..... gives a cost of 4.7.83 per ton (see schedule C) cost for working the Brockwell at 600 tons per day would probably not exceed this. I estimate the value of Plant to ...at the expiration of this lease in May to be £3,702.10s (see schedule D). Staiths & shipping & berths. Two years ago £400 were expended in dredging and at the present state of sitting it will require to be redredged in August of... year at a probable cost of £400 and from this estimate it will cost £150 per annum to the Shipping Berths. Drainage. There are only some 14 gallons of water per minute to be dealt with in these pits which is easily managed by winding with water tubs 16 hours per week at the Anne Pit.

Ventilation. This is amply provided for by a 36 ft. Guible fan driven by three boilers at the Jane Pit.

Winding, the engine at the Anne Pit is sufficient for 600 tons per day from the Low Main Seam and with the addition of a balance rope attached to the under side of the cages and worked around a sheave at the bottom of the shaft is sufficient to wind that quantity from the Brockwell seam.

Chaldron Waggons. There are sufficient quantity at this colliery for the shipment of a much larger quantity per day of unscreened coal than one day's output provided that a larger hopper were constructed into which the coals might be stored as drawn out the pit, the wagons passing underneath this hopper for the purpose of being...

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...filled as it is done at many of our coking collieries at the present day. Should it not be determined to go to this expense, then the wagons are sufficient for the shipment of a day's working.

Valuation. Supposing it were determined to work out the Low Main Seam and then that the property be abandoned and the plant sold by auction. I estimate the present

value of this colliery to be as follows. The value dependant upon the colliery being kept regularly at work say for an average of 250 days per annum and the realised selling price of the coal being 5/2 per ton. I estimate a profit of 6d per ton and this calculated upon an output of 100,000 tons per annum. And allowing say 1/8th for colliery consumption and waste we have 87,500 tons per annum as available vend yielding a profit of £2187 per annum and as the mining risks are An average of the districts I would allow upon capital invested 12% interest....of capital being at 3% present value of an annuity of £1 for 4 years and allowing for going rates is worth 2.785 years purchase and £2.187 x 2.785 = £6090.15.10d. Again the present value of £1 due at the end of 4 years and allowing 5% interest is worth .822. Value of plant (see Schedule C being £3.702.10.0 its present will be £3.702.10.0 x .822 = £3043.9.1
£913.4.11

Advantages of this colliery. I beg to draw your attention to the following advantages which attach themselves to this Colliery. First. The.....of the Pit to the....Shipment Staithes.

Second. The use of private.....

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Railway from the colliery to the staithes and consequent low cost for leadage. Also the position of the pits being favourable to a large landsale trade being carried on.

Third. The very small cost if any for drawings of the pits in working the lower seams. The drawbacks are:

First. That there are only some 70 workmen's cottages attached to the colliery which entails the payment of high rents to workmen.

Second, That the rates and taxes are excessive which results from being in a Local board district. I would also draw you to the excessive charges for salaries which at present rate of working are nearly 4d per ton. Of the unworked seams (see schedule A & Mr Simpson's letter) the Brockwell seam appears the most favourable section.

Coal 2ft 11 in

Band 0 ft 5in

Coal 0ft 6in

The....or otherwise of this section besides the Beaumont seam northwards of the Anne Pit might be proved by putting a borehole down in the district straight north from the shaft. If then it were determined on working the Brockwell it could be sunk to at the Anne Pit which is the present drawing shaft and a staple sunk from the present Low Main Seam 50 yards from the hanging on. This staple being used as an upcast and second outlet, by this means you will be able to work the whole of the coal north of the Whin Dyke with the present plant and probably by putting through the Whin Dyke at that.....work...

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....north of the Dyke or in after years if found desirable the Jane Pit could be sunk to the Brockwell seam. To sink the Anne Pit and the staple as proposed and making the necessary alterations in the shaft so as to draw 600 tons per day from the Brockwell seam with the present engine power I estimate..... cost near £2525.16.11 (see schedule A) . In the sinking of this pit and staple I would propose a small engine placed at the Low Main Seam which afterwards may be used for hauling should be employed for staking the seam from the surface from two boilers not now in use by a range of steam pipes which are already in that shaft but have never been used. In my

estimations I have provided for the necessary alterations in the shaft so Guides and Buntons consequent upon having to wind from thedepth which alterations include the.....Guides and Buntons from the surface. I estimate a further expenditure of £1000 in providing new tubs and cages of a less size than those now in use consequent upon the passing places of the cages in the shaft being in the least part of the pit namely in the tubbing. If you determined upon working the Brockwell seam which if the section at the shaft may be relied upon (see schedule A) and at the continuity of that section is obtained throughout the Royalty the that would appear to be a prudent course to adopt. It could be sunk as a proposed holed round & opened up ready for the time when the Low Main Seam shall be exhausted, or what would be the better course to adopt would so commence and make preparations for that sinking immediately upon....

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.... taking over the colliery. In this case you will be able to work the Brockwell within 12 months from the date of commencing the sinking which could be done in the following manner (see section 1) Say by firing the Engine underground on the side proposed you could sink the staple down to the Beaumont seam driving across that seam and holing into the Anne Pit bottom. Which is sunk to the Beaumont seam clearing away the debris out of that shaft and winding up the staple after which I would continue the staple down to the Brockwell Seam to a point immediately underneath and vertical to the Anne Pit and put the shaft up over from the Brockwell to the Beaumont seam thus the necessity of interfering with the present shaft hanging on. When this completed in my opinion the best course would be not to interfere by making any alterations in the present shaft viz. cages, buntons or guides but to make the engine that is used for the sinking to wind permanently from the Brockwell seam to the Low Main Level winding all coals to the surface from the Low Main Seam by the present arrangements of winding power. The coals from then worked at the Brockwell Seam would be an increased quantity upon the present output, which output could be raised up to 600 tons per day within 18 months of the date of commencing of sinking from which period the output from the Low Main Seam could be diminished as the Brockwell Seam developed, thus securing the duration of the Low Main Seam for years to come.

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.... .delaying and probably preventing the necessity for the alterations to the shaft and introduction of new cages & tubs as proposed in the first instance., the expenditure being confined to the cost and expenditure of erecting the Engine which would cost say £300 and for the sinking of the Staple and the Shaft and the fitting the Staple with guides and a further expenditure of say £1500 being all the expense that would be necessary to prove and open up the Brockwell Seam (and if found desirable the Beaumont as well. Assuming the Brockwell Seam is as represented and that all the works necessary were completed as proposed in the former case viz. to draw 600 tons a day from that seam to the surface and that a 30 years lease from.....were effected and from that seam you commence at the expiration of 4 years to draw 600 tons per day and that the working cost is 4/9 per ton for the remaining 26 years of the lease. I estimate the value of the colliery would then stand you as follows: say for 250 working days per annum we have 150,000 tons from which deduct 1/8th for colliery consumption and waste then we have coal available for vend 131,250 tons yielding a profit of £4.921 per annum the value of an annuity of £1 all owing 12% to purchaser

and redemption of capital being at 3% and for 26 years commencing 4 years hence is 4.354 purchase and £4921 x 4.354---£21,426.0.0. To which add value of first 4 years in Low Main Seam (see page 11) viz. 6090.15.10
27516.15.10

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From which must be deducted cost of sinking and fitting up shafts as per schedule E
3525.16.11
£23990.15.11

I have not estimated the existing plant as being of any value, at the expiration of 30 years lease.

I have the honour to be your obedient servant
Matthew Heckels

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Schedule C

Produce 360 = 0960 tons
Vend 80% = 3168 tons calculated upon this

	Amount per ton	
	£ s d	s d
Underground labour including screening and walling	376.6.6	2.450
Bank labour including wagonman & staithman	76.16.8	5.82
Iron castings ropes stores etc.	70.0.0	
Timber of all kinds	50.0.0	
Horse provender	30.0.0	
Total materials		
Incidental expenses	4.0.0	
Saddlery	3.0.0	
Office charges rates, fares & salaries	39.0.0	
Rents per as agreement		4.50
Grand total	649.3.2	4 1.13
Total including rents		4 5.63

Cost per ton.....4/5.63
Percentage of Round Coal38.40%
To this cost add 5%

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Estimates for 10 days working underground Labour including Screening & Walling

1 Overman	@ 40/-	4. 0 .0
1 Backoverman	@ 20/-	3. 0 .0
7 Deputies 12 days each	@4/9 a day	19. 19. 0
Deputies drawing timber		5. 0 .0
1 Master & Shifter	@ 30/- a week	3. 0 0
2 Onsetters	@ 3d a score	4 .10. 0
4 Waggonway men	@ 3/9 a day	9. 0 .0
11 Shifters	@ 3/6 a day	23. 2. 0

2 Banksmen	@ 3d a score	4.10.0
1 Weighman	@ 17/6 a week	1.15.0
1 Master Wasteman	@ 25/- a week	2.10.0
3 Wastemen	@	5.17.0
78 Hewers	@ 12/-	216.0.0
11 Putters	@ 1/2	21.0.0
14 Screening 11 days	@ 4/- a day	28.0.0
7 Boys waiting	@ 11d a day	3.4.2
1 ditto	@ 1/4 a day	13.4
18 Drives	@ 1/4 a day	12.0.0
1 Heapkeeper 12 days	@ 4/- a day	2.8.0
3 Horsekeepers	@ 18/- a week	5.8.0
1 Crankman 12 days	@ 2/6 a day	1.10.0

Produce 960 tons

Available 3168 tons costs

Calculated upon this	s	d
Cost per ton	2	4.50
Bank labour		5.82
Cost per ton upon labour	2	10.32

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Estimates for 10 days working Bank Labour including Wagonmen & Staithmen

	Rates	Time	£	s	d
3 Brakemen	4/-	a day	8.	8	0
1 Enginewright	21/-	a week	4	0	0
3 Blacksmiths	@ 3/6	a day	8	16	0
4 Masons	@ 3/9	a day	6	15	0
1 Foreman			3		
1 Pick sharper	@ 3/-	a day	1	16	0
1 Lampman	@ 3/-	a day	1	16	0
1 Repairer	@ 3/-	a day	1	16	0
3 Cartmen	17/-	a week	5	2	0
2 Waggoner	@ 3/-	a day	3	12	0
4 Staithmen	@ 3/6	a day	8	8	0
2 Boys askwheeling	@ 2/2	a day	2	12	0
2 Hiremen at coal drawing pit	3/9	a day	4	8	0
2 ditto upload pit 14 days	@ 3/8	a day	5	2	8

Produce 3960 tons available vend 3165 tons. Cost calculated upon this.

Cost per ton	s	d
	0	5.82

[ZB-14-p27

Schedule D Valuation of Plant

	£	s	d
1 Winding Engine Anne Pit	300	0	0
1 Jack Engine	50	0	0
5 Boilers	150	0	0

3 Pullers @ 15/-/-	45	0	0
2 Ropes @ 20/-/-	40	0	0
10 screens@30/-/-	300	0	0
Screening shed headgear & other erections	100	0	0
174 wagons @ 3/-/-	510	0	0
Pit Branches etc	500	0	0
1 Fan	300	0	0
3 Boilers	90	0	0
2 Feed Heaters	30	0	0
1 Winding Engine	80	0	0
Rope & guide rope	50	0	0
8 horses@ 15/-/-	120	0	0
26 ponies@ 10/-/-	260	0	0
200 tubs@ 30/-	300	0	0
9.600 yds. rails £20 per yd. 85 ton@30/- per ton	127	10	0
1 Pump 3 throw pumps	10	0	0
300 yds. Pipe	50	0	0
160 fathoms of 8" pipes	100	0	0
4 cages with chains & water tub	90	0	0
.....	1057	10	0

[ZB-14-p28

Schedule E

Estimated Cost from Sinking from Low Main Seam to Brockwell & Fitting up from Surface to Brockwell Seam for drawing coal at Anne Pit Walker Colliery

	@	£	s	d	£	s	d
Taking out of old guides & buntons 60 fathoms	5/-	40					
Putting in 200 fathoms of buntons & guides labour							
Per fathom	21/-	221.	1				
Timber 134 buntons 11"x 3" running foot	4d	6.	16				
268 buntons 9" x 3" per running foot	3 1/8	43.	17.6				
Pitch pine guides 4"x5"	5d	100.	10				
Cleaning out of 26 fathoms of sump per fathom	5/-/-	130					
60.000 bricks for walling. Walling 46 fathoms per fathom	30/-	69					
Sinking shaft 20 fathoms per fathom	14/-/-	280					
Sinking staple 40 fathoms per fathom	11/10/-	460					
For Sinking engine etc.		300					
Sinking gear & preparation work		150					
Holing round putting in shaft arching and making							
Shaft sidings		400					
Add 10% for contingencies							

[ZB-14-p29

Schedule 2

Cost of working over 6 months for a total available of tons

£	s	d	£	s	d
1	9.55				

Pit Bills	4.25	
Shift	3.00	
Screening Bill	1.10	
Joiners	1.06	
Smiths	0.82	
Masons	1.13	
Staiths	0.66	
Labourage	0.68	29.66
Rents	3.84	
Salaries	3.85	
Fitting office	0.41	
Rates	2.45	
Incidents	1.49	
Stationary	0.21	
Insurance a/c	0.00	
Gas a/c	0.46	
Water a/c	0.36	
Manager's house	0.01	1 1.12
Carried forward		3 10.1/8

[ZB-14-30]

Continued

	£	s	d	£	s	d
Brought Forward						
Timber			0.60			
Props & pitwood			3.51			
Iron a/c			0.52			
Oils grease and candles			0.79			
Cordage			1.24			
Nails & hardware			0.43			
Bricks & lime			0.39		0.79	
Hay			1.81			
Corn			2.45			
Horses			0.14			
Leather & saddlery			0.34		4.79	
Discount			0.58			
Sundries			0.75		1.33	

[ZB-14-p31]

A. Recent fortnight

An a/c of coals wrought out and vended with cost

[ZB-14-p32]

A Recent fortnight. An a/c of Coals brought out & vended with Cost

	£	s	d	£	s	d	s	d	s	d
Pit Bill	289	11	5				1	8	2	
Shift Bill	50	12	11					3	66	
Screening Work	42	10	1					3	07	
				382	4	5		2	3	65
Joiners	12	4	3					0	88	
Smiths	10	15	6					0	77	
Mason Work	8	8	3					0	61	
Staiths	15	19	7					1	13	
Labourage	6	3	3					0	44	
				53	10	10				3
Rents tradesman's a/c etc.	332	2	0				2	0	00	
				332	2	0		2	0	
				763	7	3		4	7	

[ZB-14-p33
John Hill esq.
Sneperly Hall
Durham

Dear Sir,

In obedience to instructions received from you on the 12th inst. I have visited your Cater House pit at Framwellgate Moor. Making a full inspection of the Main Coal & Low Main Seam.

Main Coal Seam. On the west side of the pit. I find this seam varies from thickness from 1' 3" to 1' 8", with a strong post roof and very mild thill, and in my opinion you have adopted the best and cheapest method of getting the coal (that of Longwall).

I found the bottom shooters were not done as well as they ought one serious drawback to them is having to get on to the canch to put in back pack walls, during my experience of Longwall I find these back pack walls a very serious drawback to the carrying of the Gateways and would recommend that they be discontinued.

I also noticed that the canches were not well squared back, and the front packs to near the edge of the canch. This should be attended to as when the weights comes on, the sides push in, in our Longwall the x heading canches are squared back 5 feet wide in the bottoms and the front packs 7' 6" apart in the Gateways the bottom is squared back 4' wide and the packs 6' 6" apart, I would also advise that the bottom.....

[ZB-14-p34

... shooters use a 4' 6" drill so as to get a good hole on before firing with these alterations. Then men would make wages at 1d an inch and find their own powder and machines.

On the east side I find a splendid section 2' of clean coal and 1' 8" of ramble. I would advise this section be worked with the "aruble stall" method (see enclosed plan) laid out into districts to place about 20 men per shift this number would be an average output of 100 tons per day after the district was won out which I think

would be done in three months. And in nine months later you would be able to lay out for 300 tons per day. On the enclosed plan you will see I have shown the stall to be carried 40 yds. You might be able to carry them further, but that will have to be settled by a trial of the work.

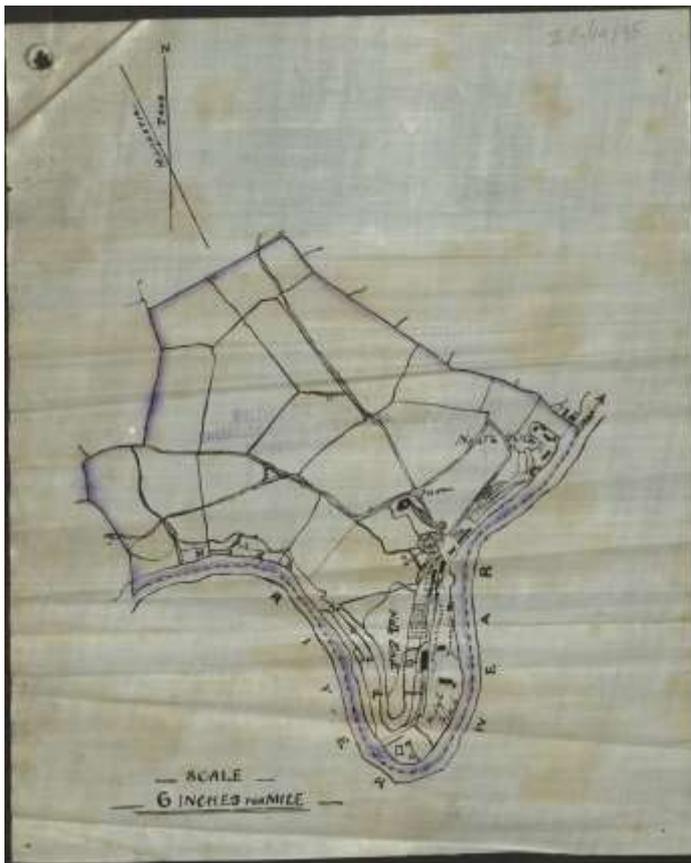
Low Main Seam

I find an average section of 2' 6" of coal with a soft metal roof. I am of opinion that this seam could be cheaply worked by the same method as the east side of the Main Coal Seam and won out in the same way gto produce 300 tons per day which would give you a total of 600 tons per day in addition to what you might on the west side of the shaft .

The cost in either case should not exceed 2/4d per ton including hewing and stonework and add 1/- a ton face to truck making the cost on the pit bill of 3/4 a ton.

I have the honour to be
Your obedient servant
Wm. Braidford

[ZB-14-p35



[ZB-14-35a

Welford Brothers Engineers & Boilermakers Sunderland
Clause of agreement made 5 September 1866- whereby the said lessor agrees to grant and the second lessor agrees to take a lease of these coal mines and seams of coals wrought or not wrought opened or unopened Lying and within benea the

certain lands within the township of Southwick and the parish of (?) Durham as known by the name of the Hylton Estate being more (?) described by (?) drawn ...margin hereof and coloured (?) Purple (?) and containing 235 acres and one reef of river bed makes 250 acres or thereabouts. The demised (?) to all and every (?) and seams of coals (?) and the private seams of (?) and fireclay which may be met within working each seam of coal and any part which is lying within the (?) several feet above and below the same but as each Ironstone and fireclay shall be wrought by itself but only simultaneously and in conjunction with working each seam and seams of coal within said intake and it shall be compulsory on the (?) work such Ironstone and fireclay or either of them (?) and pyrites shall be wrought within 10 fathoms of the surface of the river at low (?) to the said lesser stone work and carry away the said seams of coal and pyrites and Ironstone and fireclay and (?) Pit driven drift, Watergates, airshafts and dayholes which situation and manner and damage the surface as little as possible ...and shall be mutually agreed in between the parties (?) or respective agents viewers or for the time being or in case of dispute shall be determined by arbitration. But no breakage of the surface for any purpose shall be made unless a regular colliery winning be made upon the premises.

[ZB-14-35b

And...of sinking a pit or pits upon the said Intake but not at...power to make railways and build workmen's cottages, engine houses and shop and coke ovens also in such situation as shall be mutually agreed upon or determined by arbitration for the working and manufacture into coke of the said demised coal and of coal worked by outstroke and for the leading away of such coals respectively or the coke made there from and with or without sinking any pit on the said intake to drive instroke or outstroke drifts with or through the barrier therein after agreed to be accepted for the purposes for the said outstrokes of winning working and leading away the produce of the hereby demised Coal Mines pyrites and seams known hereafter belonging (?) or wrought by the said lessee or for the purpose by said outstrokes of winning working and leading through the said Barrier coal the said pyrites Ironstone and fireclay the produce of...or seams other than those hereby agreed for or for the purpose of draining or ventilating the said mines or seams hereby agreed and such of the mines and seams as aforesaid or any of them. The said lessor accepting and preserving out of the said demise all mines and minerals ...and substances whatsoever other than coal pyrites and the Ironstone and fireclay which may be (?) the limits aforesaid with power to work (?) future lead away such minerals and to grant other person or persons or Company power to do the....

[ZB-14-p35c

...same and there the use of any machinery and make works of the said Lessee erected on the said Estate for obtaining drawing and leading away the said minerals causing as least hindrance as may be (?) operations of the said Lessee and paying and compensating each shall if the parties cannot agree settled by arbitration. The said Lessee also respecting and accepting out of the said demised premises power to grant wayleave and passage having persons or further company for any purpose whatsoever over the premises and which thereby demised mines do lie on or about the use of any railways made by the said Lessee for any such purposes paying compensation for the same as (parties cannot agree) said by

arbitration. The said Lessee also reserving and accepting out of the said demise (?) and wrought a barrier of coal of not less than 30 yards in thickness all around the out boundaries of the said.... The said Lessor reserving all manure made for the hereby demised premises. In case a pit shall be sunk (?) further of himself or his tenants unless the Lessee shall farm lands belonging to the said Lessor in which case it may be used by them on the land so farmed. Term to be 42 years from January 1st 1865. Certain rent for the first two years £200 per annum and for the remainder of the term £300 per annum. The said respective rents to be paid or paid earlier as and for...

[ZB-14-p35d

...an equivalent number of tons of coal (each ten to contain 5 tons) wrought from all or any seams of coal within the said estate the said part to be reckoned on the coal as it first appears on the surface or (?) Underground operations and prior to cleaning and screening at the rate of 20/- per ton from the said seams (?) all ownership at the same rate per Ten with a deduction or allowance in the part due of one eighth portion of the total quantity brought to bank or burnt in any underground operation the same to be in consideration of cleaning and screening washing colliery consumption, (?) and brasses cleaned from the coal, loss or waste workmen or agents, fire coal and coal used for engines and for and of all other considerations whatsoever. And all fireclay wrought out of the tract hereby demised the sum of 1/- for each and every ton of 22 cwt. And all coal other than the coal hereby demised which shall be wrought by outstroke and brought back under the demise Royalty or estate be paid for at the rate of 6/- per ton (of such weight as previous) as (?) may of outstrokes shaft band underground and surface wayleave rent or at the rate of 4/- per ton (of like weight) on all coals wrought other than the hereby intended to be....

[ZB-14-p35e

...demised mine and led underground or on surface through the demised estate being drawn to bank (?)estate as and by way of an outstroke and underground and surface wayleave rent and at the rate of 2/- per Ten on all coals wrought from the other than hereby intended to be demised...another which shall have been drained or ventilated or made workable by penetrations through the barrier heretofore referred as and by way of an outstroke drainage or ventilation rent but as that coals for which either the aforesaid parts of 6/- per Ten & 4/- per Ten may be payable shall not also be changeable with the said lastly mentioned rent of 2/- per Ten . And for all Ironstone and Fireclay which shall be wrought by outstroke and brought to bank within the demised royalty or estates the sum of 1d per ton (of such respective weights as aforesaid) shall be paid at the rate of one third of a penny per ton on each of the three privileges of outstroke shaft and wayleave as they may be respectively and overally exercised as aforesaid (?) and to coal. And it is hereby agreed and declared that the certain rent shall be payable and paid half yearly on the first day of January and the first day of July in each year of the terms by equal payment and all "Overs" and other rents once a year on the....

[ZB-14-p35f

...first of January. The whole to be paid free and clear of all rates and taxes and assessments whatsoever parliamentary and parochial except the Landlord's property or Income Tax & Land Tax . It is hereby also agreed and declared that

the power of distraint and (?) usual in leases in the County of Durham in case of the non payment of the rent hereby and the nonfulfillment of covenants in lieu thereof to be settled by arbitration in case of disagreement between 21 and 60 days of their becoming due and after first having been duly demanded shall and do form part of this agreement. The lessee to have power to make up short workings during the whole of the term but the overworkings of any one year or years shall not go in and of short workings in any subsequent year or years of the said term. It is also hereby agreed and declared that the said lease at the end of the fifth and of each following third year of the term on going to the said Lessor 12 calendar months of such intention the said Lessees pay all rents due all taxes and all...

[ZB-14-p35g

...damage ground and other attached and contingent rents and shall have performed all covenants agreed to be performed or paid such compensation in lieu thereof and shall be settled by arbitration in case of disagreement but in case of any dispute such payments shall be made within three months after the award or the determination of each dispute and shall leave such of the working Pits Staplers and Drifts used within the two previous years and necessary for working the remaining coal Ironstone or fireclay (?) agent shall require in good working order and condition and shall return where practicable and if requested all ground which has been occupied by colliery operations (?) sufficient condition as fit for agriculture as the adjoining land or in default thereof or where such restoration shall be impracticable shall pay a fee simple value of the same to be determined in case of dispute by arbitration (?) by notice and without prejudice to the rights and remedies of the respective parties upon or in respect of the current agreement whatsoever performed or observed at or after the expiration or sooner determination of the lease or for in respect of any breach of Covenant made or committed before or at the expiration of the said notice. The said Lessee

[ZB-14-p35h]

...with the said Lessor, to pay all rents regularly as they become due, To pay all taxes, rates and assessments parliamentary or parochial or otherwise imposed or hereafter to be imposed on the premises or produce thereof except the landlords property or income tax and land tax. And that Lessor and Lessee shall and will increase (?) sinking of pits within the demise and such sinkings and other constructions of coke ovens and railways and all other operations necessary for the running working and manufacture into coke of such coals be wrought from the coal mines hereby demised or from other mines in the exercise of the said powers of outstroke or for the leading away of such coals and coke respectively cause as little damage on the surface as necessary and that each pit, coke ovens, railways or other operations shall only be sunk (?) as shall be agreed upon between the said Lessor and Lessee or their respective agent or agents or in case of dispute shall be determined by arbitration of not less than double agricultural value for all land and also full and fair compensation for all damage of or to any crop cattle buildings timber plantation fences drains or culverts or any other damage arising out of exercise of any such privilege (?) and shall hold the Lessor (?) and.....

[ZB-14-p35i]

...undersigned therefore and in case of differences arising out of any and damage or compensation the same shall be settled arbitration in the usual manner. And that the said Lessee shall at the said or determination of the said term where practicable and if so required all land which may have been spoiled or damaged during the said term to consider fit for agriculture and the adjoining land or in default of doing so or where such restoration shall be practicable shall pay the fee simple value thereof such value to be determined in case the parties cannot agree by arbitration. And that the said Lessee shall (?)greatest extent reasonably practicable the consumption off all (?) made at the works by the coke ovens on the surface of the said lands or by Engines ventilating furnaces or other chimneys used by the conveyance or passage of smoke. And that the said Lessee shall and will dischargeworks of any water which may have been used for working coal or which has run through or passed burning (?) coke ovens or other work are the most improved methods of “defunct pits” or otherwise to ponds or water as little less noxious as reasonably may be for allowing it to mine with any of the natural brooks or rivulets running through the said lands under which the local mines hereby demised and if the parties cannot agree about the

[ZB-14-p35j]

...and mode of application of the said “defunct pits” or most approved method or otherwise the same shall be determined by arbitration as hereby mentioned. The said Lessee shall also covenant to work and manage the demised mines and minerals according to the most approved system for the time being of the district and lease at the end or sooner determination of this said term the watercourses, drifts, shafts, pits and all workings then or under the two previous years as necessary for working the remaining coal or sinking them as said Lessor or his agent shall so require in good working order and condition and clear of foul air, water or styth and insert proper sufficient firebrick and frame or other dams in each and every of the instrokes and outstrokes into or from adjoining or contiguous coal mines at the expiration or sooner determination of the said terms requested by the said Lessee or his agent for the time being. And not to penetrate the barriers agreed to be accepted or any of them except in the places where penetrations by outstroke or instroke may be made permanent for determining (?) Of the quantities of coal, Ironstone and fireclay raised from the demised mines as well as other mines which may be wrought by outstroke etc. and allow the same to be leased and taken by the said lessor or his viewer for the time being. And in case a pit shall be sunk upon this intake by the said Lessee or his agent and such pits Ten chaldrons (of 53 cwt. Each) of best (?) coals fifteen chaldrons (of same weight) of small coals the produce of the hereby demised mines during each and every year of the said term the said coals (?) exempt from the payment of rent. The said Lessee hereby further agreeing to the usual covenants of mining coals regarding the keeping and proper & correct colliery plans & the keeping and sending half yearly copies of or extracts from true and correct fortnightly or daily accounts of coals wrought.....

[ZB-14-p35k]

...and brought to the surface and burnt in any underground operation whether on the said Hylton Estate or elsewhere and where such coals be produced from the said demised mines or of other mines wrought by outstroke and distinguishing as such account the quantity of coals chargeable with each of the several rents

herebefore mentioned. Also as to Lessor keeping Agent if deemed expedient for taking account of coals drawn to bank the said agent being had by the lessor. Also as Lessors agents inspecting and returning from the mines. And the said Lessor to covenant on his land & allow the said Lessee quiet space and possession of the demised premises and enjoyment of the powers and privileges aforesaid during the said term. And lastly it is hereby declared and agreed by and between the said parties that a Lease of counterpart shall be prepared & executed (at the request of each party the costs being defrayed in equal proportions by the said Lessee and the Lessor) containing in addition to the foregoing (?) usual customary covenant promises and considerations of mining leases of a like nature in the County of Durham and more particularly for other settlement by arbitration of the disputes or matters herinafter mentioned or referred to or of any other that may arise and for the (?) and time of appointment of arbitrators and their (?) and wishes etc.

[ENDS]