THE STANTON IRONWORKS COMPANY'S COLLIERIES.

By J. C. B. Hendy.

The President of the Chesterfield and Midland Counties Institution of Engineers (J. A. Longden, Esq.) having invited the members of the Federated Institution of Engineers and the British Society of Mining Students to visit these collieries, the following notes descriptive of the plant and pits and the results of experiments made with the respective fans and electric machinery may be interesting.

The collieries are situated on the Teversal Branch of the Midland Railway, from three to six miles west of the town of Mansfield, in the counties of Derby and Nottingham, lying immediately on each side of the boundary line dividing the two counties. The Pleasley Colliery, near the village of Pleasley, is in Derbyshire, and the Teversal and Silver Hill Pits, near the village of Teversal, are in the county of Nottingham.

The area of royalty held by the company comprises about 7,000 acres, including the estates of Pleasley, Teversal, and a portion of Hardwick, the principal lessors being the Countess of Carnarvon, Sir Harry Verney, the Marquis of Hartington, and the Duke of Portland.

It is expected that the whole of the coal now leased to the company will be worked by the present pits.

The collieries find employment for 1,700 men and boys and 150 horses. The annual output is about 700,000 tons, which, when the Silver Hill and Pleasley upcast pits are further developed, will be increased to one million tons per annum.

The seams worked are:—At Silver Hill, the Low Main and Black Shale, and at Teversal and Pleasley the Top Hard. At the two first-named pits the steep inclination of the seams adds considerably to the working cost, the dip being as much as 9 inches to the yard to the north-east. Between Teversal and Pleasley the inclination gradually changes, the average being at the latter 1 in 12.

About midway between the Teversal and Silver Hill Pits there is a downthrow fault to the east of 180 feet, which, with the dip of the measures, makes a considerable difference in the depths of the several shafts, relatively situate as they are almost on the line of full dip. The depth to the Top Hard Seam at Silver Hill is only 51 yards, whilst at Teversal it is 217 yards, and at Pleasley, 2¼ miles farther east, it is 514 yards. The Teversal and Silver Hill Pits are sunk entirely in the Coal-measures, but a few yards east of Teversal the Lower Red Sandstone and Magnesian Limestone appear, the latter increasing in thickness and reaching at Pleasley a depth of about 250 feet. All the seams are worked entirely on the longwall system.

The following are the depths of the pits and thickness of each seam, also detailed sections of the seams now being worked:—

Depth of Pits to each Seam.

Colliery.	Depth in Yards.	Name of Seam.	Thickness of Seam.	
			Feet.	Inches.
Silver Hill	51	Top Hard	5	6
Do.	72	Dunsil	4	0
Do.	109	Waterloo	2	7
Do.	290	Deep Hard... ...	2	7
Do.	300	Piper	2	8
Do.	356	Low Main	4	9
Do.	362	Three-Quarter ...	2	10
Do.	396	Yard Coal	3	4
Do.	418	Black Shale ...	3	1
Teversal	217	Top Hard	5	0
Do.	237	Dunsil	3	9
Pleasley	514	Top Hard	5	1

Detailed Sections of Seams now being Worked.

Silver Hill Pit.

Black Shale—	Ft.	In.
Tops	0	10
Band	0	1
Tinkers	0	7
Band	0	2
Bottom Coal ...	1	5
Total	3	1

Teversal Pit.

Top Hard—	Ft.	In.
Brights	1	0
Bastard Hard ...	0	5
Smooth Hard ...	1	0
Best Hard	1	8
Bottoms	0	11
Total	5	0

Silver Hill Pit.

Low Main—	Ft.	In.
Top Coal	0	11
Bottom Coal ...	3	10
Total	4	9

Pleasley Pit.

Top Hard—	Ft.	In.
Brights	1	0
Bastard Hard ...	0	7
Soft Coal	0	3
Cannel	0	9
Minge	0	5
Best Hard... ...	1	1
Bottoms	1	0
Total	5	1

Results of Tests made with different Coals in Experimental Gas-making Apparatus.

	Silver Hill Wallsend.	Silver Hill Low Main.	Silver Hill BlackShale Cannel.	Teversal Cannel.	Pleasley Cannel.
Cubic feet of purified gas yielded per ton of coal	10,439	9,868	12,832	10,659	11,278
Illuminating power of the gas in standard candles, calculated for a consumption of 5 feet per hour in standard London argand burner with six-inch chimney	18·13	18·2	21·4	21·0	28·59
Percentage weight of dry coke ...	67·88	60·31	55·0	58·98	54·28
Dry coke in lbs. per ton	1,410	1,351	1,232	1,310	1,215

Pleasley Colliery.

Shafts, etc.—Two shafts, each 14 feet 6 inches diameter. When sinking through the limestone, feeders of water from 800 to 1,000 gallons per minute were met with, and for 117 yards the shafts are lined with metal tubbing, commencing 18 yards from the surface. The thickness of the tubbing is ⅝ inch, 1⅛ inches, and 1⅝ inches; the top segments being 2 feet 6 inches by 4 feet 6 inches, and the lower 2 feet by 4 feet 6 inches. The downcast pit is fitted with wooden guides (pitch pine) 4½ inches by 4½ inches, four to each cage, the guides being bolted to oak cross-stays, the latter being 10 feet apart and fixed into cast iron boxes let into the shaft, and brackets cast on to the tubbing. The middle stays are 9 inches by 8 inches, those at the sides 9 inches by 6 inches.

There are rope conductors in the upcast pit 1⅛ inches in diameter. The top of this pit is covered by two flat "bonnets," which are raised and lowered by each cage on coming to the surface, the bonnets falling on to tight-fitting padded seats.

Ropes, etc.—Round ropes in each pit, all 1⅛ inches in diameter, of pliable plough steel, running over pulley wheels 16 feet diameter, and having King detaching hooks.

Cages and Tubs.—Downcast pit.—Double-decked steel cages, carrying two tubs on each deck; weight of each cage, 53 cwts. The tubs are changed simultaneously at the pit top and bottom. Upcast pit.—Double-decked cages carrying one tub on each deck; weight of each cage, 29 cwts.

Tubs.—Carry 13½ cwt. of coal each, have steel wheels 13½ inches diameter, and 2 feet gauge, with wood sides and sheet iron ends; weight, 7 cwts. Box pedestals carrying sufficient oil to last from four to seven days are being applied.

Winding Engines.—No. 1 pit.—A pair of horizontal engines with 40-inch cylinders and 6-feet stroke. Drum, 20 feet diameter, and 6 feet 10 inches wide, with foot and steam brakes. Double-seated Cornish valves 12 inches diameter, worked by eccentrics from trail cranks. Average speed of piston when coal drawing, 390 feet per minute; steam pressure, 48 lbs. No. 2 pit.—A pair of horizontal engines with 34-inch cylinders and 6-feet stroke, with slide valves. The reversing gear is worked with a steam driver, with 8-inch cylinder and 12-inch stroke. Drum, 16 feet 6 inches diameter and 6 feet 10 inches wide. Average piston speed when coal drawing, 448 feet per minute; steam pressure, 48 lbs. Both engines are in the same engine house, being set back to back. Stauffer lubricators are used on all the engines.

Boilers.—Steam is supplied to the winding engines, belts, and shop engines, etc., from sixteen boilers set on each side of the winding engine house. Nos. 1 to 8 are 40 feet by 5 feet 6 inches, with single tubes 2 feet 10 inches diameter. Nos. 9 to 12, Lancashire boilers, 30 feet by 7 feet, with tubes 2 feet 8 inches diameter. Nos. 13 and 14, Lancashire boilers, 28 feet by 7 feet 6 inches, with 3 feet tubes. No. 15, 31 feet by 7 feet, with 2 feet 9 inch tubes, and No. 16, 30 feet long by 7 feet

diameter, with 2-feet 8-inch tubes. When the engines are at work the boilers are fed by four No. 12 exhaust steam injectors, and when the engines are standing, by a donkey pump with 8-inch rams, and 10-inch stroke. Nos. 1 to 4 are being fitted with Whitaker mechanical stokers. Steam is supplied to the fan and electric engines from a range of four Lancashire boilers, 30 feet by 7 feet, with tubes 2 feet 8 inches diameter, the feed being from a No. 9 exhaust injector, worked by the fan engine exhaust. All the boilers have Caddy patent fire bars. The water supply is pumped from the river Meden by a Tangye special pump, 10 inches by 6 inches by 12 inches, with vertical boiler, which forces 7,200 gallons per hour, against a head of 133 feet. The water contains a large proportion of carbonate and sulphate of lime, and especially after rain is very muddy. To take the matter in suspension out of the water a pair of Torrent filters are placed near the reservoirs, each capable of filtering 4,500 gallons per hour. There is also a duplicate pump and boiler at the pumping station.

Fans.—There are two Waddle fans 40 feet diameter, with 14-feet inlets, driven by separate horizontal engines having 26-inch cylinders, and 4-feet stroke, with slide and cut-off valves. The fans are changed every month, one fan and engine being always kept in reserve. The engines are placed side by side, and the fans on either side of the engine house are 50 yards from the upcast pit. The ventilating current passes from the upcast pit 30 yards from the surface through an air drift, which on approaching the fans divides into two branches, each branch drift leading into a fan pit, up which the air ascends to the fan inlets. The shutters are placed in the branch drifts at their junction with the fan pits, and are raised or lowered by small crabs placed over them. The fans can thus be changed at any time without interfering with the ventilation of the mine.

In the following experiments the diagrams were taken with a Richards indicator, and the air measurements by an anemometer, both of which were specially tested by Messrs. Davis, of Derby. The water-gauges were fixed parallel with the air current, the orifice being about 8 feet from the fan inlet. The air was measured in the main return 20 yards from the bottom of the upcast pit, and also in the fan drift. The quantities of air given are those obtained in the pit, the drift measurements giving about 3 per cent. more useful effect than those in the pit. The coal used was carefully weighed, the fires kept in the same condition, and the water at the same level in the boilers throughout. Time occupied by the experiments, eight hours,

Some years ago Mr. A. H. Stokes, Inspector of Mines for the Midland district, conducted a series of experiments with these fans, the useful effects being then from 36 to 40 per cent. He also made some experiments with these two fans both running at the same time on the mine, similar in character to those recently communicated to the North of England Institute of Mining Engineers by Mr. W. Cochrane. Mr. Stokes would no doubt communicate the result of these experiments if the members desire it.

EXPERIMENTS WITH THE PLEASLEY FANS, JUNE, 1891.

No of Experiment	Water-gauge in Pit.	Water-gauge in Fan Drift.	Barometer on Surface.	Barometer in Pit.	Thermometer on Surface.	Thermometer in Pit.	Revolutions of Fan per Minute.	Periphery Speed of Fan in feet per Second.	Cubic Feet of Air per Minute in the Pit.	Horse-power in the Air.	Indicated Horse-power of Engine.	Lbs. of Coal per Hour per Horse-power of Engine.	Lbs. of Coal per Hour per Horse-power in the Air.	Per Cent. of Useful Effect on Air in Pit.	Per Cent. of Useful Effect on Air in Fan Drift.	Lbs. pressure of Steam in Boilers per Square Inch.	Cost of Fuel per Week at 3s. per Ton.
								WEST	FAN.								£ s. d.
1	1·70	2·0	30·15	31·23	57	70	45	94	69,525	21·9	67·1	7·5	23·0	32·6	34·2	51	5 13 4
2	1·90	2·2	30·15	31·23	58	70	50	104	79,050	27·4	85·0	9·8	30·5	32·2	34·5	50	9 9 0
3	2·30	2·7	30·15	31·23	57	70	55	115	87,825	37·8	116·0	8·2	25·5	32·1	35·0	52	10 14 0
4	2·80	3·3	30·15	31·23	61	70	60	125	95,625	49·7	142·0	7·0	20·2	35·0	37·4	54	11 6 9
								EAST	FAN.								
1	1·20	1·65	30·54	31·48	58	70	45	94	74,425	19·3	66·0	7 6	26·6	29·2	32·0	53	5 13 4
2	1·80	2·05	30·54	31·48	60	70	50	104	81,450	26·3	87·5	9·0	30·0	30·5	33·1	52	8 16 4
3	2·00	2·30	30·54	31·44	80	70	55	115	86,325	31·2	118·0	7·5	28·0	35·6	37·4	54	10 1 0
4	2·60	3·05	30·51	31·40	91	71	60	125	93,225	44·8	149·0	6·7	22·5	30·0	33·0	56	11 6 9

Cost per week for oil, waste, etc., fan at 50 revolutions per minute, 3s. 9d.

Natural ventilation measured after fan had stood two hours, 28,000 cubic feet per minute.

Belts, Screens, etc.—Until recently the coal sorting and cleaning has been done on two sorting belts and screens, one on each side of the pit. These belts were amongst the earliest of the kind put down in the district, and consequently without many of the improvements effected during the past few years in similar arrangements. The proportion of slack and small made became very excessive, owing partly to the wearing and bending of the plates and angle irons at the edges, and in a great measure to the fact that the belts were too narrow for the quantity dealt with, the coal in consequence grinding very much against the sides. As it was found that the cost of repairing this plant would be at least £500, it was decided to erect a new sorting belt, with elevator and screens complete, capable of dealing with the entire output, viz., 180 tons an hour, and keep the old plant ready for work in case of any temporary stoppage or breakdown.

The dimensions of the old belts are:—North belt, 110 feet long by 2 feet 9 inches wide. Engine, 12-inch cylinder and 2-feet 6-inches stroke. South belt, 150 feet long and 3 feet wide. Engine, 16-inch cylinder and 3-feet stroke. Both engines have pinion and spur wheel gearing, the belts being driven by the Ley patent chains and pulleys.

The new belt is erected on the south side of the pit, the sorting and cleaning being done on each side of the belt, and the remaining coal carried to the screens by the elevator. The different kinds of coal made are:—Hand picked off belt: large brights, London brights, steam, best hard, burgy and cannel. Made on screens: cobbles, nuts, nut slack, and dust.

This belt is 200 feet long from centre to centre, and 4 feet 6 inches wide, made of mild steel plates $\frac{1}{4}$ inch thick by 4 feet 6 inches by $15\frac{1}{2}$ inches, overlapping $1\frac{1}{4}$ inches at the joints, and riveted to the chains by six rivets in each plate. There are three solid forged link chains with double links, $\frac{3}{4}$ inch by $2\frac{1}{4}$ inches, and single links $1\frac{1}{4}$ inches by $2\frac{1}{4}$ inches, the joint rivets being $\frac{3}{4}$ inch. Six octagonal drums give motion to the belt, bored and fitted to 5-inch shafts, the trail end working on two adjustable pedestals, with screws of sufficient length to take up two links of the chain. The frame consists of cast iron standards every 8 feet on each side of the belt, with cross stretchers from standard to standard, and angle iron guides for top and bottom 3 inches by 3 inches, an additional line of angle irons fastened along the top forming a ledge and side for the trough of the belt. The belt is carried on rollers running under two of the chains and placed every 4 feet for the top or loaded side, and every 8 feet for the bottom or returning length. The speed of the belt is 65 feet per minute.

The elevator is 4 feet 6 inches wide, with pan buckets on a three-chain belt similar to the sorting belt, turning on six hexagonal drums, with adjustable pedestals at the bottom. The elevator frame is of lattice structure with underneath shoot plates to prevent scattering of the coal, and is carried at the bottom on a cast iron frame bolted to the brickwork. The top of the elevator and also the screen is carried on four sets of metal columns connected with H-section girders. The driving drums

have steel driving fingers fitting into a slot and fastened at the back by a cotter, so that the fingers can be renewed when worn.

Engine and Gear.—An engine with 16-inch cylinder and 30-inch stroke drives the belt and elevator, the belt being driven from one end of the shaft and the elevator from the other, the latter by a 12-inch pinion working into a 4-feet wheel, which is fitted to an upright shaft 4 inches diameter, supported by bushed footsteps. On the top of this shaft is a 12-inch pinion working into another 4-feet wheel on the shaft of the elevator drums.

On the driving drum shaft of the belt there is a bevel-wheel 7 feet diameter, working into a steel pinion 1 foot 6 inches diameter on a 4½-inch main counter-shaft. On this shaft is another gearing-wheel working into a steel pinion, keyed on the engine shaft.

Screens.—The screen is supported by H-irons on metal columns, has a fall of 6 inches to the foot and is 4 feet wide, with channel iron sides 12 inches by 3 inches, to which are attached dead plates ¾ inch thick. Beneath the screens are two hoppers, one for nuts and the other for nut slack, provided with doors and slides 2 feet square, and made of $\frac{1}{16}$ inch plates on angle iron frames. At the top of the screen the dust is taken out by a perforated plate, 3 feet 9 inches by 1 foot 8 inches, the dust running down an iron box into the fireholes. The cobble bars are 6 feet 6 inches long, and the nut bars 9 feet 4 inches long. At the foot of the screen there is a travelling belt 24 feet long and 4 feet wide, on to which the cobbles fall and are cleaned, this belt delivering the cleaned coals on to a shoot, off which they fall into the trucks after being finally screened. This belt is driven by a little engine placed by its side with an 8-inch cylinder.

Tipplers.—The Fisher double side revolving tipplers are to be used, there being two of them. The tipping stag is one the level of the top deck, the full trams being taken from the pit to this stage by creepers. A creeper also takes the empties back to the top deck, the empties running to the bottom deck down an incline with chain stops. The creepers are all driven by one engine, with 10-inch cylinder, and are made of single and double linked chains with driving fingers on the single links, the chains running in iron channelling. The whole of this plant is covered with corrugated iron roofing supported by metal columns. The cost of labour has been reduced ¼d. per ton by the new plant, and it is estimated that the total saving effected, including the less proportion of slack and small made, will pay for the whole outlay in twelve months. The present arrangement is equal to an output of 1,600 tons per day of 9 hours, the quantity now being dealt with from 1,000 to 1,200 tons, and the cost per ton for banking, screening, sorting and cleaning, etc., 3d.

Electric and Underground Haulage.—A straight main road three-quarters of a mile in length has been made from near the pit bottom to the rise side of the mine, and the coals are brought down this road by a series of self-acting inclines. No. 1 incline, 1 in 12, and 450 yards long, running 16 trams a time; No. 2, 1 in 9, and 340 yards, running 16 a time; and No. 3, 1 in 6, 260 yards long, and running 8 trams.

To bring the coals from the dip a large electrical haulage plant has recently been erected by Messrs. Crompton, electrical engineers, London, and commenced to work at the beginning of the present year. This installation is capable of giving 60 horse-power at the motor. At the present time it is working an endless rope in the north-east main road for a distance of 450 yards, which will shortly be lengthened to 850 yards, hauling from 400 to 500 tons per working day of 9 hours, the average dip of the road being 1 in 12. As the workings advance, however, this rope will be lengthened to over a mile. It is also intended to work, at the same time, a branch endless rope in the north district a mile long, as well as pump the water from the dip workings by a pair of 6-inch pumps, placed 400 yards from the motor and worked by the same endless rope. The distance between the dynamo and motor is 725 yards, the former being on the surface, in an engine house erected by the side of the fans, and the latter underground, 80 yards from the upcast pit, in an engine house by the side of the main road, in such a position as permits the ropes to bring the trams to either top or bottom deck. The dynamo is worked by an old horizontal engine, with 20-inch cylinder and 3-feet stroke, having a fly-wheel 13 feet diameter, and driving pulley 12 feet diameter, and 18 inches wide, the latter driving a pulley 2 feet 5 inches diameter, on a counter-shaft, by a patent Lancashire belt. The dynamo is driven by a belt of the same description from another pulley, 5 feet diameter on the counter-shaft. The speed of the engine is regulated by a double-seated equilibrium valve, with governors worked by belting from the main shaft. The dynamo has been tested to 606 volts and 140 ampères, and the motor to 536 volts and 140 ampères. Both dynamo and motor are mounted on rigid cast iron bed-plates, and are provided with three pedestals and bearings, the pulleys being carried between two bearings. The bed-plates rest upon two cast iron rails, upon which the machines can be moved so as to tighten the belts if necessary without stoppage. The foundations for the dynamo, etc., consist of pitch-pine balks 14 inches by 14 inches built on to solid brick pillars. The magnets are of wrought iron, the coils being wound on suitable formers slipped on to the magnets. The armatures are soft wrought iron discs, mounted on a steel shaft, 3¼ inches diameter, running from end to end through the three bearings. The driving pulley on the dynamo shaft is 22 inches diameter. The windings of the armature and magnet coils are of copper, insulated, and of 98 per cent. conductivity.

The motor is shunt-wound, and the dynamo compound-wound. There are three carbon brushes, on either side of the commutators, each 2 inches wide. In the main circuit, near the dynamo, are two safety fusible cut-outs, which fuse at about 140 ampères. Ammeters and voltmeters are placed near the dynamo and motor. The main roads leading to the bottom of the pits are lighted by twenty-four Swan incandescent lamps of 16 candle-power, arranged four in a series, the current being taken from the main cable for them. In the motor house there are four 16 candle-power lamps, and five in the dynamo house. There is a resistance frame and switch near the dynamo, by means of which the man in charge can regulate the E.M.F.

and prevent the volts rising to such a height as would break the lamps. The motor is also used in conjunction with another resistance frame, by means of which the speed can be regulated, the motor being stopped or started by a switch. The motor and dynamo shafts are lubricated by Crompton patent sight-feed lubricators, and the pulley bearings by Stauffers.

The cable consists of nineteen copper wires of 15 B.W.G., having an insulation resistance of 300 megohms per mile, the insulated cable being 1 inch in diameter. It is taken from the dynamo to the motor down the upcast pit, in pitch-pine casing 6¾ inches by 2 inches, the cables being laid into two grooves made in the casing 2½ inches apart, after which covers of pitch-pine 6¾ inches by 1¼ inches are screwed on with 3-inch brass screws. The casing is fastened to the shaft side by 6-inch brags driven into wooden plugs, every 4 feet.

The motor and driving gear are placed in an engine house 49 feet long, 17 feet 6 inches high, and 14 feet wide, arched with brickwork 2 feet thick, the end walls being 18 inches. It is of the utmost importance that this machinery should be kept perfectly level and true, and as it was feared that the floor of the engine house might at some time lift, through creep or weighting, it was not fixed on foundations built on the floor, but on to five strong cast iron girders, 15 inches by 18 inches, placed across the engine house, and built into the sides of the arching, the bed-plates being bolted transversely on to these girders. Motion is given to the gearing from the pulley on the motor shaft, 18 inches diameter, from which a patent Lancashire belt runs on to another pulley 12 feet diameter, and 16 inches wide, a pinion wheel 16¾ inches diameter on the shaft of the latter working on to a spur wheel 12 feet 5 inches diameter. The ropes are moved by two 6-feet grooved driving pulleys, with four grooves each, on the spur wheel shaft, with clutches for throwing in and out of gear. At a distance of 12 feet from the driving wheels are two grooved tightening pulleys, each hauling rope passing three times round each pair of driving and tightening wheels The latter are fixed on movable pedestals, and the ropes can be tightened at any time by a wheel and screw arrangement connected to the back of these pedestals. Fisher hauling clips are used on the engine plane, the trams being drawn in twos. At the end of the plane the rope returns around a 5-feet wheel, fixed on a bogey, set on rails, and attached to a balance weight working into a small pit. Cup pedestals are used for the rollers, on the engine plane, which hold grease enough for three or four days. The engine plane is fitted with electric signals, and communication is made between the dynamo and motor by a telephone and electric signal.

The table on the next page gives the results of experiments made with this plant. The percentage of losses and horse-power of each are :—

Engine and large pulley ...	7·4 H.P.	=	20·9 per cent.
Dynamo, cable, and lights ...	14·7 „	=	41·5 „
Motor	2·3 „	=	6·5 „
Gearing and empty rope ...	7·1 „	=	20·1 „
Load	3·9 „	=	11·0 „
	35·4 „		100·0

PLEASLEY ELECTRIC HAULAGE PLANT, JULY, 1891.

	Revolutions of Engine per Minute.	Revolutions of Dynamo per Minute.	Revolutions of Motor per Minute.	Speed of Rope in Miles per Hour.	Dynamo. Volts.	Dynamo. Amperes.	Indicated Horse-power of Engine.	Electric Horse-power given out by Dynamo.	Electric Horse-power at Motor.	Pressure at Boilers per Square Inch.	Ratio per Cent. between Horse-power supplied to Motor and Horse-power given out by Dynamo.	Ratio per Cent. between Horse-power supplied to Motor and Indicated Horse-power of Engine.*	Ratio per Cent. between Horse-power given out by Dynamo and Indicated Horse-power of Engine.
Plant running with load of twelve full trams and twelve empties on rope ...	57	650	570	1·72	415	28	35·4	15·57	14·6	52	93·7	41·2	44·0
Engine, dynamo, motor, and empty rope	57	660	585	1·77	405	23	31·5	12·48	11·6	50	92·9	36·8	39·6
Engine, dynamo, and motor	58	660	560	...	412	10	24·4	5·5	5·2	48	...	...	22·5
Engine, dynamo, and lights	58	670	...	...	410	...	22·1	...	...	50	...	...	...
Engine only, with large pulley ...	58	...	...	...	...	...	7·4	...	...	50	...	...	...

Weight of 12 full trams = 12 tons.

Do. do. empties = 4 tons 4 cwts.

* It should be noted this is not an economically constructed engine, but an old one which sank one of the pits sixteen years since.

Sixty per cent. of the power put into the driving belt at the engine is transmitted to the motor, and 52½ per cent. of the same is given out by the motor.

The above load was twelve full trams only on the endless rope, which were in part balanced by twelve empty trams running at the same time. It should be remarked that as this plant is not yet doing anything like the duty it is equal to, and will shortly have to do when the other haulage roads, etc. are ready, the useful results given above, although satisfactory so far as they go, are not so good as it is expected they will be, when, for instance, the motor works up to 40 or 50 H.P. instead of 15 H.P. as at present. Twelve horses have already been dispensed with, and the work was so hard which these horses did that they could not be kept in condition for many months together.

The company have built 102 houses at this colliery, and have also built schools and a workmen's club, and provide the services of a resident curate for the benefit of their workpeople.

Teversal Colliery.

Shafts, etc.—Downcast pit, 14-feet diameter, with rope conductors, 1¼-inches diameter, four to each cage. Iron cages with two decks and two tubs on each deck; weight of each cage, 45 cwt. There are two decks at the top and bottom of the pit, the tubs being changed at the same time on each. Ropes, mild steel, 1¼-inches diameter, with King detaching hooks. Coals are drawn at the downcast only. Upcast pit, 11 feet diameter; one cage only in this pit, with rope conductors, 1-inch diameter.

Tubs.—Weight, 6 cwt., carrying 11 cwt. of coal, and open at one end. Wheels, 12-inches diameter, steel, and 18½-inch gauge, with outside box pedestals holding sufficient oil to last three or four days.

Winding Engines.—Downcast pit, a pair of horizontal engines, with cylinders 30 inches diameter and 5-feet stroke, with slide valves; drum, 14-feet diameter. Average piston speed when coal drawing, 275 feet per minute; steam pressure, 48 lbs. per square inch. Upcast pit, a pair of horizontal engines, with 18-inch cylinders and 3-feet 6-inch stroke, geared, and drum 9 feet diameter.

Belt, Screen, etc.—A new belt and screen, etc., was erected at the beginning of last year, in place of the old dock system of banking. This belt is 160 feet from centre to centre, 4 feet 6 inches wide, with similar foundations, and of the same construction as the belt described at Pleasley. The coals are tipped directly on to the belt by Fisher tipplers, the sorting and cleaning being done on each side, and the remaining coals raised to the screen by a bucket elevator, 42 feet long, with pan buckets, 9 inches deep, on a three-chain belt of similar construction to the main belt.

The belt and elevator are driven by a horizontal engine, with 16-inch cylinder and 30-inch stroke, the gearing being interchangeable with that at Pleasley. The belt travels at the rate of 68 feet per minute. The full trams are lowered from the top deck to the lower deck level by a counterbalance cage, where all are weighed, and

then run on to a creeper 43 feet long, by which they are taken to the tipping stage, the empties being lowered again to the bottom deck by another balance cage near the tipplers. The creeper is driven by an engine with 12-inch cylinder, with double gear, viz., two 12-inch pinions and two 4-feet spur wheels on 4-inch shafts.

The screen is 48 feet long, falling 6 inches to the foot, with two hoppers underneath for nuts and nut slack. The nut bars are 8 feet long, and the nut slack bars 11 feet long; the dust will be taken out in the same manner as at Pleasley. At the bottom of the screen there is a horizontal picking plate for cleaning the cobbles; from this plate the coals fall down a movable shoot into the trucks. The whole is covered by corrugated iron roofing on metal columns. Before this plant was erected the full trams were run by hand on to the pit bank, and the large coal hand-picked out of the tubs into the trucks, after which the tubs, with the remainder of the coal left in them, were taken up to the screen by a creeper and tipped. The cost of labour by the new plant has been reduced ¾d. per ton, the cost per ton for banking, screening, sorting, etc., being now 3d., and the saleable quality of the coal greatly improved. The percentage of slack, however, has not been reduced.

Fan.—Waddle, 30-feet diameter, with 12-feet inlet. Engine, with cylinder 24-inches diameter and 3-feet stroke. This fan has been at work upwards of twenty years, and the casing and vanes have become very thin. A new Capell fan is therefore being erected, 16 feet diameter and 6 feet 6 inches wide, with single inlet, which will be driven by a pair of vertical engines with 18-inch cylinders and 15-inch stroke, working direct on the fan shaft. It is hoped that this fan will be at work when the members visit the collieries, and the comparative results of the two fans will be then given.

In the following experiments the air was measured as at Pleasley in the fan drift, as well as in the returns near the bottom of the upcast pit, the useful effects being based on the latter. The fan drift was divided into nine spaces by strings fastened at equal distances vertically and horizontally across the drift. The water-gauge was fixed parallel with the air current, the orifice being 8 feet from the fan inlet. The amount of air passing was measured with an anemometer in three different ways. First, the quantity obtained in the ordinary way in the returns near the pit bottom; second, by holding the anemometer one minute in each space in the fan drift, and then multiplying the average corrected reading obtained in the nine spaces by the total area of the drift; and third, by multiplying the area of each separate space in the drift, by the readings obtained in each, the quantities thus obtained in the nine spaces being added together. The following were the results, the water-gauge being 2·50 inches, and the revolutions of the fan 75 per minute in each:—

No. 1 method = 122,599 cubic feet per minute.
No. 2 „ = 125,364 „ „
No. 3 „ = 127,118 „ „

WADDLE FAN EXPERIMENTS, TEVERSAL COLLIERY, JUNE, 1891.

No. of Experiment.	Water-gauge in Fan Drift.	Water-gauge on Separation Doors in Pit.	Barometer on Surface.	Barometer in Pit.	Ther-mom'ter on Surface.	Ther-mom'ter near Bottom of Upcast Pit.	Revo-lutions of Fan per Minute.	Periphery Speed of Fan in feet per Second.	Cubic Feet of Air per Minute.	Indicated Horse-power of Engine.	Horse-power in the Air.	Useful Effect per Cent.	Lbs. of Coal per Indicated Horse-power of Engine per Hour.	Lbs. of Coal per Horse-power in the Air per Hour.	Steam Pr'ssure per Square Inch. Boilers.	Cost of Fuel per Week at 3s. per Ton. £	s.	d.
1	1·65	1·50	28·88	30·01	49	73	60	94	102,421	49·8	26·6	53·4	9·0	16·8	46	5	0	9
2	1·95	1·70	28·88	30·01	49	70	65	101	103,381	66·2	31·7	47·8	8·4	17·6	50	6	6	0
3	2·15	1·90	28·87	30·00	50	70	70	109	114,309	78·8	38·7	49·1	8·7	17·3	42	7	10	4
4	2·50	2·00	28·85	29·99	51	70	75	117	122,599	94·3	48·2	51·1	9·2	18·1	53	9	16	6

Cost of oil, waste, etc., per week, fan at 70 revolutions per minute = 3s. 6d.

Natural ventilation measured when fan had been standing two hours, 23,000 cubic feet per minute.

Boilers.—All the boilers are on the surface, the steam being taken down the downcast pit for the hauling and pumping engines by 7-inch pipes. The following are the dimensions of the boilers :—

	Ft.	In.	Ft.	In.		Ft.	In.	
Nos. 1 to 7 Egg-ended boilers	40	0	× 5	0				
Nos. 8 „ 11 „ „	46	0	× 5	6				
Nos. 12 „ 15 Lancashire „	30	0	× 7	0	Tubes	2	6	diameter.
Nos. 16 and 17 „ „	30	0	× 6	0	„	2	5	„
Nos. 18 „ 19 Cornish „	29	0	× 6	0	„	3	1	„
Nos. 20 „ 21 Egg-ended „	36	0	× 4	7				
Nos. 22 „ 23 Lancashire „	30	0	× 7	0	„	2	7	„
No. 24 Egg-ended „	35	0	× 5	6				
Nos. 25 „ 26 „ „	36	0	× 5	0				

Nos. 22 and 23 are set on the Hyde and Bennett principle, the tops of the boilers being arched over with brickwork, and the gases from the flues allowed to circulate between the brickwork and the boiler plates. These two boilers have Proctor mechanical stokers applied to them, one with fixed bars and one with movable bars. The results obtained will be communicated when the members visit the collieries. Nos. 24, 25, and 26, are being set so as to be heated by the waste gases from the coke ovens. The pumps for these boilers are a donkey pump, with two 12-inch cylinders, 10-inch stroke, and 8-inch rams. A special, with 8-inch cylinder, 2-feet stroke, and 6-inch ram, and a donkey pump with two 8-inch cylinders, 8-inch stroke, and 6-inch rams.

Coke Ovens.—Twelve circular open-topped ovens, 17 feet 6 inches diameter, with perpendicular walls 7 feet 6 inches high and 18 inches thick, lined with fire-bricks. The tops are open the full area of the ovens. The main flue is built at the back of the ovens, 3 feet wide and 4 feet high, with straight fire-brick walls arched over the top. The small flues are arranged in the bottom of the ovens in the form of a cross, one arm running into the main flue, the draught being taken through three brick cones 18 inches high, with holes on each side, built on the flues in the bottom of the ovens. At the front of the ovens openings are left 4 feet 6 inches wide, and the full height for the doors. Instead of these being built with bricks, there are two folding doors to each oven of wrought iron, opening on hinges and fastening with an iron bar, the crevices being daubed and made air-tight.

The coke is made entirely from smooth hard, or cannel coal, which is loaded direct into the ovens by a temporary shoot from the trucks, in the same condition as it is picked off the belts, the large and small being as evenly mixed as possible. To ensure a proper draught a layer of large coal set on the edges is put in by hand at the bottom of each oven. The ovens are filled level with the tops, the coal being covered with fine ashes, and dust, 3 or 4 inches thick, in which six or seven openings are left for firing, the coal being lighted from the top. This covering has to be watched, so that the draught is kept as even as possible, and any opening that may occur is re-covered. The ovens are burnt from six to seven days, and at completion are watered by a spray placed on the top.

Oil.—Each oven makes about 100 gallons of crude oil per week, which accumulates in the bottom flues, and is run off each day through a 3-inch metal pipe, with a tap at the end. The oil is stored in a large cistern, and is used for the tub wheels instead of tram grease, more being produced than is required for the three collieries. Each oven is loaded with from 45 to 50 tons of coal, the yield of coke being from 58 to 60 per cent., and the cost of filling, drawing, and loading, 1s. 1d. per ton. The analysis of this coke is:—

Moisture	2·63
Carbonaceous matter	88·09
Sulphur	0·48
Ash	8·80
	100·00

Underground Haulage.—Two endless ropes are at work on the levels running in each direction from the pit bottom, the north level 1,250 yards in length, and the south level 1,700 yards, the former with best patent steel rope ¾-inch diameter (Lang patent), and the latter ⅞-inch diameter of the same make. The ropes are worked by a horizontal condensing engine, with 30-inch cylinder and 5-feet stroke, geared, and with two driving wheels, each 6-feet diameter and 9-inches wide, fixed on an upright shaft, the respective ropes passing three times round each wheel. The steam pressure is 50 lbs. per square inch. This engine is placed in an engine house made underneath the engine plane on the north side of the pit, the ropes having a straight lead on to each level. The trams are brought to the pit bottom in sets of from twenty to thirty by "tongues" or men with clips.

There are also two dip engine planes, the coals being brought up them on to the levels. The south dip is 160 yards from the shaft, worked by a pair of horizontal condensing engines with 22-inch cylinders and 3-feet 6-inches stroke, geared, and having a drum 7-feet diameter; steam pressure, 45 lbs. per square inch; dip of engine plane, 6 inches to the yard, sixteen trams being drawn each time. The north dip is at the extent of the north level, 1,100 yards from the shaft, and is worked by a pair of compressed air engines, with 20-inch cylinders and 3-feet 6-inches stroke, working direct on to a drum 4-feet 6-inches diameter. Ten trams are drawn up this incline each journey, the dip being from 6 to 9 inches to the yard. The air pressure varies from 40 lbs. at the beginning of the run to 26 lbs. per square inch at the end.

The air compressors are on the surface, and consist of two steam cylinders each 30-inches diameter with condensers, and two air cylinders each 38-inches diameter, with 6-feet stroke, and running from 16 to 24 strokes per minute; steam pressure at boilers 50 lbs., and air pressure at compressors 40 lbs. per square inch. The receivers are:—

	Ft.	In.		Ft.	In.
No. 1, at compressors	23	6	×	5	0
No. 2, „	28	0	×	7	0
No. 3, at hauling engines...	23	6	×	2	6
No. 4, at pump in dips	15	0	×	3	0
No. 5, „ „	10	0	×	3	0

The following are the results of diagrams taken from each steam and compressor cylinder:—

	Steam.	Air.
Indicated H.P., west side cylinders ...	201	163
„ east „ ...	195	167
Total	396	330

The ratio between horse-power in steam cylinders and horse-power in air cylinders being 83 per cent. The diagrams show that the indicated steam used averages 30 lbs. per square inch, of which 10 lbs. is due to vacuum. This could only be obtained where there was a constant stream of cold water accessible to condense with.

The compressed air is taken down the downcast pit in 11-inch pipes, and from the pit bottom to the air engines in-bye in 10-inch pipes. The distance from the compressors to the hauling engines is 1,400 yards. A pump is also worked by compressed air at the bottom of the north dips, a further distance of 800 yards, the air being taken this distance in 5-inch pipes. This pump has an 18-inch cylinder, with 14-inch stroke and 4-inch ram, and forces the water a height of 342 feet to the top of the dips, from whence it is conducted by a water-level to the pit bottom.

Underground Pumps.—Constant feeders of water, in addition to the above, flow from the old north rise workings near the outcrop of the coal, and from the upcast pit. The former is brought by the water-level to a cistern near the pit bottom, from which the level hauling engine obtains water for its condensers, the overflow from this cistern running into the standage. The water made in the upcast pit is conducted into another cistern, from which the condensers at the dips hauling engines are supplied, the overflow from this cistern also running into the standage. The feeders amount to about 220 gallons per minute, and to deal with these there is a Hathorne-Davey pump placed near the bottom of the upcast pit, with 32-inch cylinder, 6-feet stroke and 6-inch ram, working 10 strokes per minute, and forcing the water up a 6-inch rising main in the downcast pit to the reservoir on the surface. There is also a Tangye pump kept in reserve, and worked occasionally, with 30-inch cylinder, 4-feet 6-inches stroke and 8-inch ram, delivering up the same rising main as the Hathorne-Davey.

The general offices are at this colliery, and there is telephonic communication between these and the other pits.

The workshops have recently been rebuilt on the site of the old shops, and a store-house and locomotive repairing shed erected.

The sidings having been constructed without the necessary fall for dealing with the traffic by gravitation it is necessary to keep three locomotives constantly at work for this colliery and Silver Hill. There is also a spare locomotive at Pleasley and Teversal Collieries ready for use.

The brickworks produce 30,000 hand-made bricks per week, and the perforated pan enables the ratchel to be ground and mixed with the clay and produce a good and serviceable brick.

The gas works, which have been enlarged, supply Teversal and Silver Hill Collieries and houses with gas.

The cottages, 280 in number, are nearly all at Stanton Hill, where there is a large school and workmen's club, and a resident curate paid by the company.

Silver Hill Colliery.

Winding Engines.—A pair of horizontal engines with 36-inch cylinders and 6-feet stroke, working a drum 20-feet diameter. Average piston speed when coal drawing, 384 feet per minute. The gearing is worked by a Melling patent steam driver, with 6-inch cylinder and 12-inch stroke.

There are two shafts, each 15-feet diameter, coals being at present drawn only at the downcast pit, which is fitted with rope conductors 1¼-inches diameter. It is intended when the Low Main workings become further developed, to draw coals at both shafts, and a new pair of winding engines will shortly be erected at the upcast pit for this purpose. The cages are double-decked, carrying two tubs on each deck, are made of iron, and weigh each 50 cwts. The winding ropes are 1¼-inches diameter of best patent steel, and have King detaching hooks.

Each shaft is lined with metal tubbing for a depth of 82 yards, commencing 24 yards from the surface. After heavy or long continued rains the water frequently runs over the top of this tubbing into the pits, in consequence of which a further length of 19 yards is being put into each shaft.

Boilers.—Steam is supplied to the winding, hauling, and belt engines from a range of nine Lancashire boilers of the following dimensions:—

Nos. 1 to 4, 30 feet by 7 feet, with tubes 2 feet 8 inches diameter.
No. 5 30 „ 7 „ „ 2 „ 6 „
No. 6 30 „ 7 „ „ 2 „ 8 „
No. 7 30 feet 6 inches by 7 feet, with tubes 2 feet 6 inches diameter.
Nos. 8 and 9, 30 feet 6 inches by 7 feet 6 inches, with tubes 3 feet diameter.

A Lancashire boiler, 30 feet by 8 feet, with tubes 3-feet 3-inches diameter, and set on the Hyde and Bennett principle, has been put down specially for the fan engines.

This boiler is made of ⅜-inch Siemens-Martin mild steel plates, the shell consisting of ten rings, each ring being one plate. The longitudinal seams are butt-jointed with cover straps inside and out, riveted with four rows of rivets, and the circular seams single riveted. All the rivet holes were drilled in position. The ends of the boiler are made of one plate ⅜-inch thick, the flue openings being bored out by machine. The boiler is designed for a working pressure of 100 lbs. to the square inch, and has been subjected to a hydraulic test of 175 lbs. The follow-

ing are the results of experiments made with this boiler with and without the cut-off on the valves of the fan engines :—

	Without Cut-off.	With Cut-off at $\frac{1}{10}$ of the Stroke.
Strokes of engine per minute	28	28
Duration of experiment in hours ...	6	6
Pressure in boiler in lbs. per square inch	70	70
Pounds of coals used per hour... ...	765	392
Gallons of water evaporated per hour	510	238
Pounds of water evaporated per pound of coal	6·6	6·07
Tons of Top Hard slack used per week	57	29·4

The temperature of the feed-water was 50 degs. Fahr., the boiler being fed by an injector with steam from the same boiler.

Ventilation.—From the time this pit started in 1881 to the present year the ventilation has been produced by a small furnace with a grate surface of 10 feet by 5 feet. Through the depth of the shafts and large area of the wind-roads this furnace gave exceptionally good results, the consumption of coal being 30 tons per week or 3·6 cwt. per hour, and the average quantity of air 122,000 cubic feet per minute with 1·4 inches of water-gauge. According to figures recently obtained at Hetton Colliery, that furnace with a grate surface of 60 feet by 11 feet, using 1 ton of coal per hour, gave 300,000 cubic feet of air per minute with 2 inches of water-gauge.

Inasmuch as the Silkstone Seam is worked entirely with safety-lamps, and the whole of the return air comes in contact with the fire, and as there is 82 yards of tubbing in the shaft, which was gradually being eaten away by the smoke and heat, it was decided to put down a fan, and discontinue the use of the furnace. The fan is a double inlet Capell, 12-feet 6-inches diameter and 11-feet 6-inches wide, with inlets 7-feet 6-inches diameter. It is driven with ropes, the pulleys being 20 feet and 4-feet 6-inches diameter or 4·4 to 1. The pulleys and ropes were supplied by the Bowling Iron Company, who are also the makers of the fan. A pair of old winding engines with 26-inch cylinders and 5-feet stroke, which had not been in use for ten years were utilized for this purpose. These engines were fitted with drop valves, and the following table shows very conclusively how extravagant drop valves are, where continuous running is necessary, and where the cylinders are very much too large for the work they have to perform. Until the valves were carefully adjusted and the fan had worked into its bearings, it was impossible to keep the ropes on the driving pulley without having both engines at work, so as to preserve a uniform speed at each part of the stroke. This difficulty has been gradually overcome to a certain extent, and we are now able to drive the fan with one engine. Since the engines were erected the Worsley Mesnes Iron Works Company, of Wigan, have applied a cut-off motion, which has effected considerable economy. The following are the results of experiments made with this fan, with one engine, and both engines at work, also with and without the cut-off, and with four and six driving ropes:—

EXPERIMENTS WITH A CAPELL DOUBLE INLET FAN, SILVER HILL COLLIERY.

No. of Experiment.	Water-gauge in Fan Drift.	Water-gauge in the Pit.	Revolutions of Fan per Minute.	Strokes of Engine per Minute.	Cubic Feet of Air per Minute measured in the Returns in the Pit.	Horse-power in the Air.	Indicated Horse-power of Engines without Cut-off on Valves.	Useful Effect per Cent. without Cut-off.	Indicated Horse-power of Engine with Cut-off, and Six Driving Ropes on Pulleys.	Useful Effect per Cent. with Cut-off, and Six Driving Ropes on Pulleys.	Indicated Horse-power of Engine with Cut-off, and Four Driving Ropes on Pulleys.	Useful Effect per Cent. with Cut-off, and Four Driving Ropes.	Pounds of Coal per Hour per Indicated Horse-power without Cut-off, and One Cylinder.	Pounds of Coal per Hour per Indicated Horse-power with Cut-off, and One Cylinder.	Pressure of Steam at Boiler per Square Inch.
1	1·4	1·3	123	28	110,920	24·4	Two cylinders. 116·0	21·0	One cylinder. 53	46	One cylinder. 52·2	46·7	9·4	7·3	50
2	1·5	1·4	132	30	129,150	30·5	One cylinder. 86·8	35·0	64	47*	69·0	44·2	...	...	70
3	2·0	1·6	158	36	142,810	45·0	One cylinder. 127·0	35·2	96	46	95·5	47·0	...	...	72
4	2·9	2·3	185	42	169,710	77·5	No diagrams.	...	...	...	...	...	...	...	...
5	4·1	3·2	215	49	199,550	129·0	Two cylinders. 335·0	38·5	...	...	...	...	...	...	45

Cost per week for oil, waste, etc., fan running 123 revolutions per minute.

Furnace with 1·4 water-gauge gave 122,000 cubic feet per minute using 30 tons of coal per week.

* Fan " " 129,150 " " 32 " "

Natural ventilation after the fan had stood two hours, 34,000 cubic feet per minute.

Belts, etc.—There are two sorting belts, one for the black shale or Silkstone coal, and the other for Low Main, both being of similar construction to those already described at Teversal and Pleasley. The black shale belt is 75 feet long, and 4 feet wide. The coals are tipped on to a jigging screen, with a fall of 3 inches to the foot, by a side-revolving tippler. The nuts pass through a square mesh made of ¾-inch steel wire, on to a cross belt 23 feet 6 inches long, running beneath the screen, where they are cleaned, and then delivered into the trucks. The nut slack passes through a square mesh into the trucks immediately below the screen. The jigging frame carrying the nuts and nut slack meshes is suspended by hangers, fixed to the sides of the screen; it is worked from eccentrics and makes 120 vibrations per minute. The best coals fall from the jigger on to the main belt, where they are cleaned and the cannel dressed off, the cleaned coals falling from this belt down a telescopic shoot into the trucks, the small made on the belt being taken out by a screen fixed in this shoot. This belt is driven by an engine with a 10-inch cylinder and 16-inch stroke, with gearing, and the jigger by another engine of the same size. The speed of the large belt is 54 feet per minute, and of the nut belt 58 feet per minute. Before this plant was erected the black shale coals were cleaned on nine ordinary screens with dead-plates at the foot of each. The cost has been reduced 2½d. per ton by the present system, the cost for banking, screening, sorting, and cleaning being now 4½d. per ton on a quantity of 300 tons per day. The selling price has also been greatly improved, as it was not possible to properly clean the coal by the old method.

Low Main Belts.—This is a similar arrangement to that described above, the belt being the same size. This screen is, however, a double jigging screen, each half being worked by a separate pair of eccentrics, fixed on the same shaft and making 200 vibrations per minute. The screen has a fall of 3 inches to the foot. The nuts pass through a square mesh, and the small through a mesh of smaller size. Owing to the inconvenient position of the sidings, it was found impossible to fix the nut shoot at such an angle as would permit the nuts to fall from this screen into the trucks. A back jigger was therefore put in, on to which the nuts fall and which throws them into the trucks, this jigger being worked from the same shaft as the others. The belt is driven by an engine with 10-inch cylinder and 16-inch stroke, and the jiggers by an 8-inch cylinder with 12-inch stroke. The speed of the belt is 72 feet per minute. The cost of banking, screening, and cleaning this coal is 2½d. per ton, the present quantity being 300 tons per day, part of which is drawn in the night shift. This cost will, of course, be considerably reduced when there is a greater quantity of coal drawn.

Coke Ovens.—There are 62 beehive ovens 12 feet in diameter and 7 feet high. The coke is made of black shale and Low Main small mixed in the proportion of one ton of the former to two of the latter. The black shale small is washed by a Robinson washer designed to wash 5 tons per hour, the washed coal falling down a draining shoot into a Devil disintegrator 4 feet 6 inches in diameter, capable of crushing 20

tons per hour, the Low Main small being brought at the same time from a large hopper into the disintegrator by a trough conveyor, the quantity being regulated to the proportion named. The crushed coal is raised by a bucket elevator into a large hopper, from which it is taken by pans in the ordinary way to the ovens. An engine with 10-inch cylinder, and 16-inch stroke, works the washer, and also two endless pan belts, one of these conveying the black shale coal into the washer, and the other the Low Main coal into the hopper, from which it is taken as described into the disintegrator, the latter being driven by belting by an engine with 18-inch cylinder and 3-feet stroke, which also works the bucket elevator. It is intended to add a revolving screen to this plant, for the purpose of taking out the peas or best of the small, and allowing only the smallest coal to go to the coke ovens; this will shortly be at work. The ovens are drawn twice a week, and are burnt alternately for three and four days each; the loads for three days are 98 cwt. of coal per oven, and for four days 112 cwt. The average yield of coke on the unwashed coal is 50 per cent., the cost for loading, drawing, and filling 1s. 4½d. per ton, and for washing and crushing 3d. per ton on the coke made.

Before the Robinson washer was erected the coal was washed in a pair of long wooden spouts or troughs, the water and coal being run in at the same time at the top of the trough. A series of wooden partitions or dams were made in the spouts, about 8 yards apart, over which the water flowed, carrying the coal forward to the hoppers, whilst the dirt and stones settled at the bottom of the spouts against each dam. This arrangement necessitated the use of large settling ponds, the overflow from which fouled the brook, and used nearly eight times the quantity of water required for the Robinson washer. The troughs are, however, kept in reserve and ready for work should any necessity arise.

The following is the analysis of Silver Hill coke :—

Moisture	0·70
Carbonaceous matter...	85·86
Sulphur	1·34
Ash	12·10
	100·00

A portable three-throw pump, each barrel 3 inches by 7 inches, to be driven by electricity, is being put in the Low Main Seam to pump the water out of the dip workings. The motor, with the pumps, will be fixed on a frame with wheels so arranged that the whole can be moved about the workings on the tram roads as desired. The motor will be covered with a special fire-proof casing and the pumps will be driven by means of a worm and worm-wheel connected to the motor shaft at a speed of 40 strokes per minute. The height of the pumps to the top of the air vessel above the rails will be 3 feet 3 inches, the length over all 5 feet 4 inches, and the width 3 feet. The dynamo will be fixed on the surface by the side

of the fan and will be driven by a rope from the large fan pulley. The cables from the dynamo to the motor will be taken down the upcast pit.

The pit bottom will be lighted with incandescent lamps and ultimately the screens also. If any satisfactory electric miner's lamp could have been perfected in time for the opening out of this pit it would have been adopted. A pair of 36-inch winding engines are being made, also wrought iron headstocks and belts and staging so as to draw Low Main coals at the upcast pit; this will necessitate the erection of a further lot of ovens and an independent washing and grinding plant.

Conclusion.

There is in connexion with the collieries a farm of 300 acres, the whole of which will be seeded down in the course of the next twelve months, and enough hay will be produced for all the horses. Two experimental ensilage stacks were made last year with Blunt automatic presses out of the second crop or aftermath, and were so satisfactory that this course will be adopted in future and thus prevent the necessity for buying sheep or cattle to graze during the winter.

The members of the Institution must bear in mind that these collieries are, some of them, twenty-five years old, and the newest is more than ten years old, and all the improvements that have been effected lately have been done without causing any of the pits to stand, and, naturally, there are many things which would have been different if the arrangements had all been made simultaneously, and within the last few years.

The following paper by Mr. T. M. Winstanley-Wallis on "The Low Tension System of Shot-firing" was taken as read:—