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R E P O R T :

Accidents in Coal Mines.

*Ordered, by The House of Commons, to be Printed,
1 August 1849.*



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Brought from the Lords, 31 July 1849.

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R E P O R T

FROM THE

SELECT COMMITTEE OF THE HOUSE OF LORDS

APPOINTED TO INQUIRE INTO

**The best Means of preventing the Occurrence of
DANGEROUS ACCIDENTS IN COAL MINES ;**

AND TO REPORT THEREON TO THE HOUSE ;

TOGETHER WITH THE

MINUTES OF EVIDENCE,

AND AN

APPENDIX AND INDEX THERETO.

Session 1849.

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*Ordered, by The House of Commons, to be Printed,
1 August 1849.*

R E P O R T.

BY THE LORDS COMMITTEES appointed a SELECT COMMITTEE to inquire into the best Means of preventing the occurrence of Dangerous Accidents in COAL MINES, and to report to The House; and to whom Leave was given to report from time to time to The House; and to whom were referred the PETITION of *Goldsworthy Gurney*, praying that Your Lordships will be pleased to institute some Inquiries into the SUBJECT of FIRE DAMP EXPLOSIONS in COAL MINES; the PETITION of *James Mather*, of South Shields, praying that Your Lordships will institute an Inquiry into the Condition of the COAL MINES, in reference to their Lighting, Ventilation by High-Pressure Steam, Plans and Sections, Scientific Education of their Officers, and Government Inspection; the PETITION of the UNDER-GROUND MINERS of the Counties of Durham and Northumberland, whose Names are thereunto subscribed, praying for the examination of some of their body before the said Committee, in relation to their Condition, and exposure in their dangerous Profession; the PETITION of *Richard Brain*, of No. 17, Serle's-place, Carey-street, Civil Engineer, praying that his System of Ventilation in Collieries may have a fair and impartial Investigation and Trial, and that he may be heard in support of his Petition before the said Committee; and the PETITION of *James Godfrey Wilson* and *William Pidding*, of Chelsea, in the County of Middlesex, praying that their Invention for the perfect Combustion of Fuel, and the consequent Abolition of the Smoke Nuisance, may receive the favourable Consideration of this House:—

ORDERED TO REPORT,

THAT the Committee have met, and considered the subject matter to them referred, and also the said Petitions; and have examined several Witnesses in relation thereto; and the Committee having during the short period of the Session which remained from the date of their appointment, felt the necessity of pursuing the inquiry entrusted to them with as little delay as possible, trust it will be found that they have collected much useful evidence upon most branches of the subject to which it has been directed; although they might, perhaps, if the time at their command had been longer, have rendered it in some respects more complete.

The same cause which has somewhat limited the investigation, must likewise prevent any very wide review of the subject in the present Report, and compels the Committee to content itself with little more than a reference, for the most part, to the Evidence which it submits herewith to The House. The necessity for this course, however, is less to be regretted, because the matter therein contained, though in many points new and interesting, presents nothing materially at variance with the results of former inquiries.

Several useful inquiries connected with the subject of accidents in Coal Mines have taken place of late years. To go no farther back than 1835, it may be affirmed that since that period the attention paid to it has received a considerable and effective impulse. The Committee of the House of Commons which sat in that year declined to offer any suggestions of its own, though it placed on record a valuable collection of Evidence, entering largely into the different topics of discussion, scientific as well as practical, which present themselves in connexion with such an inquiry. Since that date various other investigations of the same nature have been conducted by Commissioners under the authority of Government, which will be found among the Papers from time to time presented to Parliament. These consist, first, of the Reports of the Commission for inquiring into the Employment of Children in Mines and Manufactories in 1842; and of the Report of the Midland Mining Commission in the following year; secondly, of the separate Reports of several Special Commissioners charged with the investigation of particular matters or events on certain specified occasions; and, thirdly, of the Annual Reports of Mr. Tremenhèere, the officer appointed under the Act of 5 & 6 Vict., c. 99, for inquiring into the operation of that Act, and into the state of the population of the mining districts; some of which contain the views which he has been led to adopt from his opportunities of observation upon the subject of accidents. Besides these public records, a Committee, voluntarily instituted at South Shields for the same purpose as these inquiries, after the severe calamity at the St. Hilda Colliery, near that place, in the year 1839, published a Report, in 1843, which is distinguished by much research and ability; and these several documents, combined with various private publications, supply altogether an amount of information with reference to accidents in Coal Mines which in some degree supersedes the necessity of any lengthened disquisition of the kind upon the present occasion.

Still it appeared desirable to ascertain, if possible, whether any and what progress had been made during the above period in the knowledge and practice connected with the occurrence of these fatal events; and also whether the time is not arrived at which it may be practicable for the Legislature and the Government to effect some good, with the concurrence of almost all parties concerned, by means of a judicious system of inspection; and by promoting, in whatever manner may seem most effectual, the diffusion of knowledge among the mining population of these Kingdoms.

Keeping these objects in view, the Committee have endeavoured to confine their inquiry, as much as possible, within the limits of practical utility. They have, for the most part, abstained from mere speculative investigations, which, however curious and interesting in themselves, are not very appropriate subjects for the decision of a Parliamentary Committee, and upon which it could scarcely be qualified to arrive at satisfactory conclusions. Upon the same principle, with regard to the many ingenious suggestions and inventions which have been offered to the attention of the Committee, they have declined to undertake an examination of their abstract and intrinsic merits, feeling that no such tribunal as a Committee of the Legislature was properly fitted to perform such a task in a satisfactory manner, or to pronounce an opinion as to the results with any weight or authority. They have, therefore, limited their attention to those cases alone which have been subjected to the test of practical application, and with respect to the actual experience of which, therefore, direct evidence was to be obtained from those whose professional acquirements and experience qualified them to judge of their real value.

Under this reasonable limitation, however, the Committee have had before them several inventions of much interest and merit, which have, to a certain extent, received the ratification afforded by successful use. The plan of Mr. Goldsworthy Gurney, formerly submitted also to the Committee of 1835, for applying the high-pressure Steam-jet to the ventilation of Mines; the Centrifugal Fan, for effecting the same object, invented by Mr. Brunton; the patent Mine Ventilator of Mr. Struvé, acting upon the principle of a powerful air-pump, will be found explained in the evidence, both by the inventors and by those who have brought them into practical operation in each case. The Committee venture to invite attention to those parts of their inquiry, which, together with some collateral investigations connected with the same subject,—especially as to
the

the precise action and power of the Steam-jet as a ventilating agent, compared with those of the ordinary furnace hitherto in use,—contain much that deserves consideration. The Committee cannot pretend to pronounce an opinion as to the comparative merits of these contrivances, nor can it venture to declare that the experience of their success is absolutely conclusive in their favour respectively; but they are at least sufficient proofs that there is reasonable hope of attaining greater security by the application of proper means, and that there is a spirit of intelligent energy now awakened with reference to this object, from which the best results may hereafter be expected.

The actual condition of the Coal Mines of this country, as respects ventilation, appears to be widely different, and it is to be feared is, for the most part, seriously defective. In the Northern Counties of England, where the whole science and practice of the subject is more studied and better understood than elsewhere, there are many examples of collieries, some of them upon a gigantic scale, in which the most enlightened attention is paid to the condition of the workings, and to the arrangements for rendering them secure; and, generally speaking, there appear to be but few in those parts where at least the ordinary resources of ventilation are not applied. But in other districts,—in the Midland Counties and in Wales—it is stated that there are many Mines altogether unprovided with anything to aid the mere natural action of the atmosphere. This depends solely upon the difference between the temperature of the air at the surface and that in the Mine; and when the former is high, and therefore nearly approaches to the latter, the ventilation wholly ceases, and the air of the Mine is stagnant—a state of things involving extreme peril, and, even where this is absent, probably serious injury to the health of those employed. There can be no doubt that in these cases considerable improvement might be easily effected, and ought by some means to be secured; and there is strong evidence, from competent authority, that, even in an economical point of view, a safe and healthy condition of a mine may be ultimately the most profitable to the owner. But it should be remarked, that the arrangements under-ground, which are an essential portion of any system of ventilation, are also, in these parts of the country, often very imperfect, in consequence of faulty methods of working. To improve these is a matter of greater difficulty; and it can only be effected by more extended information on the part of those concerned—a consideration which indicates the value of any measures which may tend to direct attention to the principles upon which such operations can be best conducted.

Elliot 3013-3015.
Forster 2711, 2712.
Woodhouse
3895-3906.
3907-3909.
Barber 4216, 4217.
Dobson 4399, 4400.
Dunn 5317, 5369-
5371.
Taylor 6191, 6192.

The Committee cannot quit this part of the inquiry without pointing attention to the evidence they have received respecting the Safety Lamp. The main objections urged against the original invention of Sir H. Davy, are its defective light, and its possible insecurity in a strong current of explosive air. In the evidence of Mr. Biram and Dr. Clanny will be found explanations of two recent modifications of the instrument, for the purpose of obviating those defects, which have been both practically tried, and the latter of which has been extensively approved and adopted by some Managers of Mines. The Committee, for the reasons before stated, do not take upon themselves to express any opinion of their own upon the comparative merits of these inventions, which can be only decided by practical experience; but they have thought themselves bound not altogether to exclude the consideration of so important a branch of the subject.

Though better ventilation, however, appears to be the improvement most generally needed, and most to be aimed at, and though this, together with a vigilant observation of the state of the workings, and a judicious use of the Safety Lamp, will probably reduce the risk from fatal gases, whether explosive or otherwise, to a minimum, it seems to be admitted that there is no hope of wholly excluding all danger from such causes; and, on the other hand, although these classes of accidents give rise to the most extensive calamities, and therefore command most interest, it seems clear that they do not, in fact, entail the greatest destruction of life when compared with the other sources of danger which are of continual occurrence in the working of Coal Mines, but which, involving the loss of few lives only at a time, attract often but little notice. It is difficult to obtain any correct comparison of the amounts in either case both because the data are very incomplete, and because the numbers resulting

from the more extensive calamities vary to so great a degree with the individual circumstances of each event. Sir H. De la Beche (109) asserts that the rate of mortality from explosions has increased since 1835, when the Committee of the House of Commons considered the number of deaths from such accidents in the previous 25 years to have been much under-rated at 2,078;—yet, according to Mr. Dunn (5354), the number of explosions recorded in the Mining Journal for 1844, were only 189 out of a total of 562 colliery accidents of all kinds; and in 1847,—142 out of 462 between April and December. According to Mr. Richardson (3729), the same record gives for 1848—162 explosions out of a total of 466; and in the first half of 1849, to June 30, 184 out of 332. Again, Mr. Taylor (5998) gives 224 out of 439, as the proportion of deaths by explosions in six years ending 1 January 1845 in 55 collieries in the counties of Northumberland and Durham, on the authority of the Registrars' accounts; and Mr. Peace (5009) states, out of 384 underground accidents in the Haigh Colliery in Lancashire, between 1842 and 1849, those by explosions to have been only 25. The proportion of other accidents, out of the whole number, is, therefore, undoubtedly large. These are of various kinds; among the most formidable, and in some districts not the least frequent, are those arising from the breaking of ropes in descending and ascending the shafts, and from drawing the corves or boxes over the upper pulleys. The Committee would particularly point attention to the evidence describing the principle and the successful application of an invention by Mr. Fourdrinier, which seems to promise a valuable protection against this description of danger.

E. N. Fourdrinier
1268, &c.
Jas. Fourdrinier
1926.
Elliot 3073. 3466.
Dunn 5280.

In the evidence of Mr. Swallow, it is stated that a frequent cause of accidents in the Collieries around Bolton in Lancashire, is the existence of what are called "mouthings," or openings of upper workings in the side of a shaft, from which the corves or baskets are to be hooked on to a rope passing down to the entire depth, in which operation a loss of footing or of balance is generally fatal; and it is suggested that this would be in a great degree obviated by fixing a small platform at such mouthings. It is matter for surprise and regret that if so simple a precaution could contribute to prevent the sacrifice of life, those who are mainly responsible for the consequences should omit to adopt it.

Falls of the roof are, in most districts, a still more common form of accident than any of these; and are represented to be, to a considerable extent, unavoidable, from the usual absence of all previous warning. The risk of these occurrences varies much with the mode of working; but there is reason to fear that their probability is often increased by an inadequate supply of timber for the required supports; a deficiency which arises from considerations of expense, and therefore is in many cases difficult of remedy; though this very expense is said to be increased by defective ventilation. But there may be some room to hope, that if the state of such Mines were made more distinctly known, and thereby the responsibility of those on whose neglect it depends were rendered more manifest, some improvement might be effected even in this respect.

Woodhouse 3908.

There is one other cause of fearful catastrophes which must not be left unnoticed, though of more rare occurrence, that of inundations. These arise in all cases from a dangerous approach of the workings to some body of water, such as the sea, or frequently that collected in old and abandoned excavations. There can be no remedy for these but caution where the danger is known, and a correct record of workings, in order to secure that knowledge. One of the suggestions made accordingly with a view to the latter point is, that there should be some registration of coal-workings; and it will be found that one of the Witnesses cites certain cases of this nature as among the strongest practical proofs of the necessity of an inspection.

Dunn 5224 et seq.

In almost all the cases enumerated, it is apparent that one important step would be gained if the actual condition of the several Coal Districts were made more accurately known, and that of the individual Mines brought more distinctly under the notice of some competent authority; and even, it is to be hoped, in some instances of the owners themselves. The Committee, therefore, consider the appointment lately made of Professor Phillips, of York; and Mr. Blackwell, of Dudley, whose instructions from the Secretary of State have already been presented

sented to Parliament, to be judicious as a first advance towards this object; but a Commission so limited in its organization must be very inadequate to the effectual prosecution of such a task; and the question remains whether it would not be desirable that Parliament should authorize the establishment of some more comprehensive system, which might tend to promote the same end with greater efficiency. Upon this point there is a striking unanimity in the evidence given during the present inquiry. The Committee believes it may affirm that every Witness, without exception, expressed an opinion more or less favourable to the establishment of a Government inspection. In the Evidence of Messrs. Woodhouse and Peace, which contains information as to two considerable meetings held at Derby and at Wigan respectively,—as well as in that of other Witnesses, derived from their general observation,—it will be found that there is reason to believe that a concurrence in that view prevails among a large portion of the body of colliery owners in those and other districts. But, in considering this subject, the difficult question necessarily arises, as an essential part of it, as to what should be the powers conferred upon any such Inspectors; and upon this point also the opinions expressed appear to be on the whole remarkably uniform. On all hands it is admitted, that to enable them to discharge their duty effectually, it would be necessary to give them a right to enter and examine Mines, and probably to call for and to inspect working plans; while at the same time they should not be empowered so to interfere as to take from the owners and managers of such concerns the responsibility which naturally belongs to them, and which it is desirable not only not to withdraw, but rather, if possible, to increase. Some Witnesses, indeed, on behalf of the working miners, seem to wish, in their not unnatural anxiety for greater protection, to carry the powers of an Inspector further, and to think that this might be done even to the length of giving him a power to order and to enforce penalties, without incurring the consequences of a transfer of the responsibility. With every wish to regard in the most favourable light any proposal of theirs for attaining the common object, the Committee cannot but think that this is a mistaken view; and that interference of this kind, carried beyond a certain point, would result in vexation on the one side, and disappointment on the other, and would tend, both by substituting the responsibility of an Inspector for that of the colliery owner and his agents, and by probably preventing their friendly co-operation, to defeat the very end for which it was designed. An attempt has been made to support such views by the analogy of the Factory Acts; but it does not appear to your Committee that this analogy can be practically sustained. In so far as the Factory Acts provided an inspection for the protection of women and children from undue labour, the example has been already followed in the case of Mines; but when it is attempted to draw a comparison between the inspection of a Factory and the inspection of a Mine; and between the power to order a simple defence against dangerous machinery, and directions for the improvement of ventilation, or as to methods of working collieries, or prescribing the many other changes which may be desirable for their safety; such a comparison must be held in practice to be untenable. If there were no other reasons against such powers, the cases to be dealt with are too various in their conditions, opinions as to the fittest remedies in each particular instance are occasionally too doubtful, and the difficulty and cost of applying them often too great, to justify the positive enforcement of the views of a Government officer, however competent, against, perhaps, no less experience and knowledge in the properly responsible parties. In addition to this, it would appear to be next to an impossibility that an Inspector should make himself thoroughly acquainted with the working of a large Mine, without the willing assistance of those who manage it; and, finally, that many remedies and safeguards would require a continued superintendence to render them effectual, which it is clear that no attainable staff of Inspectors employed over the whole mining operations of England, Wales and Scotland, could possibly supply.

Swallow 4382-4385.
5160, 5161.
Atkinson 5544, 5584.
Jude 5755, 5756.
5861-5864.

It will be found, that these and similar reasonings have influenced the decided majority of the Witnesses in recommending that a Government inspection should be invested with no direct powers beyond those of entering and examining Mines, and of investigating plans, so far as may be necessary for judging of their internal condition and arrangements; and that their duties should then extend to recording and reporting, making suggestions, and communicating information

information to the managers or owners. In this view the Committee concur; and they see no reason for dissenting from the anticipations of several Witnesses, that a Government inspection on such a footing might gradually accomplish essential improvements in the best manner. It is worth while to remark that this appears to have been the case in Belgium, where such a supervision has been established for some years. In the Appendix to Mr. Tremeneere's Report on the Mining Inspection of France and Belgium, presented to Parliament in 1848, there is an account, showing that there has been a decrease from 378 in the deaths and injuries per 1,000 of the population employed between 1835 and 1839, to 268 per 1,000 between 1840 and 1844, an inspection having been in force during the whole of this period, and the system having been more completely organized in the course of the same years; and the same statement shows, that the number of deaths by accidents between 1840 and 1844 had diminished 15 per cent., though the production of coal had increased 20 per cent., and the number of workmen 17 per cent. Moreover, it appears by a Table contained in the same Paper, that of the eight different heads under which mining accidents are there classed, those have sensibly decreased which may be considered as most within the reach of an inspection, while the rest either have continued to increase or exhibit a less distinct result; and from all these data it is not unreasonable to infer, that the system has there, at least, had some beneficial effect in reducing the risk of these calamities. It is true that since in the Continental States the minerals are worked only by concessions from the Government, which in those countries stands in the position of proprietor, a State inspection there affords no strict analogy for a similar arrangement here. But there is evidence to show that both in France and in Belgium the system is found to work without difficulty or vexation, and with the good-will of all concerned; and therefore, although in several respects the circumstances may not be precisely such as to justify us in at once assuming that it forms a precedent on which we could rely in similar arrangements, still it can hardly be deemed unwarrantable to view it as affording a practical ground of hope that they might be established here, under proper modifications, with a like success. At any rate, when it is considered that if, on the one side, the endeavour may involve some objections, and possibly some obstacles, there is, on the other, to be considered the reasonable protection of the lives and limbs, and, it may be added, the health, of a great and valuable portion of the population, exposed at the best to many unavoidable dangers, it cannot be doubted that it is the imperative duty of Parliament and the Executive to adopt, for the purpose of attaining such security as is undoubtedly within the reach of precaution, any steps, whether of the nature of inspection or of direct enactment, consistent with the free pursuits of industry and commerce, with the mutual relations in this country between the Government and private enterprise, and with the due recognition of that responsibility imposed upon the owners and managers of Mines, which it should be the care of all rather to strengthen than impair.

On the inquiry into the sacrifice of 75 lives by explosion at the Darley Main Colliery, near Barnsley, in the beginning of the present year, it was proved that the "Bottom Steward," or "Agent, upon whom devolved the charge of all the under-ground operations, between the monthly visits of the viewer, was, although very careful and zealous in his vocation, a man of too little experience and general knowledge (being unable to read or write) to be able to cope with the emergencies which cannot but frequently occur, and which place in jeopardy the lives of so many human beings, and a large amount of valuable property"—(Report of Mr. Warrington Smyth, presented to both Houses of Parliament, 1849). The Committee did not fail to bear this and similar statements in mind, and to put questions to such of the Witnesses as appeared to have had means of judging as to the connexion between the occurrence of accidents and the measure of instruction among the mining population. There appears to be some difference of opinion upon this point; though none as to the ordinary deficiency of the means of useful education, nor as to the general desire among these classes to obtain it. There can be no doubt that, on general principles, improved education would have a tendency to induce greater caution among the workpeople, and to raise the qualifications of those who, as subordinate agents in the management of a Mine, are charged with the greater part of its effective superintendence. But it does not appear to be the opinion of the
practical

practical Witnesses before this Committee that its absence has much perceptible influence upon the liability to accidents. The latter class of persons are stated to be selected from the body of working miners for their steadiness and intelligence, and in the Northumberland and Durham districts, at least, to be required to have a knowledge of reading and writing; though in other parts of the country this is less general. It is represented that they are, for the most part, very competent to the range of duties with which they are charged; although some further instruction, particularly of the special kind connected with mining operations, could not but render them fitter to deal with the unusual and unforeseen circumstances which sometimes occur beyond the routine of their ordinary service, and which may involve the most fatal results. At present there is little of such instruction within the reach of persons engaged in these occupations; and among some of those best qualified to speak upon the point, a want appears to be practically felt of facilities for acquiring it, such as are provided by the Mining Schools and Colleges established in the principal Mining Districts of the Continent, apparently with the most beneficial effects.

Wood 2115.
Taylor 6199.
Swallow 5207-5209.
Atkinson 5621.
Jude 5768-5770.

The Committee finally submit the Evidence they have received to the consideration of The House. They regret that time has not allowed of their calling before them all the Witnesses that they might have wished to summon under other circumstances, especially from North Wales and Scotland. But the former district is believed to be not very different from some of those in the Midland Counties of England, to which the inquiry has extended; and from the latter it is less to be regretted that no information has been directly obtained, since it is understood that with respect to that class of accidents which are the most prominent, and most within the reach of precaution, namely, those by explosion, the Mines of Scotland are comparatively free from danger. They trust, therefore, that these unavoidable omissions will not be considered to show any very material imperfection in their inquiry, and that, on the whole, its results may be such as to contribute something towards the attainment of so important and almost paramount an object as the better protection of the working population employed in that great national branch of industry, the Coal Mines of these Kingdoms.

And the Committee have directed the MINUTES of EVIDENCE taken before them, together with an APPENDIX and INDEX thereto, to be reported to Your Lordships.

26th July 1849.

MINUTES OF EVIDENCE.

(164. 1.)

LIST OF WITNESSES:

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TO

THE PRINCIPAL MATTERS

CONTAINED IN

THE EVIDENCE

TAKEN BEFORE

THE SELECT COMMITTEE OF THE HOUSE OF LORDS,

APPOINTED TO INQUIRE INTO

**“The best Means of preventing the Occurrence of DANGEROUS ACCIDENTS in
COAL MINES.”**

Session 1849.

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— successful application of Mr. Gurney's steam-jet to, - - - - -	{ De la Beche, - 45. Playfair, - 552. Ansted, - 749. Arnett, - 774. Wood, - 1843. Mather, - 3529. Clanny, - 4690. Biram, - 1770.
— other methods suggested, - - - - -	{ De la Beche, - 24. Barkley, - 4262. Clanny, - 4682.
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— powers of inspectors, - - - - -	- - - - - 3208. 3237.
— owner of, how far responsible in case of neglect of inspector's suggestions, - - - - -	- - - - - 3225.
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	Fourdrinier, - - - 1276.	
	Wood, - - - 2080.	
	Elliot, - - - { 3073. 3096. 3466.	
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	Woodhouse, - - - 4016.	
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FOURDRINIER, Mr. JOSEPH, Evidence of, - - - - -	- - - - - 1325.	
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	Smyth, - - - 2285.	
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	Mather, - - - 3552.	
	Woodhouse, - - - 4111.	
	Barkley, - - - 4329.	
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à contra, - - - - -	Gurney, - - - 434.	
	Playfair, - - - 531.	
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	Mather, - - - 3619.	
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	Forster, - - - 2602.	
	Elliot, - - - 2394.	
	Nadin, - - - 3432.	
	Mather, - - - 3619. 3716.	
	Gibbons, - - - 4665.	
	Taylor, - - - 6120.	
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Mather, - - - 3649.		
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	Barkley, - - - 4329.	
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	Hann, - - - 6362.	
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— affected by winds, - - - - -	Elliot, - - 2841.
— its powers and expense compared with Mr. Brunton's apparatus, - - - - -	Nadin, - - 3431.
— proportion of ventilation by, according to area of shaft, as shown in various Collieries, - - - - -	Woodhouse, - 4005.
	Mather, - - 3635.
	Barber, - - 4134.
	Dobson, - - 4427.
	Gurney, - - 6311.
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GAS, nature of, in,—	
Derbyshire, - - - - -	Nadin, - - 3356.
Dean Forest, - - - - -	Roberts, - - 6241.
Newcastle District, - - - - -	Ansted, - - 765.
	Wood, - - 2021.
	Forster, - - 2641.
	Atkinson, - - 5467. 5478.
	Jude, - - 5835.
Lancashire, - - - - -	Peace, - - 4968.
South Wales, - - - - -	Vivian, - - 1090.
Warwickshire, - - - - -	Whieldon, - - 982. 993.
GAS, Carbonic Acid, or Choke-damp, manufacture and application of, in case of the first and second fires in Astley Colliery, - - - - -	Gurney, - - 455.
	Darlington, - { 868. 912.
	933.
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	Jude, - - 5684. 5835.
— its advantages in extinguishing fire, compared with water method, - - - - -	Biram, - - 1778. 1797.
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	Mather, - - 3666.
	Elliot, - - 3065. 3070.
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	Barkley, - - 4316.
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GAS, Carburetted Hydrogen, or Fire-damp, proportion of, in coal, - - - - -	De la Beche, - 23.
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— applicable to mines, - - - - -	Arnott, - - 810.
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— strictures on his mode of ventilation, - - - - -	Dunn, - - 5300.
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	Nadin, - 3421.
	Mather, - 3712.
	Richardson, - 3796.
	Peace, - 5061.
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	Elliot, - 3142.
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J.

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JUDE, MARTIN, Miner, Evidence of, - - - -	- - - - 5650.

K.

KEENE, WILLIAM, Esquire, Civil Engineer, Evidence of, - - - -	- - - - 3152.
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