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GOVERNMENT OF INDIA

REPORT

OF THE

COALFIELDS COMMITTEE

CALCUTTA
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Report of the Coalfields Committee.

CHAPTER I.

INTRODUCTORY.

The Coalfields Committee was constituted by the Government of India in Resolution No. 625-D. (Mineral Resources), dated the 28th January 1920, which is quoted below :—

"The Government of India have for some time had under consideration the question of devising means of reducing the large avoidable waste of coal known to occur at the Raniganj and Jharia coalfields, and due mainly to deficient methods of extraction, resulting in the total loss of a large amount of coal, to inefficiency in the generation and use of power, and to extravagant methods of cokemaking. After consultation with the Governments of Bengal and Bihar and Orissa, the Indian Mining Association and the Indian Mining Federation, the Government of India decided, as a preliminary measure, to engage the services of a recognised authority on modern methods of extraction, with instructions to visit the coalfields and advise on the best means of securing greater economy in the production and consumption of coal, and to submit a report which might be placed before a Committee to be appointed in this country for consideration. For this purpose, the Government of India secured the services of Mr. R. T. Treharne Rees, a partner in the well-known firm of Messrs. Forster Brown and Rees of London and Cardiff. Mr. Rees visited the Raniganj and Jharia fields and prepared a report which reached the Government of India in August last.

"The principal recommendations of Mr. Treharne Rees relate to the appointment of an inspecting and controlling authority for the supervision of the terms of leases, more efficient methods of coal extraction, including rotation of working and hydraulic stowage, the improvement of the conditions of colliery labour, the more economic use of power and more general employment of electricity, the improvement of methods of cokemaking, the introduction of coal mixing, the handling and despatch of coal, more extended employment of screening, and the possibilities of the manufacture of briquettes.

"The Government of India have now appointed the following Committee to consider Mr. Rees' report :

CHAIRMAN :

The Hon'ble Mr. B. Foley, I.C.S., Commissioner of the Chota Nagpur Division.

MEMBERS :

Raja Ban Bihari Kapur Bahadur, C.S.I., Zamindar of Burdwan.

Mr. G. F. Adams, C.B.E., M.I.C.E., Chief Inspector of Mines in India.

Mr. R. G. M. Bathgate, of Messrs. Jardine, Skinner and Co.

Mr. R. W. Church, Mining Engineer to the Railway Board.

Dr. H. H. Hayden, C.S.I., D.Sc., F.R.S., Director, Geological Survey of India.

The Hon'ble Mr. J. H. Pattinson, nominated by the Indian Mining Association.

Mr. N. C. Sircar, nominated by the Indian Mining Federation.

SECRETARY:

Mr. L. B. Burrows, Deputy Collector, Bengal.

"The terms of reference are—

To consider the recommendations, relating to the Raniganj and Jharia coalfields, made in Mr. Treharne Rees' report, to report the action which it is possible and expedient to take in connection therewith, and, if legislation is involved, to consider the lines on which such legislation should be framed."

2. We met in Calcutta, on the 2nd February 1920 and held meetings during February, March and April. We toured in the Jharia and Raniganj coalfields from February 10th to 16th, and examined witnesses during the latter part of February and the first three weeks of March. The report has been signed by seven of the eight members of the Committee, Mr. Church writing a separate report.

3. During our tour we examined colliery plans, methods of winning coal, pillar-cutting, fire areas, powerstations, cokeovens, by-product recovery plants, electric coal-cutters, sand-stowing, sand-dredging, the conveyance of sand by aerial ropeways and endless haulage, miners' dwellings, and conditions generally.

4. We wish to acknowledge the courteous treatment and valuable information we have received from various Calcutta firms, colliery managing agents, superintendents, managers and assistants, the railway companies, and various gentlemen, official, railway and commercial. We are much indebted to the gentlemen who answered our interrogatories, and especially to those who sacrificed their time to give evidence before us.

5. We wish also to express our appreciation of the services of our Secretary, Mr. L. B. Burrows, who has been responsible throughout for all arrangements connected with our tour and with our subsequent meetings in Calcutta, and who has also rendered material assistance in the preparation of our report. Mr. Burrows did especially valuable work in tracing the literature on the subjects discussed by Mr. Rees, and in ascertaining the manner in which the various problems have been dealt with in other countries.

CHAPTER II.

WASTE OF COAL AND OTHER SUBJECTS DISCUSSED IN PARAS. 1 TO 18 OF MR. REES' REPORT.

6. *Paras. 1 to 13 of the report.*—For facility of reference we annex, as Appendix A, a copy of Mr. Rees' report. Paragraphs 1 to 6 are introductory, paragraphs 7 to 12 describe the methods of mining in the Raniganj and Jharia coalfields, and paragraph 13 specifies the chief subjects which Mr. Rees thinks require consideration. We have no remarks to make except with regard to the figure of 95 per cent. in paragraph 2. In the year 1918 the Raniganj and Jharia coalfields yielded 87 per cent. of the total output of coal in British India, and 84 per cent. of the total output in the whole of India.

7. *Para. 10.*—Here Mr. Rees deals with the coal left unworked and lost in pillars formed in the first working; he points out that "the chief factors governing the quantity of such coal" are—

(*a*) the necessity for supporting surface buildings and railways;

(*b*) the inability to extract all the coal safely owing to falls of roof; and

(*c*) the prohibition by landlords of extraction of pillars.

As regards (*a*), the coal left under buildings is insignificant in both coalfields, and though there is a considerable amount locked up under railways, the greater part will be eventually recoverable. As regards (*c*), not only has extraction been prohibited, but the size of the pillars to be left has been prescribed as well; and when landlords have subsequently waived the prohibition on payment of *salami*, the pillars have proved too small to allow of proper extraction. It is highly desirable that in matters of this kind landlords should be guided by the advice of competent mining engineers.

With reference to (*b*), this inability is almost entirely due to the pillars being made too small for the area they are expected to support. It should be remembered that, in the early days of the industry, the systematic extraction of pillars was never contemplated. Pillars were regarded, not as a reserve for subsequent recovery, but as a means of support while as much coal as possible was being recovered in the first working; the pillars were then thinned to the verge of collapse, and the mine was abandoned. Even in more recent times, when the getting of pillars is looked on as the final essential stage in working, the desire for large outputs during first working has, in some instances, led to the reduction of pillars below the limit of safety. The result has been that, even in favourable cases, much of the coal has ultimately been lost, while, where conditions have been less favourable, the removal of a few of the pillars has resulted in the collapse of the mine, sometimes over large areas. In other cases, this has occurred even before any pillars have been removed. Nor has the waste ended with such collapses. Fires have frequently followed, and have sometimes spread to neighbouring mines with disastrous effect. In a number of specific cases of comparatively recent date, we have ascertained that the coal so lost amounted to about 19 million tons, and this figure does not of course represent the total loss incurred. We consider these losses to have been largely preventable.

8. *Paras. 14 and 17.*—In paragraph 14 Mr. Rees points out that there is no supervision to prevent wasteful methods of working, and in paragraph 17 that landlords have not in the past availed themselves of expert advice. We consider these remarks to be justified. The English "landlord's agent," in the ordinary sense of the term, does not exist in India. In certain leases indeed conditions are inserted (1) that the lessee shall afford the lessor or his agent all reasonable facilities to enter into and inspect the mines, (2) that

coal-mining operations shall be carried on in "as skilful and workmanlike a manner as possible", (3) that they shall be conducted in accordance with rules and regulations from time to time promulgated by Government, (4) that the lessee shall do as little damage as possible to the surface and the buildings and other erections thereon, and (5) that the lessee shall indemnify the lessor against the damage he may suffer through negligent working.

In practice, however, we find that these provisions are inoperative. No landlord employs a competent agent to inspect his tenants' mines and to safeguard his interests, any supervision exercised being confined to the prevention of fraudulent evasion of royalty.

9. In paragraph 14 Mr. Rees also comments adversely on the practice of paying the management of collieries a bonus or commission on the quantity of coal raised, and considers that this naturally tends towards greater attention being given to immediate production than to a steady output over the natural life of a property. It might similarly be argued that, since managing agents receive a commission on profits, they are tempted to press unduly for raisings.

On the other hand, it must be remembered that shareholders expect a higher rate of interest than in England, and that, unless a mining proposition can be floated with a reasonable prospect of a return of about ten per cent., it is doubtful whether capital will be forthcoming. Certain contracts necessarily carry transport facilities, and the keen competition to secure these has tended to keep down the price of coal, while, in order to maintain dividends, companies have often sacrificed the reserve funds on which depends the future development of their mines. Although it is expedient in theory that a colliery manager should be paid a higher salary and no commission, it has been found advisable in practice that a bonus or commission should be paid on the output. This matter is not, however, one which in our opinion calls for State interference.

10. *Para. 15.*—Mr. Rees considers that large areas of coal have been leased by landlords more with the object of receiving as much as possible by way of *salami*, than with a view to the economical working of the estate as a whole. Instances of this have been brought to our notice, but, so far as our information goes, the worst offenders are middlemen and not superior landlords. It has been urged by some witnesses that *salami* should be abolished. While admitting that the system generally is open to serious objections, we are not prepared to endorse this recommendation as regards the Raniganj and Jharia coalfields. There conditions are peculiar in that *salami* is treated as an advance payment of rent or royalty; its abolition would mean an immediate demand for higher rent or royalty, and there would no doubt be strong opposition both from landlords and tenants. So far as the coalfields are concerned, it will be sufficient to provide against the abuse of *salami*, a case in point being *salami* for allowing extraction of pillars; this should, we think, be prohibited.

11. *Para. 16.*—Mr. Rees comments on the fact that the areas leased have sometimes been "of such small dimensions and fantastic shapes that it is quite impossible to work the coal satisfactorily." We have found instances in which areas have been let out in a number of minute plots, but here again the middlemen rather than the superior landlords have been responsible in the worst cases. Mr. Rees correctly states the consequences, *viz.*, reduction of pillars followed by subsidences and damage to the surface, waterlogging of workings, and encroachments with their attendant dangers of communicated fires or floods.

12. In paragraph 24 Mr. Rees sums up by estimating the quantity of coal destroyed or lost by present methods as not less than one-third of the total coal *in situ*. We are unable to say what the exact figure is, but the evidence before us indicates that Mr. Rees' estimate is approximately correct; we are at any rate convinced that the wastage is high and that a large part of it is avoidable. The discovery of the best practical means of reducing this waste is the problem with which we are confronted.

13. *Para. 18.*—Mr. Rees comes to the conclusion that "as the working of the coal resources of the country under the present system is not being properly supervised, some controlling authority should be set up to supervise the

negotiations for leases, to the end that the areas to be worked shall be laid out to the best advantage, and suitable covenants inserted in the documents for proper working, with power to inspect to see that these are duly performed." This is very important and needs detailed examination.

14. The proposal may seem drastic, but we would observe that the use of the words "negotiations for leases" is rather unfortunate; they have misled many witnesses and do not in fact convey Mr. Rees' meaning clearly. Mr. Rees did not, we think, intend that a controlling authority should interfere as regards details of *salami*, rent and royalty, which are frequently determined by competition and must always be settled between the parties directly concerned; he meant rather that such an authority should supervise leases in so far as they are concerned with mining methods, in order to ensure that coal properties are laid out and worked to the best advantage.

On the other hand, we may call attention to the fact that the major part of the known coal-bearing land in the Raniganj and Jharia fields has already been leased out. A controlling authority, that would exercise control only over lands still unleased, would not therefore be able to remedy existing evils to any considerable extent, and its powers should not accordingly be circumscribed by conditions laid down in existing leases.

15. This leads us to the main objection that will at once be raised, namely that the proposal involves an unjustifiable infringement of the rights of private property. For this reason, though the waste may be admitted, it will be alleged that the problem is insoluble and that no remedy is possible.

We deny the validity of this argument. Coal is a national asset on which the manufacturing industries and the commercial expansion of the country depend. A landowner or colliery proprietor is at present in a position to waste this national asset without restriction. By such waste he may obtain immediate financial benefit, but he injures the country, damages his property, and diminishes the estate of his heirs. We hold that the State has the right, in the interests of the community, to step in and prevent the dissipation of the country's resources. Indian coal is not inexhaustible, and scientific mining methods are needed for its conservation and economic extraction. In this connection, we may call attention to the observation of the Indian Industrial Commission of 1916-18 that "the question of encouraging or even compelling economy in mining and coking will soon be forced on the attention of the authorities." We believe that the time for such action has now arrived and that, since without it no real improvement can be expected, State interference is reasonable and justifiable.

16. If this is granted, only three courses appear to be open:—

(1) that Government should assert a claim to the mineral rights in the Raniganj and Jharia coalfields;

(2) that the coal should be nationalized, the royalty-receivers being bought out at a fair valuation and the entire control vested in the State;

(3) that, without interfering with the private ownership of coal, a controlling authority should be constituted with adequate powers to prevent further waste.

17. With regard to the first suggestion, it may be noted that, in all the Provinces which have not been permanently settled, coal is the property of the State and the State is able to prescribe the conditions under which coal mining shall be conducted. Since the Permanent Settlement, however, Government has not asserted its right to the coal in the districts of Burdwan and Manbhum. Until late years the view taken was that the coal was the property of the zamindar or of that person who held his land on a permanent lease from the zamindar; thus the patnidars, darpatnidars, sepatnidars, mukararidars, brahmottardars, debottardars, etc., were regarded as owning the coal independently of the zamindar. This view has been set aside by the Privy Council rulings in I. L. R. 37 Cal. 723, I. L. R. 44 Cal. 585, and C. W. N. Vol. XXIII, page 914, dated 1910, 1916, and 1919 respectively. These rulings lay down that, where a tenure has been granted by a landlord, even though the tenure be permanent, hereditary and transferable, the mineral rights do not form

part of the grant in the absence of specific stipulation or express evidence to that effect.

It might be argued on this analogy that, as the zamindar has successfully asserted his right over the permanent lessee, so might Government assert its right over the zamindar. This question was dealt with by the Secretary of State in Lord Cranbrook's Despatch No. 35 Revenue (Minerals), dated the 25th March 1880, to the Governor-General of India in Council, from which we quote the following extract :—

"As regards the second question whether, apart from the prerogative, the Crown in India can assert a right to gold, silver, and other minerals found in proprietory lands, you are disposed to agree with Messrs. Bell and Evans that, in the permanently-settled districts, the State does not possess such right. This was the view arrived at by my predecessor, Sir C. Wood, after consideration of Mr. Millet's report, dated 26th March 1842. But, without weighing this opinion against that of your learned Advocate-General, I am disposed to think that, even if the legal right to minerals in permanently-settled estates could be established, it would not be desirable to enforce it. I agree with you that the indirect advantages resulting from making available the mineral resources of India are likely to be more valuable to the State than any direct returns, and I therefore consider that it would not be desirable to enforce the right of the State, supposing that such right can be established, to mines in permanently-settled estates. Industries requiring skilled and scientific management and the extensive application of capital have flourished under the Permanent Settlement; and I apprehend that, speaking generally, the landholders of the Lower Provinces are sufficiently alive to their own interests either themselves to develop the mineral resources their estates may contain, or to afford facilities to others to do so.

"This, however, does not apply to many other parts of India. I look upon it as pretty certain that the mineral resources of their lands will not be effectually worked by the peasant proprietors themselves of Madras or Bombay, or by the village communities of Northern India; and I apprehend that other promoters of mining enterprise would be likely to meet with considerable obstacles from intricacies of tenure and the difficulty of dealing with numerous small landlords. I consider, therefore, that care should be taken to reserve all State's rights to minerals which still exist".

Our attention has in this connection been called to the following remark of the Lord Chancellor at page 591 of the Privy Council's judgment, dated December 8th, 1916, in one of the cases referred to above, Shashi Bhusan Misra *versus* Jyoti Prosad Singh Deo (I.L.R. 44 Cal. 585) :—

"By the Permanent Settlement of 1793 all the mineral rights were confirmed to the zamindars..... If such rights were already possessed and recognized at the date of the Settlement, this confirmation would hardly have been needed, and this suggests that, up to that date, the rights recognized and granted in the lands were not considered as including the minerals; if this were so, as the grant in question could have created no rights in the property which the grantor did not possess, no right to the minerals could have been conferred."

We do not consider that it is within our province to make any recommendation on the legal aspect of this question, and we have assumed, for the purposes of our report, that the coal in the districts of Burdwan and Manbhum is the property of the zamindars of those districts.

18. The nationalization of the coal has been suggested by one witness only. This might have been possible in the earlier days of the industry, but we doubt whether it can now be considered as coming within the sphere of practical politics. We believe that the cost would be prohibitive and the difficulties generally so great as to render the proposal impracticable.

19. There remains therefore Mr. Rees' expedient of State control and this should, we consider, be adopted. We are convinced that, if the waste he describes is to be prevented, it is essential that legislation should be undertaken to establish a controlling authority.

CHAPTER III.

THE CONTROLLING AUTHORITY.

POWERS.

20. A controlling authority being regarded as essential, the next point for consideration is the extent of its powers. Throughout his report, Mr. Rees makes various proposals in connection with control and compulsion, but he does not anywhere summarize the powers to be conferred on the controlling authority. We shall discuss each of his proposals in the later chapters of our report, but it is desirable, before proceeding further, to specify the principal powers we regard as necessary.

21. These should include power to—

(1) regulate the leasing of coal-bearing lands so as to prevent such excessive subdivision as will lead to inefficient and wasteful working;

(2) bring the lessors and lessees of neighbouring mauzas to terms in order to avoid the loss of coal frequently resulting from irregular boundaries;

(3) regulate the dimensions of pillars and galleries;

(4) forbid the extension of an area under pillars where this appears likely to lead to unnecessary loss of coal;

(5) prohibit the extraction of pillars under conditions likely to result in collapse and subsequent flooding or underground fire;

(6) decide when pillars should be got and by what methods;

(7) prescribe the dimensions and positions of barriers;

(8) order the isolation of workings; and

(9) regulate rotation of working.

We consider that the same authority should also take over from the Department of Mines the control of workings under land acquired for railways.

22. The constitution of this authority will entail legislation, and it is important that any enactment on the subject should confer the power to make rules to secure the objects in view. No rules can, however, cover every set of circumstances, and the controlling authority should therefore be authorised to exercise a discretion in most respects. The powers we propose above may seem somewhat excessive at first sight, but we believe that they will not prove so in practice, the following being the considerations on which we base this belief. In the first place, a controlling authority with discretionary powers would not ordinarily interfere with mines which were being worked properly, and its decisions on occasional points would be readily accepted by the management of such mines. Again, control of this kind is not new to the industry: it has hitherto been exercised under the Land Acquisition Mines Act in respect of coal under railway sidings and branches, and we merely propose now to extend it to all the workings. Further, some leases already enjoin on the lessee the necessity of allowing free inspection by the officers of the Mines Department and of obeying their "lawful instructions," while others require the lessee "to conform to and observe all the provisions of the Indian Mines Act and any rules and regulations made thereunder, and all other Acts of the Supreme or Bengal Council or any other statutory rules for the time being in force so far as they affect the demised premises." The Mines Act and the rules framed under it are concerned with the safety of the miner; the legislation we propose will be concerned with the safety of the mineral. The two subjects are closely correlated, and we anticipate no greater

difficulty in applying the proposed control than has been experienced in administering the Mines Act.

CONSTITUTION.

23. There is a difference of opinion among the witnesses as to the constitution of the controlling authority. The bulk of the evidence is in favour of a body of Government mining officials with an appellate court, but a minority has expressed itself in favour of a board consisting of numerous members and exercising functions which were not very clearly defined.

24. We have come to the conclusion that no scheme would be satisfactory which empowered any member of the mining community to interfere in the working of a colliery other than his own, and we feel that, in order to remove any possible objection on this ground, the actual control must be vested in an agency consisting mainly of Government officers. We are further of opinion that, even if the cadre of the present Department of Mines were sufficiently enlarged to enable its officers to find time for the additional duties, that department should not be the controlling authority; on this point we agree with the majority of the witnesses that the work of coal conservation and of labour protection could not be performed satisfactorily by the same inspecting officers. On these assumptions, we have considered the two following schemes.

25. Under the first, the controlling authority would consist of a new department of Government officials, who, together with the officers of the Department of Mines, would be under one technical administrative head with training and qualifications similar to those required in a Chief Inspector of Mines.

This controlling authority would have the assistance of an advisory board, analogous to that already in existence in the Burma oil-fields, and consisting of representatives of the mining industry and royalty-receivers. An appeal would lie from the orders of the controlling authority to a court, constituted somewhat on the lines laid down in section 10 of the Indian Mines Act, and consisting of one expert nominated by the appellant, another expert nominated by the controlling authority, and a high official nominated by the Local Government.

26. Under the second scheme, which the majority of us think should be adopted, the new department proposed above would not be administered by the Chief Inspector of Mines, but by an officer having equally high technical qualifications, whose whole time would be devoted to the new department. For convenience of reference we may call this department the "Coal Conservation Department." Associated with it, and forming an integral part of the controlling authority, would be a board sitting in Calcutta. We consider it advisable to discuss in some detail the personnel and method of working of the proposed department and board.

PERSONNEL AND METHOD OF WORKING.

27. The board would be constituted as follows:—

CHAIRMAN.—(1) The Chief Inspector of Mines.

MEMBERS.—(2) An officer of the Geological Survey of India nominated by the Director.

(3) An officer nominated from his staff by the Mining Engineer to the Railway Board.

(4) A commercial member, not connected with the coal industry, nominated by the Bengal Chamber of Commerce.

(5) A commercial member, not connected with the coal industry, nominated by the Bengal National Chamber of Commerce.

28. The Chief Inspector of Mines would, we consider, make the most suitable chairman of the board. He would not be directly interested and would besides have intimate knowledge and extensive experience of Indian coal mining and of conditions generally. A permanent secretary to the board would also be required, more particularly if the proposed compensation fund under the Land Acquisition Mines Act were to be merged into the compensation fund suggested by us in Chapter IX of this report, the members of the board being the administering trustees of both funds. The secretary would convene the board without delay whenever there was business to transact, and for this purpose the two Chambers of Commerce would maintain lists of their members willing to serve on the board and able to attend meetings when required. Suitable fees would be paid to all members of the board.

29. It is possible that the work to be done by the Coal Conservation Department will exceed that of the Department of Mines, which now consists of a Chief Inspector, two senior and four junior Inspectors, and a staff of surveyors and draftsmen. In the first instance, however, besides a Chief Mining Engineer on Rs. 3,000, as head of the department, we would suggest the appointment of two senior Mining Engineers on Rs. 1,500—100—2,000, two junior Mining Engineers on Rs. 800—50—1,300, and four parties of surveyors, each costing about Rs. 300 a month.

30. The Coal Conservation Department would be authorised to inspect mines and give orders to the owners, the procedure being somewhat as follows. On receipt of an order, a mine-owner should either (*a*) proceed forthwith to carry it out, or (*b*) intimate to the head of the department in writing his reasons for objecting to the order. A heavy penalty should be imposed for failure to adopt one of these courses within a specified period. On receipt of the owner's written objection, the head of the department would forward it in original to the board with his remarks ; the board would then decide the matter, either on the documents before it or after hearing evidence, and its decision would be final.

When the head of the department considered that there was risk of damage to a mine other than the one directly concerned, he should be empowered to move the board to direct the suspension, pending final orders, of all work specified by him as likely to injure the other mine.

31. It might be argued that, without an excessive number of well-paid and highly-trained officers, it would prove impossible to enforce the proposed control. If, however, the Coal Conservation Department were to work, to some extent at least, on rules similar to those issued under the Indian Mines Act, we do not apprehend any great difficulty. One such rule would, for instance, require every owner, manager or agent to maintain accurate plans showing the size, shape and position of every pillar in his colliery ; the Coal Conservation Department could readily check such plans, and would thus, with a staff of moderate size, be able to prevent irregular pillar-cutting and to guard against subsidence, flooding and fires.

32. As already stated, legislation will be necessary to constitute the proposed controlling authority. Large profits will often be involved, and either the Act, or the rules framed under that Act, should provide therefore for deterrent penalties. In this connection our attention has been called to the Burma Oil-fields Regulation, VI of 1910, under which imprisonment may in certain circumstances be imposed in addition to fine. In ordinary cases disobedience of the controlling authority's orders might be sufficiently met by a fine, but we are of opinion that, in order to deal with cases of persistent disobedience or of action likely to cause serious damage to the property of others, power should be taken to impose imprisonment as well. We have considered the cancellation of a manager's certificate as a possible penalty, but have arrived at the conclusion that this would not be advisable.

33. The principal powers to be conferred on the proposed controlling authority have been enumerated in paragraph 21 above. Local inspection by the officers of the Coal Conservation Department would ordinarily disclose the necessity for exercising the powers numbered (3) to (9). As regards (1), we recommend that every intending lessor of coal-bearing land of less than 100

bighas should be required to refer the matter to the Coal Conservation Department. Should an objection raised by that department be unacceptable to the lessor, the matter would be decided by the controlling board under the procedure described in paragraph 30 above. It has been pointed out that this may occasionally cause hardship in the case of small plots, *e.g.*, in the corner of a property, which the lessee of a large adjoining property might refuse to take over except on very low terms. This would, however, be a case for the exercise of discretion by the controlling authority, which would be at liberty to permit the plot to be let out separately subject to suitable precautions. In all cases, however, irrespective of the area concerned, leases should include specific covenants to ensure the due enforcement of such provisions as are referred to in paragraph 8 above.

As regards the power numbered (2), it is quite feasible to provide for rectangular boundary lines between different coal properties within the same mauza, but, where such properties are situated in adjoining mauzas owned by different persons, considerable loss of coal might be prevented, if the controlling authority were given power to intervene between the lessors and lessees concerned so as to prevail on them to equalize underground boundaries without detriment to their interests.

34. As a precedent for the legislation proposed, we would refer to Chapter V of the French Mining Law, as summarized in Appendix II to the Final Report of the Royal Commission on Coal Supplies (1901—1905). Under this Law the Mine Inspectors exercise, under the orders of the Minister of the Interior and the Prefects of Departments, police supervision for the preservation of edifices and the safety of the soil. Their powers extend to mining methods, inasmuch as they advise mine-owners regarding possible improvements and notify their Government of defects, abuses and dangers. If working be restricted or suspended in such a way as to compromise public safety or the requirements of consumers, the Prefects, after hearing the mine-owners, may report the matter to the Minister of the Interior for necessary action. The Prefects themselves can take such measures as may be required, if the actual working of the mine compromises either public safety, the maintenance of the mine, the safety of the miners, the preservation of means of communication, or the stability of habitations. Goafing or stowing may be made obligatory by the Prefects in certain cases, *e.g.*, in fiery mines and where ventilation requires it, and the Mine Inspectors, though they do not as a rule interfere with the actual management of collieries, keep a check upon their working, more especially as regards the safety of the miners, the security of the mine, and the prevention of waste. The actual amount of control varies with the district and the individual, but the Inspectors have the power to intervene as regards :—

(1) barriers against water and between properties,

(2) joint pumping arrangements,

(3) the order in which seams are worked, and

(4) the size of pillars to prevent subsidences.

CHAPTER IV.

WEIGHMENT AND OTHER QUESTIONS DEALT WITH IN PARAGRAPHS 19 TO 42 OF THE REPORT.

35. *Paras. 19, 20 and 22.*—Mr. Rees recommends that all coal brought out of the mines should be weighed and an accurate record kept. A Government rule to this effect would, he considers, be useful for statistical purposes, because the figures of despatches by rail do not cover the whole of the coal actually raised. It would also be useful as a check on the coal removed by the labourers for domestic and other purposes.

The evidence laid before us on this question is rather conflicting, but is on the whole adverse on the ground of impracticability. The advantages for statistical purposes are obvious. The present statistics, obtained from the railway companies and compiled by the Department of Mines, are admittedly inaccurate and inadequate, and more complete and reliable figures would convey valuable information and would besides simplify the levy of cesses, such as the Mines Board of Health and the Jharia Water Board cesses, which are at present imposed on raisings and despatches respectively. The difficulties are, however, considerable. Weighment might be practicable in mines raising coal by shafts and haulage inclines, but would not be so in mines served by carrying-out inclines, where coal is raised in baskets and measured on the surface : although the latter produce only about 8 per cent of the whole output, they constitute nearly 43 per cent of the total number of mines. Again, owing to the many openings in most mines, a large number of weigh-bridges or weighing machines would be necessary, and the expense thus involved would be disproportionate to the advantages gained and beyond the means of the smaller collieries. There are also other practical difficulties connected with the varying size and tare of tubs.

Taking all these factors into account, we have arrived at the conclusion that under existing conditions compulsory weighment is unnecessary. We are of opinion, however, that both landlords and colliery owners would be well advised to introduce such weighment voluntarily wherever conditions render it possible.

36. *Paras. 21 to 23.*—Besides the question of weighment, Mr. Rees deals here with colliery plans. These do not at present show the correct size and shape of the pillars, and Mr. Rees suggests that "each year's workings should be shown on the colliery plans by a distinctive colour, together with the date of working and sections of the seam." We think that colliery plans should be required to show, not only each year's workings with dates, but also the accurate size and shape of the pillars. Sections are already required under the Indian Mines Act. If the controlling authority proposed by us is to regulate the size of pillars and direct when they should be got, the accuracy of colliery plans in this respect will be essential. In cases where a seam is being worked in two or more sections, there should be a separate plan for each section.

37. *Para. 22.*—Mr. Rees also suggests that reduced levels to a common datum should be marked on colliery plans at distances of not less than, say, 100 yards apart. This information would be useful, but, apart from a few employed by the large companies, the surveyors in the Raniganj and Jharia coalfields are not, we are informed, sufficiently expert to insert it correctly. The work ought, however, to be done, and the difficulty in this respect should disappear with the improvements in teaching, which will, it is hoped, soon be introduced in the coalfields.

Effect could apparently be given to all our recommendations with regard to plans by rules under section 20(2)(*i*) of the Indian Mines Act.

38. *Para. 24.*—Mr. Rees' estimate of the coal lost by present methods has already been discussed in paragraph 12.

39. *Paras. 25 to 28.*—We agree with Mr. Rees that Indian conditions are usually unfavourable to working on the longwall system.

40. *Para. 29.*—We also agree with him that the bord and pillar method is the most suitable to Indian conditions, and consider that his criticism as to the want of forethought in laying out underground workings is justified.

41. *Paras. 30 to 33.*—Mr. Rees remarks that areas standing in pillars have been goafed irregularly with the object of producing as large an immediate output as possible, and with the result of adversely affecting future economic working. We would observe that, though such irregular goafing has occurred, it is the exception.

42. *Para. 34.*—Mr. Rees notices the fact that, owing to the liability of certain seams to spontaneous combustion, several coal companies have recently formed their workings into panels as a safeguard against fire; he notes that these panels facilitate the isolation of fire areas, and make the extraction of pillars safer and more economical. We wish to endorse Mr. Rees' remarks, more particularly as regards the isolation of fire areas, which would be an important part of the duties of a controlling authority.

43. *Paras. 35 to 37.*—Mr. Rees states that, as the upper seams have for the most part been taken up and worked out so far as present methods permit, the time has now come for the winning of the more valuable coal in the lower seams: he adds that in such deeper workings the defects of the methods now in vogue will be accentuated by increasing risk and greater possible loss of coal: and his conclusion is that at these greater depths the pillars will have to be considerably larger, unless some other means can be provided for supporting the overlying strata. No comment is required as we are in entire accord with his statements.

44. *Paras. 38 to 40.*—Mr. Rees points out that hydraulic sand-stowing will provide the necessary support. The whole question is discussed in detail in Chapter IX, and we need only say here that we agree with Mr. Rees' remarks.

45. *Paras. 41 to 42.*—Mr. Rees considers that some restriction should be put on the working of lower seams before seams lying immediately above them have been extracted. Damage or loss has undoubtedly been caused in some instances, where the relative superiority of a lower seam has led to its being worked first. Commercial value must, however, always be an important factor in such cases, and it would manifestly be inequitable to insist on the extraction of coal for which no market could be found.

We recommend therefore that questions of rotation should be left to the discretion of the controlling authority. If the proposals we make later as regards sand-stowing are accepted, the task of the controlling authority would be simplified, but it would still remain a difficult one, where it involved the question of permission to work a lower seam to the possible detriment of an upper seam of temporarily unsaleable coal. The controlling authority would have to decide in each such case where the balance of advantage lay.

CHAPTER V.

LABOUR.

46. *Paras. 43, 44, 45, 49, 50 and 51.*—In these paragraphs Mr. Rees describes labour conditions in the two coalfields, and we admit the general correctness of his statements. In the year 1896 a Labour Enquiry Commission was appointed by the Government of Bengal to ascertain the best means of supplying labour to the coal mines. Various recommendations were made, which were received favourably by the industry, but which do not seem to have been acted on to any extent. Again, in 1905-06 one officer from Bengal and one from the United Provinces were placed on special duty to report on the shortage of labour for organized industries. Their reports also appear to have had little effect. There is at present no combination among coal companies for purposes of recruiting, and there are no recognized colliery recruiting agencies. Each company employs a more or less desultory and haphazard method, and no machinery has been devised to prevent labour deserting one colliery for another. So long as these methods continue, we do not consider that Government can give any effectual aid to the industry in the matter of recruitment.

Several witnesses have suggested the prohibition in certain districts of the recruitment of labour for industries other than coal, and especially for tea. We do not think this practicable or expedient except in time of war. Coal mining at its best, and however highly it is paid, is subject to certain disadvantages. It is for the industry to remove these disadvantages, and gradually to convert into a skilled mining community a population which was once wholly, and is still partly, agricultural.

47. *Paras. 46, 47 and 48.*—In these paragraphs Mr. Rees recommends the adoption of regular shifts. The evidence we have received on this subject is divergent. Most witnesses were in favour of the principle, but considered that shifts would be impracticable under present conditions. Many thought that they could be introduced without much difficulty in the Jharia field and that the miners would soon become accustomed to them, but doubts were expressed regarding the possibility of their introduction into the Raniganj field, owing to the 24-hour shift being prevalent in certain parts. It may be explained that, under this system, the miners come from distances up to eight miles and remain at the colliery for twenty four hours, working at intervals during that time.

From the evidence it seems clear to us :—

(1) that, if introduced in one coalfield, shifts must also be introduced in the other;

(2) that, if adopted at all, they must be adopted universally, since collieries working without shifts would attract the labour from those enforcing them ;

(3) that the innovation will not be effected by mutual agreement, an attempt to substitute weekly for daily payment by agreement having failed for want of cooperation ; and

(4) that, if effect is given to the proposal, compulsion is necessary and shifts must be prescribed by rules having the force of law.

No rule could be laid down fixing the number of hours for which a miner should work, but we agree with the majority of the witnesses that it would be feasible to order by rule that all collieries should work by shifts, and that these shifts should leave the mine at fixed hours, say 6 P.M. and 6 A.M. The miner would then, as he does now, start work when he pleased, but would soon discover that, in order to earn the amount he desired, he must start early. Such rules could be brought into force by amendment of the Indian Mines Act.

After considering the whole question, however, we have arrived at the conclusion that the time has not yet come for statutory interference in the

matter. This might unsettle the labour and cause discontent, and it is particularly desirable to avoid this at the present time.

48. *Para. 49.*—It is true, as Mr. Rees remarks, that most of the miners are recruited from the population living more or less in proximity to the coalfields. It is to be noted, however, that a certain number come from the district of Bilaspur in the Central Provinces, and others from certain districts of the United Provinces. Experiments have been made with labourers brought from still further afield, but with little success.

49. *Para. 52.*—Mr. Rees suggests that residents in those parts of the country where famine is periodical should be induced to come to the coalfields. A proposal was made in 1906 that Government officers should interest themselves personally in recruiting for industries in time of famine, but was not accepted by Government; nor would the course now proposed by Mr. Rees be of material assistance, since there is already a surplus of labour in the coalfields in years of scarcity. We consider that a steady flow of labour is more likely to be obtained by establishing direct relations between particular collieries and villages.

50. *Paras. 53, 54 and 57.*—Mr. Rees notes that not nearly sufficient consideration is given to improving the conditions of life in the coalfields. We believe that a marked improvement has been effected in this respect in the last few years, especially owing to the efforts of the two Mines Boards of Health, but we agree that the remark is justified, and that, though the miner's welfare does receive more attention than it did, much still remains to be done. The miner's chief requirements are a good house, a good water supply, and good bathing arrangements. Sanitation is foreign to his ideas, but he is more progressive than is often thought, and is fast learning to appreciate its value. To him, however, these considerations are merely secondary. Whatever amenities may be provided, a labourer will readily desert a well-appointed colliery, where the coal is hard, the lead from the tubs to the face long, and the galleries wet, for a badly-appointed one, where the coal is soft, the lead short, and the galleries dry.

51. *Para. 54.*—Mr. Rees recommends "better living accommodation." Many companies are sensible of the importance of the housing question and are, we believe, paying due attention to it. In December 1916, on the suggestion of the late Revd. Dr. Campbell, a Committee was appointed by the Bihar and Orissa Government to ascertain the facts connected with the housing of labour in the coalfields of that province, and to advise as to the measures that should be taken to remedy the existing defects. This Committee reported in June 1917, and the Bihar and Orissa Government have decided to give effect to its recommendations by means of by-laws, which have been circulated for criticism, and which will, if approved, be passed under the new Bihar and Orissa Mining Settlements Act. We understand that the Government of Bengal are prepared to consider the advisability of adopting similar rules. We do not think that any further action on the part of Government is necessary at present.

52. Our attention has, however, been called to one recommendation of this Committee to the effect that legislation was needed to enable mine-owners to acquire surface rights for colliery purposes at a reasonable figure; it was considered by the Committee that section 50 of the Chota Nagpur Tenancy Act might be modified so as to facilitate this. On this subject the Government of Bihar and Orissa expressed their opinion as follows in Resolution No. 16377-M (Municipal), dated the December 5th, 1917 :—

> "The Local Government do not share the Committee's view that section 50 of the Chota Nagpur Tenancy Act should be amended to facilitate the acquisition of land for colliery purposes, and are advised that the ordinary law of acquisition of land by Government on behalf of companies is sufficient without special legislation."

We appreciate the difficulty of amending section 50 of the Chota Nagpur Tenancy Act in the manner suggested, but we do not agree that sections 38 to 42 of the Land Acquisition Act, I. of 1894, are sufficient in the case of land required for the erection of labourers' dwellings. The land might be required by

an individual proprietor and not by a "company," and, even where a company was concerned, the plea might be raised that the "work" would not be "useful to the public." This question is discussed in paragraphs 199 to 202 of the report of the Indian Industrial Commission, and the opinion is there expressed that, on the recommendation of local bodies, Government should acquire land to provide fresh sites for industrial dwellings. We go further and recommend that every facility should be afforded to a colliery company or proprietor to acquire land under the Land Acquisition Act for the housing of labour. It is only necessary, we think, that the district authorities should be satisfied that there is no objection to the acquisition and that mineral rights are not involved. No landlord should in our opinion be able to prevent the erection of labourers' dwellings by demanding an exorbitant price for the land required.

53. *Para. 55.*—Mr. Rees suggests that miners should be provided with suitable plots of ground for cultivation near their houses, but the evidence indicates that it is not advisable to give them lands of any extent for this purpose. In many instances where paddy lands have been given, the result has been the opposite of what was desired; the labourers have either given up mining for cultivation, or have leased out the lands to others and continued as before. In Jharia, where land for rice cultivation is scarce, this question hardly arises, but such land is available in Raniganj. The evidence is, however, that land is not so attractive to colliery labour as is commonly supposed.

On the other hand, a small piece of land, on which garden produce, etc., could be grown, would, if attached to the labourers' dwellings, be appreciated and could be provided in many places without difficulty.

54. *Para. 56.*—On the whole we do not think that Mr. Rees' suggestion of colliery settlements adjoining the coalfields, from which the labourers could be brought daily by workmen's trains or by some other means of mechanical transit, is likely to solve the problem. There are indeed areas near the Jharia coalfields where such settlements would be practicable, but only large companies could afford the expense, and there is no guarantee that the labour would continue to work in the collieries to which the settlements belonged. Again, if Mr. Rees' intention is that the proposed settlements should take the place of the existing dwellings at the collieries, it must be remembered that many companies have already spent large sums on such dwellings, and could hardly be expected to incur the heavy expenditure that rehousing would entail.

55. *Paras. 57 and 58.*—Mr. Rees states that "the owners of collieries, and the colliery staff, make no proper attempt to teach the miners to become interested and skilful," and does not consider that "in a number of instances the personnel of the staffs is suitable for this important matter." We endorse these remarks. Of the colliery superintendents and managers who appeared before us, most admitted that the systematic training of labour was not attempted. This is a defect, and is, we consider, due to a great extent to the fact that many of the European staff are not sufficiently familiar with the vernaculars.

56. Finally, we have taken evidence as to whether labour difficulties are likely to be removed by the use of electric coal-cutters. The subject is mentioned incidentally in paragraph 28 of Mr. Rees' report. Until lately mechanical coal-cutters have proved unsuccessful, but the machines recently introduced are better suited to Indian conditions. Their utility appears, however, to be limited even now, the general opinion being that, though valuable for development purposes, their advantages for ordinary coal-getting in competition with cheap manual labour have not been established. In some collieries they would besides cut coal faster than it could be raised to the surface, while in others there would be no wagons to carry away the additional coal raised, and the cutters would in consequence remain frequently idle. There may be future possibilities for electric coal-cutters, but we believe that their introduction would at present do little to remedy the insufficiency and irregularity of labour.

CHAPTER VI.

POWER.

57. *Paras. 59 to 76.*—In these paragraphs of his report Mr. Rees deals with the methods of generating and using power at the collieries. He considers that the average annual consumption of fuel to produce power is excessive and recommends that steps should be taken to ensure a more general use of electricity, with facilities, in the case of those companies whose resources are too small to admit of an individual generating plant, for obtaining electrical power at reasonable rates. In order to give effect to these recommendations, Mr. Rees suggests the erection at suitable centres of properly equipped generating or general power-supply stations, with control over the prices to be charged and the profits to be made by such stations. He also suggests that, when electrical power at reasonable rates is thus available, collieries using fuel in a wasteful manner should be compelled to take power from these central generating stations.

58. In dealing with these suggestions, collieries may conveniently be divided into three classes:—

Class A.—Those raising over 5,000 tons a month; these constitute only 14·66 per cent. of working collieries, but are responsible for 58·98 per cent. of the whole output.

Class B.—Those raising between 1,000 and 5,000 tons; these constitute 36·28 per cent. of the total number and 34·69 of the output.

Class C.—Those raising less than 1,000 tons; numerically, these are 49·06 of the total number of collieries, but the percentage of the total output produced by them is only 6·33.

59. Electrical development has proceeded rapidly even during the short time since Mr. Rees visited India, and various schemes are being worked out at the moment which indicate that all the collieries in class A, except perhaps those which are nearing exhaustion, may safely be left to provide for their own electrical salvation. It is possible indeed that for some time to come most of these mines will use electricity mainly for pumping, hauling and ventilating purposes, and will not extend its use to winding, the engines for which are costly and cannot be lightly discarded. Eventually, however, the complete electrification of the larger collieries is in our opinion certain. The developments in this direction have, it may be added, been effected, not by public supply companies such as Mr. Rees advocates, but by individual colliery owners who have set up their own generating stations, and in two notable cases, one in each coalfield, by several owners who have combined to form a power-supply company for their mutual benefit.

60. The collieries in class B present the most difficult part of the problem, constituting, as they do, more than one-third of the collieries in the two coalfields both numerically and quantitatively. Very few, if any, of them could afford a power station or by-product coke ovens, and it is questionable how far they can be said to be consuming fuel "wastefully." The small coal or slack now used under boilers cannot usually be sold or, if sold, cannot be carried away owing to the shortage of wagons; neither can it be left in the mines, nor allowed to congest the available stacking accommodation on the surface. It is quite possible that, under existing conditions, even the extravagant or careless use of such small coal or slack in the boilers is cheaper than electric power would be. At the same time, we look ahead to a time when, with the removal of the various hindrances to the development of the Indian coal industry, of which the irregular, insufficient and unsuitable wagon supply is perhaps the most retarding, there will be an effective market for this small coal or slack.

61. It would probably be necessary for the collieries in this class to be supplied with power by a public company licensed under the Indian Electricity Act, and we understand that negotiations between the Government of Bengal and such a supply company have already reached a stage, which ensures the establishment of a public supply agency in the Raniganj coalfield in the near future. In this case it is, we believe, too late to introduce any question of controlling rates and profits in the manner proposed by Mr. Rees; nor in our opinion should there be any suggestion of compelling the collieries in this class to take power from this or any other public supply company. Their steam plant is in most cases sufficient to deal satisfactorily with their output, and will continue to be so for some years to come, and, even where this is otherwise, the matter is one that should, we think, be left to private enterprise. If electricity is more economical in any particular case, the colliery owner should be able to appreciate the fact. It is a matter of supply and demand, and it will be part of the business of a public supply company to convince such owners that electric power would be a profitable proposition. If on the other hand electricity is not actually more economical, compulsion would have the effect of enhancing the general rates paid by other consumers, more particularly if the colliery so compelled were not near the distribution line. The question of relative economy will in each case depend on (1) the initial cost of the transmission lines, cables and plant, and (2) the rate charged per unit. As regards (1), a public supply company might be encouraged to assist colliery owners by supplying the necessary plant on the instalment or hire-purchase system, or in return for a small royalty on raisings. As regards (2), though we are not prepared to recommend the control of rates, we have been impressed by the evidence to the effect that a comparatively small dividend, say 7 per cent., guaranteed by Government would tend to reduce the price per unit and to encourage the use of power. It would also facilitate the raising of capital, as the investment would be "gilt-edged" and might, as Mr. Meares has suggested in his evidence, be combined with a sliding scale of charges varying inversely with the dividends paid. Our general opinion is, however, that the whole question of electric development should be left to private enterprise without compulsion of any sort.

62. There is one point in this connection which we wish to bring prominently to notice. There are already a number of colliery companies in both coalfields with their own power stations, and if, as seems quite probable, these companies are able to supply electric power to their smaller neighbours at a rate per unit lower than that quoted by a public supply company, they should in our opinion be given every encouragement to do so. Under section 28 of the Electricity Act a non-licensed private company may be permitted to supply power to neighbouring consumers without becoming a licensed public supply company, but we are informed that the necessary sanction of the Local Government has hitherto been restricted in scope and difficult to secure without much delay; it is also subject to objection by a local authority in certain circumstances and by a public supply company already licensed in the area affected. We would urge that these restrictions should be withdrawn and that Local Governments should grant sanction under section 28 more freely, a firm offer by a private company to supply power at a lower rate than that quoted by a licensee being considered sufficient ground for a Local Government to exercise its powers under that section. If this principle is admitted, there need be no delay in granting sanction. In this connection we would suggest that the proposed Coal Conservation Department should be consulted in all such cases and that, if the scheme is recommended by that department, the Local Government should give sanction forthwith.

63. All the arguments against the employment of compulsion towards collieries in class B apply *a fortiori* to those in class C. It is idle in our opinion to consider the use of electricity by these collieries at present. Many have not even reached the stage of steam power, and those that have, if compelled to electrify, would find it impossible to dispose of their steam plant except at a great loss. Their work is carried on intermittently at comparatively shallow depths and electricity would in most cases be less economical than steam. As

regards this class, and also to a great extent as regards class B, we are clearly of opinion that the prevention of underground waste is of far greater practical importance than any saving in fuel consumption.

CHAPTER VII.

COKE PRODUCTION, COAL MIXING, BRIQUETTING AND WASHING.

COKE PRODUCTION.

64. *Paras. 77 and 78.*—Mr. Rees draws attention to the wasteful methods of coking in open ovens now employed at the coalfields, and suggests that, owing to the limited reserves of good coking coals which have so far been proved in India, some restrictions should be placed on their use.

65. Attempts have been made from time to time to estimate the available resources of higher-grade coking coal in the Indian coalfields, but the information available is still too scanty to yield more than very rough figures. It has been calculated that the Raniganj coalfield alone contains over twenty thousand million tons of coal of all kinds; most of this, however, is inferior, and only 518 million tons have been estimated to be of better, or so-called "first class," quality. The addition of the Jharia reserves of higher grade coal would bring the estimate for the two fields up to nearly a thousand million tons, but this figure may need modification in view of the large quantities of coal now known to have been destroyed in both fields by intrusive igneous rocks. Further to the west the Bokaro field is said to contain over six hundred million tons of coking coal, and it is possible that further reserves will be found in the Karanpura field. Apart from these, the only other coking coal known to occur in any quantity in India is that of Assam, the high sulphur content of which, however, renders it unfit for metallurgical purposes. So far as we know therefore, India will be dependent for her supplies of metallurgical coke on the group of fields lying in the Damudar valley and including Raniganj and Jharia; and, although the total amount of coal that they contain is undoubtedly very large, the quantity available for coke manufacture is strictly limited. We are not justified at present in placing this at more than two thousand million tons, and, when it is realized that the Indian iron and steel industry may depend on these reserves for its future existence, the necessity for their conservation becomes evident. Certain districts of Bihar and Orissa have recently been found to contain deposits of iron ore, which further investigation may prove to be among the largest and richest known, and to amount to thousands of millions of tons. To treat these, corresponding amounts of blast-furnace coke will be required, and if that is available, it is possible that at some future date India may rank among the great iron and steel-producing countries of the world. If, on the other hand, the present opportunist policy is persisted in and her resources of coking coal are squandered, the mainstay of this potential industry will be gone, and she will be left with the iron ore, but with no means of smelting it. India's annual output of coal has risen from about five million tons twenty years ago to over twenty millions today, and, if the present rate of increase continues, the output will be over fifty million tons fifteen years hence; this, again, would mean, even if no further increase took place, the extraction of two thousand million tons in forty years. Unless her resources are strictly conserved and the use of coal of lower grade substituted, wherever possible, for that of the better coking qualities, India may be faced at no very distant date with the loss of her metallurgical industries for want of coke.

66. At the same time, while recognizing the wasteful nature of the prevailing methods of coking, we do not consider that it would be practicable to impose compulsory restrictions on them at present. The material employed for the manufacture of hard coke is now itself a waste product to some extent. It consists largely of slack and other comminuted material produced in the normal course of mining. There is not a sufficiently large market to absorb the whole of this material, which, if not used for coking purposes, would merely accumulate at the collieries; this, for obvious reasons, is undesirable. The

amount of slack which can be used for by-product coking is strictly limited by the demand for hard coke. In the course of the last few years a number of by-product ovens have been erected at the coalfields, and their capacity for the production of coke far exceeds the demand. This has resulted in ovens being temporarily closed. So long, therefore, as the demand for coke is not sufficient to absorb the whole supply of slack available for coking purposes, we are of opinion that compulsion, which might result in locking up a large amount of capital in idle ovens, would not be justified, and that, until the demand for coke is greater, or until briquetting becomes a commercial proposition in this country, no restrictions can reasonably be imposed.

67. Nevertheless we consider it a matter of importance that the question of India's coal resources should not be lost sight of; additional knowledge is being acquired from year to year, and new facts and figures are constantly accumulating. Much of this information is inaccessible however, and we would suggest that it should all be placed in the hands of the State for co-ordination and review from time to time.

68. *Para. 79.*—Mr. Rees suggests that consumers should be induced to use the poorer qualities of slack or small coal in order to conserve the better qualities for the production of coke suitable for blast-furnace work. This would have the effect not only of conserving the best coal, but also of providing a market for the inferior coal. We suggest therefore that the railways should be recommended to use more inferior coals for shunting purposes in marshalling yards, and that mills and other industrial consumers might also adopt a type of furnace specially designed for the burning of low-grade fuel.

69. *Paras. 80 to 83.*—Mr. Rees points out that, although the coal used for the manufacture of soft coke is of poor quality, it appears to be rich in volatile matter, and he deprecates the loss of possible by-products. Soft coke is employed over large areas in Bengal and the adjacent provinces for culinary and other domestic purposes, and is peculiarly adapted for operations in open hearths where a free-burning, smokeless fuel is required. According to the reports published by the Chief Inspector of Mines, the annual output is nearly 250,000 tons, but we have reason to believe that the figures shown in the returns submitted to him are largely understated, possibly by as much as fifty per cent. Large quantities are railed daily to Calcutta, while, in the opposite direction, this fuel is sent as far afield as the United Provinces. Over this area no suitable substitute is available ; soft coke has therefore become an essential commodity in the daily life of a considerable proportion of the community, and, especially in view of the inferior quality of the material used for its manufacture, we would hesitate to interfere with its production. We understand that an investigation is at present being carried out on behalf of certain firms interested in coal mining, with a view to ascertaining the suitability or otherwise of Indian coal for low-temperature distillation. No information is available as yet regarding the progress of this enquiry, and, until it has been shown that the recovery of the volatile matter now wasted is commercially possible, we do not recommend that restrictions be imposed on existing practices.

COAL MIXING

70. *Para. 84.*—Mr. Rees suggests that more attention should be given to coal mixing both on the scientific and the practical side. The evidence indicates that some experiments have been made in mixing coal for steam-raising and coking purposes, and that the result of these experiments has on the whole been satisfactory. It is also a well-known fact that all coal for bunkers and for export by sea is a mixture of various seams. This mixing has not been done to secure increased efficiency, but has been due to lack of transport facilities. In this connection the experiments made by the British India Steam Navigation Company, and described in Appendix E to our report, are particularly interesting. We are informed that other experiments have also been made to ascertain whether certain kinds of coal, which are ordinarily non-coking, could be made to produce satisfactory coke when mixed with good coking coals. The results of these tests were rather disappointing, though they were not altogether a failure. There can be no doubt that mixing various kinds and qualities of coal may often be advantageous, and we desire to recommend

such mixing to the attention of colliery owners and consumers as a possible means of "increasing the efficiency and economic use of the outputs."

BRIQUETTES.

71. *Paras. 106 to 114.*—Mr. Rees points out that the manufacture of briquettes would afford an industrial outlet for the small coal or slack which, being difficult to dispose of, is now consumed wastefully for steam-raising purposes and in open coke ovens. Briquetting was tried at the Giridih collieries of the East Indian Railway Company, but was discontinued because the cost of manufacture raised the price of the briquettes above that of steam coal. Further, the briquettes would not stand exposure to wet weather; this was probably due to the use of meal as a binder, the price of pitch being then prohibitive. We are of opinion that the manufacture of briquettes should be left to private enterprise, though there does not seem to be much chance of any process being commercially successful, until cheap pitch or other suitable binding material is available.

WASHING.

72. *Paras. 115 to 119.*—In these paragraphs Mr. Rees deals with the improvement of coal for coking and briquetting by crushing and washing. "Draper" washers have not yet been tried in India. Tests of Indian coal carried out in England in various types of washers indicated that the percentage of loss was too high to justify the capital expenditure that would be involved, but further experiments are required and should be undertaken.

CHAPTER VIII.

HANDLING AND DESPATCH.

73. *Paras. 85 to 105.*—Mr. Rees here deals with the handling and despatch of coal. In paragraphs 85 to 90 he considers the question of some of the colliery branches and sidings being worked by colliery owners with their own locomotives. In paragraphs 91 to 94 he discusses the abolition of some of these sidings and the concentration at central loading depots of the traffic on the remainder. As an alternative to light broad-gauge locomotives, he discusses, in paragraph 93, the question of surface haulage in colliery tubs to such central depots. The whole question of transport on sidings is dealt with largely from the point of view of underground support, the need for which will, he says in paragraph 94, largely disappear if hydraulic sand-stowing is employed. In paragraph 95 he touches on the electrification of colliery branches and sidings; in paragraphs 96 to 99 he discusses the shortage of wagons, and as a consequence, in paragraph 100, the accumulation of coal at the collieries; in paragraphs 101 to 105 he considers the employment of screening plants and the type of wagon most suitable for use in conjunction with them.

74. Of the above questions that of the want of a steady and sufficient supply of suitable railway wagons is the most important. It is generally admitted that not only the number of wagons available, but also the facilities for moving them, have been inadequate. In various parts of this report we have referred to improvements, which cannot in our opinion be forced upon the industry, but must be effected voluntarily or by mutual arrangement. It is, however, idle to expect that such improvements will be brought about until this outstanding defect of inadequate transport is radically and permanently rectified. The owner of a middle-sized colliery cannot be expected to raise capital, for instance, for electrification, when the bulk of his coal may not be moved for months. Nor will any good purpose be served by erecting modern screening plants, where there is no regularity of despatch and coal may consequently accumulate in dumps aggregating hundreds of thousands of tons. Again, the concentration of coal, especially in collieries working more than one seam, cannot be contemplated without regular despatches. Further, as pointed out by Mr. Rees in paragraph 100, the lack of transport is itself a direct cause of waste. Witnesses estimated the loss at from 10 to 40 per cent. of the total coal in the dumps, while we are inclined to put it in the neighbourhood of 15 per cent. If the further indirect loss caused by the accumulation of stocks is also considered, the urgency of the matter cannot be gainsaid.

75. No useful purpose would be served by detailed discussion of the reasons for the inadequacy of transport facilities in the past. We cannot, however, emphasize too strongly the necessity for the removal of this deficiency. We wish, in this connection, to call attention to the evidence of the representatives of the two railway companies to the effect that it would be feasible to reserve certain wagons for use only between the collieries and the Kidderpore Docks.

76. With regard to the questions of (1) the working of sidings with light locomotives by colliery companies, which would become responsible for underground support, and (2) concentration at central loading depots by substituting haulage in colliery tubs for some of the existing sidings, the evidence generally is adverse. The transfer of some of the sidings to the colliery companies will not, we find, result in the release of much of the coal now left for support. The evidence of the East Indian Railway Company and its witnesses effectually disposes of the whole question, and in any event the introduction of sand-stowing and the proposed amendments in the Land Acquisition Mines Act (which we have considered) will solve the question of support more satisfactorily than the suggestions of Mr. Rees.

77. As to the question of relinquishing sidings and substituting surface haulage in tubs, the general opinion is against it, and we consider that the matter is one for the railway and colliery companies to settle amongst themselves without the intervention of Government.

78. As regards the proposed electrification of railway sidings and branches within the coalfields, this is in our opinion much in advance of what is now required or is likely to be required in the near future. In any event, while this is entirely a matter for the railway companies, it is doubtful whether the capital expenditure on the necessary equipment could be justified, and it seems certain that the density of traffic over such branches and sidings would not be sufficient to make electrical operation an economical proposition.

79. The general adoption of screening plants would diminish waste and, among other advantages, would have the effect of freeing a certain amount of surface labour, though we do not consider that this would have any appreciable effect on the labour available for underground work. The whole question is, moreover, largely dependent upon a constant and ample supply of wagons.

80. With reference to the most suitable type of wagon for coal transport, there can be no doubt that the open wagon is the best, more particularly where loading is done under screens. It is equally clear, however, that existing traffic conditions necessitate the use of a percentage of covered wagons, and there is no good reason why such wagons should not be adapted for the purposes of mechanical loading. As the evidence shows, the East Indian Railway Company has made successful experiments in this connection, and, if their specially-adapted covered wagon proves satisfactory in actual use, it will practically solve the whole difficulty. It has to be remembered, however, that the wagon supply of all the Indian railways is now pooled, and it would therefore be necessary for the railways receiving wagons from the East Indian and Bengal Nagpur Railway Companies to introduce similarly-adapted covered wagons, which could be utilized at the coalfields in exchange for those handed over by those two companies.

CHAPTER IX.

SAND-STOWING.

81. Sand-stowing is mentioned by Mr. Rees in paragraphs 38, 39 and 40 of his report, chiefly in connection with the recovery of pillars, in paragraph 42 in connection with rotation of working, in paragraph 74 in connection with the use of electricity, and in paragraph 94 in connection with support for sidings; his conclusions are stated in paragraphs 120 to 125, and the practical points to be considered in giving effect to those conclusions are elaborated in the Appendix to his report.

In section 1 of the Appendix Mr. Rees enumerates the various advantages to be derived from sand-stowing; in sections 3, 4 and 5 he specifies the conditions necessary to success and states that they are present in the Raniganj and Jharia coalfields; in sections 6, 7, 8 and 9 he suggests methods of distributing the sand; in section 11 he refers to the electrification of the railways, in sections 12 and 13 to the possibility of the continuous utilization of machinery in generating stations throughout the year, in section 14 to existing stowing arrangements on a small scale, in sections 15 to 20 to the question of payment of royalty on sand, in section 21 to compensation for damage done by transportation of sand, while in section 22 he points out again that conditions in the two coalfields are eminently suitable for the practical application of stowing. Sections 24 to 67 contain technical details of alternative schemes of sand-stowing, with which we are not now directly concerned, and sections 68 to 73 deal with the question of cost.

In his conclusions Mr. Rees points out that the present methods of working will result in greater damage and waste as the mines are developed, and remarks that " unless sand-stowing is therefore made compulsory in all collieries working first class quality coal, then those employing the method with a view to economising their resources will be placed at a serious disadvantage as compared with competitors working as at present." The recommendation intended to be conveyed is evidently that sand-stowing should be made compulsory in all collieries working first-class coal.

82. There can be no doubt as to the advantages of sand-stowing, and we wish particularly to call attention to the serious position that must arise, as regards water, if the present system of goafing is allowed to continue; all the witnesses are agreed that the amount of water finding its way into the mines must be largely increased thereby, and Mr. Leach's evidence contains some interesting figures on the point. Already there have been cases where development has been hampered, output reduced, and cost increased. These cases will inevitably multiply, and it is even possible that dip development, especially as the workings become deeper, may frequently be prevented altogether by the increase of pumping charges above the economic limit. Sand-stowing is the only known means of reducing this damage and keeping it within reasonable bounds.

83. Notwithstanding these advantages, sand-stowing cannot be left to voluntary effort. The additional cost involved would, as Mr. Rees remarks, place the provident owner at a disadvantage, and, even supposing that the additional cost were refunded to him, other factors, such as a diminished rate of production, would be prejudicial to his interests. As the evidence of Mr. R. R. Simpson indicates and as we have pointed out in Chapter VII of this report, the conservation of the better qualities of coal in the Raniganj and Jharia fields is a matter of the greatest importance, and we are satisfied that a voluntary system would not have the effect of stimulating the adoption of sand-stowing to the extent that the situation requires.

84. Some measure of compulsion is therefore necessary, but we are not prepared to recommend, as Mr. Rees does, that it should be restricted to collieries

producing only first-class coal. Mr. Rees does not define what he means by "first class quality coal," and, though the terms "first-class" and "second-class" are generally used, they are incapable of precise and mutually exclusive definition. Their denotation varies considerably, coal being classified for market purposes, not according to its "class," but by the name or number of the seam and by the name of the colliery producing it. Further, differential treatment on the lines suggested by Mr. Rees would immediately disturb relative values and make commercial conditions uncertain.

85. It does not follow, however, that compulsion can be applied to all collieries. Without compensation, some collieries could not afford the cost and others would have their profits reduced below the economic limit. Even if compensation were granted, the cost in many collieries would, owing to bad methods of working in the past, be disproportionate and unwarranted: in others, the coal is inferior and not worth stowing.

86. We are convinced, moreover, that the principle of compulsion cannot be applied unless accompanied by compensation. We have given the point considerable thought, and are unanimous in arriving at this conclusion. Universal compulsion would entail universal compensation, which, even if practicable, would be unjustifiable.

87. Our conclusion therefore is that sand-stowing should be made compulsory in certain cases only, and that, where it is so enforced, the cost entailed should be repaid. The controlling authority proposed by us in Chapter III would decide where and when sand-stowing should be undertaken, and would be vested with powers, as already proposed, to enforce its decisions. There should also be a fund, to be administered by the same authority, from which compensation would be paid to such collieries as may be compelled or authorised to adopt sand-stowing. We propose that this fund be raised in the following manner.

THE COMPENSATION FUND.

88. A cess should be imposed on all coal and coke, irrespective of quality, carried by rail in, or into, British India. The cess would be collected on despatches by the railway companies, whose representatives have stated in evidence that this method of collection would be unobjectionable. The same method has, we understand, been suggested for the cess proposed under the amended Land Acquisition Mines Act, and our suggestion is that the two cesses should be amalgamated.

89. The cess would be the same for all kinds of coal and coke. As regards this it has been suggested that, as railway freights are independent of quality, a fixed or "flat" rate would favour the better grades unduly, but we are confident that this would be adjusted by the operation of the law of supply and demand. We are assured, on the contrary, that, if the rate were graduated, serious difficulties would arise in the assessment and collection of the cess, while fraud could not easily be prevented.

90. We recommend that the rate of the cess should be fixed at 8 annas a ton in the first instance, but that any legislation on the subject should provide for such increase or decrease as may be found necessary. In arriving at this proposed rate, we have taken into account three factors:—

(1) that only about 25 per cent. of the output in the Raniganj and Jharia fields is at present being obtained from pillars;

(2) that the cess will include that proposed under the Land Acquisition Mines Act; and

(3) that the introduction of sand-stowing can only be gradual; if therefore the cess were imposed as soon as the necessary legislation had been passed, even a low rate would yield the nucleus of a substantial fund before any heavy expenditure became necessary.

91. We recommend accordingly that the new cess should be brought into force as soon as possible. We have stated already that it should be imposed on all coal and coke carried by rail in, or into, British India. We consider it

essential that the cess should fall on all coal and coke produced in British India and should not be restricted to that of the Raniganj and Jharia fields. Any other policy would result in a disturbance of the relative prices of coal in the various markets of India. For the same reason, coal produced in the Indian States should be subjected to an octroi tax of eight annas a ton on passing by rail into British India. Further, lest Indian coal should be placed at a disadvantage, an additional customs duty, equivalent to the cess, should be imposed on foreign coal imported by sea into British India, including Aden. The proceeds of this duty should, if possible, be credited to the compensation fund and not to Imperial revenues. Though the wide incidence of the cess should admit of a comparatively low rate, it might be advisable, if later developments necessitated an increase in the rate, to allow a rebate on exported Indian coal in order that it might not be hampered in competition with the coals of other countries in markets such as Colombo and the Straits Settlements.

92. The compensation fund would be utilized by the controlling authority to cover—

(1) the cost of acquisition of sand and other suitable materials;

(2) the cost of winning the sand or other material and of delivering it free of charge to collieries requiring it;

(3) the repayment to mine-owners of the cost of sand-stowing;

(4) the advance to mine-owners of the capital required for the purchase of plant; and

(5) the payment of fees and other expenses connected with the board.

SUPPLY OF SAND.

93. We gather, from paragraph 38 and section 4 of the Appendix to his report, that Mr. Rees did not anticipate any difficulty over the supply of sand; but he was contemplating sand-stowing for "first class quality" coal only, whereas our proposals cover all qualities of coal. We are unable to say, even approximately, what quantities of sand will be required for this purpose. A rough estimate, calculated on the assumption that about 25 per cent. of the output is got from pillars, gave about one million tons a month on the basis of present production, but the amount will vary, and the question is one that will need further investigation on the lines suggested in paragraph 101 below.

94. Appendix F contains some information as to the amount of sand available in the Damudar, Barakar and Adjai Rivers, but the results of the borings there given cannot be regarded as representative, and it would be unsafe, without further systematic enquiry, to assume a sufficiency of sand in these rivers even on the basis of a monthly demand of one million tons. The matter is obviously of such importance that we consider it necessary to recommend that a Government officer be placed on special duty to survey the resources of the three rivers mentioned above and to estimate the amount of sand available. This officer should also ascertain, as far as possible, the amount of sand ordinarily carried in suspension by these rivers during the monsoon, and the extent to which such sand is likely to replace that removed for stowing purposes.

95. Should the amount of sand in these rivers eventually be found insufficient, other material for stowing could be obtained by crushing the soft rocks which occur on and near the collieries. The cost of crushing might prove excessive in some places, but there are others where it would be cheaper to crush such material than to carry sand from distant rivers.

96. It should be remembered also, in considering the amount of sand or other material that may be required, that sand-stowing would only be undertaken under the direction of a skilled technical authority and would never be ordered where it was unnecessary or uneconomical. In this connection, we may refer to the evidence of the Superintendent of the East Indian Railway

Company's collieries, who points out that, in the Giridih field, with a very good roof and a comparatively thin seam, 95 per cent. of the coal can be won without sand-stowing, but that in the Bokaro field, where the seam is ninety feet thick, sand-stowing will be essential, if an adequate proportion of the coal is to be recovered.

97. The Government of Bengal are apparently contemplating the construction of two reservoirs, one on the Barakar River and the other on the Damudar. The evidence of the engineer in charge of these schemes indicates that, for about five years, these dams would hold up all sand brought down from above, and that the existing rate of passage of sand would not be restored for about fifteen years. Though the Barakar dam might have no appreciable effect on the supply of sand in that river in the neighbourhood of the Raniganj field, that on the Damudar would undoubtedly be prejudicial in this respect to certain collieries in the Jharia field.

MEANS OF OBTAINING SAND.

98. In sections 19 to 21 of the Appendix to his report Mr. Rees suggests that landlords should give sand free of royalty for the stowing of collieries on their own estates, but that they should be paid a royalty of one pice per cubic yard for sand required by other collieries. We have examined representatives of the principal estates in this connection. One of the largest proprietors is prepared to give sand free to his own lessees, but would demand a small royalty on sand to be used in collieries on other estates, while the remaining landlords are disposed to claim royalty in all cases.

99. Should Mr. Rees' suggestions be adopted, or even should all sand be given free of royalty, we think that difficulties would arise and confusion ensue, if this matter were left to private arrangement. It is important that the whole of the sand in the rivers should be made available to all collieries on the same terms, and we recommend therefore that Government should acquire it on behalf of the proposed controlling authority. The sand has hitherto had little or no commercial value, but negotiations for its purchase, which are possibly speculative, have recently taken place. The Land Acquisition Act should be amended, if necessary, so as to bring the acquisition of sand for the controlling authority within its scope. It would then be part of the business of that authority to arrange for its allocation and distribution. Power should similarly be taken to acquire land containing other material, such as sandstone, which could be utilized for stowing.

CONVEYANCE OF SAND.

100. The most important consideration in connection with stowage is the conveyance of the sand, and it is on this factor that the success of our proposals must largely depend. We have given much attention to the subject, and, especially in view of the present deficiency of wagons and other facilities for the transport of coal, we are sensible that the great volume of sand to be dealt with, and the wide areas to be served, render the question of distribution one of peculiar complexity. It is evident that no single method of conveyance will suffice and that the solution of the problem must lie in the combination of every possible means of transport, including railways, light railways, tramways and ropeways. This entails a more technical and more exhaustive investigation than we have been in a position to undertake, and we recommend that one or more railway officers be placed on special duty to devise a complete scheme for the collection and distribution of the sand. A serious consideration, and one which may ultimately prove to be the chief obstacle to the success of our proposals, is the large initial expenditure likely to be involved, and special attention should be directed to this aspect of the question.

101. For the purpose of the proposed enquiry it will be necessary in the first instance to ascertain the amount of sand likely to be required. The difficulty of ascertaining this has been referred to in paragraph 93 above, but we would suggest that the Department of Mines, with the assistance of colliery owners, should be requested to supply these officers with

an estimate sufficiently accurate to form the basis of their preliminary enquiries.

102. While not wishing to anticipate the conclusions of the investigating officers, we feel that the distribution of the sand could, for the greater part, be most suitably entrusted to the existing railway companies. In the case of collieries situated on, or within a short distance of, the bank of a river, it might be found advisable to require owners to provide their own means of transport, which might be constructed, subject to the safeguards mentioned below, either by individual owners or by groups of owners in cooperation. All other collieries would probably be mainly dependent on distribution by rail, and for this reason we would suggest that the railway companies might be induced to undertake the administration of the whole system and to utilize not only existing railways, but also feeder tramways and ropeways to be constructed for the purpose. If this were found impracticable, we would suggest, as an alternative, that the conveyance and distribution of sand be entrusted to some form of Government agency.

103. Compensation should be paid from the fund on account of such means of transport as are provided privately, and steps should be taken to revise the Land Acquisition Act, so far as may be necessary, to remove any difficulties likely to arise in connection with way-leave. We deprecate any action which might result in the formation of private carrying companies, from which we foresee danger through interference and monopolies. For this reason, and also for the protection of persons on whose land tramways, ropeways, etc., will be laid, we consider that no land should be acquired for such purposes without the approval of the proposed controlling authority; also that such land, when acquired, should be vested in the controlling authority and not in the individual mine-owner or group of mine-owners for whose benefit the means of transport is to be constructed, although there would be no objection to entrusting the latter with the actual working and management. If this procedure were adopted, we believe that it would obviate the danger of monopolies and frustrate attempts at obstruction or extortion in matters connected with way-leave.

104. In section 7 of the Appendix to his report Mr. Rees suggests the appointment of a central committee in each coalfield for the supply and distribution of sand, but we consider it undesirable, if it can be avoided, to introduce transport companies other than the two existing railways. We recommend that the distribution should be in the hands of those two companies and (to such extent as may be found necessary by the investigating officers) in the hands of private owners or groups of owners supervised by the controlling authority.

105. The question of employing a special type of wagon, as recommended by Mr. Rees in section 10 of the Appendix to his report, might also be considered during the course of the proposed investigation.

COST OF STOWING.

106. In sections 68 to 73 of the Appendix to his report Mr. Rees states that, for collieries at an average distance of five miles from the source of supply, the cost of sand-stowing will be 10 to 14 annas per ton for solid coal not cut into pillars, and 16 to 20 annas for coal standing in pillars. In arriving at these figures, he assumes operations on a large scale and allows for saving on timber, pumping, supervision, haulage, etc., but does not state the data on which his estimates are based.

107. Practical experience of stowing is comparatively limited in India, but, on the assumption that sand would be delivered free of charge at the collieries, certain witnesses with such experience have given figures of what the additional cost would be per ton of coal got from pillars. These figures range from 4 annas 2 pies to 13 annas 4 pies. Out of four witnesses who were asked their opinion as to the probable average total cost throughout both coalfields, three placed the figure at Re. 1 a ton.

Figures are also available regarding the cost of stowing in other parts of India. At the Ballarpur Colliery, for instance, Mr. R. S. Davies, in his paper on the subject in Volume X of the *Transactions of the Mining and Geological Institute of India*, gives the cost per ton of coal extracted from the flushing

area as eight annas; this was reduced to 4·98 annas by the higher percentage of large coal obtained and by the reduced cutting price. In his "Notes regarding proposed Sand-Packing at Ramnagar," Mr. C. A. John Hendry forecasts the cost at three annas six pies, six annas, and eight annas per ton respectively in various inclines. As regards other parts of the world, sand-stowing is extensively employed in France and Germany, and we have been told by a witness who has recently visited the Saar Valley that the cost there is not more than 7*d.* a ton. Mr. Rees mentions two mines in Silesia, at one of which, where sand-stowing was only on a small scale, the cost was 8*d.* to 9*d.* a ton, while 5*d.* a ton was the figure at the other, where the workings were stowed throughout. There is also some further information on this subject in Appendix IV to the Final Report of the Royal Commission on Coal Supplies (1901-1905), where the net cost of water-flushed stowing in the Myslowitz Colliery is put at about 2*d.* a ton, after allowing for saving in hewer contract, damage by fire, and pit timber.

108. In our opinion these data are insufficient, in the present state of Indian knowledge and experience, to permit of any accurate estimate of the average cost of sand-stowing. As we have already stated, the most important factor is the cost of distribution, and this cannot be determined until the proposed investigation has been carried out. We are convinced, however, that, unless the railway freight on sand is reduced very considerably below existing rates, it will form an obstacle likely to prove insurmountable. In addition to the transport question, the following facts would also require consideration in each individual case before the probable cost could be determined :—

(1) the thickness and inclination of the seam to be stowed ;
(2) the condition of the pillars ;
(3) the scale on which stowing is to be done, standing charges being more or less constant ;
(4) the distance between the source of sand supply and the colliery ;
(5) the vertical head and the horizontal lead underground ; and
(6) the nature of the roof and the amount of water readily available.

SUMMARY OF CONCLUSIONS AND RECOMMENDATIONS.

Our principal conclusions and recommendations are :—

(1) That no improvement in the present wasteful methods can be expected without State interference, that such interference should take the form of a controlling authority with legal powers designed to ensure conservation and economic extraction, and that such authority should consist of a new Government department and a board sitting in Calcutta—Chapter II, paragraph 15, and Chapter III.

(2) That a steady and sufficient supply of wagons, with the requisite facilities for moving them, is the most urgent need of the industry—Chapter VIII, paragraphs 74 and 75.

(3) That sand-stowing should be made compulsory within certain limits and with provision for compensation, and that funds for the purpose should be raised by a cess and a duty of eight annas a ton on all coke and coal; that the cess should be imposed as soon as possible, be collected by the railway companies on despatches, and be administered by the controlling authority—Chapter IX, paragraphs 87 to 92.

In connection with our proposals regarding sand-stowing, we also recommend—

(*a*) that a Government officer be deputed to ascertain the amount of sand available—Chapter IX, paragraph 94; and

(*b*) that one or more railway officers be placed on special duty to enquire into the question of transport and distribution of sand —Chapter IX, paragraph 100.

2. We further recommend that the Land Acquisition Act be amended to provide facilities for the acquisition of—

(*a*) surface rights for colliery purposes,

(*b*) sand and other materials suitable for stowing, and

(*c*) land required for the conveyance of sand—Chapter V, paragraph 52, and Chapter IX, paragraphs 99 and 103.

3. Among our less important conclusions and recommendations are the following :—

(1) That labour recruitment, electrical development, briquetting and coal washing should be left to private enterprise—Chapter V, paragraph 46, Chapter VI, paragraphs 59, 61 and 63, and Chapter VII, paragraphs 71 and 72.

(2) That the time is not ripe for compulsory weighment, statutory shifts, and restrictions on methods of coking—Chapter IV, paragraph 35, Chapter V, paragraph 47, and Chapter VII, paragraphs 66 and 69.

(Signed). B. FOLEY,
Chairman.

„ RAJA BAN BIHARI KAPUR BAHADUR.
„ G. F. ADAMS.
„ R. G. M. BATHGATE.
„ H. H. HAYDEN.
„ J. H. PATTINSON.
„ N. C. SIRCAR.

(Signed) L. B. BURROWS,
Secretary.

MINORITY REPORT.

I regret that I have been unable to sign the majority report, but in view of the terms of reference I do not consider that the principal recommendations made therein are expedient, and I therefore submit the following report.

2. In paragraph 77 of his report Mr. Rees speaks of the limited reserves of good coking coals which have been proved available in India. In a recent speech of the Indian Mining and Geological Institute, the President is reported to have said that there are only reserves of good quality coal sufficient for 45 years' consumption. It seems to me that the whole idea of Mr. Rees' report and the majority recommendations are based on this supposition that India's coal resources are exceedingly limited, and therefore it is a matter of vital importance to the State that they should be rigorously conserved, irrespective of the vested interests affected. As a matter of fact India possesses enormous reserves of good quality coal, both coking and non-coking. In place of the 45 years' life suggested above, I consider that in the recently-proved portions of the Jharia and Raniganj fields and in the Bokaro and Karanpura fields, to say nothing of those fields lying still further to the west, we have at least 300 years of good quality fuel available. There is no need for Government to take an *ex parte* statement however; it is a simple matter to depute one or two officers of the Geological Survey to make an enquiry into the coal resources of India, based on the prospecting work done in the past two or three years; this enquiry should not take more than a year to complete and if, as I confidently anticipate, my estimate is proved to be correct, the need for what I might describe as panic legislation disappears, as after all, with 300 years' life, vested interests might claim they should not be prevented from "wasting" coal if it suited them to do so, as the community could not possibly suffer by their action. I am of the opinion however, as I shall explain later, that where "wasteful" systems are now employed there will be a great improvement without any legislation.

3. There is a good deal of loose talk about "waste" of coal, a great deal of it by people who do not understand anything about practical mining. Actually in considering waste of coal the consumer with an inefficient steam plant is not only wasting coal but also transport, but it has not yet been suggested that he should be regarded as a criminal for doing so. In dealing with mining problems it is too often forgotten that mining is not an exact science, but is purely a matter of compromise and common sense. There are theoretically-perfect systems of mining to suit nearly all conditions, but it is not usual for them to be adopted, as the capital employed would probably receive no return for its services. It is not generally known that coal mining, which is usually looked upon as a dangerous occupation, could be made absolutely safe as far as labour is concerned, if expense were no object, but this expense would certainly shut down the mines. So far both capital and labour have compromised in the matter, a reasonable amount of safety as well as a fair return on capital being agreed upon. The same argument largely applies to the question of waste in working. Capital naturally wishes for as early a return as possible and in India this has been easy owing to the conditions under which the coal occurs. As to whether there has been undue waste in India, it is possible to get two opinions. On the one hand we have the theorist who points to the amount of coal which cannot now be extracted, and on the other hand we have the following arguments:—

(i) The coal occurs in thick shallow easily-worked seams and was mined at first at extraordinarily low cost. All over the world cheap coal has meant wasted coal.

(ii) As the majority report states, when working was first started, it was seldom intended to attempt to extract the pillars formed, which were looked upon as coal inevitably lost under the system of mining employed.

(iii) Owing to the deficiency in transport no colliery owner was certain of being able to despatch his coal. With the prospect of having to stack coal for months on the surface there was little inducement to attempt to work the coal in the most economical way. I will return to this question later.

I am personally of the opinion that under the circumstances the waste of coal has not been greater than might have been expected, and is by no means as great as has occurred in some of the bituminous coal areas of the United States of America.

4. The majority report recommends the creation by legislation of a controlling authority with powers as follows:—

(1) power to regulate the leasing of colliery lands in such a way as to prevent such excessive subdivision as will lead to inefficient or wasteful working;

(2) power to bring the lessors and lessees of neighbouring mauzas to terms in order to avoid the loss resulting from irregular boundaries;

(3) power to regulate the dimensions of pillars and galleries;

(4) power to forbid the extension of an area under pillars where this appears likely to lead to unnecessary loss of coal;

(5) power to prohibit the extraction of pillars under conditions likely to result in collapse and subsequent flooding or underground fire;

(6) power to order when pillars should be got and by what method;

(7) power to prescribe the dimensions and positions of barriers;

(8) power to isolate workings; and

(9) power to regulate rotation of working.

In practice this control would amount to the entire working of all mines being taken out of the hands of the present management, who would simply carry out the authority's orders. I consider there are several fatal defects about such a proposal which I will indicate briefly.

(*a*). At present if, owing to any underground difficulties, a colliery manager is unable to proceed with his ordinary development, in order to keep up his output he selects a portion of a colliery for "pillaring"—it is quite possible by wasteful methods from a theoretical point of view, but such a proceeding is quite justifiable and is constantly done in all countries. It is of more importance to see that output and consequent profit are maintained than that a small portion of the total resources of the mine should be conserved. Under the proposed authority such a proceeding would be prohibited, *i.e.*, if the authority were to act up to its name as a coal conservation authority. It is not suggested that the owner of the mine should be compensated for any loss of immediate profit arising out of orders of the controlling authority; on the contrary, in paragraph 15, Chapter II, it is definitely laid down that in the interests of the community he shall not be allowed to "waste" his coal. I consider it unlikely that an authority without responsibility as to the financial results of its orders would be approved of by any legislative body. The proposal actually amounts to nationalization of the mines without compensation to the present owners.

(*b*). It is suggested in the majority report that a superior staff of one chief mining engineer and four assistants would be sufficient. At the present time in the Raniganj and Jharia coalfields there are 640 working collieries of which 53 are in the development stage. I am of the opinion that, if the proposed authority is to be anything more than a pretence, it would be necessary to have at least 20 qualified assistant mining engineers. This would give each assistant 32 collieries to look after and, if he is to give each colliery the consideration such extensive powers as are suggested demand, he could not in fairness be expected to do more. It is acknowledged that the smaller mines, which compose the majority of those working, would give more trouble than the larger.

(*c*). Attention is drawn to the fact that the majority of the witnesses examined were in favour of some sort of controlling authority, but I must emphasize that the committee had no witnesses to represent the capital employed in mining. Without exception I think all the witnesses examined on this point were employees of mining companies, men without any financial stake in the industry other than their salaries and commissions.

5. Up to the present my report may be considered as merely destructive criticism, but I have the following proposals to make which I consider will do all that is necessary to improve mining methods and conserve coal :—

(I) In the first place the principal and only really important factor is transport. By this I do not mean that a year's output of the coalfields should be moved some time within that year, but that each colliery should receive all the transport facilities it requires, at the time it requires them. This has never been the case up to the present, and to carry out my proposal will mean a very much greater capital expenditure on railways than has ever been considered necessary. It will also mean the less economical working of railways owing to fluctuating demands for transportation, but the question is one of policy and can only be settled by the Government of India.

At the majority of collieries about 50 per cent. of the output is obtained roughly between the middle of January and the end of May in each year, that is to say railways should now be prepared to afford transport facilities for about two million tons of coal per month between January and May, or roughly 4,000 wagons a day during this period instead of the present maximum of about 2,700 wagons. This is the period when unfortunately most of the crops have to be shifted and, if the coal industry is to obtain the facilities its importance demands, railways will have not only locomotives and wagons lying idle, but transport facilities working only up to a proportion of their total capacity, during the monsoon months. This however must be faced if the coal trade is to be required to improve its mining methods, and I am of the firm opinion that, when facilities such as I have described are available, the extra profits the trade will make will be sufficient to induce it to improve its methods without any form of compulsion.

II. Secondly, in order that no colliery owner shall destroy his neighbour's property or threaten the life of labour employed in adjacent collieries, I recommend that a rule be made under the present Mines Act requiring each colliery owner to preserve a barrier of 50 feet of solid coal on the boundary of his mine, and that, where he has already worked within this limit, he should be compelled to stow the barrier to the satisfaction of the Chief Inspector of Mines. This would give 100 feet of solid coal between collieries and, while it would not prevent the percolation of water to dip workings, it would prevent sudden floods and explosions spreading from one colliery to another. This rule would also have the effect, without any legislation as proposed in the majority report, of preventing the excessive subdivision of mining properties, as no man would take up an absurdly small property if he had to leave 100 feet of coal as a barrier, assuming he had neighbours working on both sides of his mine.

SAND-STOWING.

6. I do not agree that sand-stowing should be compulsory or that a cess should be levied to pay a portion of the cost of stowing in collieries which may adopt the system whether by compulsion or not. I am of the opinion that, if the transport facilities I have recommended are made available, the extra profit collieries will make will be sufficient to induce them to adopt sand-stowing where it is desirable and, if the matter be left to private enterprise, it

will be done at considerably less cost than if carried out under the orders of a Government department and paid for by a cess.

In the evidence it is stated that in pre-war days collieries worked at an overhead profit of Rs. 1-8 per ton. As far as collieries working first class coal are concerned, the average cost has not increased since by more than 8 annas per ton, while the present rate of profit is in the neighbourhood of Rs. 3-4 after allowing for the extra cost. I agree with the opinion expressed in the majority report that the lack of transport facilities in the past has caused such competition for certain contracts that the rate of profit has been less than would otherwise have been earned, and I consider that, when adequate transport facilities are available, the profit per ton on good quality coal will be nearer Rs. 5 than Rs. 3, and that the prospect of an extended life at this rate of profit will be sufficient to induce all collieries to adopt the best means of conserving their coal without any need for compulsion.

If the majority report is to be adopted, I consider that the proposed cess of 8 annas per ton will be quite inadequate. In the first place the railways serving the coalfields are already congested and, if my recommendation is accepted that they should be prepared as soon as possible to carry from 50 per cent. to 75 per cent. (50 per cent. now, 75 per cent. in five years) more coal traffic during four months of the year than at present, very heavy capital expenditure will have to be faced. Now add to this very largely increased tonnage of coal an equivalent amount of sand (in the Jharia coalfield on the average from 3 to 4 tons of sand will be required for each ton of pillar-coal obtained) which must be carried in each year before the monsoon starts, it is not likely that whatever combination of railways, tramways and ropeways is adopted for conveyance of the sand will cost less than 1½ to 2 crores of rupees in capital expenditure, which according to clause 2, paragraph 92, Chapter IX, of the majority report is to be met from the cess.

We have had it in evidence that the cost of excavating the sand from the river bed and delivery into a hopper will be about 8 annas per ton, and in the railway evidence that the railways would expect annas 9-1 per ton for conveying the very limited amount of sand they could deal with to the collieries, we get a total cost per ton of coal obtained of Rs. 3-3-3 assuming that 3 tons of sand only is required per ton of coal. At least 8 annas per ton of coal must be allowed for dealing with the sand after it has been delivered at the colliery, so that the total extra cost per ton of coal would not be less than Rs. 3-11-3. It is generally assumed that at present 25 per cent. of the total output is obtained from pillar-coal, so that, without meeting any of the other expenses for which the fund is to be responsible (*vide* paragraph 92, Chapter IX) or any of the capital cost of ropeways, etc., a cess of 15 annas per ton on all coal is necessary for the cost of delivering the sand and expenditure in connection with sand-stowing.

I am therefore of the opinion that, if Government will acquire the sand in the rivers in the coalfields and allow it to be taken by any collieries which may wish to adopt the sand-stowing system, it will have done all that is necessary for the coal trade. I do not agree with the view expressed in paragraph 83 of Chapter IX of the majority report that to recommend voluntary sand-stowing would be useless.

We had it in evidence that one of the most important coal-owning firms was actually preparing to adopt sand-stowing for a group of large collieries in the Jharia field. We also know that several combinations of firms in regard to the most economical generation and use of electric power have already taken place, and I am convinced that these firms, if left to themselves, will adopt, wherever practicable, co-operative schemes for the most economical method of sand-stowing. I feel very strongly that sand-stowing, if it is to be done at a cost which will not cripple the coal trade, must be left to private enterprise.

If in order to meet my objections the proposed railway freight on sand is reduced as suggested in paragraph 108, Chapter IX, of the majority report, this will simply mean that the cost of sand-stowing will be reduced at the expense of the general revenues of the country.

7. *Weighment and other questions,* vide *Chapter IV of majority report.*—I am of opinion that all Mr. Rees' recommendations should be left to private enterprise and that it is unnecessary for Government to take any action.

8. *Labour, Chapter V.*—I agree generally with the majority report. Not nearly enough has been done by colliery owners to give miners reasonably good living accommodation and good drinking water. The smaller mines are the worst offenders in this respect, but the question may be left to the present Mines Boards of Health to deal with.

9. *Power, Chapter VI.*—I agree with the majority recommendation particularly in regard to paragraph 62 of this chapter of the report.

10. *Coke production, etc., Chapter VII.*—I agree that India must rely for her supplies of metallurgical coke on the Damudar valley coalfields. I do not agree that the total probable reserves of coal suitable for coke manufacture is not more than two thousand million tons, but am of the opinion that, if the Bokaro and Karanpura fields are taken into account, the total amount of coking coal will be found to exceed this estimate very considerably. At present the total annual requirements of metallurgical coke are not more than 1½ million tons and the principal consuming company has already secured coal areas in the Jharia coalfield alone which gives it a reserve of 100 years' supply. The whole of the coal rights of the Bokaro and Karanpura fields are in the hands of two important coal-owning firms and it is not likely that they will countenance wasteful methods of work on the part of their future sub-lessees. I do not consider that there is any likelihood of a shortage of coal for metallurgical purposes even in the distant future. In the majority report an estimate of the life of good quality seams has been given of 40 years. This assumes that the whole present output is obtained from these seams, whereas more than half the present total output is from seams which have little or no value from a metallurgical point of view and which are humanly-speaking almost inexhaustible. I am of the opinion that the whole matter should be left to private enterprise, as should be the questions of coal mixing, briquetting and washing.

SUMMARY OF CONCLUSIONS AND RECOMMENDATIONS.

My principal conclusions and recommendations are :—

(i) that adequate transport facilities must be provided for the coal trade, that until this is done it is unfair to expect mining methods to be much improved, and that, when the facilities are equal to the demand, there will be no need for Government interference ;

(ii) that all colliery owners should be compelled under the Mines Act to give a barrier of 50 feet of solid coal on the boundaries of their mines ; and

(iii) that Government should acquire the sand in the coalfield rivers and allow it to be taken free of charge by any colliery company wishing to sand-stow, and that the best and most easily-worked reaches of the rivers should be reserved for groups of colliery companies prepared to work on a co-operative system.

(Signed) R. W. CHURCH.

APPENDICES TO REPORT.

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APPENDIX A.

Report by Mr. Treharne Rees on the Methods of Coal Mining in India.

FORSTER BROWN AND REES,

Mining and Civil Engineers.

15, VICTORIA STREET,

WESTMINSTER, LONDON, S. W. 1,

AND AT GUILDHALL CHAMBERS, CARDIFF,

31st May 1919.

SIR,

I now have the honour to submit a report on the investigation which I have carried out under your instructions into the methods of coal mining in India, with a view to securing the more economical working of the coal resources and treatment of the outputs.

2. To fully investigate this matter in detail and inspect all the working coalfields in India would occupy a period of probably not less than two years. I have, therefore, in view of the short time arranged for carrying out these investigations, confined myself in this report to the conclusions arrived at from enquiries and inspections made more particularly in the Jharia and Raniganj coalfields, which at present yield about 95 per cent. of the total output of coal in British India, but no doubt some of the suggestions may be applicable to some of the other coalfields.

3. I also paid a short visit to the collieries in Assam, which are dealt with separately.

4. I understand that it is proposed to form a Committee, which will include members directly interested in coal mining in India, to consider proposals for dealing with this subject after consideration of this report.

5. As the result of investigations I am of opinion that considerable economy can and should be effected.

6. In setting out my conclusions I do not propose citing any individual cases of want of economy in working and treating the coal, but to deal with the subject generally.

7. As the physical and geological features of the two coalfields in question have already been described at length in the Memoirs of the Geological Survey of India, and other publications, it is unnecessary in this report to recapitulate them.

8. A short general description, however, of the prevailing methods of mining work at the majority of the collieries is desirable to illustrate the subject.

9. The seams of coal now being worked are for the most part considerably thicker than those usually found in other countries, and the coal is won by what is known as the Bord and Pillar method which consists of driving galleries and dividing the coal into more or less rectangular pillars.

10. These pillars, which vary considerably in their dimensions, are finally either partially or totally extracted as circumstances permit. The chief factors governing the quantity of coal left unworked and lost in these pillars are the necessity for leaving support for surface on which buildings or railways are situated, and the inability to extract all the coal safely owing to the falls of roof which occur when support is removed or weakened by working the pillars. In addition, instances have been brought to my notice where the lessors of the coal have prohibited the extraction of pillars, and large quantities of coal have been irrevocably lost in consequence.

11. Speaking generally, the seams of coal can be cheaply and readily won by incline roads driven from the outcrops, or by shallow shafts, and from this has resulted the existence of a large number of small colliery proprietors working at or near the outcrops who have not the necessary financial resources to win and work the coal in a proper and efficient manner. This is dealt with later in the report.

12. This method of mining has been in operation since the commencement of coal-getting in India, and is being continued today with varying modifications.

13. The chief heads requiring consideration with a view to greater economy and efficiency, are—

(1) Methods of extraction, rotation of working, and labour.

(2) The generating and use of power at the collieries, and coking.

(3) Handling and despatch of the coal at the collieries.

(1) METHODS OF EXTRACTION.

14. In the two coalfields in question, the owners of the collieries have either acquired the coal they are working by purchase or hold it on lease or sub-lease. In either case there is no supervision such as inspections by landlords' agents or Government officials to prevent wasteful methods of working. Neither do there appear to be any covenants to work economically, and in such a manner as to safeguard the property for the future, so as to produce the greatest quantity of coal consistent with safe and efficient mining, whilst ensuring protection from dangers arising from fire and water. The unfortunate result is that, in a large number of properties, the colliery has been worked chiefly with the object of producing outputs at the earliest possible moment, without due consideration being given to the most efficient methods of laying out the collieries for the more distant future. It is to be regretted that some competent supervision is not carried out to guard the future as the practice in vogue seems to be to pay the management at the collieries a bonus or commission on the quantity of coal raised, which, naturally tends towards the chief attention being given to immediate outputs rather than to a steady output over the natural life of the property.

15. It has further come to my notice that, in the case of large tracts of coal property, the areas let off for working by the landlords have not been so arranged as to conduce to the economical working of the estate as a whole, but rather with the object of receiving as much as possible by way of "salamis" or sums of money paid down as a consideration for granting a lease.

16. This has led, especially in the case of the smaller takings near the outcrop, to the areas worked being in a number of instances of such small dimensions and fantastic shapes that it is quite impossible to work the coal satisfactorily. In consequence, the pillars of coal near the outcrops have been reduced in size until they became too dangerous to work, and the roof has caved in, causing considerable subsidence and damage to the surface; or the workings have become water-logged, thus jeopardising the working of the coal in the deeper part of the taking. It has also led to encroachments on neighbouring takings, with the result that the underground workings of various companies have become connected up for considerable distances which, in the event of fire or water troubles being experienced in one of the takings, might then be communicated to others, which has unfortunately already occurred in several instances.

17. It is, in my opinion, for this and other reasons much to be regretted that expert advice was not obtained by the landlords in arranging the various colliery lettings, and inserting covenants in the deeds providing for proper working, with supervision to see that the covenants are duly performed in the laying out of the workings and extraction of the coal.

18. I would therefore suggest that, as the working of the coal resources of the country under the present system is not being properly supervised, some controlling authority should be set up to supervise the negotiations for leases, to the end that the areas to be worked shall be laid out to the best advantage, and suitable covenants inserted in the documents for proper working, with power to inspect to see that these are duly performed.

19. It is not possible, except in a few isolated cases, to arrive at the quantities of coal mined, as there is no proper check. The miner is paid either at the rate of so much per tub, or, in the event of the coal being carried to the surface by hand, it is stacked in small heaps and measured. The workpeople also carry away quantities out of the mine for their own use, or which they sell privately, and of which no record is obtainable.

20. Practically the only means of arriving at an approximate figure is by inspection of the railway companies' weights of coal and coke despatched by rail, which however only forms a portion of the coal actually extracted.

21. In consequence of this it is not possible to arrive at an accurate estimate of the coal left unworked at the various collieries, as the plans cannot be relied on to show the actual state of the pillars. In some cases, these are marked as having been completely worked out, whereas portions have been left behind and lost, and, in other cases, pillars are shown of certain dimensions, which have been reduced in size by irregular working, or by splintering due to weathering or roof pressure. This is more especially the case at the older collieries and underground workings near the outcrops.

22. In order to rectify this state of things, and to ensure better supervision of the extraction of coal, I would suggest that all coal when brought out of the mine should be weighed, and an accurate account recorded in a book at the colliery; also that each year's workings should be shown on the colliery plans by a distinctive colour, together with the date of working and sections of the seam. Further, that reduced levels to a common datum be made and marked on the working plan at distances of not less than, say, 100 yards apart.

23. These are details which are now enforced in coal mining in Great Britain, and should be adopted in India.

24. Under present conditions, at all the collieries with perhaps a few exceptions, it is impossible for the reasons given above to gauge the actual loss of coal, but it is perfectly obvious that the waste is abnormally high, and from information received, and from my

own observations, I estimate that the quantity of coal destroyed or lost by present methods is not less than one third of the total coal *in situ*.

25. Generally speaking, the roof immediately overlying the seams of coal, together with the thickness of the seams, produce conditions unfavourable to working on the Longwall system (that is to say, the extraction of practically all the coal in the first operation) as there is not sufficient material for stowing up the space from which the coal has been extracted.

26. Further, this Longwall system is not to be recommended as its success is largely dependent on a uniform rate of advance of the working face, which unfortunately cannot be looked for here, owing to the very fluctuating attendance of labour in the mines.

27. It might, however, be possible to introduce this system in some of the thinner seams, where the roof immediately over the coal is of a comparatively soft nature, and would produce material for stowing the spaces from which the coal had been extracted.

28. To increase and produce a uniform rate of advance of the working faces in the thinner seams, consideration should be given to the introduction of coal-cutting and coal-conveying machinery, which would tend to overcome the difficulty incurred by the irregular attendance of the miners.

29. With regard to the thicker and more important seams, the Bord and Pillar method is probably the most suitable, but, in a large number of the collieries visited, it was evident that sufficient consideration had not been given, in laying out the underground workings, to produce the greatest quantity of coal from a given area, consistent with safety, and to conserve the resources available to the mine.

30-33. The areas standing in pillars have been goafed in various irregular areas, the main object appearing to be production of as large an immediate output as possible and by so doing adversely affecting the future economic working of the mine.

34. Many of the seams of coal in the two coalfields under consideration are liable to spontaneous combustion and in consequence several of the companies owning large collieries have in recent years provided safeguards against this by forming their workings into panels, that is to say surrounding areas of coal, which have been divided into pillars, by solid barriers of coal pierced by as few galleries as possible By so doing, comparatively easy means are afforded of isolating any particular area in which fire may break out. This method also makes the work of extracting pillars far safer and more economical, and is preferable to having all the workings inter-connected by numerous openings, as is the prevailing condition at most of the mines visited.

35. The seams near the outcrops, and at the shallower depths having now been taken up for the most part, and, in some cases, nearing exhaustion so far as present methods permit, the time has arrived when the companies have to consider the winning of the more valuable coals at greater depths, and sinkings are at present actually being made to win the seams lying at varying depths of about 1,000 feet and over.

36. In the deeper workings which I inspected, the pressure of the superincumbent strata is distinctly more noticeable on the sides of the pillars of coal formed by the driving of the galleries, and the removal of these pillars by the methods now in vogue will be attended by increasing risk, and still more coal is liable to be lost than under the present conditions.

37. In view of this additional pressure, the pillars will have to be considerably larger at these greater depths, which will result in the number off roadways available for coal-getting over a given area being proportionately decreased, unless other means are provided for supporting the strata, and thus enabling the coal in the pillars to be extracted without loss.

38. A considerable number of the most important collieries in the Raniganj and Jharia fields are favourably situated for the application of hydraulic stowing owing to the presence of very large deposits of sand in the rivers near at hand. Briefly, this system consists of filling the spaces from which the coal has been removed with material sluiced into the mine through pipes from the surface by means of water which, after depositing the material, is drained away leaving a compact mass capable of supporting the overlying strata and preventing the caving in of the surface.

39. With present methods, it is not possible, generally speaking, having regard to the thickness of the seams, to obtain an appreciably greater yield of coal without considerable risk, more especially owing to the labour being to a very large extent unskilled.

40. I consider therefore that hydraulic stowing should be employed largely in the two fields in question, and in an Appendix hereto are set out particulars regarding the system and possible schemes of working, together with the advantages accruing therefrom.

ROTATION OF WORKING.

41. In the course of my inspection I noticed several instances of lower seams being worked, or about to be worked, before seams lying immediately above have been exhausted.

This in some instances is due to the lower seam being of a somewhat better quality, or having a more favourable market at the time. Some restriction should, I consider, be exercised in this respect, as it endangers the future working of the upper seam owing to the subsidence of the roof into the goafs at the lower seam when the pillars are extracted, and either rendering the upper seam impossible to work, or doing it great damage, thus causing the loss of a national asset.

42. This danger, however, would largely disappear if efficient hydraulic stowing were carried out in the lower seam.

LABOUR.

43. The question of labour is a very important factor in the coal mining industry of Bengal and Bihar and Orissa, and the material available is at present very inadequate and unsatisfactory.

44. The majoriry of the Indian labour working in or about the collieries is inefficient and unambitious, and the output per person employed is very low as compared with European countries. The general position is unsatisfactory, and organised efforts will necessarily have to be made towards improvement as time goes on, when larger sums of capital have to be attracted and employed for winning coal at greater depths.

45. At present the majority of the work people are primarily agriculturists, who treat mining as a secondary occupation and periodically disappear from the collieries to their villages to cultivate their ground; consequently the supply of labour is fluctuating.

46. They have also no fixed hours of work, but enter and leave when they feel inclined. No discipline or control can be exercised at any individual colliery in this respect, as the workers at once leave, and can readily find work in neighbouring mines where there are no restrictions of hours.

47. It is most important for the proper and economical working of the collieries that regular shifts should be adopted so that the management can be assured of a fairly constant supply of labour.

48. Under present conditions this is impossible, and it is very difficult to find efficient remedies, but it is evident that, whatever reforms may take place, they must necessarily be adopted by all the colliery companies simultaneously, and should be very gradual and only put into effect after full and serious consideration.

49. The supply is always more or less inadequate, and apparently can only be recruited from certain classes of the population living more or less in proximity to the coalfields. A favourable monsoon seriously depletes the coalfields of labour, as the labourer does not return to mining until he has exhausted his resources from cultivation.

50. There has been a gradual but non-uniform increase in recent years in the number of persons employed in coal mining, and this figure now stands at about 170,000, of which about one-third are women, but this number forms a very small fraction of the classes of the population who should be available for colliery labour.

51. Owing to the very important part that the mining of coal must play in the future industrial development of the country, every effort should now be made to attract labour to the coalfields.

52. Shortage of food and employment are more prevalent in certain parts of the country than in others, resulting in periodical famines, and I would suggest that it should be demonstrated to the people in those parts that there is permanent and remunerative work in the coalfields, and small drafts of the inhabitants should be induced to come to the coalfields where they could see the nature of the work and the pay attached, with a view to increasing immigration to the coalfields.

53. With a view to reducing the periodical excursions of labourers from the coalfields, and to attract new recruits, measures should be taken on a larger scale to improve the conditions of living on the coalfields. This refers more particularly to Jharia and the congested parts of the Raniganj field.

54. Steps should also be taken to provide better living accommodation and to improve the surroundings of the people, so that they would compare more favourably with the villages from which they originate.

55. The attractions would be greatly enhanced if they could be provided with suitable plots of ground for cultivation near their houses whilst at the mines.

56. Possibly by making settlements for them just off the coalfields, so far as Jharia is concerned, and providing them with better accommodation and land so long as they work at the collieries, the labour question might be improved, and if mechanical transit were provided at stated times between these settlements and the collieries, the workpeople could be got to attend more regularly, and fixed shifts arranged at the mines. If this were brought about, it should more than repay the necessary outlay.

57. With some few notable exceptions, not nearly sufficient consideration is given to improve the lot of the people in the coalfields. The owners of the collieries, and the colliery staff, make no proper attempts to teach the miners to become interested and skilful.

58. I would suggest that, in engaging colliery staffs in the future, this shall be kept prominently in view, as I do not consider that in a number of instances the personnel of the staffs is suitable for this important matter.

(2) POWER.

59. Having regard to the comparatively shallow depths from which the coal is at present won in the Jharia and Raniganj coalfields, at the short distances it is hauled or hoisted mechanically, and also at the prevailing pumping requirements, I certainly think that the average annual consumption of fuel used for producing power to work the collieries is excessive, standing as it does at over ten per cent. of the total annual output.

60. Taking into consideration the general conditions, a substantial saving could be affected in this direction by which the consumption should be reduced to not more than an average of five per cent. Calculated on the combined outputs of the two fields, this would have liberated in 1917 an additional 750,000 tons of fuel for disposal.

61. The principal causes of this high rate of consumption are the excessive number of separate steam-raising plants of wasteful design, together with the unskilled feeding of the boilers, and the comparatively small extent to which electricity has as yet been applied.

62. A very noticeable feature in these coalfields is the large number of collieries or openings at work, compared with the total outputs. This is due to the seams lying at or near the surface and thus being readily accessible. It has consequently been found more convenient, and has become the practice, to win the coal from a number of openings rather than to convey it by underground roads to a common centre or centres before bringing it to the surface.

63. In the majority of cases, each of these little openings, raising only small outputs, has its own steam plant, consisting usually of one or more vertical boilers, and occasionally horizontal boilers of the Lancashire type. Very little or no insulation is used to prevent radiation and the steam used is generally at a low pressure, whilst the stoking is unskilled and wasteful.

64. Owing to the irregular times at which the miners work and the absence of underground shifts at recognised hours, the machinery has to be prepared to deal with the coal from underground at any time, entailing constant firing of these boilers, although the total collective time during the 24 hours actually taken in raising or hauling coal to the surface is exceedingly short. In fact, one of the noticeable features of the coalfields is the lengthy periods during which the machinery used for bringing the coal to the surface is idle.

65. The remedy is a more general use of electricity, both for winding, hauling, and pumping, and for the other purposes for which steam is now used.

66. Several of the larger companies or groups of collieries have erected electrical generating stations for providing power to their collieries in their immediate neighbourhood, and have effected considerable saving in consumption of fuel previously used for raising power for steam engines. But I consider that steps should be taken to ensure a more general use of electricity, and that those companies whose mineral areas are too small to admit of the initial outlay necessary for an individual generating plant should have facilities for obtaining suitable electric power at reasonable rates for use at their mines.

67. To provide the necessary power a general survey should be made of the two coalfields, and power stations should be erected at suitable centres, from which current would be transmitted at a high voltage to sub-stations, and thence through transformers to the various collieries. These central generating stations should be equipped on a large scale to centralise the work as far as economically possible, and should be situated on sites to which coking coals could be most conveniently brought, and by-product coking ovens erected of the "regenerative type", so that the gases from these might be used to raise steam for driving turbo-generators.

68. In fixing the sites and capacity of these central generating stations, regard should be had to the future development likely to take place in the coalfields, as well as present requirements.

69. The method of treating and financing these central power stations, and the rates to be charged to consumers, is a matter requiring the consideration of the various interests concerned in the economic use of the coal resources and their development and extraction.

70. The cost of the fuel supplied to the ovens and the profits arising from the sale of the coke, by-products, and electric current would also require the consideration of the various interested parties.

71. Control should be exercised over the prices charged for the electric current which should not be allowed to make a profit over and above a figure sufficient to pay proper interest on the capital expenditure, depreciation, and upkeep of the plant, after paying the working expenses. This is necessary, as I consider that steps should be taken, when electric power at

reasonable rates is thus available, to compel the collieries now using fuel in a wasteful manner to take power from these generation stations.

72. The charges per unit would have to be slightly in excess of what they might have been in those cases where the requirements for current remained more or less constant throughout the year, owing to the additional pumping necessary during the rainy season.

73. The increase in the quantities of water to be dealt with at these times would necessitate additional machinery being installed at the power stations, which would be practically idle during the dry weather.

74. Should however hydraulic stowing be adopted on the lines suggested later herein, the higher cost per unit should disappear.

75. Under present conditions, a large number of the companies are unable to proceed with the extension of their opening-out roads to the dip for the major portion of the year, due to the flooding of the lower workings caused by the rains. This of course seriously interferes with the proper development of the seams, and tends towards premature goafing and a higher rate of exhaustion of the reserves of coal in the rise workings, in proportion to the progress of the development work, than would be prudently undertaken were the dip workings always available.

76. With an ample supply of power at hand, however, for working the pumping machinery, the normal development of the dip workings could be proceeded with at all times of the year, which would be of great benefit to the collieries and tend towards increased efficiency of working, and more than counterbalance any slightly increased cost per unit of the electric current.

COKING.

77. Owing to the limited reserves of good coking coals which have so far been proved available in India, the Committee should seriously consider the advisability of placing some restriction on the very wasteful methods of coking now for the most part in practice, more especially in the case of the better quality coals. The present prevailing method is most wasteful and primitive. It consists in treating the coal in open ovens, and the result is little better than carbonizing the coal in open heaps on the ground. The volatile matter is driven off into the air and the by-products lost. A large proportion of the material left is of little or no use, the coal at and near the bottom of the oven has not been converted into coke and is wasted, whilst the portions exposed to the air at the top and ends of the oven are destroyed.

78. From figures obtainable, and from my own observations, I estimate that the yield of coke produced in this way does not on an average exceed 40 per cent. of the coal carbonized, whereas by the use of suitable by-product ovens the coke yield should average about 75 per cent. In addition, the quality of the coke would be improved and the volatile matters collected for the making of by-products, such as tar, pitch, sulphate of ammonia, etc.

79. Further, with regard to the best quality coking slack or small coal, I would call the Committee's attention to the general uses to which it is now put, such as as steam-raising, smithy work, etc., and suggest that the consumers be induced to use other grades of fuel, so as to conserve the best class coking coals for the production of coke suitable for blast furnace work.

80. The manufacture of soft coke should also receive consideration. The seams from which this class of coke is usually made are of a poorer quality owing largely to the higher percentage of ash which they contain, but, as far as can be judged from the analyses available, they are rich in volatile matter.

81. These coals are generally obtained from small collieries working near the outcrops, and it is the practice to place the coal in heaps on the surface at the mine and set fire to them. When the coal is partially coked, and most of the hydro-carbon driven off, it is then quenched by water. The product finds a good market as household fuel among certain classes of the population, and is also sold to sweetmeat makers requiring a cheap fuel with little smoke, but the yield of coke per ton of coal carbonized in this manner is very low.

82. The present method of dealing with this grade of coal is very wasteful, and I suggest that experiments should be made to ascertain whether an equally good or better class of soft coke cannot be produced from this coal by distillation of the coal in ovens from which the by-products could be collected, and the waste gases used to work the collieries in the neighbourhood, and which would moreover give a greater yield of coke.

83. Possibly by the use of mechanical stampers after breaking the coal to a uniform size, a more closely grained and firmer coke would result.

COAL MIXING.

84. Serious attempts do not appear to have been generally made, either from the scientific or practical side to mix the various qualities of coal found in these two fields, with a view to increasing the efficiency and economic use of the outputs, whether for coke-making purposes or otherwise. This has been done in other countries with very beneficial results, and deserves attention.

(3) HANDLING AND DESPATCH OF COAL.

85. Before dealing with the above subject, I consider that the question of ownership of the sidings, and their connection between the railways and the collieries, and the sites of these sidings and connections, should receive some consideration.

86. Contrary to the usual custom in England, these lines are, I understand, owned and maintained by the railway companies, and constructed mainly at the railway companies' expense. This creates an undesirable position in several respects.

87. It prevents the colliery company, without permission of the owners of these connections, from obtaining access to another railway company's system, causing in some instances a detour of traffic.

88. A larger margin of safety for support is required than would be necessary if the traffic to and from the collieries were worked by light locos, such as would be used by the colliery companies for shunting purposes. At present, the railway companies send their heavy locomotives over the colliery sidings, together with their wagons, at their own risk, and naturally require substantial and excessive safeguards against any subsidence or disturbance of their line.

89. Owing to the great number of colliery coal-loading depôts within comparatively small areas, especially in the case of Jharia, the amount of coal which has to be left unworked for the support of these sidings is very considerable, whilst the tonnage conveyed over them is comparatively small.

90. In the event of the colliery companies owning their own branches, running their own locomotives, and becoming responsible for any damage accruing to the railway company's wagons whilst on the colliery company's property, the railway companies would be safeguarded and large quantities of coal would be liberated for working.

91. I consider that the coal left for support of colliery branches might be further reduced if the colliery companies were to make efforts to centralize their loading depôts to a greater extent than is done at present, and so obviate the length and number of sidings that now exist, and save the time of the locomotives picking up small train loads.

92. With the provision of central loading depôts, better supervision could be given at less expense to the loading of the railway wagons, and a reduction made in the number of loading coolies required. I understand that a number of these would not be prepared to work underground, but some of them no doubt could be induced to do so, and in time others would also follow.

93. As an alternative, and with the provision of more colliery tubs, these could be run to central loading places over light rails requiring but little support, and which could be easily moved, if necessary, from time to time at little expense.

94. This question of support for sidings will largely disappear in the case of colliery companies employing hydraulic stowing underground, which if carried out efficiently will allow of all the coal being worked under these sidings.

95. With the erection of central electrical power stations, on the lines suggested, there should be sufficient power available not only for working the collieries, but for conveying the coal to central loading depôts, and electrifying the railway sidings and branch lines within the coalfields. This would allow of the collecting and marshalling of the coal wagons, and making up of the trains for delivery on the main lines.

RAILWAY WAGONS.

96. The regular supply of sufficient railway wagons suitable for carrying coal is a most important factor, and goes far in effecting the efficient working of the collieries and use of the outputs. Most serious efforts should therefore be made to improve the position in this respect, for the number and type of the wagons supplied to the collieries in the Jharia and Raniganj areas are totally inadequate, and the loss of coal from this cause is much to be deprecated.

97. The War has no doubt seriously depleted the railway companies' resources of rolling stock, and this should be taken into account when viewing the present unfortunate position. But I am informed that the supply of wagons, both as to number and type, at the collieries was very little better before the War.

98. Coal being so largely the foundation of the future industrial welfare of this country, it is imperative that proper supplies of railway wagons for coal traffic should be provided without delay, for, until this is done, much of the waste that is now taking place on the surface at the collieries cannot be prevented.

99. I understand that additional wagons are being ordered for the railways, but, unless these are suitable for loading under colliery screens, the waste and delay will still continue.

STOCKS OF COAL AT COLLIERIES.

100. At present there are immense stocks of coal lying on the ground at the collieries. The coal in these stocks is continually depreciating in quality, especially those rich in volatile

matter, due to the action of the sun and atmospheric influences, and is becoming broken into small or slack by pressure and traffic, whilst quantities are stolen and the small blown away by the wind. Further, the increased handling of this coal increases its cost and the proportion of small coal.

SCREENING.

101. In order to obtain better results from the coal and to put it on the market in suitable condition, it should be screened, sized, and, if necessary, picked or otherwise cleaned, and then loaded without delay into railway wagons for despatch.

102. Owing however to the inadequate supply of wagons and to the large number of covered wagons sent to the collieries for loading, it is quite impossible to deal satisfactorily with the outputs.

103. If it is necessary to use covered wagons to prevent theft of coal conveyed for long distances, apart from the convenience of using them returned with grain and other general traffic, I would suggest that some contrivance be made so that the roof can be temporarily removed to allow of the wagons being filled under the *chutes* or screens.

104. Efforts should, however, be made by the railway company when supplying wagons for shorter runs, such as for instance to Calcutta, to eliminate the covered wagons and standardize the coal wagons for this traffic as much as possible.

105. There is an unduly large number of persons at present employed above ground at the collieries in India, amounting to between 35 and 40 per cent. of the total number of persons employed. This number could be greatly reduced, as already stated, if the scattered loading depôts could be reduced, and the coal brought in the colliery tubs to central depôts on each taking, to be loaded direct into railway wagons over screens.

BRIQUETTES.

106. Consideration should, I feel, be given to the manufacture of briquettes, more especially those of the "ovoid" type. By this means, quantities of the various classes of small coal could be utilised, which has at times in the past been difficult to dispose of.

107. These ovoids could be made of various qualities by mixing the coals or from both hard or soft coke breeze, or mixing with coal dust to suit the various markets.

108. Varying sizes could be made from 1½ ounces to 7 ounces according to market requirements.

109. With tar distillation plants installed at the by-product coke works connected with the power stations, pitch should be available at a reasonable cost for use as a binding material.

110. Fuel in this form does not suffer from exposure to the air by disintegration, or deteriorate by absorbing moisture, the pitch making it practically weather proof, and, when stacked, it is not liable to spontaneous combustion.

111 With regard to the market for ovoids, it should be remembered that their success depends largely on whether they can be made at a price to compete with large coal, not forgetting, however, the position of the dust coal if left as dust, and its market price as such.

112. The cost, including capital expenditure and labour necessary for producing this class of fuel, is not excessive, the chief item being the binding material, but as already stated this should be relatively light if pitch is made at the by-product coke works.

113. By washing or otherwise cleaning and mixing the material to be briquetted, a uniform quality of fuel can be maintained by which the consumer can rely on the results he expects from its use. It can thus be made to compete with the large coal either for domestic use or especially in steam-generating plants, where the output of steam required is more or less constant.

114. The ovoids form a convenient and clean fuel for handling, and are almost self-rimming in bunkers, and capable of being used for certain marine or railway traffic.

115. Whilst consideration should be given to the conservation of coking coals carrying below 12 per cent. of ash, for use in recovery by-product ovens, attention might be given to the improvement of these coals by crushing and washing and also to the other coals with higher ash contents.

116. The Indian coals are relatively high in ash and past attempts have so far failed to remedy this by cleaning and washing.

117. The ash does not exist, generally speaking, in distinct bands in the coal, a large portion being found in laminated streaks which cannot be separated by hand, whilst the slight difference in specific gravity has hitherto made washing ineffective.

118. In some of the latest types of machines, such as the 'Draper Washer" used for hydraulic separation, effective means could very possibly be found to reduce the quantity of ash in the coal, and improve the coal for coking or briquetting, as these machines are capable of effectively separating materials in which the margin beween the specific gravities is very slight.

119. The coal for the purpose should be reduced to as small a size as practicable for the use to which it is ultimately to be put, in order to obtain the most beneficial results. It might also be found economical to mix washed small from some of the second quality coals with the slack from the cleaner seams for both coking and briquetting purposes.

CONCLUSIONS.

120. It will be seen, on reference to the Appendix, that the introducing of hydraulic packing, as suggested, for the coalfields in Bengal and Bihar and Orissa, will increase the cost of production of coal from the seams in which it is employed to the extent of an estimated average of about one rupee per ton.

121. Unless sand-stowing is therefore made compulsory in all collieries working first class quality coal, then those employing the method with a view to economising their resources will be placed at a serious disadvantage as compared with competitors working as at present, and this will require the very careful consideration of the Committee.

122. I would further point out, however, that, in the case of the Jharia coalfield, the present methods of working can only lead to the very considerable damage and waste of the resources.

123. As the present mines become more and more fully developed, larger proportions of the total outputs will have to be obtained by goafing the pillars and, unless some means are employed to fill up the empty spaces from which the coal has been extracted, a very serious position will arise. The seams are thick, with comparatively little intervening strata, and the measures are very porous.

124. In consequence of the methods of extraction now generally in force, the old workings near the outcrop and at comparatively shallow depths will continue to cave in over increasing and larger areas than has already occurred, with the result not only of permanently damaging the surface, but of forming large reservoirs of water menacing the future deeper workings in the coalfield.

125. Action should therefore be taken without delay to reduce this damage to a minimum.

ASSAM.

126. I accompanied Dr. Hayden on a short visit to the collieries in Assam.

127. The conditions and problems here are very different from those of the Jharia and Raniganj coalfields, owing to the quality and nature of the coal, and the geological conditions of the beds. The seams so far opened upon are of steep gradient, the coal being soft and very liable to spontaneous combustion owing to its high percentage of sulphur, but higher in calorific value than the Bengal coals.

128. Owing to this sulphur, the mine water becomes charged with sulphuric acid which seriously affects the colliery pumps and water pipes. Mining operations have therefore been practically confined to working the coal above free drainage level.

129. Greater efforts should, in my opinion, be made to win the coal below this level than have taken place up to the present.

130. Most of the water now met with in these mines is surface water which, on coming in contact with the sulphur in the coal in the surrounding beds, produces sulphuric acid which causes the difficulties with the pumping arrangements.

131. In order therefore to win the dip coal, some of the old roads should be kept open, to form adits to drain off this water and prevent it going to the dip. I would also suggest that the dip-winning roads should be driven half course, and as far away from the clay beds as possible, as these beds carry the surface water.

132. Under these conditions, any water met with in the dip workings should not be more than can be dealt with in water tanks attached to the coal journeys, and so obviate pumps and pipes.

133. Careful analyses should be made of the various coals to ascertain the condition of the sulphur contents, with a view to treatment for its removal. If it is found to be inherent in the coal and not merely as pyrites, its removal would probably not be commercially practicable, but, if it is in the form of pyrites, the coal on being brought to the bank could be crushed and washed in a hydraulic separator, which would very possible make it impervious to spontaneous combustion on being stacked, and would not have such a destructive effect on railway wagons, loco-tenders, etc.

134. Should the sulphur be found to be inherent in the coal, experiments might be made in manufacturing ovoid briquettes, in which form the coal would not be so liable to spontaneous combustion.

135. In any event, it will of course be found that the free drainage coal can be more cheaply and readily worked than coal lying in the dip, but the companies engaged in coal mining in this district should be induced to make more serious efforts to win the coal below free drainage level, while they still continue to hold resources of the more cheaply won coal in the rise workings.

136. In conclusion, I should like to express my thanks and appreciation for the assistance and facilities given me by all parties for visiting the various mines and obtaining information, and I especially wish to thank Mr. G. F. Adams, the Chief Inspector of Mines, whose long and varied mining experience has been of great value to me, and also his staff whose arrangements have been very helpful in facilitating and expediting the enquiry.

I have the honour to be,

SIR,

Your obedient servant,

R. I. TREHARNE REES.

APPENDIX TO MR. REES' REPORT.

HYDRAULIC STOWING.

1. The seams in the Jharia and Raniganj coalfields lie for the most part at favourable gradients for hydraulic stowing, and, if a system were adopted which would enable the whole of the coal, or nearly so, to be safely extracted, many advantages will result to the colliery companies apart from the prevention of waste of the coal resources.

(2) Chief amongst these may be mentioned the following:—

(3) Subsidence of the overlying strata and surface would be reduced to a minimum, obviating payment of heavy compensation for damage.

(4) It would remove the risk and expense of dealing with underground fires.

(5) It would be possible to keep the working more concentrated for a definite output, as each acre would yield a very much larger quantity of coal, and this would economise in length of roadways and in haulage.

(6) The mine, and especially the working faces, could be placed under better and more frequent supervision without increase of staff.

(7) Haulage and traffic are simplified and the circulation of colliery tubs, which under the present system is a troublesome matter, could be improved.

(8) Ventilation of the workings and roadways could be simplified and improved. I do not consider, speaking generally, that sufficient attention is now paid to ventilation.

(9) Although a large number of the seams do not give off explosive gases, all portions of the mines where work is carried on should, in my opinion, be supplied with adequate fresh air. It is now frequently stagnant and stale.

(10) Considerable quantities of water now finding its way into the mines, due largely to the condition of old workings and cavities made by goafing, would be reduced.

2. To enable a system of hydraulic stowing to be practically applied, three essentials are necessary:—

(1) A supply of sand or other material suitable for sluicing, at a reasonable cost, into the mine.

(2) A general falling gradient in the mine, to enable the sluiced material to be readily got into the goaves.

(3) A sufficient supply of water and means for re-pumping it to the surface.

3. Numbers (2) and (3) do not require dwelling upon for, as already stated, the angles at which the seams lie are favourable for hydraulic stowing, and the supply of water for this purpose can be more or less readily obtained at all collieries, and can be used over and over again with only a small loss.

4. With regard to the supply of material, the two coalfields are well provided in this respect, owing to the very large quantities of sand produced by the rivers either traversing them or lying near at hand.

5. The distances of some of the collieries lying farthest from the sources of supply do not compare unfavourably with the distances from which sand has to be carried for hydraulic stowing in other countries, for instance in Germany, where sand is brought from distances, in some instances, of nine miles.

6. It is of course not practicable that each colliery company should have its own independent supply of sand. Some of the collieries lying adjacent to the rivers would be able to make their own arrangements, but those more distantly situated would require joint schemes for the supply and general distribution of the sand.

7. I would suggest for consideration a general control committee in each coalfield for the purpose of supplying and distributing the sand. This body should arrange for the collection of the sand at the sources of supply, and convey it to distributing depôts at suitable points, at which large stocks should be accumulated to prevent any interruption in supplies to the collieries caused by the flooding of the rivers or by delays in transit.

8. With regard to the conveyance of the sand in the above fields, as already stated, the collieries lying within easy access of the sand supplies would probably find it more advantageous to make independent provision for their supply by the use of aerial ropeways or light surface haulage.

9. The other collieries lying a farther distance away, say three miles and over, would require joint schemes, probably in groups, as their geographical positions warranted.

There are two alternatives for these, *viz.*—

(*a*) utilisation of existing railways and sidings for conveyance and distribution of sand, with the necessary extensions to the rivers, and

(*b*) provision of independent systems, such as railways on the standard gauge, worked by electric power obtained from the central generating station.

10. In either case it would be very essential that special standard wagons should be provided and used solely for the conveyance of sand. These wagons should be of the self-emptying type, and as large as economically possible, say with a capacity of forty tons.

11. With regard to the use of the existing railway with extensions, and having in view the increased traffic, it might also be found economical to electrify the railways within the coalfields, and obtain power from the central generating stations for this purpose.

12. The conveyance of sand from the rivers would probably, to a large extent, cease during the monsoon and be at its maximum in the dry weather, whilst underground pumping is at its maximum in the monsoon and its minimum in the dry weather.

13. This forms an important factor, inasmuch as it would give employment to the machinery in generating stations, which would otherwise be idle in the dry weather, and this would therefore tend to lower generally the price at which power could be supplied.

14. Sand-stowing has already been adopted on a small scale in one or two instances in the Raniganj coalfield and is under consideration elsewhere.

15. The question of payment of royalty on sand taken from the rivers, for use at the collieries, is already exercising the minds of the colliery owners and the sand-owners in a number of cases.

16. It is highly desirable that this should be definitely settled without delay, so that speedy arrangements can be made for the supply of sand for hydraulic stowing in collieries where the more valuable seams are being goafed or about to be goafed.

17. The settlement of this royalty question is also necessary in order to arrive at an estimate of the cost of procuring and delivering the sand.

18. Landlords are already in some instances demanding unreasonable rates of payment for the sand. It has been pointed out to them that they will greatly benefit by the introduction of hydraulic stowing in consequence of the increased yield of coal per bigha, but they set off, against this, the loss of the money payable as compensation for the subsidence damage, which they are not likely to get if hydraulic stowing is employed and damage does not accrue, and therefore they are not favourably disposed towards the proposals.

19. This attitude is of course quite indefensible. In my opinion no royalty should be payable on sand taken from an estate when it is used for stowing purposes under that estate, and whereby the landlord will benefit by increased payments in royalty on the coal which would otherwise be lost. In Great Britain this principle is adopted, for instance, where clay is dug by a colliery company and made into bricks or otherwise used on the estate for the purpose of equipping and working the mines belonging to the estate; it is usually royalty free.

20. In the event of sand being taken from an estate to be used for hydraulic stowing in an estate of other ownerships, I consider a royalty of one-fourth of an anna per cubic yard would be a reasonable rate.

21. Also a reasonable amount should be paid by way of compensation in the event of any actual damage accruing to property, due to the transportation of this sand.

22. As already stated, the conditions in the coalfields in question appear to be eminently suitable, so far as the practical application of the system is concerned, and can be employed without undue difficulties.

23. Before proceeding with proposals for the actual stowing underground, it may be as well to describe some of the principal requirements for getting the sand to the underground areas to be goafed.

24. In operating the system, the pipes are either put down boreholes from the surface, or laid down a shaft or incline, according to which is the easiest and cheapest means of reaching the area to be filled.

25. Various methods are employed on the surface for getting the sand into the sluicing pipe. A good arrangement is to provide a form of small hopper with a grid or screen placed in it to prevent stones, etc., being carried into the pipe. The sand is fed on to this screen usually from a large supply hopper or bunker, the feed being regulated through openings fitted with sliding shutters.

26. The sluicing water is brought into the small hopper under a head of 10 to 20 feet below the screen, the water in the sluicing pipe being controlled by a valve.

27. The main sluicing pipe should not be less than six inches internal diameter, and should be of wrought iron and, in some cases, it is found desirable to place an internal metal lining which can be removed when worn out.

28. It is desirable that all bends should be as large and as easy as possible, and should be of good quality cast iron, and the thickness of metal in the outer portion of the curve increased.

29. Before starting stowing, the water should be turned on into the bottom of the small surface hopper for, say, ten minutes before the material is put into the pipes, to ensure their being clear of any material.

30. The material is then fed as regularly as possible on to the grid or screen, and is carried down the pipes to the goaf which is to be stowed. It is important that no interruption shall take place during the sand-stowing, and, after the material has been sluiced, the water should be allowed to run in the pipes for a further five to ten minutes to prevent any material being left in them.

31. The proportion of sand to water will vary according to the vertical head, and distance to be traversed horizontally, ranging from 1 to 1·5 up to 1 to 5.

32. Owing to the relatively short distances likely to arise in the present instances, since openings into the seams are numerous and boreholes easily and cheaply put down, the proportion of sand to water would probably average about 1 to 2.

33. Direct telephonic communication should also be provided between the surface plan and the place where the stowing is being carried on.

34. It is advisable to do the stowing in short lengths. Wooden dams made of one-inch or an inch-and-a-half deals, strengthened or held in place by props, are necessary where any pressure is likely to be exercised. The joints of these dams should be filled with some suitable material to prevent the sand being carried away with the water returning to the pumps.

35. Where little or no pressure from the sand is expected brattice cloth supported by props can be used.

36. In some instances, it is often possible before covering these barricades with the next length of stowing to recover some of the timber, especially if they do not exceed eight feet in height.

37. The operation of the system is simple and the only difficulties likely to arise may be summarised under the following headings:—

(1) *Choking of pipes.*—This can to a large extent be provided against by—

(*a*) placing a good screen in the hopper at the top of the inlet pipe;
(*b*) running the water for 5 to 10 minutes through the pipes before and after the material has been put down them;
(*c*) making all bends of large radii.

(2) *Choking of underground pumps.*—This would result if the water returning to the underground pumps, after depositing the sand, still contained appreciable quantities of the material. This can be provided against by allowing the return of water to flow along roadways in which a number of shallow obstacles, in the shape of small dams 6 inches to 12 inches in height, or other means, are placed to check the flow of water and allow time for any sand to be deposited. It is more advisable, where large quantities of water already have to be dealt with, to provide separate pumps from the main colliery pumps for dealing with the sand-stowing water, so that any stoppage owing to choking would not necessarily affect the mine as a whole.

38. With regard to the methods of working and stowing at the various collieries, these will be governed by the actual conditions prevailing at each colliery. They may be broadly divided into two classes: firstly, when the seam or seams are intact, and, secondly, when the areas in which sand-stowing is to be used have been already divided into pillars.

39. The question of the cost of working a system of sand-stowing will partly depend upon the method of laying out the working.

40. Dealing firstly with the areas that are intact:—

41. Whatever actual system of working is adopted, it will be advisable to divide the mine into separate "districts" or "panels," which can be readily kept free from any other

district roads or galleries driven not more than 8 to 10 feet high. In the case of the thick seams, the sand-stowing should be commenced in the bottom portion, and each lift should not exceed 8 to 10 feet in height.

42. Some of the colliery managements may wish to retain the bord and pillar method so far as possible, and to which they are accustomed, especially as it provides more coal-getting places in the earlier stages of development.

43. On plan No. 1 is shewn therefore a panel 300 yards by 200 yards, with pillars left in the first working 40 yards by 22 yards.

44. It will probably be found advantageous to work on to the full rise of the seam, sluicing in the sand behind, on similar lines to those shewn on plan No. 2. The working face on plan No. 1, however, is shewn proceeding along the line of strike, in case any difficulty arises with the Indian labour in working to the rise.

45. By this method the coal would be brought along the level roadways on to the cross roads marked A B on plan, and thence out to the main haulage road C D, which is driven at the level of the second lift from the floor, and would serve for the two bottom lifts of each panel as will be seen by section E F.

46. The chief disadvantage of this method appears to be that it necessitates two separate operations to work out each lift of coal, *i.e.*, driving bord roads and then extracting pillars.

47. It is also necessary, with such a system, to provide that the pillars left should be of large size in the first working, and as regular as possible, as otherwise varying sizes of dams will be required, and it will be more difficult to apply the method in a systematic manner.

48. It is evident that the ultimate benefits will be greater if it is decided to work each lift in one operation instead of two. It would materially lessen the cost of working, as a larger output would be obtained per working face.

49. Plan No. 2 shews a scheme to operate in this manner. It would by this means be possible to work out the full height of each seam in succeeding lifts by a longwall method.

50. These panels would be formed in the first place by driving "levels" with very slight gradients falling towards the main inclined roads. These "levels" would be say 330 yards apart, protected both on the rise and dip sides by pillars of solid coal, each 80 yards wide.

51. These "levels" would constitute the permanent haulage roads off the main dips. Two of these "levels" would be required both on the rise and dip sides of the blocks of coal to be worked. Of these two "levels" the lower, or first to be driven, would be at the level of the second lift from the floor of the seam, *i.e.*, say 8 to 16 feet above the floor. The second level, which would not require to be kept so far ahead as the first, would be driven on the top of the seam under the roof.

52. On the rise side of the pillar protecting the dip levels on the top side of the block, a subsidiary road would be driven and connected at certain points with the main level. On the side of the blocks, a road would be driven up in the solid in the bottom lift, and connected to the top level to enable the sluiced pipes to be laid down and to provide ventilation.

53. Off this subsidiary level, the main longwall face would advance in the bottom lift to the full rise, with roadways, say 70 to 100 yards apart, and the coal could be either carried by hand or in tubs, level course, and jigged down the roads to the subsidiary level, and thence taken on to the main haulage level, or direct on to the main level.

54. The water-stowing pipes would be brought down from the upper level, and led into the working face as required, and the stowing carried on in this way as the faces advanced.

55. It would be necessary to erect dams in the first place along the bottom subsidiary level and along the rise roadways in short lengths, but those in the rise roadways could be removed when these roads had gone their full distance, and possibly also those along the level before filling in the subsidiary level and rise heading in the bottom lift.

56. The stowing along the working face would, if necessary, be kept in place by brattice cloth, and would not necessitate wooden dams. It is also possible that brattice cloth might be used on the sides of the rise roadways.

57. The second operation would consist of driving a second subsidiary level on top of the first one, which would have been filled in, and connecting it as in the previous case with the main haulage level, which would be high enough up to allow of this being done. Thus the bottom main haulage would be at a suitable level to deal with the two bottom lifts as shewn on the section G. H. The second lift would then be worked to the rise similarly to the bottom haulage.

58. When the main levels have gone their full distance off the main dips, the protecting pillars which have been made of such a size for economic working can be worked back from the far end and stowed.

59. By the adoption of this latter system, the weight would rest back from the working face on the sand pack, and should render the working safer. The number of jigs would be few. It would also obviate having to erect fairly substantial dams along the working face when stowing, as would be necessitated if carrying the working face level course, which would require a good deal of timbering and handling. Brattice cloth would be sufficient to keep the sand in place along the working face, whilst stowing is proceeding.

60. This latter method would entail a considerable departure from the present system of working, and may not be viewed favourably by a number of the colliery managers, but I consider it more advantageous than dividing the areas into pillars, and suggest that at any rate it should be kept in mind and made a basis when laying out the workings for sand-stowing. No doubt the dimensions of the panels may require modification to suit local conditions.

61. The methods of hydraulic packing in areas already standing on pillars will require special consideration for each individual colliery, owing to the many different conditions existing at each, both as to character of roof, thickness of seams, dip of strata, condition of pillars, etc.

62. It will probably, in the case of seams up to 16 feet thick and underlying a fair average roof, be possible to extract the pillars singly, or perhaps up to three according to the roof, and fill up the empty spaces with sand before starting on adjoining pillars.

63. In the case, however, of thick seams, when the roof has been standing for a length of time, I would suggest a method on the lines set out on plan No. 3 whereby the pillars would be extracted in batches of six, starting at the most distant and deepest workings in the mine.

64. In order to obviate persons travelling along the high galleries while the adjoining pillars are being removed, a new road would be driven in the bottom of the seam next the floor, say, 8 feet high and 8 feet wide, bisecting pillars Nos. 5 and 2. The seam would be taken out in successive lifts of 8 to 10 feet starting at the bottom in pillars Nos. 1, 2 and 3, and sand filled in behind. The pipe would be brought along the level tramming road, with a branch down the new road through pillars Nos. 5 and 2, and the water drained off through the stopping at A, and subsequently when pillars Nos. 4, 5 and 6 were reached by a further stopping at B.

65. The whole of the bottom lift in the six pillars would be removed before starting on the second lift. As soon as the sand in this bottom lift has drained sufficiently, the next lift can be started by driving another road 8 feet by 8 feet through pillars Nos. 5 and 2.

66. Several areas such as described could be worked simultaneously in the same colliery.

67. The foregoing schemes are set out more particularly as a basis on which hydraulis stowing may be carried on, but no doubt modifications, both as to sizes of panels and pillars, will be necessary to suit the varying conditions at the different collieries.

68. The cost of sand-stowing at each mine in the Jharia and Raniganj fields apart from the royalty paid for the sand, will depend chiefly on the magnitude of the scale on which it is adopted. As an instance of this, it may be cited that, at two mines where the conditions were alike, *viz.*, at the Kottowitz Colliery Company's mines in Silesia, sand-stowing at the Ferdinand Mine was on a small scale, and cost 8*d.* to 9*d.* per ton of coal, whilst at the Myslowitz Mine, where it had been adopted throughout the workings, the cost was 5*d.* per ton.

69. The cost of conveying sand to collieries near the river will naturally be somewhat less than to the collieries lying farther away.

70. Considerable time would be required to go into detailed estimates of transporting the sand and packing underground, but the following approximate figures are given as a rough guide.

71. Assuming operations are on a large scale, the rough average costs might be expected to be somewhat as follows for collieries averaging, say, 5 miles from the source of supply.

72. In collieries working *solid coal* not cut into pillars, and allowing for saving in timber, pumping, supervision, haulage, etc., the cost of sand-stowing would be, say, 10 to 14 annas per ton of coal.

73. In the case of extracting pillars already formed, 16 to 20 annas per ton of coal.

APPENDIX B.

Interrogatories to Witnesses.

Interrogatories to Colliery Superintendents and Managers.

(1) What are your mining qualifications? What is your experience of mining in India or elsewhere?

Para. 18 of Mr. Rees' Report. (2) According to Mr. Treharne Rees' recommendation, a controlling authority will be set up in the coalfields; this authority will supervise existing and future leases, and ensure that all coal areas shall be worked to the best advantage. Give your opinion as to the advisability of such an authority and, if advisable, how it should be constituted?

Paras. 19 to 22. (3) It has been suggested that, for statistical purposes and as a check on waste, all coal brought out of mines should be weighed at the colliery and an accurate account of it kept in the colliery books. Do you consider that this proposal is practicable? Have you any objections to offer to it on this or other grounds? Would there be any difficulty about weighing coal brought up in baskets, and could the coal taken by the miners for their own use be included?

Para. 22. (4) Do you consider it practicable that each year's working should be marked on the colliery plan in different colours, and that such plan should show accurately the size and shape of the pillars?

Para 22. (5) Do you consider that, apart from a few surveyors employed by large companies, the surveyors in the coalfields generally are capable of putting correct levels to a common datum on plans?

Para. 24. (6) Have you ever, at any colliery at which pillars have been got, calculated what the percentage of the coal lost was of the total coal in the seam? If so, what was the percentage?

Paras. 41 and 42. (7) Have you any experience of a lower seam being worked out under an upper seam which was left unworked owing to its relative inferiority, and of such upper seam being destroyed in consequence?

Paras. 41 and 42. (8) Do you consider it advisable that the controlling authority should have power to insist that seams should be worked in vertical rotation? If sand-stowing were made compulsory, would this affect your answer?

Para. 47. (9) Mr. Treharne Rees proposes that regular shifts should be worked at collieries. Do you consider this practicable or advisable? In what way would you suggest that its universal introduction might be effected?

Para. 51. (10) What is your system of recruiting labour? Can you suggest any improvement to increase the supply of labour?

Para. 55. (11) Do you consider that the provision of suitable plots for cultivation on the collieries would improve labour conditions?

Para. 56. (12) What is your opinion about the suggestion to form colliery settlements just off the coalfields, the labourers being brought in by workmen's trains or other mechanical transport? Do you think it feasible for colliery companies to combine to form such settlements?

Para. 57. (13) Have you any system of training the different classes of labour employed at your collieries? If so, describe it.

Para. 71. (14) Mr. Rees suggests that collieries now using fuel in a wasteful manner should be compelled to take power from central generating stations. Do you consider that this is practicable or advisable? Give your general views on the subject.

Para. 84. (15) Have you made any experiments in mixing different seams at your colliery from the point of view of steam-raising or coking? If so, what were the results?

Paras. 85 to 90. (16) Do you consider it practicable or advisable for colliery branches and sidings to be worked by colliery companies with railway company's wagons and colliery locomotives?

Paras. 85 to 90. (17) If this were done, do you consider that much of the coal now required for supporting branches or sidings could be removed without impairing the safety of the branches or sidings? What further percentage of the total coal underlying the land required for the branches or sidings would be obtained compatible with safety?

Paras. 91 to 94. (18) Do you consider it practicable or advisable for a number of the existing sidings to be removed and coal hauled instead on the surface in colliery tubs to central loading depôts?

Paras. 92 and 105. (19) Would such concentration result in the reduction of the number of loading coolies required, especially if screening plants were installed at the central loading depôts? Do you consider that such persons would consent to work underground if they lost their employment as loading coolies?

Paras. 96 to 99. (20) Do you consider that there has been a sufficient supply of railway wagons constantly available for the transport of coal? If not, give your views as to the effect of the insufficiency on waste of coal.

Para. 101. (21) If coal on its arrival at the surface were immediately passed over screens into wagons, what benefit would be derived?

Para. 101 to 104. (22) Why have screening and sizing plants not been generally adopted in India? Have you any remarks to make from this point of view as to the type of railway wagons supplied to collieries?

(23) If the controlling authority were empowered to insist that pillars should only be got by a sand-stowing process, do you consider that this provision alone would diminish waste unless the controlling authority were also empowered to direct when such pillars should be got?

(24) Do you consider that the introduction of such control would affect the output?

Appx. Sec. 8. (25) If sand-stowing were made universal throughout the Jharia and Raniganj fields, could a sufficient supply of sand be assured by a system of ropeways alone?

(26) At the colliery with which you are connected, in order to get the existing pillars by a sand-stowing process, how much sand approximately do you consider would have to be put into the mine to obtain one ton of coal?

(27) What do you consider would be the extra cost per ton of coal got from pillars by sand-stowing, if sand were delivered at your colliery free of cost?

(28) What effect do you think sand-stowing would have on the life and productivity of your colliery?

Para. 75. (29) What do you consider would be the effect, as regards the "come" of water in the collieries, of continuing the present system of breaking up the surface by goafing?

Para. 28. (30) What is your opinion as to the usefulness of mechanical coal-cutters in India?

Interrogatories to Landlords' Representatives.

(1) What landlord do you represent? What is the extent of his coal properties? How long have you been in his service and in what capacity?

Para. 14. (2) What kinds of leases are given in your estate? Do any of them give the landlord any power of supervision over the methods to be followed in extracting the coal? If so, has this power ever been exercised, and how is it enforced if the lessee refuses to comply with the instructions so given? Do the leases ever specify any particular methods of working, and, if so, what are the methods so specified?

(3) What is the usual period of your leases? Is renewal granted and, if so, for what period and on what terms?

(4) What percentage roughly of the total quantity of land leased or sold is, do you think, worked by mine-owners who have obtained their holdings directly from your estate, and what approximate percentage is worked by mine-owners who are sub-lessees?

Para. 15. (5) Is it a fact that the areas hitherto leased for coal mining purposes have not been arranged so as to conduce to the economical working of the property as a whole? Do you know of any instances of such uneconomical working in your estate?

Para. 15. (6) Do you agree that very large areas of coal lands have been leased or sold in your estate, not so much with a view to extracting the greatest amount of coal, but rather with the object of receiving as much as possible by way of *salami* or other ready money payment?

Para. 14. (7) Do you know personally of any instance in your estate or elsewhere in which coal has been won with a view to speedy profit, with the result that damage has thereby been done to other unworked coal and loss caused to the landlord's future interests.

Para. 16. (8) Would you advise, in the interests of the landlord, that a limit should, in future, be placed on the minimum area which a landlord can lease out for coal-mining purposes? If so, what minimum would you suggest?

Para. 17. (9) Would you object to expert advice (not paid for by the landlord) being available on the most advantageous methods of working? Would you object if such advice took the form of expert instruction from some controlling authority set up by the Legislature for the purpose, assuming that this may result in the landlord receiving less money at the time though he would receive ultimate benefit?

(10) Do you admit that, if clauses for working coal to the best advantage were inserted in new leases only, it would not much affect the coalfields as a whole, owing to the fact that most of the coal land has already been leased out or sold?

Para. 121. (11) In the case of land already leased or sold, have you any observations to make on the proposal that a controlling authority should step in and issue instructions to ensure the best methods of working the coal regardless of the terms of the lease?

Para. 18. (12) Would you object if such controlling authority were empowered (*a*) to supervise negotiations for leases, (*b*) to see that they include covenants for economical working, and (*c*) to inspect such working to ensure and, if necessary, to enforce due performance of such terms?

Para. 16. (13) Do you consider that leasing coal by mauza boundaries instead of in rectangular blocks has been conducive to good economical mining?

Paras. 19 to 22. (14) Do you approve of Mr. Treharne Rees' recommendation that all coal raised should be weighed at the colliery? Have you anything to urge for or against this?

(15) Have you any other suggestions to offer, from the landlord's standpoint, which would tend to the economical working of coal properties?

Appendix—Sections 15 to 20. (16) It is proposed to adopt universally the practice of sand-stowing in mines, whereby the surface of the land will be kept intact and a larger proportion of the coal seams be recovered. Have you anything to urge why sand from the rivers for this purpose should not be given by your estate to the collieries free of all charge?

Interrogatories regarding Electrical Development.

(1) What are your qualifications as an electrical engineer and what experience have you had of electrical work in India?

(2) Will you state the general provisions attached to electrical licenses in India? In particular, are the amounts to be charged to users and the profits to be made by licensees specified in the licenses? Is there any guarantee by Government against a licensee's failure to make a profit?

Paras. 57 to 71. (3) Mr. Treharne Rees has advocated the general use of electricity and the erection of central generating stations in the Raniganj and Jharia coalfields. He has also recommended that "control should be exercised over the prices charged for the electric current, which should not be allowed to make a profit over and above a figure sufficient to pay a proper interest on the capital expenditure, depreciation, and upkeep of the plant, after paying the working expenses." What is your opinion of this and, if you consider it advisable, what in your opinion would be "a proper interest" in the terms of Mr. Rees' proposal? What rate per unit would probably have to be charged to mine-owners?

Para. 71. (4) Mr. Rees considers that mine-owners who are using fuel wastefully for steam-raising should be compelled to take electricity from the central generating stations. What is your opinion of this? How could it be applied in the case of small mine-owners who have little or no capital?

Paras. 67 and 68. (5) If you have sufficient knowledge of the localities, can you say how many generating stations will be required (*a*) in the Raniganj and (*b*) in the Jharia coalfields, in order to make the use of electricity practically universal having regard to the possible future development of these coalfields?

Para. 67. (6) Mr. Rees has recommended that, as far as possible, generating stations should be worked in conjunction with batteries of by-product coke ovens to which coal would be brought from the various collieries. What is your opinion of this proposal? Could it be carried out by limited companies?

Para. 67. (7) Mr. Rees is of opinion that such ovens should be of the regenerative type so that the gases might be used for the purpose of raising steam to drive turbo-generators. Do you agree with this suggestion from the point of view of steam-raising? Do you think it would be more economical to use the gases in gas engines than for generating steam under boilers?

Para. 95. (8) Mr. Rees considers that, with the erection of these central power stations, there should be additional power available for conveying coal over the surface to central loading depôts and for electrifying the railway branches and sidings in the coalfields. What is your opinion as to the advisability and practicability of using electric power for these purposes?

Interrogatories regarding Railway Questions.

(1) In paragraphs 85 to 90 of his report, Mr. Treharne Rees suggests that some, at any rate, of the colliery branches and sidings should be worked by the colliery companies, apparently with railway wagons and colliery locomotives. He considers that, if this were done, colliery owners would be responsible for, and would make their own arrangements for, the support of such sidings, and this would probably mean that less coal would be left for support. What is your opinion as to the practicability and advisability of this from the point of view (1) of capital expenditure on sidings where traffic is handed over, (2) of recurring expenditure, and (3) of any other considerations that may occur to you?

(2) In paragraphs 91 to 94, and also in paragraph 105, Mr. Rees recommends the relinquishment of several of the existing sidings and the surface haulage of coal in colliery tubs to central loading depôts. In recommending this, Mr. Rees assumes that such central depôts would be fitted with screens over which the coal would be loaded into wagons without delay, thus obviating the necessity for stocking coal. Your views on this project are requested.

(3) Please give your views on the suggestion of Mr. Rees in paragraph 95 that railway branches and sidings in the coalfields should be electrified, if central generating stations are established for the purpose of supplying power to collieries.

(4) In paragraphs 96 to 104, Mr. Rees emphatically draws attention to the waste caused by the insufficient supply of wagons constantly available for transportation of coal necessitating the stocking of coal, often for long periods, and preventing the general introduction of screening and sizing plants over which coal could be loaded into wagons without delay; he also points out that the type of wagon now supplied is frequently unsuitable; he further emphasises that wagons for coal traffic should be standardised, and that, for shorter runs, covered wagons should be eliminated. Can you say what, in your opinion, should be done to remove these defects and causes of waste?

(5) What is your opinion of Mr. Rees' suggestion in paragraph 103 that, when covered wagons are necessary, they should be so constructed that the roofs can be temporarily removed so as to allow of the wagons being loaded under screens? If you consider this impracticable, can you offer any other suggestion which would facilitate loading under screening plants?

(6) In paragraph 40 of Mr. Rees' report, it is proposed, in order to prevent the great waste of coal in working by present methods, to introduce the system of sand-stowing in mines. This will probably require a supply of one million tons of sand per month distributed to such collieries in the Raniganj and Jharia fields as may require the sand from time to time. It is considered that ropeways will not be able to supply more than a small portion of this sand and that the greater part of it will have to be delivered to the collieries by railway. Mr. Rees recommends that special wagons, of a capacity of 40 tons, should be used for this purpose. What is your opinion of this? In any case, it is recognised that some years must elapse before the necessary amount of such wagons can be obtained. Can you state how a regular supply of sand could be maintained?

(7) The adoption of the sand-stowing system will necessitate the depletion of the sand in the rivers on a very large scale. Will this affect prejudicially the railway bridges over the rivers? If so, can you suggest any means of counteracting this prejudicial effect?

(8) Has your railway been approached by any mine-owners on the subject of conveyance of sand from the rivers to the collieries by railway? If so, can you let the Committee know the result of such negotiations, the quantities of sand being conveyed or proposed to be conveyed, and the freight charged?

Interrogatories to Inspectors of Mines.

(1) It is proposed, in paragraph 18 of Mr. Rees' report, to set up a technical authority which would control the working of coal. Such authority would have power to arrange for clauses in new leases to prevent wasteful methods of working, and to interfere, with the same object, in the case of mines already leased. It would also have power to compel mine-owners to get their pillars and to call upon them to do so by a sand-stowing process if necessary. It would arrange for the supply of sand to such collieries. It would also have power to compel mine-owners to take electric power from central generating stations. It would also be an important part of its duties to consider figures of cost and of compensation from a central fund, which latter it would administer. Do you consider—

(*a*) That this work could be done by the existing department of mines, if the necessary additions were made to the staff?

(*b*) If a new department were created, that such department and the present Department of Mines could be worked separately under one technical chief?

(*c*) If a new department were created, that it could deal with the question of supporting railways now undertaken by the Department of Mines?

Paras. 41 and 42. (2) Do you consider that much damage has been done in the Raniganj and Jharia coalfields by the working of a lower seam to the destruction or damage of an upper seam? Have you any remedy to suggest for this?

Interrogatories to Mr. E. S. Tarlton.

Appendix—Sections 7 and 8. (1) The Committee understands that you have made a special study of aerial ropeways, and that you gave evidence before the Industrial Commission on the comparative capacities and usefulness of such ropeways as compared with sidings in the coalfields. It is considered that the universal adoption of sand-stowing may necessitate a monthly supply of one million tons of sand distributed to various collieries in the Raniganj and Jharia coalfields. To what extent do you consider that such a quantity could be dealt with by ropeways? Can you point out any advantages in using ropeways for this purpose instead of conveying the sand to the collieries by rail along the existing branches and sidings? If so, can you describe in any detail how such ropeways should be arranged, and by what agency they should be erected and maintained, having regard to the fact that it is proposed that the cost of conveying sand to the collieries should come from a central fund, and that each individual colliery where the adoption of sand-stowing is required should have the sand delivered free of charge?

Paras. 91 to 94. (2) In your evidence before the Industrial Commission, you argued that, by the adoption on a considerable scale of ropeways in the coalfields, several of the existing branches and

sidings could be relinquished. Mr. Treharne Rees, in paragraphs 91 to 94 of his report, has also argued the advantages to be gained by abolishing some of the existing branches and sidings. Do you consider that any scheme could be made available whereby ropeways could serve the double purpose of conveying coal from the pit-mouth and sand to the pit-mouth?

(3) We understand your firm has constructed several ropeways that are now in use. Please give details as to their design, carrying capacity, capital cost, recurring expenditure and utility.

APPENDIX C.

Statement of Interrogatories issued and Witnesses examined.

Head of Interrogatory.	Number of interrogatories sent out.	Number of witnesses addressed.	Number of written replies received.	Number of witnesses examined orally on written replies.	Number of interrogatories covered by (a) Written replies.	Number of interrogatories covered by (b) Oral evidence.	Number of witnesses who did not reply to interrogatories.	Number of witnesses examined outside the interrogatories
1. Landlords . . .	16							
2. Colliery Superintendents .	30							
3. Railway . . .	9	57	46*	44	51	49	6	2
4. Electrical . . .	13							
5. Inspectors of Mines .	5							
6. E. S. Tarlton . .	1							

* (Including one not addressed.) —

APPENDIX D.

Evidence of Witnesses.

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COLLIERY SUPERINTENDENTS AND MANAGERS.

Written Evidence of Mr. J. B. Argyle, General Manager of the Lodna Colliery Company, Ltd. (Jharia), nominated by the Indian Mining Association.

Question 1.—I was an articled pupil to a mining engineer in England for five years. I hold a first class English colliery manager's certificate. I have had six years' experience of colliery management in India. I was superintendent of a colliery in America for two and-a-half years, and have been general manager of the Lodna Colliery Company for one year.

Question 2.—I am not in favour of Government control of collieries; it has not been a success in England, and I do not think it would be a success in India. If some form of control is necessary, the powers should be limited to general principles and should not extend to the actual working of the collieries. The controlling authority might have the power to supervise future leases, and thereby arrange, for better boundary lines, surface acquisition facilities, and titles. The authority should be constituted of men representing the legal, mining, and civil engineering professions.

Question 3.—It is quite practicable for all coal brought out of mines to be weighed where the output is from shafts or confined to one or two inclines, but, at collieries worked by a number of inclines, it would be expensive to do this. If the coal and slack could be loaded into wagons as soon as it is brought out of the mine, there should not be any necessity to weigh the tubs since the miners are all paid by the tub and not by the weight. Regarding the coal taken away by the miners, this is difficult to check, as it is impossible to weigh all the small quantities brought out by them. The slack used for power purposes could be weighed, if necessary, when taken to the boilers. If miners were not allowed to take the coal out in baskets they would steal the coal from the stock heaps or wagons. However it might be arranged for a certain amount of coal to be provided for them.

Question 4.—Yes.

Question 5.—Yes.

Question 6.—Only on a very small scale and in a section of a mine where goafing was being carried on near the surface under a bad roof.

Total quantity extracted from eight pillars, which I calculate contained about 4,400 tons, was 2,490 tons or an average of 56½ per cent.; about 50 per cent. had been got from the galleries, making a total of 71¾ per cent. of the seam won.

Question 7.—No.

Question 8.—I do not consider it advisable for the controlling authority to have power to insist that a seam left unworked owing to its relative inferiority should be worked in vertical rotation. It is a question of whether the colliery could afford it or not. If sand-stowing were adopted and properly carried out, the extraction of a seam below another should not render the upper seam unworkable.

Question 9.—I do not consider it practicable to work in regular shifts in India owing to the labour conditions. It might be made compulsory by law to work in regular shifts, but this would be difficult to regulate.

Question 10.—The system we adopt at all our collieries is to let out sections of the collieries to raising contractors, who employ their own recruiters for going into the villages to obtain miners. An improvement might be made by restricting the recruiting of labour from the neighbourhood of the collieries for tea gardens. The number of persons annually taken from Chota Nagpur to Assam must be very large, and a great number of these might be brought to the coalfields if the agricultural nature of the work on the tea gardens were not more attractive to them. The tea gardens could recruit their labour from districts where miners are not obtainable. Improved conditions for labour at the collieries may have some effect in increasing the supply of labour. A better system of recruiting from greater distances might be adopted on the same lines as that followed by the tea gardens

Question 11.—Provision of land for cultivation on collieries would to some extent improve labour conditions, but at some collieries there is no land to give the miners, and at others the land is difficult to procure. I believe, however, that it has been proved that miners do not work much better when land is available at the colliery, than when their homes are some distance away; only very few miners can be induced to give up their original homes.

Question 12.—I do not think it would be practicable to have colliery settlements off the coalfields; there are not sufficient suitable sites near to existing railways. I do not think it feasible for colliery companies to combine to form such settlements.

Question 13.—No. Any efforts we have made in this direction have not met with success.

Question 14.—Taking into account the fact that there is a poor demand for slack, and no provision of wagons for its transport if sales could be obtained, there are very few collieries in the Jharia coalfield that cannot burn slack in their boilers for their power cheaper than they could buy power from a central power station.

Question 15.—No.

Question 16.—Only in a few instances where the sidings occupy considerable space and are situated at some distance from the main line.

Question 17.—In some cases, about 20 per cent. more might be worked, where the workings are restricted to only ⅓ to ½ the full height of the seam, but where the pillars stand well when the full thickness of the coal is taken out in the galleries.

Question 18.—It is practicable, but only in a few cases advisable, for sidings to be reduced. In large collieries it would be impossible to find adequate stocking accommodation within range of only one or two sidings. Long haulages on the surface are not successful in this country, partly owing to the length of time the tubs are kept above ground under this system, and partly on account of the irregular times at which winding and hauling takes place. I have known a case where the siding was brought into the middle of a colliery to do away with surface haulage.

Question 19.—If screening plants were installed and an adequate supply of wagons maintained, the number of loading coolies would certainly be reduced. Only very few of the loading coolies could be induced to work underground and still fewer as miners. They would probably go to the tea gardens or take up some other kind of surface employment.

Question 20.—There has not been a sufficient supply of railway wagons constantly available for the transport of coal. The effect of the shortage of wagons has been to prevent colliery companies adopting moderntippler arrangements at the loading wharfs. It has frequently compelled the collieries to carry large stocks of coal which have been exposed to the sun, wind and rain for considerable periods, the coal thereby losing largely in tonnage, calorific value and appearance.

Question 21.—The benefits derived by screening the coal would be to reduce waste and to enable coal to be loaded better and more economically.

Question 22.—The shortage of wagons and consequent irregular supply is largely responsible for the absence of screening and sizing plants in India. The condition of the coal trade is also responsible to a certain extent, because almost all coal consumers in this country require what is called "steam coal," consisting of both large and small coal mixed, but with all the dust and fine coal taken out. If consumers studied the fuel question more carefully, it is possible a demand might arise for sized coal, such as nut or pea coal.

A third influence on the question is that of cost. Screening plants are costly, and it is difficult to see where they could be very profitably used under the present conditions particularly as they may lie idle for a large period of the year. There are too many wagons of a type unsuitable for coal traffic supplied at the collieries. Covered wagons of large size constructed for jute or cotton are very unsuitable for loading coal. Covered wagons are very inconvenient for loading where screening plants are installed, but this is not an insurmountable difficulty. Covered wagons are loaded with coal in America, but special mechanical contrivances are necessary to do this.

Question 23.—If the controlling authority were empowered to insist that pillars should be got by a sand-stowing process, I have no doubt that waste would be diminished, without giving the authority power to direct when the pillars should be got.

Question 24.—Yes.

Question 25.—No.

Question 26.—In the dip workings, where better conditions prevail than those to the rise, about 2·4 tons of sand to one ton of coal. In the rise workings, from 2·5 tons to 3 tons of sand to one ton of coal. At Chasnalla, in a seam 90 feet thick, where the percentage worked is only 16 to 20 per cent., it will require 1·75 to 2 tons of sand to 1 ton of coal.

Question 27.—About 10 annas 6 pies per ton of coal.

Question 28.—Sand-stowing, if it could be adopted economically, would undoubtedly prolong the life and productivity of all my collieries, because by such means we could extract a larger proportion of coal than is possible by simply taking out the pillars and allowing the roof to fall. Moreover, the surface would not be damaged, and buildings which would otherwise be destroyed, or have to be removed, would not be disturbed.

Question 29.—At Lodna, there are some large areas where it would be impossible to break up the surface as the mines would be flooded during the rains. In all cases, the "come" of water will be increased in proportion to the area of surface that is broken.

Question 30.—Mechanical coal-cutters should prove to be of great use in India, chiefly for opening out new collieries more rapidly by cutting the headings. Coal-cutting machines might also be used for coal-getting, and, if sand-stowing were adopted, their use might even be extended to the extraction of the pillars.

Oral Evidence.

Question 2.—I am not in favour of any controlling authority. I think that stoppage of the present waste is essential, but I have not thought out any alternative to the proposed controlling authority. I suggest a legal member to consider leases mainly. If the controlling authority were merely to control (1) the size of pillars, (2) when the pillars should be got or an area left further unworked, and (3) sand-stowing, such an authority would be unobjectionable, and men like the present Inspectors of Mines would be suitable. Both the new department and the present Department of Mines should be under one technical head. He might have executive authority with a representative advisory board to assist him. I would accept such a system and think it would work well. There should, however, be some provision for appeals, say before a tribunal, but appeals should be limited and only allowed on some scale of importance. Legal advice would be taken by the tribunal when required.

We have had difficulty with one lease as the amount of the surface land we could acquire was limited. This might have been provided for originally, but probably the property was wanted and the terms were accepted although not favourable. It would be a good thing if colliery requirements were declared to be a "public purpose" under the Land Acquisition Act, but I think future leases should also be supervised. I do not see that this would involve any greater interference with private rights than the proposal to interfere with the right of working coal as one pleases.

Question 8.—The controlling authority might be allowed discretion as regards rotation, but it will be dangerous.

Question 9.—I consider shifts impracticable owing to their effect on the labour. I agree to regular shifts in principle, and I think it might be possible to lay down hours at which shifts would end and require all miners to be out of the mine by then. The miners might gradually adopt his work to suit these hours, but the system would have to be universal and compulsory.

Question 19.—My reply about loading coolies declining to work underground is based on experience.

Question 20.—I agree that wagons might be much better utilised. It is a matter for organisation by the railways. I recommend open wagons for coal. Thefts would not occur if transport were expeditious. I think that wagons with removeable tops would have to be much better handled than at present.

Question 23.—I agree that collapses and losses occur owing to the small size of the pillars relatively to the area worked. This is a big cause of waste. I would not agree to interference and instruction as to the time of getting pillars unless there were adequate safeguards as regards appeal. The appeal might be made to the tribunal mentioned in my answer to Question 2. The members of that tribunal should be appointed for fixed periods and meet as required.

General.—I have experience in working deep seams. Up to a depth, say of 700 or 800 feet, sand-stowing will be necessary to prevent damage to the surface. At a thousand feet, sand-stowing might not be necessary as the surface would be very little affected under ordinary conditions.

Written Evidence of Mr. W. C. Banerjee of Messrs. Banerjee & Co., nominated by the Indian Mining Association.

Question 1.—I have got no mining qualifications in the way of any diploma. I have been a colliery proprietor since 1898, and am owner of a dozen collieries, and managing and selling agent for several others, whereby I have acquired some experience of mining in India.

Question 2.—In my experience, I have found different managers holding different views or adopting different methods of working for one and the same mine. The opinion of experts also differed. The controlling authority, if set up, should not, therefore, be an individual, but should be formed of a committee of mining experts, so that their joint opinion would be of some value to the trade. This committee, if formed, should be an advising authority and not a controlling authority vested with absolute power. It is regarded with fear that, if such authority is vested with the power of a controlling authority, it would interfere with the rights of individuals

i.e., the landlords will not be free to let out land to anybody and everybody. It will impose hardship on him that his tenants must be selected by this controlling authority, who would dictate certain terms of development. It will also interfere with the free rights of investors in laying out their capital. Of course, if it is an advisory body, the capitalist may take into consideration the advice of the advisory committee, and, if it appeals to him or to his mining experts, he will adopt the method of working. But, if the proposed authority is a controlling body, it will press the capitalist to adopt its mode or method of working and laying out the working of the land. I may explain this more fully by a concrete example. A capitalist will naturally like to work a colliery from the rise by inclines or shallow pits with mechanical and steam power, but this controlling body will ask that the property should or would be better worked from the dip with two deep pits sunk, electric plant fitted up, etc. In this case, if the funds of the capitalist do not permit, he will be debarred from working the property, and must make room for a capitalist with larger capital. In case a controlling body is set up, the landlords will be mere puppets in its hands, and investors will be handicapped by the controlling authority, who may reject any person or syndicate, saying that, in its opinion, he or they are not fit people to work a mine. The landlord will get the same amount of royalty, if the property is worked by a small or a big capitalist, but he will have to wait to let out his land, until he finds a lessee with capital required for the working of the plot on the terms of the controlling authority. As the interests of the landlord and the capitalist are identical, namely, to get out as much coal as possible out of a plot of land, control is notnecessary in this direction.

In most of the existing leases, there is a general clause that the mine should be worked in the best method possible by driving inclines, pits, etc. It is also stated in such documents that any person authorised by the landlords may inspect the mine at any time, giving due notice to the lessors or their representatives at the collieries. Inspections are made by landlords' men from time to time to make or check working plans of collieries. If the covenants of such documents are enforced by the controlling authority, it will be a great hardship to the existing lessees. I mean to say that the controlling authority may, taking advantage of the general clause "mine to be worked in a proper and skilful manner," point out to the landlords that, in its opinion, this has not been done, and, on their behalf, act and put pressure upon their tenants, stating that the existing mines have not been, in their opinion, properly laid out to the best advantage, and are not being properly worked. The landlord, taking advantage of the opinion of the controlling authority, may coerce his tenants to pay compensation, and this may lead to lots of unnecessary and vexatious litigation. So objections should be taken by all companies in respect of any supervising control over existing leases. If a controlling or advising authority is decided upon, it should be formed of the representatives of the interested and affected parties by election and be composed of—

(1) Representatives of the two railways concerned,—*viz.*, Colliery Superintendent, East Indian Railway, and Mining Engineer, Bengal Nagpur Railway.

(2) Two European colliery managers or agents of the two coalfields (Jharia and Raniganj, including Dishergarh).

(3) Two Indian colliery managers of the two fields.

(4) Two representatives of the landlords of the two coalfields.

(5) One Government official, *i.e.*, Chief Inspector of Mines or any officer to be appointed for this purpose.

Question 3.—It is quite impracticable in India to weigh all coal raised either in buckets or tubs. It would be practicable if the mines were only worked by machinery, and if coal were loaded into wagons as raised. Weights of coal tubs have been kept at Apcar's Charanpur Colliery, but it has not shown any advantage in checking waste. It will mean delay in the return of tubs and less raisings. There would be lots of difficulty in weighing coal raised by baskets. It will interfere with the output. It will mean employment of lots of scales and lots of men to supervise the weight, and there will be lots of jobbery. In a word, it will simply increase the cost of coal to no purpose. It will not serve the statistical purpose a bit better than at present. It is quite impracticable to keep a check on coal taken by miners or other employés by weighing it. Miners generally come out with a basketful on their heads for their own consumption and for sale of the saving made. The surface labour take away their requirements from the heaps. It will entail lots of trouble to weigh these. So, for the purposes of statistics, the weigh-out is not worth the trouble. It will not serve any useful purpose to the colliery owner, rather it will bring more difficulties and jobbery amongst the overmen. A miner will claim more money for fictitious raisings. Now the raisings of a colliery do not include coal used on the colliery for any purpose whatsoever. How weighment can serve as a check on waste is not understood. Then again, whatever coal is taken away by the miners is not a wastage, but is useful for the purpose for which it is intended. The miners either use or sell, so it does not come under wastage in the true sense. Of course, it is a loss to the owners, but is an additional remuneration to the miners, for which the owners do not pay. If there is any interference with the coal taken by the miners, then there will be labour trouble and discontent. Lastly, royalties are paid on despatches, so the landlord are not affected if all coal raised and consumed at the colliery is not weighed.

Question 4.—It is to some extent practicable to show each year's working in the colliery plan in different colours—the portion of the mine worked at different periods—with the size and shape of the pillars, *as originally worked.* But as pillars are robbed, it is impracticable to keep plans up to date, showing accurately their sizes and shapes. To fix responsibility, in case of change of managers or contractors, I generally have a survey made and a plan prepared, showing accurately the sizes and shapes of pillars, and get these plans signed both by the old and the new managers and contractors, so that the successor cannot say that pillar-robbing was made in his predecessor's time. Lots of coal is lost by pillar robbing, and the sizes of pillars are even reduced to nooks. At the time of extraction of pillars, these small-sized and irregular pillars cannot bear the weight and are crushed and coal is lost. I spoke at the Mining Association about taking this matter up, but it did not probably appeal to its members, because they were to a certain extent to be blamed for putting undue pressure upon their managers to complete important orders with limited facilities at the mines. The managers get a certain commission per ton on raisings. The contractors to make more raisings, and the miners to get easy coal, rob the pillars. Surveyors too, to make money from the contractors, keep their eyes shut. So, for trying to earn money quickly, the poor owner or owners (be he an individual or a company) is the loser in the long run, and it is beyond their control because this malpractice is, in my opinion, universal. There should be a law penalising pillar-robbing, so that a check to a certain extent may be put on it, and the companies or the owners may be saved from the hands of all these self-interested persons, and loss or wastage of coal be also saved.

Question 5.—My answer is in the affirmative, because, even in small collieries where their surveyors cannot, they are now-a-days employing two surveyors—one on small pay doing the daily work of several small groups of collieries, and another or better man of European collieries to check their plans, etc., and, under their directions, everything required by law can be done. Moreover the managers holding competency certificates are also qualified surveyors, so when they check the plans, they can arrange to keep correct levels to a common datum on such plans.

Question 6.—Pillars are now being extracted at my Poniati and Baraboni Collieries. My experience is that the percentage of loss in the extraction of pillars depends most upon their size. If they are of proper size and thickness, then the percentage of loss is small—10 to 15 at the most. But, if the thickness of the seam is great or the size of pillars irregular and small, then the loss is considerably more, because coal in these irregular pillars is crushed and cannot be extracted. Then again, some coal has to be kept in the roof to make it safe. Thus, coal is lost to a certain extent in pillar extraction by the ordinary method.

Question 7.—Yes. Some people, in their anxiety to win a better class of coal, did not work the upper seams. A glaring example of this is in the East Indian Railway Kurhurbari Collieries, where Bhadra and two other upper seams have been left out, although they are being worked by the Bengal Giridih Coal Company at a profit. Then again, to avoid complaints of mixing, *viz.*, good and relative inferior coal being mixed by being raised from the same pit and thrown on the same surface, such top seam workings were left out. Top seams in such collieries have been even partially destroyed by pillar extraction of the bottom seam.

Question 8.—The advising authority should insist on the working of the seams simultaneously (not in rotation), provided they are workable at a profit. The upper workings should be in advance so that they could be finished before the pillars in the bottom section are started; out of the two outlets, in one, top seam coal is to be raised, and in the other, bottom seam coal. If the seams are thin, of 3 or 4 feet in thickness, and the quality of coal is very inferior, or there be a natural steep gradient, kutcha roof or other natural interference in working, the controlling authority should not insist that seams should be worked in vertical rotation, even if sand-stowing were made compulsory. The working of such seams should be allowed to be left out. If sand-stowing were made compulsory, then rotation is not necessary, nor is it necessary if the upper and lower seams are more than 300 feet apart and the thickness of the lower seam is not great, *e.g.*, 8 to 10 feet, and is at a great depth, when the subsidence on the surface is practically nothing.

Question 9.—I am doubtful about the greater practicability of working mines by regular shifts with the present labour conditions of the country, than by the usual two shifts we have now, *viz.*, miners working alternately according to their will during day or night; we can keep a time-keeper to record the hour of a miner going down and coming out of the mine. It will be a difficult problem to make him work 6 hours according to the labour hours fixed by the Washington Conference. A miner goes to work at his sweet will at any hour of the day. It is quite impossible even to force a miner to come out of a mine at a certain hour. A miner will not come out of a mine unless and until he cuts a certain number of tubs, which, in his opinion, is his proper earning for the day. He will not, like jute mill or factory labour, go into or come out of the mines as the whistle goes at fixed hours. Even if a law were made fixing certain working hours, it will take some time to make the miner follow the same rigidly. Then also, this work by shifts may be possible with settled miners within collieries (by making them gradually accustomed to it), but not with outside miners from neighbouring villages, because they generally come after doing their domestic work and, during cultivation and harvesting season, their work in the fields. Then again, there are difficulties about distribution of tubs, due to coal being put into stock for non-supply of wagons.

Question 10.—We have recruiters and under them certain miner sirdars. We send these men into the districts. We pay travelling expenses and advances to the miners and bring them.

They know certain people as miners and coolies and bring them. We do not bring all the coolies and teach them coal-cutting. So there is want of skilled labour. These sirdars bring with them their relatives, acquaintances and co-villagers, and employ them in surface or underground work according to their abilities. We do not recruit all the year round; so more coolies are being taken away by the tea-planters who have more labour than they can employ (as appeared from the annual speech of the Chairman at the last Dooars Tea Gardens Association's Annual Meeting). We should bring all men available from Singhbhum, Kolhan, Lohardaga, Hazaribagh, Jamtara and Madhupur districts, and offer some remuneration to the sirdars and miners that, for every cooly they teach and turn out as coal-cutter, they will be paid a certain sum of money in addition to what we pay them, namely, certain wages and certain commission per tub of coal raised by their gang of coolies.

With regard to paragraph 54 of Mr. Rees' report, we do, in my opinion, provide better living accommodation for the miners than they enjoy at their native villages. Rather Sonthal miners and certain people do not like to live in pucca coolie lines on account of their superstitions of ghosts, etc. They prefer that new rooms with straw should be made for them at a site in the colliery selected by them.

To increase the supply of labour, legislation should be passed that no labour from the Chota Nagpur Division (*i.e.*, Manbhum, Hazaribagh, Singhbhum, Ranchi, Giridih, Palamau and Sonthal Parganas) should be allowed to be recruited save and except for colliery purposes.

Question 11.—We all know that provision of suitable plots for cultivation on the collieries by the miners would attract labour and make them what is called "settled labour" of the colliery. As it is quite impracticable to provide suitable plots for cultivation in the collieries, most of the collieries pay rent for miners to provide them with cultivated lands at a distance or even at their own villages under the coolies' zamindars. It is difficult to say whether this would improve labour conditions, because some of the big coal companies have their own zamindaris, where labour is settled, but these people cannot be forced to work at any mine. They will work at a place where they will take a fancy. Nothing can force them to go to any other mine under the same management. If legislation is passed restricting recruits from a certain area, the question of providing cultivated land or of making a mine settlement will not arise.

Question 12.—Practically we draw our miners from a certain settled area lived in by the miners and coolies mentioned before. Now we get lots of difficulties in even getting our miners to come out of their huts to work within our colliery limits at a certain hour of day and night. I do not think that these people will come of their own accord, like other labourers in a workman's train at a certain hour. Even now-a-days there is fighting between one company or contractor for robbing the labour of his neighbour, and the combination of a labour bureau will not be successful in this country. The result will be that miners will live in good huts in mine settlements and work in other collieries, as some of the settled miners are now doing. There will be more shortage of labour if labour has to be brought from a mine settlement. There have been big combinations of several coal companies and it will be interesting to watch how coolies under the same management are diverted to work at their different collieries. Moreover, if sand packing is made compulsory and there is no surface shrinkage, then the question of colliery settlement outside the coalfields does not crop up.

Question 13.—Generally speaking, there is a system of training different classes of labour in a colliery. To keep two strings to our bow, we train sets of men as firemen of boilers and of pumps and baling khalasis. The miners put their relatives at first for surface work, then they take them to underground work and employ them to work as carriers. When they are accustomed to live in galleries, they are given floor-cutting and are gradually put in galleries to work coal. We do not actually train miners nor teach them how to use picks and cut coal, so that they can with the same amount of labour cut more coal.

Question 14.—In the first instance I do not agree with Mr. Rees' statement in paragraph 71 that some collieries are now using fuel in a wasteful manner. Secondly, it will be impracticable for some time to provide electrical power from central generating stations to *all* collieries. Then again, why should a colliery owner be compelled to take electric power when he can manage the requisite power with steam by burning slack coal, which is practically of no value to him, and so unnecessarily increase his cost of raising by paying so much per unit for the current consumed. Compulsion is not admissible even if it is practicable to provide power from central generating station. The generating powers must be in duplicate, so that if one fails by accident, the power may be had immediately from the other, otherwise there will be disastrous effects to certain groups of collieries using the power from such a station, more disastrous than the failure of pumps or engines for insufficiency of steam. Only for deep mining, say below 300 feet, should electric power be employed, or in a mine where there is water trouble and ordinary steam pumps cannot deal with the water. But it should not be enforced in other collieries.

Question 15.—As a consumer of coal, and as supplier of several mills and steamers, I have tried the mixing of different seams from the point of view of steam-raising. With my own Faridpur coal, I have used top and bottom seams mixed together, and the result has been more satisfactory than in burning the top seam alone. In fact, there was very little difference in consumption between the bottom seam and the mixed coal for generating the same amount of steam pressure working the same number of hours and doing the same amount of work. In mixing slow-burning Jharia, with fast-burning Raniganj, coal, the volatile matter of Jharia coal with the

ash of Raniganj coal, it was more satisfactory and economical in burning than in burning Jharia alone forming clinkers or in Raniganj coal with large percentage of ash. If you mix first and second class Jharia coal, the mixture will give good results.

I got good results in making hard coke at New Kusunda in mixing dust of different seams (10, 12 and 13). The mixing will improve the efficiency of the lower grade coal and it will be economical in use and cost, whether for coke-making or other purposes.

Question 16.—I do not consider it practicable nor advisable for colliery branches and sidings to be worked by colliery companies with railway company's wagons and colliery locomotives. The sidings are not constructed mainly at the railway company's expense as stated in Mr. Rees' report. The cost of sub-grade work and land acquisition are borne by the colliery company. Permanent way materials are supplied by the railway company, and the siding is maintained by the colliery company at their own cost. The detour of traffic in certain collieries in Jharia is due to a zone made by the Government as to collieries to be served by the Bengal Nagpur Railway or the East Indian Railway or by both.

By the colliery company's bringing the coal to a central depôt by small locomotives, a large quantity of coal blocked in sidings in close proximity to each other will be liberated no doubt. But from a colliery point of view, it will not facilitate the despatches of coal as with railway sidings into the property. We shall not be able to despatch as much coal by tramming with locomotives as with wagons at the sidings near pit-mouths. Such an arrangement will also be detrimental to the interests of the railway company, because their traffic will be reduced. Then again, the cost of providing a broad gauge engine will be prohibitive, and several small colliery owners will not be able to provide it. The travelling of heavy engines over colliery branches and sidings is dangerous, not the wagons even with their loads. So, the same support will be necessary whether the sidings will be worked by colliery companies with railway companies' wagons and locomotives or with railway companies' wagons and colliery locomotives. Then again, the colliery manager's hands are quite full with their coal raisings, etc., and if they are to look after transport, the whole thing, I am afraid, will be upset.

Question 17.—If the sidings were worked with colliery companies' broad gauge locomotives the same amount of coal now required for supporting branches or sidings would be required to be kept to ensure the safety of the railway line as will be required in the case of railway locomotives. But if it is meant by the question that small branch lines or tram lines are to be worked with colliery locomotives up to the main line, then there will be a saving in the percentage of coal being lost in sidings, because, for a broad gauge line, we have to keep 50 feet on both sides of the line *plus* 10 feet 6 inches, whereas, with a small locomotive line, a support of 15 feet on both sides with 2 feet 6 inches will be quite sufficient, and the quantity of coal in the remaining area can be obtained with safety. Here is another advantage of railway sidings. No colliery owner will be able to remove the coal blocked in the railway sidings, even if his colliery is worked out, but with small tram lines or branch lines passing over other collieries to serve different properties, such a support will be impossible. As soon as the colliery will be worked out, the lines will be gradually taken up and the surface made to fall by underground working, and the collieries beyond will not have any means of transport.

Question 18.—I do not consider it advisable nor practicable for a number of the existing sidings of different owners to be removed and coal hauled on the surface in colliery tubs to one big central loading depôt. This is only possible in the case of big collieries, who are using 3 or 4 sidings, being asked to centralise their loadings at one siding instead of at each incline or pit-mouth siding.

(1) It will cause mixtures of different kinds of coal if loaded by one or two mechanical screening plants. And you cannot put aside the tubs of different collieries, even differently coloured for distinction sake, at the time of screening and loading in one or two tubs. To work the endless rope economically, there must be constant supplies of loaded and empty tubs which is not possible over long distances.

(2) It is not possible to load wagons of several collieries with tubs drawn by small locomotives through a mechanical loading plant.

(3) To do this, each colliery must have its own mechanical loading and screening plant which is costly.

(4) Then again, the utility of the mechanically-screened coal of different sizes has not been established in India. It can ensure coal of a certain size, but it is not possible during the working of the screening plant to keep out shells, slates and water-marked coal (which is more objected to) even with a number of coolies employed for the purpose of picking up and throwing them out.

(5) I have already said that it will reduce the despatches of a colliery and restrict the raisings compulsorily. The small locomotives are always a source of trouble. Even with 3 or 4 locomotives at a colliery, it has not been successful. The working by endless rope from each colliery to a central depôt is not feasible. From what I noticed of the working of the aerial ropeway from Daukha to Jambad siding, namely the tubs falling, the plant stopping and not working all the hours, I have not been much impressed in favour of such working. The carriage of coal and sand by such method will not be fully satisfactory, even without the least trouble, like the haulage by locomotives in wagon loads.

(6) If small tram lines or branches have to be made to the central depôt for the transportation of coal, then it will destroy more cultivated lands, and it will cause more trouble about surface

rights, not to speak of underground rights pointed out before, as in cases of assisted sidings, surface rights are acquired under the Land Acquisition Act, and the colliery companies have to guarantee the underground support.

Question 19.—It may, to a certain extent, reduce the number of loading coolies required, if screening plant were installed at the central loading depôts for all collieries. I do not consider that all such persons would consent to work underground if they lose their employment. They will go back to cultivate or take up some other surface work in some other industry. If central loading is introduced, it will facilitate the supervision work of the Assistant Coal Superintendents, and save them the trouble of visiting all the collieries sidings situated in distant places over the coal fields, but there will be more chances of mixing of coal of different seams. Then there will be fighting over stocks of coal being robbed, mixing of coal tubs, etc.

Questions 20 and 21.—There has never been a sufficient supply of railway wagons constantly available for the transport of coal. As a result, stocks have to be kept on the surface for months and months. Wastage of coal depends upon the time it has to lie in stock. In ordinary handling, it is only 1 to 2½ per cent. If coal on arrival at the surface were immediately passed over screens into wagons, there would be no loss for there would always be some surplus. The collieries lose in several ways by having coal in stock, namely :

(1) It gives a handling to the overmen to rob in the number of tubs raised. He knows that the stock is not going to be cleared away. He shows more numbers of tubs raised and robs. He does not take full loading of tubs and so forth.

(2) All big lumps lying in stock at the pit-mouth or surface are robbed by the miners and other labour. Then what is left is reduced to slack. The Mining Engineer has been recently pleased to allow even up to 20 per cent. slack or small coal in Royal Indian Marine coal for lying in stock for want of wagons.

(3) The last and worst difficulty and danger is fire in stocks due to spontaneous combustion. One has to spread out the coal all over the colliery to put out the smouldering fire.

(4) Then again, if there is stock, it affects the raisings. None, either the owner, manager, staff or the miners, has a mind to raise more coal.

(5) If all stock is cleared away, then all concerned endeavour their best to make raisings. If wagons are available, raisings are clear, and there is always surplus and no wastage. If wagons are immediately available for daily despatch of the output of a colliery, then the cost of stacking and reloading into tubs is saved.

(6) Small coal is blown away by wind and carried away by rain, which is another cause of wastage and loss to the colliery.

The evaporative quality of the steam coal is reduced by lying in stock, resulting in more consumption. It is also difficult to sell weathered coal.

Question 22.—Screening and sizing plants have not been generally adopted in India because there was no great demand for screened coal. The buyers did not find any special benefit in using such sized coal. Only for a certain class of boilers, rubble coal of a special size is wanted. The colliery companies did not get any encouraging rate for sized coal; so they did not bring out these plants even if they could afford the expense. For mill or locomotive consumption big lumps had to be broken in small sizes to suit the requirements of the boilers. The supply of wagons is another factor. As only open trucks can be loaded with mechanical plant, instead of removing the whole of the top of covered wagons, half of it may be rivetted and the other half may be made in the form of a lid, so that it can be taken up and put down again. The whole of one side of a covered wagon can be removed from a certain height as at present with side doors, and with a little addition or alteration of the feeding part of the plant called the chute, a covered wagon can be loaded from a screening plant.

Question 23.—Extraction of pillars by sand- stowing will not remove the wastage in a colliery, unless the several other items are remedied especially, and unless a larger daily supply of wagons is given to deal with the output of several collieries. There is no necessity for direction as to when such pillars should be extracted because this will be an interference with the work of a colliery.

Question 24.—Certainly the introduction of sand-stowing will affect the output of a colliery. Firstly, there are not so many expert labourers to do the sand-stowing, even if plants were provided by the Government. It will take some time to provide all the collieries with so many plants and men to work the same. Then again, unless all the galleries of a certain section are sand-packed, a colliery will not probably be allowed pillaring. Now pillaring is done as when and where it is considered safe by the manager, but, if there is a controlling authority, you will have to wait for his visits and wait for his orders to start pillaring.

Question 25.—I do not think that aerial ropeways will be able to deal with the requirements of sand of all the collieries. Of course aerial ropeways will be a desirable thing, because, with them, a colliery will get sand at the site of the sand-stowing plant, but, if it is delivered into wagons at sidings, there would be much difficulty in taking it to the plant. Then again, all the collieries are not similarly situated in respect of sand in close proximity to a river.

Question 26.—Sand required to obtain a ton of coal depends upon the size of galleries and the specific gravity of the coal. To take one ton of coal, it will require about two tons of sand.

Question 27.—As follows, the extra cost will be nothing less than Rs. 2-8-0 to Rs. 3 per ton at the least, even if sand were delivered at collieries free of cost:—

(1) Take the rent of the plant if it is supplied on the hire-purchase system, and the cost will be more or less per ton according to the output of the colliery.

(2) The cost of carrying sand from the siding to the site of the plant and galleries.

(3) The cost of working the plant either with electricity or steam power.

(4) The cost of providing sufficient water for the purpose. There are several collieries, both in the Raniganj and Jharia coalfields, where in the dry months sufficient water is not available even for drinking purposes and for feeding of boilers. On account of water trouble, sand-packing will have to be deferred during certain seasons of the year at most of the collieries.

(5) Extra establishment charges for this particular work with an expert mining engineer and his staff.

Question 28.—It will increase the life of a colliery to a certain extent on account of the wastage saved and also on acccount of the pillar extraction being delayed by sand-packing. It will only save 10 to 15 per cent. of the coal now wasted by pillaring. The life of a colliery depends upon the annual output; increase or decrease of life of a colliery cannot therefore be exactly told. If, by "productivity", the total quantity of available coal is meant, certainly it will be increased, but if it means annual production, it will be decreased, and thereby life increased of a colliery. In my opinion, the sand-stowing process will stand in the way of steady development of a colliery, and will increase the cost by Rs. 2-8 to Rs. 3 per ton without any commensurate gain.

Question 29.—There will be less water in mines due to sand-packing compared with the ordinary way of pillaring, but so far the water trouble in existing mines has been overcome by steam or electric pumps. As sand is a porous thing, and sand-packing cannot be tightly done in galleries, a certain amount of water will come through cracks in the surface caused by pillar-drawing even with sand-packing or through underground connections from different properties.

Paragraph 75 of Mr. Rees' report hints at what I remarked in in my answer to Question 2. Whether one works a colliery from the dip or rise, certain pillars will be exposed throughout the life of the colliery. In the case of pillars at the dip, there is more danger, because of the heavier weight, than in the case of rise pillars, the weight of which is less and hence less dangerous.

Question 30.—Mechanical coal-cutters have not so far been a success in India. They were brought out by the Bengal Coal Company, Limited. Indian miners could not be instructed to work them with success, nor could the coal-cutters who came out from Home give us an intelligent display and impress us with their utility and increased output at a less cost. Mr. McLeod, late Superintendent of the Bengal Coal Company, Limited, showed me a note with facts and figures about this, which may be called for from that Company. Messrs. Kilburn and Co., Managing Agents of Tatas' Choitodih Colliery, have brought out some coal-cutting machines with expert miners from Home. From what I have heard, they have not been successful. The Committee might examine their manager on this point. Bird and Co. introduced coal-cutting machines at their Loyabad Collieries some 7 or 8 years ago, but they were a sad failure.

General.—Now, I beg leave to offer some general remarks on certain paragraphs of the report.

Para. 10.—I am not aware of any lease where extraction of pillars has been totally-prohibited, except for support to temples, mosques, or valuable holdings of the lessor. If Mr. Rees has come to his conclusions from certain leases, where permission to extract pillars was reserved or prohibited, this was not done to stop raisings of large quantities of coal left in the pillars. The lessor's object was to take fresh *salami* for pillar extraction, and an increased or same rate of royalty on the coal left, before giving permission for pillar extraction. Fresh leases or permission to extract coal from pillars were subsequently granted. During my experience of 23 years, no instance has come to my knowledge where the lessors of coal have altogether prohibited the extraction of pillars, large quantities of coal having been irrevocably lost in consequence.

Para. 12.—I cannot understand why Mr. Rees has criticised, with special reference to India, the method of mining described in his paragraph 11; if we study the primitive mode of working shallow mines in different countries, we do not see any exception.

Para. 15.—The force of Mr. Rees' argument is not clear. The landlords have not let out large tracts of coal properties with the object of receiving as much as possible by way of *salami* or money paid down as consideration for granting a lease. The landlords let out properties at a *salami* of so much per bigha. They look at the total sum, whether the property was let out to one or more lessees, nor do they charge any higher rate for letting out small plots. They let out as applications are received.

Paras. 16-17.—Regarding the encroachments referred to in this paragraph, I stated at the Indian Mining Association Meeting of 6th March 1914, as follows:—

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"The next matter to which I wish to draw your attention is the desirability of having barriers left in contiguous properties. In some leases, it is compulsory to keep a barrier, but more generally there is no such condition made, and the result is that each owner works right up to his boundaries. I do not for a moment say that he is wrong in doing so, but a little consideration of the matter must, I think, convince you all that the leaving of a barrier between each property is desirable. Had such barriers existed, I venture to think that the floods which occurred

in August 1913 would not have done so much damage, nor would so many collieries have been affected. May I suggest, gentlemen, that legislation be introduced to deal with the question of barriers being maintained and workings kept within boundaries. It is, I admit, a very big question and one that requires very careful consideration, but it is also one that vitally affects the interests of all colliery proprietors and therefore should not be overlooked. I am aware that there are remedies under the civil law for encroachments, but it is to avoid such encroachments being possible that I think the aid of the law should be invoked. It should be a criminal matter for a manager to encroach on another's land, and I would strongly urge that steps be taken to have my suggestion given effect to."

Certain barriers between two properties should be kept, and this should be looked after by the Mines Department, which is not done nowadays. The underground connections between the workings of two collieries are the creation of the bigger company, who, thinking that, before the smaller company comes to work the spot, they will be finished, indulge in encroachments so as anyhow to secure large quantities of coal and earn bonus or commission on the coal raised. The landlords are not therefore to be blamed in the matter. They insert covenants in the leases to keep barriers, but if these are observed in the breach, they are not to be blamed. No amount of supervision of the negotiations for leases will be of any help and, unless there is legislation penalising such offences against the miner, the raising contractor, the surveyor, the manager and the owner (last of all), the encroachments cannot be stopped. Nowadays, poor owners have to pay civil damages, but the above mischief-makers go scot-free.

Paragraphs 35 to 40.—(*a*) With reference to Mr. Rees' remarks: "In some cases, these are marked as having been completely worked out, whereas portions have been left behind and lost," I do not agree with such a view. At present, the landlords check the working plans by their surveyors, and the colliery owners are anxious to get the last ton of coal out of a property and do not leave any solid portion unworked.

(*b*) By the coolies going in for cultivation, they get rest and change, which improve their health and brings some harvest. So, it gives them more life to work more vigorously. They do not claim higher wages for having some means of livelihood at home. If they are settled at the mines, they will be like indentured coolies without any independence.

(*c*) Mr. Rees suggests that the coal from several collieries be conveyed by underground roads to a common centre or centres before being brought to the surface, whereas he rightly took objection to underground workings being connected up in paragraph 16. How is this to be reconciled?

(*d*) If we read conjointly, Mr. Rees recommends hydraulic stowing for winning more valuable coal at depths of about 1,000 feet and over, and not for all seams near the outcrop and at the shallower depths, as they have been taken up for the most part and in some cases, are nearing exhaustion. He does not aim at making sand-stowing universal throughout the Jharia and Raniganj fields.

(*e*) Mr. Rees suggests that sand-stowing should be made compulsory in all collieries working first-class coal and refers specially to collieries in the Jharia coalfield. Action should therefore be taken to reduce loss to a minimum and to conserve first-class coal, the life of which in India is another 45 years according to Mr. Simpson's estimate. Moreover, there are no facilities for the provision of sand for the requirements of all collieries in the way of wagons and quantity of sand available, sand transport, electric power, sand-stowing plant, and expert labour to do the work, etc. Action should first be taken to save waste by adequate supplies of wagons and not by the compulsory introduction of electric power and sand-stowing. According to Mr. Rees' report there is wastage under the following heads:

1. Coal consumption at collieries may be reduced from 10 to 5 per cent. by the universal electrification of all collieries. I do not think that this will be a gain, even if the initial outlay is available and can be recovered in additional price of coal by means of a cess.

2. The wastage in pillar-extraction by the ordinary method, including coal lost by pillar-robbing (say 10 to 15 per cent.); this might be saved by sand-stowing, but, as stated above, such-stowing is impracticable at all collieries.

3. The next item of wastage is on account of the inadequate supplies of wagons. This percentage is 20 to 25 per cent., due to deterioration in quality and quantity of coal lying in stock. If the amount required to be spent in the electrification of collieries and in providing stowing plants and free sand be invested in providing wagons, the chief item of wastage will be eliminated.

4. The last item of wastage is coal left to support sidings and branches and also for keeping barriers round small holdings. These cannot be avoided as the remedies suggested are not in my opinion practicable.

Oral Evidence.

Question 2.—I have said that pillar-robbing should be penalised by legislation. Also that barriers between properties should be enforced by legislation. This could be done by some addition to the rules under the Mines Act or by a new law if necessary. The Chief Inspector of Mines

could enforce these rules under the Indian Mines Act. On other points, I would have an advisory board on which the Chief Inspector of Mines would serve as a member. This board should only advise and not enforce or dictate methods of working. It might be tried as an experimental measure for 10 years, during which education in mining methods might proceed. If during the above experimental period, the advisory board, constituted as above, found a colliery working in such a way that the colliery was on the verge of collapse owing to too large an area having been left on pillars, I do not think the advisory board should have the power to step in and stop such working. I know of cases where fires have been caused by collapse, but I think the colliery owners should be allowed to take the risk of loss by such causes irrespective of the interests of the State. If there is no improvement in the methods of working and the wastage is not reduced within these 10 years, then a controlling authority should be constituted with legal powers to interfere with the working of collieries.

Question 4.—By pillar-robbing, I mean robbing both by miners and by managers to keep up raisings. I want to be protected from both.

Questions 24-28.—I have no practical experience of hydraulic sand-stowing. My figure of cost in Question 27 is based on calculations of what my ideas on the subject are. My 10 to 15 per cent. of wastage in Question 28 is based on experience in my own collieries The seam was 16 feet I think. The percentage will be higher in thicker seams, more especially if the pillars were not left large enough in the first instance or were subsequently robbed. The percentage will be very small in thin seams.

General Remarks—Paragraph 10.—I think further *salami* should be stopped.

Paragraphs 35-40.—I would have a cess on all coal raised in order to provide a fund to encourage sand-stowing of all first class coal only. If the coal reserves of first class coal are sufficient for the next 300 years, I would not have compulsory sand-stowing at all. Irrespective of the life of coal in the country, I do not think there should be any interference because Mr. Rees has, in my opinion, exaggerated the amount of waste that is taking place.

Written Evidence of Mr. R. Barrowman, Manager, Standard Coal Company Limited, Jharia.

Question 1.—Home 1st class colliery manager's certificate.

Two years under-manager in Scotland, Barron Company.

Two years manager in Scotland, Barron Company.

Indian experience as colliery manager, 18 years.

Question 2.—(*a*) In my opinion, it is advisable that there should be an authority, so that, when leases were taken up, the lessee would be assured they would be free from future litigation.

(*b*) The proposed method of working to be submitted for its approval, and suitable barriers between different owners of adjoining collieries to be made compulsory.

(*c*) Its constitution to include three separate units :—

(1) Lawyers to supervise the lease as to its legality only.

(2) Mining engineers with 1st class Home certificate, and with nothing less than 10 years Indian experience of colliery management, to ensure that all coal areas be worked to the best advantage.

(3) The Mines Department to be responsible for seeing that the barriers between adjoining properties are not reduced, especially just prior to pillaring.

Question 3.—(*a*) The suggestion is practicable.

(*b*) In the majority of the collieries, steam and slack coal is loaded in tubs separately, but should miners be paid by weight, there is every likelihood that rubbish and slack would be mixed with steam coal to make the tubs weigh heavier. Unless the raisings are centralized at a screening plant, it is not advisable to alter the present system of loading underground. Further, I consider that the record of despatches from the railway companies, combined with an account of colliery consumption, including miners' coal, will meet the case.

(*c*) The amount of coal at present being carried out of the mine by miners is trifling, and, as the mines develop, the system will automatically cease. Their coal can be supplied from the raisings of which an account could easily be kept.

Question 4.—(*a*) Yes.

(*b*) Yes.

Question 5.—Yes.

Question 6.—Yes.

(*a*) The following records were taken from an area of 320 feet × 112 feet of 15 seam Height 25 ft. Percentage of loss from pillars 23 per cent., depth 1 0 feet from surface. Per centage of loss of total coal in the seam, 11·83 per cent.

(*b*) No. 2 section in the same seam, area 390′ × 260′. Percentage of loss of the total coal in pillars, 12·88 per cent. Percentage of loss of the total coal in seam, 7·4 per cent.

Depth from surface 80′ to 100′.

The chief reason for the lower percentage in No. 2 section was the method of extracting pillars on the Giridih system. It was abandoned, and another system adopted which suited the conditions much better.

Question 7.—No.

Question 8.—The quality of coal has always been the deciding factor in the opening out of collieries. If it was compulsory that seams should be worked in vertical rotation, it would be a serious matter for several collieries, which would have to stop raising their first class coal and raise inferior coal for which the demand is limited.

Should sand-stowing be adopted, there would, in my opinion, be no necessity to enforce this system, as the seams could be worked as desired with special precautions, and a suitable system adopted, namely "drive to boundary and work back".

Question 9.—Regular shifts for all workers should be compulsory, and is advisable. The hours of shifts to be fixed by the Mines Department.

Question 10.—Eighty per cent. of the labour on this colliery is recruited from the United Provinces. This class of coal-cutter will only blast the coal, and other labour, such as loading coolies, load the coal. To attract labour, it is essential that they should be made comfortable both on the surface and underground.

(1) *Surface.*—Good houses and water facilities.

(2) *Underground.*—Galleries to be well ventilated and kept dry. A surplus of tubs, with tram lines laid as near the working places as possible, so that there is no congestion of traffic. Opportunities of causing friction between one another underground to be reduced to a minimum. Further, when a miner has to make his living under the present system, by cutting with a pick, it is very hard work for him to cut more than 2 tubs per day, whereas, if he was either mechanically assisted, or given explosives, this miner would increase his output at least 40 per cent. In my opinion, with the present amount of labour in the coalfield (properly supervised, combined with the above suggestion), the raisings could be increased 30 per cent., but the cost would be increased probably by as. 6 per ton. In order to make coal cutting as easy and attractive as possible, patience, care, and attention should be given to new labour until they are satisfied, and are able to make good wages. These men will become the best recruiters when they go home and explain the satisfactory conditions they work under. The low selling price of coal in the past has prohibited the universal introduction of any appliance to assist the miner in increasing his output per head.

Question 11.—I do not consider that giving suitable plots of land for cultivation would in any way induce the real miner to come to the colliery. As a rule, they will not accept land. They prefer to occupy their spare time otherwise.

Question 12.—I do not approve of the suggestion, and consider that it is essential that all labour should be settled on the colliery, and as near their own shaft or incline as possible. By this means, the mining staff get in personal touch with the labour, and are in a position to assist them in their difficulties; they also understand one another better than if they were housed anywhere off the colliery. Colliery companies could combine in forming settlements, but, as mines are worked in various methods, such as by contractors, sub-contractors, commission agents and sirkari, there is an opportunity for any, and all of these, to induce the labour to work for them. Consequently rates would go up, and the labour would eventually get a wrong impression of their importance. Discontent would be the result.

Question 13.—Yes. The system most successful here is to pay a living wage to a prospective miner for a few weeks whilst he is being taught and getting used to the work. He is generally put along with two good men. The result has been that, in about three months, he is as good at cutting coal on this system as the others. Further, Bilaspore labour which has not been a success in driving galleries, has been taught this system of working here, and in my opinion, this class of useful labour will be one of the future coal producers.

Question 14.—There is no doubt that the centralizing of power would be a saving in boiler consumption, but to compel collieries, already fitted up with steam, to reconstruct all their plant, and adopt electricity, just to save boiler consumption, would be a hardship, as more capital would be required. Repairs, renewals, and upkeep of electric machinery are much more than steam. I would recommend that electric power should be adopted in (1) all new developments and (2) collieries with heavy growths of water. When colliery boiler consumption is principally used for winding and haulage with a minimum of pumping, any saving of fuel under these conditions would in no way compensate the company for the outlay on electric plant.

Question 15.—No.

Question 16.—It is practicable, but not advisable, as the colliery companies could not marshal the wagons for final despatch. In most cases, there would be very little shunting work to be done beyond what is being done just now, *viz.*, supplying and drawing. As the loading wharfs can accommodate a large number of wagons, very little hand-shunting would be saved by keeping a locomotive and its necessary staff.

Question 17.—I do not consider that much more of the coal could be removed without impairing the safety of the sidings. A further 20 per cent. at this colliery.

Question 18.—It is practicable, but not advisable, as a larger stock of tubs, ropes, haulage and machinery will be required; also the cost per ton will be increased compared with the siding direct at the pit-top.

Question 19.—Such concentration would certainly reduce the amount of loading coolies required, provided all the coal raised was despatched daily over tipplers or screening plants. Yes, these coolies will work underground. At this colliery, a large amount of the coal is loaded by this class of labour, who insist on getting work underground if the wagon supply is unsatisfactory.

Question 20.—This colliery has no stock. Wagons have been available to take away all the raisings. There are complaints in the district about shortage of wagons, and about collieries having to restrict raisings on this account. In my opinion, there are sufficient wagons to meet present demands, if all coal especially railway and seaborne coal, is despatched in rakes. The rake should be loaded at one colliery and, where possible, at the same siding. Special arrangements should be made at their destination for unloading, so that the rakes could be unloaded and ready for drawing out in the same time as the collieries are allowed for loading, *viz.*, 10 hours.

Re waste, with a stock of steam coal of 5,000 or 6,000 tons, 20' feet high, lying for two months there will be an increase of slack of 8 to 10 per cent. due to crushing and weathering.

Question 21.—If coal on its arrival at the surface were immediately passed over screens into wagons, increased raisings would be the result owing to the quicker return of tubs, and there would be fewer complaints of small coal and slack; but, if the screens have no picking tables, then the quality of despatches will be inferior to hand-loading.

Question 22.—The purchaser is not prepared to pay a sufficiently enhanced price to justify the cost of introducing mechanical screening and sizing plants. With hand-loading, it is immaterial what class or type of wagon is supplied, but, with tipplers or screening plants, the low side type with a carrying capacity of 20 tons is suitable.

Question 23.—I do not think it advisable that the controlling authority should have power to direct when such pillars should be got. This should be left to the colliery management. The controlling authority ought to have powers in conjunction with, or similar to, the Mines Department to prosecute, if the system of working with sand-packing is causing any unnecessary loss.

Question 24.—Yes, as they would not be sufficiently conversant with the colliery to decide the best method in each individual case.

Question 25.—In my opinion ropeway transit is not enough.

Question 26.—Approximately 2 tons.

Question 27.—Without making allowance for depreciation on plant and pipes, I consider the extra cost about Re. 1 per ton.

Question 28.—The life of this colliery would be prolonged about 20 per cent. at the present output. The raisings from the pillar sections would be increased, due principally to a less amount of stoppages from goaf weights; and the working face being more uniform, an increased output per head would be the result.

Question 29.—In my opinion, there would not be very much more increase in the quantity of water to be dealt with. Should the present system be continued with the underlying seams, the surface area would be the same, but pumping would be done from greater depths; and, if large standages were made at the various outlets on the rise side, combined with a through system of surface drainage, there is no reason why dip development should not be carried out, except in very exceptional monsoons. Should these mines be abandoned, then they would be a source of danger to the adjoining collieries.

Question 30.—Mechanical coal-cutters are a mechanical success, especially the more recent types. Native labour soon become expert at handling them. Their universal adoption has been prevented in the past owing to the low selling price of coal. In my opinion they are a considerable help in increasing raisings, especially in hard seams less than 12 feet high.

Oral Evidence.

Question 2.—Uncertainty of leases is one of the great difficulties of coal working. My idea is that the controlling authority should examine leases and satisfy itself as to their legality, and that the lease should then be final and unchallengeable. New co-sharers and claimants crop up unexpectedly, litigation ensues, and working is hampered. We had a claim recently after 16 years of undisputed possession. It referred to surface rights only, but may be extended to underground rights later on. The claimant disputes the title of the Raja of Jharia, our lease being direct from the Raja. I want to be safeguarded from such claims, but I agree that lawyers would be of no use on the controlling authority, unless they had the final power of decision on legal points. My idea in c(iii) is that pillaring should not be allowed unless barriers are intact. Sand-stowing would alter the position as regards fires, but would not remove the water difficulty. I do not care what department does the work as long as it is done. As regards c(ii), I think 10 years' experience

is essential for a proper knowledge of Indian conditions. I do not think 10 years' experience as an Inspector of Mines would be sufficient as the Mines Department only looks after one part of the manager's work. If, however, the controlling authority is only to control (1) the size of the pillars, (2) the percentage of waste in pillaring by deciding when pillars should be got or areas left further unworked, and (3) sandstowing, then I think Mines Department experience would be sufficient.

Question 3.—Our colliery consumption is arrived at by actual measurement and periodical test of the amount of coal used in boilers. Our average consumption figure is based on these tests. I allow miners to take coal from stock as they please, but I do not take this into account as the amount is trifling. I have no record of this amount, but I think 2 per cent. would be a fairly correct figure.

Question 6.—The Giridih system was not suitable for No. 15 seam. It was used in the first example given in my answer, but not in the second example. I would not agree that the figures of waste I give are generally acceptable or correct as an average. I know of no place outside Giridih where the Giridih system has been successful. The roof at Giridih is particularly good. My own opinion is that, with 250 feet cover and a 25 foot seam, the average percentage of wastage is 20 per cent of the pillars or about 12 per cent. of the total coal. I always leave big pillars and the width of my galleries varies. I have no experience below 250 feet, but the loss would be much greater.

Question 9.—By regular shifts, I mean that the miners should remain down for a certain fixed time. There should be two shifts, the first to go down between 6 and 8 A.M., and come up between 4 and 6 P.M. This could be brought about by legislation, but I know of no precedent for such legislation. The majority of the miners in Jharia do not work more than 6 hours. Shifts could not be brought about by mutual agreement except as an initial experiment. Legislation would be necessary eventually as I do not think combination would last. It would answer equally well if hours were merely fixed for coming up or for the termination of the shifts, as the miners would adapt their work accordingly so as to get the amount of coal they want. But this must be universal. If so, there will be no difficulty with the labour, but the system would have to be enforced by Government rules

Question 13.—Most of my labour comes from the United Provinces between Cawnpore and Barielly. My system of training is fully described in my written evidence. One man after training gives about 44 tons a month, his outturn being about double the ordinary miner. In 1918, many of these men left me and got Rs. 5 a day at a neighbouring colliery. I could not recover my expenses even.

Question 14.—Saving in underground waste is much more important than saving in wasteful fuel consumption

Question 20.—My idea is that the wagons are sufficient numerically, but are not utilzed properly. Railways should set an example by concentrating the loading of their coal as I suggest. The big industrial consumers could also take rakes on their own. The same time should be allowed for unloading as for loading.

Question 23.—I would not go so far as to say that sand-stowing should be made compulsory. I would not even allow the controlling authority power to insist on sand-stowing when it was considered necessary. It is primarily a matter of finance. I would not be in favour of financing the system of sand-stowing by putting a cess on coal as I think it would react on the trade even if the cess were paid by the consumers.

I agree that great losses have occurred owing to pillars being too small relatively to the area standing in pillars, but I think the manager is the best judge as to the time at which such pillars should be got. He might accept advice, but would resent direction. I agree, however, that collapses should be prevented at any cost, though I still think the manager would be the best judge of this.

Question 27.—My figure of Re. 1 is based on what I saw in Scotland. I do not want to make a profit on sand-stowing, and would accept compensation on the basis of the net increase in colliery costs.

Question 29.—I have 100-150 bighas of goaf in the area referred to. My answer is based on the assumption that the first seam was pillared, and that I was being asked the effect on the lower seam. I agree that there will be much more water if the present system of pillaring is allowed to continue.

Written Evidence of Mr. W. Burt, Manager, Central Kurkend Colliery, Jharia, nominated by the Indian Mining Association.

Question 1.—I have 34 years mining experience. I am a first class certificated colliery manager. I was a colliery manager for 8 years in Scotland. I have 12 years Indian experience as manager, agent, and superintendent.

Question 2.—In view of the fact that the number of concerns working coal is out of all proportion to the total output, and that the whole area of the Jharia field is parcelled out in piecemeal plots, causing an enormous waste of coal in running and working, it is certainly

advisable that some censorship should be instituted to supervise all existing and future leases Further, the practice of extorting and paying *salami* should be abolished. The controlling authority should have the legal experience necessary for such a post and, as it will be rather difficult to find a man with the dual experience to decide when any area is being worked to the best advantage or not, it appears to me that, he will have to be attached to the Mines Department, which will advise him.

Question 3.—The proposal is quite practicable in conjunction with the proposal to centralize the raisings at one point. Under present conditions, it is less practicable as it would involve having a large number of weighing machines. I quite appreciate the advantages of weighing all coal, but personally I would not entertain the idea until I was in a position to concentrate all coal at one or two points.

The coal carried out in baskets could be emptied into tubs, instead of on to the ground, and taken to the weighing machine. The basket system, however, will gradually disappear with the advent of centralization.

I am afraid it will be impossible to weigh the coal taken by the miners for their own use. A pretty fair estimate of the coal used for domestic purposes could be got by allotting one basket of coal daily for each miner and his *kamin*.

Question 4.—It is not only practicable, but advisable, to show each year's working in different colours on the plan. One will see at a glance the area or progress made in comparison with previous years. Further, the area may be measured and checked with the amount of coal raised and weighed, thus giving an idea of what coal has been lost underground.

To be strictly accurate, the plan should also shew the exact size and shape of the pillars, and offset surveys should be made so that the exact width of all galleries would be shown. It will necessitate fresh surveys from time to time to maintain this, as the size and shape of the pillars are liable to be altered on account of splintering, especially at the corners.

Question 5.—I have to admit I could not trust the ordinary compass babu to give correct levels to a common datum on the plan. The time has arrived when all surveyors should pass an examination and only certificated men should be employed.

Question 6.—In extracting pillars at one colliery, I reckoned I lost about 5 per cent. of the coal.

Question 7.—I have experience of working a lower and upper seam together, but not where the upper one was left unworked or destroyed.

Question 8.—It would certainly be advisable to put some restraint on any one who would be foolhardy enough to work seams otherwise than in vertical rotation. If sand-stowing were made compulsory, it would affect my answer to the extent that vertical rotation would be of secondary importance, if sand-stowing were systematically and efficiently carried out in the lower seam.

Question 9.—This is certainly advisable, but impracticable under existing conditions. There is no doubt regular shifts would conduce to a more uniform output. Compulsion at the present juncture would have disastrous results. It would be difficult to organize or maintain such a system at present, even universally. There are far too many means of ingress and egress, and it would be impossible to check the coming and going of the miners. In my opinion, this can only be instituted when the proposed schemes of centralization have matured, and by closing up all the present means of ingress and egress.

Question 10.—I have no system of recruiting. Any scheme I have tried has been a failure and a financial loss except to the so-called "recruiter." There is no proper system of recruiting in the Jharia field. It is simply a case of "poaching" each other's labour. I have given this matter much thought, and I have come to the conclusion that this is also a case for some controlling authority or labour bureau; such authority or bureau would recruit labour and distribute it where most required with some system of registration.

Question 11.—This proposal does not appeal to me, and I do not agree that it will improve labour conditions. From experience and from a productive point of view, I am against all such proposals. I maintain that all our efforts should be directed towards obliterating all agricultural ideas out of the miners' heads. It is miners we want, and, until we have a mining class entirely apart from the agricultural class, our productive chart will be like the peaks of the Himalayas. The time spent in cultivating these proposed plots is time lost and should be spent in the mine. Further, even with this inducement, the native will not relinquish connection with his native village or his lands at home.

Question 12.—From a moral standpoint I would agree to this, but my sympathies end there. The whole fabric of the mining industry in India rests on a very frail foundation, and I cannot see where many companies will be able to find the money for such Utopian schemes. The margin between working costs and selling price is so little that, however much we may be inclined to do all that lies in our power to ameliorate the lot of the native, we have to throw all philanthropic ideas aside as we cannot afford them. There are other objections to the proposal, the most serious one being that the coolies would be outside the control or jurisdiction of the manager. *Apropos* of this proposal, if sand-stowing is to be universally adopted, I do not see the necessity of going outside the collieries. Further, large sums of money have already been spent on housing and sanitation.

Question 13.—I have no special system of training the different classes of labour.

Question 14.—From the point of view of economy and conservation of fuel, it is certainly advisable and practicable, if the means are provided, to compel owners to desist from using fuel in a wasteful manner. The want of the necessary capital would be the only reason that would render it impracticable, but, where such is the case, the electric supply company should be bound by a clause in their agreement to supply not only the current, but pumps, haulages, etc., on the hire system. If some such arrangement could be made, very little compulsion would be required.

Question 15.—I have not made any experiments in mixing different seams for steam-raising or coke-making.

Question 16.—It would be quite practicable and advisable on large collieries having several sidings to have their own locomotives with railway company's wagons. It would facilitate the work on the colliery and save considerable time for the railway company. On small collieries it would not be advisable.

Question 17.—The amount of coal that could be removed from the existing coal supporting the sidings will depend on circumstances. In many cases, where the coal has been worked on either side of the railway land, it would not be safe to strip any of it for fear of bringing on a creep. In the case of the new sidings or branches, and with colliery locomotives, I should say that 50 per cent. less coal would be required as a support.

Question 18.—It is quite practicable, and also advisable, especially in view of taking all coal to one loading centre, to have surface haulages and do away with some of the existing sidings.

Question 19.—Concentration and screening plants would certainly do away with loading coolies ; also a large number of coolies who are now engaged in hand-screening. The coolies dispensed with would certainly prefer to do other surface jobs, but a considerable number would eventually take to the mines.

Question 20.—It is a well-known fact that there has never been a constant or sufficient supply of wagons available for the transport of coal. The result is that coal has to be dumped on the ground and may have to lie there for several months, exposed not only to the disintegrating influence of sun and atmosphere, but to continual grinding from overhead traffic and, if space is limited, to further dumping of coal on the top of it. A considerable leakage also takes place through pilfering, not only by the people on the colliery, but also by adjacent villagers. The net result is that *50 per cent. of the coal may be rendered into slack* and there is always a shortage when stocks are cleared. There are also cases where such coal has taken fire through the effects of the sun and its inherent liability to take fire.

Question 21.—If coal on arriving at the surface were passed over screens into wagons, the following advantages would accrue :—

(1) There would be less waste and a greater percentage of round coal.

(2) The various classes of small coal, such as slack, rubble and dust, would be automatically got without having to pay screening charges as in the case of hand-screening.

(3) It would mean a saving in cost of 1 anna per ton as compared with hand-loading.

(4) It would release all coolies who are now engaged in loading and screening coal, and these would be available for other purposes.

Question 22.—Screening and sizing plants have not become general because the conditions have been unfavourable. Where screening was adopted, the advantages have been nullified through coal having to be dumped on the ground for want of a regular and sufficient supply of wagons. The class of wagons supplied to the collieries is so cosmopolitan in character as to militate against the adoption of screening plants. It is quite a common thing for covered wagons to be supplied and they cannot be loaded from screens. Therefore screening plants will not become general until an adequate supply of standard wagons is available for coal traffic.

Question 23.—It will not diminish waste unless the controlling authority has the power, in addition to his power to insist on sand-stowing, to say when such pillars should be got. Otherwise the tendency will be to have the pillaring too far in advance of the stowing, and leave large empty areas which would be liable to collapse. He should have the power to dictate as to how many pillars should be taken out at a time, after considering the nature of the roof, the thickness of the seam, and the size of the pillars.

Question 24.—It is quite probable that control in the matter of sand-stowing will effect the output. The controller will intervene if he considers sand-stowing is not being systematically carried out.

Question 25.—To ensure a universal and adequate supply of sand, I am afraid a more efficient means of transport than ropeways will have to be introduced. This system may suffice for collieries adjacent to the Damudar River. I would suggest a light railway running alongside the existing Bengal Nagpur Railway with branches into the collieries and worked by electric locomotives.

Question 26.—At the colliery with which I am connected, I reckon I would require fully 2 tons of sand for 1 ton of coal.

Question 27.—The extra cost per ton in extracting pillars by sand-stowing will depend on circumstances. It will be less in some collieries than in others. I should say Re. 1 per ton extra will be about the average throughout the coalfield.

Question 28.—Sand-stowing will prolong the life of the colliery with which I am connected. It would also increase its productivity, as there are large areas of pillar workings which could be worked, but which will be lost if sand-stowing is not adopted.

Question 29.—If the present system of taking out pillars, and causing subsidences to take place on the surface, is continued, it means that, in order to work the dip coal, the conditions are rendered infinitely more difficult. The "come" of water will be increased, especially in the rains, to such an extent that all lower workings will be drowned out. In fact, it is quite a common occurence in the rains for this to take place. Larger pumping installations will have to be provided in order to safeguard the mines against the extra flow of water which gets into the workings through these surface subsidences.

Question 30.—I had 15 years' experience of mechanical coal-cutters in Scotland, where they are now almost universally adopted and are an absolute success. Generally, the conditions in India are ideal and, from a productive and labour-saving standpoint, they would be very useful. If machines were generally adopted, the labour-problem would be solved. There are several factors which militate against their adoption and, since I have had the humiliating experience of having had to abandon one attempt I made to introduce them into the coalfield, I am not speaking from conjecture. The main drawbacks are as follows :—

(1) Any isolated effort is doomed to failure as the machines have to compete with cheap native labour.

(2) The cost per ton will be no less than at present.

(3) The miners prefer to go to a colliery where no machines are at work.

(4) The basic factor in keeping back this, and all other reforms in the mining industry, is the small margin of profit. Unless an enhanced rate is got for coal, machine coal-cutters will not become general. If the standard value of Indian coal be raised to such an extent as to warrant the adoption of machines, then their adoption will not only become general, but will be amply justified, if a scheme is drawn out on the following lines :—

(*a*) An approved type of "short-wall" machine should be chosen.

(*b*) The requisite number of machines should be provided to give the desired output, and all coal-cutting should be done in the night time only.

(*c*) Tram-lines should be laid into every working gallery.

(*d*) Electric locomotives should be used to transport the coal tubs from the faces underground.

In conclusion, I would warn all against haphazard attempts at coal-cutting by machines. Unless all conjunctive arrangements are in unison, and on the lines laid down above, the advantages will be nullified to such an extent as to render them a failure.

Oral Evidence.

Question 2.—If present leases could not be dealt with, I think the question of controlling leases is rather belated. My written answer is with particular reference to the Kirkend end, Nos. 13 and 15 seams. The properties are comparatively small and the mischief has been done already. I think *salami* should be abolished altogether. It is not taken at Home. Once the landlord gets his *salami*, he takes little further interest in the working. He should only get rent and royalties, and I would have maximum royalties and rents fixed. With a controlling authority, the *salami* question would largely disappear. The lessee would, however, still have to obtain a quick return and would work the coal most easily available. He might not, therefore, work economically, and I would, therefore, still do away with *salami*. I do not know how *salami* could be stopped. Legislation would not necessarily put an end to it. I do not know of any case of sub-leasing at a higher *salami* than that demanded by the landlord or revenue-payer.

Question 3.—There is a lot of wastage owing to all coal not being weighed. Under present conditions, it would be impossible to prevent miners taking first class coal as there are too many openings. Any compulsion as to quality or place of taking would mean loss of the labour.

Question 5.—There must of course be more facilities for teaching surveyors before better qualified surveyors can be obtained. Such surveyors would not, in my opinion, be more costly.

Question 6.—My answer refers to Nos. 13 and 11 seams, 14 feet and 22 feet (less 8 feet left at the bottom) respectively, with 40 feet between the two seams and about 250 feet of cover. The calculation is not very exact. The roof was very good and the results would not be correct generally.

Question 9.—Even with a Government order making two 12-hour shifts universally compulsory, I do not think such shifts would be practical because of the larger number of openings, and because of objections from the labour if forced to stop work at a certain time.

Question 10.—I have never heard of miners leaving the coalfields to go to tea-gardens. I had to turn away miners last year during the rains owing to the workings being flooded.

Question 14.—No compulsion of the smaller collieries would be required if electrical plant, etc., were provided on a hire-purchase system.

Question 16.—Colliery locomotives would facilitate work because they could take wagons to any part of the colliery where they were required at the moment.

Question 18.—There is no reason why coal of various qualities should be mixed at central loading depôts. I would have separate screens at the depôts for each kind of coal. This is practically what we are doing at present.

Question 20.—I have no coal in stock now, but I know of stocks which have been lying on the collieries since the beginning of the War.

Question 22.—I see no reason why there should not be standard wagons for the coal trade. They may be returned empty without any backward load.

Question 25.—I do not think that the sand supply is sufficient for the sand-stowing requirements of the collieries, but ash and earth ordinarily used for bricks might be used mixed with sand, and would make a better stowing material than sand by itself as it would harden like cement. This would be cheaper than sand from the rivers. I do not think ashes would fire. With these additions, the material available for sand-stowing would be sufficient, I think. The water would not always be sufficient; sometimes a water-supply would have to be installed, sometimes extra provision would have to be made to remove the additional water. There are, in my opinion, more collieries with water to lend than collieries which would have to arrange for or borrow additional water.

Question 26.—The pillars are 40 feet and the galleries 10 feet wide.

Question 27.—My figure of Re. 1 includes the cost of bringing sand to the collieries. The latter would be from annas 4 to annas 8 a ton including the cost of distribution at the colliery. Kirkend is about eight miles from the river.

Question 28.—I have not gone into any detailed figures as to the extent to which life and productivity would be increased.

Written Evidence of Babu Lalit Mohan Chaudhuri, Manager, Babuisole Colliery, Raniganj, nominated by the Indian Mining Federation.

Question 1.—I am the holder of a first class mine manager's certificate. My experience extends over a period of 25 years in Bengal and Bihar and Orissa.

Question 2.—Considering the unreasonable and unconscionable terms embodied in some of the existing leases for coal lands, I think it desirable that there should be a controlling authority to supervise existing and future leases and advise as to the best method of parcelling out when required. This would ensure a systematic and scientific method of working each plot. This may, however, require legislation to empower such an authority to enforce its orders.

If such an authority is set up, it should be composed of old and experienced colliery proprietors and chief mining engineers with one Government mining official at the head, and there should be an appellate court composed of the Commissioner of the Division and four mining experts as assessors.

Question 3.—I do not think it practicable to set up a weighing machine at each colliery for weighing all coal taken out of the mines. Except in the few cases, where large holdings are worked by two or three pits only, the proposal will tell heavily on small mines, as also those where coal is carried to the surface from a number of inclines (and their number is not inconsiderable) considering the fact that coal is drawn from shallow depths near the outcrops. In such cases, weighing coal will be impracticable. Coal taken by miners for their own use should not be weighed.

Question 4.—It is practicable to shew each year's working in different colours on the colliery plan, and the accurate size and shape of the pillars. If this is done, the necessity of weighing coal, will be obviated for the purpose of ascertaining the actual quantity of coal cut.

Question 5.—The surveyors that are now generally employed in the coalfields are, I think, capable of putting correct levels to a common datum on the plan.

Question 6.—During the whole of the last year, I had occasion to extract pillars from a seam 7 feet in thickness and practically no coal was lost. Even the old slack that was lying in that part of the mine from which the pillars were extracted has all been got out.

Question 7.—I have no experience of working a lower seam under an upper one which was left unworked.

Question 8.—I think that, as a rule, the controlling authority should have power to insist that coal seams should be worked in vertical rotation when the ordinary methods of working are in vogue. This body should, however, have wide discretionary powers so as to allow of a thin or unmarketable upper seam, or one much cut up by faults or other disturbances, being abandoned.

If sand-stowing is made compulsory, a lower seam may be worked leaving an upper one untouched. Much still will depend upon the nature and thickness of the strata between the two seams, and upon the thickness and nature of the coal worked.

Question 9.—Considering the fluctuating and independent nature of the labour now employed in the collieries, and the fact that the demand is always more than the supply, it would not be

advisable that a system of regular shifts should be adopted by the collieries. It would only be effective if its introduction is made universal and gradual.

Question 10.—There is a recruiting staff maintained in the colliery whose duty it is to go round the villages whence miners generally come, pay advances and *khorakee*, and send the miners, as soon as a sufficient number has been collected, to the colliery with a sirdar. It will be a great improvement if miners can be induced to settle in a colliery.

Question 11.—The provision of suitable plots of land for cultivation may improve the supply of labour, but would not improve raisings. Experience, however, shows that those companies who have provided lands for the miners, do not get more coal than those who have not made such provision.

Question 12.—Under present circumstances, the formation of a colliery settlement off the coal-fields is not practicable. There would be an increase of expense and less likelihood of efficient control being exercised and there will be better opportunities of inducing labour to go elsewhere. Colliery companies will never combine to form such settlements so long as the supply is much less than the demand.

Question 13.—There is no system of training the different classes of labour here.

Question 14.—In this country, mining is not even 100 years old. The majority of the mines are shallow, and the winning of the coal is generally confined to small inclines, the coal being carried to the surface in baskets. Heavy flows of water are not usually met with. A vast quantity of the coal land in the Raniganj field still remains virgin. Considering these facts, I do not think that the time has come when the general use of power is a necessity. Power is only efficiently used in deep pits for pumping and underground haulage.

Question 15.—I had no occasion to make any experiments in mixing different seams of coal from the point of view of steam-raising or coking.

Question 16.—Under present circumstances, I do not think it practicable for colliery branches and sidings to be worked by colliery locos. These branches and sidings are owned by the constructing railway company and, even if they can be induced to allow such branches and sidings to be worked by colliery companies' locomotives, the difficulties and drawbacks are many, specially cost. It is doubtful if the companies working their collieries on a particular branch would combine to have their own locomotives.

Question 17.—The present practice is that restricted workings begin from a distance of 150 feet away from the railway line or siding, which means railway boundary. The acquirement of such additional lands, which are at some places very extensive, does not appear to be reasonably necessary for their safety and actual support. If all such lands were relinquished, the coal underlying such tracts will be available for ordinary workings. The restricted workings may thus be confined to the actual branches or sidings. The additional coal required for larger pillars under them would not then be much.

Question 18.—I do not think it practicable or advisable to remove a number of the existing sidings and haul coal on the surface in colliery tubs to central loading depôts. There would be much increase in cost and various complications would arise among the combined colliery owners and their staff.

Question 19.—Such concentration would not result in a reduction of the number of loading coolies. They or, for the matter of that, surface coolies generally do not consent to work underground. A few of them may take to underground work when they cannot find sufficient work on the surface. If screening plants are installed, the number of loading coolies required for loading a wagon would undoubtedly be less, but the cost would be higher.

Question 20.—Of late years there has never been a sufficient supply of railway wagons. This deplorable state of things is the main cause of the waste entailing great loss that is now taking place on the surface at collieries. The stocks depreciate in quality, the volatile carbonaceous matter being all lost by long exposure. The coal disintegrates and turns into slack, while quantities are stolen and blown away by the winds or washed away by the rains and floods. The increased handling of coal also increases the percentage of small coal.

Question 21.—The general quality of the coal and the sizing of different descriptions will be advantageous if coal on arrival at the surface were immediately passed over screens into wagons. All the loss mentioned in the reply to Question 20 will be obviated.

Question 22.—Screening and sizing plants have not been generally adopted in India on account of heavy working expenses. Covered wagons are not suitable for being loaded by screening plants, unless a change is made in them to suit the purpose of such loading.

Question 23.—It is certain that, unless the proposed controlling authority is empowered to direct when such pillars should be got, the power to insist that pillars should only be got by sand-stowing process would not be useful. The expenses would, however, increase so much as to make it impracticable for small collieries to adopt sand-stowing.

Question 24.—The introduction of such control would affect the output unless a mine is so arranged that the working in a particular district or districts could be going forward in the first or "whole" working, while other districts would be "following up" or "coming back" in the second working, or "broken" with packing. This brings in the question of working in panels.

Question 25.—Ropeways alone could not assure a sufficient supply of sand for stowing.

Question 26.—Approximately 29 c. ft. of sand will be required to replace one ton of coal.

Question 27.—The approximate extra cost per ton of coal got from pillars by sand-stowing would be 12 annas, if the sand were delivered at colliery free of cost.

Question 28.—Sand-stowing would increase the life and productivity of the colliery.

Question 29.—If the present system of breaking up the surface by goafing continues, the "come" of water in the collieries would materially increase if sufficient barriers are not kept to isolate the parts from which pillars are extracted from those where whole workings are going on.

Question 30.—Mechanical coal-cutters have been tried in the past, but have not proved a success. They may be, however, profitably employed in first class seams.

Oral Evidence.

Question 2.—The controlling authority should have executive officers and a technical head to co-ordinate their work and pass orders in the first instance. This technical head should be of the same status as the present Chief Inspector of Mines. There should be an appeal from his orders to the board which I propose and, in order to provide for differences between the board and the technical head, there should be another appellate authority of some sort. The "mining experts" I refer to would be of the status of superintendents or chief mining engineers. Perhaps after all a further appellate authority beyond the board would be unnecessary, but I would not limit the rights of parties to appeal as they like.

In my remarks about leases, I have in particular the leases of the Kasimbazar estate in view. In them, the terms on which work is to be carried out are often impracticable, *e.g.*, the pillars cannot be extracted without permission and the payment of further *salami*, and there are difficulties about getting further land for colliery purposes. A penalty of eviction for non-compliance with the various terms is also too severe. I think the terms of existing leases should be modified in these respects. The power to do so would have to be conferred by legislation. The parcelling out of land should be made more scientific and practicably workable. I would have no minimum limit to the amount of land which could be parcelled out. I agree that plots should not be too small because such plots could not be properly worked, but lessees should not be restricted provided they work properly. Also the landlord's rights to let out large areas to one lessee should not be interfered with.

Question 5.—I refer to surveyors ordinarily employed by companies. I have no experience of *thika* surveyors.

Question 6.—A 7 foot seam would not require sand-stowing. In the case I mentioned, the surface dropped. I have no experience of extracting pillars from thicker seams.

Question 9.—Some of my miners work 24-hour shifts. This labour would be lost if shifts were restricted to 12 hours. None remain more than 24 hours. They come from villages a mile away, labour coming from longer distances being settled on the colliery. If 12-hour shifts were compulsory and universal, there would be trouble with the labour. The coal of the Chora Colliery, where I was manager for some time, is exceptionally hard and I do not think the miners could complete their work in 12 hours. Over the two coalfields as a whole, 12-hour shifts would, I think, be practicable as proposed, except in carrying inclines.

Question 14.—"Majority" means numerical majority.

Question 17.—I mean that, within 150 feet, notice must be given of working.

Question 23.—In small collieries, especially those working inferior coal, sand-stowing in order to win pillars would be too expensive, even if sand were delivered at such collieries free of charge.

Question 26.—29 cubic feet of sand would weigh about 1·4 tons. My figure only covers the actual coal recovered. It is only an estimate.

Question 27.—My price of annas 12 only refers to the 1·4 tons mentioned above. The cost of the whole stowing would be two or three times as much. I have 40 feet pillars and 10 feet galleries.

Question 30.—The cause of the failure of mechanical cutters was the dislike of the miners and the expense. I have seen no electrical coal-cutters and do not know how the labour regards them.

Written Evidence of Mr. D. N. Das, General Manager of Messrs. Banerji and Company's Collieries, Raniganj, nominated by the Indian Mining Federation.

Question 1.—I am a Bachelor of Science in Mining Engineering of the University of Glasgow, and holder of the Indian first class manager's certificate of competency. I have worked in different collieries in the capacity of surveyor, assistant manager and superintendent of mica, plumbago, manganese and coal mines in India since 1906; and I have over two years' experience in some mines in the counties of Lanarkshire and Cumberland.

Question 2.—In view of the enormous loss of coal resources under the present system of working, it is advisable that a controlling authority, composed of the various interests concerned, should be set up. This body will interfere with the leasing out of lands only in respect of areas to be leased out at a time, *i.e.*, it will demand production of a plan from the landlord who desires to lease out his land, and point out therein the manner in which the property should be leased out. It will further advise the landlord as to the best manner in which the property may be worked only in so far as prevention of wastage of coal is concerned. It is unnecessary that the controlling authority should insist on a particular manner of laying out a property which affects other points, such as a high output, a low cost, etc., which are matters that concern the capitalist only and his landlord. In short, the controlling authority should exercise its power of dictating the manner in which a property has to be let out and worked, only with the sole object of saving unnecessary loss of coal, and it should not have the power of dictating other terms and conditions of the lease, which will tend to interfere with the liberties of the landlords who will choose their own tenants. A capitalist or a limited company, before laying out his workings, should submit his plan of working to the controlling authority, who will examine such and approve of it if such plan of working is consistent with the purpose for which this body is formed, namely, saving of wastage, and, in case of disapproval from this point of view, the controlling authority will offer alternative suggestions not inconsistent with the capital available for the purpose, and will invite the capitalist to adopt any one out of them that appears best suited to his requirements, and this shall be final. The above refers only to leasing out of prospected coal areas, but, in the case of unprospected coalfields, the interference of the controlling authority will serve no useful purpose and is inadvisable.

To ensure success and justification for the formation of such an authority, it is necessary that the various interests concerned should be represented, and the controlling authority therefore should in my opinion consist of 14 members as follows:—

1 Government Official (Chief Inspector or an Inspector of Mines) as President.
2 Representatives of the two railways.
2 Indian colliery managers, one each from the Raniganj and Jharia fields.
2 European colliery managers, one each from the Raniganj and Jharia fields.
2 Representatives of landlords, one each from the Raniganj and Jharia fields.
2 Representatives of the mine-owners, one each from the Raniganj and Jharia fields.

When taking up the case of a particular land or colliery, the landlord, owner and manager and, where there is no manager, an expert appointed by the owner, will also take part in the deliberations. Each of the members will have one vote and the president will have a casting vote

Question 3.—It is impracticable to weigh all coal brought out of mines except where machinery is employed for the purpose of raising. Besides, in mines where coal is raised in baskets and heaped up on the surface by miners, it will be a tedious and expensive job to weigh such. The same will be the case with the coal taken by miners from mines for their own use. It is admitted that weighment of coal raised will serve as a check on all waste underground, for instance over-riding of pillars during pillaring, any scaling of pillars, stooks left in the goaf, etc. But for the reasons mentioned above it is impracticable.

I may add here that an accurate percentage of total waste is, in my opinion, obtainable only by a quarterly or half-yearly measurement of all pillars and galleries in the mines by the colliery surveyor, such measurements to be checked by special surveyors under the Controlling Authority. The difference between the figures obtained by these two successive measurements and the actual despatches will represent the total waste.

Question 4.—It is quite practicable that each year's working should be marked in the colliery plan in different colours showing the size and shape of pillars accurately enough for the purpose for which it is intended.

Question 5.—The surveyors in the coalfields generally are not capable at the present time of putting correct levels to a datum in plans. But, if such is required of them, it will be necessary to teach them to do so by holding a periodical training camp under the direction of the controlling authority.

Question 6.—Pillars are being extracted in collieries under my supervision where, from galleries and pillars 14′ wide and 35′ square, and 10′ wide 25′ square, and leaving about 3′ of coal in the roof, about 40 per cent. had already been taken in the first working. Out of the balance, calculations from an average of six months' workings have shown a loss in pillaring alone of 25 per cent. The percentage of the coal lost out of the total quantity in the seam comes therefore to about 15 per cent.

Question 7.—I have known of an inferior quality top seam having been left and destroyed while a bottom seam of better quality has been taken in E. I. R. Karharbari coalfield. I have also experience of a bottom seam being taken away underlying an old top seam containing very wide galleries and extremely small pillars unfit for pillaring, and consisting of practically unmarketable coal.

Question 8.—It will be advisable to empower the controlling authority to insist on working of seams in vertical rotation (if "working" means "extraction of pillars"), but it need not object to the simultaneous working of top and bottom seams, or to the mine-owner's option of working the whole bottom seam before the top seam is begun because probably the market is unsuitable for the top seam for the time being. The controlling authority should, however, make an exception in the case of a top seam which is not profitable to work, either on account of its bad quality, or from any very great

difficulty in the working of the seam, or where the area of a bottom seam lying below 400′ is as small as 8 to 10 bighas.

If, however, sand-stowing were not made compulsory, and if the bottom seam underlies at a distance of less than 250′-300′, the controlling authority, subject to the exceptions described above, should insist on working in vertical rotation.

Question 9.—It is advisable to introduce regular shifts universally, but it will not be practicable under existing labour conditions. At present, there are not enough miners to work even two shifts in all the collieries all the year round; and, in some instances within my knowledge, mines had to be closed down during the night for a few months for sheer want of miners. In order, therefore, to give effect to this most desirable suggestion for proper and economical working of the collieries, the first thing that should engage attention is some means of securing an adequate supply of labour in the collieries.

Question 10.—We have recruiters and miners' sardars—in some mines only the latter—through whom we get our miners. We pay travelling expenses and certain advances to the miners for this purpose, and only the districts, where miners accustomed to the particular nature of work in a mine are available, are chosen. As for surface labour, we get as much as possible from the neighbouring villages where a few miners are also sometimes available. When there are not enough supplies from this source, and this deficiency is not made up by labour coming to work of its own accord, we have recourse to the services of recruiters also. In this way, we induce many of the miners and surface labourers to get settled down on the collieries, while the rest of them, recruited from distant villages, work for a month or two, sometimes longer, and then go home again, either for the purpose of attending to some domestic work or for cultivation during the rains, and after that recruiters are again sent for them and some return of their own accord.

To improve the labour conditions, I would suggest that a regular system of recruiting, either by individual mine-owners or through recruiting bodies, on the same lines as those adopted by tea companies, should be established. These recruiters will recruit their labour from far-away districts and get such labour to take to mining work, for which the recruiters will receive certain sums of money for each labourer they bring as a miner, besides a commission per tub or per ton of coal or per working day, in order to induce them to carry on with their work. It will materially help if an enactment is possible to set apart certain districts for recruiting coal-mine labour only. This, I believe, is possible, since it appears that the supply of labour for the tea districts is at the present moment quite satisfactory after the continued annual famine of the past few years. It is so much easier for the tea companies to get labour, because the recruited labourers do the same kind of work at home as on a tea garden. It will, in my opinion, be a good idea to try to form a large recruiting company, possibly subsidised at the beginning by the general coal trade, which would take up the question of recruiting labour from out-of-the-way and famine-stricken districts, and make some sort of arrangement with the existing colliery companies for their training. Besides the above, it is possible to get a large supply of labour from amongst the inmates of Government prisons who are at present condemned to do hard labour. This would fetch a very good income for the Government, while training the convicts to take to this very lucrative profession, and follow it after they receive their liberty, will tend to improve their morality and will materially decrease crime in the country.

Question 11.—I do not agree with Mr. Rees' suggestion that the provision of suitable plots of ground for cultivation to miners would improve labour conditions to any extent. In certain cases, this system induces the labour to settle down on the collieries, but such labour devotes more time and attention, as a rule, to its land than to the colliery work, and thus becomes habitually irregular in attendance and induces others to do the same. It may be contended that this prevents the miner going to their native homes for cultivation, but it is neither possible to supply enough lands for this migratory miner, nor is it any good if he stays on the colliery and attends to his cultivation.

Question 12.—Formation of colliery settlements will, in my opinion, not improve matters over the present system, as the districts from which we recruit our labour will not then be dissimilar to the proposed colliery settlements, since miners from such settlements would be just as difficult to bring in regular shifts by means of mechanical transport, and would be as difficult to recruit for a particular colliery as under the present system, until and unless the present scarcity of labour disappears, when cause for the formation of such settlements will not arise.

It is not feasible for colliery companies to combine to form such settlements.

Question 13.—My answer is in the negative.

Question 14.—In view of a large amount of fuel consumed in inefficient separate steam generating plants, and in view of the want of an adequate supply of power in the collieries specially for pumping purposes, which complaint is practically universal, it will be a boon to receive electrical supply from central generating stations at a moderate cost; but, as regards an enactment to enforce universal application of electricity, it is practicable only when the electric company would undertake to supply and erect all the necessary machinery and appliances for all those owners who cannot lay out the necessary capital, and realise the cost thereof with reasonable interest in equal yearly instalments over a period of, say, 20 years or in the shape of a royalty on raisings.

As it is not possible to supply power to all the collieries for some time to come, any enactment may as well be postponed, and a start made with having enough current available at a very moderate cost. This will probably induce the majority of large mine-owners, who contribute nearly 80 per cent. of the total output of the Jharia and Raniganj fields, to take advantage of electric

power without the necessity for any enactment whatsoever. The remaining 20 per cent. will find it to their advantage to follow suit, particularly if the electrical companies offer inducements in the way of supplying and erecting the appliances on an easy payment system.

Question 15.—For consumption in boilers, I have mixed 1st class and 2nd class slack coal and have got almost the same results as with 1st class slack alone, thus making a certain amount of 1st class slack available for despatch. I expect, in the case of coking also, a judicious regulation of the proportion of two seams of different quality will, except under special circumstances, give beneficial results.

Question 16.—It is neither practicable nor advisable for colliery branches and sidings to be worked by colliery companies with railway company's wagons and colliery locomotives, because, though it will liberate a certain amount of coal, yet it will be very expensive for most of the colliery owners to provide and maintain broad gauge locomotives. Besides, it will introduce a lot of complication of, and unnecessary addition to, the duties of a colliery manager. It is not advisable, as the introduction of such a system may induce colliery owners to reduce the support underneath sidings beyond the limit of safety, thus probably causing subsidences and loss of locomotives and railway wagons.

Question 17.—If the above system is introduced, the saving of coal from barriers compatible with safety will probably not exceed 20 to 25 per cent; but, considering the cost and upkeep of a broad gauge locomotive, even though small, for the purpose of dealing with a very small number of wagons, the additional use of fuel, and, if electricity is employed for the purpose according to Mr. Rees, the additional complications necessitated thereby, it is not in my opinion, worth the trouble.

Question 18.—It is not advisable nor practicable for a number of existing sidings of different owners to be removed and coal hauled on the surface in tubs to one big central loading depôt for the following reasons:—

(1) It will be difficult to distinguish tubs belonging to different collieries and, even if tubs are marked with some distinguishing mark, it will give rise to smuggling of each other's coal.

(2) To maintain the output, an extremely large number of tubs will be necessary, which will represent a prohibitive investment for colliery owners and, as a result, the raising and despatch of collieries will be reduced.

(3) Feeding tram lines from, different collieries will destroy more cultivated land, and will cause unnecessary trouble and litigation about surface rights unless such surface rights are acquired under the Land Acquisition Act.

(4) It will induce pilfering of coal from tubs.

(5) To ensure smooth working of the system, and to ensure the coal reaching its proper destination, the cost of supervision will be unnecessarily large.

(6) On account of the distance of the loading depôt from the colliery, the supervision of such loading depôt by the manager will be tedious.

Question 19.—Such concentration of loading depôts will undoubtedly reduce the number of loading coolies employed to some extent under the present system of wagon supply, but so few of those relieved from loading will be willing to take up mining work, that such benefit will not be appreciable, particularly if the wagon supply is improved. If screening plants are installed, it will introduce further complications and unnecessary investments of capital, as the Indian market does not demand screened coal. This will save a certain number of loading coolies, but so few of them would consent to work in the mines that such investments on screening plants, until the wagon supply is materially improved, and until the market demands it, will not be worth while.

Question 20.—There has never been a sufficient supply of railway wagon constantly available for the transport of coal. The effects of this insufficiency of wagon supply are as follows:—

I. Collieries run into very heavy stocks and such stocks lying for months and months deteriorate in the following manner:—

(*a*) Outbursts of spontaneous fire.

(*b*) Lumps crumble into dust by atmospheric influence, falling of coal tubs, traffic of tubs over coal, traffic of carts where such is employed, more handling, etc.

(*c*) Dust blown away by wind and washed away by rain.

(*d*) Loss of quantity from oxidation, thus reducing its market value.

(*e*) Loss of evaporative power of coal due to miscellaneous atmospheric influences.

II. Such accumulation of stocks seriously interferes with proper working of the collieries, and
(*a*) reduces the output on account of delay in return of tubs;
(*b*) advantages from a mechanical loading plant cannot be obtained;
(*c*) such reduction of output increases cost per ton and increases fuel consumption per ton of coal raised;
(*d*) a large amount of capital as represented by the stock lies idle, the interest on which increases cost per ton;
(*e*) delay in return of tubs causes difficulty in proper distribution of tubs to miners, and thus recruiting of miners becomes more difficult; and

(*f*) it is difficult to keep the tramming coolies at their work on account of increased work due to congestion, besides requiring many more leading and loading coolies.

Question 21.—If sufficient wagons were available, all the ill effects, as enumerated above, will be eliminated, and saving of coal in quantity and quality (heat energy), which is as great as 20 to 25 per cent., and in some instances even up to 40 or 50 per cent. when fire occurs, will be effected.

Question 22.—Screening and sizing plants have not been generally adopted in India for the following reasons:—

(*a*) There is no great demand for sized coal except in isolated cases.

(*b*) No extra price is therefore obtained by colliery owners for sized coal.

(*c*) Scarcity of wagon supply.

(*d*) Want of wagons suitable for loading by mechanical means.

(*e*) Supplying of wagons in one shift only which makes it imperative to stack output obtained in the other shift.

The most convenient type of wagons for loading by mechanical means is the open one, though in some instances covered wagons are loaded by loading plants provided with suitable telescopic chutes. But, this being rather inconvenient, some such alteration in the existing covered wagons as—

(1) dividing the top of the wagon into two halves lengthwise, or across the width, and having one part sliding over or under the other;

(2) half of the top may be kept rivetted, and the other half in the form of a lid working on hinges and actuated by a simple mechanical arrangement attached to the loading plant;

(3) by alteration of the sides.

Question 23.—If sand-stowing is made compulsory, it will serve no useful purpose for the controlling authority to dictate when pillars should be got, as the colliery manager, who is qualified to ascertain how and when pillaring operations should be commenced, would be as good a judge of the situation.

Question 24.—Such control would unnecessarily interfere with the ordinary working of the collieries and would tend to disorganise labour and affect output unless—

(*a*) a sufficient supply of sand is available on the colliery at an uniform cost, even during the rainy season;

(*b*) the necessary appliances are made available;

(*c*) sufficient power for dealing with additional pumping is available.

(*d*) there is no interference and total stoppage of work on account of the choking of pipes and temporary break-downs of pumping appliances.

Question 25.—My answer is in the negative.

Question 26.—In some of the collieries under my supervision, 40 per cent. of the coal has already been removed by gallery working. In order to get a ton of coal from what is left, I calculate that, for one cubic foot of coal, 1·2-3 cft. of sand will be necessary. This represents about 2½ tons of sand to a ton of coal.

Question 27.—If sand were delivered free of cost at my colliery, the cost per ton will be somewhere about R1-8 per ton of coal because of the limited facilities for output.

Question 28.—In some collieries under my supervision, sand-stowing will reduce output, and this, together with the saving of wastage, will necessarily increase the life of these collieries.

Question 29.—Under the existing system of breaking down of surface by goafing, the water accumulation in such goaf after the rainy season does seriously interfere with working in the neighbourhood of goaf areas, especially where pumping appliances do not have sufficient margin of power, which I believe they don't have in most collieries.

Question 30.—Mechanical coal-cutters have been introduced by several companies, such as Apcar & Co., Bird & Co., Bengal Coal Co., but they have invariably been a failure on account of the fact that they could not get Indian labour accustomed to work such machines and have found output obtained much cheaper by miners' picks. Universal introduction will, in my opinion, be unsuitable and unwelcome, because labour is too cheap, while the thickness of seams in most collieries does not permit of the efficient employment of machine-cutters. Besides the above, a suitable form of energy, *i.e.*, electricity or compressed air, is not at present available at all collieries.

Oral Evidence.

Question 2.—I want a board and not an individual technical authority. The board, when fully constituted, could appoint experts as it found necessary. The board would of course have to see that its orders, *viz.*, stipulations or conditions in the lease to prevent wasteful working, have been carried out. The controlling authority should only decide on general principles and leave details

to the managers. Power should, however, be given to the controlling authority to interfere and stop wasteful working where it was occurring. I do not think the present leases should be revised as this would not do much good by itself. Inspection and instruction are the important points. The controlling authority should be given such powers by legislation if necessary. I would not mind the interference involved with the authority and working methods of managers who are working wastefully.

Question 6.—15 per cent. is, I think, fairly accurate, though not actually based on measurements. The seam was 14 to 16 ft. thick.

Question 14.—Most of the first class coal is in the hands of larger companies.

Question 22.—Open wagons are best for mechanical loading, but thefts from them would be easier. I would prefer covered wagons adopted in some way for mechanical loading.

Question 23.—I quite agree that, if a manager is not working properly and his mine is likely to collapse, the controlling authority should be able to step in and stop his bad working.

Question 27.—I would not object to sand stowing if the controlling authority had discretion to insist on it according to the circumstances of each case, but sand-stowing should not be absolutely compulsory in all mines in all circumstances. There are some collieries which could not afford sand-stowing, and would have to stop paying dividends if compelled to sand-stow. My figure of Rs. 1-8 per ton is the estimated running cost at three or four of our collieries where facilities for a good output are limited, and it does not include interest or depreciation on sand-stowing plant.

Written Evidence of Mr. Jhaverilall Dholokia, Manager, Joyrampore Colliery, Jharia, nominated by the Indian Mining Federation.

Question 1.—My mining qualifications are colliery manager's first class certificate of competency. My experience of mining in India is over 15 years, 12 years in the Jharia and 3 years in the Raniganj field.

Question 2.—The controlling authority is not advisable. There seems to be no necessity to supervise existing leases; the negotiations were best understood by the buyers and sellers before the leases were executed and properly registered under the rules and regulations of the benign British Government. Supervision of existing leases means, if carried out in a wider sense, affecting all leases of the country and would produce instability throughout. The Indian Mines Act was passed in 1901 and the rules and regulations are being strictly carried out without infringing the terms of the leases, which were the same before as they are after. If we refer to the leases of 50 years ago, and of the present day, there is a decided improvement. If landlords who are not mining men could be placed in a position to trouble the management every now and then, there would be endless litigation and there won't be peaceful work. Regarding future leases, the landlords can well consult mining experts if they can yet understand their value, and buyers may then effect future leases on the best terms arranged and agreed upon. There are collieries in India from which suggestions can safely be taken, and these collieries, having exceptional advantages, could work out their plans without any controlling authority. Let me illustrate Giridih, where the coal is always sold up above raisings, supplies are guaranteed, assured and constant, where the best brains can put into effect whatever they think should be tried and done, and, where the above factors allow of such schemes being put into practice, the work becomes, and, is bound to become, a model one. The owner can instal screening, sizing and direct loading plants, he can give house accommodation, ground for cultivation to the labourers, he can instal coke-ovens of modern type and plants for recovery of by-products without any suggestions from any controlling authority. Give this industry a fair chance of quick despatch of coal, and much of the waste on the surface will be eliminated; not only waste, but expenditure and labour too will be curtailed. Let me illustrate this. The collieries have in fact very little siding accommodation. They cannot stack the coal there. Sidings in most cases may be far away from the pits or inclines. The coal has to be dumped near the pit, stacked, deteriorating as it does in quality, reloaded in tubs when about to be sent off to the wharf, trammed, unloaded there and loaded into wagons. All these separate operations require separate expenditure and labour, and entail reduction in size and quality, but if there should be, on the other hand, constant daily despatch, the tubs coming to the surface could be sent off by endless rope or other suitable contrivance, would be taken to the tippler, dumped and returned to the rope, and the contents passing over screens would automatically load the wagons, the size and quality remaining fair, working on the expense of only one of the many operations detailed above. New methods and new devices come out of different brains working independently according to local conditions by introducing new methods after trial on their collieries; but no invention, no improvement from stagnating the intellects of various men following certain courses fixed by authority possessing local experience, would be possible.

As explained above, by the constant wagon supplies, the expense and the number of labourers employed on the surface would be greatly reduced, and waste would be minimised. Most of the labour thus depleted would after a time consent to go underground and, with the introduction of coal-cutting machines, and with labour tempted and brought from other healthy districts, the raisings from the mines could be increased and to a certain extent maintained constant. Of course, stacks will have to be made at the time when labour will be abundant and these, if greatly accumulated, could be moved on during the rainy season when the wagons would be available to a greater extent.

To minimise the waste underground, it would be safer if, when laying out a colliery, the detailed plans and sections of the pits, surface arrangements, underground workings, power and plant to be adopted, could be prepared by the owners with express advice and guidance from a mining man, and could be forwarded with the notice of opening the mine to the Chief Inspector of Mines, who, if he can advise any improvements consistent with circumstances, may advise the owners and return all plans and sections as approved; if the owners work up to this, I think there will be a decided improvement. In this way India will always tempt the best mining men to come forward and will thus reap the benefit of their knowledge and be a direct gainer; also, the man in charge of the work will always be keen to eliminate waste. If, at a subsequent date, amendments in the methods and plans seem necessary to the management, these may be sent with details and, after acknowledgment, followed. This will also help landlords in getting an assurrance that the coal is worked in a better way and that their royalty per ton is improved and secured. But the functions of the Chief Inspector of Mines will be purely advisory.

This industry has experience in control over despatches, control over indents and supplies, control in fixing the rates for purchase of coal for the railways, the greatest consumers, and, as the wagon supplies are quite dependent on these controls, I think this industry should not be saddled with any more control, because, with these over-pressures, the industry would be made unable to raise its head. Control therefore is undesirable and not advisable.

Question 3.—The coal brought out in tubs from pits and haulage inclines can be weighed, but there will be difficulty in weighing the coal brought up in baskets and taken in baskets by the miners for their own use.

Question 4.—Yes. Each year's workings could be marked in different colours and, to some extent, the size of the pillars, but not the exact height of galleries.

Question 5.—Yes, they can put correct common datum after they are once shown.

Question 6. —On an average of three seams, 10 to 12 per cent. was the loss. The thickness of the seams where pillars are being removed is 25 ft., 11 ft. and 8 ft.

Question 7.—No.

Question 8.—It all depends on the market. All classes of coals cannot be sold at all times, and, at times, only the best variety has to be worked. The top seam should not be first worked when it is very close to the bottom seam, which with hydraulic stowing should be worked first.

Question 9.—The regular shift is advisable, but does not at present seem practicable.

Question 10.—The system of recruiting labour at my colliery is that we have a sirdar over a gang of miners. He brings the miners and looks after them. We pay commission to these sirdars, and any advances given are cut off from their commission amount. Better treatment, good houses and plots of land for cultivation, if possible, and recruiting labour from places where there is not enough work and consequent low wagon, would all help in increasing the supplies of labour.

Question 11.—Suitable cultivation plots could not be arranged on the Jharia collieries and no provision can be laid down for this. Each colliery owner works for his own interest and it is up to him to provide decent houses and better facilities to tempt miners to go to him.

Question 12.—It is impossible. How can children be left back? In this way they lose their liberty. Labour will not be constant. Miners will not be fixed and attached to a particular colliery. Attendance could be given to any colliery. Strikes will be common and the industry will be insecure.

Question 13.—Yes. A person is placed in charge of his work, the necessary instructions for which are imparted by his next superior, and practical training and constant work teach him a lot.

Question 14.—General use of electricity is advisable, but should not be compulsory. It can safely be used as power for pumping, haulage, coal-cutting by machines, running workshops and for all sorts of works; but winding engines would better be worked by steam. Because, if there becomes something wrong in the electrical power when the workmen be underground, pits being only available, the steam engines would help us in bringing the men out. I remember a case where electrical winders were fitted to the pits, and where the current was off for over 12 hours, the miners and the men underground experiencing the greatest difficulty. If either of the pits should have a steam winder, it would serve the same purpose.

Question 15.—No.

Question 16.—No. It is neither advisable nor practicable here, where there are so many concerns wanting to run their locomotives on the same line. The difficulty is wagons. If the railway companies be also short of locomotives, as could be presumed from the very slow transport, the number of locomotives might usefully be increased.

Question 17.—Retaining the present railway system, if the coal under the railway could be got by hydraulic stowing, over 80% could thus be worked, and this would be applicable for coals lying at various depths and of various thickness.

Question 18.—It is not advisable.

Question 19.—If screening plant be adopted even on the colliery wharf, the number of abourers required will be lessened, provided the railway wagons are plentifully supplied so as to

make it convenient to despatch the daily output. Unless the railway wagon supplies are assured and given, screening plants are no good, because the coal will have to be dumped, stacked, shifted and reloaded in tubs on the colliery, and hauled to the colliery wharf, or if stacked on the wharf be filled in baskets and loaded by men. This would not lessen the number of labourers in this case. But, if supplies are assured and given and all the raisings despatched directly, some labourers will be liberated and they may after some time work underground.

Question 20.—The hardship is the wagon supplies. Wagons are not supplied to the collieries according to their requirements, nay, some collieries have to fast for days together and, when favoured, they may get a wagon or so. This is most deplorable. Either the railway takes much time in running the traffic on their lines, or the wagons are short, or the locomotives are short; whatever the cause may be, no serious attempt at any time is made to cope with the demand. Thus the coal trade and the industries of India suffer, and much coal, by weathering and deteriorating on account of stacking, is wasted.

Question 21.—If coal were to pass immediately over screens into wagons, there would be no loss by weathering and other causes, so far greater tonnage would be despatched ; besides the dumping, stacking and loading expenses would be nil. If siding space is limited, the coal would have to be stacked on the colliery, and reloading into tubs, etc., would also be curtailed. There would be a quick return of money, and working cost and waste would be reduced.

Question 22.—The reason why screening sizing and plants have not been adopted in India is that the wagon supplies are almost nil, and these plants, where installed, could not be worked regularly and the coal had to be stacked. Open wagons are the best, but, if any contrivance be made so as to open the roof of the wagon, so that it can be by hinges accommodated in the side and expanded afterwards on hinges, the difficulty to some extent could be met.

Question 23.—It should be best left to the management for consideration. We do not think ropeways can supply us with the quantity of sand required. If sand be supplied by railway in wagons, it is impossible. On the one hand, coal is not being removed by the railway, then how can it supply sand ? If sand is not supplied up to requirements, the work would stop, and the constant and fixed working expenses would be so dear as to be an impossibility. Besides, the collieries favourably situated with respect to sand would have to pay less for haulage.

Question 24.—Certainly, a great deal, and the working cost will greatly increase in consequence.

Question 25.—No. Ropeways could not supply sufficient.

Question 26.—Theoretically 3·5, and practically 4·5, tons of sand to one-ton of coal.

Question 27.—If sand is got free of cost at the colliery, the extra cost per ton of coal will be Rs. 1 only, provided water in enormous quantities is also supplied free. At present most of the collieries in the rise have not got enough water to meet even their labourers' requirements.

Question 28.—The life and productivity of the colliery will be greatly increased by sand-stowing.

Question 29.—An enormous quantity of water will have to be dealt with in the deeper workings.

Question 30.—If the coal-cutters could be worked more cheaply than the ordinary miner, they would be welcome, but the power, *viz.*, compressed air, is very costly. The labour is cheap. Therefore they were abandoned where tried. If cheap power could be arranged, it would be very useful, the raisings would be constant, and would further be increased per head.

Oral Evidence.

Question 2.—If rules could be laid down for better and economic working without infringing the terms of present leases, I would have no objection. For better and economic working, I think working plans should be submitted to the Chief Inspector of Mines before opening out. I agree that there has been waste in the past owing to bad transport facilities and mining methods, but this cannot be remedied now in the older workings. One of my seams is 25 feet thick. In the old workings, the pillars are 22 feet and the galleries about 18 feet wide. In the present workings, the galleries are 10 feet and the pillars 30 feet. The rules and regulations should be so arranged that the lessees should follow the advice of the Chief Inspector of Mines regarding methods of working and conservation of coal. If his advice were not followed, there should be compulsion after a trial of ten years, and a controlling authority would be necessary to enforce such compulsion. This would be to the interest of the landlords, and the lessees could not be interfered with by landlords who are not mining men. The example of Giridih in my written evidence is cited because it shows, as a practical illustration, what could be expected without control if railway wagons were supplied according to requirements. The rules and regulations must be used with discretion and not so as to make any colliery work on any other than commercial lines.

Question 6.—In my 25 feet seam, the loss was 13 to 14 per cent. The roof was good, the cover being 90 feet. During 15 months of pillaring, 77 pillars were removed and 29,858 tons were recovered from small pillars. I have calculated that, taking an original pillar centre of 40 feet × 40 feet × 25 feet high, 825 tons were recovered at the first working, and 389 tons when the pillars

were goafed, thus making a total of 1,214 tons out of a possible recovery of 1,400 tons, the loss being 13 per cent. The loss in the 11 feet seam was about 10 per cent. and that in the 8 feet seam about 8 per cent.

Question 9.—12-hour shifts with a time fixed for their termination would be quite practicable if made universal and compulsory. Labour would adapt itself if it could not get any work elsewhere.

Question 12.—Women workers are necessary in India.

Question 23.—If sand were supplied free or at the same cost to all collieries wherever situated, my objection would disappear. As regards the proposed all-round flat rate of cess on all coal irrespective of quality, I do not think that, if such a cess were paid by the consumers, it would result in any alteration in the present ratio between first class and other classes of coal. The disproportion is, as a matter of fact, due to the wagon supply as a rule. If I sell to a railway, I can sell at a low rate as I know I will get wagons. If there were enough wagons, and all classes of coal were despatched on an equal basis, the market would not be disturbed by the cess as conditions would adjust themselves according to supply and demand. I quite agree that we should get all the first class coal we can. I think every colliery will want to sand-stow if they have paid cess and are to be repaid the working expenses of sand-stowing. The addition of a cess will mean increased cost to purchasers. Indian coal cannot compete with some foreign coal. Export of Indian coal will diminish and, if a rebate is allowed, internal industries will be at disadvantage. The Indian finished products will be sold dearer and hence could not compete with foreign products. The accounts of individual collieries may or may not be reliable, and thus somebody may make his all-round working cost cheaper. Sand-stowing would therefore be best left to the collieries. The minimum waste of coal in working should be arrived at and allowed after considering the expenses of capital expenditure, supplying sand to the collieries, and recurring working expenses of stowing.

Written Evidence of Mr. Glen George, A.M.I.C.E., Consulting Mining Engineer, Calcutta.

Question 1.—Certificated colliery manager. Bachelor of Science in Mining of the University of Wales, Chief Mining Engineer to the Bengal Coal Company from 1910 to 1920, Associate Member of the Institute of Civil Engineers.

Question 2.—While the controlling authority suggested by Mr. Rees would be desirable, it would be of little value without compulsory acquisition powers over mineral areas, which is, I presume, out of the region of practical politics.

Question 3.—The weighing of coal is strongly desirable in the interests of everyone, and there is no practical reason why it should not be gradually insisted upon, *i.e.*, first made compulsory in large mines, then in small. Weighment of coal taken by miners for their own use is, I fear, impracticable.

Question 4.—Practical and desirable.

Question 5.—No.

Question 6.—Yes. Loss 35 to 40 per cent.

Question 7.—Yes.

Question 8.—(*a*) No. (*b*) If sand-stowing for all coal were made compulsory, there would be no necessity for any such interference.

Question 9.—Practical and advisable. It should be brought about by legislation limiting hours.

Question 10.—(*a*) Offering labour free land for cultivation, free housing, and favourable working conditions.

(*b*) Offering better housing and general welfare conditions.

Question 11.—Has some practical effect, and is a good policy, but results are rather disappointing.

Question 12.—(*a*) An excellent suggestion for the congested areas in Jharia.

(*b*) Yes.

Question 13.—No.

Question 14.—Desirable, and practical if gradually introduced. The first step is the prevention of the erection of numerous comparatively small generating stations at present going on, and the development of large stations offering power at a low rate. The use of electric power might then be gradually made compulsory.

Question 15.—Yes. By the mixture of 1 part Disergarh seam coal (a coal low in ash, but high in volatiles and unsuitable for making blast furnace coke) with 3 parts of a Jharia coal, a satisfactory blast furnace coke can be made.

Question 16.—Practicable, but highly undesirable.

Question 17.—I fail to see that a mere change in ownership of the locomotives can affect the situation.

Question 18.—Practical, but inadvisable.

Question 19.—It is waste of time talking about the introduction of screening plants until an adequate wagon supply is provided.

Question 20.—There never, in my experience of 14 years, has been an adequate wagon supply except for two or three periods of 6 months each. The effect on Indian mining is most harmful. It prevents the introduction of improved methods of pitching and screening, and depresses the price of coal, as it places in the hands of the Railway Board an unequalled lever for that purpose. All large suppliers having collieries with expensive and up-to-date plant realise that their concerns must keep despatching, and thus must, whatever be the price, obtain railway contracts. It prevents any real combination by coal-owners, and hampers the development of large well-equipped collieries.

Question 21.—Larger sized and cleaner picked coal. Reduction in cost of working. Improvement in general equipment of collieries.

Question 22.—(*a*) The indifferent wagon supply is the chief reason.

(*b*) Screening plants require open wagons or covered wagons with hinged doors in the roof.

Question 23.—No.

Question 24.—Yes.

Question 25.—As a general expression of opinion, I would say ropeways alone are not likely to give such a supply of sand.

Question 26.—Three tons of sand per one ton of coal recovered from pillars.

Question 27.—If sand were delivered free, the net extra cost (*i.e.*, allowing for economies effected) would be small, not more than 4 annas per ton.

Question 28.—Increase its life by 25 per cent. and its productivity by 10 per cent. I presume, by productivity, output is meant.

Question 29.—The effect of pillar-cutting seams thicker than 16 feet at depths less than 300 feet will result in a great increase of water, unless special measures are adopted.

Question 30.—In special cases, *i.e.*, for development, where labour is particularly expensive, or where working cost is not the first consideration, their scope is great. For general use, hand-cutting is considerably cheaper.

Oral Evidence.

Question 2.—I do not see how a controlling authority could control leases without the power to acquire land. A landlord could not be prevented from refusing to lease. I think legislation would be preferable to a controlling authority whose decisions will be variable. If it is known exactly what the interference is to be, it would be better than a variable interference which would have a prejudicial effect on trade, *e.g.*, on the flow of capital. I have no objection to rules being laid down regarding the size of pillars, etc., and I agree that these rules should be enforced by a supervising rather than a controlling authority. I would have fixed rules revisable at considerable intervals. I agree that a great deal of waste takes place, and that much of it can and should be stopped. I do not think that a controlling authority is the only remedy. I have no objection to Government rules similar to those under the Mines Act, and to a new department, under an officer like the Chief Inspector of Mines, to enforce those rules. I see no reason why rules should not be drawn up fixing the size of pillars with relation to the depth and thickness of the seam. Only minima should be fixed, latitude being allowed above these minima. My main point as regards a controlling authority is that its decisions should as little as possible be left to individual discretion. Interference that can be calculated is better than interference that is incalculable. As regards existing leases, I agree that the amount of yet unleased coal land is comparatively small, but I do not think that control of leases is the only remedy for the present state of affairs. Personally, I would nationalize minerals, meaning in this connection coal in particular. Government would compulsorily acquire the minerals on a fair market value. I think this could be arranged to the satisfaction of the landlords. The rules already proposed would, I think, be in the landlords' interest. Nationalization would do away with the indifferent royalty owner. I know of no landlord, except the Bengal Coal Company, who inspects his properties. I know of no instance of a landlord's agent being refused inspection. Landlords have powers of inspection, but I do not know of any cases where even the Bengal Coal Company has interfered with the lessees. I agree that it is very doubtful whether nationalization of minerals is practical politics. It would give Government a strong lever for controlling waste in the national interest. The controlling authority would then be the agent of Government for purposes of supervision. The present Government in England has accepted the principle of nationalization. I have no experience of Government agency or of the working of Government mines, but I know that Government is easily the most reasonable landlord. *Salami* as *salami* is justified, but it is often abused. This abuse is largely due to competition among the lessees. I do not blame the landlord, I blame the system. This system, *i.e.*, private ownership of minerals, can only be remedied by nationalization.

I admit that, if something is not done in the way of compulsion, the present waste will continue. It is an urgent question and should be remedied as such. I do not think economic

causes will of themselves provide a remedy. They will in fact operate the other way. No business firm can run its business except on business lines, and any one now doing sand-stowing would lose money, because he could not compete with the other people who do not sand-stow. Dividends would be restricted or wiped out, and a longer life for the property would not be sufficient compensation. Taking Rs. 1-8 a ton as a fair average of profit on all first and good second class coal, and an additional cost of annas 12 a ton for sand-stowing, a coal owner, even if he got 50 per cent. more coal, would lose annas 4 a ton on his whole output. I think it could be made an economic proposition for Government-owned minerals. Supposing Government acquired at annas 6 a ton royalty, and leased at a flat rate of Re. 1 a ton royalty, it could give a rebate of annas 8 a ton on all coal won by sand-stowing; failing this, there is no chance of sand-stowing though it is highly desirable. I know the new Land Acquisition Mines Act, and that a cess to provide compensation is proposed. I see no reason why the same principle should not be extended to sand-stowing, because you must subsidise the man who sand-stows. But, if you go so far, you might as well go the whole length and nationalize minerals. Nationalization could be effected by annual payments, but these would be matters for financial experts. Bad titles are a great difficulty at present and these difficulties would be removed by nationalization. Government, as the owner of minerals, would have the power to acquire such surface land as is necessary to the proper workings of the minerals. This is a common principle of leases and has been accepted by the Calcutta High Court. I have applied it myself in practice. The controlling authority would be a palliative if Government is not prepared to acquire minerals. I mean a controlling authority with definite rules to follow and powers of inspection and supervision.

Question 3.—As regards weighing the coal taken by miners for their own use, I think that the interference with the miners would outweigh any advantages there might be. I know of no mine where the miners are not allowed to bring coal up the shaft and are compelled to take coal from stock. Weighment is very desirable for statistical purposes, and would also reduce thefts. Payments would then be made by weight. I have successfully used weighing machines, and found that the tub averages were higher. The cost is not great. Where there are lots of openings, weighment would tend to reduce the number of those openings I would introduce weighment gradually in the larger mines first where conditions are more favourable.

Question 6.—The seam was about 16 to 18 feet thick and about 400 feet deep. I have done pillaring up to 800 feet. The loss varies but, where pillars were not taken systematically, the percentage of loss was much higher.

Question 9.—I would again start with large collieries and work down gradually to the smaller. Agreement is hopeless and legislation would be necessary. I include, amongst the small collieries, those raising up to 1,800 or 2,000 tons per month, but I do not insist on this limit. I do not think the smaller collieries could entertain the labour which the larger collieries might lose by introducing regular shifts. I think 12-hour shifts to end at a certain time would do very well for a start, but I would not fix the hour for finishing absolutely, as some mines might find other 12 hour periods more suitable. I think such regular shifts could be worked in the neighbourhood where the Sibpur seam is mined.

Question 10.—Granting of free land for cultivation gives disappointing results. It does no harm, but it does yield the results one would expect. If a man does not work on his own land during the rains, he would work on someone else's. The best recruiter is the colliery with the best underground conditions, *i.e.*, an easy face, tramlines, and, generally, the practicability of earning money quickly. One of my deepest pits was also my most popular one.

Question 14.—How the present companies should be treated in the event of the establishment of large power stations is a matter for expert evidence. As more facilities were provided I would gradually introduce compulsion as regards those collieries using fuel wastefully and refusing to adopt electrical power. I would also work down from the larger to the smaller collieries. I think the large supply company should be run on the co-operative principle. If run by a company, Government might have to guarantee a dividend, and I think it would be worth while to do this. As regards the application of compulsion, I think the balance of advantage in each case should be considered and decided on by experts.

Questions 16 and 17.—I do not see any advantage in the collieries using locomotives owned by themselves. In fact, all practical arguments are against it. Nor do I see how less support would be possible under such conditions.

Question 18.—This would be a retrograde step in my opinion. The sidings are already in existence and are a great advantage.

Question 20.—The periods of adequate supply to which I refer all occurred during the monsoon when of course sufficient coal is not usually being produced.

Question 22.—I would prefer open wagons, and do not think thefts would be excessive. The railway is responsible for loss of weight.

Question 24.—The output would be affected if the controlling authority could hold up working while sand-stowing is being arranged for, but I agree that the controlling authority ought to be able to look ahead.

Questions 25 and 26.—I do not think sand-stowing is an universal panacea. For example, seams less than 16 feet thick might be worked economically without sand-stowing. If compensation or a rebate were given, everybody will sand-stow even where it was not necessary. The controlling authority would of course refuse compensation or rebate in such cases.

I think crushing sandstone would be too expensive at the present selling price of coal. The whole question is one of Rs. as. pies. Coal is at present much too cheap. A cess on all coal mined would involve an import duty on foreign coal and a rebate on exported Indian coal as well. I think prices could be increased up to Rs. 2 or Rs. 3 a ton without injuring the other Indian industries. A very low price for coal is mischievous in the interests of the country as a whole.

Question 27.—My figure of annas 4 is per ton of coal. It includes depreciation on pipes and plant, but assumes a free supply of sand in the hoppers; it includes the extra pumping that would be necessary. The total cost at a colliery which I worked was annas 10 a ton, including the cost of excavating sand; there was a saving of annas 3 on timber and fire stoppings, and the extra cost was thus annas 7, of which annas 5 was paid for sand measured in the colliery. The pillars were under the river and could only be recovered by sand-stowing. An all-round figure of Re. 1 per ton for both coalfields would be quite fair in my opinion. This would cover mines up to 14 miles from the rivers. It includes transport costs assuming that special wagons would be available, *i.e.*, that they would be provided by the railways. Even if the railways increased rates to two-thirds of an anna per ton mile, which is twice the charge for carrying coal, it would only mean annas 8 per ton for a 12 mile haulage.

Written Evidence of Mr. R. Heron of Messrs. H. V. Low & Co. (Jharia).

Question 1.—I am the holder of a first class certificate as manager of a mine. My experience of mining in India extends from the year 1907 to date. I have experience of both fields.

Question 2.—In view of the manner in which leases have been prepared and coal mined, it is advisable that an authority be created to correct the errors and omissions of the past. The authority should have the sanction of law and such elasticity as admits of representation of the various conflicting interests. A scheme might be devised whereby the work could be undertaken by the Department of Mines.

Question 3.—I consider that it is practicable to weigh all coal brought out of mines and to keep an accurate record of it. Arrangements could be devised whereby one weigh-bridge would serve the purpose of weighing all coal raised from two or more pits or inclines as the case may be. In the matter of weighing coal brought up in baskets, there would be difficulties, but there is no reason why they should not be overcome The coal thus brought up in baskets might be loaded into tubs in the first instance (instead of being stacked in heaps) and the tubs brought to the weighing machine as in the case of tubs from pits and hauling inclines. The practice of allowing miners to carry coal out of the mine for their own use should be discontinued. (Incidentally the introduction of the weigh-bridge would serve as a solution in the matter of over and under-loaded wagons.)

Question 4.—I consider that it is practicable to have each year's working shewn on colliery plans in different colours. The plan should be an accurate representation of the working of the mine.

Question 5.—I should say that the qualifications of the average surveyor are not of a high order.

Question 6.—I have, from areas in which I have extracted pillars, calculated the percentage of recovery in relation to the amount of coal remaining in the pillars. In a seam 14 feet in thickness, the recovery was about 85 per cent. In a seam 24 to 26 feet in thickness, the recovery varied between 60 to 65 per cent. The recovery varies with—

(*a*) Width of gallery.

(*b*) Size of pillar.

(*c*) Thickness and depth of seam.

Question 7.—I have been concerned with the management of a colliery in which there were two seams. The lower seam was of the most commercial value. The distance between the two seams was about 75 feet. The lower seam was extensively worked and formed into pillars, and the pillars were ultimately extracted. The extraction of the pillars led to subsidence and rendered the working of the upper seam impossible.

Question 8.—To be effective, the power of the controlling authority must be such as to admit of the conservation of the mineral resources of the country. If, therefore, the controlling authority be given power to insist that seams should be worked in vertical rotation, the authority should likewise be given power to create a market for the sale of the commodity. If sand-stowing was made compulsory, it would effect my answer, because the mineral resources would, as the result of sand-stowing, be made secure.

Question 9.—The adoption of shifts would make for efficiency and provide better for control and discipline. The human element here presents itself for consideration. If legislation be adopted, you introduce compulsion. We know that the miner is an agriculturist first and a miner second. He often has to walk long distances to his work. You cannot compel him to be a miner. I feel convinced that anything in the nature of compulsion would be disastrous to recruiting, and that many now following the avocation would merely remain until they had made other provision. There further remains the manager to be considered. If he is of opinion that his mine will, by ignoring the regulation, be more popular, what is there to prevent him from ignoring it? The solution therefore is one of time and combination. I should say that the advent

of the mining settlement off the coalfields will play an important part in the solution of the problem, inasmuch as the miner would, in that event, be obliged to join some means of conveyance at an appointed time.

Question 10.—The system is to keep representatives in labour colonies. These representatives attend to the wants of the miners at their home, *e.g.*, advancing money to them to meet their requirements during seed-time and harvest. He further assists them in meeting expenses required in the matter of repairs at their homes. He is further arbitrator in the matter of petty disputes, etc. He therefore acquires a considerable influence over men thus situated, and this influence is exerted by him on behalf of his firm and enables him to send them into the mining settlement. An improvement in the supply of labour would be effected by better accommodation in the matter of housing, provision for bathing and recreation, and in general making the avocation of mining as attractive as possible.

Question 11.—The arrangement of suitable plots for cultivation at the collieries would improve the supply of labour thus far that those miners who have no land to cultivate at home could be induced to take up permanent settlement.

Question 12.—The areas reserved in the coalfield for housing accommodation is, by virtue of pillar extraction, rapidly shrinking, and this fact, together with the efficiency to be derived from fixed shifts, will do much to bring about the building of settlements outside of coal-bearing land. On the other hand, the introduction of sand-packing will preserve areas suitable for building accommodation which in other circumstances would be rendered unfit. I am rather inclined to think that the difficulties and inconvenience, apart from the expense, of transporting such a labour force daily from the mining settlement to the colliery, would be such as to deter the greater number of firms, and that few would be willing to build outside the colliery area unless and until they are compelled to do so by force of circumstances.

Question 13.—I have no system of training the different classes of labour other than that the son usually follows the avocation of the father and receives his training in that manner. In the case of a new recruit, he is placed under the guidance of an experienced workman.

Question 14.—In order to reduce the waste of fuel to the minimum, it would be necessary to compel collieries now using fuel in a wasteful manner to take power from central generating stations. In this connection, there are many small concerns which may not be in a position financially to arrange for the necessary plant. It would therefore be necessary to devise a means of financial aid at a moderate rate of interest. There is further the question of the existing plant. It may be quite capable under existing conditions of maintaining an output for a number of years. In the event of the adoption of a central generating station, such plant would be difficult of disposal. The prevention of waste, and the advantages to be derived as a whole, outweigh the hardships, assuming of course that control is exercised over the price charged for the electric current.

Question 15.—For steam-raising purposes, I have mixed different seams at the colliery and the results in steam-raising were satisfactory. In the manufacture of coke, I have mixed Nos. 13 and 14 seams (Jharia) and the coke thus produced was hard and dense and suitable in every way for blast furnaces.

Question 16.—I consider it is practicable, and from an economical point of view advisable, that colliery branches and sidings be worked by colliery companies. It would lead to the introduction of light locos for shunting. The area required for right of support would therefore be considerably reduced. It would further lead to the construction of marshalling yards and the centralizing of loading depôts. It would therefore liberate a considerable amount of coal and effect a saving of time now occupied in shunting, and it would be permissible, without loss of time, for colliery companies to make such alterations to their sidings as circumstances demanded.

Question 17.—The area of right of support required in the event of colliery companies working their branches and sidings would be considerably reduced owing to the fact that light locos would be introduced to do the work now done by heavy locos, and, in order further to economize, colliery companies could combine and form marshalling yards at points most convenient. I have not considered the matter with reference to the whole field, but, with reference to my charge, it would effect a reduction in the area to the extent of 33 per cent.

Question 18.—In this connection, much has been left undone that ought to have been done, and many collieries have been laid out in such a manner as to make the introduction of central loading depôts difficult and expensive. With the introduction of light locos, the colliery companies would assume responsibility and the matter would receive more attention. The colliery companies would have to bear the expense of shunting, and means would have to be devised whereby it would be discovered whether it was advisable to continue shunting or construct central loading depôts. If it was discovered that the coal could be hauled in tubs to a central loading point at an expense commensurate with shunting, the governing factor in the relief of coal required for right of support would decide the issue and would lead to many of the existing sidings being removed.

Question 19.—The concentration of plant tends to the reduction of the number of attendants required and would do so in this case, inasmuch as haulage would be designed to do the work of men and the screening plant (provided sufficient and suitable wagons were supplied) would do the work of the loading labour. As to whether loading labour would consent to work underground, the answer must be in the nature of conjecture. I should say that

provided they were comfortable in other ways, I see no reason why a considerable number of them could not be persuaded to undertake underground work.

Question 20.—There is a considerable discrepancy between my indents and supplies, and this discrepancy keeps me constantly carrying forward a stock balance. Whether this discrepancy is caused by an insufficiency of wagons or locos, or both, I am unable to say, but I do know that I am constantly carrying a stock balance, and that this is productive of waste due to atmospheric influences, traffic and pressure, and is productive of slack which in other circumstances would be despatched as coal.

Question 21.—If coal on arrival at the surface was passed immediately over screens into wagons, the loss incurred due to stacking would be avoided. There would be a reduction in surface and loading labour and consequently a reduction in cost.

Question 22.—The first maxim of business is return on capital expenditure. If circumstances enable me to determine that a return on the capital expended would not be forthcoming in the matter of erecting screening and sizing plant, it would be wrong of me to advise its erection. The type of wagon as supplied at present does not warrant the expenditure, inasmuch as the greater number could not be loaded direct from the screens.

Question 23.—If the controlling authority were empowered to insist that pillars should only be got by a sand-stowing process, the difficulties in the matter of transport of sand would render it necessary to vest such an authority with powers to determine where and when such pillars should be got so as to enable the authority to prepare a schedule of the various collieries, or sections of collieries, which had arrived at a stage when pillar extraction might be permitted, and thus enable him to arrange a sufficient supply of sand for that purpose.

Question 24.—The effect on the output of control in pillar-getting would largely depend on the ability of the authority to meet requirements in the matter of sand. Control might be held in abeyance until arrangements had been made, for a supply of sand sufficient to meet requirements; sand-stowing and control would then tend to an increase in output.

Question 25.—With regard to collieries situated adjacent to the source of supply, ropeways or surface haulage would meet the requirements. But for the greater number of collieries situated at a considerable distance from the source of supply, railway transport would be necessary.

Question 26.—The average amount of coal which has been removed in the first working is about 50 per cent. Sand weighs about 98 lbs. per cubic foot and coal about 80 lbs. per cubic foot; so that the amount required per ton of coal in the getting of the existing pillars would be 2½ tons of sand per ton of coal.

Question 27.—The cost per ton would be determined by the following circumstances:—

(*a*) The extent of the property.

(*b*) Position of the bore-holes in relation to the railway siding.

(*c*) Nature of the ground between bore-holes and railway siding.

(*d*) Depth of seam from the surface and inclination of seam, or in other words horizontal length to vertical head. This would determine the mixture of sand and water, and consequently the amount of water to be returned to the surface by pumping.

(*e*) Arrangements for storing water for flushing.

In the absence of data, I am not sure that I could state with any degree of accuracy the extra cost per ton.

Question 28.—It has been ascertained from experience that recovery from pillars by sand-stowing has reached the figure of 95 per cent. The recovery under the ordinary system of extraction varies in accordance with the thickness of the seam and may range from 60 to 85 per cent. The increase in length of life of the mine would (other matters being the same) be in accordance with the increase in percentage of recovery. The increase in round coal would be pronounced. Sand-stowing is favourable to extraction. The amount of subsidence is practically *nil*, consequently the periodical stoppages brought about by subsidence would be avoided, and provided a sufficient supply of sand was maintained, the increase in productivity would therefore be considerable.

Question 29.—If the present system of goafing be continued, the surface would be broken up to such an extent that the increase in the amount of water to be dealt with would very seriously impair development, resulting in a reduction of output and an increase in cost. It would further render the development of lower seams a matter of considerable difficulty.

Question 30.—With the advent of central generating stations and the supply of current to the collieries, I should say that coal-cutting machines will become part of the equipment of a colliery. The improvements which have been effected in coal-cutting machines have been such as to establish their success beyond question.

Oral Evidence.

Question 2.—A controlling authority, supported by an advisory board, should be created and a scheme devised whereby it could be undertaken by the Department of Mines.

The present leases are defective and should be revised, clauses being inserted regulating the proper working of the properties and making provision for supervision in order to ascertain that the properties are being mined to the best advantage. There should be a check on subletting so that properties may not be divided into plots, the areas of which preclude the adoption of modern mining practice.

Question 9.—The adoption of shifts would make for efficiency and provide the better for control and discipline. There would be difficulties in introducing the shift system but, if universally adopted, the difficulties would disappear.

Question 14.—Electrical development should be left to private enterprise, and there should be no compulsion in the case of small collieries using fuel wastefully.

Questions 16 and 17.—The area required for support would be reduced. Collieries using their own locos would be prepared to accept greater risks.

Question 18.—I favour central loading depôts; conditions can be created which would make central loading an economical proposition. Mixing would have to be avoided. I have carried stock to the extent of 30,000 tons in six sidings. It would not be possible to stack 30,000 tons at one siding.

Question 19.—Surface labour could be accommodated underground at work other than coal-cutting.

Question 20.—I do not receive a sufficient supply of wagons. I am unable to say whether the cause is due to a numerical deficiency or bad management or both.

Question 25.—I am unable to say whether the supply of sand from the rivers would be sufficient to meet the requirements of all the collieries in the matter of sand-stowing, but any deficiency could be made good by crushing sandstone brought in from areas adjacent to the coalfields.

Question 26.—In getting the pillars the amount of sand required would be about 2½ tons of sand per ton of coal recovered. I have not actually weighed the sand.

Question 27.—The supply of water required for flushing would be one of the practical difficulties in introducing sand-stowing generally.

Question 28.—For opening out a mine rapidly, mechanical coal-cutting is a success. It has not been used more because output is already excessive and good prices cannot be obtained.

Written Evidence of Mr. A. B. Hughes, Mining Engineer, Bengal Nagpur Railway.

Question 2.—It is, I think, generally agreed that there are insufficient safeguards in India to ensure that coal is worked to the best ultimate advantage of the country and even of the shareholders. I therefore thoroughly agree with Mr. Treharne Rees' recommendation that a controlling authority should be set up in the coalfields to supervise existing and future leases, and to control as far as possible the methods of working the coal mines. In my opinion, a great number of coal mines in India are worked for the immediate profit of both the lessor and the colliery proprietors without proper regard to the recovery of the maximum possible quantity of coal which would otherwise be available in the properties.

Question 4.—I consider that it is quite practicable to mark each year's working on the colliery plan in different colours. If the date was added in a few places, it would be seen at a glance during which year or half-year the workings of a certain colour were driven, and I consider that this system would be helpful to all concerned. I do not consider it necessary that it should be made generally compulsory for the exact size and shape of all pillars in a mine to be shown on the plan. I do think, however, that it should be within the power of the Chief Inspector of Mines, or the proposed controlling authority, to order this exact system to be adopted in respect of any area of workings which they consider necessary to be so shown upon the plans.

Question 5.—I do not consider that the average surveyor in the coalfields is capable of putting correct levels to a common datum on the colliery plans.

Question 6.—I have no calculations sufficiently accurate to show the percentage of coal which has been lost in goafing operations in this country. I am aware that many colliery superintendents and managers have made calculations of this nature; but I submit that, in the majority of cases where such calculations have been made, the information obtained is of doubtful accuracy owing to (1) the proper size and shape of the pillars prior to goafing not being shown upon the plan, and (2) the actual amount of coal got from each pillar not being measured.

Question 8.—I consider it advisable that the proposed controlling authority should have power to insist that seams should be worked in proper rotation. This does not necessarily mean that the shallower seams shall be developed before the deeper seams, but that the deeper seams shall not be goafed in such a manner as to prevent the working of the upper seams in future. If sand-stowing were made compulsory, the same answer applies.

Questions 16, 17 and 18.—My replies to these questions are given in my replies to interrogatories Nos. 1 and 2 regarding railway questions.

Question 22.—I consider that screening and sizing plants have not been generally adopted in India for the following reasons:—

1. Coal buyers in the past have not insisted upon coal being carefully screened. Hand picking, being cheap, has generally been considered sufficient.
2. The collieries have been worked with insufficient capital.
3. The price of coal in the past has fluctuated very considerably.
4. The system of raising small outputs from scattered inclines, and the lack of proper surface haulage, has been unfavourable to the erection of screening plants.

To work screening plants economically, the despatches must be steady. For a variety of reasons, the despatches from collieries in India have been anything but steady, necessitating coal being stacked at the depôts. I consider that the type of railway wagons supplied to collieries has not had any considerable bearing upon the erection of screening and sizing plants.

Question 23.—I consider that, if sand-stowing is made compulsory, it will be necessary for the controlling authority to direct when goafing operations shall be carried out, and I suggest that the distribution of sand to the various collieries shall also be controlled by the controlling authority. If the controlling authority considers that an application to goaf a certain area, even with sand-stowing, is likely to have a prejudicial effect upon the future working of the mine, it should, I consider, be within the power of the controlling authority to prevent such goafing being carried out. Such powers would only be exercised in extreme cases.

Question 24.—The immediate effect of a compulsory system of sand-stowing will, I consider, be to reduce the output from the Indian coalfields. This reduction should not be permanent as a large quantity of coal, which would otherwise have been lost, would be worked.

Question 25.—I do not consider that sufficient sand could be distributed throughout the Raniganj and Jharia coalfields by a system of ropeways alone, and I consider that a combination of ropeways and railways would be essential for such distribution. Every colliery is served by the railways, but it would not be a practicable undertaking to erect ropeways to serve each colliery.

Oral Evidence.

Question 2.—I see no reason why the rights of landlords and colliery owners should not be interfere with by legislation in cases of serious interference with the interests of the country. I think instances of bad working requiring interference are fairly numerous in both coalfields.

Question 24.—The output would be temporarily reduced by a system of control preventing indiscriminate goafing, pillar-robbing, and working easy coal to the rise.

Written Evidence of Mr. L. A. Jacobs, General Manager of Messrs. Martin & Co.'s Jhusick and Muslia Collieries, Raniganj, nominated by the Indian Mining Association.

Question 1.—I hold a 1st class competency certificate (English) and am a B. Sc. in mining of Durham University. I have had six years' experience at large collieries in the north of England, and 14 years' experience of colliery management in India.

Question 2.—The constitution of such an authority is advisable, but I do not care to give an opinion as to how it should be constituted.

Question 3.—It would be a considerable hardship for a colliery which got its output from numerous openings to instal and maintain weigh-bridges at each mine, though I do not say the proposal is impracticable. With regard to coal raised in baskets, and coal taken by miners for their own use, it may be possible to weigh it all, but I do not think it likely that the people to whom the weighing would be entrusted could be impressed with the importance of weighing the same sufficiently accurately for returns based on such weighments to have much value. Quite as valuable returns could be got by simply counting the number of baskets taken away in the case of miners' coal.

Question 4.—There is no difficulty in showing each year's working in different colours.

It is not difficult to show the sizes and shapes of pillars in the plan, though, in mines where scaling is considerable or robbing is taking place, there would be much difficulty in keeping the plans up to date. To show the shapes of the pillars in section, however, on an ordinary colliery plan would be highly impracticable.

Question 5.—Some are, I should say probably the majority are, capable of so doing.

Question 6.—No, but in comparatively thin seams from 6 to 12 feet in thickness, I have seen practically the whole of the coal extracted.

Question 7.—Yes.

Question 8.—I do not, as such an authority could easily ruin a coal company by insisting on an unmarketable coal being worked. Taking the case of a lower seam of good quality, and a poor class overlying seam, the adoption of sand stowing in the former would alter the circumstances altogether, as then the controlling authority could not object to the good seam being

worked in full, while the upper seam could be worked to an extent controlled by the amount of coal which could be disposed of.

Question 9.—Both practicable and advisable. The introduction of regular working shifts could only be effected by legislation.

Question 10.—Through sirdars mainly. The only way to improve the supply of labour is, in my opinion, to make working and living conditions as agreeable as circumstances will allow.

Question 11.—Yes, plots for cultivation are an attraction to miners, and provide them with a healthy change from underground work.

Question 12.—Yes, this might be done, though personally I would not have my labour away from the colliery unless I had no alternative. A miner or khalasi on the colliery is worth at least two away from it.

Question 13.—None. All classes of workmen simply pick up their jobs from their fellows.

Question 14.—Generally speaking yes, though I cannot see how a colliery which is working to-day, but may have to close down to-morrow because there is no market or no transport for the coal they are raising, and perhaps remain so closed for years, can be reasonably expected to throw out its old plant and instal new and expensive machinery, for the express purpose of saving fuel which no one wants, or, if it is wanted, cannot be sent away from the colliery.

Question 15.—No.

Question 16.—I think it quite practicable for colliery companies to handle the wagons in their sidings or branches, or in such sections of these as are threatened with subsidence, by locomotives or other means, though, in the case of several collieries using the same branch, there would arise complications, most of which, however, should be capable of adjustment by arrangement. However, apart from sidings which are being undermined, I see no advantage in colliery companies working their own sidings.

Question 17.—Except in the case of thick seams lying at small depths, I consider that the whole of the coal underlying a siding could be extracted. It is only when the cost of making up the siding would exceed the value of the coal extracted that I should leave any coal at all to support it.

Question 18.—There are possibly some sidings which could be dispensed with; but, as a rule, a surface haulage of any extent is a very big handicap in the working of an Indian colliery, and generally speaking I would not put a siding out of use, except as a temporary measure while it was being undermined. In many cases now, the central loading depôt would be impossible owing to the objections of royalty owners on the ground that coal could not be kept separate.

Question 19.—I do not think so, though it would make supervision easier. Screening plants would of course reduce the amount of loading labour providing they were served with a sufficient and reasonably regular supply of wagons. Some of the labour would work underground eventually.

Question 20.—No. The waste is in some cases very high, as much as 50% due to pressure and weathering. To a smaller extent, losses occur owing to coal being stolen from the stacks.

Question 21.—Better loading, both as regards size and quality, less breakage since there would be no tipping on to the ground from a height, and no stacking of the coal. A saving in loading, and in tub-unloading charges, and on the wear and tear of tubs.

Question 22.—The majority of Indian collieries do not raise sufficient coal to justify the installation of screening plants, and, even when the output is considerable, it is usually obtained from a number of openings far enough apart to render concentration at one plant difficult. A very great drawback moreover is the uncertainty of the wagon supply, and the large proportion of wagons of the covered type in use which are difficult to load mechanically. Moreover, the necessity for keeping coal from different seams separate for the fulfilling of contracts, and from different parts of the same colliery for payment of royalty, materially reduces the quantity of coal which could be loaded over one flat.

Question 23.—Yes. Any supposition to the contrary implies that colliery owners and managers have no interest in the reduction of waste.

Question 24.—If this means control for enforcing efficient sand-packing only, I see no reason to fear a reduction of output once full working conditions are established, but, if the control extends beyond that, there is every possibility of reduced raisings.

Question 25.—I do not feel competent to express an opinion on this point.

Question 26.—2½ tons.

Question 27.—I cannot say.

Question 28.—Perhaps a 10 per cent. prolongation of life.

Question 29.—This would vary very much at individual collieries. There are some which, if carefully goafed, need not suffer any appreciable increase of water, while others could not be goafed without immediately flooding the workings.

Question 30.—I consider that such usefulness as they have is largely discounted by the heavy cost involved. I think it has been the general experience that any increase in output which has been got through their use, has been found insufficient to compensate for the increased cost of production. Where speed in opening out a new mine or district is the first consideration, and cost only secondary, the advantage of using them becomes greater.

Oral Evidence.

Question 2.—The controlling authority should be under Government with technical non-official advice. I would agree to a technical head like the Chief Inspector of Mines with representative advisory board to assist him, appeals to be allowed only in such cases as the advisory board agree to.

Question 3.—Where there is unsaleable or inferior coal available, miners should be prevented by the management from taking good coal from the pits for their own use. They would not object, providing the coal was stocked in convenient places. The difficulty is that many collieries have no such inferior coal.

Question 5.—I have no experience of *thika* surveyors.

Question 6.—I have no experience of pillar extraction in thick seams. We are getting 90 per cent. exclusive of the roof coal in one of my collieries. The seam is 11 feet of which 1½ feet is left in the roof. The pillars are 40 to 50 feet. Where pillars are small or split, and only a few can be recovered with safety, the loss might amount to as much as 40 per cent. but has generally been not more than 20 per cent. I have a fire-area where 10 pillars or about 6,000 tons will be lost, but this is inclusive of pillars which in any case would have been left for the support of surface buildings and a railway siding, and in which the fire-stoppings were built as far as possible. The railway barrier was in no other way of any value in building off the fire. Over a lakh of tons had been extracted from the area in which the fire occurred.

Question 8.—I have no objection if the authority was discretionary and the disposal of inferior coal was arranged for.

Question 9.—I would have 12-hour shifts with going up and coming down within certain limits. I do not think the labour would object. I am against the 24-hour system. I would allow plenty of grace in the matter of the hours fixed. I think 12-hour shifts to end at a fixed time, but with freedom about the time of going down, would be a useful start. The miner would have plenty of time to do his work within the shift hours. He might not complete it at first, but would soon fall in with the new conditions, which would not be any hardship.

Question 14.—I would not have compulsion, but leave the matter to private enterprise.

Question 18.—The nearer sidings are to pits, the better for the work of collieries.

Question 19.—My 50 per cent. is perhaps an extreme case. It includes the consumers' loss through having to use an inferior article.

Question 22.—I prefer open wagons to adapted covered wagons. Thefts do not matter to us so much as to the consumer.

Question 23.—After further explanation, I think that, if the controlling authority found a colliery working in such a way as to be on the verge of collapse, it should have the power to interfere, with of course the usual right of appeal.

Question 24.—I think the output must be prejudiced by the control contemplated.

Question 25.—It is very unlikely that ropeways could convey the sand alone.

Question 28.—This figure is based on the earlier 10 per cent. in my answer to Question 6. It would always vary with the percentage of waste saved.

Question 30.—This was compressed air plant.

Written Evidence of Mr. P. S. Keelan, Chief Mining Engineer and Superintendent of No. 1 Circle (Raniganj), Messrs. Andrew Yule and Company.

Question 1.—First class Indian certificate of service, and 27 years' mining experience in India.

Question 2.—Controlling authority desirable; authority to be restricted to supervision of future leases and eradication of unworkable and inadequate conditions of existing leases. All future leases should have the sanction of the controlling authority.

Where inferior seams are destroyed owing to working of seams of better quality, permission should be obtained from the controlling authority, and should not be withheld if coal from inferior seam cannot be dealt with commercially. Present Mining Board to constitute controlling authority.

Question 3.—This is practicable. No objection to offer.

Question 4.—First portion practicable; second portion could not be undertaken with any great accuracy.

Question 5.—I know nothing about surveyors in smaller companies.

Question 6.—Yes. Consider 80 to 85 per cent. of coal in pillars is got.

Question 7.—Yes.

Question 8.—Read my No. 2.

Question 9.—Yes; this is very necessary, but not desirable until supply of labour meets demand.

Question 10.—Recruitment by sirdars and recruiting baboos. Consider this could be greatly improved.

Question 11.—Yes. Area to be restricted.

Question 12.—Suggestion certainly worthy of trial. Question of transport does not at present arise. Difficult to answer in regard to combine. Consider that some of the larger companies may be induced to give it a trial with the help of the Salvation Army, who are now dealing with certain criminal tribes in the Punjab and United Provinces.

Question 13.—Miners trained by miners for which a bonus is sometimes paid, if apprentice is not member of family.

Question 14.—Practicable and advisable, but will operate adversely on small Indian concerns with little capital. Power should be available before action is considered.

Question 15.—No.

Question 16.—See little advantage.

Question 17.—As Land Acquisition Act applies, no advantage unless land acquisition restrictions withdrawn. Consider temporary diversion suitable; this will allow of extraction of coal under acquired area. Land acquisition proceedings not necessary for temporary diversions.

Question 18.—Practicable, but not advisable. Consider handling charges will be increased.

Question 19.—No. Loading coolies would not be induced to work underground.

Question 20.—No. Consider shortage of wagons has acted adversely to the interests of trade. Consider 5 per cent. per annum of output raised has been lost in depreciation of coal due to exposure.

Question 21.—Automatic loading would reduce cost of handling; ready despatch would avoid loss as stated in 20.

Question 22.—Several reasons, including different types of wagons, objection of purchasers to anything but hand loaded coal, shortage of wagons, and sometimes irregular sales.

Question 23.—Yes. Waste of coal would be reduced by sand-stowing without direction of controlling authority. Consider compulsion would operate hardly on small Indian concerns.

Question 24.—Probably.

Question 25.—No.

Question 26.—About 2 to 2·5 cubic feet of sand for each cubic foot of coal.

Question 27.—Six annas per ton.

Question 28.—Doubtful if productivity will be increased; life of colliery would naturally be increased to extent of coal now left in barriers.

Question 29.—Cost of pumping bound to become heavy in the future and perhaps, in the case of smaller mines, tend to suspension of work due to cost of production exceeding market value of coal.

Question 30.—Consider there is an opening for mechanical coal-cutters. Labour with mechanical knowledge is, however, expensive. Difficulty to me appears to be to obtain labour to remove coal got by cutters at a cheaper rate than coal obtained by manual labour.

Oral Evidence.

Question 2.—The scope of the controlling authority's powers should be limited to those I have enumerated. I think that, if the controlling authority found a colliery working in such a way as to threaten collapse and loss of coal, it should have the power to stop such working. I do not want the controlling authority to settle all the terms in leases, but only to supervise those terms which deal with the working of mines. I would prefer the controlling authority to be a board. As far as my knowledge goes, there is no need for control over working except as mentioned above, but my knowledge does not go beyond my own collieries. I agree that people, who do not look after their coal properties, should have those properties looked after for them.

Question 6.—I have 6 to 7 per cent. loss in a 15 feet seam, of which 1 foot is left in the roof, and which is at a depth of 150 to 250 feet. This is based on actual calculations, but excludes the coal left in barriers amounting to 9 to 11 per cent. The barriers are 20 to 30 feet broad, and are often taken out where fires do not occur. We allow a period of incubation of about 18 months. If sand-stowing were adopted at our collieries, I do not think the gain would be more than 10 per cent. of coal, and even that might be too high a figure. This is true of depths up to 250 or 300 feet with pillar centres of 40 feet and galleries of 12 feet.

Question 9.—The so-called 24-hour shifts are largely worked in my collieries, the actual working time being 16 hours, *i.e.*, 2 shifts of 8 hours with 8 hours rest in between. The system allows of the labourers walking about 8 miles in every two days instead of having to do so every day. Our labour is very scarce, mainly aboriginal, independent, and liable to resent any interference as regards hours of labour. I would welcome shifts if I could be sure the labour would not be unsettled. The kind of labour I have been referring to constitutes about 80 per cent. of my labour force. I agree that labour usually settles down to changes very quickly.

Question 12.—We have *taluk* labour living in villages off the colliery. The labourers come in every day up to a distance of 3 miles away. Coal-cutting is looked on as coolie labour and

consequently is considered derogatory to a man of fairly good caste. I think something might be done to attract the surplus poor Eurasian population of Calcutta to the mines for employment on coal-cutting machines.

Question 14.—I would leave electrical development to private enterprise, and am not in favour of any compulsion as regards collieries using fuel wastefully.

Question 17.—If I were working a colliery siding myself with colliery locomotives and railway wagons, I do not think any more coal could be taken out from under the sidings.

Question 19.—Loading coolies would return to earth-cutting rather than go underground.

Question 27.—By "compulsion" I mean compulsory sand-stowing. This would not operate hardly on small concerns if they were helped financially or compensated for the cost of sand-stowing. If the controlling authority uses discretion in insisting on sand-stowing, I think it would be all right.

Questions 26 and 27.—My figures are not based on personal experience.

Question 28.—The gain on my collieries would not be more than 10 per cent., perhaps less.

Written Evidence of Mr. John Kirk, Chief Mining Engineer, Messrs. Kilburn and Company (Jharia).

Question 1.—British colliery managers' first and 2nd class certificates of competency. My first trip underground was taken when I was 8 years of age, and I used to spend the greater part of Saturdays and of my school holidays in and about the mines managed by my father for the Dalmellington Iron Company. I commenced actual work in the collieries when I was 14 years of age and, as my father insisted on my being able personally to do every class of work in or about a colliery, I have worked as engine driver, boiler fireman, onsetter, pony driver, haulage and jig attendant, roadsman, timberman, fireman, miner, brusher, sinker, master sinker, steam and electrical pump attendant, coal-cutting machineman, brushing, drifting and sinking contractor. Was overman and later under-manager at 3, 4, 5 shafts, Polmaise Colliery, one of the most gassy mines in Scotland.

In India, I was Manager of Kustore South, Raniganj Coal Association, for 5 years, General Manager, R. C. A., for 4 years, and Chief Mining Engineer, Messrs. Kilburn and Company, for 2 years.

Question 2.—I agree with Mr. Treharne Rees' suggestions.

Question 3.—There would be no difficulty in weighing all coal tubs as they come out of the mines, but it is questionable if the information obtained would be reliable. I have no objection to the proposal as I consider the information is necessary. It would be difficult to weigh all coal brought up in baskets, and I do not think that, as mines are operated and coal stacked, reliable information regarding coal consumed by labour can be obtained.

Question 4.—Yes, but with present mining methods it would be difficult to keep the plans accurate, as far as the size of the pillars is concerned. With coal-cutting plant, I would anticipate no difficulty.

Question 5.—I have practically had no occasion to question any work of this description carried out by Indian surveyors employed by me.

Question 6.—Yes, I have personally measured the pillars in an area of 16 seam before extraction and, from railway weighments, estimated that I recovered 87½ per cent. and lost 12½ per cent.

Question 7.—No.

Question 8.—If a market for the coal can be obtained, and the controlling authority can prove that a commercial success can be made of it, yes; otherwise, no.

If hydraulic stowing *under proper supervision* were enforced, there would (in my opinion) be no necessity for the controlling authority having such powers *unless under exceptional circumstances.*

Question 9.—I consider it advisable, but not practicable under present conditions. With machine-mining introduced, and elimination of female labour underground enforced, I would anticipate no difficulty.

Question 10.—We have tried European, Anglo-Indian and Indian recruiters, and prefer the latter. There would be no immediate necessity for increasing the labour force if machine-mining, mechanical loading, and a regular and adequate wagon supply were introduced.

Question 11.—No, but good houses with small garden plots would help. In all industrial countries, success has only been obtained by having a regular labour force who have adopted industrial work as their profession, and given up all idea of either owning or cultivating land, and we will never have a similar labour force in India until the agricultural instinct or desire decays, and is supplemented by a desire for purely industrial work. To assist our labour in cultivating this desire, we must make the conditions of work, income, housing, etc., compare favourably with conditions in their own villages.

Question 12.—This was discussed with Mr. H. T. Thomson of Kilburn & Co. years ago, but was turned down owing to high capital cost and low price obtained for our coal. In the interests of the

workmen the scheme is good, but at present it is not a commercial proposition, and I do not think colliery companies would combine to form such settlements.

Question 13.—New labour is always put under the charge of experienced workmen. Our mechanical and electrical attendants all start as fitter coolies and are conversant with the working of plant before they are placed in charge of it. Fitters, both mechanical and electrical, start as apprentices.

Question 14.—I am not in favour of compulsion, as many coal companies could not obtain the necessary capital to purchase the plant, and orders of this description would mean many closed collieries. But the success and economy of electrical operation should be pointed out to them, and, in any case, if electrical operation is a success, it would mean lower operating costs with a corresponding lower sale price, which would ultimately either force the owners of wasteful steam operations to change or shut down. The Government might also issue instructions that the whole of the State railway purchases were to be obtained from electrically-operated mines.

Question 15.—We have mixed 15 and 13 seams for steam-raising, but did not obtain satisfactory results. We have mixed all seams from 15 to 12 for coke-making with satisfactory results.

Question 16.—With large companies, yes; with small companies, no, as they could not purchase the necessary plant.

Question 17.—The support demanded by the East Indian Railway is in my opinion reasonable, and I would leave the same support if the sidings were owned by our companies. The Bengal Nagpur Railway generally insist on greater support than in my opinion is necessary, and I think that at least 20 per cent. of recent reservation could be recovered without endangering the railway.

Question 18.—No. Colliery tubs as used in the fields are not suitable for long hauls and, if a mine is worth operating, it is necessary to have a siding.

Question 19.—If an adequate supply of suitable wagons were given, it would reduce the number of loading coolies, as many small operations could not purchase a loading plant, either from lack of capital, or because their mine produced so little coal that the running and depreciation charges would make it an uneconomical proposition. The bulk of the labour would ultimately go into the mines and more readily to load machine-cut coal.

Question 20. —No. Coal exposed to the atmosphere and trampled over depreciates in value, and the percentage of lump coal, which is the most desirable product for market demands, is greatly reduced. There is also the extra expense of stacking and loading which must necessarily be handed on to the consumer.

Question 21.—Lower raising cost and a greater percentage of lump coal; larger outputs and an incentive to the management to adopt better and more economical mining methods.

Question 22.—Because buyers would not pay a higher rate for mechanically-screened coal; in fact, at one of the mines under my control, the State railways paid us annas 8 per ton less for mechanically-screened coal than they paid us for hand-loaded coal from the same seams. The question of capital expenditure is also a serious one for small mines.

Sidings.—If mechanical loading plant is adopted, the railway engineers will have to adopt modern ideas in regard to grading; at present sidings are put in on a maximum grade of ½ per cent. with the result that all cars have to be man-handled.

Wagons.—Generally the type supplied is unsuitable. Mr. Rees' suggestion about a door in the roof of the wagon has already been put forward by Mr. H. T. Thomson, but was turned down by the railway company.

Question 23.—If sand-packing were enforced and adequately supervised by a department not responsible to the operators, there would be no necessity for the controlling authority having power to state when pillar-cutting should be carried out. I consider that this system would diminish waste.

Question 24.—Yes, until it was firmly established.

Question 25.—No, nor do I think it can be obtained from the rivers in the district.

Question 26.—It is hardly possible to give figures, as it is questionable what proportion of the excavations would require to be filled to prevent subsidences. However, if the whole of the area had to be filled, it would vary from 1¼ to 3 cubic yards of sand to one of coal.

Question 27.—The cost would vary in the same ratio as the percentage of coal left in pillars varies with the total quantity, and it is hardly possible, unless by a practical experiment, to give a figure, but I would not place it at less than 8 annas per ton.

Question 28.—It would enable me to obtain from 15 to 40 per cent. more coal from certain areas in certain seams, and therefore either increase the productivity or life of the mine.

Question 29.—It will undoubtedly increase the "come" of water in deep mines, and increase pumping charges above an economical limit.

The mining of deep coal in the Jharia field requires more consideration from a temperature standpoint, as, in two of the mines under my control, heavy feeders of water having a temperature 99° S. F. are met with.

Question 30.—I consider the general conditions are ideal for machine-mining and expect to have them successfully operating in the near future.

Oral Evidence.

Question 3.—I do not think the miners could be prevented from taking first class coal for their own use unless the first class stocks were very carefully watched. On my collieries, the labour is not allowed to bring such coal up the shafts. We also insist on the labourers taking second class coal if we are working two classes of coal at the same mine. Weighment would not be reliable because of the class of men we have to employ. An automatic weigh-bridge would help, but even then some arrangement would be necessary by which a tub could not be run back and weighed over again. We now over-pay about 5 to 6 per cent. of our coal.

Question 6.—This working was by the ordinary method of pillar-cutting, the seam being from 10 to 12 feet. The loss will be more in a thicker seam.

Question 9.—Shifts would not be practicable even if Government made them compulsory. In my opinion, the reason for the absence of strikes and other labour trouble in our mines is because miners and their families are allowed to work when they please, and to come up and down when they choose. The present system is the lesser of two evils. Female labour should never have been allowed below and I am certain, had this labour not been available, modern methods would now have been the rule in India instead of the exception. With mechanical plant, a miner will earn as much himself as a miner and his wife now do together.

Question 10.—Recruiters are sent out regularly to villages where labour is available. We have not touched any new villages for some years. Some of our villages are as much as 300 miles away near Bilaspur in the Central Provinces. We have improved housing conditions lately, and I think this would have increased the output but for our excessive stocks.

Question 12.—Settlements would be too expensive and the price of land would be certain to go up. It would have to be acquired under the Land Acquisition Act or by some similar legal means. Labour would leave one colliery for another, if worth its while, whether it lived in settlements or on the colliery itself. There is always a proportion of labour living on one's own colliery and working on another colliery. Such labour is allowed to remain until the houses are required. Our improved houses are very popular, and the labour appreciates a good and sufficient water supply.

Question 13.—The period of learning varies with physique. I have not found labour afraid to go underground. Hardly any of the miners are skilled.

Question 14.—Electric development should be left to private enterprise, but electrically-operated mines might be encouraged by Government preference in orders. The small colliery owner might be frozen out, but this would be to the advantage of the trade and of the country. I prefer to express no opinion about the prices to be paid for coal purchased by Government on a preferential basis.

Question 16.—I prefer the present method of working.

Question 19.—My experience is that labour goes down shafts as readily as inclines.

Question 22.—In 1918, we loaded 15 and 13 seams mixed over mechanical screens for the North-Western Railway and were paid Rs. 4-8 per ton; coal from the same seams, hand-screened and sold to the Admiralty, fetched Rs. 5 per ton. I do not know anything about one of these being requisitioned coal.

Question 23.—I am aware that a large amount of coal has been lost through leaving too small pillars relatively to the area standing in pillars. I would object personally to instructions as to the time of getting pillars. I have no experience of badly managed collieries. I would not object to an advisory authority who should have power to deal direct with the managing agents. I object to control in practical working as it would mean interference with managers. My answer only has reference to the collieries under my control.

Question 25.—We have 3½ miles of the Damudar River in our property. It has been surveyed and I find that, in order to sand-stow, we would require to excavate all over this length up to a depth of 4 feet a year. The average depth of sand is 12 to 15 feet; this has been ascertained by borings. We have coal to last 140 years of the present requirements of Messrs. Tata Iron and Steel Company, *i.e.*, 3 million tons of coal per annum. We hold about 25 thousand bighas of coal land. I do not think that sand excavated would be replaced altogether by the fresh sand brought down. I think it would be feasible to crush sand from the hills near the Grand Trunk Road north of the Damudar River. It would not be more expensive than sand from the rivers if done on a large scale.

Question 26.—I have no figures of the probable average amount of sand required. I have no practical experience of sand-stowing.

Question 27.—My figure of annas 8 per ton does not include the cost of bringing sand to the colliery.

Question 28.—It is not necessarily a commercial proposition to suggest doing sand-stowing without a controlling authority. On the Steel Company collieries we are not bound to make a profit as we only want coal for the steel works.

Question 29.—The "come" of water has not been appreciably increased by heavy pillaring in the mines, but I agree that the pumping question will be serious if the present method of pillaring continues.

Question 30.—I have experienced no trouble with labour over mechanical coal-cutting. We do not pay the same rates. Machine-cut coal is paid 2¼ annas per ton; hand-cut coal is paid 7½ annas per tub of 13 cwts. I think costs will be reduced by mechanical cutting. We are getting 4 tons per man and should go up to 5 tons. We only got 7 or 8 cwts. per man in hand-cut places, but no coal is now being produced at this mine by pick labour.

Written Evidence of Mr. H. Lancaster, Inspector of Mines in India, No. 2 Circle.

Question 4.—I am of opinion that it is quite practicable and most desirable to define each year's progress on the plan of a mine, and in addition to showing the size and shape of the pillars. I know of collieries where galleries and pillars are measured periodically.

Question 5.—I do not consider the average surveyor capable of putting correct levels to a common datum on a plan.

Question 7.—I know of collieries where a lower seam has been worked under an upper seam which, owing to its inferiority, was not developed and has been rendered unworkable by subsidences in the lower seam.

Question 8.—The controlling authority should insist on seams being worked in vertical rotation where, owing to its thickness or nature, the intervening strata is not capable of preventing damage to an upper seam through the working of a lower seam. If sand-stowing were made compulsory, the working of seams in vertical rotation would not be so necessary, except where thick seams are separated by only a few feet of ground.

Question 9.—It would be difficult to institute a system of regular working shifts at collieries in India, especially at those mines which depend on outside labour. Where a large force of settled labour exists on a colliery, it might be possible to institute regular shifts. I am afraid, however, that, unless regular working shifts were made compulsory at all mines, labour would be attracted to those collieries where the present freedom from restriction prevails.

Question 11.—I think it has been conclusively proved that the provision of land for cultivation on, or in proximity to, the mines has attracted labour and resulted in whole families settling permanently on the spot.

Question 12.—There is no doubt whatsoever that labour settlements at a short distance from the coalfields would be an advantage in Jharia, where desirable building sites are few and land for cultivation is scarce. It is extremely doubtful whether colliery companies would combine to form such settlements. If one large company made a success of such an experiment, others might co-operate afterwards. I imagine that the idea is too Utopian to appeal to the majority.

Question 14.—I consider that mine-owners who are using fuel wastefully should, as far as is practicable, be compelled to take electricity from central generating stations. Such compulsion should in the first instance be applied only to mines working the better class coals. Small mine-owners usually require power for driving pumps and possibly one or two haulage engines. For a group of such mines, I consider that electrical power would prove economical. It would not be practicable to supply small isolated mines with electricity. The steam pumps in use at small collieries are often inefficient and wasteful. It might be possible for several small collieries to co-operate and use one portable electrically-driven pump of considerable capacity, which would enable each owner to de-water his dip workings in a very short time. Otherwise, several owners might co-operate and have a common water lodgment and one pump capable of draining a considerable area of inter-connected workings.

Oral Evidence.

Question 9.—Regular shifts are more possible in Jharia than in Raniganj, but even in Jharia a certain proportion of the labour comes from outside. The 12 hour shifts with fixed hours for termination would be suitable for all labour living fairly near the mines. Shifts must be universal if introduced at all. I managed a colliery in India myself for four years.

Question 14.—I think Government will have to step in to make a group of small collieries working first class coal take electricity. Other uses might be found for the slack and rubble now used as a fuel. There are no such uses at present, and this is certainly an objection, but the coal now of little value might be valuable at some future time, say for briquetting. The point would be met if the power of compulsion were discretionary and were only used where the circumstances indicated it to be necessary. A group of six collieries producing 1,000 tons a month each would produce about 25 per cent. of slack.

General.—In addition to the mines which have actually collapsed or fired, there are thousands of tons in other mines which cannot be recovered for fear of such collapses or fires due to bad methods of working. All this coal might have been saved with proper laying out and working. I agree generally with Mr. Rees' estimate that one-third of the available coal is wasted under present conditions.

Written Evidence of Mr. G. C. Leach, Chief Mining Engineer of Messrs. Bird & Co., Jharia.

Question 1.—Pupil five years in mining engineer's office, pupil one year in mechanical Engineer's shop, pupil one year in electrical engineer's shop, and two years colliery management in England. Holder of first class English mine manager's certificate of competency. Member of the Federated Institution of Mining Engineers, Associate of the Institution of Electrical Engineers, and Fellow of the Geological Society. My experience of mining in India extends over 17 years, and comprises 5½ years in the Giridih coalfield, 9½ years as an Inspector of Mines, and 2 years as Chief Mining Engineer, Messrs. Bird & Co., Sijua Division.

Question 2.—It will, I think, be to the advantage of the industry if a controlling authority is set up in the coalfields to supervise existing and future leases, and to ensure by legislation that coal areas shall be worked to the best advantage. Such authority should consist of not less than two mining engineers of high standing, who should be Government servants.

Question 3.—There is no objection to all coal brought out of the mines in tubs being weighed at the colliery. Apart from acting as a check on waste, it would be an incentive to the miner to produce more coal and make greater use of the tubs. The compulsory installation of weighing machines would encourage concentration of outputs. The coal taken by the miner should be included in the weighments. Coal taken out of the mine in baskets should not be weighed. It represents so small a proportion of the output of India, that the difference between measurement and weighment is negligible.

Question 4.—There is no objection to the marking of each year's working on the colliery plan in different colours. It is done every half-year at our collieries. It is sufficient for all practical purposes, in my opinion, to take offsets at the corners and the middle of all pillars to show their size and shape. This is also done at our collieries.

Question 5.—I consider that colliery surveyors, generally, are capable of putting correct levels to a common datum on all mine plans.

Question 6.—I have not carefully calculated what the percentage of coal lost was of the total coal in the seam. It is possibly as low as 5 per cent. in some of our thin seams, and as high as 40 per cent. in thick seams.

Question 7.—I have no experience of such working.

Question 8.—I consider that the controlling authority should have power to insist that seams should be worked in vertical rotation. If sand-stowing were made compulsory, my answer would be the same, for the controlling authority, it is presumed, would not be unpractical in its demands. In my opinion, there are several seams in the Jharia coalfield that should be worked in vertical rotation even if sand-stowing is compulsory.

Question 9.—I am of opinion that it is both practical and advisable that regular shifts should be worked at collieries. All our overmen, deputy overmen, enginemen and pumpmen already work eight hour shifts. The daily labourers work two nine hour shifts. I do not think that the miners residing on the colliery would object to remain underground between the hours of 9 A.M. and 4 P.M., and 9 P.M. and 4 A.M. The miners not residing on the colliery may find these hours irksome at first, but I am of opinion that they would soon conform to the new conditions. These hours of labour for miners should be made compulsory by law, and no miner should be allowed to descend into or leave the mine between the hours stated except in case of illness or for some other urgent reason.

Question 10.—The recruiting of our labour is done by contractors who are paid a definite rate per ton of coal despatched. They make their own arrangements. The contractor may bring in labour to a colliery, and, if the working conditions underground are good, enabling the miners to earn a reasonable wage, the housing accommodation satisfactory, and the water supply sufficient and uncontaminated, the medical service good, and the complaints of the miners listened to with sympathy, justice being applied, he cannot take it away again and it becomes settled labour on the colliery. The contractor introduces the labour to the colliery, and it is up to the management to keep it.

Question 11.—I do not consider that the provision of plots of land for cultivation near the colliery would of itself attract labour. A piece of *bari* land attached to each house would make the labour more contented.

Question 12.—In my opinion, colliery settlements near the coalfield would be advisable when there is congestion on the collieries, the labourers being brought in by workmen's trains. I do not think it is feasible for colliery companies to combine to form such settlements.

Question 13.—We have no system of training to cut coal. The system practised does not require much skill, and is readily picked up by agricultural labourers. Skilled labour, such as fitters, blacksmiths, carpenters, engine khalasis, pump khalasis, timber mistries, and line mistries are gradually taught to improve their methods by the colliery staff.

Question 14.—I think it advisable that existing collieries should take electric power from central generating stations, because it would reduce the wasteful use of coal to a minimum, but I do not think it is practical. Government should be given the right to compel new companies to make use of electric power when current is available.

Question 16.—I think it is advisable that colliery branches and sidings should be worked by colliery companies, with railway company's wagons and colliery locomotives, such locomotives being allowed on the railway company's marshalling yards.

Question 17.—I do not consider that any coal now required for supporting branches or sidings could be removed without impairing the safety of the branches and sidings.

Question 18.—I think it is both practical and advisable for a number of the existing sidings to be removed, and the coal hauled instead on the surface in colliery tubs to central loading depôts.

Question 19.—Such concentration would result in the reduction of the number of coolies required. If screening plants were economically practical, a very great reduction in the number would be effected. Such coolies would consent to work underground. When wagons are scarce, the men cut coal and the women carry out slack from the mine galleries.

Question 20.—I consider there has not been a sufficient supply of wagons. This insufficiency has led to accumulation of stocks, which has resulted in extreme cases of steam coal being reduced by 22 per cent. to dust coal.

Question 21.—If coal on its arrival at the surface were immediately passed over screens into wagons, there would probably be less conversion of steam coal into dust, the small coal would be more efficiently graded to meet customers' requirements, and picking would be more thorough. The difference in steaming qualities between hand-screened and machine-screened rubble is noticeable at the power station at once.

Question 22.—Inadequacy of wagon supply and want of a suitable type of wagon are responsible, I think, for screening plants not being generally adopted. In one half year, 1,255 covered wagons and 1,375 open wagons were supplied to the Katras screening plant, and 703 and 570 to the Teetulmuri screening plant, with the result that a full force of loading coolies had to be maintained. I think covered wagons could be designed with a sliding roof or half sliding roof to enable loading to be done from a chute.

Question 23.—I am of opinion that it would be a sufficient safeguard against waste if the controlling authority were empowered to insist that pillars should only be got by a sand-stowing process.

Question 24.—I think the universal application of a process of sand-stowing would increase the output.

Question 26.—In order to extract the existing pillars in 15 seam Bhulanbararee Colliery (actual survey of an area), 2·55 tons of sand would be required to obtain one ton of coal.

Question 28.—It would shorten the life and increase the productivity.

Question 29.—By continuing to break up the surface by goafing, an enormous increase in the "come" of water will be the result during the monsoon period. Pumping figures taken during the last monsoon show this conclusively.

Question 30.—I consider there is a wide field of usefulness for mechanical coal-cutters in India.

Oral Evidence.

Question 2.—I do not think the present Mines Department could do the work of the controlling authority. The new Department should be separate from the Mines Department. I consider that two departments under the same technical head, with a representative advisory board to assist him in questions of principles is sound. Appeal should be allowed from the decisions of the technical head, the court of appeal to consist of a president of the standing of a District Magistrate with two mining engineers as assessors. I do not consider it is necessary to place the advisory board in a position to limit the number of appeals.

Question 5.—Colliery surveyors generally are capable, but their work often requires expert supervision.

Question 8.—The controlling authority should have power to insist.

Question 9.—I know of no precedent for legislation fixing the hours at which miners go down and come up the mine. Hours as fixed in my original evidence would be sufficient for a start. The labour would not object. I do not think the outside labour affects us seriously one way or the other.

Question 14.—The following figures show the saving in boiler consumption brought about by the substitution of electric for steam power. At Loyabad, the average monthly consumption of coal in 1917 was 1,675 tons; in 1920, it has come down to 216 tons. At Katras, the consumption has been reduced during the same period from 1,146 tons to 166 tons. Similarly at Mudidih, the difference is 839 tons as against 314 in 1920. By the end of 1920, these collieries will be entirely electrified and the boiler consumption will be *nil*.

There are several power stations in the Jharia field already, but it is possible that it would still pay to erect large generating stations. The larger the ring main, the smaller the cost per unit within limits. I do not think a public supply company's rate of ·75 anna per unit could be much reduced if Government guaranteed them a dividend.

Question 18.—Stacking accommodation for our stocks could be made available at a central depôt. The coal is of two qualities and could be stacked separately. We are putting in surface haulages rather than sidings wherever we can.

Question 20.—22 per cent. is an actual figure.

Question 23.—My answer has reference to the general conditions in the coalfields. On reconsideration, I think that the further power to say when pillars should be recovered should also be given to the controlling authority.

Question 26.—Under favourable conditions of grade, soft earth can be used for stowing, but there is only sufficient available for stowing very limited areas. We are now using such earth in places. My figure of 2·55 is based on actual measurement.

Question 29.—The following figures show the difference in the come of water during the monsoons in (1) an area partly goafed and partly standing on pillars and (2) an area entirely standing on pillars. With a goafed area of 2,697,500 sq. feet and a pillar area of 1,962,500 sq. feet, the come of water was 183,367,400 gallons. In a pillar area of 6,962,900 sq. feet, the water only amounted to 58,019,500 gallons. There was thus about three times as much water in the first area which was only about half the size of the second. Again in another case with a goafed area of 2,698,000 sq. feet, and a pillar area of 2,453,000 sq. feet, the water amounted to 115,861,916 gallons. Again with a goafed area of 1,816,000 sq. feet, and a pillar area of 1,881,000 sq. feet, the come of water was 29,497,250 gallons. At Katras, during the month of August 1919, we were pumping 21·3 tons of water for every ton of coal raised.

Written Evidence of Mr. J. Mackie, Agent, Messrs, Mackinnon, Mackenzie & Co., Bhowra Colliery, Jharia.

Question 1.—My practical mining experience in coal, iron, and fireclay was gained with my father, who was a mine-owner, and gave me early responsibility. I also spent a short period with the Glengarnock Iron and Steel Company, Limited. My technical education was gained at Glasgow University and at the West of Scotland Technical College I joined the Eastern Coal Company, Limited, in October 1908, and have managed all their collieries in Jharia and Raniganj at different times.

Question 2.—I do not consider it advisable to have a controlling authority. The only compulsory measure in my opinion should be the introduction of hydraulic stowing for *all pillar extraction*. The landlords and royalty receivers could have consulting mining engineers to look after their interests.

Question 3.—The introduction of weigh-bridges at pit and incline heads is practicable and, if the coal could be despatched at once, I would begin the system at the company's mines as a check against the railway weighments and boiler and and other consumption on the colliery. I consider it would be impossible to weigh coal brought out in baskets or taken from the mine by miners for their own use.

Question 4.—To show each year's workings of *thin seams* in different colors on the plans is practicable and also to show the correct size and shape of the pillars. It is quite impossible to do so, however, in the case of thick seams with two or more sections worsing.

Question 5.—Yes, I consider a large percentage of the surveyors on the coalfield can put reduced levels on plans; it is an easy part of surveying.

Question 6.—Yes, I have kept notes on the percentages of the total coal recovered from pillars for a considerable period. The loss varies from 62 per cent. in thick seams in difficult districts to 20 8 per cent. in the best instances.

Question 7.—No, I have had no experience.

Question 8.—No authority should have the power to insist on the working of seams in vertical rotation. If sand-stowing is introduced universally, no material damage can be done to seams above one worked out and properly stowed.

Question 9.—The only way to introduce regular shifts, and to make the system practicable, is for Government to make the duration of the shift into law. I consider this would interfere with coal-raising at most collieries during cultivation and harvest.

Question 10.—All this company's collieries are worked on contract and the contractors recruit the labour. As far as I see, the universal system is to go to villages and tempt the inhabitants with food and money while the contractor with the longest purse scores. The small landlords also have to be dealt with, and they receive a price per head of miners taken away from their villages. It appears that the recruiting ground for miners is limited, but, probably if Government would send the inhabitants of famine-stricken districts to the coalfields instead of starting relief work near their villages, an improvement might result. Recruiting for tea gardens should be stopped in this district.

Question 11.—Yes, undoubtedly the granting of small plots of land to miners, or even to the headmen only, on the colliery properties would assist in retaining some of their number

permanently. The difficulty would be to furnish sufficient plots and also the acquisition of the land would present obstacles to companies who do not have the surface rights of the properties.

Question 12.—The suggestion is good, but Utopian. Colliery companies cannot combine as has been proved in the past.

Question 13.—Teaching miners to "undercut" has been tried, but without success. I have no special system of training except in the workshops and in bringing up lampboys and propping mistries to be sirdars. I have a number of mining apprentices on each colliery.

Question 14.—I do not agree that collieries should be compelled to take electric power from central generating stations. If electric power was available at a low unit cost, most collieries would take the current without compulsion. The experience so far has been that private generating stations can produce current at a much lower unit cost than public companies who must have profits and directors' fees.

Question 15.—Yes, all the seams of coal in this company's properties were experimented with in England in 1919, but it was found that no marked improvement was gained by mixing and that each seam made an equally good coke.

Question 16.—It would be practicable for large collieries with several sidings to work their branches with their own locomotives. This would simplify the introduction of colliery weigh-bridges. The wagons could all be weighed and marshalled ready for the railway company's locomotive and much time would be saved.

Question 17.—In thick seams, I consider it would be safe to work two sections of a less height instead of the one section usually allowed, keeping the size of the pillars as at present. This would allow 7·5 per cent. more coal to be extracted.

Question 18.—It is not advisable to remove existing sidings and have surface haulages instead. The number of coal tubs would be increased, as would the delays in dealing with outputs.

Question 19.—Tub-tipplers and gravity screens are simple and can be erected at each loading point so that central screening plants are not needed to reduce the number of loading coolies. These coolies are unwilling to work underground, but perhaps, if wagons were supplied regularly and no other employment were forthcoming, they would become coal-cutters.

Question 20.—The supply of wagons has been most inadequate for many years and the transport of coal has suffered accordingly. Owing to the scarcity of wagons, the freshly raised coal has to be stacked on the surface and in some instances lies there for months deteriorating in value and becoming small. A risk of spontaneous combustion is always present with large stocks. Raisings are restricted in that coal tubs cannot be returned to the miners quickly enough.

Question 21.—With the introduction of screening plant, coal free from dust and dirt would be got, while a better output would result, less damage would be done to coal tubs, and no loading charges would be incurred, provided always that a regular supply of wagons was assured.

Question 22.—The Eastern Coal Co. already has tipplers and gravity screens at most of their loading points, but these are idle most of the time owing either to no wagons at all or to covered wagons being supplied. Screening and sizing plants would be in the same position unless the coal could be stacked, reloaded into tubs, and passed over the screens into wagons when they come. It is difficult and practically impossible to design a chute suitable to load each of the many types of covered wagons now being supplied in colliery sidings.

Question 23.—Yes, by insisting on pillar-cutting by the hydraulic stowing process only, the waste would be diminished at once.

Question 24.—In many cases of small properties (and in large properties too), the output would be reduced if ordinary pillar-cutting were stopped.

Question 25.—If the ropeways are made big enough and plenty of them, I consider large quantities of sand could be handled. By utilizing the railways too, the position would be stronger.

Question 26.—About 2·25 tons of sand per ton of coal. This amount depends on the size of pillars compared to the size of galleries already worked, and might in some cases be as much as 4 to 1.

Question 27.—Even with sand delivered free on the colliery, it must be transported to the point of hydraulic stowing. The daily standing charges would be about Rs. 42-8 plus 3 pice per ton for loading the sand. The cost per ton on coal can then be calculated if 50,100 or 200 tons per day of coal are extracted.

Question 28.—By extracting all coal by sand-stowing, the life of a colliery will be lengthened while a steady output is assured, provided a regular supply of sand is available, with no stoppages for roof weight or gob fires. In *one district* alone in this company's properties, total available coal of 1,600,000 tons is standing in pillars. By extracting these pillars as we are doing and filling the goaf with sand, I hope to get 90 per cent. or 1,440,000 tons, while by the ordinary method we could hope for no more than 40 per cent. recovery or 640,000 tons of coal.

Question 29.—By breaking the surface by goafing, the "come" of water during the rains is enormous and usually results in complete flooding of the mines.

Question 30.—My only experience of mechanical coal-cutters in India was gained in 1908-09 at this company's Bankola Colliery. The machines "holed" the galleries quickly enough, but after that the "malcutter" had to be called in to break up and load the blasted-down coal

Sometimes the machines were idle for days waiting on galleries being cleared. In my opinion, mechanical cutters are most useful in driving headings, but not for coal-getting to compare in cost with hand-cutting.

Oral Evidence.

Questions 2 and 23.—I agree that further power should be given to direct when pillars should be got, but that power should be used with discretion. I agree to a controlling authority which would control (1) the size of pillars and galleries, (2) the time for getting pillars or for ceasing to extend an area under pillars, (3) sand-stowing and (4) clauses of leases dealing with the methods of working. This controlling authority might be constituted as suggested, *i.e.*, a technical head of the same status as the Chief Inspector of Mines with executive inspecting officers and an advisory board, consisting of representatives of the mining industry, railways, and landlords, to assist him on questions of principle, and with a right of appeal from the decisions of the technical head on such points as the advisory board considered proper ones for such appeals. I think such a controlling authority would work well in practice, especially if it were worked as the Mines Land Acquisition proceedings are now worked.

Question 4.—There would have to be separate plans on tracing cloth for each section of a seam.

Question 5.—The Mines Department and the railway people are best qualified to answer this question.

Question 6.—These are figures based on actual measurements taken during the last 3 years. 62 per cent. loss was in a 40 foot seam, No. 14.

Question 9.—With shifts, those miners who work half a day during the agricultural season would not come to the mines. If only hours for the end of shifts were fixed, this labour would, I think, still be lost. Such shifts would be impossible in Raniganj where the 24-hour shift system is in force. You could not work shifts for parts of a year excluding the agricultural seasons. I think it quite probable that the labour would only be upset by the introduction of shifts in the beginning and would settle down fairly soon, but raisings would suffer more than at present during cultivation and harvest.

Question 14.—My company has ordered plant for a generating station. I think enough capital has been expended on electrical development in the Jharia field already. The present companies could, I think, deal with all demands if they were given facilities for supplying power to neighbouring collieries. I think they can do it for less than ·75 annas a unit. It would be necessary to get a license to supply other collieries.

Question 17.—My answer to the question, as put in the printed interrogatory, would be not much more than the 7·5 per cent. mentioned in my written reply—not more than 10 per cent. at the outside.

Question 22.—I would prefer open wagons always. It would be difficult to adapt a covered wagon for mechanical loading.

Question 25.—I have been working my ropeway for 12 months without the rope showing any signs of wear, but it has only been worked at half its full capacity. The life of a rope is expected to be about 3 years. It was a "war" rope and cost about Rs. 20,000 for 2,500 yards. The whole ropeway cost about one lakh completely erected. This included two sets of clips, the only wearing parts being the ropes, clips and pulleys. There is also expenditure on the driving engine. We allow 10 per cent. depreciation and 5 per cent. interest. The capacity of my ropeway is 40 tons per hour.

As regards the sand available, I have put down a boring and found 30 feet of sand without getting to the end of it. But only the top sand is dry, and I think dredging will be necessary. Sufficient sand could be collected to last during the rains. In some places, sand-stowing would not be possible during the rains owing to the increase of water in the mines. But if sand-stowing were generally stopped during the rains, it would interfere with raisings. I think the sand-banks do change their position and their size according to changes in the bends and the bed of the river. I intend using the surface soil at Amlabad for stowing. This consists of sand, clay and gravel in places.

Question 27.—The figures I gave work out as follows as the cost per ton of coal :—

	Rs.	A.	P.	
For extraction of 50 tons of sand	0	13	4	per ton.
" " " 100 " "	0	7	7	" "
" " " 200 " "	0	4	2	" "

I refer to the extra cost involved in the extraction of the largest percentage possible of this company's valuable seams. We are in a very advantageous position as regards sand-stowing. We require coal for the company's steamers and would be quite satisfied if we could produce at anything below the market rate for coal which we would otherwise have to purchase. My company has no objection to the principle of a cess with compensation. We would benefit at our collieries further from the river.

Written Evidence of Babu Govardhandas Manishanker, Manager, Jayrampore Jinagora Coal Mines (Jharia), nominated by the Indian Mining Federation.

Question 1.—I am a first class service certificated colliery manager. I have been working in Jharia coalfield for 21 years.

Question 2.—There should be no controlling authority.

Question 3.—Impracticable; a waste of time and money.

Question 4.—Yes, it is practicable.

Question 5.—With the exception of a few surveyors, I believe the others are capable of taking actual datum levels.

Question 6.—Pillars are being extracted in one of the coal seams under my charge and the calculated loss will, I think, be 8 per cent. excluding coal left in barriers.

Question 7.—No.

Question 8.—I prefer hydraulic stowing, but it should not be compulsory.

Question 9.—Regular shifts are advisable and they should be twice a day, day shift and night shift as they are now in the field.

Question 10.—I recruit labourers through a representative. The best course for the improvement of recruiting labourers is that the Hazaribagh, Monghyr and such other districts should be specially reserved for coal mines. The labourers must be given comforts and good treatment.

Question 11.—Yes.

Question 12.—Not practicable nor desirable.

Question 13.—Training is only necessary for persons employed underground. They are trained (1) in cutting earth, (2) to cut coal in a quarry, (3) to cut coal in floor from galleries under the care of a sardar, and (4) ultimately to drive galleries in company of persons known to them and trained previously. To cut coal in a quarry is the first lesson for a miner.

Question 14.—Compulsion is not desirable. Electrical power is not safe for a mine being worked with shafts having no outlet in the form of an incline. I am afraid it would be impossible to save miners employed underground in case the current stopped owing to some accidental cause at the central power station, especially if at the same time, unexpected danger happened at the mine. It is not at all advisable to stop all mines at the same time in case the machinery at the central power station got out of order. Electricity is not safe in gassy mines, and can only be conveniently used for pumps, haulage and coal-cutting machines.

Question 15.—No.

Question 16.—Not advisable.

Question 17.—Since I prefer hydraulic stowing, I find no loss of coal lying under railway sidings for support.

Question 18.—Not advisable.

Question 19.—Screening plants are of no use unless the coal is despatched directly it has been raised from the mine.

Question 20.—No, wastage of coal is about 10 per cent. Insufficiency in wagon supply makes huge stocks at the collieries and, had there been a large percentage of sulphur in coal, it would have resulted in fire. Coal in stock deteriorates in quality.

Question 21.—Coal raised, screened properly and loaded into wagons will be good in quality, will prevent wastage, and will save labour to some extent.

Question 22.—Screening and sizing plants have not been adopted owing to insufficiency in wagon supply and coal lying in huge stocks at pit-mouths. Open wagons, above thirty tons capacity, will be more suitable for loading coal just after it has been screened.

Question 23.—I agree to hydraulic stowing with sand or with debris where it is possible, but the scheme should not be compulsory. Power given to controlling authority to restrict the time and system is not advisable.

Question 24.—Such control will affect the coal output and will result in a loss.

Question 25.—It is quite impossible to get a sufficient supply of sand for stowing by a system of ropeways alone.

Question 26.—Four tons of sand will be put into the mine to obtain one ton of coal.

Question 27.—The extra cost per ton of coal got from pillars by sand-stowing will be more than one rupee eight annas per ton in case sand were delivered at the pit-mouth free of cost.

Question 28.—The sand-stowing system will extend the life of the colliery, and it will be more productive with some exceptions.

Question 29.—The present system of breaking up the surface by goafing will increase the come of water.

Question 30.—Mechanical coal-cutters will be useful in some cases.

Oral Evidence.

My evidence represents my own views.

Question 2.—I admit that a great deal of waste is going on, but not in all mines. Improvement is certainly required, but compulsion is not necessary. Suggestions would, I think, be sufficient, similar to those made by Mr. Grundy in 1896. An advisory board might be constituted for the advice and guidance of managers. (Witness declined to answer the further question as to what should be done if such advice were given and were not followed.)

Question 6.—This relates to a 12 feet seam, 40 feet deep. The pillars were 40 feet × 40 feet. The percentage is based on actual measurements. If proper precautions are taken, natural conditions are favourable, and the seam is not more than 15 feet thick, the loss should never be greater than 8 per cent. I have done no pillaring in thicker seams.

Question 9.—Legislation is not necessary. Strikes would follow compulsion. Good treatment and explanation would be sufficient to persuade the labour to accept regular shifts.

Question 10.—I do not mean that the people of these districts should be prevented from going elsewhere. They should be encouraged to come to the mines, but should not be compelled.

Question 14.—I have not seen any electrical winding myself.

Question 23.—If pillaring is so done as to cause fear of collapse and loss of coal, I agree that it should be stopped compulsorily.

Question 24.—Sand-stowing will still entail a loss of about 6 per cent., but it would have other advantages such as prevention of gases from goafs and consequent epidemics.

Question 26.—I have no experience of sand-stowing. The river near my mines would not supply enough sand to stow those mines.

Written Evidence of Mr. J. J. Marshall, Coal Superintendent, State Railways.

Question 1.—Five years articled pupil to a well-known North of England mining engineer. First class colliery manager's certificate—English and Indian. Two years under manager in England, and four years manager in India.

Question 2.—I certainly consider an authority should be set up. I have recently had an opportunity of seeing a plan of the Jharia coalfield on which was shewn practically the whole of the various holdings. In one particular area, there was about 3,000 bighas divided up amongst twenty-two separate collieries, the smallest being under thirty bighas in area. The working of small areas of this description is, to say the least, most uneconomical. As far as the constitution of the controlling authority is concerned, in my opinion it should be composed of a mining engineer with a qualified staff.

Question 3.—No, and for the following reaons:—(1) As the miner is paid by the tub of coal cut and loaded or stocked, it would be hard to convince him that this tub would be taken care of until weighed at the surface. Further trouble might again arise as probably the number of his tubs weighed in one day would not correspond to the number loaded by him underground. (2) Owing to the large number of separate openings at many collieries, separate weighing machines would be out of the question.

I do not consider the weighing of coal brought up in baskets practicable. For statistical purposes, I consider that a record of the coal actually despatched as per railway weighments, *plus* the colliery manager's estimate of coal consumed in boilers and miners' houses, would be sufficiently accurate

Question 4.—(*i*) No. I do not consider it practicable in every case.

(*ii*) I always understood that one of the purposes of colliery plans was to show the actual shape of pillars at the time the survey is made.

Question 5.—From my experience, generally speaking they are not.

Question 6.—I am aware of one case where an existing pillar area is on fire and, if sand-stowing is not immediately adopted, the coal unrecoverable will be equal to a loss of about 60 per cent.

Question 7.—No.

Question 8.—(*i*) No.

(*ii*) If sand-stowing were compulsory and efficiently done, it should be possible to work seams in any order.

Question 9.—(*i*) I should certainly consider it better to have regular shifts, but doubt very much whether it would be practicable, especially in the case of collieries worked by inclines.

(*ii*) Only by legislation.

Question 10.—From my mining experience in India, I consider the only way in which to draw labour to the coalfields is to provide them with their own small plot of land for cultivation, better water supply and better bazars.

Question 11.—The miners being agriculturists, it would certainly attract labour.

Question 12.—The idea in the main is sound. But I do not consider it would be possible to run settlements outside the coalfields except in the case of the large colliery companies.

Question 13.—No.

Question 14.—No. I do not consider it right to compel any colliery to take power from a central station, but certainly consider that the larger collieries, whose lives are assured for a good few years to come, should be advised to combine and take power from a central power generating station. Certain collieries have already installed their own power generating plant and these could not be reasonably compelled to scrap their existing plant. Regarding some collieries whose areas are limited, financial loss would be entailed in re-equipping the mechanical outfit to suit the new method of power transmission.

Question 15.—No.

Question 16.—I do not consider it either practicable or advisable. There are few branches in existence which would be treated as purely colliery branches and, in a case of a branch with a lot of sidings belonging to different collieries taking off it, how would the working of locomotives belonging to the different collieries be controlled so as to avoid their clashing?

Question 17.—Mr. Treharne Rees objects to colliery sidings and their connections between the railways and the collieries being maintained by the railway company. I can only say that, in the case of the Lutchipur Branch belonging to Messrs. Apcar & Co., and taking off at Sitarampur, I understand there has been trouble owing to subsidence due to indifferent upkeep by the colliery proprietors. Mr. Treharne Rees also recommends the use of light locomotives, but I question very much whether the amount of coal left underground as a support would be much less if a lighter type of loco was adopted. Moreover, the gradients in many sidings prohibit the use of anything but a heavy type of loco.

Question 18.—No, generally speaking it would be most inadvisable to centralise and mix the coals. Moreover, fewer sidings would mean more haulage tubs, more rails, and consequently heavier expenses for the colliery concerns.

Question 19.—If screening plants were installed at central loading depôts, the number of loading coolies would be reduced considerably, but I do not for a moment think that these coolies could be induced to work underground.

Question 20.—No. The only waste that I can think of is a slight deterioration in quality. Stacking of steam coal increases the percentage of slack and thereby results in a certain financial loss to the colliery.

Question 21.—The use of screens would reduce breakage and save extra handling. If screen were used in conjunction with picking belts, a cleaner coal could be put on the market.

Question 22.—In my opinion this has been due to two reasons, *viz.*:—

(i) Owing to the scattered position of the various outlets on a colliery.

(ii) Owing to a fear that railway companies would not be in a position to supply the number and type of railway wagons required.

Question 23.—No.

Question 24.—I would not go so far as to say that such control would affect the output, but I certainly consider that sand-stowing would prolong the life of a large number of collieries.

Question 25.—No.

Question 29.—Owing to the breaking up of the surface in the past, a large number of collieries have already been left with legacies. If several of the thicker seams are extracted without sand-stowing, it will only result in the formation of large underground reservoirs. This could not continue indefinitely, and the time would soon arrive when it would be impossible to deal with the "come" of water.

Question 30.—I have not had any experience of mechanical coal-cutters in this country.

Oral Evidence.

Question 2.—The area I refer to is Tisra. For the controlling authority, I would prefer a mining engineer with English qualifications and Indian experience. His staff should have similar experience. I do not consider interference with practical management is necessary where pillars are being left at a proper size. If there is no interference except where it is absolutely necessary to prevent waste, I have no objection. I may add that my reply to the question was based on the assumption that the controlling authority had already been decided on. I think control is advisable as regards leases to prevent waste, but it should not interfere with the rights of proprietors. I am inclined to think that nationalization of minerals would be the best course.

Question 3.—My first two objections would disappear if miners continue to be paid by the tub. I do not think that weighing machines would give any more accurate results than at present.

Question 6.—The losses at one colliery are, to my knowledge, about 25 to 30 per cent.

Question 9.—Regular shifts are not practicable even in Jharia. If only the time for the termination of shifts were fixed, this might be worked if made universally compulsory by Government

orders. It would not interfere with the labour supply under such circumstances. There might be trouble for a week or two, but not longer.

Question 14.—You cannot compel small collieries working 50 or 100 bighas to take electric power. Nor those raising up to 3,000 tons a month. It would not pay them as the coal they are now using for fuel is of little value. I am not in favour of compulsion, but I think more facilities should certainly be provided.

Question 17.—This is the only privately-managed siding I know of.

Question 18.—The present tub-blocks would not be suitable.

Question 20.—I think deterioration is as much as 25 per cent.

Question 22.—I prefer open wagons.

Question 23.—I think the further power is necessary, but it should be used with discretion.

Question 24.—The output will be kept up if possible and there would be ways of doing this.

Written Evidence of Mr. F. Owen, Agent for Messrs. Macneill & Co.'s Collieries, Raniganj.

Question 1.—I am a trained mining engineer and certificated colliery manager under the English Coal Mines Act of 1887. My position is Superintendent of all collieries and zemindaris of the coal companies under the managing agency of Messrs. Macneill and Company. My experience in India is nearly 21 years and in Great Britain 9 years.

Question 2.—I am in favour of the establishment of a controlling authority vested with limited but reasonable powers, its members being fully representative of the mining industry—professionally and commercially—and the mineral owner. There should also be at least one representative of the legal profession, preferably with some knowledge of the technicalities as applied to mining operations and mineral leases.

Question 3.—I do not consider the suggestion of weighing all coal, as brought out of the mine, to be a practical proposition for universal adoption. The conditions prevailing in both coalfields are adverse to such a proposition, owing to the large number of openings producing coal in comparatively small quantities, thus necessitating the installation of a large number of expensive weigh-bridges. At the better equipped and more modern collieries, where there are fewer openings producing comparatively large outputs, the proposal is feasible, but such places are in the minority. Colliery tub-weighing machines, to be efficient and reliable, require a good deal of skilled attention which they are not likely to get in the coalfields. In Great Britain, the conditions are different, because the machines are subject to periodical inspection and test by Government officials of a special department. Further, at a large number of collieries, the coal tub is not of uniform size or weight; therefore it would be very very difficult to average the tare on the steelyard of the weighing machine.

As regards weighment of all coal brought up from the mine in baskets or otherwise by the labour, I do not consider this to be either practicable or advisable yet awhile. A check on the coal carried away by labour, in excess of their own requirements, is necessary, but so long as colliery works are so open, *i.e.*, not enclosed such as most of the collieries in Great Britain are, it will remain a difficult matter effectively to check the practice. In many mines, labour is not allowed to bring up coal from the mine in baskets owing to the tendency to rob the pillars near the shaft or on the haulage roads near the shaft.

Question 4.—I consider it to be quite practicable to shew on the colliery plans each year's or half year's working of the mine in different colours. This is already done at the collieries under my control. I agree that at every mine there should be a plan shewing the shape and size of coal pillars, which really means that underground surveys should be offset surveys. In several mines this is done. Rule 9 of section 20 of the Indian Mines Act provides for accurate plans being kept.

Question 5.—As to the recording of reduced levels on colliery plans, at distances of, say, 100 yards apart, I do not consider this to be of such importance as having accurate plans of the workings. Proficiency in surveying and levelling has not yet reached that stage among Indian surveyors as to warrant their being entrusted with the task of recording reduced levels on the mine plan. At mines where more efficient surveyors are kept, such reduced levels would be recorded at the wish of the controlling authority or Department of Mines. Some of the mines under my control, with an irregular inclination, already have reduced levels recorded on the plans of workings, but I find it difficult to rely on such levels unless the work is done by a proved reliable surveyor.

Question 6.—I have frequently calculated the percentage of coal obtained and lost in goafing areas and, taking into consideration the full thickness of seam, including roof coal usually left, and unworked pillars or half pillars within an isolated area, I consider the following to be a conservative estimate :—

		Per cent.
Dishergarh Seam old areas	22'—0" thick	15 to 35
Ditto do. new do.	14'—0" do.	10 to 20
Jamuria do. old do.	14'—0" do.	15 to 25
Ditto do. new do.	12' to 14' do.	10 to 15
Sanctoria do.	10' to 12' do.	10 to 15
Jharia 17 do.	8' thick	8 to 12
Chowrassi and Nodiaha	9' to 12' do.	10 to 20

Question 7.—I have had experience of several instances where the lower seam has been worked under an upper seam which has been left unworked, and also where an upper and lower seam have been worked together, but I cannot quote any specific case of importance where the upper seam has been destroyed by reason of such working.

Question 8.—If a controlling authority such as is contemplated is established, I am not in favour of it being vested with powers "to insist" that seams should be worked in vertical rotation. It might advise in the matter and, if such advice is supported by sound reasons, I do not think that any colliery owner would act adversely to the advice offered. If sand-stowing were made compulsory, I consider it would still be necessary to use discretion in working upper and lower seams together, particularly in cases where the intervening strata is less than 150' and the seams being worked are, say, over 12 feet thick.

Question 9.—I do not consider specified regular shift working to be practicable in the Raniganj field so far as the coal-getter is concerned; neither do I consider it advisable to introduce such measures while the general supply of coal-cutting labour is in such defect and so unstable during certain periods of the year.

Question 10.—Our systems of recruiting labour vary rather considerably, but the main one is that of inducing labour to settle on the colliery property, of offering land and monetary inducements, and providing the best facilities underground at the coal face. I cannot suggest any improvement for universal adoption.

Question 11.—Labour settled on the mine property usually get a small area of land to cultivate. This also applies to labour in outlying villages over which we exercise control. The provision of such land, which need not exceed half a bigha, is much appreciated, but it is not a means of preventing the usual exodus of labour from the colliery for cultivating other lands in which they are interested at their homes, often situated at a considerable distance from the mine.

Question 12.—The success of any attempt to form colliery settlements a short distance off the coalfields, and bring in labour from such settlements by workmen's trains, is very problematical. Such a scheme is likely to meet with more success in the Jharia than in the Raniganj coalfield, as the labour of the Jharia field is more of the roving or migratory type, and will often reside in dwellings that do not appeal to the miner of the Raniganj field. I do not consider that any combination of coal companies to form such labour settlements would be a success. Combination has been tried several times in other directions and failed hopelessly.

Question 13.—We have no hard and fast system of training coal-cutting labour. The ordinary miner has no defined methods of cutting or getting coal such as is in evidence with the British miner The advantage to be gained by under-cutting the coal seam and slotting up the side has been shewn and explained to the older miner by managers and overmen, but such efforts have not appreciably improved the methods used by the average miner of to-day. The raw recruit is put with experienced men of his gang and is usually paid *khoraki* until he becomes sufficiently skilled to earn a reasonable wage by the value of the coal hewn from the face. New recruits are also frequently given easy coal such as floor coal or coal of a pillar being extracted. I do not agree with Mr. Rees that owners of mines and colliery staff make no proper attempt to teach the miners. Skilled hands, such as mechanics, engine-men and carpenters, usually learn to become efficient by practice from youth through working with older hands. For instance, a fitter often begins as a fitter's boy, whose duty it is to carry the fitter's tools. Later, he becomes a half or assistant fitter and subsequently is made a full fitter. The same system applies in the machine shops. Engine men are usually cleaners and begin on a small haulage engine, ultimately gaining confidence and experience to entitle them to be full enginemen, *i.e.*, winders Our electrical mechanics begin as apprentices and are trained under older mechanics and under European supervision. Surveyors begin as paid or unpaid apprentices in our survey department, and frequently leave to take up a surveyor's post at some small colliery before they have gained sufficient experience to warrant their occupying such a position.

Question 14.—I do not agree with the proposal of Mr. Rees to *compel* collieries to take electrical power from a central supply station. It is only within a comparatively short period that small coal, such as slack, has been saleable at a reasonable figure, and I can well recall the time when Dishergarh seam slack was sold at less than Re. 1 per ton in order to get rid of it, and at this price it was often difficult to effect sales. Even to-day, slack of anything below first and best second grade coal is often difficult to dispose of, therefore its use for boiler fuel may be justified as such use often relieves a congested pit-bank. As mining becomes deeper and the growth of water increases, coal companies of any standing will need no compulsion as regards the adoption of electrical energy in its most economical form, but no colliery owner will go to the expenditure of installing electrical machinery when he has a surplus of unsaleable fuel for steam-raising on the colliery. I am in favour of central supply stations as a source of supply of electrical energy to mines. At the present moment, the demand for electrical power is considerably greater than the existing stations can meet and the demand is increasing rapidly.

Question 15.—I have had no experience of mixing coals of different seams from a commercial point of view of steam-raising or coking.

Questions 16 and 17.—In my opinion, it is neither practicable nor advisable for colliery companies to work the colliery sidings and branches with their own locomotives. As regards the suggested reduced support of sidings and branches, I do not see how the support can be reduced, as what is safe for a colliery locomotive should be equally safe for a railway company's locomotive. It may be argued that the average colliery locomotive would be lighter than the

existing railway locomotives, but where underground support is the point for consideration, a few extra tons in the weight of a locomotive is insignificant. If the contention be that it would be easier to re-rail a lighter locomotive, then the railway company should use lighter locomotives, establish a larger number of marshalling yards, and work the colliery sidings more frequently.

My experience of goafing at depths over 700 feet, in a seam up to 18 feet thick, is that surface subsidence is so gradual, and the depression so small, that the present restrictions stipulated by railway company are not warranted, and that under 700 feet, and down to 350 feet, the restrictions can be modified very considerably. Where seams of 4 to 10 feet are being goafed, lying at a depth of 300 feet and over, there should be little need for any restriction under colliery sidings and immediate branches, so long as the speed of trains is limited to 5 to 8 miles per hour over siding branches.

Questions 18 and 19.—In my opinion, the suggestion put forward will be proved, in several cases, to be both practicable and advisable. A great deal more can be done towards concentration in the loading of coal at wharves. I do not favour the haulage of ordinary colliery tubs on the surface over long distances and would say that 1,500 feet should be the limit. By concentrating the loading of coal within a colliery property, a number of sidings serving that colliery might possibly be discarded, but this is a matter for very careful consideration and only after a complete survey has been made shewing the relationship of the various mine openings to the colliery sidings on the property, and the various classes or qualities of coal to be loaded at such sidings. Concentration, combined with the installation of mechanical screening plant and a free supply of wagons of the desired type, would tend to reduce the number of labour now ordinarily required to be kept for hand-loading wagons and screening small coal. This, though, only applies to coal immediately as raised, but there are times when output is often in excess of the orders to be executed and so has to be put into stock. This stock has to be lifted by coolies whether it be loaded into tubs and tipped over the screening plant or put into wagons direct. Apart from the slackness of orders, stocks are frequently accumulated to meet heavy forward demands for shipping, so, taking all these points into consideration, I would say that not more than 35 per cent. of the present loading labour would be liberated by the general introduction of mechanical screening plants. Of this 35 per cent., perhaps 45 per cent. would be persons who could be induced to work underground on work other than coal-cutting.

Question 20.—Although in my opinion there has not been, during the past 14 years, a sufficient supply of railway wagons constantly available at the collieries for the required transport of coal, I do not consider the shortage of wagons has been in such defect as the shortage of locomotive power for accelerating the movement of wagons between departure and receiving stations. During the last few years, it was well known that colliery sidings have been used for stabling empty coal wagons when the colliery wharves have been congested with coal, and indents for wagons have been turned down by the railway company. The result of carrying heavy stocks may be summarised as follows :—

1. Disintegration and deterioration in quality.
2. Excessive loss by reason of coal being carried away by persons employed and not employed, as well as loss in weight amounting to about 20 per cent.
3. Risk of spontaneous combustion which has, in many cases, resulted in the loss of several thousand tons of coal at depôts.

Question 21.—If coal could be loaded into wagons over a screening plant and despatched immediately it is raised from the mine, the cost of handling would be reduced to a minimum, less breakage would result, and the consumer would receive a clean fresh coal of guaranteed quality. In Great Britain, "no wagons" usually means idle pits. At Indian collieries, our best wagon supplies are when the pits are idle.

Question 22.—Up to about the year 1905, the screening plants fitted at several of the larger collieries were in the nature of coal-loading chutes erected to facilitate loading from high level heapsteads. On it being represented by shipping company's agents that they required a steam coal containing less small coal, these loading plants were subsequently fitted with fixed screening bars to remove the small coal or slack. The market gradually became more particular and it is only a few years back, probably about 12 years, since the first shaking and sizing screens were installed at a Jharia colliery. Since then, several such screens have been installed at a few collieries in both coalfields and the reason more such plants have not been installed is due, mainly, to the inadequate wagon supply and to the type of wagons available. Many collieries have installed screens of the fixed bar or non-vibrating type for loading steam coal only, the small being dealt with by hand-screening or a rotary screen worked by power. At small collieries, capital expenditure has been a consideration in introducing mechanical loading appliances. Indian coals are mainly used for steam-raising purposes, and, as such, the need for sizing has not manifested itself.

Question 23.—Sand-stowing would certainly minimise waste in the winning of the whole seam and tend to reduce the present percentage of loss in working the pillars already existing, but I do not agree that the proposed controlling authority should be empowered to insist that all pillars should only be got by the sand-stowing process, as there are several instances where the thickness of seam, and its roof and cover, are such as to warrant the working of pillars without introducing sand-stowing. I refer chiefly to seams up to 9 feet in thickness. When the thickness is 10 feet and upwards then the controlling authority should consider the case and exercise such powers as are necessary to compel sand-stowing. Consideration should be given to the length and breadth of the

areas to be dispillared, the cover, thickness of seam, and probable effect on the surface by reason of subsidence.

Question 24.—If the controlling authority decides to exercise its full powers immediately it is formed, then I am of opinion that the result would be an immediate decline in raisings. But, if the controlling authority allows a reasonable time for effecting improvements and the introduction of sand-stowing where feasible, I do not think the effect on output would be serious so far as first and best second class collieries are concerned.

Question 25.—I understand it is already estimated that 12,000,000 tons of sand will be required annually for the Jharia and Raniganj coalfields if sand-stowing is made compulsory in working out pillars. In my opinion this estimate is too low if the old workings now standing on pillars have to be stowed with sand before extraction of pillars. There are only three rivers of importance, the Barakar, Adjai and Damudar, as a source for the supply of sand, and the latter will be the main one. Approximately, 12,000,000 tons of sand represents 300,000,000 cubic feet equal to about 20 miles of sand 500 feet wide and 5½ feet thick. As to whether a system of ropeways could deal with such a quantity of sand, I do not feel myself competent to express an opinion, but, if expert opinion decides that such is feasible, then I do not consider there is sufficient additional labour in the whole of the field to handle this amount of sand, as it will not be possible to handle the whole quantity automatically and discharge it into the mine workings without employing a large amount of labour.

Question 26.—Roughly, I estimate that to get the existing pillars of the old workings by sand-stowing, an average of 2½ tons of sand would be required per ton of coal.

Question 27.—I have no actual or reliable data to work on in estimating the extra cost per ton on coal from pillars by sand-stowing, but, assuming that sand is delivered free at the flushing-in hopper, my idea is about 9 annas per ton. This would include wear and tear on piping, labour, bratticing and the cost of re-pumping the flushing water up to a head of 500 feet with current at ·5 of an anna per unit.

Question 28.—By introducing sand-stowing generally at the collieries under my control, I estimate the life would be increased by fully one-third, and the productivity increased and then steadily maintained with greater certainty than under existing conditions. The present output could be maintained by working within a more compact area, thus reducing the general maintenance charges to a minimum.

Question 29.—In my opinion, the water growth would ultimately become unmanageable.

Question 30.—In my opinion, there is a great future for mechanical coal-cutters for opening out or developing mines. The failure in the past has been due mainly to the lack of constant skilled supervision. As there is a growing tendency on the part of miners in the Raniganj field to prefer pillar working to gallery work, and as coal-cutters who have previously been engaged on pillar working are refusing to return to gallery work, there is every indication that it will be necessary shortly to form pillars by the use of mechanical coal-cutting machines in addition to their use as a developing machine.

Oral Evidence.

Question 2.—I agree to a controlling authority with a technical head of the same standing as the Chief Inspector of Mines, this technical head to be assisted on questions of principle by an advisory board on which the collieries, railways, and landlords would be represented. Appeals to be allowed in such cases as the advisory board should declare fit for such appeal. The appellate court should consist of a District Magistrate or some similar Government official with two mining engineers as assessors.

Question 6.—The depth in these cases varied from outcrop coal to 900 feet. Roof coal is not always saleable as first class coal. It can always be sold as second class coal. I think Mr. Rees' estimate of 33 per cent. of waste is correct as a general average; if anything, it is rather under the mark.

Question 9.—Approximately 50 per cent. of our labour for the Dishergarh group of collieries comes from *taluks* across the Damudar River. It is often held up by floods during the rains, and the shift system could not therefore be applied to it.

Question 14.—I would leave the whole question of electrical development to private enterprise. A private company should be allowed to supply power to neighbouring collieries without becoming a public supply company That would help towards extending the general use of electricity. There are already enough private companies in the Jharia field and they should be allowed to supply others at their own price by private arrangement. The present legal restrictions on such a course should be abolished.

Question 16.—This would involve very great capital expenditure with very little corresponding advantage. I think some of the conditions, for example Clause 6 of Memorandum 4, of the Bengal Nagpur Railway siding terms are more onerous than those of the East Indian Railway.

Question 20.—I should think that the percentage of 25—on which the estimate of 12 million tons of sand per annum is based—is too low as there is more pillar recovery going on in Jharia than 25 per cent. of the output. In many places in the Damudar River, you could get sand by and labour for about one-third of the time during the monsoon months. The average weight of dry sand consolidated is about 104 lbs. per cubic foot. Sand in the river bed is often wet after about 3 or

4 feet down. One is not confined to sand for stowing purposes, but sand would be cheaper at equal distances.

Question 27.—If a colliery adjacent to a river had to carry sand itself, the additional cost would be about annas 7, or about Re. 1 in all. It is now costing us annas 8 per ton from the river into hoppers about a mile away. This is not a *pakka* method of course. The railway is now charging us Re. 1 per 10/12 ton wagon per day. We have hired 8 wagons and load 4 daily. This is a special arrangement. An all-round rate of Re. 1 for both coalfields would be too low I think. My figures could be reduced by improved methods and would not apply generally.

Written Evidence of Mr. R. Purdey, President, Association of Colliery Managers in India.

Question 1.—I hold a 1st class colliery manager's certificate under the Coal Mines Regulation Act of Great Britain. I have been in charge of mining operations in thick and thin seams at various depths and inclinations in England and India since the year 1900. I have 13 years' experience as a colliery manager in the Raniganj and Jharia coalfields.

Question 2.—I am of the opinion that such an authority is advisable, and should be constituted of whole-time experienced mining engineers.

Question 3.—The proposal is quite practical if miners are prohibited from bringing their allowance coal out of the mine.

Question 4.—This regulation is already in vogue at some collieries *re* marking up of workings quarterly. The proposition *re* size and shape of pillars is a rather more difficult one, but they could be re-surveyed at reasonable periods, say yearly.

Question 5.—Very few so-called surveyors in Indian collieries are "capable." I have always contended that these men should be "certified as competent," *i.e*, that there should be, for colliery surveyors, a certificate of competency under the Mines Act. So much depends on the accuracy of their work, and they are as a class very incompetent.

Question 6.—In trying to extract pillars that have been left many years ago, more as a support than as a reserve for second working, and which constitute in many cases one-third of the seam, half of the pillar coal may be recovered, giving a loss of 17 per cent. (about), but I have known large areas of these old pillars crushed and buried after extracting only a few pillars; however, a mine can be won with a view to subsequent depillaring and 90 per cent. recovered by ordinary methods, such I have calculated in goafing an area of a 7-feet seam. The loss is greater in thicker seams.

Question 7.—I have had this experience. The damage depends on the thickness and method of working of the bottom seam, the vertical distance apart, and total cover to surface. With good cover to surface, say above 100 feet, and above 100 feet intervening, the top seam could be worked after settlement.

Question 8.—No! This would prevent the working of first class bottom seams for which the property has been primarily bought. If sand-stowing were made compulsory, then it would not matter which seam was worked first.

Question 9.—I think this advisable. An "ideal" shift should be aimed at, and machinery set in motion with that ideal as its ultimate object. I consider 8 hours underground sufficient for any hard-working employee; in the case of a coal-hewer, this would mean seven hours at the face. Our present day Indian miner prefers a long easy shift, the shift to commence and end at his own inclination. He occupies a face twice as long as is necessary. Twelve hours could be made a compulsory maximum shift above and below ground at once. Ten hours after one year, nine hours after another year (for underground workers only), and after another year eight hours only, for all underground labour. The Colliery Managers' Association to have the power to hold back the eight hours' shift for another year, if the majority of their members by vote consider it expedient.

Question 10.—We give them free houses, and medical treatment, suitable *bakshcesh* for celebration of pujahs, births, weddings, and funerals, travelling expenses to and from their country at stated periods, plots of rice land on easy terms when available, and make their working conditions elastic and as pleasant as possible. *Re* suggestions for improvement, I consider that all gifts tend to lower general morality, especially dignity, tenacity and thrift. The Indian labourer requires a general toning up, being generally of a loose, idle and thriftless temperament; also a better all-round domestic standard of comfort and privacy with suitable education and healthy relaxation for his spare time. Housing accommodation could be arranged more in accordance with domestic and communal requirements, provision being made for religious and simple secular education, as also for harmless amusement and play. A grog shop need not resemble a pig-stye, and it would be better if the charges for grog were doubled, if the places were made respectable, the refreshment wholesome, and the hours of consumption regulated more in accordance with spare time. Advances and daily payments only pander to the thriftless; weekly payments should be made compulsory, Saturday afternoon should be pay-day, and Sunday play-day," and all *hâts* within the mining settlements held only on that day.

Question 11.—I only agree in so far that he should have a garden for his spare time occupation and suitably enclosed with his house.

Question 12.—This is only possible on a big scale by a combination which I consider impossible, though large companies could build model mining villages on available land close to their collieries.

Question 13.—Except for the training of the mechanic class by apprenticeship, all attempts at training the ordinary labourer to mine or get coal, are futile. He is not a miner, but a "malcutter"; he cuts coal in his own way, and has only passive contempt for any other; being independent, he is left to do it in his own way. I am speaking of the miner of Raniganj and Jharia.

Question 14.—There are so many small places and complications that I think it impracticable; but a tax on all consumption, except at a power-house, or other efficient deterrents could be devised.

Question 15.—I have experimented with the coking of almost every seam in the two coalfields. We have some seams high in impurities, but first class cokers; we have some low in impurities but poor cokers, some cokes that will carry almost any load, and others the reverse. We have some seams that will not coke at all, but not many. Some can be mixed with good results and would thereby considerably increase the country's available coke.

Question 16.—This could only be a business proposition on large collieries, and in conjunction with weighing and marshalling.

Question 17.—Very much lighter types of shunting locomotives could be used by the railways between colliery sidings and marshalling yards, but I am not of opinion that any of the existing siding supports could be safely interfered with.

Question 18.—It is practicable, but transport would have to be paid for.

Question 19.—Such reduction would thereby be effected, and I am of opinion that most of the labourers would become available below ground.

Question 20.—I do not. Coal is dumped on the ground even where arrangements have been made at considerable cost to mechanically screen, grade, and load it direct into wagons; it has to be stacked, picked up again, re-screened, and loaded, every action resulting in more breakage. The coal is weathered with a resultant heavy loss in volatiles, screened dust is washed away from the heaps by torrential rain, and some coals are very liable to spontaneous combustion when stacked in such large quantities and for such considerable periods as has been necessitated by continued wagon shortage, and in fact have actually fired in some cases.

Question 21.—Increase of round coal, reduction of labour, better grading, cleaner coal, and a more efficient turn-round for the mine.

Question 22.—Mainly on account of non-supply of suitable wagons, as also insufficient and irregular wagon supply. Any wagon can be built in such a way as to be easily convertible when of necessity it must be loaded with coal from a screening and sizing plant. No attempt has been made by the railway companies to meet the collieries in this respect. Very few firms realize the increased efficiency of a graded coal, or are not aware of it being available, as there is nothing extra offered for it, although many of them are using mechanical stokers.

Question 23.—It would certainly diminish waste and it would not be necessary for the controlling authority to have any say in the matter. Control over the time for depillaring would cause incalculable friction and is an unnecessary interference.

Question 24.—Sand-stowing should increase rather than decrease the output from depillaring districts, as it is safer on extended work.

Question 25.—No. I am of the opinion that every system known would have to contribute.

Question 26.—Sand would have to be supplied bulk for bulk and not only for the coal to be got, but for the coal already got. In fact, if you admit that coal can be depillared in the ordinary way with a loss of only 10 per cent., then you must supply 100 per cent. sand to get 10 per cent. of coal, *i.e.*, by weight 160 tons of sand for 13 tons of coal.

Question 27.—I consider the cost should be calculated on the extra 10 per cent. only that the method enables us to get, and not on the total available coal from the pillars.

Question 28.—It would prolong the life and productivity and conduce to safety and security.

Question 29.—The come of water will be increased.

Question 30.—In my opinion they will be most useful in maintaining and increasing the output, and countering the shortage of labour and the disinclination of the miner to tackle the laborious under-cutting and shearing. The lighter work of filling would attract labour.

P. S.—

Question 14.—My Council are of the opinion that it is advisable.

Question 17.—My Council are aware of many cases.

Oral Evidence.

General.—I answered the interrogatories myself, but the Colliery Managers' Association approved of my answers with the two postscripts at the end of them. You may take it that my answers are those of the Colliery Managers' Association.

Question 2.—I would not have more than three individuals in the controlling authority. It should be a department in addition to the Mines Department, but united with it under one technical head.

Question 9.—By a 12-hour shift, I mean that the miners should not be allowed to remain down more than 12 hours. Legislation would be necessary as the system must be universal and could not be brought about by agreement. Miners would have to be prevented from doing 12 hours on one colliery and then another 12 hours on another colliery. I have had no labour difficulties in introducing 8 hour shifts in an isolated colliery; I have not yet attained punctuality in starting the morning shifts, but the miners come out punctually at the end of the shift and do their work within the shift time.

Question 10.—I do not think grog shops should be opened at all in the morning. My Association has already applied to have the hours altered so as to suit the leisure of the labourer. If weekly *hâts* on the same day were introduced and enforced, weekly payments would follow.

Question 13.—If any pressure (not being universal) is used to improve methods, the miners would simply leave and go elsewhere. In all these years they have not yet learnt how to cut coal properly.

Question 22.—Two sliding sections of roof could easily be devised, and would be water-tight if made in angle iron.

Question 23.—I think there should be some scheme to prevent collapses owing to too small pillars being left without barriers. A danger point is often reached and some discretionary power to insert safeguarding conditions in the mining leases might be necessary.

Question 25.—I do not think there will be any difficulty about getting sufficient sand for sand-stowing in the Raniganj field from the Damudar and Adjai Rivers. If there should be, sandstone can be crushed.

Question 26.—My loss of 10 per cent. is for a 7 feet seam, 200 to 250 feet deep. The surface was little affected, but the come of water increased. This was achieved by up-to-date methods under favourable conditions. As a rule the loss would be much greater. In a 15-feet seam 250 feet deep, and in an 18-feet seam 300-feet deep, the approximate losses were 30 and 20 per cent. respectively, but these areas were not well adapted for depillaring.

P. S. 14.—This was decided at a meeting of the Association. Though they consider it advisable, my Council do not think it practicable.

Written Evidence of Mr. W. J. Rees of Messrs. N. C. Sircar and Sons, Raniganj.

Question 1.—1st class English certificate. Many years' experience in the South Wales coalfield and over 20 years' experience in Indian coalfields.

Question 2.—I consider it advisable to have a controlling authority constituted of a board of four or more colliery superintendents with the Chief Inspector of Mines as Chairman. The board to be remunerated for its services. Members of the board to be nominated by the Chief Inspector of Mines and elected by the Indian Mining Association and the Indian Mining Federation. There should be a court of appeal.

Question 3.—I consider the proposal practical and that, if weighment of coal at the collieries (*viz.*, pit-tops) becomes compulsory, it should also become compulsory for the miners to accept payment by weight based on the rate of the present calculated weight of coal tubs in use at the various collieries. My objection to the scheme is the big outlay required in purchasing weighing machines where there are several pits or inclines taking the coal to the same depôt. I consider there would be great difficulty in weighing coal brought up in baskets.

Question 4.—I consider it quite practicable that each year's workings should be marked off in different colours. But I suggest that each half-year's workings should be marked off in colours, the first half-year (from the time the rule comes into force) being marked, say, in red, the next half-year, say, in blue, the following half-year in red again, keeping these two colours only, with the half-year for which the workings were coloured out marked in bold letters and figures. Otherwise, if every half-year is coloured in any colour which takes the fancy of the surveyor, the plan after a few years will resemble Joseph's coat. I consider that plans should show accurately the size and shape of the pillars at the time of survey and from the time the rule comes into force.

Question 5.—I consider that, apart from a few surveyors, the surveyors generally in the coalfields are not competent of putting correct levels to a common datum on the plan.

Question 6.—Yes, but not over large areas; the percentage lost was 8 per cent.

Question 7.—Yes. In Giridih a valuable 4 feet seam was lost over a large area by the bottom seam being worked out first; also Hatnal seam over Sanctoria seam.

Question 8.—No, and again no.

Question 9.—Advisable, but not practicable. The only way it can be universally introduced is by legislation, and this would I consider upset labour.

Question 10.—We now recruit labour by sending out recruiters. We also pay head sirdars a tonnage on coal cut by the miners they bring in. In the case of famines, before Government or

voluntary aid is given to any great extent, the labour in the famine districts should be brought to the mines at Government expense in the first instance, and, should the people remain at work, the colliery company should pay a tonnage to Government on the coal got by these miners, until the initial expense of bringing them to the mines is reimbursed.

Question 11.—This has been done times without number, and the invariable consequence is that the miners, through debt or other causes, hand over their land to the local mahajan or other person. I do not consider they should have more than a small plot for a garden near their houses.

Question 12.—With the class of labour in the coalfields, I consider it impracticable to form colliery settlements off the coalfields. It would be a very complicated matter to distribute the labour to their various collieries. Further, the collieries are so scattered over large areas that workmen's trains would be out of the question. It may be feasible in new fields.

Question 13.—No.

Question 14.—I do not think it practicable, especially for small owners, as it would mean scrapping all existing machinery and boilers. A big outlay would be required to purchase the necessary electrical pumps, winders, etc. Nothing could be realized on the steam-driven machinery as, being constructed for colliery purposes, it would be useless for other work.

Question 15.—No.

Question 16.—No. Neither practicable nor advisable. The responsibility of colliery owners working railway rolling stock would be too great.

Question 17.—The fact of having colliery locos to work sidings instead of railway locos would not affect the removal of coal now supporting colliery sidings. If sand-stowing becomes compulsory, would not this in itself enable a very large percentage of the coal supporting railway sidings to be taken out?

Question 18.—It may be possible in a few cases, but generally speaking, it is impracticable. Besides, suppose the sidings from ten collieries were removed, and these ten collieries had to load at a central depôt, that particular depôt would have to be big enough to accommodate wagons for ten collieries or nearly so, and consequently take up nearly the same amount of land. No doubt there are cases where individual companies could tram their coal to one depôt and so save a few sidings. Many of the coolies put out of work by the installing of screening plant would work underground.

Question 20.—Wagon supply absolutely insufficient. The effect of this insufficiency is that we have to keep large stocks at the collieries; through stacking, the effect of the atmosphere and other causes, a large percentage of steam coal is turned into dust, opportunities for stealing are given, and, if the stacking ground is soft, a lot of the coal becomes embedded in the soil. Here I should mention that towns like Asansol, Raniganj, and Dhanbad are fuelled by coal stolen from the collieries and, if the coal-stealers are caught red-handed and prosecuted, the magistrate insists on the identification of the coal before he will punish the offender.

Question 21.—Less coal would be lost due to dumping cleaner coal, loading would be cheaper and labour would be saved.

Question 22.—Chiefly owing to the impossibility of loading covered wagons from screening plants and the irregular wagon supplies.

Question 23.—Yes, I do not consider the provision alone would diminish waste.

Question 24.—Yes, but I do not see why the authority should insist on sand-stowing, as in many cases pillars can be got without sand-stowing. Further, I am afraid the output would very often suffer for the want of a regular supply of sand and, in many cases, water also.

Question 25.—No, I do not consider a sufficient quantity of sand could be assured by ropeways alone.

Question 26.—2·45 or, say, 2½ tons of sand to one ton of coal.

Question 27.—It would probably cost Re. 1 per ton.

Question 28.—In some cases it would have very little effect on the life of the collieries. This depends on the thickness of the roof and whether the coal fires or not. But, in other cases, pillars could only be split and the life of the colliery considerably shortened. The production would depend on whether sand and water could be got in sufficient quantities.

Question 29.—The "come" will be considerably increased.

Question 30.—My experience of coal-cutting machines in India is limited, but the little I have seen of them they have not been successful.

Oral Evidence.

Question 2.—There should be a paid mining engineer as the servant of the board, who would inspect and report to the board. He should be engaged out here as a man from Home would not know the Indian conditions. I would not have an individual controlling authority in any case. Colliery superintendents on the board might certainly be a source of friction with other colliery superintendents and managers. On reconsideration, I agree to a Government Department with an officer like the Chief Inspector of Mines at its head, and with an appeal from his decision. The technical head ought to be the same as the head of the Mines Department. I agree to an advisory board to assist him on questions of principle, and, in that case, no

appeals need be allowed unless the advisory board said the case was a fit one for appeal. The court of appeal should consist of a District Magistrate, or some similar Government officer, with two mining engineers as assessors. The procedure under the Mines Act for appeals will suit very well. I would be satisfied if the advisory board said there should not be any appeal.

Question 3.—Miners should not be allowed to bring coal for their own use up the pit, but should be required to take it from stock. I think weighing is worth the extra expense even for small collieries. Payment by weight would be more satisfactory to miners I think. I know of one mine where they are so paid, and I anticipate no serious objection by the miners on this point. I would put a good babu on to supervise the weighment. I have no great faith in railway weighments, and agree that there is nothing to prevent the babu weighing the same tub two or three times over. There would, therefore, be no greater accuracy than at present. Counting baskets would be as good as weighing them as the difference would be negligible for the small quantity of coal. There should be a check on the miners' coal however inferior the coal they are allowed to take.

Question 9.—The proposed 12-hour shifts, with fixed hours fortheir termination, would equally upset the labour however they were brought about. Many workers come from long distances and work for 24 hours, the actual working time being from 9 to 11 hours. I do not like this system and wish it could be stopped. Some of these men come for three or four days at a time in the Raniganj district. I do not think the unsettlement of labour would disappear in three months. The miners who would object are not more than 10 per cent. of the whole labour force. Perhaps they would become reconciled if they found the same system in force everywhere. I should be glad to see it introduced myself.

Question 10.—Last year I had more labour than I wanted, but this was due to the accumulation of stocks.

Question 12.—This would be more difficult in Raniganj than in Jharia.

Question 14.—The controlling authority should have no say in this matter unless the scheme was financed by Government.

Question 16.—Drivers would have to be arranged for and the other practical difficulties would be very great.

Question 20.—Thefts might be prevented to a large extent by licensing the retail dealers.

Question 22.—I meant to agree that the controlling authority should have the further power of saying when pillars should be recovered after giving fair notice.

Question 24.—I have no objection if the controlling authority has discretion to insist on sand-stowing according to the circumstances of each case. It would be ridiculous to insist absolutely on sand-stowing in every case. I do not think the effect on output would be very serious if the power were discretionary. The output would decrease for a short time, but would recover eventually. The small collieries would have to be assisted financially. By a small colliery, I mean one raising up to 1,000 tons a month. There are many cases where, in comparatively thin seams, sand-stowing would not be necessary as the pillars could be drawn without much waste or damage. There should be plenty of notice when sand-stowing is required to be done. Small collieries should be compelled to sand-stow if advances are given. I think waste should be prevented as much as possible whatever the quality of the coal. I therefore think that discretionary compulsion should not apply to first class coal alone.

Question 26.—I have not actually worked out these figures in practice. I have never done any sand-stowing.

Question 27.—My Re. 1 includes the cost of bringing the sand to the colliery. The cost would vary. At one of my collieries near the river, I could do the whole thing for Re. 1, but I would put the average all over both fields at Rs. 2 or 3.

Question 30.—I saw these machines twelve or fourteen years ago. I have not seen any of the latest machines.

Written Evidence of Mr. R. R. Simpson, Inspector of Mines, No. 1 Circle.

Question 1.—M.Sc. in Mining, Durham University.

1st class certificate of competency to manage coal mines in Great Britain.

27 years experience of mining in Great Britain and India.

Question 2.—Under the present system of numerous mine-owners working small irregular areas, I consider it advisable to set up a controlling authority to prevent waste. It is probable that the first effect of control by such controlling authority would be a considerable decrease of output. Decisions would be of such importance that the interests of mine-owners might be prejudicially affected. For this reason, it might be unwise to vest control in a single officer. The controlling authority might consist of a Chief Mining Engineer (a whole-time officer) with a board of control consisting of three members. The Chief Mining Engineer would be president of the board and would have executive authority. The members would be mining engineers employed in the coalfields. They would be nominated by Government, and paid for their attendance at meetings. All questions of importance would be decided by the board. The

president would have a casting vote. In this connection, there is an interesting report by Mr. J. W. Pearse on the extent and effect of State intervention in French collieries. A resumé of the report is given in the "Digest of the Evidence given before the Royal Commission on Coal Supplies (1901—1905)," Vol. I, pp. 427—432.

Question 3.—Until such time as the number of openings from which coal is raised has been considerably reduced, and carrying coal to the surface in baskets has ceased to be practised, the proposal to weigh all coal at the pit-mouth is not reasonably practicable. So long as miners are paid by the tub, I can see little advantage in the proposal.

Question 4.—Some mine-owners in India already mark each year's working in a different colour on the show plan. In the case of small mines, there is often only one plan, frequently on tracing cloth. On such a plan, colours would not show up so well as Indian ink, and might fade readily. Moreover, coloured inks are already usefully employed on Indian mine plans for showing the contiguous workings of separate seams on the same plan. I do not favour compulsion in this matter of using coloured inks.

It is practicable to show on mine plans the actual size and shape of the pillars at the time when the survey was made, but pillars tend to grow smaller as they age, and it would be difficult to keep pace with such alterations. I do not favour compulsion in this matter.

Question 5.—No. The majority of the surveyors employed are not capable of reducing levels to a common datum.

Question 6.—Yes. Examples in the Jharia coalfield are :—In Kurkend 15 seam (20 feet thick), from 45 to 60 per cent. of the coal was got in the first working, leaving from 40 to 55 per cent. in pillars. The smaller pillars were lost. Not much more than half of each of the larger pillars was extracted. In both cases about 10 per cent. of the seam was left in the roof or floor. Cover not more than 250 feet.

Small pillars—

$40+10=50$ per cent. loss.

Larger pillars—

$20+10=30$ per cent loss.

In Bansdeopur 14 seam (28 feet thick), 55 per cent. of the coal was left in the pillars, and of these about $\frac{3}{4}$ were extracted. 7 feet of roof and floor coal was left unworked. Cover about 200 feet.

$22+25=47$ per cent. loss.

Question 7.—See my answer to No. 2 of the questions to Inspectors of Mines.

Question 8.—(*a*) Yes. I consider that the controlling authority should have discretionary powers to insist on seams being worked in vertical rotation.

(*b*) Even if sand-stowing were the rule, the controlling authority should still have discretionary powers. There will always be a certain amount of subsidence.

Question 9.—I consider it both practicable and advisable that regular shifts should be worked at collieries. If compulsion was applied to all mines, there would be little difficulty in arranging for day-shift workers to be out of the mine by 6 P.M. and night-shift workers out of the mine by 6 A.M. Under Rule 2 of the Rules published by Government in August 1918, registers are being kept of the number of persons going below ground and returning therefrom. In many cases the names are written down. This is a useful preliminary step towards the institution of regular shifts.

Question 11.—I consider the provision of plots of land for cultivation would improve labour conditions, but it might not increase the labour force to any marked degree. It would tend to stability and check migration.

Question 12.—I made the suggestion myself some years ago, and I consider that it will eventually have to be carried out in the Jharia coalfield. Some large companies are already in a position to carry it out, and I understand that one company has already made plans for something of the kind.

Question 14.—I do not think compulsion necessary. There is already a great demand for electrical power.

Question 17.—I do not think the weight of a locomotive has any considerable effect on the stability of the surface, except where the underlying mine is very shallow. If support for the line only was required, and not support for the whole of the acquired land, probably the width of the reserved strip of coal underlying sidings might be reduced by one half. In many cases the lines might be diverted and all the coal extracted.

Question 18.—In recent years the tendency has been all the other way. This has been largely due to the greater cost of surface haulage and the inefficiency of many of the tramways. It is quite practicable to haul the coal in mine trams to central loading depôts, but it entails more trouble for the colliery company, and there is more risk of stoppages of work.

Question 19.—Fewer loading coolies would be required.

Question 23.—I think power to insist upon a filling method of extraction would be sufficient to prevent waste, and that it would be going too far to do more than advise when pillars should be got.

Question 24.—Yes. I think the output would decrease.

Question 25.—I do not think so.

Question 29.—I am of opinion that, if the present system of breaking up the surface continues, collieries in the future will have greatly increased pumping charges, and, in some cases, it will not pay to work the coal.

Question 30.—I consider that, by the use of mechanical coal-cutters in India, the output of coal could be largely increased. The difficulties are (*a*) lack of machine operators, (*b*) irregular hours of loading labourers, (*c*) defective track laying, and (*d*) inefficient supervision; machines have already done good work by facilitating development.

Oral Evidence.

Question 2.—The shareholders would object to decrease of output. The members of the proposed board, other than the president, would be local colliery superintendents and the other colliery men might not like this. This would certainly be a great practical difficulty, but I see no other way of working the control without making a single dictatorial authority. The members would in fact only be called in to decide big and important questions. An appeal to the Local Government is allowed under the Mines Act, but there has only been one such appeal since the Act was passed. The advisability of a controlling authority depends on what power you are going to put into its hands. In England, royalty owners can interfere under their leases, but there is very little interference in practice. I do not think much good can be done as regards the waste question without some measure of compulsion. I think the more enlightened companies will adopt sand-stowing of their own accord and in their own interest, but they would not be the majority working first class coal, and the enlightened companies more distant from a supply of sand would probably decide to leave things alone unless sure of a commercial profit.

Question 3.—The coal carried in baskets I refer to is not coal for the miner's own use. The quantity is small, perhaps not more than 5 per cent., but is raised in a large number of places. Mr. Rees' proposals would cover probably 95 per cent. of the total output.

Question 4.—I can recall many cases of loss through pillars being too small. If no compulsion were applied as regards showing the size and shape of pillars, isolation and surveys would be the only alternatives I know of. The cost of such surveys would be great and the surveyors might be squared. The plans would have to be on a larger scale than 100 feet to an inch.

Question 9.—The times I suggest for shifts might be enforced by Government rules. I think that it will be going too far to keep certain hours of each shift for winding coal alone. Labour would fall in with the shift system as I suggest it. It would have to be enforced by prosecution.

Question 12.—Settlements might be anywhere off the coal-bearing land. Government ought to help as far as possible in acquiring land. If there is no such power under the present Land Acquisition Act, it ought to be put into that Act. I think the labour would agree to come in at regular hours.

Question 18.—I think more might be done in this direction, but it means more trouble and expense to the colliery manager. Some of the sidings can be done away with by the greater use of surface haulage.

Question 23.—I admit that hundreds of thousands of tons of coal have been lost by leaving too small pillars relatively to the area of extraction. I think, therefore, that it might be advisable to give more power to the controlling authority to direct when pillars should be got or when an area on pillars is no longer to be enlarged. There might be both a time and an area limit, or it might be insisted that the area must be packed even if the pillars are not extracted.

Question 25.—I doubt whether there is enough sand in the rivers to supply all the coalfields for sand-stowing. This is only my own opinion as I have made no measurements.

Question 30.—The difficulties I refer to can be overcome.

General.—The reserves of first class coal at Home are estimated to last about another 120 years. According to my rough figures, there are 1,863 million tons of superior coal (689 millions in Raniganj and 1,174 millions in Jharia) remaining in the Raniganj and Jharia fields. The production of these fields in 1918 was 17·3 millions, and of this about 12 millions was superior coal. Allowing that production will increase at the rate of 5 per cent. per annum, the present reserves of better class coal would, I calculate, be exhausted in 45 years. Hitherto, the production has doubled itself every 10 years. The above figures of production exclude wastage. The reserves of poorer class coal are inexhaustible humanly speaking.

Written Evidence of Mr. S. N. Simpson, Manager, Jealgora Colliery, Jharia.

Question 9.—Working regular shifts at collieries is advisable; it would increase output, but I hardly think it practicable because time is no object to the Indian miner. Its universal introduction might be effected if all collieries in Bengal adopt it together and remain firm on it. If there be any slackness, then the attempt would be useless, and more so if the miner could not be supplied with tubs. A miner can easily cut and load 4 tubs daily.

Question 10.—Labour is recruited in the usual way by paying advances, rail fares and a good food and drink. I have not found any difficulty in recruiting labour; the difficulty is to keep them.

Question 11.—I hardly think it would in the Jharia and Raniganj fields; we have on our colliery some permanently-settled gangs who live mostly on the produce of the land let to them. I don't think in the aggregate they work more than three months in the year. 90 per cent. of my output is got from labour who are not permanent settlers.

Question 12.—} No.
Question 13.—}

Oral Evidence.

Question 9.—The 12-hour shifts with a fixed time for their termination would be practicable if introduced universally by Government orders. Miners would go down earlier in order to finish their work in time. I anticipate no trouble with the labour. It would be no hardship to them if they could get the tubs and tramming facilities. A man and his wife actually cut and load on an average 3 tubs a day. We pay annas 0-8-0 a tub owing to the long lead and the mine being wet. The usual rate is annas 6 for cutting coal. The proposed system might not be workable in Raniganj owing to the 24-hour shifts there. In Jharia, we lose our labour during the cultivating seasons in any case.

Question 10.—The difficulty of keeping labour is due to competition among the collieries, and to the fact that some collieries can pay higher rates owing to low establishment and running charges.

Question 11.—At Jealgora, we let out land to miners, but they do not help us when the other labour clears out for cultivating purposes. It has not been a paying proposition. We have experienced no difficulty over occupancy rights.

Written Evidence of Mr. E. S. Tarlton of Messrs. Bird & Co.

Question 1.—I cannot claim any special qualifications. I have had 16 years' experience of mining and mine management in India and England.

Question 2.—I believe it will be to the advantage of the Indian mining industry if a controlling authority be set up in the coalfields. This authority should consist of two whole-time mining engineers of high standing, who will legislate for future leases and ensure that all coal areas shall be worked to the best advantage. These engineers should be Government servants working under such laws as may be drawn up or recommended by your Committee to the best advantage of the coal industry. These officers should have as their headquarters Dhanbad, which is central for the coalfields.

Question 3.—I see no reason why all coal should not be weighed at the pit-mouth, this to include that taken by the miner.

Question 4.—It is practicable to mark each year's working on the colliery plan. I don't think it practicable to show accurately the size and shape of pillars.

Question 5.—Yes, I think surveyors in the coalfields are capable of putting correct levels to a common datum on the plan. The managers must insist on accurate work.

Question 9.—I agree that regular shifts should be worked at collieries. Where electrical winding is adopted, there is positive proof of the waste of energy in raising and lowering men at any period of the day. Working hours can be arranged on the same lines as those adopted at works and mills if made universal.

Question 10.—Our method of securing labour is by giving good housing accommodation, good water, efficient medical service, good conditions underground, and sympathy and justice.

Question 11.—I do not think providing plots for cultivation near the coalfield would improve labour conditions. Providing plots for cultivation on the colliery, on the lines of a miner's garden in Europe, would assist labour conditions.

Question 12.—I cannot see how this would be feasible.

Question 14.—I do not think it is possible to compel collieries to take electric power. It is certainly advisable in the interest of the country, and in view of the great industrial development, that all waste should be reduced to a minimum. As I have mentioned earlier, no new flotation should be permitted without Government reserving the right to compel the colliery to take electric power when current is available.

Question 16.—I think it advisable that colliery companies should be allowed to handle wagons in the colliery siding, and be permitted to marshal wagons. By so doing, a considerable amount of railway locomotive stock would be liberated and used to better purpose, and this would assist generally in expediting the movement of wagons.

Question 18.—Yes, I think it practicable and advisable to remove a number of the existing sidings and to replace them by aerial transport, delivering the coal direct into bunkers at a central

depôt and loading direct into railway wagons. By such methods a great amount of coal would be liberated, wagons would be more readily turned round, and the time taken for loading considerably reduced.

Question 19.—With such concentration a great reduction in the number of loading coolies would be made. I further believe that most of the loading coolies would be persuaded to work underground.

Question 20.—No, I do not consider there has been a sufficient supply of railway wagons. Due to the accumulation of stocks, we have had steam coal stocks reduced by 20 per cent. to dust coal. We have on several occasions lost from 16 to 33 per cent. of stocks due to the stocks firing.

Question 21.—If coal on its arrival at the surface were immediately passed over screen into wagons, the probable result would be the saving of from 7 to 16 per cent. of small coal. Coal would be graded to meet the purchaser's requirements and would thereby show a considerable decrease in consumption for him brought about by efficient combustion.

Question 22.—(1) Better prices have not been obtained for screening.

(2) For the want of suitable wagons.

It is quite understandable that a certain percentage of wagons must be of the covered type to meet down-traffic from up-country, but I am of the opinion that covered wagons could be so designed as to permit of a sliding roof whereby it would be feasible to load this class of wagon direct from screening plants.

Question 25.—If sand-stowing is made universal, it would not be possible to use ropeways alone. Ropeways would only be used when it would cheapen the cost of supply by reducing the length of lead to the collieries.

Question 26.—1·25 tons of sand will be needed to replace every ton of coal taken out of the mine. On the basis of 60 per cent. of the coal remaining in pillars, for each ton of coal obtained by pillar cutting, 2·3 tons of sand would be required for stowing, allowing 10 per cent. for wastage.

Question 27.—The cost per ton will depend entirely on the following conditions :—

(1) Depth of seam which is to be sand-stowed.

(2) Amount of stowing to be done.

(3) If water is available on the property for stowing.

(4) The length of lead underground.

Question 29.—This is impossible to gauge as it depends on :—

(1) the position of the surface,

(2) the thickness of the seam, and

(3) the depth of the seam pillared.

It is self-evident, from figures I have at my disposal, that the loads at pumping stations where pillars have been extracted is as much as 70 per cent. greater during the monsoon period than under similar conditions where there has been no pillaring.

Question 30.—I believe there is a future for mechanical coal-cutters in this country.

Oral Evidence.

Question 2.—The two whole-time mining engineers are not necessarily to be men with the same authority, but I think there should be a second man who could sanction things without delay if the chief authority were away. I am not in favour of any advisory boards as I think they would increase rather than decrease friction. I think the Local Government should be directly over the controlling authority. A non-technical Member of Council might be very much in the hands of the controlling authority, but we would be prepared to trust the latter and to fight him if necessary.

Question 3.—I think it is quite practicable even with a dozen outlets to one colliery.

Question 4.—I do not see any difficulty in marking where there is more than one seam being worked. More than one plan would be necessary, in fact as many plans as there are seams.

I agree that the largest causes of waste are subsidences and fires due to insufficiently large pillars not having been left, but, though it would be possible perhaps, and would certainly be useful, I do not think it would be practicable to show the size and shape of the pillars on plans. Pillars vary from causes other than robbing, and I think the controlling authority would have to be dependent on penalties for not sizing as he directs. The size and shape of pillars might perhaps be shown in new workings.

Question 9.—Hydraulic stowing could be carried out efficiently without regular shifts. I think regular shifts could be made universal by co-operation. Agreement between owners is quite possible, but would be difficult to arrange, and control might be necessary as to hours of work. The regular shifts must, however, be universal if they are introduced at all. The labour might give a little trouble at first, but would soon settle down to new conditions.

Question 16.—Where several companies share the same siding, it would pay the company owning the land and minerals to do the work of the other companies on payment. They would use Government wagons at their own risk and could recover as much coal from under the sidings as they consider safe. There are many sidings where Mr. Rees' proposal could be carried out. I think colliery companies would combine to work one siding.

Question 18.—A colliery working different qualities of coal from several sidings need not necessarily mix coal if only one siding or a ropeway were used for all coal. This could be prevented by penalizing such mixing if it took place.

Question 19.—My experience supports my answer, though I admit that every body would not agree.

Question 30.—Mechanical coal-cutters would increase output.

Written Evidence of Mr. H. M. Tarlton, Chief Mining Engineer, Barakar Coal Company, Limited, Raniganj.

Question 1.—I have been trained in English mining and am the holder of a first class colliery manager's certificate of competency granted under the English Coal Mines Regulation Act. I have had 15 years' experience in the management of large English mines, six years of which were employed in actual management dealing with outputs of 3,000 tons daily. During this period, I had experience in sinking shafts to a depth of 2,000 feet. I have had six years' experience as a colliery manager in India, and six years' experience as a superintendent of a group of mines In addition, I have made a study of Continental mining, more particularly in regard to thick seams worked in conjunction with sand-stowing ; and I have inspected a number of mines in France, Belgium, and Germany, where the conditions in respect to thickness of seams are similar to those prevailing in India. I have also made a study of mechanical coal-cutters and conveyors in present-day English mining.

Question 2.—I consider it would be greatly to the advantage of the Indian mining community if a controlling authority were set up which would have power to fix the minimum percentage of coal which should be recovered from each particular lease. Two mining engineers of high standing and wide experience should be appointed to work under such laws as would be drawn up by your Committee. These mining engineers should be Government servants.

Question 3.—There is no reason, in my opinion, why all coal should not be weighed and a correct record kept of it. In my opinion, a considerable saving of first class coal would be effected if miners were prevented from carrying coal (intended for home consumption) away with them out of the mine. Inferior coal such as " coal dressings " or coal from some other poorer seam, might be allowed to be taken from the surface, and the allowance should be limited. This can only be brought about by concerted action.

Question 4.—I consider it quite practicable for each year's survey to be shown on the colliery plan in different colours. This is done in quite a number of collieries.

The accurate size and shape of pillars will provide some difficulty in being kept up to date, because, for various reasons, these frequently change. A re-offsett survey could be made at fixed periods.

Question 5.—I do not consider the surveyors capable except in a small percentage of mines. An improvement could be made in this respect by making a qualification certificate necessary and by enforcing the law.

Question 6.—Yes, from my experience I have calculated the total loss to be thirty per cent. of the coal *in situ*.

Question 7.—I have had experience of lower seams having been worked under an upper seam. In some cases, the upper seam is made practically unworkable, and, in others, the damage is not so appreciable, but requires more care in mining. In thick seams with less than 90 feet of strata between the upper and lower seams, my experience has been that the upper seam is lost. In the case of two seams, the intervening strata having a greater thickness than 100 feet, the damage done to the upper seam decreases, until, with a thickness of 120 feet of intervening strata, the practical effect is that, with careful mining, very little more than the normal amount of coal is lost.

Question 8 (a).—Yes, I consider that the controlling authority should have power to deal with vertical rotation.

(*b*).—If sand-stowing were adopted, it would not matter whether the upper or lower seam were worked first, and this could then be left entirely to the lessee.

Question 9.—I agree with Mr. Treharne Rees that regular shifts should be worked at the collieries. This may be arranged by dividing the day into two shifts of ten hours duration, allowing a generous period for raising and lowering persons into the mine, but keeping six hours of each shift for coal-winding only. These periods could be amended after shift work had become confirmed.

Question 10.—Our system of recruiting is in addition to an endeavour to make the housing popular, to make the working places in themine as cool as possible, and bring the loading line as near to the working face as possible.

Question 11.—If by this question is meant plots of land sufficient for rice cultivation, I do not consider it would improve labour conditions. From experience I find that, with labour in the Raniganj coalfield who generally have land given to them, the output per man per year is much less than in the Jharia field. A miner will only work for his immediate wants and, if he can grow rice, will only work intermittently. If a small garden is meant sufficient to grow vegetables and fruit, then an improvement may be looked for.

Question 12.—I do not think the suggestion feasible.

Question 13.—All partially skilled labourers such as electrical, engine-men, blacksmiths, carpenters, etc., are taken on as apprentices and taught their different work. Efforts have been made to teach the miners how to under-cut and side-cut coal to take advantage of the structure of the coal, but so far results have not been encouraging.

Question 14.—I do not think it practical to compel collieries to take electrical power from a central station, but, if leases are so fixed that a given amount of coal must be taken from a given area, this will tend to make the proprietor economise in his boiler consumption.

Question 15.—I have not made any such experiment.

Question 16.—Much railway time would be saved if collieries marshalled their own wagons.

Question 17.—If sidings remain, I do not think much coal could be saved by the use of lighter locomotives.

Question 18.—Yes, a considerable number of sidings could be removed with advantage and the coal be conveyed by aerial transport to a central loading station and discharged into hoppers, from which it could be screened directly into wagons if suitable wagons were provided.

Question 19.—A considerable reduction of loading coolies could be effected, and a majority of these coolies could be induced to go below ground and cut coal.

Question 20.—The supply of railway wagons has been quite insufficient for the transport of coal. The effect of this shortage of wagons is that the coal has to be dumped from the pit tram on to the ground, carried away and stacked, then again picked up and screened before being finally put into wagons. The result is an increase of five to ten per cent. of small coal due to extra dumping, and anything from ten to thirty per cent. of small, according to the length of period which the coal must remain in stacks.

Question 21.—Coal being passed over screens into wagons directly on its arrival at the surface would result in :—

(1) Fifty per cent. decrease of loading labour employed at collieries fitted out with mechanical loading and screening plants.

(2) A large increase in the percentage of large or round coal.

(3) Increased raisings due to the pit trams being returned more readily from the surface to the mine underground.

(4) Better loading supervision and a decrease in cost of production.

Question 22.—Screening plants have not been more generally adopted owing to the lack o supply of suitable wagons. A colliery fitted out with up-to-date screening plant must also provide arrangements for dealing with the coal by hand, and loading coolies must be held in reserve even when not actually required. There is no higher price paid for mechanically-sized coal than for hand-screened coal.

Question 23.—I do not consider it necessary or advisable for the controlling authority to direct when pillars should be won.

Question 24.—If time were given for the introduction of sand-stowing to be thoroughly grasped, I anticipate that the output of coal would be increased and not decreased.

Question 25.—I do not consider that any one system will meet the case; it will have to be a combination of a number of systems adopted to meet the positions as they arise.

Question 26.—The collieries with which I am connected have a variety of conditions. Older collieries have been worked into smaller pillars than the more recently developed mines. At one colliery at present being sand-stowed, the amount of sand going in is five tons of sand for three tons of coal raised (the calculation is by weight). At other collieries three tons of sand would be required per ton of coal won as practically 55 per cent. of the coal has been taken in the first working. As mines became developed on the sand-stowing principle, the amount of sand required would be one and a quarter times the amount of coal raised, or practically bulk for bulk.

Question 27.—This will depend largely upon the amount of the property worked into pillars, depth of seam from surface, etc., etc.

Question 28.—I consider that the life of the property would be increased by about 30 per cent.

Question 29.—The present system of breaking up the surface will result in large tracks of pillars having to be abandoned as the water made during monsoon weather will not be pumped out before the following monsoon.

Question 30.—Mechanical coal-cutters will remove the harder work of coal-cutting, reduce the amount of small coal produced and increase the output of coal.

Oral Evidence.

Question 2.—The two mining engineers should have equal powers. They would only carry out the orders of the controlling authority. There is no reason why the Chief Inspector of Mines (or a similar officer on a similar pay and of similar status) should not be at the head of th controlling authority or tribunal, or be the controlling authority himself without a tribuna I would be quite prepared to do without any tribunal. The officer concerned would have a advisory board to assist him; that board would contain local technical repre sentatives and commer cial men as well. Managing agents would agree to this I think.

Question 3.—Weighment would not be impracticable provided it was universal and compulsory by Government order. The amount of coal taken by the miners is about 2 per cent; I have made a practical test on this point at one colliery. I would weigh the coal carried up in baskets as well, but there is not much commercial coal raised in this way. I would not allow baskets at all myself. It would be an advantage to us to weigh all coal. I do not anticipate any difficulty from the labour.

Question 4.—A great loss of coal has been caused by the robbing of pillars. It would be quite practicable for the controlling authority to direct surveys from time to time. There is not so much weathering if pillars are of proper size at first. There is not much flaking at Saltore.

Question 5.—The teaching of surveyors would of course precede the granting of certificates of competence.

Question 6.—The following are instances within my experience. In a 9 feet seam at a depth of 200 feet, where the pillars were worked without any intention of depillaring, less than 50 per cent. was left at the first working. Another case was a 16 feet seam at a depth of 300 feet.

We are getting at least 98 per cent. of the coal intended to be won where we are sand-stowing. One foot of inferior coal is left in the roof. This one foot of inferior coal is not included in the 2 per cent. lost. We will also eventually remove barriers against fires by sand-stowing. Barriers are not necessary where sand-stowing is adopted.

Question 7.—In a case I know of, the lower seam was 16 feet and the upper seam 12 feet, the intervening strata being 120 feet in thickness. The working of the lower seam damaged the upper seam a little, but the latter was quite workable. Where the upper seam was on pillars it was not workable; where it was solid, it was workable. A workable thickness of seam in this country would be 4 feet 6 inches.

Question 8.—The controlling authority should have discretion to enforce rotation even where the upper seam was an inferior one and not marketable at the time.

Question 9.—If a shift is from 8 A.M. to 6 P.M. no miners should be allowed to go down or come up between 10 A.M. and 4 P.M. Regular shifts should be universal and compulsory by Government order. Mutual agreement would not be possible as there is no co-operation. Hydraulic stowing could be done efficiently without regular shifts. We have shifts of 8 hours at Saltore for sand-stowing only. The actual stowing only takes place for about 5 to 6 hours out of each 24 hours. The men in question are employed taking out or setting timber. There are two shifts, which should be three shifts, but we are not getting enough sand now.

Question 14.—Such a lease would probably obviate the need for compulsion in sand-stowing electrical power, etc. If I were taking such a lease, I would try to make the percentage 60, but I would not expect to get this figure. I would not take a lease requiring 90 per cent to be extracted unless I could sand-stow. I think such leases quite practicable. I would prosecute if the percentage fixed was not worked up to.

Question 17.—The coal left for the support of sidings is excessive in a number of cases, but not generally.

Questions 18 and 20.—Mixing would have to be prevented to carry this out generally. My answer referred to a number of sidings working the same seam. There is not much small coal as a result of dumping into hoppers of medium size, but there is more slack coal made by dumping on the ground owing to the insufficiency of railway wagons. This insufficiency causes as much loss as waste in working. I do not mean that coal is actually lost, but the coal deteriorates and the profits are lessened. Ropeways, if designed for the purpose, could carry up to 200 tons an hour or any other quantity and could easily be worked for 20 hours a day.

Question 23.—My answer does not deal with the question put, I can now see. I agree that the controlling authority should in the circumstances also have the power to direct when pillars should be got.

Question 26.—I know of no case where the supply of water would not be sufficient for sand-stowing. It would mean no water at all as practically all the water is used over and over again. I do not think the loss is more than 5 per cent.

There are some collieries where pillars could not be extracted except by first filling up the whole of the district or mine with sand, as the pillars are too small. I have never seen coal in such pillars recovered through the sand after sand-stowing. It would be a matter of the quality of coal and the market.

Question 27.—The cost in one colliery I have worked was 5 annas a ton; this included everything from one end of the process to the other. It included deterioration and European establishment. The pillars were good. We are preparing to extend sand-stowing to Jharia and are satisfied that it is economical. I can conceive of other collieries where the cost would be three times as

much. We are favourably situated as regards supply of sand. I think sand-stowing is very desirable as it would mean getting about 100 per cent. of the coal. I would support Government action for general compulsion, and I think the present waste will go on unless sand-stowing is generally adopted. Sand-stowing is compulsory in the Saar Valley as the coal properties now belong to Government. I did not get any figures of cost, but it is comparatively light, not more than 7*d.* a ton. I assume the figure of 7*d.* per ton from my calculations of the number of persons I saw working to quarry, crush and stow the sand. All the mines are sand-packed. Some are at a distance of 9 miles from the sand supply. The cost is then greater. The sand is quarried from sand stone and carried to the collieries by railways.

Question 30.—I have made a study of coal-cutters and think they have a future. I have tried some and averaged five tubs per man as against one tub by hand-cutting, the labour being paid at the same rate. We have not yet much experience in India, but there is no reason why coal-cutters should be too expensive to work now as the machines have been much improved.

The average cost of a number of mines in Europe where coal-cutting machines had been adopted was—

Cost of machine-cutting 4*d.* per ton.

Cost of repairs, renewals, oil, etc., 4*d.* per ton.

The coal miner was paid 8*d.* per ton less for coal which had been machine-cut, so that the actual cost was about the same, but against this must be put the advantage to the colliery proprietor of an increase of 50 per cent. output per man at the coal face. The above were figures from seams ranging from 3 feet to 4 feet 6 inches in thickness and it can be readily seen that with the Indian thick seams their cost would be reduced very considerably.

Written Evidence of Mr. J. B. Wardlaw, Agent, Dishergarh Group, Bengal Coal Co., Ltd., Raniganj.

Question 1.—First class certificated colliery manager, 9 years training and practical experience in Scotland, 11 years a colliery manager, and 2 years agent of a group of collieries in India.

Question 2.—I consider there is scope for the establishment of a controlling authority in the coalfields on the lines suggested by Mr. Treharne Rees in his report, to examine leases and to advise as to the means of working all coal areas to the best advantage. Such an authority in my opinion should not have arbitrary powers, but its functions should be primarily advisory, since a number of the large coal companies already employ, as advisors, experienced mining engineers, and men with extensive knowledge in zemindari matters. The authority as constituted should include representatives of the mining and commercial interests, of the Mines Department, of colliery proprietors, of landlords, and of the legal profession.

Question 3.—I do not think it either advisable or practicable to instal small weighing machines at the entrance of every mine from which coal is raised to obtain the actual quantity of coal extracted for statistical purposes, and it would not, in my opinion, tend to give any more accurate results than that obtained by the system now in vogue. Where coal is won from a modern colliery consisting of a pair of shafts at which all coal is raised to a common centre, raisings could be weighed on the surface, such being the custom at collieries in Britain. Due however to the variable dimensions and tare of the coal tub in use at an Indian colliery, the exact weighing of the contents of each tub is not possible. In deep mines, I have found it better policy to allow underground workers to take a little coal for their own use from the surface, as it prevents pillar-robbing near the shaft bottom and along the travelling roads; I keep a rough check on the amounts so taken.

Question 4.—I consider it advisable to have each year's working indicated on the colliery plan in distinctive colours and, at a number of the collieries under my control, each survey of the workings is shown on the plan in a different colour. The exact size and shape of the pillars should be shown if the plan is to be relied on as accurate.

Question 5.—I consider the colliery surveyor who is capable of surveying correctly the workings of a large colliery, is equally capable of putting correct levels to a common datum on the colliery plan. In my opinion, the necessity of having reduced levels marked on the plan does not arise as the gradient of most Indian coal seams is fairly uniform.

Question 6.—At collieries under my management, I have found the following average figures :—

	Per cent.
Seams up to 10 ft. thick . .	10
„ „ 20 „ . .	15 to 20
„ „ 30 „ . .	25 to 30

Question 7.—I have not had any experience of a lower seam being worked beneath an upper unworked inferior seam, where the upper seam was destroyed by the working of the lower seam.

Question 8.—Where seams are of equal commercial value, the controlling authority might be empowered to direct that seams shall be worked in vertical rotation. With the compulsory introduction of sand-stowing, the seams could be worked in any order.

Question 9.—The working of regular shifts at collieries is advisable, but in my opinion impracticable, particularly in the Raniganj coalfield, where the labour is scattered and only about 30 per cent.

of those employed actually reside on the collieries. Labourers residing in outside villages have to walk several miles daily to work and cannot be induced to conform to a regular time of commencement of shifts. Only in districts where resident labour is in the preponderance, is a system of regular shifts possible, but, unless it is universally adopted, there is but slight chance of its success.

Question 10.—It is customary for coal companies to acquire villages in the neighbourhood, and thus gain the right of entry to such villages to recruit and induce the inhabitants to work at the company's collieries.

Question 11.—I have always found it an inducement to miners to settle on a colliery if a small plot of homestead land is allotted to each, but I do not consider the allotment of paddy land advisable, because of the fact that any benefits to be derived are neutralised by the miners retaining the land already in their possession in their villages, the cultivation of which entails their absence from the collieries for periods extending over 3 or 4 months of each year.

Question 12.—I do not consider the establishment of labour settlements just off the coalfields would be a success or tend to improve the labour supply; and, owing to the prevailing lack of confidence existing between the colliery companies, a combination to form such settlements is certain to prove a failure.

Question 13.—There is no regularised system of training in operation in the coalfields. In the case of the miner, the untrained man is usually put to work with one trained in cutting coal. The underground pit sirdar is commonly a man who commands labour, and by his ability has risen from the miner class. The overman, in many cases, commences work as a pit sircar or munshi, and thus gains practical underground experience. A number of educated Indians serve a short period of unpaid apprenticeship, and their training is commenced in the survey department. As their knowledge improves, they are promoted to be overmen and assistants at collieries. In the mechanical and electrical departments, fitters, mechanics and others usually commence in the workshop as boys, acquiring efficiency as a result of experience and working under the guidance of skilled men. Engine-drivers, boiler-firemen and pump-attendants gain knowledge of their duties in a subordinate capacity and attain to the more responsible duties when qualified by experience.

Question 14.—I do not agree with Mr. Rees' suggestion that all collieries should be compelled to take power from central power stations. Where large coal companies, however, are mining extensive properties containing first class coal, it is indisputable that great benefits would accrue by utilising power obtained from such stations. But this in my opinion does not apply to collieries working small holdings containing inferior coal at comparatively shallow depths. It is only in recent years that any demand for the smaller varieties of coal has arisen, and, even at the present day, the marketable value of second class dust and rubble coal is so small, that their utilisation for steam plants at small collieries can scarcely be considered wasteful.

Question 15.—I have made no experiments in mixing different seams from the point of view of steam-raising or coking. I utilise as far as possible inferior coal, when available, for lime and brick-burning.

Question 16.—I do not consider it either practicable or advisable for colliery companies to provide their own locomotives for the working of colliery branches and sidings. The initial expenditure would be enormous and would outweigh any advantages to be gained, nor in my opinion would the inauguration of such a system provide better facilities for, or accelerate the transport of, coal between the collieries and the main lines. It should be borne in mind that the conditions obtaining at collieries in Britain are not comparable with those in India.

Question 17.—Since I do not agree that the scheme outlined in the previous interrogatory deserves consideration, the question of support to railway branches and sidings does not now arise. I would, however, add that, except in workings less than 200 feet in depth, the difference in weight between a heavy and light locomotive is negligible in its effect on the supporting coal pillars when compared with the weight of the overlying strata.

Question 18.—At small collieries, it is most advisable to concentrate the loading of coal at a central depôt, thus obviating the necessity for leaving an unduly high percentage of coal as support for railway sidings. But I do not consider it practicable for coal raised by different colliery companies to be concentrated at the same central loading depôt: on the contrary, each colliery should have its own loading depôt.

Question 19.—At central loading depôts, if screening plants were installed, a reduction or otherwise of the number of loading coolies required would be governed by a uniform and adequate wagon supply. I have known loading coolies accept employment underground loading dust, but never to cut coal.

Question 20.—The insufficient and irregular supply of wagons points to a lack of transport facilities offered by the railway companies, but not necessarily those in the coalfields, as it has been brought to my knowledge that a large number of wagons have been stabled in colliery sidings at a time when colliery indents for wagons were not being complied with. The position in my opinion might be improved by an increase in the number of marshalling yard in the coalfields. I estimate that, through shortage of wagons, a loss of at least 20 per cent. of the steam coal placed into stock ensues, due to breakage, theft, fire and deterioration of quality by exposure.

Question 21.—The following are the benefits obtainable by passing coal direct over screens into wagons on its being raised to the surface :—

1. Improved raisings.
2. Quicker return of empty tubs to the mine.
3. Saving in stacking charges.
4. Diminished cost of handling.
5. Abolition of hand-loading.
6. Prevention of theft.
7. Increased percentage of steam coal.
8. Accurate check on output.

Question 22.—The call for properly sized Indian coal has only become prominent within the last ten years owing to the demand for it by State railways, steamship companies, and manufacturers, but the delay in the adoption of mechanical screening plants has been in a large degree influenced by those already installed being rendered inoperative, and their full benefits not obtained, due to an almost continuous shortage of wagons. As far as possible, the open type of railway wagon should be supplied to collieries; failing this, covered wagons could also be satisfactorily utilized in conjunction with screens, if the roof was so adapted that at least some part of it were removable.

Question 23.—I have already stated in my reply to Question 2 that in my opinion the functions of the controlling authority should be advisory. There is no doubt whatever that, by the introduction of systematic sand-stowing, the waste in the present system of working thick seams of coal would be considerably diminished.

Question 24.—The establishment of such a control would affect output at first, pending the organised introduction of a system of simultaneous coal extraction and sand-stowing, and might even result in closing down a number of collieries for a time.

Question 25.—I cannot give a definite opinion on this question which I consider to be a subject for careful and special expert investigation.

Question 26.—In the case of extraction of coal standing in pillars, 2½ tons of sand would have to be put into the mine to obtain one ton of coal. In the case of simultaneous coal extraction and sand-stowing in the solid, 1½ tons of sand would be required for every ton of coal got.

Question 27.—In a seam 16 ft. thick, dipping 1 in 5, the approximate additional cost per ton of coal got from the pillars by sand-stowing is 7 annas if sand is delivered free on the colliery. This rate, however, would be dependent on the distance the sand is to be conveyed underground, and the thickness and dip of the seam.

Question 28.—In the case of seams up to 20 ft. thick, the estimated life of a colliery would be increased by ¼, and, in the case of seams up to 30 ft. thick, the total life would be increased by ½, were an organised system of sand-stowing adopted. I should not however expect a largely increased output.

Question 29.—In collieries of comparatively shallow depth, if the present system of working coal is continued and the surface allowed to subside over large areas, the consequent flooding during the annual monsoon period will be more than can be dealt with by the normal pumping equipment of the mine, and may finally result in complete suspension of all development in the direction of the dip, and a gradually increasing volume of water in the lower workings of the mine.

Question 30.—The adoption of mechanical coal-cutters in the near future will be more general as a means of attaining rapid development, especially in deep mines, owing to the difficulty of obtaining sufficient miners for the production of a uniform output, as well as to justify the largely increased expenditure involved by the sinking deep pits. The utility, however, of mechanical coal-cutters in Indian mines for the purpose of obtaining outputs has not yet been proved by extensive use.

Oral Evidence.

Question 2.—The cause of continued waste, in spite of managers and superintendents being fully qualified, is the small margin between raising costs and selling prices. I do not think the controlling authority should have anything more than advisory powers, but it might have an ultimate power of compulsion if its advice was not followed. I agree to a technical head assisted by a representative advisory board, with an appeal in cases which the advisory board certified as fit for appeal. I think such a scheme could be practically worked. I agree that the inspecting officers should be different from the Inspectors under the Mines Act, but both departments should be under one technical chief.

Question 6.—These figures are based on calculations of actual work.

Question 9.—I do not like the 24-hour shift system as the miners do not turn out in time in the morning. The miners actually living on the collieries in the Raniganj coalfield are much less than 30 per cent. A miner does not do more than 48 hours work a week on the colliery. If he worked 12 hour shifts, he would only have two to three days off weekly. Twelve hour shifts to

end at a certain hour would not be practicable in Raniganj. The majority of the miners arrive too late in the morning to finish their work in time. I do not think such compulsory shifts in Jharia would drive out labour to Raniganj as the conditions are quite different.

Question 19.—The leading coolies are generally Jhola Mahommadans and Nunias and would not cut coal in Raniganj.

Question 20.—I think the shortage of wagons is due largely to bad handling.

Question 27.—My annas 7 is made up as follows:—

	Rs.	A.	P.
Labour	0	1	6
Pumping . . .	0	2	0
Repairs and renewals .	0	1	0

Depreciation on plant annas 2 to 2/6 annas

This is for sand delivered free into the bunkers. Surface haulage to the bunkers for a colliery near the river would cost another one anna per ton. For collieries 5 miles away, the cost would not be more than 1-6 per ton mile. I should think a general average of Re. 1-per ton, including everything, would be a fair all-round rate for both fields.

Written Evidence sent in by the Honorary Secretary, Indian Mining Federation.

Question 2.—A competent body of experts may render considerable help to the cause of economic working of the coalfields. But, for reasons stated in the reply to the interrogatories to the landlords, such authority should have no control over the negotiation of coal properties. General provisions by legislation for economic working of a colliery might be made and the controlling authority might supervise such working. Such power should properly be exercised by a board consisting of a representative of the landlords and two representatives of the mining interests to be nominated, one by the Indian Mining Association and one by the Indian Mining Federation. The board should have for its president the Chief Inspector of Mines as the representative of the Government and as mining expert. There must be provision for an appellate board consisting of the Commissioner of the Division concerned and four representatives of mining interests, two to be nominated by the Indian Mining Association and two by the Indian Mining Federation. The board should be helped with an adequate staff of supervisors.

Question 3.—The proposal for weighing all coal at the colliery would involve considerable expense, while its adoption would serve no useful purpose.

Question 4.—Yes, it is practicable to mark each year's working on the colliery plan in different colours showing therein the size and shape of the pillars; but it has to be remembered that with time, specially in the case of some kinds of coal, the pillars become irregular.

Question 5.—The surveyors in the coalfields generally are capable of putting correct levels to a common datum on the plan.

Question 6.—The percentage of loss, where pillars have been got, of the total coal in the seam is not generally calculated, but an estimate can be formed of such loss. There are cases, in comparatively thinner seams, where pillaring has been done without any appreciable loss.

Questions 7 and 8.—No, we have no experience of a top seam being entirely abandoned and the bottom seam worked, except in certain cases where the top seam is not worth working, as in the case of the Hatnol seam over the Sanctoria seam. Sometimes, when the comparatively inferior coal of the top seam can find no market, the bottom seam has to be worked in advance. Under the circumstances, the controlling authority, if empowered to intervene, should do so with due caution. The present actual state of affairs, however, does not point to the necessity of such intervention.

Question 9.—It would be eventually to the advantage of all concerned if regular shifts could be worked, but it is doubtful if an effective combination of the collieries could be formed for the purpose.

Question 10.—There are two varieties of labour, one settled at the colliery and paid a certain *sardari* commission, the other not resident at the colliery. The latter come to work in January, leave for home by the end of June for agricultural work, return to the collieries about 3 months later by the end of August or beginning of September, and again leave for home in the beginning of November and stay away for about two months. These miners have to be sent for and some of them sometimes change their colliery. Contractors are employed to recruit these miners and are paid 3 to 4 annas a ton on the quantity of coal raised by them. The discouragement of labour emigration out of India, specially from the area from which mining labour is chiefly recruited, active help by the Local Government to recruiters of colliery labour, improvement of the conditions of life in the collieries—better housing, copious and wholesome water supply, control of undue profiteering in foodstuffs, better medical relief, provision for education, primary and in simple colliery technique, as would go to open out better prospects in life—are factors which would immensely help the flow of labour to coal mining.

Question 11.—We are not in favour of allowing lands to miners for cultivation; such a concession will simply keep the miners off mining work during the time of cultivation and harvesting

but small plots near their houses at the colliery for gardening purpose would be an inducement. From experience we find that those who have given lands have not been able to get better results than those who have not.

Question 12.—We do not approve of colliery settlements for the existing coalfields where labour is already settled, but it may be feasible for new fields, though such a course will be expensive and lead to misunderstanding between collieries.

Question 13.—Practical training in company, and under the guidance of experts, is given in coal-cutting and in other mining work.

Question 14.—No compulsion should be exercised. Big collieries are already erecting installations on their own motion as they find it to their advantage to do so, and small collieries adjoining these power houses, who can afford it or who would find it to their advantage, may take their power from such big collieries, but small collieries, specially very small ones and those working inferior coals, will not be able to bear the expense, and to compel them to take power would amount to forcing them to close down. If wagon supply is guaranteed to them, they may arrange to form combinations of small collieries to arrange for a central pumping station and take power from the central station. But then again the question would arise as to the disposal of the present boilers and pumps and engines; if everybody is to take electrical power, there will be no buyer for the abandoned steam-driven machinery, and so a very huge loss will be occasioned. It may further be mentioned that there are collieries which do not at all require mechanical help.

Question 16.—No, many collieries will not be able to afford to buy such locomotives and it remains to be seen whether railways would allow their wagons to be handled by colliery locomotives, without satisfying themselves as to the adequacy of the protective arrangements, and then where is the advantage?

Question 17.—No, we do not think much of the coal could be removed, even if the railway company allows colliery locomotives to work railway wagons and the colliery can afford to buy the locomotives, as adequate support has in either case to be kept. The present restricted area now left unworked may in some cases be reduced.

Questions 18 and 19.—If it is meant that there should be a central depôt for each colliery, in some cases it may be feasible, but not universally; for new collieries now in the course of development, it is feasible. But we do not see how it will liberate loading coolies unless the coal is loaded by shoots and there is a steady supply of open railway wagons. But if a central depôt for several collieries is meant, this is not practicable.

Question 20.—No, insufficiency of wagons leads to a large waste. The coal deteriorates and withers, turns into rubble and dust, and is pilfered.

Questions 21 and 22.—Theoretically speaking, if arrangements could be effected by which coal on its arrival on the surface would be immediately passed over screens into railway wagons, it would be an advantage, as the buyer will get clean coal and the colliery will be saved loss through deterioration. But such an arrangement would be impracticable for most of the collieries owing to the following principal reasons: (*a*) irregular supply of wagons, (*b*) railway sidings being at a distance and requiring a high tram line, large quantity of rails and a number of extra tubs. The cost of the above, with that of screening and sizing plants, will make the scheme a prohibitive one for small collieries. In many cases, the size of collieries, and the quantity of coal raised and despatched, would not admit of such an outlay being made. There is at present no supply of wagons worth taking into account suitable for screening purposes.

Question 23.—Sand-stowing should not be universally enforced. The present process is a cheaper and effective method in cases of thin seams up to 12 feet. For collieries working an inferior quality of coal, sand-stowing cannot be recommended on account of its high cost as compared with the price of the coal. Compulsory introduction of sand-stowing will seriously accentuate the present shortage of labour supply for the purpose of raising coal. Besides, small collieries would not be able to make the necessary outlay.

Question 24.—Introduction of such control would diminish the output and add considerably to the cost of raisings.

Question 25.—It would be impossible for ropeways alone to supply all the requirements of the collieries in the Jharia and Raniganj fields. It is also problematic whether sand and water in sufficient quantities would be available for the purpose.

Question 26.—Considering the number of collieries the members of the Federation have got, this question cannot be answered within so short a time. But taking 20 c.ft. of sand to be a ton and 30 c.ft of coal a ton, and that 30 to 35 per cent. of the coal is won by gallery driving when sand-stowing is not required, and about 65 per cent. is left in pillars of which 10 per cent. is lost, to obtain 55 per cent. of the coal, we will have to pack the whole area, and one ton of coal will require over 3 tons of sand.

Question 27.—We have no idea as none of the Federation members are doing it yet, but, if the sand is delivered free, and taking the whole cost at Rs. 2 per ton, the cost of packing alone will be over Rs. 1 per ton, but collieries far away from sand-stowing will certainly cost more.

Question 28.—This process will no doubt increase the life of a colliery inasmuch as coal, which under ordinary circumstance could not be won, will be won, but the raisings will diminish.

Question 29.—Areas to the dip of the goaf areas will always have to contend with a much larger quantity of water.

Question 30.—Mechanical coal-cutters might be introduced with advantage in deep first class collieries, but the cost involved does not make it suitable for introduction into small collieries and collieries working inferior coal, and also at collieries where the labour supply is plentiful.

Oral Evidence in connection with the Indian Mining Federation's replies by Mr. N. N. Sarcar, General Manager, Kharkhari and Mehespur Collieries and South Kujama Colliery, Jharia.

I agree generally with the written evidence sent in by the Indian Mining Federation.

Question 2.—The controlling authority might be a department similar to the present Mines Department with provision for appeal. Supervisors the same as the present Inspectors would do.

Question 5.—Surveyors in the coalfields generally are capable of putting correct levels to a common datum on the plan.

Question 9.—I am in favour of such shifts if possible, but it is doubtful whether the miners would accept them at first, though they might soon settle down.

Questions 23—28.—I have no personal experience of sand-stowing. The cost of handling between the railway siding and the colliery opening would be large and much labour would be required. I have calculated that, with an output of 5,000 tons, the cost of actual packing, exclusive of handling between the siding and opening, would be about Rs.1-4-0 a ton.

Oral Evidence in connection with the Indian Mining Federation's replies by Mr. H. K. Nag, General Manager, Messrs. Holmes, Wilson & Company's Collieries, Raniganj.

I agree generally with the written evidence of the Federation.

Question 2.—By "supervisors", I mean men of the standing of the present Inspectors of Mines.

Question 5.—Barring a few, all the surveyors are so capable at present. The general run of the smaller company surveyors are not very capable and perhaps all require more training.

Question 9.—The Mugma labour is local. There is no trouble with it except during the rains. The proposed 12-hour shifts would not work in Mugma, because the so-called 24-hour shift system is in force. I have tried to alter this, but without success. A 12-hour shift with a time fixed for its termination might be practicable, if made compulsory and universal. I do not think that labour would be driven away from the collieries.

Questions 23—28.—If all the expenses of sand-stowing were paid, I would have little objection to it except in thin seams. If sand-stowing were not insisted on universally, but were enforced with discretion, I have no objection except as regards its effect on the labour supply. Raisings also would be reduced. The coal derived from pillar-cutting is generally about 35 to 40 per cent. of the total output. The net increase in cost will probably be more than Rs. 2 a ton. I have only a very little practical experience of sand-stowing.

Oral Evidence in connection with the Indian Mining Federation's replies by Mr. S. N. Sarcar, Agent, Niga Valley Collieries, Limited, South and West Jambad Collieries, Limited, Raniganj, and New Dharmabad Collieries and the Central Jamdiha Colliery, Jharia.

I agree generally with the written evidence of the Federation.

Question 2.—The supervisors would be the same as the present Inspectors under the Mines Act.

Question 9.—Shifts are not practicable with labour coming from distances of more than two or three miles. This objection applies almost as much to Jharia as to Raniganj. Such labour would be lost to the collieries. The Mining Settlements Act affected the labour force considerably, but they have all returned to coal-cutting, some rules having not been enforced. If regular shifts were universal and compulsory, miners who are actually cultivators, and who come to the collieries for extra earnings, would cease to come if the shifts do not suit them.

Questions 23—28.—If all the expenses of sand-stowing were paid, I would still object to sand-stowing being universally compulsory as it would not be economical to stow in some collieries. If stowing were insisted on with discretion, I would still have some objection on the score of its effect on the available labour supply.

Written Evidence by Mr. Thomas Adamson, Manager, Dhori Colliery Messrs. Anderson, Wright & Co., forwarded by the Indian Mining Association.

I have had 33 years' mining experience in India, of which 30 years have been spent in working seams of 20 foot thickness and over, and I wish to state that I strongly protest against compulsory sand-stowing in Indian mines. Compulsory stand-stowing has not been introduced in English mines, although I have known cases where sand-packing has, to the observer, seemed advisable. I refer particularly to the thick seam (10 yards seam) in South Staffordshire. The only stand-stowing collieries put before us by Mr. Treharne Rees in his report are in Silesia.

In my opinion, there are sufficient qualified mining engineers in India who have studied for years the conditions met with in working thick seams, who have experience which very few mining engineers in Great Britain have had, and who are quite capable of dealing with any mining problem likely to be encountered. I admit that, up to 10 or 12 years ago, and in a few mines at the present time, work has been and is being carried on in a manner detrimental to obtaining the best results, and that a large percentage of coal has been lost because it was found to be unsafe to get out pillars which in the first working have been made too small. This, in my opinion, is the exception rather than the rule. It is to the colliery owner's interest to get out as much as possible of the coal, and, to obtain this result, it is to their interest to employ suitably qualified men to superintend the working of the seams, particularly thick seams.

With reference to compulsory sand-stowing, in the case of working the Giridih thick seam, which in places is over 20 ft. in thickness, to my personal knowledge this seam, over a period of 15 years working, yielded 90 per cent. of coal at a cost of less than Rs. 2 per ton. I may state, in connection with the above, that most of the mining engineers at Home, in the discussion of my paper on "Working a thick coal seam in Bengal" read by me before the Institution of Mining Engineers in England in 1903, expressed their opinion that the system of working adopted there was highly satisfactory. If sand-stowing had been compulsory in the working of the Giridih seam, no better results would have been obtained and the cost would have been nearer Rs. 4 per ton. The Giridih system of working, in a modified form to meet local conditions, has been in operation in the Jharia coalfield during the last 12 years with good results. It may be necessary to the interests of mine-owners and all others concerned to work some of the thick seams by a combined Giridih system and sand-stowing. The mining engineer under whose superintendence the operations are conducted is, in my opinion, the best judge of this.

There are undoubtedly cases where sand-stowing is necessary, such as where pillars were made too small in the first working, and where underground fires have occurred. In most of these cases, the whole of the worked-out area would have to be sand-packed before any attempt could be made to work out pillars. The cost of working out such places should be borne by the colliery owners concerned, as it was up to them to see that their collieries were worked in a practical and systematic manner, with the ultimate view of getting out the pillars with a minimum amount of waste. Also, if the working had originally been laid out on the panel system, the pillars could have been safely and successfully removed.

Did not appear for Oral Examination.

Written Evidence of Mr. H. T. Thompson of Messrs. Kilburn & Co., nominated by the Indian Mining Association.

Question 1.—I am a practical engineer holding a first class certificate of competency and have been in charge of Messrs. Kilburn & Co.'s Coal Mining Department for about 25 years; the collieries which I represent are situated in the Raniganj and Jharia coalfields.

Question 2.—Mr. Treharne Rees' recommendation for a controlling authority to be set up in the coalfields, though in my opinion rather vague, is intrinsically sound, provided it is possible to constitute an effective authority to ensure the coal areas being worked to the best advantage. The first question needing control and amendment by such authority, if and when constituted, is the form of mining lease in use. There should be a standard form of mining lease with an option to relinquish, and power under the Land Acquisition Act to acquire all surface rights for colliery purposes. Under present conditions, a coal proprietor has great difficulty in finding out who are the owners or legal heirs to the waste lands comprising a colliery. In many instances, the zamindar has agreed in his mining lease that all waste land shall be free of any rent, but, on the other hand, the patnidars plough these waste lands with the object of creating a claim against the coal company for compensation. Trouble therefore arises as to who is the rightful owner and the result is litigation. The zamindars should, as far as practicable, give a straight boundary line to obviate the wasteful and expensive working of irregularly shaped corners of properties as is necessary under the present system. With reference to existing leases, the controlling authority should have power to compel the exchange of equal areas with the object of straightening out the boundaries, the zamindars accepting their royalties from the exchanged areas without the

payment of any additional fees or *salamis*. The payment of *salami* should be prohibited, and coal proprietors should pay on a royalty basis only with an annual minimum payment. If this system was introduced, the speculation in acquiring coal land and promoting coal companies would cease, as under present circumstances the major portion of a company's capital has been paid out in *salamis*, chiefly to middlemen and not zamindars. The large *salami* demanded and paid has been the chief cause of the small collieries. It should be compulsory on the zamindars to grant a prospecting license for a given period with the object of proving the areas by borings; a prospecting license fee should not amount to more than 8 annas a bigha. The Burdwan estate gives a good mining lease and has a system of including the patnidars as parties to the lease, these patnidars being paid a certain percentage of the royalties. This is an excellent system as the coal company, with the assistance of the zamindari estate, has a considerable influence over the patnidars, as the latter's authority over a mauza is considerable. No other zemindar, in my experience in connection with many leases which I have had to deal with, considers the patnidars or other interested parties to the same extent as the Burdwan estate does. There is also the case of the cultivator who in time past received certain lands as a gift. The mineral rights in such cases have not yet been decided by a court of law, but in my opinion these men have a legal claim to such rights, as a gift is a gift, therefore a part cannot belong to a second party. I have had to decline to accept mining leases on many occasions as the terms were prohibitive. The minimum area of a colliery depends on the number of workable seams, but the area should, if possible, not be under 7,000 bighas.

I will now deal with the question of working the coal areas to the best advantage. The idea of a controlling body, with authority to introduce compulsory by-laws for the good working of the mines, would in my opinion only add to the many troubles which the mining manager already has to contend with. The chief controlling authority required is money as there are few of the coal companies in the Raniganj or Jharia coalfield who have sufficient capital to carry out more than the daily needs of colliery development. Twenty years ago, it was practically impossible to find the capital for a company of even nine lacs. This capital had chiefly to be found by the managing agents and a few of their influential friends. I remember in the formation of a new company, when I endeavoured to influence certain Marwaris to subscribe part of the capital, they declined to do so as there would be no dividends forthcoming during development, and told me they preferred to deal or invest capital where it was speculative, but, if I required a mortgage of twenty lacs on a property on a public thoroughfare in Calcutta, the whole sum would be paid within a week. Collieries had to be opened out under Eastern and not Western conditions, as the miners had to be trained from the cultivator class and the only houses they would occupy were built of mud and straw. This class of miner also refused to go down a mine where machinery was employed; therefore large sums of money were laid out annually on buildings. The pioneers of the coal industry, in order to attain success, had to spend large sums in training these cultivators to become miners and in persuading them to adopt a house which was permanent and less expensive in upkeep to the coal companies. I have never known a coal company that was formed that had sufficient working capital to equip a mining settlement as one of its principal objects. Epidemics such as cholera, etc., are well known and have seriously affected the development of collieries; any improvement in methods of sanitation is entirely due to, and has been carried out by, the coal proprietors; as far as the Government is concerned, the coalfields of Raniganj and Jharia are in the same condition to-day as they were thirty years ago. Solely due to private enterprise, during the time that coal has been mined in India, Government have been paid large revenues in the shape of cesses and income-tax, and only within the last few years have Government done anything for the improvement of roads and bridging of rivers, but much still requires to be done in this direction. If the controlling authority is to be a success, it must have large spending powers and, conversely, a large source of revenue.

Question 3.—It would be a waste of money and time to weigh coal as it comes out of the mines, as many of the seams of coal being worked contain a large percentage of shale which, in those collieries working under modern conditions with screening plants and picking tables, is afterwards removed and treated as waste material. There is always great difficulty in regulating or ascertaining the quantity of coal consumed by the miners for domestic purposes, more especially if there is a stock of coal near the miners' village. There is, however, a means of checking the quantity of coal consumed by the miners, if coal proprietors would transport the coal from the second class seams and stack it freely throughout the villages for the free use of the colliery workers, but this means money, which most proprietors cannot afford to pay.

Question 4.—I certainly agree that each year's working should be marked on the colliery plan in different colours; this system was introduced in my development schemes many years ago. A plan is worthless unless the accurate size and shape of the pillars are shown, but, under present conditions of working, it is practically impossible to maintain the original size of pillars due to the excessive pillar-robbing that takes place even under the best of management, though a liberal supply of capital for tram-lines and coal-tubs close up to all working faces would go a long way to reduce the pillar-robbing system. On the other hand, there are a certain class of miners who chiefly earn their living by robbing coal from the pillars; when found out, they simply remove to a neighbouring colliery where employment is always waiting for them.

Question 5.—There is great difficulty in finding capable surveyors, either as additions to existing colliery staff, or for the opening out of new collieries. The younger men do not appear to have a practical training for colliery work and there is much need of a survey department for the training of Indian surveyors. In my opinion, colliery plans would as a rule be

more reliable if underground surveys were made by an independent survey department. This I consider one of the most important and urgent needs, namely an up-to-date well-equipped and staffed firm of surveyors established on the coalfields for independent survey work.

Question 6.—No.

Question 7.—No.

Question 8.—I should have no objection to the controlling authority having power to insist that the seams should be worked in vertical rotation, provided that the authority could guarantee a market and a paying price for the coal. There are considerable variations, not only in the quality of the various seams, but also in the same seam in different localities, and customers stipulate that the coal from the various seams and localities shall be loaded separately. The better qualities obviously obtain the best prices, but the raising costs of both 1st and 2nd class qualities are the same. I should not advocate such a system of vertical rotation unless the upper seams had only a short life. My answer would be the same if sand-stowing were made compulsory.

Question 9.—Regular shifts are practicable, but only with co-operation and under compulsion. The best system to introduce is the three-shift one, but this is not possible with the number of workers available; two shifts are all that can be arranged for at present with an 8-hour day without stoppage, or 10 hours with stoppage. This shift system would be one of the most difficult changes to adopt at the collieries, as a miner works by piece work and, when he has cut his three tubs of coal, he stops, as the money earned thereby he considers sufficient to meet his wants. I am greatly in favour of the reduction of hours at the collieries, and that all work on the colliery should be stopped at 2 P.M. on Saturdays, the night labour to receive their pay on Saturday morning and the day shift on Saturday afternoon. All working days should be from 6 A.M. With the object of regulating the working time of the night and day shifts, the night shift would require to start work at 12 o'clock on Sunday night. If the system was successfully introduced, a colliery would have a better class of labour and they would be able to have a good week-end's rest, and also allow the mines to cool down and be thoroughly ventilated, enabling the workers to work in a better atmosphere. There must be no half methods about the introduction of the system if it is intended to do so, and the change must be firmly carried out from the commencement.

Question 10.—The system of recruiting labour is through Indian sirdars. There is no infallible panacea for troubles in connection with the labour supply. Each sirdar of the coal companies endeavours to obtain as many miners as possible for his employers and there are few miners working who have not their own sirdar. My plan has always been to promote as many miners as possible to the position of sirdar with the object of obtaining a better supply of labour. This system is not always successful as the miner prefers to choose his own sirdar and does so. The main factor in attracting a good labour supply is good colliery villages, good sanitation, and a plentiful supply of water. Given these conditions, recruiting of the young labour is simple as it is very difficult to train a grown-up man from a country village to work in a mine. Under modern conditions, he must be trained from youth. In my opinion, the system of recruiting at the collieries has been very successful, as is proved by the large force employed throughout the Jharia coalfield. The majority of these men and all their predecessors were cultivators 27 years ago.

Question 11.—I am not in favour of providing suitable plots for cultivation on the collieries in order to improve labour supply. I have always been strong on this point and have been so far successful in making miners and not farmers. As a case in point, the Raniganj Coal Association, which is under my management, at their working colliery, namely Kustore, which is in the Jharia coalfield, are the owners of the surface rights over a large portion of the colliery. The miners of this company's colliery have no cultivated lands, and I think I am correct in saying that, for any individual colliery, Kustore has the largest number of miners, and the same colliery holds the record for the largest output in Jharia. One of the great difficulties arising out of giving colliery surface to miners, no matter under what conditions, is that changes take place from time to time, and in many cases retired miners would still cultivate their plots and would decline, and rightly so, to give up these plots for the extracting of the coal underneath. After a certain time he obtains occupancy rights, and, as the law is in his favour, he cannot be turned out. In the early period of mining, many coal proprietors made an effort to give suitable plots for cultivation in the Raniganj coalfield. This resulted in no benefit being obtained as the outputs for collieries in this field from any individual colliery are very poor, and I doubt if there are more than half a dozen collieries throughout this large area who can depend on a regular monthly output of 15,000 tons. All this in spite of the fact that facilities by means of shafts for easy access for the labour could not well be improved upon. The miner is very conservative as to where he will work, but will cultivate any land which may be given to him, and has no idea of compensating his company for doing so, nor will he hesitate to work at a neighbouring colliery if the conditions are favourable. Should he do so, he retains his cultivated area, and also his *daura* in many cases, although working for someone else.

Question 12.—I do not approve of the suggestion to form colliery settlements just off the coalfields, my chief reason being that the labourer attends to his work better if his village is close to the pit-head. Every mining manager prefers to have direct control over his own labour. It is unfortunate that these villages have to be built over the coal measures, but we are no worse off than the coal proprietors in other countries who have to work seams of coal underlying villages or towns. I do not think it feasible for colliery companies to combine to form such settlements, as each company would have to put down its own houses again and could not then depend on the

occupier working at the company's colliery. Such a scheme would involve a very large expenditure which I estimate, with water supply and sanitation, at 5 crores of rupees at the least.

Question 13.—Many of the imported European mining men, when taking up their duties in India, have made efforts to teach the Indian labour the system of undercutting and an easy method of working a seam of coal, but I fear with little success. The chief system of training, and such practical knowledge as is acquired, is being, and has been, handed on from father to son.

Question 14.—I do not think it is possible to compel a colliery to take power from a central generating station. Compulsion in my opinion would not be necessary as colliery proprietors would readily see the advantage of utilising electricity for the better working of their mines chiefly with the object of reducing cost. In the case of new undertakings, no colliery proprietor would consider any other scheme for development than electricity, if current is available. I am greatly in favour of working the collieries by electricity as the present system of Lancashire boilers, etc., is very wasteful and a miner's business should be to raise coal and not steam. It is not possible to work a colliery economically without electricity, nor is it advisable for a colliery to have its own installation should a public supply be available, on account of the number of spare units and spare parts which have to be carried to meet a case of emergency. It is therefore preferable for a coal company to spend what money it has on the development of its colliery instead of a generating station, and to purchase from an outside electrical company its daily requirements of power. A colliery is always in need of money if developments are to be maintained.

Question 15.—I have had considerable experience of mixing different seams of coal for steam-raising purposes and have had excellent reports as to the results of mixing Jharia and Raniganj coals. The former gives a hard clinker and the latter a very soft clinker, the result being that the mixture allows the air to pass more freely through the fire causing better combustion. This is very noticeable in mixing the first class seams from Jharia with second class seams from Raniganj, but one of the principal mistakes made by consumers is putting large lump coal into a fire, and, unless the coal companies supply only large lumps to the consumer, complaints are frequent. What happens is that the firemen shovel the large pieces into the furnace, with the result that they start burning on the outside only, assuming that the lump coal is, say, a 6 inch cube. If this block of coal was broken up into 100 small pieces, it stands to reason that all these small pieces would commence burning on their four sides; the combustion therefore would be better, and the loss arising from the large percentage of coal which finds its way to the ash-bin would be obviated. The smaller the coal utilised for a furnace, the better the results. Many consumers would argue that the small coal would only be blown through the furnace and out through the chimney; if this ever happens, then the fire was not in need of any coal as it is useless to put small coal on a fire if it is only giving off black smoke, as, with a strong draught, dust coal will pass through the chimney unless thrown into a clear fire. The efficiency of a boiler depends on the quantity of coal that has to be put through the furnace to evaporate a given quantity of water and, if Indian coals are forced in any way, the wastage is heavy, but by means of pulverising there will be no trouble in getting through the quantity. This latter process opens up an avenue for the disposal of the many million tons of second class coal throughout the Raniganj and Jharia coalfields at favourable rates and allowing the first class coking seams to be reserved for the manufacture of hard metallurgical coke. I estimate that these fields contain 60 per cent. more second class than first class coal.

Question 16.—I do not consider it advisable for colliery branches and siding to be worked by colliery companies with railway company's wagons and colliery locomotives. If such a system were ever introduced, it would be a shortsighted policy and a very serious waste of money which colliery companies could not afford. The system adopted in India by the East Indian Railway and Bengal Nagpur Railway could not in my opinion be improved upon, the working of these sidings being free of cost to the coal companies. The consumer pays for the working of the sidings, namely 2 annas per ton as a collecting charge, and it is advisable to leave well alone and allow the present system to continue.

Question 17.—No matter what system is introduced for the working of sidings, the underground support must be the same. I do not therefore consider that much, if any, additional coal could be removed from under colliery sidings, whichever agency is utilised to work them.

Question 18.—I do not advise the removal of existing sidings and the surface haulage of coal in colliery tubs to central loading depôts. This would be a very costly method of working a colliery, as the tubs would be seriously delayed and further capital would be required for the purchasing of new tubs to maintain the output. The nearer a colliery siding is to the pits, the greater the efficiency and the less the risk of wastage. It would, however, be an advantage to the coalfield if the alignment of the branch lines and sidings were altered, and carried as far as possible over the numerous faults and dykes which are now known to exist throughout the coalfields. This would, however, mean that numerous curves would take place in following the lay of the faults, but, if carried out, large areas of coal would be made available for working. Colliery owners would naturally oppose the supporting of a line for the working of a neighbouring colliery and are justified in doing so. A fund might, however, be organised, and the money found for the fund in the shape of an additional charge on railway freights with the object of compensating the collieries concerned for the coal left for support. The compensation should be in the neighbourhood of one rupee eight annas per ton for the quantity of coal left for support less 10 per cent. for wastage. Assuming that the support left amounted to 200,000 tons by measurement, this less 10 per cent. equals to 180,000 tons. Payments to be spread over a period of 20 years and

an annual payment to be made of Rs. 13,500, the coal after 20 years to become the property of the fund. The system of sand-stowing of the above mentioned branches and sidings could be taken in hand when it was proved a success, as experiments cannot be carried out under a siding with the risk of subsidence and the consequent blocking of the colliery. All railway marshalling yards, including buildings, should be removed early from the coal measures, especially those marshalling yards overlying first class coal. The number of colliery sidings will reduce themselves when the upper seams are worked out as, owing to the small area of many colliery holdings, it will not be practical to sink and equip deep shafts with a short life.

Question 19.—If screening plants were installed at central loading depôts, the number of coolies employed would be reduced; at present the hand-loading depôts are a means of training the young labour to colliery work as the loaders chiefly consist of women, girls and boys. Able-bodied men without any deformity take more readily to mining work, therefore the class of labour employed in loading wagons is not altogether suitable for cutting coal.

Question 20.—I have never known of a sufficient supply of railway wagons available for the transport of coal throughout the year. The Committee of the Indian Mining Association, long before I joined the coal industry, were continually complaining about the short supplies of wagons and this complaint to my knowledge has been a monthly one for the past 25 years. The insufficient wagon supply has meant a direct loss of 5 per cent. in coal, and has reduced the percentage of steam coal from 75 per cent. to 70 per cent. of the total. Collieries, for the want of wagons, have had to sell the small coal at a considerably lower price on the average than was obtained for the steam coal, as contracts with consumers are principally for lump coal only. A remedy for the wagon supply difficulty can be found if the Railway Board and the local railways would adopt a system of bunkers on similar lines to the Assisted Siding Agreement, and build double bunkers or bins over the sidings according to the respective weekly raisings for each colliery. The system followed by the railways throughout the coalfield at present is to visit each siding daily if wagons are available, and to supply empties in accordance with indents. These wagons are allowed to remain on the colliery sidings for twenty hours for loading. Now, assuming that the local railways carry 16,000,000 tons of coal annually, and taking the carrying capacity of each wagon at an average of 16 tons, the number of wagons to be placed on the colliery sidings to remove the above-mentioned quantity amounts to 1,000,000, and taking 300 working days in the year, the daily average supply of wagons to the colliery siding is 3,333; of course the average capacity of the wagons may be more, but I am only citing a case. Therefore the total number of hours that the 3,333 wagons remain in the siding daily is 66,660 hours, or annually at 300 days equals 19,998,000 hours. If bunkers were erected, the largest capacity being 1,200 tons, as I presume that a train-load is seldom more than 1,000 tons, the difference of 200 tons being a margin against the late supply of wagons, under the double bunker system, 8 wagons being loaded by the one operation, and 1,000 tons in 4 hours, thus, on the same allotment of daily supplies of 3,333 wagons, the daily number of hours employed in loading would amount, to 13,332 hours and, at 300 working days, the number of hours employed would amount to 3,999,600 hours only. In the case of small collieries, where they were only able to raise 500 tons daily, the railway company would only visit such siding on every second day; others with smaller outputs would be visited twice or once weekly according to circumstances. The time and expenses of working the pilot system, as at present, would be considerably reduced by the bunker system. The method of sorting wagons from the despatching station of the coalfield would, under a proper invoice arrangement, also facilitate matters. The system of weighing wagons should also be abandoned and flush loads in open wagons should be the carrying capacity of all open wagons where railway bridges were sufficient to carry the loads; top loads and piling of open wagons should be abolished, but, in the case of open wagons requiring to carry a lower load, then the flush load line mark, as is the case with the covered wagons, should be the carrying capacity. If it is necessary to obtain a larger tonnage by piling up the wagon, the sides of all new wagons should be raised to meet the wishes of the railway to enable them to obtain the tonnage. If this system were adopted, there would be no overloading with the margin of load allowance per axle; the station yards would then be free for all overloaded coal and malpractices which are reported from time to time on the part of middlemen, who obtain supplies of coal from the overloaded surplus at the despatching stations, would be done away with. The bunker system for the early release of the wagons and early turn-round of steamers might also be introduced at Kidderpore Docks. If the bunker system were adopted, and the coal all mechanically screened and picked before passing into the bunkers, there should be no grounds for complaint nor for penalising coal companies for further breakage of the coal.

Question 21.—If the coal was loaded direct from the pits over screens into wagons, the wastage would be considerably reduced, and the colliery would be able to despatch a larger percentage of lump coal.

Question 22.—The reason why screening and sizing plants have not been generally adopted in India was that there was no inducement to do so. I was amongst the first to introduce, many years ago, screening and sizing plants for the collieries under my management, but never got any consideration from consumers on account of supplying coal mechanically-screened and loaded. The Railway Board also gave no encouragement whatever to the adoption of screening plants as, if my neighbours for hand-loaded coal quoted an anna a ton less for the same qualities, they got the business, other things being equal. The first consideration by consumers, including the Railway Board, was price, the benefit of screening was another matter. When the screening plant was introduced, the Railway Board would have nothing to do with

screened rubble coal, but the Calcutta Electric Supply and Calcutta Tramways soon found out to their advantage the great saving in consuming a rubble coal which was mechanically-sized as the quality was maintained throughout the year. I was then able to secure the best prices for the mechanically-screened smithy coal, also for the dust for the manufacture of hard coke. My chief failure was to obtain increased prices for the mechanically-screened steam coal. These screening plants referred to above were fitted with small bunkers of 50 tons each for the dust, smithy and rubble coal. The cost of such plants complete at pre-war prices was over Rs. 45,000, therefore the colliery which worked a mine under the quarry system without up-to-date machinery was in a better position to make profits than the colliery which adopted up-to-date methods of loading coal.

Type of Railway Wagons.—The open wagons are always preferable, but under Indian conditions I fear it is impossible to withdraw the covered wagons from the coal trade and allow them to proceed up-country empty, as grain is available for the downward traffic. All that is required is round man-hole doors of sufficient diameter to be fitted on the roofs of the covered wagons to enable them to be correctly loaded and trimmed from the screening plants or bunkers. The E. I. Railway, at my suggestion, are experimenting with the above-mentioned man-hole doors on the roofs of two covered wagons.

Question 23.—I am not able to offer an opinion.

Question 24.—I cannot say.

Question 25.—It is not possible to be assured of a sufficient supply of sand by ropeways alone.

Question 26.—I estimate the quantity of sand to be put into a mine to be 1½ tons to obtain a ton of coal.

Question 27.—I can give no figures.

Question 28.—I cannot say as I have had no experience in sand-stowing.

Question 29.—If some means of sand-stowing is not adopted, the Jharia coalfield, due to the large subsided areas, will more or less be a large underground reservoir, as subsidence will sooner or later occur in one of the many nullahs or rivers, and only those companies who have large efficient pumping plant will be able to maintain their output, and it is my opinion that the large subsided areas in quarrying have already allowed a number of old workings to fill up. The Raniganj Coal Association, Kustore Colliery, have for the past nine years in the dry season pumped from one shaft bottom not less than 50,000 gallons of water per hour night and day, and yet for miles on the surface during the dry season there is no water to see; during the rains, the pumps at the same centre and same colliery require to deal with 200,000 gallons per hour night and day. It is usual to expect large quantities of water when new areas are opened out owing to the strata being water-logged, but our workings to the rise of the colliery are free from water. The same water troubles are again met with when the lower seams are worked.

Question 30.—I recommend the installation of coal-cutting chain machines for Indian mines, along with mechanical underground loaders. The puncher machines are not suitable for Indian labour.

General.—I have mentioned elsewhere that money will be required to carry out the schemes mentioned by Mr. Treharne Rees. The railway stock will require to be increased by at least 50 per cent. over what is now required for the transporting of coal, as I presume the lead for sand will be much less than for coal. I fear it is not possible for the coal companies to carry out sand-stowage systematically unless they are financially assisted from a fund, which would require to be a very large one, as it is to the advantage of Government to preserve the economic resources of the country and assist the industry to prevent wastage, and not to depend upon private effort and enterprise alone. It would require very large sums of money to sand-stow the old workings, and I would recommend that seams of coal with a cover of only 200 ft., from the surface be allowed to subside without sand-stowing, and only the new lower workings be taken in hand. This would save a considerable sum of money and sand for stowing of the old workings.

Did not appear for Oral Examination.

LANDLORDS' REPRESENTATIVES.

Written Evidence of Mr. W. C. Banerjee, of Messrs. Banerjee & Co., nominated by the Indian Mining Association.

Question 1.—I hold leases of properties from the Rajahs of Jharia, Nowagarh and Katras of the Jharia coalfield, Rajas of Burdwan and Kasimbazar of the Raniganj coalfield, and Tikait of Pachamba for Kurhurbari coalfield, and I have sublet these properties. So I am in a position to say something about the terms of several leases.

Question 2.—(*a*) 999 years or perpetual leases are granted by the Rajahs of Jharia, Katras, Nowagarh and Burdwan and the Tikait of Pachamba. The Rajah of Kasimbazar grants leases for periods of 20 years. I hold sub-leases for Messrs. Apcar & Co. for a period of 5 years with option of renewal.

(*b*) Power of supervision is provided in the leases.

(*c*) Landlords' men are allowed every facility of supervision by the Indian lessees. In the cases of European lessees, it is believed that they are working all right, so supervision is not made in most of these cases.

(*d*) The method of working a mine, *i.e.*, whether by panel, long-wall or ordinary gallery system, is not mentioned in the leases. It is simply mentioned that the land is to be worked either by sinking quarries, inclines or pits.

Question 3.—The usual period of leases is 999 years. In some cases, they are for a fixed number of years with option of renewal, with or without fresh *salami*, for the same number of years and on the same terms.

Question 4.—This question can be answered by landlords by a reference to their various settlements. It may be said in one word that they are largely worked by the lessees themselves.

Question 5.—By properties being let out in pieces, certain barrier coal between the different leasehold properties has been lost; otherwise nothing has been lost.

Question 6.—Properties have been let out as applications were received for the same. If a landlord is forced to let out a vast property to one firm or syndicate, the amount of *salami* and royalty is very small. But if it is let out by *mouzas* or in pieces, the *salami* and royalties are more and the landlord's loss of royalty on coal locked in barriers of properties let out in pieces is fully compensated. The development will be quicker and thereby the output will be more, fetching more income to the landlord and more coal to the industries and public and more traffic to railways. The Ramgarh-Bokharo Coal Co., Ld., took a lease of this field on a *salami* of Rs. 40 per bigha and annas 4 royalty. They are sub-letting at Rs. 400 per bigha *salami* and increased royalty per ton. If they let out in plots of 100 bighas, they can probably get Rs. 1,000 per bigha *salami* and annas 8 per ton royalty, as certain land in the Jharia coalfield has been let out on these terms recently. The other day a plot of 90 bighas of 10 seam land was let out at a *salami* of 2 lakhs by Bhagbankora.

Question 7.—I am not aware of any instance in which solid coal has been left out in a seam and pillars extracted, thereby causing loss to the landlords' future interest. There are instances in which the better kind of coal has been worked and the inferior seams left out. The glaring example is the East Indian Railway Company's Kurhurbari Colliery.

Question 8.—I am not in favour of any minimum being fixed. Suppose if a minimum is fixed then, if I have a plot of land below the minimum, I am debarred from letting it out. It will also mean locking-up of coal.

Question 9.—I do not see any objection to expert advice (not paid for by the landlord). Certainly expert instruction of a controlling authority by legislation is quite different to expert advice, and it is objected to because it will take away the free rights of landlords to deal with their properties. It will affect their interests financially too.

Question 10.—It would affect the lessees of coalfields, because the old lessees will be more advantageously placed and it will reduce the value of new leases.

Question 11.—I would not like the position of my tenants to be jeopardised by any instruction from a controlling authority regardless of the terms of my leases.

Question 12 (*a*).—I would object to negotiations being supervised by any controlling authority, as it will be interfering with my free rights as a landlord.

(*b*) No objection to covenants in general terms for economical working.

(*c*) There is provision to inspect workings of mines under the existing leases.

(*d*) The right of enforcing performance of working terms should be vested in the landlord.

Question 13.—Certainly, letting out coal by mauza boundaries instead of in rectangular blocks, has been so conducive; as the sizes and shapes of mauzas are irregular, it is quite impossible to let them out in rectangular blocks. If such is enforced, lots of land will be left out. Then again, it may be that two contiguous mauzas do not belong to one and the same landlord. In cases of different ownership of different mauzas, it is impossible to arrange for leases in rectangular blocks between two landlords. There will be lots of boundary disputes with different owners, if not let out by mauzas.

Question 14.—I do not approve that all coal raised should be weighed at the colliery, as it will not serve any useful purpose to landlords who are paid royalties on despatches. No royalty is paid on coal consumed at the collieries in steam-raising, lime and brick burning, burning by coolies and labour and staff of a colliery, as these are essential requirements of colliery working.

Question 15.—I have none to offer.

Question 16.—I do not see any reason why a landlord should give sand free of all charges for the supposed better working of a mine let out by him, and so lose his income on the sand. I do not think that the landlord would be sufficiently compensated in increased royalty on the coal saved by pillar-drawing with sand-stowing, if he has to give sand from the rivers in his estate to the collieries free of all charges. Then again, if a landlord has no sand in his zamindari, this suggestion is impracticable. He cannot arrange for sand, free of cost, for his tenants. The zemindar in this case, instead of getting any royalty income, will have to pay something out of his pocket to provide sand to his tenants free of all charges.

Oral Evidence.

All my evidence represents my own views.

Question 2.—I have two 5-year sub-leases from Messrs. Apcar & Co. In one I had to sink pits. My option of renewal is on the same terms, the total period of lease being for 20 years to be renewed at the end of every 5 years. All leases should be for long periods depending on the size of the property. I have no objection to long leases for small properties with a relinquishment clause after 6 months' notice. Even 5 years' leases have a relinquishment clause.

Question 6.—I know Kirkend mouza in the Jharia field. That mouza was not let out to the best advantage economically because it was leased, as applications were received, at a time when there was no demand or rush for coal properties and those concerned had no proper knowledge as to the suitability of the sizes of a property.

Question 9.—I have never seen any leases binding the lessee to work according to the rules of the Mines Department. From the landlords' point of view, it would be advantageous to have such terms provided they were inserted both in existing and future leases, but without interference with the workings already done under the present leases.

I do not admit that large quantities of coal are being lost at present. I know the Sudamdih Colliery of the Empire Coal Co., Ltd., which is 600 bighas in extent, of which 30 or 40 bighas of a 60 feet seam collapsed owing to the way in which the pillars were robbed under European management. Assuming that such large amounts are being wasted, I would approve of Government taking action to prevent such waste by pillar-robbing in the interests of the nation, and more particularly in the case of first class coal, the supply of which is limited according to Mr. Simpson. I think mining men should also be educated to better mining methods. I would place the landlords' interests before those of the State as the coal belongs to the landord. I do not think the State should ever interfere if the landlords' interests are adversely affected thereby. I am not an accredited representative of any superior landlord or zamindar, but I am a landlord myself. I am not a superior landlord or zamindar. State control might give more life to a colliery, but the landlord would not get any more out of it.

Question 13.—I have no objection to leasing by rectangular boundaries, if the rights of the landlord to royalties are safeguarded.

Question 16.—I have no sand. What I say in answer to this question would be my opinion if I were a superior landlord or zamindar.

Written Evidence of Rai Ganga Charan Chatterjee Bahadur, I.S.O., Manager, Panchkote Estate.

Question 1.—I represent the Raja of Panchkote in the district of Manbhum and have been in his service for about 1½ years as manager. The extent of the coal properties in his estate will be about 110 or 112 square miles, of which about 102 square miles is in the Raniganj field, and the rest in the Jharia field.

Question 2.—Generally leases for a term of 999 years are granted, except in a few instances where they are for a period of thirty years with the option of renewal. No such renewal has yet taken place. There are clauses in the leases by which the lessor or his agents can supervise or inspect the collieries of the lessees and the lessor can make rules for the health and good of the public. It is also provided in the leases that the lessees are to work the collieries in a thoroughly workmanlike and skilful way and in an up-to-date fashion. The lessees will have to follow the directions of the Government officials who are authorised by Government to make any rules. Up to this moment, no occasion has arisen for enforcing the provisions of the clause. The clause can be enforced by suing the lessee for breach of covenant and having the lease cancelled. The leases do not provide for any particular method of working.

Question 3.—The question is already answered in answer to Question 2.

Question 4.—In this estate almost all the mines are worked by mine-owners who have obtained the leases direct from the proprietor of the estate. In recent years there have been sub-leases, but not a single colliery has yet been opened by a sub-lessee. There are cases in which the mine-owners work under the patnidars of this estate. In these patnis the sub-soils were also included. There are cases in which some companies still hold leases under tenure-holders who have no right to the sub-soil, and they work the mines. But this estate contemplates suing these trespassers for possession and damages.

Question 5.—Almost all the collieries are held by the bigger colliery companies who have got eminent mining engineers, and these companies selected the lands and took settlement of the same. From this fact I presume that settlements made up to date have been so based as to conduce to the economical working of the properties. I give a concrete example, *i.e.*, the Bengal Coal Company hold about 20 or more villages which are all contiguous and they have obtained the right to work coal by instroke and outstroke. This will help the company to get out more coal than if they had not the right to work by instroke and outstroke. I don't know of any instance of uneconomical working save in one or two cases where the mines being very old, recent methods of working could not be adopted. There is, however, no supervision exercised by this estate to see that the coal is economically worked.

Question 6.—I do not agree to this. In this estate the proprietor charges only a reasonable *salami*, say Rs. 10 or Rs. 15 at the utmost per bigha, in leasing out the coal lands. The proprietor made settlements with a view to a steady progressive income from the royalties neglecting the *salami*.

Question 7.—I don't know of any instance in which such a thing occurred. In one case, I was informed that the top seam being of inferior quality was left unworked, while the bottom which is of superior quality was worked.

Question 8.—I would not advise making any hard and fast rule about minimum and maximum areas to be settled by the landlord. The reason is that, in the estate I represent, I find there were isolated small strips of land round which other parties acquired coal mining rights about 60 or 70 years back. If there were a maximum limit fixed, these plots would have remained unworked, thus allowing the mine-owners of surrounding collieries a chance of encroaching upon them. Again, the fixing of a minimum area would interfere with the rights of the landlord. I do not see how it can benefit him.

Question 9.—Expert advice on the most advantageous methods of working (if available without payment) would be of benefit both to the landlords when leasing out the coal lands, and to the lessees for working the mines, but it should not be made compulsory for them to follow such advice. I object to such advice taking the form of expert instruction from some controlling authority set up by the legislature, as this would be an infringement of the rights of the landlord.

Question 10.—Just the case in this estate. This estate has only a very small area open for settlement and, if such clauses were inserted in a few leases to come, it would not materially affect the coalfields.

Question 11.—The question is not clearly understood. Is it meant that the controlling authority set up by the legislature may declare existing leases and covenants to be void and issue instructions to ensure the best method of working the coal regardless of the terms of the leases? If this is the meaning, I am opposed to the procedure suggested. Leases and covenants, as already executed, should be allowed to stand. If the controlling authority is of opinion that modification of the existing leases is necessary for a better method of working the collieries, he may address the landlord and lessees on the point, pointing out what modifications are necessary in the lease, and leaving them to decide whether fresh leases with the required modification should be executed. If the landlord and the lessees are satisfied that the modification is conducive to the interest of both, there is no reason why they should not adopt the modification. What I advocate is that improvement in the method of working collieries should be effected by persuasion and advice and not by legislative enactment, which will necessarily interfere with the existing rights of parties.

Question 12.—Supervision by a controlling authority in the matter of negotiation for leases will not only complicate matters, but will greatly interfere with the lawful rights of a zamindar. I believe, under the existing leases, the lessees are bound to follow the instructions of Government officials, such as the Chief Inspector of Mines and his assistants, and they can advise the lessees how they are to work the collieries. No fresh legislation is necessary for enforcing covenants on the lessees as they can be enforced through the civil courts.

Question 13.—I believe that leasing by rectangular plots would have been conducive to good economical mining, but there are many cases in which surrounding properties belong to different parties and there are disputes regarding titles too. So leasing by rectangular plots may not be practicable in most cases.

Question 14.—In the leases there are provisions by which the lessees are bound to keep weighing machines, but the omission to keep them is overlooked as the lessees find it difficult to weigh all coal raised. The enforcing of this covenant will place the lessees in a difficult position, as it will increase their cost per ton.

Question 15.—The only suggestion that I have to make is that the lessees should be advised not to neglect coal even of inferior quality.

Question 16.—Yes, my case is this:—This estate has leased out all lands at a commission of 4 annas per ton, subject to a certain minimum royalty, and this is fixed for ever It is the mine-owners who make the biggest profit and the zamindar gets an insignificant fraction of it. I don't see why the proprietor should allow them free use of sand, which is also a resource of his estate, and from which he often derives an income. Supply of sand on a reasonable royalty will not minimize the profits of the lessees as they, will, by sand-stowing, be able to extract a larger amount of coal and make more profits. Since larger outputs mean larger profits in the shape of increased royalty to the estate, the estate will undoubtedly allow the colliery owners to take sand on more favourable terms than others, each case being decided on its own merits.

Oral Evidence.

Question 1.—I am the Manager of the whole Panchkote Estate, which lies on both sides of the Damudar River.

Question 2.—The option of renewal in 30 years' leases is on the same terms without any fresh *salami*. No inspections are ever done by the Raj agents.

Question 4.—Only a few patnidars have mining rights. If such rights are not mentioned in the lease, they belong to the zemindar. This is the ruling of the Privy Council. We do not give

patnidars any share in royalties unless they are entitled to them under their leases. Our usual royalty is annas 4 per ton for all coal with, in some cases, a smaller rate for rubble.

Question 5.—It is by accident that the Bengal Coal Company's 20 villages happened to be contiguous. An extra royalty or *salami* is taken for instroke and outstroke work as a kind of way-leave.

Question 6.—I know of sub-leases on a higher *salami* than we charge. ₹35 or ₹40 per bigha is the most I have heard of.

Question 7.—This case was in Raniganj. As a landlord I would object to a lower seam being worked to the damage or destruction of an upper one, but there is no provision in the leases to prevent this. We merely inspect now to ascertain whether royalties have been rightly paid on despatches. We do not interfere with working at all.

Question 8.—If any landlord let out a mouza in such a way that it could not be worked economically without waste, he should, I think, be prevented from doing so. This should not, however, be done by legislative compulsion, but by advice. If the advice was not followed, the landlord would lose in the long run and should be able to see this. I agree that he may gain immediately, but yet I do not think that the right of private ownership should be interfered with on any account. Theoretically, I agree that national loss should be placed before private right; practically, I would place private right first. I would not interfere with such right in order to prevent national loss, unless such loss was of a very serious character, which is not the case in the present instance.

The isolated strips I refer to might of course be let to the neighbouring collieries, but we would be at a disadvantage in the discussion of terms.

Question 10.—There is a clause in our leases about the lessee having to follow any orders passed by the Mines Department, and I would have no objection to this clause being extended to the new department or controlling authority. This would benefit the landlord. It has never occurred to us that mining engineers should look after our interests with our lessees. I would have no objection to Inspectors of Mines doing this provided the landlords' rights were not interfered with.

Question 11.—I would not object to the controlling authority altering a clause in an existing lease requiring too small pillars to be kept, which cannot be cut without permission and without payment of further *salami*. I quite understand that this further *salami* would thereby be lost. This would be all right provided there was no interference with the royalty.

Question 12.—I have no objection to control over the purely mining terms of leases.

Question 13.—In some places leasing could be done by rectangular blocks. I have mouzas where this could be done. Where contiguous mouzas belong to different proprietors, I would object to any compulsion in order to bring about equalization of boundaries. I would have no objection from the landlords' point of view provided the surface boundary remained as before and neither owner lost anything.

Question 14.—Weighing would be good from a landlord's point of view.

Question 16.—The present income from sand is small. The Bengal Iron and Steel Company are arranging to take a lease from us at ₹250 a year. It will cover a fairly long stretch of river, but I cannot say exactly how much. We would be prepared to give very favourable terms to colliery owners, but we would not give sand free. I agree that the excavation of one year would be filled up the following year from above, but I think we should also get royalties on this replaced sand though it may come from someone else's property. For collieries which do not belong to our estate, I would suggest the same rate of rent for sand as for cultivated land. For collieries belonging to the estate, all I want is a nominal rent to keep our rights over the sand alive, but I cannot undertake to give an entire remission to such collieries.

General.—I am not prepared to give any opinion on the proposed nationalization of minerals.

Written Evidence of Babu Bhudev Prosanna Mukerjee, Raj Coal Mines Superintendent, Burdwan.

Question 1.—The Honourable Sir Maharaja-adhiraja Bahadur of Burdwan.

(*a*) About 250,000 acres.

(*b*) Circle Officer and Coal Superintendent since 1912.

Question 2.—For unproved areas generally, we grant a prospecting license to which the form of the mining lease is attached and the lessee is allowed to exercise his option of taking a mining lease after proving coal in the property. The prospecting lease is granted generally for a period of one to five years according to the area to be prospected. The prospecting and mining leases are granted by Bengali *pattahs* and *kabuliyats* or by English indentures.

In the leases granted by the Burdwan Raj, no particular methods to be followed in extracting coal are laid down, and hence the Raj does not interfere with the methods adopted in working the mines, but the Raj has a general power of supervision over the working. That power is being recently exercised in some of the collieries. If the mine-owners refuse to comply with the

covenants of leases, we can only enforce them by civil suit, which is always troublesome and in some cases impracticable. The leases do not specify any particular method, but direct that the mine shall be worked according "to the most approved practice for the time being adopted in similar mines and according to the rules framed and adopted by the Government Mining Department."

Question 3.—The usual period is 999 years, but in a few instances the period has been limited to 400 years. There is no stipulation in the leases as regards renewal.

Question 4.—About 70 per cent. is worked by mine-owners who obtained their leases directly from the estate, and about 30 per cent. is worked by mine-owners who are sub-lessees.

Question 5.—In some cases, the areas have not been so arranged as to help the economical working of the mines. But, as the Raj was not aware of the leases granted by the present lessees of the Raj, the Raj could not interfere in the matter then. Instances are the collieries worked at Jote Janaki, Kenda, etc.

Question 6.—No. The Raj is at present leasing out properties and trying its best to see that the coal lands are properly developed.

Question 7.—I personally know of such instances of working at Jote Janaki, Bansra, Dobrona, Haripur, and Madhabpur in our properties, and a particular instance of such working at Damra, which belongs to the Hon'ble Maharaja of Kasimbazar.

Question 8.—The area of coal lands to be leased is generally governed according to the depth of the seams of coal, and accordingly a big area is required to work deep mines, whereas small areas can be suitable for shallow mines. Moreover, if more persons work mines, the greater will be the output. Therefore I cannot suggest any minimum or maximum limit of coal areas.

Question 9.—Primâ facie I have no objection to the suggestion being translated into action. But I cannot commit myself to any definite opinion, unless I can form any idea as to how far the income of the Raj from coal lands would be affected and of the "ultimate benefit."

Question 10.—Yes. I admit.

Question 11.—I have no observation to make on the proposal which seems to be beneficial to our interests, provided that the authority does not interfere with any of the terms of the lease other than those relating to the method of working coal. As every case of lease will be dealt with on its own merits, the Raj must dictate its own terms regarding royalty, etc.

Question 12.—I do not quite understand what would be the scope of such supervision by the controlling authority. Certainly there should not be any interference on his part where negotiations for leases are carried on between the Raj and intending lessees. Of course, economical working is desirable, and he may see that covenants for this are included in the leases, and he is quite welcome to inspect such working and to ensure and, if need be, to enforce due performance of such terms.

Question 13.—Yes. If, by making rectangular blocks, the whole coal area of a mouza can be covered, leasing coal lands in rectangular blocks is conducive to good and economical mining, but, as the mauza boundaries are generally of irregular shape, the block system is impracticable, and hence it is better to lease coal lands by mouza boundaries.

Question 14.—Yes. I approve of Mr. Rees' recommendation. Much coal is wasted at the collieries of which no account is kept. The pit sarcar and other workmen working in and about the mines dispose of the surplus coal they get from the miners in any way they please. The agents cannot check it, as the coal thus disposed of is taken from the surplus coal of the tubs because these loads, if they are properly loaded, exceed the standard carrying capacity of the tubs. If all coal tubs are weighed and payment made to miners according to the weight, much coal can be saved.

The coal taken by the miners is also too much. Generally miners and their companions take away much coal, and the mine-owners to keep the miners well in hand as willing workers, connive at their taking away the coal so long as they do not take it from their stack, but from the mines. The miners are allowed some coal for their consumption. But it is generally found that the miners sell much coal locally which they take away from mines. Standard sizes of baskets and buckets of known carrying capacity can be used in mines to ascertain the quantity of coal taken by the miners and the workmen.

Question 15.—To work a mine properly, the mineowners require much surface lands to develop their properties. At present, almost all the surface lands of the Raj have been leased out in patni and other tenures, and the tenure-holders also, in their turn, have settled the lands in plots with other tenants. Now, to ensure proper working and save lots of litigation, the Raj is obliged to lease the mines to the tenure-holder of the surface lands. As the original tenure has been subsequently partitioned off in most cases, many share-holders have now cropped up and the Raj cannot settle the mining rights leaving out all the surface tenure-holders. Even when the surface tenure-holders come to terms, their sub-tenants raise objections to the acquisition of surface lands though proper compensation is offered to them. If the surface lands for mining purposes are acquired on the lines followed when lands for public purposes are acquired, the coal lands may be settled satisfactorily and in a manner conducive to the proper development of the collieries; otherwise, it will ever remain a problem how to lease out properties to the best advantage of working.

Question 16.—Sand lying on the beds of rivers running through the Burdwan Raj zemindaris may be given free of royalty for the collieries, lying within the ambit thereof, in which it is interested, but if supplied to collieries belonging to others, the Raj should get a reasonable royalty for it. Here also, for the purposes of extracting sand from the *churs* thrown up in the rivers, the surface

land, if leased out, is to be acquired at the mine-owners' cost with the help of some legislation on the lines adopted when lands are acquired for public purposes.

Oral Evidence.

Question 2.—There are still unproved areas in the Burdwan Raj Estate. The clause in our leases about following the Mines Department rules is meant to cover rules regarding the safety both of miners and of mines. There are, for example, provisions regarding ribs and barriers, economical methods of working, prevention of fire, and removal of pillars. We also provide that the lessees should obey any future legislation affecting the mines, but there is no way of enforcing these clauses except by civil suits.

Question 5.—The Jote Janaki and Kenda collieries are both sub-leased collieries.

Questions 8 and 9.—I agree that, where circumstances will permit, no mine or let area should be so small that it cannot be economically worked, but the landlord's royalties and such other terms should not be affected by any interference of the controlling authority.

Question 13.—There would be no objection to this if done by mutual arrangement with the controlling authority intervening.

Question 15.—Restrictions on the acquirement of surface rights do interfere with the working of mines. There are many cases where surface rights belong to one owner and mineral rights to another.

Question 16.—I would call a royalty of one anna per ton of sand reasonable. I would also demand royalty on sand which comes down the river to replace the excavated land. I would agree to one anna per cubic yard.

Written Evidence of the General Manager, Nowagarh Estate.

Question 1(a).—I represent the Zamindar of Perganna Nowagarh, Kismut 1 and 2.

(*b*) Approximately 50,000 bighas in round numbers.

(*c*) I have been in his service since June 1919 as General Manager of his estate.

Question 2(a).—"Meadi Mokrari" leases, *i.e.*, leases for a fixed term of years, with fixed rent or fixed commission and minimum royalty, are ordinarily given.

(*b*) No.

(*c*) No answer arises.

(*d*) A general clause specifies that the coal mines will be worked according to "dustoor" *i.e.*, without causing any injury to human life or property.

Question 3(a).—999 years.

(*b*) No occasion for renewal has arisen

Question 4.—The information is not readily obtainable.

Question 5(a).—I have no personal knowledge as to the arrangement made by the lessees for extracting coal from the leased area.

(*b*) No.

Question 6.—Both the objects were kept in view, as the reservation of rent or commission and minimum royalty conclusively proves. But the matter of extracting the quantity of coal has been entrusted to the lessees as having the greater interest in extracting the greatest quantity of coal.

Question 7.—No.

Question 8 (a).—I do, except in cases in which the landlord or the lessee will prove circumstances to the satisfaction of the authorities justifying the necessity of settlement of a lesser area.

(*b*) I suggest 100 bighas.

Question 9 (a).—I do not object, provided it comes from a body or, if it comes from an individual, there be an appellate body over him.

(*b*) I do not object, provided this controlling authority be a body of persons composed of high Government officials and colliery managers (both Indian and European) and representatives of the landlords, and that they be paid for the work. The control should be limited to the matter of extracting coal only.

Question 10.—Yes, it may not affect the coalfields already leased out or sold, but it may affect the landlord's interest by rendering the situation less tempting for capitalists.

Question 11.—The controlling authority should be a body of persons composed of Government officials and representatives of landlords and colliery managers (both Indians and Europeans) and be paid for the work.

Question 12.—I do strongly object to the controlling authority being armed with such formidable weapons as in clauses (*a*) and (*b*). With regard to clause (*c*), I recommend a set of

rules to be framed for the economical working of the coal, which rules the lessees will follow irrespective of the terms of their leases.

Question 13.—I consider that leasing coal by rectangular blocks is more conducive to good economical mining than leasing by mouza boundaries. But this will not be practicable in all cases as Nature has not placed the coal in rectangular blocks.

Question 14 (*a*).—Yes, I do approve.

(*b*) Such a measure will ensure a correct account of the quantity of coal raised from a colliery every year, and at the same time put a check on the abuse of the privilege given to the lessees of coal regarding consumption free of cost for colliery purposes.

Question 15.—To ensure—

(1) that Government gets at a moment's notice as much coal as it requires in time of need,

(2) that the public gets coal easily at cheap rates,

(3) that all the coal is extracted from underneath the soil by the best scientific methods,

(4) that the coal mines are protected from inundation and fire,

(5) that as little damage as possible is done to the surface, and

(6) that as little injury as possible is done to human life and property,

a joint-stock company should be formed with sufficient capital to acquire all the coal lands in India.

Question 16.—Sand is an important source of income and forms part of the zamindari.

Moreover the zamindars have been so much over-burdened with—

1. Revenue,
2. Road cess,
3. Income tax,
4. Adjustment tax,
5. Super-tax,
6. Mine cess,
7. Jungle cess,
8. Road patrol cess,
9. Choukidari tax,
10. Health Board cess,
11. Water Board cess,
12. Municipal tax,
13. Arms tax,
14. Petrol cess,
15. Subscriptions for dispensaries,
16. Subscriptions for schools, etc., etc, etc.,

that the proposal of making free gifts of any property, be it in the shape of sand or clay or stone or ghooting or kankar or coal, is altogether out of the question. But a proposal at a concession rate, say two annas per 100 cubic feet, may be entertained.

Oral Evidence.

Question 1.—The Nowagarh income is about a lakh and a quarter.

Question 2.—Our usual royalty is As. 4 a ton. It is less in some cases, but never more. This is the rate for all kinds of coal. Our leases do not provide for following approved methods of working or for obeying the orders of the Chief Inspector of Mines. I have no objection to the insertion of such clauses in future leases.

Question 8.—I think that this should be provided for by a set of rules which landlords will have to follow in framing leases. I object to any interference with actual leases, *e.g.*, the submission of leases to a controlling authority for previous approval.

Question 10.—I think such clauses should apply both to old and to future leases. If limited to future leases, it might effect competition among lessees for new leases.

Question 13.—I do not think equalisation of boundaries can usually be brought about by private arrangement. I have no objection to rectangular boundaries where less than a whole mauza is being leased. In other cases, the mauza boundary should be followed.

Question 14.—Weighing would be particularly advantageous where royalties are paid on raisings.

Question 15.—This company will be the lessee under all landlords. The controlling authority will be over it in order to prevent abuses.

Question 16.—We will now get As. 3 per 100 c.ft. for sand sold to the Jharia Water Board. This is a temporary source of income. Previous to this, there was very little income from sand.

Question 17.—Our land revenue is about Rs. 1,200 a year; road cess about Rs. 1,500; income-tax about Rs. 5,000, and adjustment of tax on income about Rs. 1,800; super-tax Rs. 1,800; mines cess Rs. 3,500; jungle cess Rs. 100; road patrol cess Rs. 46; chaukidari tax Rs 96; Health Board cess Rs. 800; Water Board cess Rs. 800; municipal tax on Dhanbad and Purulia houses, Rs. 150; Arms Act Rs. 100; petrol licenses, Rs. 5; subscriptions for dispensaries, schools, etc., about Rs. 1,000. The approximate total is about Rs. 18,000.

Written Evidence of Mr. F. Owen, Agent for Messrs. Macneill & Co.'s Collieries, Raniganj.

Question 1.—(*a*) Our superior mineral landlords are:—

(1) Burdwan Raj.
(2) Kasimbazar Raj.
(3) Pachete Raj.
(4) Jharia Raj.

(*b*) We have no idea as to the extent of the coal properties owned by the above-mentioned landlords.

(*c*) The leases of coal properties taken from the above-mentioned landlords date from various periods.

Question 2 (*a*).—In the case of Dishergarh, Neamutpore and Sathpookuria, the minerals are held under a *mokrari* or permanent title. Other properties are held under lease for various periods.

(*b*) The leases give the landlord power to inspect the mines, and stipulate that the methods of mining shall be in accordance with the practice prevailing in the district. The leases do not specify any particular methods of working.

Question 3.—Except where the lease is held under *mokrari*, the periods vary from 999 years to 10 years with option of renewal, which may be granted free in some cases, and, in others, on payment of *salami*.

Question 4.—This question may be answered by the superior landlords only.

Question 5.—We do not know of any instances of such uneconomical working as is referred in this question.

Question 6.—We do not agree with the contention put forward in this question.

Question 7.—We have no knowledge of any instance as referred to under this question.

Question 8.—We do not consider any limit should be placed on the minimum area of minerals to be leased out by a mineral owner. The value of a mineral property is usually regulated by the quantity of accessible coal of commercial value that it contains and not by its area. For instance, an area of 500 bighas in certain parts of the Jharia field is probably of more value than 1,500 bighas in the Raniganj field owing to the greater number and thickness of seams in the former field and their proximity to one another.

Question 9.—There would be no objection to expert advice, provided it emanates from a properly constituted authority of recognised mining and commercial experts.

Question 10.—As we believe, the majority of leases already provide for the coal to be worked in accordance with the best practices followed in the field, and such covenants cover any modification of working methods. New leases should therefore contain similar covenants.

Question 11.—In cases where the existing lease makes no special provision for economical working consistent with the best practices followed in the coalfield, we are in favour of a properly constituted authority exercising such control.

Question 12.—There would be no objection to this proposition provided the controlling authority is fully representative and constituted as mentioned in answer No. 9.

Question 13.—So long as the mineral rights are held by various large zamindars as at present and not by Government, we do not see how it would be possible to lease out mineral areas in rectangular blocks. The mauza boundaries of Bengal agree pretty well with village and parish boundaries at Home, which usually form the mineral boundaries of leaseholds taken up by colliery companies in Great Britain. These boundaries, as in India, are very irregular, but are more clearly defined than in India. This is due to the small scale and often inaccurate Indian Revenue Survey maps defining the boundary of mauzas. Some of the superior landlords lease out their minerals as per plan of their holding of surface rights, whereas others observe the Government Revenue Survey as their mineral boundary. The difference in such cases is often considerable and, from a mining point of view, is a very serious matter.

Question 14.—The recommendation that all coal raised from the mine should be weighed at colliery is sound, but impracticable owing to the large number of openings raising coal and the vast number of small mines. The cost of installing colliery tub-weighing machines at each opening would be heavy, their maintenance inefficient and, owing to the great variety of coal tubs in use at individual collieries, particularly Indian-owned ones, there would likely be considerable discrepancies in weighment.

Question 15.—The following suggestions from a landlord's point of view would be conducive to the more economical working of collieries :—

1. Leases should have a tenure of not less than 60 years.
2. The mineral boundaries of each leased-out holding should be accurately defined, and the mineral boundaries of each superior landlord or mineral owner should also be defined and agree.
3. There should be a solid rib of coal left, not less than 60 feet, between adjoining properties owned and worked by different colliery proprietors, and this should be enforced by a regulation under the Indian Mines Act.
4. In the event of suspected encroachment, a joint survey should be allowable by law.
5. There should be a regulation as to the size of pillars to be left in the first working, and also as to the formation of suitable barriers where large areas are involved.
6. There should be no restriction in pillar working.
7. The allowance of coal free of royalty for boiler consumption should not exceed a specified percentage of the output raised. This would be conducive to greater economy in the use of small coal.
8. Free access to and across the surface of properties for the transport of sand and other debris for stowing material should be allowed.
9. Sand from rivers, and debris thrown up from railway cuttings, should be free for use by the collieries.

Oral Evidence.

Question 2.—Dishergarh is a *mokrari* and carries a mineral rent. In the present Burdwan lease, it is laid down that the lessee must follow any orders of the Government as regards mining methods. There is no such clause in the Jharia leases so far as I know.

Question 8.—I think Government should be able to step in and regulate leasing in small plots in which proper economical working is not possible.

Question 13.—There is a Government cadastral survey now proceeding, but this is not likely to have any effect in defining the boundaries of existing leases. I do not think an irregular boundary is so serious a matter as the difficulty of getting a boundary clearly defined at all. I consider the controlling authority should be able to step in and equalize boundaries as between landlords, more especially if the tenant colliery owners are agreed on the point.

Question 15.—(3) By a 60-feet barrier, I mean 30 feet on each side of the boundary line of two properties. I do not care under what act this is enforced. Every case should be decided at its own merits, and I am not particular about any absolutely fixed figures as depth and situation would be controlling factors. Encroachments are really serious matters in deep mines where water-logged workings to the rise are likely to be met with. In the case of a recent suspected case of encroachment, a joint survey of the surface boundary only was agreed to. The other side would not agree to our seeing their plans, and we could not force them to do so. This should be rectified.

(5) This should be done by the controlling authority and would prevent a large amount of waste. There is only one large mineral landlord, so far as I know, whose leases specify the minimum size of pillars to be left and the size specified is absurdly small. I would have no objection, as a landlord, to existing leases being amended to provide for the minimum size of pillars to be left in future working.

(6) I refer to the demand for further *salami* on recovery of pillars. I know of a case where pillar working was restricted and, on an application being made for working the pillars formed, an enhanced royalty was demanded for their recovery. In this connection, we were advised that, once a pillar had been formed, of whatever size, it could not be reduced further even though the lease allowed a smaller size of pillar to be formed in the course of first working. All such restrictions on pillar-cutting are, I think, imposed with the object either of getting more money in the form of *salami* or of saving the surface or both. We have recently paid a *salami* for pillar-cutting equal to the *salami* per bigha paid originally for the whole estate. When *salami* has been paid, pillars may be cut without regard to the safety of the surface, but compensation has then to be paid in the event of surface damage.

(7) Royalty is not usually paid for colliery boiler fuel. When royalty is paid on despatches there is no percentage allowance for boiler or other colliery consumption. When the royalty is, paid on cubic capacity, about 12 per cent. is allowed to cover all colliery consumption.

Written Evidence of Kumar Prabal Narayan Sinha, General Manager, Katras Estate (Jharia).

Question 2.—The only important lease granted in this estate is one of 22 mouzas granted to the Nowagarh Coal Company, Limited. It was granted by the Deputy Commissioner of Manbhum

as manager of the estate which was, at the time, under the operation of the Chota Nagpur Encumbered Estates Act. This lease was for 30 years and there is no power of supervision over the methods to be followed in extracting coal. Most of the other leases are in respect of properties, the existence of coal wherein was doubtful, and in which the landlords' right to the minerals was not then quite free from dispute.

Question 3.—The usual period of lease is 999 years: there is no provision for renewal in such leases.

Question 4.—It is difficult to answer this question as the information is not readily obtainable.

Question 5.—It is difficult to answer this question, but it cannot be said that the leases hitherto granted have been arranged so as to conduce to the economical working of the property as a whole.

Question 6.—I do not agree because the lease of the 22 mouzas was granted at a nominal *salami* of As. 8 per bigha and at a low commission of As. 4 per ton.

Question 7.—No.

Question 8.—No.

Question 9.—No.

Question 10.—I do not. As most of the lands have not already been leased out or sold, the lease to the Nowagarh Coal Company of the 22 mouzas has become liable to forfeiture, and, even if it is allowed to continue, it would expire within 6 or 7 years.

Question 11.—No; it would rather be desirable and the matter may be left to the Mines Department.

Question 12.—I would object to the controlling authority being empowered to supervise negotiations for leases, but I would not object to (*b*) & (*c*).

Question 13.—The leasing out of coal by mauza boundaries is desirable from the landlords' point of view, and I am not prepared to say that such leases have not been conducive to good economical mining.

Question 14.—Yes. This will stop disputes between the lessors and the lessees, and prevent fraud being perpetrated by unscrupulous colliery owners.

Question 15.—The authorities under the Indian Mines Act may be authorized to issue instructions to the colliery owners for the economical working of the seams.

Question 16.—The sand is usually taken by the people on commission and this yields a decent income to the estate. There is no reason why the collieries should be allowed to have it free of all charges.

Did not appear for Oral Examination.

Written Evidence of Mr. A. J. Smith, Manager, Jharia Estate.

Question 1.—The Zamindar of Jharia, Perganna Jharia, Sub-Division Dhanbad, District Manbhum.—Area of estate about 70 square miles. Have been working for nearly 15 years. I joined as Assistant Manager in 1905 and have been Manager since about 1911.

Question 2.—All leases contain provision that the work must be carried on according to approved methods of mining, but the estate has never exercised any supervision over the work of the lessees, hence it has rarely been necessary to enforce a breach of the terms. In fact the estate has always shirked expensive and unsatisfactory litigation on the subject. There is no specified method of working mentioned in the leases, but the assumption is that the work has to be done on the bord and pillar system, and some leases even state that the surface must be kept intact, whilst a few state that special sanction must be obtained for pillaring.

Question 3.—The leases are usually in perpetuity or for a period of 999 years. Hence it has never been necessary to renew them.

Question 4.—It would be difficult to give you exact figures, but, from my personal knowledge, I would say that considerably more than half of the land leased by the estate pays royalty or rent in some form to middlemen. In some instances, there is more than one middleman between the producer and the zamindar.

Question 5.—I would answer the first query in the affirmative. As regards the second, I once heard of 17 seam being worked and goafed before 18 had been worked, but I was never able to get this fact confirmed. I think I would be fairly correct in stating that No. 15 seam is habitually worked regardless of 16 seam, the coal of which does not command a ready sale in the market.

Question 6.—I do not think the question of *salami* or disregard of our best interests has played any part in determining the conditions of leases. The estate has never had any large sum of money as *salami*, as these princely amounts have usually been paid to middlemen, who were fortunate enough to acquire these lands years ago when land was cheap and the proprietor had no idea of the value of the coal lands. I would here point out that this question would apply more to Hazaribagh than Manbhum. In the former district, whole fields have been acquired by individual firms, but the *salami* paid to the zamindar, or which is to be paid in the future according to the

terms of the lease, is and will be very small when you consider the quantity of coal which has and will change hands. The firms have undertaken a risk and will probably have their money locked up for years to come without the smallest chance of a return. The zamindars, seeing the hopelessness of their situation, have rushed into the arms of the big firms in the hope that their influence might bring the railways into their properties at an early date and enable them to get an immediate return. Had railway facilities been assured them, the zamindars of Hazaribagh could have got far better prices, as, with the experience of the Jharia coalfields to work on, they were in a position to know what to demand.

Question 7.—This would be a very difficult question for an amateur to answer, but, looking at it from a business point of view, I would say we might safely assume that the principle of "speedy profits" has been the habitual order of the day, and, on that assumption, we might confidently infer that losses must have been incurred. I do not think the zamindar has suffered very heavily, but the middlemen and the colliery proprietors must have suffered to an appreciable extent.

Question 8.—I am not prepared to advocate interference in this matter. The zamindar and the lessee might be left to work out their own salvation.

Question 9.—Personally, I would be very pleased to obtain this expert advice, but I would like to understand something of the duties of the controlling authority before accepting it.

Question 10.—As matters stand at Jharia, there would be little use in interfering. All the valuable coal lands were given out long ago, and, since I have been in the place, I have not thought it worth my while making any changes in the leases. The Hazaribagh leases are, however, quite a different matter. There you have virgin fields to work in. I see no reason why legislation should not prevent a repetition of the mistakes made in Jharia.

Question 11.—Jharia would not object to any legislation in this matter. Our rents could not be effected and our royalties are in the hands of sound companies who can look after their own interests, which are also ours.

Question 12.—Sub-clauses (*a*) and (*b*) might be easily settled by approved drafts of leases being supplied to would-be lessors, who would be forced to abide by the spirit of the same. In some instances, it would be quite impossible to abide by the letter. Still I think this power should be exercised very judiciously and sparingly. There can be no objection to sub-clause (*c*).

Question 13.—The question of economy never entered into the idea of acquiring *mouzas*. In Jharia, tenure-holders claimed the underground rights, and lessees first obtained these from them, and afterwards compromised and had their titles acknowledged and accepted by the zamindars. The primary question was what *mouzas* you could lease from the tenure-holders and the question of the compromise with the zamindar was quite an afterthought. The rights of the zamindars and tenure-holders have now been practically settled, and there need be no difficulty regarding this matter in Hazaribagh.

Question 14.—I cannot see how the question affects the zamindar to any appreciable extent. I would be quite prepared to accept the deductions arrived at from the studied opinions of colliery proprietors and managers.

Question 15.—The two biggest sources of loss in the field are and will be (*a*) the coal lost owing to barriers to support the railway lines, and (*b*) the loss accruing from an insufficient and irregular wagon supply. Both questions are under enquiry by the Committee and I would not like to record anything on the subject in these answers.

Question 16.—The question of sand-stowing is a purely technical one. The owner of the sand would undoubtedly be open to reason, but it is hardly reasonable to think he is going to dispose of his rights in a philanthropic spirit and give the sand away. The estate would probably have far more consideration for the royalty-payer than the for the lessee who holds his land on rent, and there is no reason why we should not come to an understanding in the matter.

Oral Evidence.

Question 2.—We have no power to compel lessees to adopt any particular approved method of working such as sand-stowing. All our big leases had been given out by 1896 long before the Indian Mines Act came into force. There is therefore no clause in our leases requiring lessees to follow the rules and orders of the Chief Inspector and Inspectors under the Mines Act. Where such clauses do exist in the leases of other landlords, there is no penalty clause by which they can be enforced and they are therefore practically useless. When our leases were first given out, it was doubtful whether the proprietorship of the minerals vested in the zamindar. Some of the large companies on our estate are only paying rentals of two to five rupees a bigha for underground rights; they pay no royalties at all. This was settled by compromise between us and the lessees before the Privy Council ruling that mineral rights belong to the zamindar. Some of our coal lands have been leased on tonnage royalty, but these are all comparatively recent leases. Our royalty is generally 4 annas all round, but we have charged 6 annas and 8 annas where competition has been keen. Sometimes the rate is only 2 annas on the other hand. There is a separate rental for surface rights. Unless there is a provision in the lease that the surface must be kept intact, but the law is, I believe, that the letting of the coal confers liberty to drop the surface as a necessary consequence. We have so far charged Rs. 10 a bigha for getting pillars where the leases provide for this point. Such leases are very few. We have never prevented anybody

cutting pillars. We would always discover if anybody was cutting pillars against the terms of his lease.

Question 6.—I would always prefer to lease in small plots than in large ones. This insures larger outturns as the bigger lessors do not develop all at once. We are not responsible for the conditions in the Kirkend *mouza*, nor for those in the Tisra section. All this letting out in small strips was done by middlemen and not by us. It was done in order to get as much as possible in the smallest time. I would certainly not let out land in this way. There is a minimum limit of size of plot according to the depth of the coal to be worked. There should also be a maximum limit according to the financial resources of the lessee. Indian lessees seem to be able to work second class coal much more profitably than European lessees. I do not know that the Tisra leasing will result in large losses of coal. Our leases do not provide for ribs or barriers between properties. We leave the lessees to fight such matters out and they are usually settled on the give and take principle. Loss of coal may possibly result from this system. I would not, however, be prepared to agree to the expropriation of such small mines, but I would agree to compulsory combination into groups which could be worked economically. This would be to the advantage of the landlords.

Question 7.—We would have suffered by this if we had been on a royalty basis.

Question 8.—I think there is a minimum limit, but I do not want Government interference to fix this. I cannot give any reason for this opinion other than that it would be impossible to fix any minimum area to suit all circumstances.

Question 9.—It would not hurt the zamindar if the power under the Land Acquisition Mines Act to fix the size of pillars under railways, were extended to the whole of the collieries. I think there should be expert advice, but the zamindars will not pay for this themselves. I think there should be a controlling authority, but I foresee many practical difficulties. If this authority is well paid, I see no objection, from the zamindar's point of view, except that his *izzat* would suffer. I do not agree to the nationalization of mines in Bengal and Bihar. It is not within practical politics in any case. Much of the coal lands have been leased out at rates which do not represent present market values. Very high prices are paid nowadays for coal properties.

Question 11.—Such clauses would, I think, also have to provide for a power of re-entry if the terms were not carried out. We have no objection to such clauses from the landlord's standpoint.

Question 12.—I think there should be some sort of standard lease to which lessors and lessees would have to conform in their lease leaving details of rates, etc., to be settled between themselves.

Question 13.—Rectangular boundary lines would not necessarily be the basis in many cases where there are faults and dykes. As a landlord, I object to any equalization of boundaries by the intervention or mediation of the controlling authority. This is a matter which should be settled for themselves between the interested parties. If the zamindar comes into the matter, *salami* should be paid.

Question 15.—The barriers to support railway lines could safely be reduced by railway companies and Government should insist on this. So far as I know, many of the barriers will be lost entirely.

Question 16.—This is a matter of supply and demand, and there may be companies formed with large capital to supply sand who may be prepared to pay for that sand. I have in fact been approached with such a proposition. As regards facilities for the laying down of light railways or ropeways to convey sand, it is difficult to say off-hand whether royalty owners would afford such facilities. There are so many interests concerned, for there is much land in which the zamindar and several tenure-holders are equally interested. Such facilities have, however, been provided on *khas* land on payment of a way-leave of 1 anna a ton. I cannot on any account agree to the principle of a rebate of royalty on coal won by sand-stowing. I can see that this coal would not be won otherwise. The question would only affect royalty-payers. It might also affect rent-payers if the life of the coal were prolonged. It might of course be considered whether sand could not be given free for collieries on the zamindar's estate. If the Maharaja of Burdwan is prepared to allow this, it might influence my zamindar. The sand supply might be arranged on a co-operative basis, but I would not have a State supply in any case.

Written Evidence of Mr. H. Guha, representing the Maharaja of Kasimbazar.

Question 1.—I have the honour of representing the Hon'ble Maharaja Sir Manindra Chandra Nandy, K.C.I.E., of Kasimbazar. A vast area of his zamindari in the Asansol Subdivision is comprised in the Raniganj coalfield. The area of coal land already leased out and recently prospected is about 55,000 bighas. Some of the mauzas have not yet been prospected.

I have been serving for ten years as the officer in charge of the Hon'ble the Maharaja's English office, which includes the coal department for transaction of all matters in connection with his coal lands and khas collieries.

Question 2.—No permanent leases are granted. Leases are given for a period for mining operations under the bord and pillar system. The lessee is entitled to such coal only as is obtained by driving galleries. He is under the terms of the lease, bound to keep pillars of specified dimensions, for support of the roof. Fresh settlement is to be taken for extraction of pillars. There is a stereotyped form of lease in vogue in this estate since the first opening of

collieries in Chotiballiapur nearly half a century ago. Occasionally, some clauses are slightly altered in special cases, but such alterations do not affect the tenor of the stereotyped lease. Recently the Hon'ble the Maharaja has granted concession of instroke and outstroke in connection with lands where mining operations will have to be carried on at a great depth.

Our lease reserves the power of supervision over the method of working as embodied in the lease and to be followed by the lessees in extracting coal. This power has been exercised. In many cases, steps were taken for infringement of terms of the lease, but I cannot vouch for the fact that supervision has been carried on efficiently.

Question 3.—There is no fixed period for the leases granted. Generally, the period is determined according to the quantity of land settled. Renewal is granted on the same terms and on the same principle. For infringement of terms, lessees are liable to pay penalties and, in some case to be ejected from the land. As stated above, our lease specifies the bord and pillar method of working. If any lessee applies for permission for work being carried on according to methods other than the one referred to above, permission is granted or the prayer rejected according to the reasonableness of the prayer made.

Question 4.—In this estate, the European coal companies managed by managing agents have each of them taken settlement of a considerable area of land. None of them, it appears, has sub-let his rights to any other party. The Indian individual lessees work on their own behalf. Formerly there were 2 or 3 lessees who sub-let their lands.

Question 5.—As regards the economical working of the property as a whole, as explained by Mr. Rees in paragraphs 15 and 16 of his report, the matter has never been considered at the time of settlement, because neither the applicants for lands have ever raised the question nor has the attention of the proprietor been drawn thereto. There are, however, instances of bad working in the outcrop area and of encroachment as described in paragraph 16 of the report.

Question 6.—No. I do not agree that very large areas of coal lands have been leased in our estate, not so much for the purpose of extracting the greatest amount of coal, as for the purpose of obtaining a large amount of *salami*. In fact the proprietor does not offer his lands for settlement, but parties apply to him either for a whole mauza or for a portion thereof. There are also lessees who have taken leases of comparatively very small areas.

Question 7.—I can quote specific instances of coal having been won with a view to speedy profit with the result that damage has been done to other unworked coal.

Question 8.—I am not in a position to offer any opinion on the suggestion as the restriction suggested involves manifold questions, some of which are beyond my experience, while others are such as I am not competent to deal with.

Question 9.—There can be no objection to expert advice being available on the most advantageous methods of working. For the purpose of ensuring efficient economical working according to accepted advantageous methods under expert instructions, it is essential that such instructions should be binding upon the proprietors of collieries and lands respectively. But I should not venture to express any opinion unless a clear explanation is given as to the assumption about "ultimate benefit."

Question 10.—Yes, I admit.

Question 11.—If such a course is decided upon, of course in consultation with the proprietors of coal lands and colliery owners, the controlling authority will of necessity have to inspect the old collieries leased or sold before the legislation and issue instructions for better work according to the nature of defects noticed. It is supposed no fixed and uniform instructions can in all cases be useful, inasmuch as defects noticed in different collieries cannot but be of varied character. Consequently, the controlling authority will have to exercise functions similar to those exercised by Inspectors of Mines, although his duties will be shaped according to the legislation as suggested.

Question 12(a).—There will be objection to supervision of negotiations for leases by the controlling authority. General rules guiding the preparation of leases are sufficient for the purpose of ensuring proper settlement as may be contemplated by the legislation.

(*b*) As a lease will be rendered invalid under the proposed legislation if a particular covenant or covenants are not included therein, it is not necessary for the controlling authority to personally become convinced of the fact that covenants, as sanctioned by legislation for economical working, are embodied in the document.

(*c*) In my opinion there cannot be any objection.

Question 13.—I am not in a position to express any opinion on this question without details of economical working being furnished.

Question 14.—Yes, I quite appreciate Mr. Rees' recommendation.

Question 15.—I am not in a position to make any off-hand suggestions from the landlord's standpoint unless detailed expert opinion is obtained on economical working. But I have some doubt as to what advantage may possibly be derived from the advantageous methods suggested for "economical working," in view of the fact that there are factors in coal business which will invariably interfere with the systemetical working, and thus minimise in great measure the expected good result. I mean the supply of labour and supply of wagon are two important factors. The benefit of expert instruction will not be fully realized owing to adequate number of efficient labourers not being available at a time when they may be urgently required. So there is no certainty as to mining operations being carried on methodically and

uniformly. If adequate labour be available, and quantity of raising is satisfactory, wagon scarcity is likely to cause loss to mine-owners. Coal exposed to sun and rain for a long time will surely deteriorate and a portion thereof will be reduced to dust, etc. Of course one purpose at least will surely be served if operations are carried on under expert advice. There will no longer be any possibility of any such defect as noticed by Mr. Rees and pointed out in paragraphs 15 and 16 of his report.

Question 16.—The practice of sand-stowing in mines will no doubt be conducive to the protection of surface and the recovery of larger portions of coal seams. But this will increase the cost of raising heavily. Of course colliery proprietors are the best judges with regard to the adoption of this process.

I am not in a position to express any personal opinion on the last part of the question inasmuch as the same involves several points and entirely depends upon the proprietor's decision, but this much I can assert that there should be reasonable and legitimate co-operation between lessors and lessees for mutual benefit.

Oral Evidence of Mr. M. N. Roy, Superintendent of the Maharaja of Kasimbazar's Collieries, in connection with Mr. Guha's written evidence.

Question 1.—The figure of 55,000 bighas excludes our *khas* collieries.

Question 2.—The period varies from 25 to 99 years with an option of renewal on the same or revised terms. We claim *salami* on such renewals.

Question 3.—We have an inspecting staff to see that pillars are kept to the sizes specified in the leases. The head surveyor gets Rs. 100 a month and travelling allowance. We rely on these surveyors' reports. The original idea was that the pillars should remain permanently at the sizes fixed in the leases. These sizes were considered sufficient to support the surface, and the pillars were not intended to be extracted. There have, however, since been many cases where the Maharaja has agreed, for a consideration, to such pillars being extracted. I agree that the size of the pillars should be increased if the pillars are to be won.

We take a *salami* on the original lease and another for getting pillars. We also usually charge *salamis* on transfers from one company to another.

No lessee has ever been ejected for not working properly. The Maharaja himself decides whether the usual bord and pillar method should be modified. He relies on the reports of the surveyors. I have now been appointed to inspect our mines, but have only so far inspected *khas* collieries and those run by European companies.

Question 6.—I have no objection to a clause in leases providing that the lessee should follow Government rules under the Mines or any other Act to ensure both the safety of miners and economical methods of working. This would perhaps be to the advantage of the landlord, but it would interfere with his private rights. I think, however, that Government should so interfere in order to conserve the coal resources of the nation.

Question 9.—My landlord would, I think, agree to expert instruction as to the size of the pillars and as to the time of getting pillars. If Government legislates on this point, the Maharaja must agree like any other landlord. He might object if his monetary interests were prejudiced.

Question 13.—I would prefer leasing both by mauzas and by rectangular blocks. I think equalization of boundaries should be arranged, where possible, in the interests of coal conservation.

Question 16.—Half the bed of the Barakar River belongs to Kasimbazar and half to Pachete I think the Maharaja would agree to supply sand to all collieries at the nominal royalty suggested by Mr. Rees. He would not give sand free even to his *khas* collieries.

Written Evidence sent in by the Honorary Secretary, Indian Mining Federation.

Questions 1, 2 and 3.—The members of the Indian Mining Federation are not landlords in the sense of owning any coal-bearing estate; but they possess coal-bearing lands under landlords and lessors and, in some cases, they have sub-let the whole or a part of their holdings.

The periods of lease are generally 999 years and, in some instances a residue thereof, except in the cases of lands under the Kasimbazar Estate where the period of lease varies from 20 to 40 years; the lease is however renewed on payment of a fresh *salami*.

Question 4.—It is not possible to formulate a definite reply to this question within the short space of time allowed.

Questions 5, 6 and 7.—It is a fact that large areas of coal lands have been leased in consideration of the ready money obtained as *salami* without including any terms in the contract ensuring economic working of the mines in such a way as to extract the utmost possible coal from them, and as a matter of fact some collieries were and are being worked with a view to win coal for speedy profit, though such work is occasioning damage to the unworked coal.

Question 8.—It would no doubt be to the common interest of the landlords, as well as of collieries, if the area a colliery possesses be such as to admit of economical working; but no general limit can possibly be defined, as the minimum limit will depend upon the number of seams which the coal land might contain and the depth of such seams; the deeper the seam, the larger would be the area necessary. The existing collieries must not be disturbed in consideration of the large vested interests involved, even if some be found which cannot be worked economically.

Question 9.—There can be no objection to expert advice being available on the most advantageous methods of working, but such advice must not be in the form of orders from a controlling authority, as in that event the private rights of the landlord will be seriously interfered with and many other complications will arise.

Question 10.—No, if clauses for working coal to the best advantage be inserted in new leases, it would gradually, though indirectly, affect the whole coalfield.

Question 11.—In most of the existing leases, there are terms to the effect that the colliery should be worked in a skilful and scientific manner prevailing for the time being. Violation of such terms makes the colliery liable for damages, but those terms are not in most cases rigidly enforced. The controlling authority may advise as to and look after the proper working of coal in compliance with such terms. But it should not have the right to enforce new terms, regardless of the terms of the lease, for the working of collieries already leased out or sold.

Question 12.—We strongly object to the controlling authority having power to supervise negotiations for leases and controlling the terms and construction of a contract. Under such an arrangement, the private right of landlords will be very materially interfered with on one hand, and, on the other, it is quite conceivable that not unoften the property will pass into the hands of a different lessor. General terms for economical working of a colliery might be definitely provided for by legislation and be enforceable whether they be inserted in a new lease or not, and the controlling authority might look to the due performance of such terms.

Question 13.—Leasing of coal lands by *manza* boundaries instead of in rectangular blocks affects the cause of economical mining, but it cannot be helped, and it cannot be reasonably proposed to Government so seriously to interfere with the rights of private property as to intervene in the interest of economical working of collieries and disturb the *manza* boundaries.

No Oral Evidence Offered.

Written Evidence of Mr. A. M. Walter, Manager, Ramgarh Wards' Estate, Hazaribagh.

Question 1.—(*a*) Kumar Kamakshya Narain Singh, minor, Proprietor of the Ramgarh Court of Wards' Estate, Hazaribagh.

(*b*) About 700 square miles.

(*c*) Two years and six months as manager.

Question 2.—(*a*) Leases for specified periods are given subject to the payment of varying rates of royalty on different kinds of coal and coke.

(*b*) The leases provide that the mines should be "worked in as skilful and workmanlike manner as possible so as to obtain the largest possible quantity of best steam coal, and so as to comply with the rules and regulations from time to time promulgated by the Government in that behalf, and with as little damage as possible to the surface of any portion of the said land under cultivation and to the buildings and erections thereon, and shall indemnify the lessor against all damage he may suffer by reason of any negligent working of the mines demised."

(*c*) No such contingency has taken place as yet as the area is still under development.

(*d*) No particular method except the above-noted condition has been specified.

Question 3.—999 years with no renewal option. Leases for small areas have also been granted for 30 years with option of renewal for a further period on the same terms.

Question 4.—67 per cent. of the area leased is worked by sub-lessees and 33 per cent. by original lessees.

Question 5.—(*a*) So far as my knowledge goes, the areas leased out for mining purposes have been arranged so as to conduce to the economical working of the property.

(*b*) The field has not been sufficiently developed yet.

Question 6.—It is true that the immediate object, at the time the prospecting licenses were given, was a ready-money consideration; fortunately the leases were on a royalty basis, so the interests of the estate are safeguarded.

Question 7.—There has been no such instance in the estate, but, as I have said, our experience is very short.

Question 8.—(*a*) I would advise that a limit should ordinarily be placed on the minimum area to be leased out, though exceptions may arise.

(*b*) The minimum to be 100 bighas.

Question 9.—(*a*) No, I would not object to expert advice being available.

(*b*) If I assume that the result would be ultimately beneficial, I can have no possible objection if the advice took the form of expert instructions from a controlling authority.

Question 10.—Yes. As the greater portion of the coal-bearing area is already under prospecting licenses, the insertion of new clauses in future leases would not materially affect the area as a whole. In the event of the prospecting licenses being surrendered, new clauses for working coal could be added in the deed of lease.

Question 11.—I would suggest that such a controlling authority as is contemplated should be appointed.

Question 12.—I would consider it as a necessary corollary to the appointment of a controlling authority that such controlling authority should be empowered (*a*) to supervise negotiations for leases, (*b*) to see that they include covenants for economical working, and (*c*) to inspect such working to ensure and, if necessary, to enforce due performance of such terms.

Question 13.—I would suggest that the mauza boundaries be observed. This estate is the sole proprietor of all mineral rights within its own area, but our experience has not been sufficient for me to answer this question fully.

Question 14.—No, the weighing of coal at the colliery would require the attendance of a representative on behalf of the lessor at each colliery. The railway despatches may be accepted as they seem to be the only sure safeguard.

Question 15.—The modernization of the mining of coal would be the best insurance towards economical working with a *sufficient supply of wagons.*

Question 16.—In view of my answer to Questions 11 and 12, I would have no objection to allowing sand being taken free of charge.

Not called for Oral Examination.

ELECTRICAL WITNESSES.

Written Evidence of Mr. H. Burkinshaw, Consulting Engineer to Messrs. Bird & Co.

Question 1.—I am a trained engineer and a member of the Institute of Electrical Engineers. I have been in India since 1910 and during that period have been connected with schemes for the use of electrical power in industrial undertakings and mining; during the War, I held the post of Controller, Electrical and Mechanical Engineering, in the Indian Munitions Board.

Question 2.—The general provisions attached to electrical licenses in India are all framed with the intention of—

(*a*) assuring an efficient supply of electrical power to the public, and

(*b*) protecting the licensee against any unreasonable action by a consumer.

The maximum rate at which a licensee is permitted to charge consumers is specified in the license, but the minimum rate is not specified. In the event of a consumer's demand for power being of an unusual nature, so that the maximum rate which the licensee is entitled to charge in the terms of his license would be unremunerative, then the licensee may require the consumer to agree to pay a minimum sum per annum which will yield a fair return upon the capital expenditure involved. The Local Government has power to modify and add to the general provisions attached to electrical licenses so that it may provide for any special circumstances which may arise. It may call upon a licensee to revise his rates after the first period of seven years and again every fifth year thereafter. I do not know of any case where the Local Government has guaranteed a licensee against failure to make a profit.

Question 3.—The general use of electricity in the Jharia and Raniganj coalfields would be advantageous especially in conserving the coal resources. The installation of central generating stations is urgently needed, but no control over the rates per Board of Trade unit is necessary other than that already provided by the Indian Electricity Act, particularly clause xi of the schedule. The rates of charging should be so proportioned that, after providing for generation costs and amortization, the return on capital would be 8 per cent. per annum. Experience has shown that electrical power can be generated and distributed to consumers in the Jharia coalfield at rates per Board of Trade unit on a sliding scale, varying from one anna as a maximum to ·4 annas as a minimum. The actual rate to any individual consumer would be regulated by the following conditions:—

(*a*) the magnitude of the load,

(*b*) the load factor,

(*c*) the power factor of the load, and

(*d*) the distance of the load from the generating station.

Question 4.—I do not consider that mineowners who are wastefully raising steam for working their mines should be compelled to take electrical power from a central generating station, or even to instal their own generating station; competition with more enlightened coal-owners would compel them to reconsider their position. Further, it is already known that such mines are either small and of no importance, or, if large and of importance, the owners already realise that modern methods must be resorted to. Legislation on this matter would be difficult to frame and onerous in administration.

Question 5.—On data which has been collected during the last ten years, and more particularly during the last two years, I have formed the opinion that one large central station in each of the Raniganj and Jharia coalfields would not prove attractive to capitalists or to power users. It must be remembered that this problem has to be considered on the facts pertaining today and not upon more favourable conditions which might be found in opening up a new coalfield where no capital expenditure on plant had previously been incurred. There is an economic size of power station combined with an area of distribution, and there is no royal road to deciding upon this size; each case must be carefully and comprehensively considered, and all special and local factors taken into account. There are several comparatively small, privately-owned, power stations in the coalfields and these are equipped with modern and efficient machinery. I am inclined to believe that the most efficient procedure would be the cautious extension of these power stations on a co-operative basis to supply power to the mines in their immediate environment. The mine-owners would become the proprietors of the power supply and would run it for their mutual benefit.

Questions 6 and 7.—By-product coke ovens should be installed in conjunction with generating stations wherever possible, but schemes of this nature must be approached with extreme caution or there will be danger of over-production with its attendant evils. At least one such scheme is already working and others are in course of erection. It may be of interest to note that a battery of 40 modern regenerative type coke ovens, capable of dealing with 300 tons of coal per diem and equipped with by-product recovery apparatus, yields surplus gas which when burnt under boilers is equivalent to one ton of coal per hour. Burners for the gas have been successfully manufactured, and furnaces designed to combine gas burners and mechanical stokers for coal burning. This combination is most desirable, as full use can be made of all surplus gas and, at the same time, the steam raising is independent of complete or partial cessation of the gas supply. From a strictly thermo-dynamic point of view, it would be more efficient to use the surplus gas in gas engines than to burn it under a boiler for raising steam. It is, however, more important that continuity of service be assured than that the last fraction of thermal efficiency be secured. The capital expenditure on comparatively slow-speed large gas engines and alternators would be the same, if not greater, than a steam plant comprising water tube boilers and steam turbo-alternators including all the auxiliaries and chimney.

Question 8.—The problem of electrifying the sidings and marshalling yards in the coalfields is one which cannot be discussed in general terms. The actual energy consumed would be comparatively small, but the capital expenditure involved would be very great. There would be no difficult engineering problems to solve, but the enormous capital expenditure might prove difficult to justify.

Oral Evidence.

Question 2.—The present Electricity Act and Rules are suitable for the conditions in the coalfields on condition that the Local Government uses its discretionary power sympathetically. Those private companies sanctioned under Section 28 would have to get further sanction to supply power to any collieries not specifically named in the original sanction. I cannot define the words "engaging in the business" in Section 28, but a private company generating power for use on its own properties would *not* be held to be "engaging in the business." If such a company wishes to supply its surplus power to its neighbours, it should not be held to be engaging in the business, and I believe a decision to this effect has been made in England. I do not think that a private company working on a co-operative basis (that is to say, each power user would be a part owner of the generating station and mains) would be held to be "engaging in the business" under Section 28, but no Local Government has yet given a decision on this point. The Government of Bengal have the question under consideration and their reply is expected very shortly. Even though the Local Government decides that such a co-operative company is "engaging in the business," it does not mean that the company could not proceed with its work as there is no reason to believe that the Local Government would withhold sanction.

A public supply company with a full license has no monopoly as Section 3 (2) (*e*) protects the public from this. The Local Government would, however, doubtless make very careful enquiries before granting a second license for the same area. I do not think the Local Government would force consumers to go to a public supply company when they could make better terms with a private company, or become members of a co-operative company; such action would be unreasonable and obstructive. A private company may not, except by arrangement with the owners, take its mains across private property; it cannot cross a public road except by special permission from the local authorities. It may not wish to assume all the obligations of a public licensee, in order to obtain powers to enforce way-leaves, but a Local Government has powers under the present Act to help such a company, and there is every reason to believe that it would do so. I do not

think that the Act requires amendment on this point, it is only necessary that it be sympathetically administered and that there should be no avoidable delay in giving decisions.

Question 3.—Clause xi of the schedule protects the public against profiteering and the supply company against loss. It is usual for licensees to arrange their rates on a sliding scale. I agree that the sliding scale system of charging is a good one. A co-operative company should be able to sell at an all-round rate of ·5 anna per Board of Trade unit. My opinion is based on data which I have collected over many years in India. I know of no cases in any country where a dividend has been guaranteed by Government. I have never looked for such cases as a matter of fact and I do not think that Government should be called upon to give any such guarantee for the Indian coalfields. It would not in fact be fair to the tax-payer; the coal itself should pay for its own "getting" and this includes the cost of the electric power used on the mines. In my opinion, the supply and sale of current should be left to private enterprise under the existing regulations of the Electricity Act.

Question 4.—I think the colliery owner working with vertical boilers and steam power is bound to disappear shortly by the operation of economic laws. The amount of fuel so wasted will gradually become negligible automatically.

Question 5.—There is an economic limit to the size of a power station taken in conjunction with the area of supply and nature of the load in the Jharia coalfield. It would now be uneconomical financially to supply the Jharia coalfield from one large generating station. I have worked for years on this problem, and I have failed to arrive at figures to show that a public company under existing conditions could supply power from one large generating station, with its resultant expensive network of mains, at as low a rate as a few well-placed stations with a local concentrated load. It must be remembered that these smaller power stations are already in existence and others are in the course of construction; their capital is spent and cannot be recovered and their existence therefore cannot be ignored when considering the problem. Further, the most lucrative type of load is already supplied by them. I think ·75 anna per Board of Trade unit is too high a rate. In one case I found that the difference between ·5 anna at which a private company is generating (including all capital and amortization charges) and ·75 anna which was the minimum rate of a public supply company's sliding scale, would mean an increase of Rs. 2·65 lakhs a year in the cost of power.

Questions 6 and 7.—Two additional modern regenerative coke oven plants with by-product recovery processes are now being erected in Jharia alone, and the more of them there are at work, the less chance there will be for a public company to come in usefully. It is one thing to put up efficient coke ovens, but quite another matter to find a market for the coke.

Written Evidence of Mr. J. W. Meares, M.Inst.C.E., M.I.E.E., M.Am.I.E.E., Electrical Adviser, Government of India, and Hydro-Electric Survey.

Question 1.—Works training; diploma at University College, London; and 30 years' experience, of which 24 has been in India; first on construction of hydro-electric works, then as Electrical Engineer to the Bengal Government, now as Electrical Adviser to the Government of India and lately Chief Engineer, Hydro-Electric Surveys. Member of the Institutions of Civil Engineers and of Electrical Engineers, both of England and America.

Question 2.—The general provisions of electrical licenses are laid down by rules under the Indian Electricity Act, 1910, and in a model form of license attached to those rules. Every license contains a clause as to the *maximum* rate or rates (there are often several) which a licensee may charge; but he seldom finds that it pays to charge that maximum. There is no provision as to the profits to be made by the licensee; nor is there usually any guarantee by Government against a licensee's failure to make any profit. In several cases, however, an initial guarantee has been obtained from Government by the licensee to purchase so many units at a certain price (generally lower than that paid by the public and therefore wrong in principle) and this has practically ensured the success of the undertaking.

Question 3.—(*a*) I agree whole-heartedly with Mr. Treharne Rees in his general advocacy of the further use of electricity in the coalfields and have long advocated it. If the company formed to try and exploit this for use both there and in Calcutta (*viz.*, the Hooghly River Power Company, long defunct) had thought in large units and gone ahead, there is no doubt that success would have resulted and that power even in Calcutta would have been cheaper than it is, for the whole of the mills on the Hoogly would unquestionably (whatever they may think now) have been compelled by competition to come in.

(*b*) The control of maximum profits is excellent in theory, but in practice it can only be obtained when coupled with a guarantee of a minimum return also *i.e.*, a sliding scale of prices and dividends, coupled with a guarantee like that given to many railways in India. This sliding scale has been recommended by the electric supply companies themselves through their "Electric Supply and Traction Federation." Their representatives urged it on the conference of Government Electrical Engineers and Inspectors and, at my suggestion, the proposal was sent round for opinion by the Government of India to all Local Governments. Most of them, however, appeared to take little interest in the subject. In my "Preliminary Report on the Water Power Resources of India", I again recommended the combination of a Government guarantee and a sliding scale; but, so far as I am aware, no action whatever has so far been taken nor any expression

of opinion been given by higher authority on this important aspect of the research. Meantime, owing to the vast time required for consideration of matters of this sort, concessions are no doubt being given for water power that will be regretted hereafter.

(*c*) A "proper rate of interest" to be taken as a "standard dividend" in a sliding scale in India would in my opinion be 10 per cent., though possibly 8 per cent. might attract capital in some cases. In most industries in India debentures give 5½ to 6 per cent. and preference shares 7 to 8 per cent. Dividends of course presuppose that proper provision has been made for depreciation and reserve funds, though frequently dividends are in fact paid when this provision is inadequate. This may be good for raising extra capital, but is unsound.

(*d*) It is quite impossible to say "what rate per unit would probably have to be charged to mine-owners." This depends on many factors, *viz*:—

(*i*) Capital cost of the plant installation,
(*ii*) „ „ „ the transmission (if any),
(*iii*) load factor of the individual mine owner,
(*iv*) „ „ „ the whole undertaking,
(*v*) cost or value of the fuel used,
(*vi*) „ „ „ „ condensing water, lubricating oil and other items of generating station,
(*vii*) cost of rates, rents, taxes on the undertaking,
(*viii*) cost of establishment and supervision,
(*ix*) profit aimed at or allowed.

The actual cost charged would invariably be a matter of supply and demand. If the promoter asked too much, the mine-owner would obviously either put his own plant down or go without electricity. The promoter, on the other hand, would not obtain capital for the venture unless he could show a fairly certain return on the rates he proposed to charge; and he would know that (as always), as he was able to reduce those rates, the demand would increase. To show the impossibility of giving definite figures, the generating costs in the "List of Electrical Undertakings in India" should be consulted. They vary from several annas down to a small fraction of an anna with water power. If an undertaking could not supply power to mine-owners at 0·75 anna per unit or less, it would be unlikely to make any headway; if big enough to supply at 0·5 anna per unit or less, it would probably seriously compete with privately-owned stations. But in all such cases, the proper way to sell power is to charge a fixed price per annum per horse power or kilowatt of maximum demand (based on bed-rock price) *plus* a very small charge per unit. This is better for both buyer and seller; the former, by improving his load factor, can lower the price paid per unit greatly, while the latter is sure of a return whatever happens.

Question 4.—I regard Mr. Rees' suggestion to compel certain mine-owners to buy electricity from central stations as impossible of realization. It would not be business and still less would it be politics. They would buy if it paid them to do so and not otherwise. The waste of fuel is no doubt lamentable, but business men must to some extent be allowed to be judges of their own business. The compulsion would have to come from Government, and Government officers for the most part know nothing whatever about business. When Government learns to write off depreciation on its own old and often obsolete machinery; to make loans comparable with the life of the plant bought with those loans; and to realize that total production costs include capital charges; then, and not before, should it control commercial undertakings.

Question 5.—A single generating station could supply the Raniganj coalfield and another the Jharia one; but it would not be wise. I think the multiplication of small power stations to be a grave error, and have so advised more than once, but at least a couple of interlinked stations in each area is desirable. To ensure this, it is essential that the British standard frequency of 50 cycles should be adopted in all cases of alternating current stations, and the coalfields are not likely to use continuous current in future. I would make this compulsory, if I could, for all alternating electric supply in India. There is a very distinct gain in "works costs" in large stations up to a limit of about 100,000 or even 150,000 kilowatts; but this may easily be offset by transmission costs. It must also be remembered that, as long as there is practically valueless coal lying at the pit's mouth (*i.e.*, unless it can be made to pay to use it on the spot or elsewhere for coking and by-products or otherwise), the owner can probably produce power cheaper than a dividend-earning company can afford to sell it after transmission. This may waste the already waste coal; but if it pays, it will be done.

Question 6.—I am not sufficiently acquainted with the business side of the by-product industry to say whether generating stations should be worked in combination with recovery plants; all the evidence I have seen in English technical papers seems in favour of it. I should imagine that (*a*) the freight costs on the coal so brought, (*b*) the demand for the coke so made, and (*c*) the market for the by-products, would determine the question. And by-products again may mean anything from simply tar and sulphate of ammonia to their thousand-and-one derivatives in the chemical industry, each of which requires large works and large capital expenditure, and brings the producer up against other producers in the world's markets. If done at all, this business could hardly be undertaken otherwise than by limited companies with unlimited experience of the business in hand.

Question 7.—I can express no opinion upon the regenerative or low temperature carbonisation processes, as I have no first-hand knowledge of them. But I am quite clear that in India it will

pay better to use gases for steam raising and use with turbo-generators rather than in gas engines, as the latter are much more limited in size and troublesome in every way.

Question 8.—The suggestion to electrify the sidings and railway branches in the coalfields is of course practicable; but I very much doubt if it would pay, and this is the only touchstone. Railway electrification has enormous advantages in accelerating suburban or inter-urban traffic, where there is a fairly constant stream both ways. It will largely increase the use that can be got out of the capital laid down in track by improving its load factor, to use an electrical simile. Similarly, for mountain railways it is eminently suitable. For the work suggested by Mr. Rees, I hardly think the small saving of fuel would justify the capital expenditure involved or give a reasonable return on it. In any case, seeing that the electrification of the suburban lines of Calcutta and Bombay has been under discussion for years, as has also the electrification of the Simla and Nilgiri railways (where there is water power available), I think it exceedingly unlikely that anything will be done in the direction indicated during this generation's lifetime.

Oral Evidence.

Questions 2 and 3.—The reason that I stated in my written evidence that a Government guarantee to purchase so many units at a lower rate than that paid by the other consumers is not sound in principle is because it means that these other consumers in the same area have to pay a higher rate than they would otherwise have to.

In my opinion there is nothing in Mr. Rees' report which calls for any amendments in the Indian Electricity Act or the Rules under that Act. It is true that the Act has for the most part been used for urban undertakings, but it is equally applicable to power schemes in larger areas giving bulk supply. The Tata Hydro-Electric Power Supply Company works under a license under this Act without difficulty. The criticisms as to the Act are really aimed at its administration in the Provinces, which is often unsatisfactory.

There is a Section (Section 28) in Part III of the Act under which a non-licensee may be allowed, with Government sanction, to supply other neighbouring consumers without becoming a licensed public supply company. This clause was specifically drafted to meet cases such as those under discussion. Thus the Sijua Jharia Company is working under this section and not under license, but its powers have been definitely limited to some six collieries. A company generating power for its own use comes under Section 30 of the Act and does not need a license or a sanction under Section 28. I think that such a company could legally supply power to adjoining collieries without Government sanction because the supply of power is not their primary business; it has been laid down by the courts in England that "engaging in the business of supplying energy" means that this is the main object of the company and that, where such supply is merely subsidiary, the words are not to be read so. This is, however, a matter for the courts to decide and, in any case, sanction could always be obtained under Section 28, where the decision rests with the Local Government under sub-section (2). If there were a public road or any property in between the supplier and the supplied, sanction would be necessary if there were any objection raised to crossing the road or the property. Sanction under Section 28 would be subject to the consent of the local authority, such as a District Board, or of any licensee already generating power in the same area; [Section 28 (1), 2nd proviso.] I think an offer by one company to supply another at a lower price than the licensee would be sufficient ground for a Local Government to exercise its powers under Section 28 and give sanction in spite of a licensee's objection. Messrs. Bird and Company's so-called license at Sijua is actually a sanction under Section 28. If a public licensee came in after a private company had begun supplying its neighbour, it could not interfere with the latter company, except perhaps by an injunction from the courts, and I see no grounds of law or equity on which they would be likely to get such an injunction. A private colliery, using its own waste coal, could probably always supply itself more cheaply than a public company would sell to it; if it had modern plant, the private company could certainly supply itself more cheaply. The public company would be saddled with transmission and distribution costs as well as the necessity of making a profit.

The sliding scale is practically worked in the case of gas supply companies in England and has often been recommended in India. Under this scale, the rates charged vary with the dividends paid, the rates rising or falling automatically as the dividends fall or rise. A standard rate of charge and a standard rate of dividend are fixed; and, in order to pay a higher dividend than the standard one, a lower charge must be made according to a predetermined scale. If the maximum rate of dividend is to be fixed, then the minimum dividend will, I think, have to be guaranteed, if capital is to be raised. This sliding scale system should, I think, be recommended very strongly for industrial purposes. In ordinary circumstances, a dividend of 10 per cent. is quite high enough for any public electric supply company, and the consumers should get the benefit (or most of the benefit) of any profits beyond that limit. With a Government guarantee, 7 per cent. should be enough; with a sliding scale, some rate between 7 and 10 per cent. would be all right as the "standard" rate.

I do not think that Government should do anything directly in the matter of supply in the case of the coalfields. I think it quite possible that the coalfields could be supplied with hydro-electric power from the Hundrugagh Falls at less than half an anna per unit, and possibly at less than a quarter anna, but the investigation is still at an early stage.

The "proper way to sell power"; which I refer to at the end of my answer to Question 3 is one used by several companies in India in supplying power for industrial purposes; the Calcutta, Bombay and Madras companies all have an industrial tariff of so much per kilowatt per annum plus a small unit charge. It might not work well in the collieries on account of the very high demand for pumping purposes during the rains only. The annual rate might be averaged out, but the greatly varying load would militate against any such arrangement. I cannot say definitely whether, from the point of view of the colliery proprietor, this varying load would militate against the success of a public supply company with a guaranteed dividend on a sliding scale. From the Government point of view, it would be difficult for Government to guarantee a dividend under the circumstances, and I think it would be better to leave the whole thing to private enterprise. There would be more saving in the long run if it were left entirely to the ordinary law of supply and demand, as administered by business men.

Question 5.—My point is that it would be uneconomical for every colliery to have its own power station. I think large concerns on a co-operative basis would be better. At the same time, I agree that the Jharia field cannot wisely be served by a single generating station. I do not believe in having all your eggs in one basket when there is no necessity for it. Any monopoly of supply would also be highly undesirable.

Question 8.—The electrification of railways cannot be considered practicable unless there is a large traffic both ways at all times. The capital expenditure on the equipment would not be justified in the coalfields.

Written Evidence of Mr. E. J. Oakley of Messrs. Kilburn & Co.

Question 1.—I have no technical qualifications as an electrical engineer, but in the course of my business I have been in close contact with electrical enterprise in India during the past 25 years.

My firm, during this period, have been responsible for the starting of the following undertakings in India *inter alia*:—

The Darjeeling Hydro-Electric Scheme.

The Calcutta Electric Supply Corporation, Limited.

The Indian Electric Supply and Traction Company, Limited.

The Barrackpore Electric Supply Company, Limited.

The commercial and management branches of all these undertakings have, at one time or another, been in my charge.

I was a member of the Committee appointed to revise the Indian Electricity Act under the Chairmanship of the late Sir Herbert Carnduff.

I am an Associate Member of the Institute of Civil Engineers.

Question 2.—The general provisions attached to electrical licenses in India may be very broadly given as follows:—

(*a*) The names of the licensees, the object aimed at, and the purpose for which the license is sought.

(*b*) The area covered by the license, in which powers to generate and supply electric current are sought.

(*c*) The pressure and system of distribution proposed.

(*d*) The maximum prices to be charged and the method of charge.

(*e*) The duration of the license and the terms on which the undertaking may thereafter be purchased by Government or any local authority concerned.

As regards (*d*), only the maxima are fixed and no attempt is made in the terms of the license to limit or in any way control the profits made by the licensees, but at the same time I understand that it is possible for the Government, during the duration of the license, to revise the maxima at certain periods. There is, on the other hand, no guarantee on the part of Government against a licensee's failure to make any profit. In other words, the licensee takes all commercial risk. In the case of failure to supply, the concern may be sold and the plant dismantled.

Question 3.—Mr. Treharne Rees' advocacy of the general use of electricity is sound, and has long been recognised by all interested in the coal trade. The establishment of a general supply scheme has been attempted several times in the past without success, mainly owing to lack of co-operation on the part of coal owners and support on the part of the investing public.

As regards the question of control over the prices to be charged for electric current, I do not consider this desirable or necessary for the following reasons *inter alia*:—

(*a*) If such control is exercised, it will be impossible to raise the capital required for the establishment of power supply companies unless, *per contra*, a direct guarantee is given of a reasonable return on the capital employed, as is done in the case of railways constructed and financed by private enterprise.

(*b*) It is to the licensee's interest to charge as low a rate as possible, otherwise he cannot expect to obtain a sufficiently large consumption of electricity to give a return

on the heavy capital outlay. Owing to the enormous increase in the cost of plant, material and stores in recent years, it would be impossible to fix a rate in the first instance that could be relied upon to give a fair return to the licensee, unless it was so high as unduly to alarm prospective consumers.

I do not consider that anything less than an 8 to 10 per cent. return on any capital employed, other than that in the form of preference shares or debentures, would prove sufficiently attractive to the ordinary investor, unless a definite guarantee from Government were forthcoming. In the latter case of course the investment is on quite another footing.

In the case of industrial concerns in India, the shares are usually valued on an 8 or 10 per cent. basis broadly speaking, that is to say a concern paying an 8 per cent. steady dividend on its ordinary shares is worth "par" rising or falling in value *pro rata* to the dividend paid above or below this figure, and according to the number of years such dividend has been paid with regularity.

Question 4.—I do not see how compulsion can be enforced without a corresponding control over prices to be charged. For the reasons given in my answer to question 3, I am not in favour of such control and consequently am not in favour of compulsion for the prospective consumer. I do not see how it is possible to make the purchase of electricity compulsory from a public supply company without entailing considerable hardship on those companies who have been sufficiently far-seeing to instal their own generating plant. Here again this may be left to the public supply company to make their charges sufficiently attractive to consumers to ensure their ultimately securing the custom even of those who have their own generating plant. Compulsion could only be possible provided Government is prepared to advance the necessary capital at a very low rate of interest.

Question 5.—In my opinion two central supply stations will be necessary, one for the Jharia field and one for the Raniganj field. Two such stations will fully serve the present and future requirements of both fields.

Question 6.—Whilst agreeing with the principle enunciated by Mr. Treharne Rees, I am of opinion that the question of the utilization of waste coke-oven gases either for steam raising purposes, or direct in internal combustion engines for the generation of electrical power, may well be left to the engineers of the supply company itself. If local conditions are suitable, and when a market has been established for the coke-oven by-products, I have little doubt that the system suggested will be adopted. It could certainly be carried out by a limited company or companies without Government or other assistance. It is purely a commercial and engineering question, which may safely be left to those responsible for the electric supply.

Question 7.—See reply to question 6. This is a question for experts when the time arrives.

Question 8.—Personally I am of opinion that, with the provision of a cheap electrical supply on the coalfields, there is room for a practically unlimited expansion of its use in the directions indicated. I consider that ultimately the whole of the haulage, both over and underground, will be carried out electrically, in the case of colliery sidings either by the coal companies themselves by means of electric locomotives or by the railways. There is no reason whatever why the whole of the colliery lines and branches should not ultimately be worked electrically. There is at present, I understand, a proposal to electrify the East Indian Railway and Eastern Bengal Railway suburban and main lines, to be served by a joint electric power house at or near Naihati, or by arrangement with the Calcutta Electric Supply Corporation. I look forward to the time when this scheme is extended to a point where it would be practicable to link up the colliery supply scheme with the Calcutta scheme, and electrify the whole of the railways within the two areas. This would result in a demand for current which would enable the licensees to supply at a very much lower rate than will otherwise be practicable.

Oral Evidence.

In my opinion, there is no necessity for Government to take any action in connection with the provision of a supply of electrical energy in the coalfields. A general supply company called "The Coal-Fields Power Company, Limited" has been formed to supply the whole of the Raniganj field in the first instance, and it is intended that this company shall apply for a license covering similarly the whole of the Jharia field, excluding the area now served by the Sijua (Jharia) Electric Supply Company, Limited. I am informed that this latter company has no intention of extending their area of operations to other parts of the Jharia field and will raise no objection to the issue of the proposed license. In the case of the Coal-Fields Power Company, acting on the advice of their consulting engineers, it has been decided for the present to charge a minimum price to large consumers of ·75 of an anna per unit. In my opinion, the minimum cost to any public supply company nowadays would not be less than ·6 of an anna per unit under favourable conditions of load owing to the enormously increased cost of plant, machinery and maintenance charges. The maximum chargeable as fixed by the license for supplies in bulk is annas 2 per unit, but this will not of course necessarily be charged. The suggested minimum of ·75 of an anna has only been taken as a starting point and, should the demand and the load warrant it, I have no doubt this may subsequently be reduced. Assuming a Government guarantee of say 6 per cent, it is possible that the minimum of ·75 might be reduced, but I do not see how any question of Government guarantee is applicable in the case of a public company unless in the first instance Government bought out the existing

shareholders. The license granted to the Coal-Fields Power Company will be under the existing Electricity Act. The license covering the Jharia field has not as yet been applied for, but the Government of Bengal have notified us that the license for the Raniganj field will be granted in due course, and, on the strength of this, the new company has been formed. The power station will be situated on the banks of the Damudar River near Asansol, and it is proposed to carry distribution lines from this point throughout the field. Should the demand warrant it, it is proposed to have a feeder line across the Adjai to serve a portion of the field now being opened up in this direction. The present company has a nominal capital of Rs. 150 lakhs of which Rs. 50 lakhs have already been subscribed. This company will ultimately serve both coalfields. In my opinion 10 per cent. depreciation, speaking generally, should be sufficient. A second station will be put down in the Jharia field to serve that area.

2. Firms and companies who already have their own generating plant will not be bound to scrap their plant and purchase power from the new company. It will be up to the latter to demonstrate to them that it is to their financial advantage to do so and purchase current. Licenses granted under the current Act cannot claim any monopoly, but it certainly constitutes an advantage to be first in the field. Although the Electricity Act grants no actual monopoly, any company successfully established and working is in a very strong position to prevent competition as is instanced in the case of the Calcutta Electric Supply Company which so far has no competitors in spite of the possibilities in this direction. Having regard to the exceptionally favourable conditions in Calcutta, where the load is practically constant throughout the 24 hours, I consider that, speaking generally, the rates charged are high, but, by restricting dividends and investing surplus profits in the business, they have been able to give a very efficient supply, at a very large saving in capital cost, which would otherwise have been impossible. On the coalfields, the demand is likely to be very variable and to a large extent a seasonal one, and, until actual experience is gained in working, it is impossible to say that any specific rate is too high or too low. The present scheme is a commercial speculation and must be worked on commercial lines.

3. I do not consider that compulsion in any form can be introduced, nor do I consider it necessary; the only possible way to make compulsion possible would be for Government to supply electrical energy themselves. Compulsion as regards consumers of energy is quite impossible without Government control of the supply, and in any case I strongly deprecate any form of compulsion. There are many small companies or privately-owned concerns which could not afford expensive electric motors, cables and pumps. It is possible of course that, in approved cases, loans may be granted by Government on a small guaranteed interest to be paid, to enable them to purchase what was necessary. It is also possible that the Coal-Fields Power Company may ultimately be prepared to supply the requisite plant on some form of hire-purchase system. Information as to the cost of individual requirements of this nature can be obtained quite readily from any of the leading electrical firms in Calcutta to enable colliery owners to calculate how much electric power would cost.

4. I do not consider that a hydro-electric scheme for the Bengal and Bihar and Orissa coalfields is practicable owing to the lack of a suitable source of supply and seasonal rainfall. In any case, even with a source within 40 miles, I doubt whether a hydro-electric scheme could possibly compete against a steam plant on the field itself. No such scheme has been taken into consideration in the case of the Coal-Fields Power Company.

5. In the terms of the license a supply company is called upon to supply all consumers, but can protect itself by a method of charge which differentiates between small and large consumers. In other words, such a method of charge automatically ensures that the small consumer pays a higher rate than the large consumer.

6. Licenses issued under the existing Electricity Act give little control over prices charged by the licensee except in so far as fixing the maximum. This maximum is, however, usually so high that it is rarely, if ever, charged and in most cases the prices charged are much below what is legally permissible. Government have, however, I believe, power to take action should the powers given to a licensee under his license be in any way abused. I very much doubt whether capital would be forthcoming for a limited liability company in which Government attempted to control profits. We should in any case object to any such proposal in connection with the Coal-Fields Power Company. Personally I object to the principle of Government control generally.

7. There is no limit to the distance at which a supply company is bound to supply current so long as it is within the area of their license, but they are protected by the right to demand a guarantee of a fixed return on the cost of the connection. Any company would be willing to supply a consumer so long as he is near the distribution line, and in the case of a group of small collieries some distance away, it is probable that they will combine in order to obtain the advantage of cheap electrical power. In my opinion, given an efficient electrical supply, there will be few, if any, steam boilers left on the coal fields in a short time. As the present boilers wear out, attractive offers can be made by the supply company for the substitution of electrical power. Many applications have already been received from owners who are faced with the question of renewals or replacement of the existing boilers and steam plant generally. It is hoped that the Coal-Fields Power Company will be in a position to supply current within two years, or earlier in the case of collieries in the neighbourhood of the power station. The plant will be ordered as soon as possible and should be shipped during the course of the present year.

8. It is true that a public supply company would not be able to supply current in certain cases as cheaply as a private owner or a group of owners can do with their own plant, but there are many other factors which operate to give the advantage to the supply company sooner or later.

9. As regards the question of combining coke-oven recovery plant with power supply schemes, expert opinion is very much divided, the majority of opinion being in favour of their being kept separate, as they are two entirely different businesses.

10. I am a strong believer in the ultimate electrification of the whole of the railway lines throughout the coalfields. Should this come about, it is probable that ultimately the main lines would be electrified as well and the coalfields area of electrical supply be linked up with the Calcutta area. It is all a question as to whether, or up to what distance, it is cheaper to transmit electric current or carry coal. A special wagon supply for the coal trade would help matters very considerably. It is estimated that, to electrify the whole of the colliery sidings and lines, a supply equivalent to 50-60,000 H. P. would be required, but it is purely a matter of surmise as the question has not been considered in any detail. I do not think there are any special conditions in this country which need militate against the electrification of railways. Traffic both existing and potential at the collieries would in my opinion warrant the expenditure involved.

11. I reiterate my previous expressed opinion that the question of electric supply should be left to private enterprise, as also the method of generating such supply, particularly in regard to the use of waste gases from coke ovens.

Written Evidence of Mr. H. H. Reynolds, Consulting Engineer, Messrs. Andrew Yule & Co.

Question 1.—I was trained as an electrical engineer and have held responsible positions for the past 27 years. I am a Member of the Institute of Electrical Engineers.

Question 2.—Electrical licenses granted under the Electricity Act, contain provisions regarding the maximum rates that may be charged for the supply of electrical energy by the licensee. The Government have the right, under the Electricity Act, to revise the rates charged by the licensee every seven years. I do not know of any guarantee by Government against a licensee's failure to make any profit.

Question 3.—I am of opinion that the general use of electricity in the Raniganj and Jharia coalfields would be an advantage, as stated by Mr. Treharne Rees. The prices to be charged for the supply must be as low as possible, but should be sufficient, after paying running expenses and depreciation, to give a return on the capital invested of 8 per cent.

With regard to the question of the " rate " per unit that would have to be charged, this depends on many factors, among the greatest being the capital charges and the load factor. A power station costing with its distribution system, say, 24 lacs, with a load factor of 60 per cent. and a full load capacity of 5,000 K.-WTS., should be able to supply electric energy at an average rate not exceeding ·4 anna per unit; of this figure, the capital charges amount to ·2045 anna (coal @ Rs. 4-8 per ton) to ·0883 anna. If, by further capital expenditure, it may be possible to reduce the coal consumption per unit by 20 per cent. then the saving will be ·01766 anna per unit, but to do this, increasing the capital by 20 per cent. will add ·0408 anna per unit.

Question 4.—Although coal is being wasted raising steam in the coalfields, this does not mean that it will pay all collieries to instal electric plant. Steam plant must not be condemned because some people waste coal. I am of opinion that it would be quite wrong to compel mine-owners to take electric supply from central generating stations as, if a supply is available at reasonable rates and it will pay them to take it, they will do so. There has been a suggestion of a supply for the coalfields, from one of the much talked of super-power stations, at a rate of ·75 anna per unit, and it will not pay any colliery to take current, for continuous pumping or fan driving, at this rate. To drive a 60 H.P. fan, 438,000 units per annum will be required which, at ·75 anna per unit, will cost Rs. 20,531-4, whereas with a good steam engine, non-condensing, the coal consumption would be about 750 tons costing, at Rs. 4-8, Rs. 3,375, and even allowing fully for depreciation, etc., on the necessary boiler plant, the total cost would not exceed Rs. 10,000 per annum. The collieries must be safeguarded against exploitation by power companies under the plea of saving coal.

Question 5.—The whole question of the number of power stations required to serve the coalfields requires to be very carefully gone into, as there are already several private stations that are doing good service which should not be scrapped, but utilized to their fullest extent for the areas best served by them. I am of opinion that it will not be wise to supply the Raniganj and Jharia coalfields from one central power station as accidents will happen, and wrecking of such a station would ruin all the mines. I would add that, from my knowledge of the conditions, I consider there should be at least two stations in each district. The stations in each district should be linked together, but there is no need to go to the expense at present of linking the two districts. It must be remembered that it pays to erect cooling towers for cooling the circulating water rather than to place a station 30 miles away where water would be available for condensing purposes without the use of towers; in like manner, it will pay to have separate power stations for the Raniganj and Jharia groups.

Question 6.—The question of coking plant does not fall within my province, but, if coking plants are erected, it would be advisable for them to be near the power stations so that the waste gases could be utilized.

Question 7.—I agree with the suggestion to use waste gases for steam raising for driving turbo-generators. It might be more economical to use the gases in gas engines, but it would not be advisable.

Question 8.—I do not consider it would be advisable or economical to electrify the railway branches and sidings in the coalfields as the capital outlay would be large and the number of accidents great.

I would add that I consider the whole question of power stations for the supply of electric energy to the coalfields should be thoroughly thrashed out and the necessary licenses under the Electricity Act drawn up to suit the conditions and not, as at present, to suit the supply for domestic purposes such as lights and fans in houses.

Oral Evidence.

Question 2.—The maximum rate in licenses usually leaves a considerable margin to work up to, the actual rate charged being usually less. We have two electric plants running, both working on a co-operative basis. We have no license and cannot supply the neighbouring collieries without such a license. I think all private plants should be allowed to supply neighbouring collieries. Government ought to reserve the right to allow a small colliery to take power from a private company if the latter could supply the power cheaper than a public supply company. A public supply company cannot stop a private company from making power for the use of its own collieries. I think there is sufficient provision for power in Jharia already. The present stations ought to be thoroughly developed before any public supply company is considered. I would, however, leave everything to private enterprise, the only Government assistance necessary being to keep down the rates. The rate of ·75 annas per unit is too high for pumping and fan purposes. We hope to be able to do it for less than that at Sibpur. We are actually doing it for ·4 annas at Radhanagar (Sodepur). Government might guarantee a dividend to a public supply company in order to reduce its rates. It is possible to have too big an area for the economic supply of electricity, but it depends upon circumstances. I am convinced that power can be supplied cheaper by a power station like Loyabad than by a big public supply company. It is understood that the dividend of the Calcutta Electric Supply Company should not exceed 10 per cent. I do not think any public supply company would be allowed to make more than 10 per cent. in the coalfields. The consumers would agitate and have rates reduced if the profits were higher. I do not think Government need guarantee a dividend. A public supply company must present a commercial proposition or no one would buy their power.

Question 5.—My suggestion of two power stations in each coalfield is the minimum. The distances to which supplies can be made depend entirely on the load. There is nothing to prevent the bringing of the present power stations into a scheme of general supply. They could always be linked up through transformers. I agree that rates should be revised periodically. We intend to revise our rates annually. If a small colliery shut down owing to market conditions in the coal trade, they would have to be charged a rent while shut down, and this rent would be based on the capital expenditure on the plant. I would leave to private enterprise any scheme for the supply of plant to small collieries.

Question 7.—Gas engines are not advisable as the largest gas engines are only 4,000 H. P. The cost of repairs is heavy and so are capital charges. The cost of lubricating oil alone is a large item.

Question 8.—The present Electricity Act and the Rules under it were, in my opinion, drawn up mainly to suit small consumers. Bulk supply, as is required in the collieries, was hardly thought of.

Written Evidence of Mr. R. R. Simpson, Inspector of Mines, No. 1 Circle.

Question 4.—It would be very difficult to compel small mine-owners to use power supplied by central generating stations. Such mines are worked intermittently, and frequently are closed for months or years. The coal wasted is no great matter. Many of the small mines are in remote situations where the cost of transmission would be high. Small mine-owners would find it difficult to find the capital necessary for the purchase of plant, and to pay for expert electrical staff. It would be possible for the power company to do the pumping and hauling for such mine-owners, and to recover the cost by means of a cess. It would probably be best to exclude such mines at the to discretion of the controlling authority.

Question 5.—In the Jharia coalfield, a single generating station would suffice. With the exception of a few small mines some 10 miles west of the Jamuni river, all the collieries are within 12 miles of the Loyabad Power Station.

Oral Evidence.

Questions 4 and 5.—Electrical development should be left to private enterprise and there ought to be no compulsion except in very extreme cases. In Jharia, there is at present a larger demand for power than there is a supply of power. The Jharia field is sufficiently supplied with generating

stations and I would not advocate a big central supply company nor that Government should have anything to do with it. If there were a central supply company, I would leave it to private enterprise, but agree that rates should be controlled. If profits were limited and dividend guaranteed by Government, I would still leave the matter to private enterprise. The controlling authority might control rates, and I do not think a company would object if interference was commercially justified. The rates should be periodically revised. I see no objection to Government guarantee of dividend as I think it would be good speculation, but they might not be able to get a company to take up business on those terms.

Written Evidence of Mr. E. S. Tarlton of Messrs. Bird & Co.

Question 1.—My training as an engineer covered the general principles of electrical engineering. For the past seven years, I have been engaged on obtaining particulars for the total electrification of the Jharia coalfield. The results achieved in combination with other members of my firm resulted in establishing the Sijua (Jharia) Electric Supply Company. This supply is now dealing with the load within a ring main of 10 miles circumference with a full unit capacity of 13,000,000 units.

Question 2.—As far as I am aware, the general provisions attached to the electrical license in India are not specified in the license, and there is no guarantee by Government against the licensee's failure to make any profit.

Question 3.—I support Mr. Treharne Rees' ideas for the general use of electricity, and the erection of central generating stations in the two coalfields. I also support his recommendations for the control of the price charged for electric units. This unit figure should be sufficient to pay interest on capital, depreciation, amortization, after paying working expenses. The rate per unit will in certain areas vary from ·5 of an anna to one anna. If dealt with by a public supply company, from ·75 of an anna to two annas.

Question 4.—In most collieries fuel is wastefully used for steam raising. I do not see how it is possible to compel small colliery owners to take electricity; further colliery flotations should not be permitted without it is agreed to use electricity.

Question 5.—I am of opinion that it will take two power stations in each coalfield to deal with the load. My reason for stating this is that the fluctuating load in Indian coalfields will compare with the very worst known in any country. This difference of load is brought about to a large extent by pillaring in the past, and there is no reason to hope that this state of affairs in old mines can now be remedied; an increased monsoon pumping load can be prevented if immediate action is taken.

Question 6.—I agree with Mr. Rees that generating stations should be worked in conjunction with by-product coke ovens, but I do not see how it is feasible for companies to send their small coal to a central battery for the purpose of coking. Such a scheme 10 years ago would have been ideal. Companies to-day have built and are building batteries of by-product coke ovens, using the surplus gas under the boilers at their power stations.

Question 7.—This is answered by the remarks I make agreeing to the use of surplus gas for raising steam to drive turbo-generators. Referring to the last paragraph of Question 7, I do not think it would be advisable to use gas engines, rather than raise steam for driving turbo-generators. I think it is sufficient, without going into further detail, to say that the market for coke is a speculative one, and at times the demand for this class of fuel would not be sufficient to produce sufficient gas required for the gas engines. If gas is used under boilers, an alternative combustion chamber in the shape of a coal grate can be held in readiness in case the gas fails.

Question 8.—I do not agree with the proposal for electrifying the railway branches and sidings in the coalfields, unless it is proved there is sufficient freight to cover the capital expenditure.

Oral Evidence.

The control of the price of power would be governed by the generating cost. I do not think a public supply company should be given a monopoly. Any previous private company might have to surrender its customers, but could continue to work for itself. A private company could supply several collieries not necessarily under the same managing agents. The company at Sodepur is a private one on a co-operative basis, and cannot make any profit. A colliery company owning its own power station on its own colliery would not have to surrender to a public supply company. This is the position under the existing law and rules. I do not think you would get enough money for a public company at 6 per cent. even if Government guaranteed that rate of profit; with 7 per cent, it would still be doubtful, but 8 per cent would be all right. No public supply company could touch the rates a private supply company could supply its own collieries at. The small mine-owners cannot afford the initial expenditure on plant. The cost would probably be more than the value of the property. I do not think that the demand from the smaller collieries would justify a public supply company, and the bigger collieries should not be required to take power from a public supply company in order to accommodate the smaller collieries. I very much doubt whether, for the smaller collieries, the expenditure would in any case be justified by the value of the extra coal recovered. Collieries raising from 2,000 to 4,000 tons might

be able to instal plants and use electric power if the property has not been ruined by pillar-cutting, and if they could work at an economic rate; otherwise they would tend to raise the general rate on account of the cost of transmitting power to them, especially so if they were not within reasonable distance of the transmission lines, and would so put up the price for the other consumers.

2. I think Government ought to intervene to conserve the coal resources in view of the industrial development that is coming. There is no cause for panic over coking coal. There is however, a terrific waste in fuel consumption. We have effected a large saving by our electrical power station. It amounts to 6,500 tons a month, and this goes to the coke ovens, and so to the market. I think there will be a market for all coal now wasted. The smaller collieries burn about 15 per cent. of raisings, but I do not think they should be compelled to come in, or that the controlling authority should be empowered to compel them to come in even if they were near enough to do so economically without affecting the general rate. The small owners might be educated to place ultimate benefit before immediate profit. We often have applications for power from such small owners.

3. I am not in favour of Government doing anything directly. Nor am I in favour of one big public supply company. The best course would be for Government to encourage the present private companies to supply outside companies. We are now only allowed to supply five outside companies and there are always difficulties about increasing the number. We want a free hand to take in as many companies as we please. The supply company knows how far it can economically go. We do not want any monopoly and we agree to control of rates. I think the Jharia field is too large to be supplied economically by one public supply company having one generating station.

Written Evidence of Mr. H. W. Walton, Electrical and Mechanical Engineer, Central Kurkend Colliery, Jharia, nominated by the Indian Mining Association.

Question 1.—I served 5 years apprenticeship as a Mechanical Engineer with Messrs. James Simpson & Co., Newark, Notts, England; 3 years apprenticeship with the British Electric Plant Company, Alloa, Scotland; 2 years Electrical and Mechanical Engineer with the Grangemouth Coal Company, Grangemouth, Scotland; 2½ years as Electrical and Mechanical Engineer with the Camp and Broomside Coal Company, Motherwell, Scotland; 2 years with the Equitable Coal Company as Electrical and Mechanical Engineer at their Bejdih Colliery; 2 years as Chief Electrical and Mechanical Engineer with the Raniganj Coal Company at their Kustore Collieries; 2¼ years with Messrs. Bird and Co. (9 months in the Sijua Jharia Power House as Engineer-in-charge and 18 months as Constructional Engineer and Engineer-in-charge of their collieries in the Sijua division).

Question 2.—In applying for a license to become an electrical supply company, a plan has to be sent to the Local Government showing the area which it is proposed to supply, the voltage price per unit, the demand and supply. There is no guarantee by Government against a licensee's failure to make any profit.

Question 3.—I quite agree with the proposal to have central generating stations in both coalfields. If such proposals are carried out, I also agree with the recommendation that control should be exercised over the price charged for electric current to users. The charges should be such as to yield a fair profit on the capital expenditure after paying the working expenses and allowing for depreciation and upkeep of the plant. In my opinion, control will be necessary to ensure the universal adoption of electricity, and in the interests of the smaller collieries and the whole industry in general. If current is supplied at reasonable rates, there will be less need for compulsion in the case of the small collieries. I would consider 10 per cent. to be a fair interest on the capital expenditure. The rates that the mine-owners will have to pay will probably be about one anna per unit.

Question 4.—In the interests of economy, it is only right that all who are using fuel wastefully should be compelled to take electricity from the generating station. In the case of small owners, special consideration will have to be given. In such cases, the central generating stations should be bound by a clause in their agreement to supply not only the current, but also the necessary plant on the instalment or hire system.

Question 5.—In consideration of the fact that the collieries on the Raniganj field are scattered over a very wide area, I should say it would be more advantageous to have two central generating stations, but, in the case of Jharia, I do not see the necessity for more than one fully equipped generating station. It would be necessary, however, to make a complete survey of the two fields to get an idea of the aggregate requirements and to make allowances for all future developments.

Question 6.—The suggestion to work generating stations in conjunction with by-product coke ovens is to be commended. It is entirely consistent with judicial economy, and in line with all the other proposals to reduce the amount of waste in fuel. It will do away with the present primitive methods of coke-making. The yield, and quality of the coke will be improved, and the profits realized from the sale of all the by-products will enable the central generating station to give the current to the collieries at a cheaper rate. Taking these things into consideration, it appears to me that the whole concern should be run on the co-operative principle instead of by separate limited companies.

Question 7.—I quite agree with the proposal to have ovens of the regenerative type and to use the gases for the purposes of raising steam. I am of the opinion that it would be more economical to use the gas in the gas-fired boilers with turbo-generators than with gas engines.

Question 8.—In all electrical undertakings, it is advisable to make ample provision for miscellaneous purposes, especially so in the case of collieries. It is totally inconsistent with judicial economy to have steam for some purposes when sufficient electric power is available to do the work. It is quite practicable and advisable to use electricity for the purposes specified under this heading. It would be rather incongruous to have surface haulages worked by steam when one has electric power on the colliery. Similarly, with locomotives in working sidings and branches. In fact, it will be found preferable to use light locomotives to convey the coal to the central loading depôt instead of rope haulages electrically driven.

Did not appear for Oral Examination.

Written Evidence of Mr. W. C. Banerjee, of Messrs. Banerjee & Co., nominated by the Indian Mining Association.

Question 1.—None.

Question 2.—In electrical licenses the purpose for which it is to be used is mentioned and for how many units. A minimum and maximum charge per unit is given. No specification about the percentage of profit to be allowed to the licensees. The Government does not give any guarantee against a licensee's failure to make any profit.

Question 3.—Interest 10 to 15 per cent. The charge per unit should be as small as possible.

Question 4.—There should be a fund from which small colliery owners are to be supplied with the electric plant and a certain rate per ton charged to recoup the advance from the fund.

Question 5.—In Jharia to serve—

(1) Jharia to Pathardih.
(2) Kusunda to Jharia.
(3) Loyabad to Katrasgarh.
(4) Katrasgarh to Jamuni.
(5) Across the Jamuni zone.
(6) Bhaga to Khanindih.
(7) Barakar.

Raniganj.— (8) Sitarampore to Baraboni.
(9) Baraboni to Jamuria.
(10) Ondal to adjoining river.
(11) Across the adjoining river.
(12) Asansol to Radhanagar 2.

Question 6.—It will be paying to limited companies with by-product coke ovens in certain sections of the Jharia coalfield and Disherghur coalfield, but not in the Raniganj coal district.

Question 7.—Gases might be used to drive turbo-generators.

Question 8.—It depends upon the demand of units and the power available, whether of sufficient quantity to meet the electrification of sidings and branches.

No Oral Examination.

Written Evidence sent in by the Honorary Secretary, Indian Mining Federation.

Questions 4 and 6.—For small collieries and collieries working inferior coal, it will not either be practicable or economic to work their collieries with electricity obtained independently or from a central generating station. Though, by the use of by-product ovens, a profitable business might be developed, it cannot be used with profit in a small colliery, and it is not likely that a combination of a group of small collieries would be possible under the existing circumstances for such working. When the fact remains that second class collieries are suffering a considerable loss of 10 to 15 per cent. of their output by deterioration on account of inadequate wagon supply, the question of economic working and conservation of resources cannot properly apply to such collieries. The central depôt arrangement contemplated in Mr. Rees' report does not meet with our approval.

No Oral Evidence Offered.

RAILWAY WITNESSES.

Written Evidence of Mr. A. M. Clark, Agent, Bengal Nagpur Railway.

Question 1.—I understand that Mr. Treharne Rees' suggestion is that colliery companies should own sidings and branches, and should work railway wagons over them with their own locomotives. This would mean that sidings worked in this manner would cease to be assisted sidings. In such a case, it would be necessary to retain the rights reserved to the railway under the assisted siding terms. The adoption of this proposal would not, in my opinion, entail prohibitive capital expenditure on the provision of sidings where traffic would be handed over, or prohibitive recurring expenditure, provided the liability of the railway company is limited to the provision and upkeep of such sidings.

Question 2.—At present wagons are supplied to and removed from numerous sidings and collieries, both large and small. The adoption of central loading depôts would reduce the number of points where this service would be given, and would thus automatically result in better service being obtained both from engines and wagons. In view of the difficulties that would arise in connection with the location of the central depôts, the arrangements for working them in several different interests, and the necessity for providing stacking grounds in their neighbourhood, it is doubtful whether the proposal would work satisfactorily in practice.

Question 3.—The question as to the party who would bear the expense of electrification needs to be decided in connection with this reference. If at the expense of the railway, it is doubtful if the necessary capital would be available. It is not clear if the proposal contemplates the electrification of the main coal lines as well as coal branches in the coalfields.

Question 4.—Three reasons for waste are suggested :—

(*a*) Insufficient and irregular wagon supply.

(*b*) Use of unsuitable types of wagons.

(*c*) Use of covered vans.

(*a*) and (*b*) are connected subjects. Indian railways have large numbers of wagons not specially constructed for coal traffic which, if not used for coal, would greatly reduce the number of wagons available for coal traffic. The supply of standard wagons to carry all coal traffic could not be provided under many years. If wagons for coal traffic were standardized, all Indian broad gauge railways would have to agree to provide this class of coal wagon since the East Indian and Bengal Nagpur Railways could not bear the burden alone.

Question 5.—The provision of a covered wagon that can be loaded through the roof is under investigation.

Question 6.—The provision of special wagons would be advisable. The railway would offer every reasonable assistance towards sand-stowage, subject to suitable rates being paid that would give a reasonable profit. I am unable to express an opinion regarding the regular supply of sand until the matter has been investigated further.

Question 7.—I do not anticipate a prejudicial effect on bridges provided a sufficient reserve of sand is maintained near large bridges.

Question 8.—I am not able to give details at present.

Oral Evidence.

Question 1.—I do not see that any advantage will be derived from this proposal. The amount of coal released will not be large, while a certain amount of additional coal will be locked up under exchange sidings. The railway company capital expenditure would have to be refunded. The railway company's capital expenditure on an assisted siding includes the permanent way, but not the earthwork; in the average case, it amounts to rather more than half of the total cost. On branches, the railway bears the whole capital expenditure. More land would also be required for marshalling yards, and the position will thus be practically the same as it is now. If sidings were only worked by the collieries and still owned by the railway, the capital expenditure need not perhaps be refunded, but I have not considered the point fully. Among the rights I refer to, I would include the right of support of the sidings because a colliery might wish to give up a siding after taking it over, and there is also the question of access to collieries beyond. The railway would have no objection to collieries working the sidings if properly indemnified for the damage to stock I would, however, prefer the present arrangement to continue. The proposed arrangement could only affect a few sidings. The coalfields have developed under a certain policy, and the beneficial results of any changes in that policy should be made very clear before they are adopted.

Question 2.—I interpreted the question to mean that there would be central depôts for several collieries under different managing agents. If the collieries were under the same managing agents, many of my practical objections would disappear. I am in favour of central loading depôts. The railway always enquires whether a proposed new siding is necessary, but, as a rule, we give collieries the sidings they want, and have not made it a point that loading should be centralised rather than sidings increased. The proposal reverses this policy, but I should welcome it all the same if it can only be worked practically.

Question 3.—On main lines and branches, this would be purely a railway question. On sidings, the collieries would not have anything to do with it unless they had taken over the siding.

Question 4.—The principal cause of the wagon shortage is the increase of ton-mileage during the War without any increase of the railway stock. Our figure of ton-mileage was 1,297 in 1913-14, and 2,202 in 1918-19, the increase being due to great enhancements in tonnage and lead, more particularly the latter, owing to the fact that the traffic which used to go to Bombay and other places by sea was despatched by the all-railway route. The shortage will be relieved when more steamers are available and freights are lowered. We are providing facilities to meet the development meanwhile. As regards standard wagons, the two despatching railways (the East Indian and the Bengal Nagpur) are dependent on the receiving railways to replace the wagons they send to them, and the latter will therefore have to provide for standard wagons as well. Further, if standard wagons are adopted, future improvements cannot be adopted, otherwise wagons will not be standard wagons. We have a large amount of engines and rolling stock on order and they are now coming out fairly fast. Engines are not perhaps coming as fast as we would like, but they have been hung up by strikes at Home. I do not think that the statement that one-third of the wagons sent to the Docks with coal are required to be covered wagons, for the purposes of other traffic, is correct so far as the Bengal Nagpur Railway is concerned. We have never made any provision in loading coal for the Docks that at least 80 per cent. of the wagons should be covered wagons. The despatches of up-country produce from the Docks by our railway are small in a normal year. From the Bengal Nagpur Railway point of view, there would on this account be no objection, so far as I can see off-hand, to having special wagons for the coal traffic between the collieries and the Docks. I do not think the new Dock would make any great difference. Our railway does not serve many big towns with such traffic. At present, two-thirds of the traffic in the coalfields is carried by the East Indian Railway, and one-third by the Bengal Nagpur Railway. The development of the Bengal Nagpur Railway is rapid in the Raniganj, Jharia and Bokaro-Ramgarh fields and this proportion may be altered within the next 15 or 20 years.

Question 5.—I think some adaptation of the covered wagons is the best solution, but the device must be absolutely water-tight. I understand that experiments made by the East Indian Railway are promising, but our investigations have not yet reached the experimental stage. We do endeavour, as far as possible, to supply open wagons to collieries which have installed screening plants. The turn round would be quicker, but this is governed by the time within which the collieries can be served, and this again depends on the movements of the pilots.

Question 6.—I think special wagons with hopper bottoms will be necessary if you are going to sand-stow. If open four-wheel wagons of existing types were used, such wagons could probably be loaded with sand, and be back-loaded with coal by the colliery. The use of wagons of existing type for sand-stowage is a matter that I should like to consider in greater detail. The work involved in sorting out wagons loaded with sand, so as to attach them to the particular pilots serving the collieries for which the sand would be intended, might prove a serious difficulty and add considerably to the cost of working, but the use of existing types of wagons in preference to special sand wagons appeals to me.

The maximum capacity of wagons on a narrow gauge railway, say of 2½ feet gauge, is from 17 to 17½ tons. Assuming that 4 million tons of sand would have to be carried by my railway in a year, I doubt if we have the facilities to deal with this traffic at present. I would therefore welcome the assistance of ropeways and other means of transport. Extra wagons would certainly be required; also engines and line facilities. The railway would not supply the capital for these without seeing a definite promise of a return. As regards cost, I have calculated that, for a train-load of 800 tons in special wagons operating over a radius of 10 miles, the charge would be Rs. 100 per train or annas two per ton. Without full train-loads, annas 3 per ton for a radius of 10 miles is a rate I would be prepared to discuss. Contractors do loading and unloading, and the railway could not supply facilities for unloading sand and loading coal even with an additional rate. This should be left to the collieries. I should add that my annas 3 per ton is only the transport charge. The provision of wagons would depend entirely on the provision made under the railway budget of the Government of India.

Question 7.—The Bengal Nagpur Railway crosses the Damodar at three points; our records of the bridge founds are as follows:—

Near Asansol—average depth of sand 45′ for a width of 1,750′.

Near Mohuda—15′ of sand for a width of 400′.

Near Bhojudih—20′ of sand for a width of 750′.

General.—I know about the proposed cess under the new Land Acquisition Mines Act. It is to be collected by the railways, and the collection of a further cess of Rs. 2 per ton on all coal despatched would not present any practical difficulties. It would, however, be practically impossible, from a railway point of view, to collect any such cess except at an all-round rate. It would have to be the same on all qualities of coal, because, besides the practical difficulties of collection, there would be no reliable means of check to see that the correct rate of cess had been charged. The collection of an all-round cess might increase accounts work a little, but this would be comparatively negligible. I agree that the incidence of such a cess would probably fall on the consumer, principally the railways, and it certainly would if collected from the consignees by the railways. It might however re-act prejudicially on the coal trade generally, and would, I think, have a far-reaching effect in this and other respects. For one thing, it would raise the question of the possibility of using oil fuel by the railways and by such industries as jute. Further,

if the railway had to pay more for its coal, it would have to raise its rates, and this would also be necessary if the railway were put to more expenses in providing facilities for the various improvements contemplated. Moreover, I consider it undesirable that the collection of a heavy cess should be undertaken by the railway.

Written Evidence of Mr. A. B. Hughes, Mining Engineer, Bengal Nagpur Railway.

Question 1.—The capital expenditure and recurring expenditure on sidings where traffic is handed over to colliery companies are matters to be referred to the railways concerned, and I therefore refrain from giving any opinion other than the following suggestions for consideration :—

Unless the permanent way was purchased by the colliery company, the upkeep of the siding must be directly under the control of the railway company. Otherwise the permanent way might be considerably damaged by neglect or unskilled maintenance. Unless the acquired land was relinquished, the custody of such land must be retained by the railway company. Otherwise trespasses would occur and the land be interfered with or damaged by surface works or subsidences. The construction of loop or spur sidings alongside the main line, and connected with the siding to be handed over, would be necessitated. The railway company would place supplies in these sidings beside the main line, from which they would be withdrawn and replaced after loading by the colliery locomotives.

I consider that it would be impracticable for colliery companies to work branch lines, as these lines serve more than one colliery company. I also consider that it would be impracticable for colliery companies to work any siding, which either serves more than one colliery company or is likely to serve other collieries in the future. In the case of existing sidings which only serve one colliery, and are not likely to be extended to other colliery companies' properties, the cases which need to be considered are those sidings which diverge from the main line or branch line. In such cases, a considerable amount of time would be saved by the railway pilots, and colliery companies might be permitted to arrange for the support of such sidings themselves. This arrangement would necessitate the following precautions :—

Colliery companies would be required to indemnify the railway companies against cost of damage to wagons and demurrage.

Strict rules would have to be enforced to ensure any accident to a wagon being reported to the railway staff before being withdrawn by the railway pilot. A damaged wagon not reported might cause a serious accident to a train.

The necessity for the construction and maintenance of the additional loop or spur sidings and the other difficulties I have referred to, would appear to render this suggested scheme undesirable.

Question 2.—I thoroughly agree with this suggestion. Such a system would very greatly facilitate the supply and withdrawal of wagons; would release permanent way, reduce capital and maintenance charges, and release a very large amount of coal left for the support of the present "herring-bone system" of sidings. The system of serving each small group of inclines or each shaft with a separate siding is the result of collieries having been worked with inadequate capital and the favourable terms on which railway sidings have been provided. Large schemes for efficient surface haulages and central screening plants having in the past been out of the question, the present evil system has grown, and has, until recently, been allowed to continue unchecked. I consider that arguments against the economic superiority of central loading depôts would largely disappear, if the final scheme of development of all the seams in a colliery property was the basis upon which the "lay-out" of the surface plant was decided. Electric haulage on the surface tramways should also greatly facilitate the working of such a system.

Question 3.—If any sidings were taken over by the colliery companies, the haulage on such sidings would, I consider, be facilitated by the use of electric tractors, provided that the colliery was supplied with the necessary power. To electrify the branch lines and sidings worked by the railway companies, merely for the distribution and collection of coal wagons, would of course not be practicable.

Question 4.—Up to the present time, the shortage of material and rolling stock caused by the War has prevented the railways keeping pace with the coal trade.

The following is the present position on the Bengal Nagpur Railway in regard to additional wagons and engines :—

Wagons.—Since the conclusion of the War, 118 new four-wheeler wagons and 52 coal hopper wagons (equal to 104 four-wheelers) have been put into traffic up to the end of 1919. In addition to the above, 432 ordinary wagons and 18 hopper wagons have arrived and are now under erection. 765 ordinary wagons and 40 coal hoppers are on order from Home and are now being delivered. About 3,000 more wagons are due from Home during the next two years, and 1,600 American wagons have been allotted by the Railway Board.

Locomotives.—99 Locomotives are on order. Five of these are expected to be delivered during the current financial year and the balance next year. Government are being asked to provide funds to enable a further 39 engines to be ordered.

Standardisation of coal wagons and the elimination of covered wagons are matters which are under consideration, but can obviously not be put into practice during the present shortage.

Question 5.—I consider that it would be quite impracticable for the roofs of covered wagons to be temporarily removed for loading under screens. It should be possible, however, to design flap-doors for the roofs of covered wagons which would enable coal to be evenly loaded into the wagon from screens, and at the same time be water-tight for the carriage of grain and other perishable goods. I suggest that the railway companies be asked to arrange for this if possible.

Question 6.—To transport one million tons of sand per month from the rivers and to distribute it throughout the coalfields, I suggest the following scheme:—

Several main ropeways to be erected in each coalfield, the number depending on the quantity of sand estimated to be required in each field. The loading terminals of these main ropeways to be sited at intervals along the river banks, and these terminals to be fed by subsidiary ropeways running to various excavating depôts up and down the river. The main ropeways to discharge into hoppered bins at convenient sites on the railways for distribution of sand to the collieries by rail. Special rakes of hoppered sand wagons (each rake with its own engine and staff) to be loaded from the bins at these distributing depôts. After loading, the sand rakes to proceed to their destination and unload into bins, or in other cases into sand pits between the rails. Full rakes only should be loaded and delivered. No marshalling nor weighing, other than at the loading depôts, should be done. The allotment of rakes of sand from day to day to the collieries requiring it would have to be carefully controlled. This allotment would probably be done to the best advantage by the controlling authority recommended by Mr. Treharne Rees.

Without attempting at this stage to estimate the proportionate quantities of sand required by the two coalfields, I will treat the estimated quantity of one million tons per month as a whole for the purpose of the following rough calculations:—

The ropeways being divided between the two coalfields, separate allowance must be made in each field for breakdowns, stoppages and other contingencies of traffic. It will also be impossible to keep the requirements of sand at anything like a steady figure throughout the year, and provision must therefore be made for the probable maximum requirements in any one month. Having regard to these contingencies, and taking the estimated average requirements of sand at one million tons, provision would need to be made for a maximum quantity of at least 1,400,000 tons a month. Allowing 20 working days per month and 10 hours per day, the quantity of sand required to be transported over the main ropeways is 70,000 tons per day and 7,000 tons per hour. This quantity could be dealt with by 10 main ropeways with a capacity of 700 tons per hour each. An approximate quantity of 6,000 to 7,000 tons of sand having to be collected and delivered by rail daily from each depôt, 3 rakes of 20 hopper wagons would probably be required per depôt. If the capacity of the wagons was 40 tons, the capacity of a rake would be 800 tons. As some rakes would have to go farther afield than others, it would not be possible or advisable to make each rake do the same number of trips per day. Eight trips per day divided between the three rakes would deal with 6,400 tons and nine trips would deal with 7,200 tons.

The capacity of the hoppered bins at the discharge terminals of the ropeways has now to be considered. This cannot finally be settled until the working hours of loading into the sand rakes and unloading at the collieries is decided upon. If, however, the ropeways are only active for 10 hours out of the 24, the capacity of the bins should be not less than two full rakes, *i.e.*, 1,600 tons, and the bins should be fully loaded before stopping the rope for the day.

Question 7.—Provided that sand was not excavated within a quarter of a mile of the bridges crossing the rivers, there would in my opinion be no interference with the stability of the foundations of these bridges.

Question 8.—The Bengal Nagpur Railway has lately been approached by one of the largest mine-owners in the coalfields in regard to the conveyance of sand by rail from one central ropeway depôt to their various collieries in the Jharia coalfield. The negotiations have as yet only reached the inception stage and nothing definite has been decided. The scheme outlined in my reply to Question 6 is partly based upon this firm's proposal.

Oral Evidence.

Question 1.—The proposal would only be practicable in the case of sidings serving single collieries and not likely to have to serve more. I do not think much more coal could be taken out as, in cases of sidings serving only one colliery, the railway company is always prepared to permit the removal of the maximum quantity of the supporting pillars, or even to divert the siding if necessary. The colliery companies could not safely do more.

Question 2.—I do not think that the proper separation of the coal from the various seams would be an insuperable difficulty, particularly with regular and sufficient wagons and quick despatches.

Question 3.—Electric traction would be desirable on colliery sidings as it would mean saving of steam power. The railway companies could not electrify their branches and sidings only, as it would mean a duplication of systems and of staffs. I assume that electric power would also be used for the tramways on collieries.

Question 5.—I have since been informed that suitable covered wagons have been designed.

Question 6.—Special sand wagons will be necessary under these proposals. A small group of collieries might well use a common tramway for the carriage of sand and of other material required to supplement the sand supply. This question of sand supply is, in my opinion, the great stumbling block to the whole scheme. The dry sand is certainly not sufficient; if wet sand were used with dredging operations, even then I doubt whether one million tons per month could be obtained from the Damudar River. The sand would probably be deeper and more plentiful in the Raniganj field than in Jharia. The amount of sand brought down by the rivers is likewise uncertain and would depend on the floods which vary from year to year. Owing to the heavy grades and broken country, ropeways would probably be necessary to transport the sand from the river, but, where it is possible to build tramways, the latter would probably be more efficient. I think the maximum capacity of a wagon on a 2'6" gauge is about 18 tons. I think 15 tons of sand could easily be carried. More sand could be carried by a tramline than by a ropeway, though I think ropeways will also be necessary in some places. The question of transport of sand is, however, nothing like so difficult as that of getting the sand. The bed of the Damudar largely consists of, first, soft rock, then shales, and then hard rock. The sand is always slowly on the move towards the sea.

Question 7.—I do not think there would really be any serious effect in any case.

Question 8.—A very careful survey would be necessary to ascertain the best location for ropeways.

Written Evidence of Mr. F. C. Legge, Coal Transportation Officer, Railway Board.

Question 1.—I am not in favour of colliery branches and sidings being worked by colliery locomotives and railway wagons. My experience has been that, where colliery sidings are maintained by collieries and not by the railway, they have periodically to be closed to traffic as unsafe for the railway company's rolling stock to enter and pass over. I consider that Mr. Rees' recommendations referred to in Question 2 are greatly to be preferred. If, however, this suggestion were adopted, presumably the collieries would have to refund to the railway companies the capital expended on the permanent way of existing sidings, and would have to deposit the necessary capital for the acquisition of land and the sub-grade work in connection with the provision of transfer sidings at the entrances to the colliery sidings or branches, where the empty wagons would be placed by the railway companies, and from which the loaded wagons would be drawn out. The recurring expenditure would be the cost of maintaining the sidings handed over to the collieries, and the cost of the maintenance of the sub-grade work of the transfer sidings if constructed under the existing assisted siding terms. Presumably locomotives, whether worked by electricity or steam motive power, would have to be provided by the collieries concerned equal in haulage power to those at present provided by the railway companies, and it is not quite clear to me where the advantage would come in.

Question 2.—From the point of view of transportation, this would be an excellent arrangement and, if the collieries can be brought to agree to the proposal it should be brought into effect wherever possible. In cases, however, where coal is at present hauled in tubs from a colliery to a loading depôt, colliery owners, in the majority of cases, request the railway to provide a siding right into their colliery so as to save them the expense of tramming the coal to the loading depôt.

Question 3.—I imagine that it would be a very expensive proposition to electrify the railway branches and sidings in the coalfields, and, I am not aware what effect the very steep gradients to be met with on many of the branches and colliery sidings would have on the cost of operating by means of electricity instead of steam. I consider that it would be as well to have a scheme, worked out by an expert in such matters, in front of one before expressing an opinion one way or the other.

Question 4.—The wagon shortage in the coalfields and elsewhere has been a regrettable fact for many years now, and the position has been rendered worse by the fact that, owing to a shortage of sea freight, a great quantity of coal formerly carried to Madras, Bombay, Karachi and their vicinities by sea from the Kidderpore Docks has been diverted to the all-rail route. The turn round of a wagon between the coalfields and the Kidderpore Docks, generally speaking, is roughly 5 days, whereas the turn round of wagons between distant points like Madras, Bombay and Karachi is anything up to 30 days. It is clear, therefore, that a much greater number of wagons are now required to transport the coal traffic than were required in pre-war days, and that thus the wagon shortage has been greatly intensified. Further, during the last five years, the rolling stock of all railways has been worked to death, and repairs and renewals have been practically *nil*. It is not possible therefore to say exactly where we are as regards the insufficient supply of wagons until we get back to pre-war conditions, and coal for the destinations named is transported partly by rail and partly by sea. I think it is, however, quite clear that the wagon stock of railways must be increased in order to cope with the development of all industries which is taking place, and that the yard and other facilities required for dealing promptly with an increased rolling stock should be provided *pari passu*. Certain measures have been taken recently with a view to improving the position to some extent, *i.e.*, the purchase of a large number of American wagons originally intended for the Russian Government, and the general pooling or indiscriminate loading of wagons belonging to all railways.

From a transportation point of view, I would deprecate the use of a particular type of wagon as the sorting out of particular types of wagons for different traffics increases the work in railway yards and reduces their already limited capacity. Moreover, if the particular type of wagon selected could only be utilized for loading coal and would not be suitable for loading any class of commodity offering, it would entail a lot of empty mileage when returning to the coalfields, a very uneconomical result and one to be avoided on all accounts. A particular case in point was the introduction of the mechanical loading plant in No. 19 berth at Kidderpore Docks, which was only suitable for use with a particular type of wagon, *i.e.*, open wagons with end doors. The sorting out and supply of this particular type to collieries for loading to the docks for shipment was a source of infinite trouble to the yard staff. As regards eliminating covered wagons from use on the shorter routes, collieries have for a long time past been asked to load covered wagons up-country as far as possible. I am of opinion that the wagons of all railways should be made suitable for coal-loading, whether covered or open.

Question 5.—The E. I. Railway have been experimenting with two covered wagons fitted with roof doors with satisfactory results. I understand, however, that it would be necessary for all existing screening plant to be raised by some 4 feet to permit of the loading through the roof of a wagon. It also must not be overlooked, in connection with general pooling of all wagons, that all railways would have similarly to provide roof doors for covered wagons to permit of their being used in a similar manner.

Question 6.—I would strongly deprecate the railways being called upon to transport over the colliery sidings and branches, in addition to the existing traffic, a number of sand wagons of 40 tons carrying capacity. The existing line and siding capacity in the coalfields is already fully occupied in dealing with the existing coal traffic, and I do not consider that there is any margin for transporting this sand traffic in addition, except at the expense of the existing coal traffic. I suggest that a combination of rope railways, overhead railways and light tramways might meet the case.

Question 7.—I am not competent to pass an opinion on this point.

Question 8.—I understand that the E. I. Railway has been approached on the subject of the conveyance of some 7,200 tons of sand daily, but the matter is still under consideration and no definite conclusion has yet been come to. Personally, I am of opinion that the railways would be ill-advised to attempt to cope with this traffic in addition to their existing coal traffic.

Oral Evidence.

Question 1.—If I were a railway man, I would object to my wagons going on to a siding not maintained by me.

Question 2.—60 wagons is at present the maximum daily supply to any one colliery siding. There would probably be much friction on sidings worked by several collieries, and I am doubtful if they could be got to agree. From the point of view of railway transport, the suggestion is excellent, but I doubt whether it is practicable under existing conditions.

Question 4.—It is very difficult to discuss the wagon question properly as the factors are so uncertain at the moment. Normal conditions have been entirely upset by the War, and no one can say for certain what is going to happen in regard to sea freights. It is impossible to say now how far the cause of the present wagon shortage is numerical, or due to defective handling, or to want of engine power. In order to provide wagons for coal, some of the railways are carrying very little, if any, merchandise traffic. My opinion is that there is a certain numerical shortage of wagons, but I would not have that shortage rectified by supplying large numbers of additional wagons without improving the traffic facilities correspondingly. The conditions on the various railways differ. What we want now is general renewals and a certain number of additional wagons. If a full and regular supply of wagons were secured, I think it would mean an increased transport of coal, at any rate during the first half of the year. A minimum of 3,000 wagons a day, perhaps more, would be required. I do not think a railway would increase its rates merely because it had increased its rolling stock. The coal traffic is not the one that pays a railway best.

I agree that, wherever possible, open wagons should be supplied to a colliery which has gone to the expense of installing screening plant, and that the railways should be prepared to face this. The demand for covered wagons for merchandise is no argument against supplying open wagons for coal traffic. Open wagons can be protected by tarpaulins. At the same time, if covered wagons with adjustable tops can be mechanically loaded with success, I would not go further than to say that the majority of wagons should be open ones. I personally do not think that wagons should belong to individual railways, but to the Government of India, and that they should be standardised. Personally I would work up to the ideal of having all wagons, open or covered, equally suitable for all kinds of traffic as far as possible.

Question 6.—The Bengal Nagpur Railway capacity, generally speaking, is at present unequal to the demand. I have no special knowledge in regard to their colliery lines. I do not like the idea of loading 40 ton wagons with sand to collieries and back-loading them with coal. If the 40 ton wagon idea is abandoned, I see no objection provided sufficient wagons are available. I think a supply of 20 wagons a day could be easily managed. As regards rates, sand might possibly

be treated as ballast, but the Government of India could decide what rates would be fair. I think Mr Rees' suggestion of a special 40 ton wagon for the carriage of sand is impracticable.

Written Evidence of Mr. R. R. Simpson, Inspector of Mines, No. 1 Circle.

Question 1.—It would not be prudent to leave the question of support for colliery sidings to mine-owners, except perhaps in the case of sidings which serve a single owner, and are not likely to be extended to serve collieries belonging to other owners. Some few years ago, the whole of Messrs. Apcar and Company's Luchipur Siding was closed for some time because the workings of a petty mine-owner had endangered the support of the line for a short distance at the outer end Inconvenience and loss was caused to large mine-owners using the siding.

Oral Evidence.

Question 1.—The present conditions should be left alone I think. There would not be much advantage in Mr. Rees' proposals, and they would certainly cause much inconvenience. When the new Land Acquisition Mines Act is passed, it will be possible to allow a smaller margin of safety. This point will be decided by a tribunal and the responsibility will not rest entirely on an individual. More coal is necessarily locked up now because the whole width of the railway line has to be supported. I think it is quite sufficient to support only the line itself.

Written Evidence of Mr. S. C. Williams, Vice-Chairman, Calcutta Port Commisssioners.

Question 1.—The Calcutta Port Commissioners are concerned in that they are responsible for the shipment of coal from Calcutta. There are, in No. 2 Dock, a total of 10 coal berths, 8 of which are worked entirely by cooly labour, 1 by the "Beckett" plant utilizing cranes and skips, and 1 by a Belt plant which has not yet been brought into regular use, while at Garden Reach there is also a new coaling berth at which the British India Company, who have the preferential right to this berth, load their ships by cooly labour. At present, coal is brought down from the coalfields by the East Indian Railway *viâ* the Jubilee Bridge, and by the Bengal Nagpur Railway *viâ* the Shalimar Ferry. The wagons utilized are covered wagons of various types, and open wagons of various types, the proportion being roughly 50 per cent. of covered, and 50 per cent. of open. The Commissioners are allowed by the railways a total of 36 hours free time for the unloading and return to the parent line of these wagons, after which they incur demurrage. It is impossible in all cases to load direct from wagon to ship, and roughly speaking 33 per cent. of the total coal brought to Calcutta is dumped from the wagons on to the ground and loaded thence into ships, involving an additional charge to the exporter of 2 annas per ton. The difficulties now being experienced are attributable chiefly to the use of covered wagons and of high-sided open wagons without end doors, and in some cases even side doors, both of which types involve an excessive amount of hand labour in order to empty the wagons, and render altogether impossible the use of any purely mechanical method of loading. The necessity for dumping, although it means expense to the exporter, does not, in practice, prejudicially affect the rate of loading, as the labour employed is of a different class from that which works direct from wagon to ship, and it is found convenient and conducive to rapid loading for the vessel to take up to, say, one-fourth of her total cargo from the ground. If we were in a position to consider the question of wagons solely from the point of view of the coal trade, it seems beyond question that some type of open wagon would be selected as most suitable. But the balancing of traffic is necessarily a most important consideration, and the Traffic Manager, Port Commissioners, informs me that, in normal times, it is necessary to utilize roughly about 30 per cent. of wagons sent to the Docks loaded with coal for back-loading with produce despatched up-country ; as by far the greater part of this produce requires the use of covered wagons, the most economical course, from the railway point of view, is to send a sufficient number of covered wagons loaded with coal. I do not think, therefore, that covered wagons can be altogether eliminated, though it is clear that the partial use of covered wagons will necessarily increase largely the amount of shunting to be done. It would still seem well worth while, however, to insist on using only open wagons for the remaining two-thirds of the coal traffic. Such a proportion would probably be ample to cover the despatches of the larger collieries which could face the expenditure requisite for screening plant, and were in a position to load entire rakes. The question of the best type of open wagon to be selected is somewhat difficult. Of the different mechanical plants which have been tried in different parts of the world, my personal preference is for a crane and skip system, such as the "Lewis-Hunter" or "Beckett" type, both of which are simple, strong and economical. The "Lewis-Hunter" system works by end-tipping an entire wagon load into one skip, which is then hoisted direct on board ; it eliminates any intermediate movements, but necessitates the wagon standing under load until the ship and the crane are ready for it. The "Beckett" type has no tipping arrangement. It involves unloading the coal by hand into a chute from which the coal falls into the skip. Unless the coal is dumped and loaded by hand from the dump into the skip, it also involves keeping wagons under load, and either way it has the great disadvantage of requiring a large head of labour to empty coal from the

wagon. It may be found possible to avoid the difficulties of these two systems, but no true mechanical plant can be properly worked unless greater latitude can be allowed by the railways in regard to detention of wagons, as ships cannot, in the nature of things, work to an exact time-table. Whatever system be decided upon—and the constant tendency of labour charges to increase will, in my view, render the extension of mechanical loading inevitable before long—it seems clear that the question should be decided by representatives of *all* the interests concerned, that is the colliery owners, the railways and the Port Trust, and that full consideration should be given to the claims and interests of each party, the whole operation of transport and loading being treated as one somewhat complicated operation, and not as a series of operations independent of one another.

Questions 6, 7 and 8.—I am not clear that the Port Commissioners can offer any useful remarks. The river beds of the Barakar, Damudar and Adjai Rivers suggest themselves as the nearest sources of supply, and the expenditure entailed in delivering at the pit's mouth the large quantity of sand, estimated at one million tons per month, will apparently comprise the cost of putting the sand into trucks, the cost of haulage and maintenance of rolling stock, and special sidings, and any further labour necessary in unloading from wagons at the pit's mouth. I understand from one of our contractors, who supplies sand, that the cost of putting it into wagons is about 8 annas per ton, and it seems probable that, even if the lead be a very short one, the total cost will hardly be less than some two to three rupees per ton. So far as my present information goes, I do not think the Port Commissioners could be of any assistance by supplying sand from their dredgers, as the cost of removing it from the dredgers to wagons, and the railway freight from Calcutta, would involve a total cost far higher than supply from the three rivers mentioned. It does not appear probable that the River Hooghly would suffer from the point of view of navigation by sand being taken even in large quantities from these rivers, but the matter is one of such magnitude and the issues involved by any change of the régime of the whole system of rivers, so important, that the highest expert advice should be obtained, and the detailed proposals put forward should be very carefully scrutinised before being put into action.

Oral Evidence.

Question 4.—We have had one mechanically-operated loading berth for coal—the "Beckett" type, utilizing cranes and skips—in actual work for about 18 years As regards type of wagons, a specially designed coal wagon, if it were an open one, would be of no use for back-loading with other commodities—chiefly rice and sugar—nor do I think that a covered wagon with a removable top would be found satisfactory, as I doubt if it could be made water-tight, and unless this were done, there would be large claims raised against the railways and the Port Trust for damage by water. For such proportion of the coal wagons as would not be back-loaded, *i.e.*, roughly about two-thirds of the total, the Port Commissioners would prefer some type of open wagon as being more suitable for mechanical loading, and also easier to empty by cooly labour. As regards the time taken in turning round coal wagons at the Docks, we generally work well within the 36 hours allowed, and I should put the average time taken at about 24 hours, *i.e.*, from the time the wagon is handed over to us at the Dock Junction until the time we hand it back at the same place. It is of course desirable, if possible, to have only one type of wagon, and that an open one, for the carriage of coal to the Dock, as the utilization of both open and covered wagons necessarily means more shunting everywhere, but my idea was that all collieries might not be able to afford the expense of installing a screening plant, and that the requirements of all those who could, would be covered by the provision of two-thirds of the total wagon capacity required in the shape of a specially designed type of open wagon, the requirements of the remaining collieries being met by the one-third of carrying capacity in the shape of covered wagons.

Questions 6, 7 and 8.—The very rough figure I mentioned of from two to three rupees per ton as the cost of sand, was intended to apply to sand obtained locally as near as possible to the collieries; the cost of sand obtained anywhere near Calcutta would, I think, be much higher. The Port Commissioners' dredgers do not pump dry sand, but sand or silt mixed with water, and we have had no experience in pumping dry sand. As regards the effect of taking sand from the Damudar River, even if the bed of the river were lowered by 10 feet, this would be at a distance of 150 miles from Calcutta, and might have no effect whatever upon the Hooghly, but the régime of that river is so uncertain that any possible effects should, in my view, be very carefully considered, and the Port Commissioners would, I think, require to be satisfied that no serious consequences would result. Generally speaking, of course, the removal of sand from the navigable part of the River Hooghly is an advantage rather than the contrary.

Written Evidence given by the East Indian Railway Company.

Question 1.—Relinquishment of broad gauge sidings and branches to colliery companies.

(*a*) It is not clear how the shifting of the responsibility for working coal sidings from the railway to the colliery companies, and thereby making them definitely responsible for providing support, would result in less coal being locked up for support. If sand-stowing be not extensively undertaken, there will still be the necessity for coal to be left under railway lines to afford support, and the only question is to what extent any modification of the present method of haulage

could reduce the amount of support necessary. At present, the amount of support is prescribed in each case by the Chief Inspector of Mines, and it is presumed that he bases his restrictions on a careful calculation of the effect of broad-gauge locomotives and loaded wagons moving on the surface. The important factor in this calculation must be the weight per axle and it does not appear likely that, with loaded coal wagons working up to axle loads of 16 tons (which is the figure towards which most railways are working), there would be much reduction in support found possible by the elimination of the present East Indian Railway C. T. engines which do most of the haulage, and which impose a maximum axle load of 17 tons and an average over all axles of 15 tons. If the Chief Inspector of Mines considers that less support than he now prescribes could not be allowed with due regard to the safety of the persons working the traffic and the rolling stock, it is not clear how any colliery company could take the responsibility of providing less support, nor how Government would be justified in allowing such a risk to be taken. If, however, it be conceded that the present locomotives are the determining factor in the matter of support, it is doubtful whether there are many parts of the coalfields where the haulage could be done by lighter broad gauge engines than those at present in use, unless speed be regarded as a matter of secondary importance. In many cases, with the comparatively powerful engines now used by the railway company, it is not possible to draw out more than ten loaded wagons at a time with one engine. Therefore it is doubtful whether light engines will be able to do the work required of them. Where gradients permit, it is possible that small rakes of railway wagons could be moved by a lighter locomotive, but it is suggested that the work might be more economically done by interlacing metre gauge or 60 centimetre tracks with the broad gauge, and using locomotives of the smaller gauge.

(*b*) Putting the above question aside; however, and looking into what sidings could be handed over for this purpose to the colliery companies, it is found that the number of such colliery sidings would be very small. The East Indian Railway consider that, if Mr. Treharne Rees' suggestion is carried out, it would be essential for colliery companies, situated on the same branch, to co-operate and work such branches jointly. If they did not do so, there would obviously be loss in each company maintaining its own engines and staff to work the same, in addition to having a joint man to control the traffic on the sidings, as it would be obviously impossible to let a number of collieries run their engines and wagons up and down the line without some efficient traffic control. The scheme would therefore be restricted to collieries situated close together and owned either by the same companies or worked by the same managing agents.

(*c*) The branches, or groups of sidings, on the East Indian Railway, in both the Raniganj and Jharia coalfields, which could possibly be handed over to collieries for working are mentioned below :—

Names of Sidings or Branches.	Number of Sidings on the Branch or in the Group.	Name of Colliery Company or Managing Agents.
Mandalpur and Ackalpur Group	5	Macneill and Company.
Pretoria Branch	3	Andrew Yule and Company.
Katras-Jharia Branch	5	Ditto.
Damudarpur Branch	3	Ditto.
Sodepur Branch	3	Ditto.
Ghusick and Muslia Branch	7	Martin and Company.
Jealgora Branch	6	Jardine, Skinner and Company. Heilgers and Company.
Bhuggutdih and Ena Sidings	3	Andrew Yule and Company.
Kustore Branch	3	Raniganj Coal Association.
Godhur Sidings	2	S. B. Kaha and Sons and Kanga and Company.
Khoira and Billiari Group	5	Jardine, Skinner and Company.
Bansdeopur Branch	4	Jardine, Skinner and Company and B. N. Dass and Company.
Ekra Branch	5	H. V. Low and Company.
Kankanee Branch	4	Mackinnon, Mackenzie and Company.
Loyabad Branch	5	Bird and Company.

(*d*) It would be necessary, at the entrance of such colliery-worked sidings, to put down transfer lines, on which the railway company's pilot would come at stated hours and leave empties and take over loaded. The number of such lines would be governed by the maximum number of wagons loaded on such branches and would in cases only amount to two lines, but in a good many cases four lines, capable of holding 50 wagons each, would have to be put down.

(*e*) Even with the branches mentioned above, a re-arrangement, and possibly in some cases re-alignments, of branches and sidings would be necessary. It is impossible to say without a close investigation what re-alignments would be necessary. This investigation would not only involve surface enquiries, but also underground surveys to see if such transfer sidings and re-aligninents are possible.

(*f*) In regard to the capital expenditure involved in the application of such a scheme, the following have to be considered :—

(1) The value of the permanent way materials in the present assisted sidings and the cost of their construction would have to be paid to the railway. Figures for this could be given for any particular area where definite investigations were required, but it will suffice at present to note that the total capital spent on assisted sidings for coal on the East Indian Railway is now approximately Rs. 90 lakhs, of which Rs. 50 lakhs relates to the Raniganj field and Rs. 40 lakhs to the Jharia field.

(2) A portion at any rate of the cost of the transfer sidings referred to in (*d*) above would have to be borne by the coal company or group of coal companies concerned. The amount would vary in different places, but, where the requirements were limited to two sidings each to hold 50 wagons, the approximate cost would not be less than Rs. 50,000 in each case, of which perhaps ⅓rd would have to be borne by the coal companies.

(3) The cost of the re-arrangements or re-alignments referred to in (*e*) above would have to be borne by the coal companies concerned. No estimate can be given of this.

(4) The cost of new narrow gauge track, new locomotives, and all the accessory requirements of working the traffic independently of the railway, can only be guessed at. It would however be a considerable figure.

(*g*) The recurring expenditure to be faced depends to some extent on the standard of efficiency which the colliery companies would work to in maintaining their sidings and working the traffic over the sidings :—

(1) As regards maintenance of sidings, the experience of the East, Indian Railway is that private sidings are never maintained up to the point of efficiency demanded on the railway itself, both from the point of view of safety and of guarding against heavy periodical renewals. As a result, from time to time, some of these private sidings have to be closed under instructions from the railway engineer, who is responsible for safety of rolling stock, etc., resulting in a dislocation of the colliery work. In the event of these sidings being handed over, the burden of maintenance will be transferred to the colliery company, but the necessity for constant supervision will still remain with the railway company. In this lies ground for constant disputes between the colliery companies and the railway, because, as has been stated above, it is with the greatest difficulty that the colliery companies can be induced to maintain their sidings in even a moderately safe condition.

If the maintenance were done as it should be, it is difficult to see how any other agency than the railway, with its resources in staff, material and superior supervising staff, could do the work more cheaply than at present. The cost to the railway at present may be taken to be roughly Rs. 15,000 per annum for all colliery assisted sidings.

(2) It is not possible to form any estimate of the recurring cost of working the traffic. It may be safely said that the saving in working expenses to the railway would not be such as to warrant any reduction in freight charges, and that the introduction of a separate transportation agency between the mines and the railway, however low its cost, must therefore result in an additional burden being thrown on the consumer.

(3) Another consideration is the cost of the increased damage to rolling stock which may be expected to occur while it is in the hands of the coal companies. Owing to the heavy grades, with light locomotives and possibly inadequate supervision and care, accidents and damage to rolling stock will be much more frequent than under existing circumstances, especially as it will be found very difficult to fix responsibility for damage on the colliery companies. It is easy to rule that colliery companies owning these branches will be responsible for damage to rolling stock whilst on their property, but in practice it will be very difficult to get collieries to admit liability and even harder to induce them to pay for damage. Under the existing assisted siding terms, they are responsible for damage or loss caused through their negligence, but they very seldom pay for any damage, even when any wagons are proved to have been actually derailed by them. Responsibility is either denied or evaded by some such excuse as defective wagon brakes, etc. It would, therefore, be necesary for a very thorough joint examination to be made at the transfer lines by the staff of the railway and the colliery, and this again will involve additional expense; it must not be forgotten that a defective wagon may be a source of great danger to all travelling on or using a railway.

(*h*) If, however, it is possible to overcome the difficulties and objections pointed out above, there could be no question that this proposal would be of some indirect benefit to the railway.

In the first place, it would reduce the amount of haulage and shunting that is now undertaken by the railway company as it would reduce the number of sidings to be served. This would considerably reduce the time occupied by engines in serving these collieries, more especially as the transfer lines at the entrance to these branches would, in a fair number of cases, be on the same level as the main line concerned, and consequently the railway company would be saved the haulage of wagons up severe grades to the main line, which in practice has often to be done at present. Also, if collieries owned their branches and sidings as well as locomotives, they could provide weigh-bridges and weigh their own wagons with a view to preventing overloading.

(*i*) The extent, however, to which broad gauge sidings could be handed over to collieries to be worked by them, in comparison with the large number of sidings in the coalfields, would be very small indeed. This will be clear when it is realised that there are, on the East Indian Railway in the Jharia and Raniganj coalfields, 339 assisted sidings owned by 228 collieries, and in addition to these there are 61 railway sidings on which 244 collieries have loading accommodation. Some of these collieries do not have more than one or two wagons space each. The very small owner is a special feature of the Bengal collieries and one which has to be taken into consideration.

Question 2.—Centralisation of loading depots and replacement of broad gauge sidings by light tramways.

(*a*) As regards this suggestion, it is one eminently to be desired from a railway point of view, and, if the collieries decide to adopt it, there can be no arguments against it. It will save the railway company a very large amount of shunting and haulage and consequently engine hours. If this centralisation of loading depôts is carried out to any very great extent, it will undoubtedly also release a large amount of permanent way and the coal now locked up underneath the sidings for the support of the same. The sidings at these loading depôts will actually require considerable enlargement, as, if screening plant is installed at them, several lines will be required at each depôt. While, however, the railway would welcome such a scheme, the policy is very much opposed to the practice so far adopted by collieries. Invariably, up till now, they have objected strongly to having to tram coal further than they are absolutely obliged to do. Whenever a new opening is made, if it is at all possible, they require a siding right up to it. Requests are not at all uncommon for extensions of existing sidings by as little as 200 or 300 feet in order to save tramming that distance.

(*b*) To carry out this proposal will require co-operation between the proprietors of collieries, both large and small. The experience of railway officials is that such co-operation will be very difficult to bring about. At present, when several collieries have to load at one siding, constant quarrels arise amongst them not only on account of encroachments, but even with regard to right-of-way, etc.

Question 3—Electrification of colliery branches.

(*a*) It can be shewn conclusively that, where there is sufficient density of traffic, the electrical operation of railways is decidedly an economical proposition, offering many advantages that are absent with steam working; but the question as to whether it is justifiable to proceed to such electrification in supersession of existing steam traction is usually very largely dependent upon considerations connected with the large outlay required for providing the electrification, and with the disposal of the existing steam equipment.

(*b*) In the present case, it is proposed to derive the necessary electric power from privately-owned generating stations, either already existing or to be provided by concerns other than the railway undertakings. In such case, the latter would not be burdened with the necessity of furnishing the outlay required for the generation of the power, and the proposal is, for this reason, the more feasible from the railway's point of view. The disposal of the displaced steam locomotives may not present any great difficulty.

(*c*) This in itself is a consideration of importance, but at the same time it would be necessary before it is possible to appreciate the position properly, to ascertain in full detail all the factors which enter into the matter; the nature and distribution of the track over which the electrification could be applied usefully, and the density and volume and weight of the traffic to be dealt with would have to be investigated, and, when all these particulars have been ascertained, it could be seen at what cost the electrical unit would have to be supplied from the outside source for the change to be a profitable one.

Question 4.—Insufficiency and unsuitability of rolling stock for coal loading.

(*a*) The necessity for maintaining a full and regular supply of wagons for loading coal at the collieries has for years past been recognised by the East Indian Railway, but, though great efforts have been made in the direction of increased wagon stock and increased transportation facilities both in the coalfields and along the routes over which coal has to be carried, various causes have prevented the transportation arrangements generally from keeping pace with the increased output of coal.

(*b*) Prior to the commencement of the War, the efforts of the East Indian Railway had been concentrated on the problem of dealing with the coal traffic in the downwards direction, *i.e.*, from the coalfields to Calcutta. A programme of regular annual additions to the wagon stock had been adopted, and various schemes were in progress for the improvement of the handling of traffic in and out of the coalfields, as well as the improvement of the route to Calcutta. It is believed that, if normal conditions had continued, the number of wagons available for coal traffic would have been sufficient to meet the regular annual increase in output to which the country had grown accustomed up to the year 1914.

(*c*) The War, however, brought about a complete change in conditions, the most important changes being the sudden development of a heavy traffic to the west of India as the result of the absence of shipping facilities for transporting coal by sea, and the rapid increase in output following on the development of indigenous industries stimulated by the absence of external competition and by the heavy demand for Admiralty and transport work. Thus the railway was faced with a complete reversal of direction of the main part of the coal traffic, coupled with a more rapid increase in output than had been expected.

(*d*) The effect of the reversal of the flow of traffic was threefold. Firstly, the arrangements for dealing with traffic at the various depôt stations and junctions in the coalfields required extensive alteration, and, until these could be carried out, difficulties and delays were bound to occur. Secondly, the capacity of the routes over which the coal traffic had now to travel was entirely inadequate, and, thirdly, the longer distance which individual wagons had to travel on the round journey resulted in a reduction in the available stock at any one time.

(*e*) Considerable improvements have now been made in the arrangements for getting the loaded coal wagons away from the coalfields and also in the transportation facilities along the routes over which the coal traffic has now to travel, and further work in these directions is still in hand. Broadly speaking, it may be said that, so far as the East Indian Railway is concerned, (1) the capacity of the railway in the coalfields for getting away coal is at present in excess of the possibility of output, (2) the capacity of the up-country routes is not quite equal to the capacity for getting coal out of the coalfields, but, with the doubling of the grand chord and the line above Allahabad, these routes would be able to deal with the coal traffic for some time to come, and (3) the determining factor is, and for some time will be, the inadequacy of the junction arrangements with the Great Indian Peninsula Railway, the Bombay, Baroda and Central India Railway, and the North Western Railway, and the want of capacity on those lines beyond the junctions.

(*f*) If the coal traffic is to continue to be carried across India instead of by sea, it will be necessary to provide additional wagons as well as carry out the works mentioned above, and, until this has been done, it is quite impossible to avoid occasionally supplying coal wagons which are not suitable for coal loading.

(*g*) Standardization has been taken up seriously and standard designs for wagons for all purposes have been prepared and agreed upon, but it must be many years before any considerable proportion of the total wagon stock of India can be of the standard type.

(*h*) On the East Indian Railway, any additions to goods rolling stock are undertaken with an eye to providing for the carriage of coal, but it must be remembered that the East Indian Railway has also an enormous volume of merchandise traffic to handle, which traffic is in many cases as indispensable as its coal traffic to the life and commercial prosperity of the country. Until there is a sufficiency of open wagons for the carriage of coal, it is not possible to supply only that type of wagons to collieries. Further, owing to the long lead that wagons loaded up-country have before returning to the collieries, it is most uneconomical to return them all empty from their destinations up-country to Bengal, especially as, for a large number of them, return loads of merchandise are available. It is for this reason that collieries are asked to load covered wagons in preference up-country and open wagons down-country. Unfortunately, in the majority of cases, very little notice is taken of these requests. Also it should be noted that, in many cases, collieries not using screening plant ask for covered wagons to be supplied to them for loading, more especially when loading coke. This is in order to safeguard against theft.

Question 5.—Adaptation of covered wagons to mechanical loading.

This railway has been experimenting with two covered wagons, each fitted with two roof doors. These have been tried for two months and loaded at Messrs. Kilburn & Co.'s Kustore siding on the Bengal Nagpur Railway. The reason why this test was made on the Bengal Nagpur Railway was because none of the mechanical loading plants on the East Indian Railway gave sufficient clearance for a covered wagon. Messrs. Kilburn & Co. have reported very satisfactorily on the suitability of these two wagons for the loading of coal from screening plants. The roof doors in question are having some alterations made to them in order to make the wagons secure from train thefts when loaded with merchandise, and there is no reason to believe that these roof doors will prove anything but satisfactory. It will, however, be necessary for all screening plants to be raised about another 4 feet, and for new screening plants to be erected to take these covered wagons, if these roof doors are adopted universally. But it must be understood that, for any real benefit to be attained, it will be necessary for all railways to provide roof doors to covered wagons. The Railway Board and the railways of India have agreed to broad gauge lines pooling their stock. This means that foreign railway wagons will be most extensively used and, for roof loading to be of any use, all broad gauge lines will have to alter their stock to suit the new conditions of loading. This is a very big order and it is doubtful whether a large number of the wagons now running could be so altered.

Question 6.—Provision of transportation for sand.

(*a*) It is not known what amount of sand will be required for this purpose, but it has been variously estimated at from 12 million to 50 million tons per annum, representing an increase of from 60 per cent. to 250 per cent. over and above the tonnage of coal now required to be transported, and, with the increase in the output of coal, there will be a corresponding increase in the amount of sand required.

(*b*) Whilst admitting that it is in the interests of the railway company to foster the conservation of the coal properties, if the bulk of the sand required is to be transported by the railways, the latter will be faced by great difficulties in accomplishing it.

(*c*) In the first place, the capacity of the yards at the weigh-bridge stations and of the colliery branches is, with the present traffic, very fully occupied and, when loading is heavy, most of them are strained to the utmost. Such additional facilities as are in contemplation are purely to meet existing requirements and anticipated increases of coal traffic. It will be quite impossible to deal with the sand traffic without very considerable and expensive additions to our facilities, both in the yards and also in some cases on the colliery branches. Colliery companies will also require additional siding accommodation.

(*d*) Furthermore, the time of the pilots now serving the collieries is in many cases fully occupied, and therefore in such cases a special service of pilots will be necessary for the supply and clearance of sand wagons to colliery sidings.

(*e*) Presumably the sand will be obtained from the Damudar River in both districts except where, in the neighbourhood of Barakar, the Khudia and Barakar Rivers will be found handy. This being so, on the Jharia field the transportation will be complicated by the transference of wagons, loaded and empty, between the East Indian Railway and Bengal Nagpur Railway. To minimise roundabout haulage, it will necessitate the construction of more connections with the Bengal Nagpur Railway. In any case, whether the loaded wagons come from the Bengal Nagpur Railway or direct from the depôt near the river, it will mean hauling them up heavy grades usually 1 in 80 and sometimes 1 in 100. When it is realised that up such grades our standard shunting engine will only haul at the most five of the 40-ton wagons (proposed by Mr. Rees), the difficulties involved will be realised.

(*f*) Further, in very many cases, although the distance between the sand loading points and collieries may be small across country, transportation of the sand in broad gauge wagons will almost certainly involve haulage over a long round-about route and heavy delays.

(*g*) Finally, what freight and empty haulage will collieries be able to pay for these sand wagons? Obviously the work involved on the part of the railways will be heavy and expensive, apart from the enormous expenditure involved in the provision of additional facilities. If the railways are to make any charge that will be commensurate with the cost, it would certainly be one that will cause a very heavy burden to fall on the consumer of coal.

(*h*) From the above it will be seen that the transportation of these sand wagons by the railways, even if found practicable, will be expensive and slow and would interfere with the transportation of coal itself. The method of transportation which would seem to be indicated would therefore be light railways in supplementation of the ropeways.

(*i*) The best method of dealing with this sand question will probably be by means of 60 centimetre stock. This gauge was found most suitable for somewhat similar work in France during the late War, and it would probably be found that a system of light lines could be put in to carry this unexpected traffic. The construction of such lines would of course have to be surveyed in conjunction with the East Indian Railway engineering department.

Question 7.—Effect of withdrawal of sand from rivers.

(*a*) So far we have been approached by only one group of colliery companies about sand supplies, and it is sufficient at the present time to examine their requirements. This amounts to *four million cubic feet* of sand per month. Assuming that the effective breadth of the river from which sand can be obtained is 1,000 feet and the depth 2 feet, this means that a frontage of 2,000 feet is cleared each month, or that this particular group of companies will require a frontage of at least two miles of the river bed for their six monthly supply. When several similarly powerful groups of companies are in work, it is obvious that in course of time the river bed will be seriously depleted of sand. It is obvious too that, if this enormous quantity of sand is to be transported by rail, it will necessitate the construction of a line parallel with the river bank with loading sidings at various points, the doubling of the Dhanbad-Katrasgarh and Kusunda-Pathardih branches, the provision of additional sidings at the collieries and a large addition to our rolling stock. It is suggested that these additional wagons shall be of 40 tons capacity, and such wagons would presumably be used for sand traffic only and would be unsuitable for coal. In this case it is necessary, in order to keep these wagons in commission, that sufficient sand be raised from the river bed during the dry season to meet the loading requirements during the monsoon as well. There is no inherent objection to the adoption of 40 ton wagons, but the advantage gained by the saving of wagons and wagon space is balanced by the greater facility of handling wagons of a smaller capacity on the severe grades and curves of the colliery sidings.

(*b*) As sand is required in such enormous quantities and from along such an extended frontage, it would be necessary that the supplies should be nationalised or placed under a board of control, which board would be responsible to the Local Government. It would be the duty of the board, in order to maintain equality of treatment, to arrange for the distribution of the sand, to regulate the working areas, and to determine the manner of working according to the varying conditions of the river. Powerful collieries might have their own conveyors and aerial ropeways, but smaller concerns would have to depend upon a supplying agency. The work of excavating the sand from the river be and conveying it to the railway sidings would have to be done by mechanical conveyors.

(*c*) The assumption has been made that no sand will be excavated below the low water level of the river. Each season will bring down fresh supplies of sand to fill up the areas that have been depleted, so that for many years to come the bed of the river will not be materially lowered. The source from which most of the sand will be obtained will be the Damudar River across which we have no bridge. The Barakar and Adjai will be drawn upon to a lesser degree. It is not anticipated that any prejudicial effect upon the bridges across these rivers will be caused. Such, if it does occur, could be counteracted by boulder-pitching.

Question 8.—Application from Messrs. Bird & Co. for conveyance of sand.

The Bengal Nagpur and East Indian Railways are at present considering an application from Messrs. Bird & Co. for the conveyance of sand from Pandakanali (Loyabad) on the Bengal Nagpur Railway to their collieries, principally Nawagarh, Budroochuck, Loyabad, Sendra, Teetulmari and North and South Mudidih. The proposition is still under consideration.

Oral Evidence in connection with the written replies of the East Indian Railway by Mr. E. Rogerson, Deputy Chief Engineer, East Indian Railway.

Question 1.—(*a*) In answering this, the railway has not taken any mining advice.

(*g*) There are very few sidings which are now privately owned or managed. We would not be prepared to stand by and be content with reimbursement for damage to rolling stock. There are even now constant disputes on similar points. The general opinion of the railway is that the present system of control should continue. At present, the collieries pay for all sub-grade work on sidings, while the railways pay for and maintain the permanent way.

(*h*) This is ideal rather than practical.

Question 2.—If some of the sidings could be re-aligned in Jharia, there would be a saving in working expenses, but sand-stowing would be necessary first and is not worth while everywhere.

Question 3.—This is not a question of practical politics at present. There would be no point in electrifying a siding which only has three trains running over it in a week.

Question 7.—(*c*) This is correct unless dredgers are used. Suction dredgers would be feasible but, unless the dredgers were anchored to piles or to the bank, there would be a risk of them being washed away in floods. Such dredgers could not work during high floods. Several dredgers would be necessary in proportion to the number and position of the main leads. We have proved 40 feet of sand in a boring near our bridge at Barakar, but this does not necessarily mean 20 feet all over the bed of the river. The excavation of 20 feet of sand near our railway bridge would affect that bridge, but it would be quite all right if no sand were excavated within two miles below the bridge. I have no idea of the amount of sand which is brought down by the rivers. The suggestion that the dredgers should work within bunds of boulders thrown into the stream is scarcely conceivable as the bunds would disturb the regimen of the river. Their construction would almost certainly be opposed by the Public Works Department irrigation authorities.

General.—More wagons by themselves would merely mean greater congestion, unless more facilities were also provided for handling these wagons. The sea traffic will, we expect, be resumed before long. We are adding to our line in order to deal with the expected eventual resumption of coal traffic to Calcutta.

Oral Evidence in connection with the written replies of the East Indian Railway by Mr. H. A. M. Hannay, Coal Manager, East Indian Railway.

Question 1 (*a*).—A lot of sidings are 1 in 80 or 1 in 100.

(*g*) (3) Disputes as to responsibility for damage would occur constantly. Joint examination of wagons would be necessary at the transfer sidings, and the collieries and railways would have to entertain suitable staff for this purpose, thus adding to their expenses.

(*h*) I would prefer the present arrangement to that under which collieries took over and worked our broad gauge sidings and branches.

Question 2.—This would suit the railways very well, but there are practical difficulties from the point of view of collieries. We are now often asked to place wagons for coal from particular seams at different parts of the same siding.

Question 4.—Blocking back by the Great Indian Peninsula and the Bombay, Baroda and Central India Railways is frequent. The provision of more wagons is primarily a matter of finance, to be decided by the Government of India. We must continue to supply Bombay by rail until sea freight is available. When this happens, the congestion will be very greatly relieved, but I think the up-country coal traffic will remain much the same as it is now, because the demand for coal up-country is increasing every day both for industrial and domestic purposes, which demands we could meet if coal for Western India and Karachi went by sea. The down-country traffic will probably be doubled. At present the Mining Engineer allots wagons for Government purposes, and the railways are supposed to allot wagons for all other purposes, but, owing to the shortage of supply, the Coal Transportation Officer has to step in and allow priority to industries which cannot readily obtain coal. He is also the Wagon Controller and regulates the making over of

wagons by one railway to another. The pooling of wagons was decided on at a general railway conference. With more wagons, much more traffic could be moved, though there is of course an upward limit. The provision of more ships is the essential remedy. Special open wagons are now supplied as far as possible to collieries with mechanical loading plant.

The meaning of (*e*) (1) is that we can supply transport for the whole year in excess of the whole yearly demand. Our utmost maximum up-country capacity is about 1,400, but a limit of 1,250 is more practicable. We cannot always supply the collieries in full at all seasons, and more wagons would enable us to do so.

Coal does not pay so well as other merchandise, but, as it is so necessary for other industries, it may be said to be the basis of our goods traffic. So far as the East Indian Railway is concerned, it is not correct that one-third of the wagons for the Docks must be covered for the purpose of up-country merchandise. The bulk of the wagons which go to the Docks come back empty as a matter of fact. In normal times, there is a good merchandise traffic to the Docks from the East Indian Railway and this provides practically enough covered wagons for the up-country merchandise from the Docks. I think it would be quite feasible to earmark a sufficient supply of open wagons for the traffic between the collieries and the Docks.

Question 5.—As regards wagons for mechanical loading plants, the solution, in my opinion, is roof doors to covered wagons, but the difficulty is that the other railways are not interested in supplying specially adapted covered wagons, and there would, therefore, have to be Government orders on the point. Our adapted covered wagon is perfectly water-tight. Certain collieries prefer covered wagons on account of thefts.

Question 6.—I do not think the railways could move the sand at all. Assuming that the idea of the 40 ton special sand wagon is dropped, it might be possible to arrange for ordinary wagons to take in sand and bring out coal, but it would be a bad arrangement and reduce the number of wagons available for coal loading. We could not undertake to supply, for carrying sand, an increase even of 60 per cent. over the present number of wagons. We have not got the wagons, and, if we had, we have not got the other facilities. The pilots are already overworked for the coal traffic alone. A separate service of pilots would be necessary, lines would have to be doubled, and more sidings provided. I think, if the railway is to move sand at all, a special sand wagon would be better, as much sand would be lost in ordinary wagons. The minimum possible freight on sand would be 9 annas 1 pie per ton within a 10 mile radius. This is at one-tenth of a pie per maund per mile over a minimum distance of 10 miles, plus a terminal charge. The above is the minimum rate approved by Government. I think the railways, with their present wagons and other facilities, could only move a very small proportion of the sand. Even then, it would not be a commercial proposition as the above rates are not commensurate with the work that would have to be done. But this is not of course the only point of view, as the railway is interested in conserving the coal.

Sixty centimetres is six-tenths of the present metre gauge of 3 feet 3 inches, *i.e.*, about 2 feet. I cannot say what maximum tonnage wagons such a line could carry, but I should imagine about 16 tons. The greatest difficulty would be the grades up from the rivers. The steepest portions of these grades are, however, not very long.

General.—The railway could collect a Rs. 2 cess as easily as a 2 annas one, but the rate would have to be all-round on all qualities of coal. It will be impossible to collect a sliding rate according to quality as we could not check loading and dishonesty would be encouraged.

Oral Evidence in connection with the written replies of the East Indian Railway by Mr. A. Wright, Colliery Superintendent of the East Indian Railway.

General.—If we had to sand-pack at Giridih, we could get our sand from the Barakar River about 8 miles away. We would probably put in a metre gauge line to carry the sand. We would never carry the sand through the air if we could bring it over the ground. But it is not necessary to sand-stow in Giridih, where we get 95 per cent. of the coal with a comparatively thin seam and a very good roof. We are, however, arranging to sand-stow on the Bokaro field. The cost there would probably be about 12 annas per ton and there would be corresponding advantages. Sandstone could be crushed if there were no sufficient sand in the Damudar River which is quite close. The seam at the Bokaro Colliery is 90 feet thick and the method of working out the coal in lifts or layers from the floor upwards, and stowing the goaves completely, is the only one by which the whole of the coal or nearly so can be recovered. The half-yearly profits will be a little less, but, as the mines will last much longer, the total profits will in all probability be more than if worked on the bord and pillar system. I think there will be plenty of sand in the river for stowing. If, however, it should prove insufficient, sandstone or other suitable material could be crushed and used in place of sand.

We have two shifts of work at the Giridih mines, a day shift and a night shift. There is no fixed time for the commencement or termination of these shifts. The miners, however, do not work more than 8 hours a day as a rule and some work less. The day shift miners are usually all down about 10 A.M. and the average time of coming up is between 5 and 6 P.M. Some come up earlier and some later. We are not strict on this point and there is no

compulsion. Shifts with a time fixed for their commencement and termination would in my opinion be dangerous if made compulsory by Government rule. It would drive the labour off the collieries. We raise a large output without compulsion and are satisfied with the present arrangements.

There is no special system of training at Giridih beyond the usual one by which the recruits learn from the older miners.

I think there ought to be a controlling authority to prevent waste in badly-worked mines Such an authority is necessary and advisable.

Practically all our coal-cutters are settled on the collieries and have about 2 bighas of paddy land each to cultivate, besides half a bigha of *bari* land surrounding their houses. The *hazri* labour has *bari* land only. The cultivation of the land by the coal-cutters interferes somewhat with the mining, and it would be a good thing for them to be miners and nothing else. Our people have many advantages in the way of good houses to live in, the Benefit Fund—from which men get Re. 1-2-0 per week, and women 0-12-0 a week, for sickness, Rs. 4-2-0 for a death, and Rs. 5 for a birth, and a marriage allowance of Rs. 5, besides a pension at the end of their service. The widows and orphans also get 0-12-0 and 0-6-0 a week respectively. In case of necessity, they can also get a loan of up to Rs. 25 from the same fund. In order to persuade them to give up the cultivation of their paddy land, we should probably have to increase their rate during the planting and reaping seasons so that they could afford to pay other people to do this work while they work in the mines. They all have service tenure leases and will never give up the land if they can possibly help it.

I would like to add that, with reference to paragraphs 91 to 94 and 105 of Mr. Rees' report recommending the centralization of loading depôts and the replacement of broad gauge sidings by light tramways in order that the coal under the siding could be taken out, although our Agent has said in his reply that it is a suggestion eminently to be desired from a railway point of view, I consider that it is not advisable from a mining point of view to take out the coal. It seems to me that Mr. Rees, when recommending this, was not aware that nearly all the coal under the sidings is shallow. The seams are very thick and, if extracted on the present system of work, the surface would be much broken up and subsidence would be very considerable; this would let a lot of water into the mines, make the dip coal more difficult to get, and increase the cost of pumping.

Written Evidence of Mr. W. C. Banerjee, of Messrs. Banerjee & Co., nominated by the Indian Mining Association.

Question 1.—The colliery owners, according to the present assisted siding terms of the two railways, have to provide support to the colliery branches and sidings. The railway company provides permanent-way materials for such sidings, the maintenance cost being met by the colliery companies. It will not improve matters, if the branches and sidings are worked by the colliery companies, and not by railway companies, with railway wagons and colliery locomotives.

Question 2.—As for a certain number of years the railway companies would not be in a position to supply wagons in full of indents, this project is impracticable. Even taking it for granted that arrangements can be made to supply wagons in full to avoid stacking and ensure prompt loading, the despatches depend upon demand for coal. The coal will have to be kept in stock. Then again, all collieries are not in a position to provide screening plants. If there are a limited number of screening plants at central loading depôts, then there will be always rows and confusion as to what users' tubs should be loaded first. Then again, these tubs from a colliery cannot be sent at certain fixed hours. They must be sent from the colliery as soon as they are raised to the surface, released and sent back.

Question 3.—If the small, narrow or metre gauge lines for the transport of coal tubs or small wagons to the main line siding or central depôt are electrified, it will be an improvement over traction by small locomotives, but it will not serve any useful purpose for broad gauge locomotives.

Question 4.—If coal wagons are standardised, the number of available wagons will be reduced. Now-a-days we are using all sorts and types of wagons of different railways. Covered wagons are seldom used for downward traffic. The waste in stocks can only be removed, when sufficient wagons are available.

Question 5.—It is practicable to remove the roofs of covered wagons. Half of the tops of these wagons are to be rivetted or fixed and the other half are to be in the form of a lid with hinges, to be taken up at the time of loading and put down when the loading is finished. Now-a-days the doors can be opened out and set in. If the whole of one side of a wagon over a certain height is put on hinges like doors, it can be put back. Here certain adjustment is to be made in the funnel of the screening plant discharging the coal and a covered wagon can be easily loaded.

Question 6.—With the present transport facilities, it is quite impracticable to provide such a large quantity of sand to meet all the requirements of collieries.

Question 7.—Removal of sand will affect the piers of railway bridges which can be saved by boulders being put on all sides.

Question 8.—So far as I am aware, no mine-owner has asked the railway authorities to convey sand in large quantities for packing purposes.

No Oral Examination.

Written Evidence sent in by the Honorary Secretary, Indian Mining Federation.

Question 1.—Mr. Rees seems to have arrived at the conclusion that undue restriction is put on the working of collieries for the protection of sidings, and he proposes, by the transference of the responsibility of such protection to collieries, to free at least that portion of the coal, the working of which is unnecessarily restricted. This, however, can as well be effected by amending the present railway siding rules. The course proposed is impracticable as a large number of collieries are too small to be in a position to make the capital expenditure and to bear the recurring expenditure. We consider that most of the recommendations of Mr. Rees in this connection have been made without due regard being had to the existing circumstances of the collieries, the position of the coal trade, the circumstances of the transport arrangements, the machinery of the working of mines, financial and otherwise, and, as such, some of the recommendations, though they might appear theoretically sound, are quite unsuited to most of the collieries.

No Oral Evidence Offered.

INSPECTORS OF MINES.

Written Evidence of Mr. H. Lancaster, Inspector of Mines, No. 2 Circle.

Question 1.—I do not consider that the existing Department of Mines could undertake to control the working of coal in mines. It would not be consistent for a department concerned with the safety of mines to supervise the economical working of mines. I am of opinion that, if a new department were created to control the working of coal, such department and the present Department of Mines should be under one technical chief. That officer should, however, not exercise more than administrative control over the Department of Mines. I consider that all questions relating to the support of railways, now undertaken by the Department of Mines, should be dealt with by the new Department.

Question 2.—Considerable damage has been done in the Jharia and Raniganj coalfields by the working of lower seams to the destruction of upper seams. In many cases, it would be possible to extract the upper seams subsequently. When the seams are not separated by sufficient ground, sand-stowing should be adopted.

Oral Evidence.

Question 1.—I am constantly ordering coal to be left behind in the mines because it would be unsafe to work it. The functions of conservation and safety are, therefore, inconsistent and this is the reason why I think that the new department should be separate from the present Mines Department. There would be no harm in having an advisory board to assist the technical head of both departments on general questions of principle. There should be some provision for appeals in such cases as the advisory board considers fit for appeal, and the appellate court might take the same form as that now provided for in the Mines Act. I do not think the present Inspectors of Mines could also look after economy of working. Assuming that the result of the proposals is to extend the present Land Acquisition Mines Act procedure to the whole of the collieries, I think that at least double the staff of the present Mines Department would be required for the new department. Nothing should be left to subordinates except surveying as a check. Even with a full staff of surveyors, say 10 field parties, I still think that double the present Mines Department staff would be necessary even at the beginning. The powers of the present Inspectors of Mines would have to be increased as the technical head of both departments would certainly only have time for administrative control over the Mines Department.

Question 2.—I think sand-stowing should be made compulsory where it is economically possible. This would cover small collieries working valuable seams.

Written Evidence of Mr. R. R. Simpson, Inspector of Mines, No. 1 Circle.

Question 1.—(*a*) No, I do not think that the Inspectors of Mines could do such work without detriment to the performance of their duties under the Indian Mines Act.

(*b*) Yes, the Mines Department and the suggested new department could be controlled by one technical chief, but he would not be able to exercise more than administrative control over the Department of Mines.

(*c*) Yes, the work under the Land Acquisition (Mines) Act would preferably be done by the suggested new department rather than by the Department of Mines.

Question 2.—No large amount of damage has been done as yet to upper seams by extracting pillars in lower seams, but great damage is probable in the future. Examples in the Jharia coalfield are :—

In the Raniganj series, the bottom seam has been dispillared in certain areas under the middle seam from 5 to 10 feet above. The middle seam is of inferior quality.

In the Barakar series, there is a colliery where pillars in 12 seam have been extracted over pillars in 11 seam only a few feet below. Efforts were made to dispillar both seams simultaneously, but most of the 11 seam pillars, and many of the 12 seam, were lost. At another colliery, simultaneous extraction of pillars in top and bottom sections of 15 seam led to considerable loss of coal. In another large colliery, 13 and 14 seams (lying close together) were worked into pillars. Collapse occurred over a large area. At many other collieries, contiguous seams of great thickness are standing on pillars.

In the Raniganj coalfield, certain areas of the Koithi (or Charanpur) and Hatnal seams have been damaged by the working of underlying seams.

The best remedy is to defer the working of lower seams until the upper seams have been extracted. This counsel of perfection is usually followed so far as the extraction of pillars is concerned, but in the case of closely contiguous seams this is not enough to prevent loss. Where contiguous seams are already standing in pillars, loss can only be prevented by filling the lower workings before extracting the pillars in the upper seam.

Oral Evidence.

Question 1.—I do not think it will be advisable for the present Mines Department to do the work of the controlling authority even with an increased staff. I think the safety of labour and the control of working should be kept distinct. If the Mines Act work took three whole-time men, and the control work seven whole-time men, I still think that the two departments should be separate and would not have all ten men in one department. The Chief Inspector of Mines might be at the head of this department, but I do not think he would have much time for Mines Act work. It would, however, be a good idea to have one technical chief over both departments to prevent friction. The size of the staff of the new department would depend entirely on what work they would be required to do. I am not prepared to say anything definite without complete information on this point. It would be more a question of surveyors than of inspectors in the new department. A number of qualified mining engineers would also be required of much the same type as those in the present Mines Department. There is, however, the French precedent for control being exercised by the Mines Department.

Question 2.—Rotation might be left to the discretion of the controlling authority. He must be guided also by commercial considerations, but much discretion would be necessary. Private ownership would of course be interfered with, but I think something should be done to stop the present waste. Interference might extend to stopping work in a mine if necessary. In my opinion, the minimum workable thickness of coal in India at the present time is about 4 feet.

SPECIAL WITNESS.

Written Evidence of Mr. E. S. Tarlton of Messrs. Bird & Co.

Question 1.—Replying to this, I have made a study of aerial ropeways and have been instrumental in designing aerial ropeway plants for the purpose of carrying coal and sand. In both the Jharia and Raniganj coalfields, ropeways might have saved the locking up of many million tons of coal which is now locked up by railway sidings. I will here point out that I do not think it is now possible in all collieries to adopt this method of transport. Many of the old collieries were laid out long before ropeways were thought of for this country, thereby making it impossible to create angles in the aerial line to meet all circumstances. Each and every colliery therefore must be considered on its merits, and transport arranged accordingly. Where the railway is brought in and split up on the property to permit of sidings reaching several loading wharves, aerial ropeways would be useful and save the locking up of coal prevalent to-day. At several of the collieries in which I am interested, much coal is locked up in this way ; thus, for example, we have as much as 4 million tons of coal locked up in one property to provide support for railways. This coal cannot be removed until the railway track is either taken up, or the area sand-packed, as the railway is feeding other properties in which my firm has no interest.

I notice your Committee refers to a monthly supply of one million tons of sand distributed to various collieries in the Raniganj and Jharia coalfields. This amount of sand would give a recovery

of 432,000 (*i.e.*, 480,000 less 10 per cent. wastage) tons per month from areas now standing on pillars, *i.e.*, 40 per cent. of coal already removed, the balance being in pillars. My firm have a scheme already in preparation for dealing with 225,000 tons of sand per month for one section of the Jharia collieries; I am afraid it will be necessary for you to consider far larger quantities to be of any use to the two coalfields. There would be no difficulty in ropeways carrying such quantities of sand. Ropeways should not be used, nor is it possible to use them, to deliver sand to every individual colliery requiring sand. My idea is to bring about a combination between the railways, collieries and aerial ropeway companies, whereby the aerial line shall be erected between the rivers and a central distributing station or marshalling yard, the railway being used to convey the sand to the colliery sidings, except in cases where the ropeway can conveniently deliver and is cheaper than the combination with the railway; the number of ropeways to be determined by the quantity of sand to be carried. Sand would be delivered into elevated bunkers, which would be so built as to allow special hopper-bottomed wagons to pass underneath. These wagons would be loaded through shutes in the bottom of the bunker (this operation will occupy only a few minutes—half an hour for one rake of 20 forty-ton wagons). The rake or rakes will be removed by the railway company (special stock allotted for this purpose) to the colliery indenting for sand (nothing shall be supplied under one rake), the colliery company having the sand hopper placed in such a position as to permit of wagons being drawn over the top of the sand pit and unloaded by the method applied at the loading bunker, *viz.*, through shutes in the bottom of the hoppers.

Question 2.—There is no reason why ropeways should not be so designed as to serve the double purpose of conveying coal from the pit-mouth to several central sidings, and sand from such sidings to the pit-mouth.

Question 3.—Owing to the varied duties aerial ropeways are now called upon to perform, we have designed and installed numerous systems, but the only two suitable for transporting sand any considerable distance across country are the *Monocable System* and the *Double Rope System*; there are, however, few cases where the former does not show to advantage over the latter, owing to its greater simplicity and flexibility if properly constructed. It is impossible to determine which system should be adopted without going very carefully into the technical details which are affected by the local conditions of ground, etc., and one cannot lay down any hard and fast rule as to where one type or the other should be installed, as there are so many governing factors. *The Monocable System* consists of one constantly moving endless rope which is employed both to support and haul the loads; in the case of the *Double Rope System*, the loads run on a standing or rail cable and are hauled along by a separate light traction rope. The loads on either system are automatically attached to, and detached from, the ropes at the terminal loading and unloading stations, and run round the station rails by hand to and from the loading and unloading bins. We have erected *Monocable* lines dealing with hourly capacities of 200 tons, a line of this capacity, 4 miles long, would to-day, erected complete, cost approximately 4½ to 5 lakhs of rupees, and the cost per ton mile including renewals, labour, power, supervision, and interest on capital be under ·75 annas. The sand can be automatically dumped from the ropeway buckets at any point along the line, consequently, by raising the heights of the trestles, the necessary stock dumps of sand at the collieries for use during the rains can be most economically formed close to the bore hole and when required washed along troughs to it. I am convinced that aerial ropeways, designed and constructed by engineers who have specialised on this method of transport, will play a leading part in supplying the Indian collieries with the necessary material to adopt a system of hydraulic stowage, whereby the coalfields can be economically worked and conserved for the future benefit of the numerous industrial concerns now starting in this country.

Oral Evidence.

The quantity of sand which could be carried by ropeways would depend on their number. All the sand would not be brought to one place nor would there be one line to each colliery. We should be able to supply a number of collieries in Jharia (Sijua) from the Pandkanali centre, 4½ miles from the Damudar River. I don't think there will be any difficulty about land except in one small section where the land does not belong to the Central Jharia Coal Company. The railways are willing to help in distributing from this central point. They will have to supply specia rolling stock for sand, *i.e*, 40-ton open hopper-bottomed wagons. If the controlling authority took over our scheme, we would not want a royalty on sand carried over our properties unless the superior landlord charged us royalty. I cannot say whether any such royalty is charged without reference to the lease. I am satisfied that our scheme is economical in view of the coal which we will be able to recover and which is otherwise irrecoverable, but I hope Government will continue with the general scheme as it will cost us about Rs. 1-4 per ton to sand-stow and other companies may not do it. The sand deposit is 80 feet deep at the point we suggest taking up, the width of the river being 1,350 feet. The large quantites of sand will be taken from different sections of the river and there will be no need to go below the water level.

2. The number of ropeways would depend on the number of centres selected. At the Jharia end, our centre would be at the Standard Colliery. I have not gone into the comparative cost of ropeways as against light broad gauge railways worked by ourselves.

3. The depreciation we allow on ropeways is 10 per cent. The life of the rope depends on the tonnage carried. Without looking into the matter, I cannot say what proportion of the total cost

would be represented by the rope alone in a ropeway of 4,000 feet. I have no idea what it would cost the railways for extra stock. The trucks would be run over bunkers and emptied as they pass. The bunkers would be connected with bore holes and the mixing would also be done under the railway line.

4. I saw the Ropeways Bill about a year ago. It would be necessary to acquire land for trestles. I think it necessary to take up land, say a strip about 10 feet wide on either side of the centre line, for repairs, etc.

5. As regards the question of royalty, we cannot get anything definite out of the Jharia Raja. Our own idea is a very small royalty—a quarter anna per ton. This is somewhat higher than Mr. Rees' rate of quarter anna per cubic yard. We are not paying any royalty at present and would of course like to get sand free of charge.

6. The question of ropeways in Raniganj would involve longer leads, but a less amount of sand would be necessary on account of the thinner seams. Ropeways work satisfactorily over 10 mile sections. For short leads, endless haulage is cheaper than ropeways. Our line for 750 tons per hour will cost about one lac a mile. I do not think light locomotives could take the quantities of sand required, nor could they work over the ground covered by ropeways. In some cases a railway would be better than a ropeway from the river to the distributing depôt, but, in view of the liability to floods, I do not think that the railway would put down a siding near the river. We would use high level sand banks during the rains. I do not think that suction dredgers would be suitable as they could not be used for the required head of 40 feet.

7. To handle 7,800 tons of sand per day with our mechanical appliances, the extra labour would not be more than 25 men at the loading end and 5 men on the bunkers. The effect on labour would be small, and I do not think the labour question would present any difficulty in sand-stowing. Mechanical loading is, however, essential owing to the quantities of sand required. The capacity of our machine is 2 tons a minute, and its cost is £1,500. Much larger machines than these can be obtained and would be necessary for handling 40,000 tons of sand per day.

8. I think the banks of sand would replace themselves after excavation; not in the same place perhaps, but in the other bends which would fill up after floods. I do not consider that any difficulty may be feared as regards the amount of sand available for sand-stowing.

9. I think 5 or 6 central stations would be required in the Jharia coalfield. It would not be advisable to have a radius of more than 6 or 7 miles from these central stations.

APPENDIX E.

Note by Mr. Hockly of Messrs. Mackinnon, Mackenzie & Co. in regard to Coal Mixing.

The question of the mixture of Indian coals in order to obtain the best results, from the point of view both of efficiency and of economy, has for long occupied our attention.

2. In the purchase of coal, the British India Steam Navigation Company confines itself as far as possible only to the better qualities of coals, as it is found that no less than three advantages are gained by doing so :—

1 Vessels steam better and therefore occupy less time on the voyage.

2 Less consumption and therefore less bunkers required, and consequently more carrying capacity for cargo.

3 Less wear and tear for boilers as good coal does not require constant stoking and replenishing. Lower percentage of ash and clinker, and therefore less trouble for engine room crew.

3. For the Company's fast mail steamers, Equitable or Bengal Coal Company's Desherghur coal was very largely employed by itself, or selected Jharia 14 and 14-A seam, from Bhowra Colliery, or from collieries in the near vicinity working the same seam, such as Bararee. Coal of either of these qualities gave excellent results, some steamers preferring Desherghur, others the selected Jharia. We then tried a mixture of half Desherghur and half Bhowra, which yielded excellent results. The former is a softer coal and high in volatiles, but is greatly improved and the consumption reduced with an admixture of Bhowra or similar coal which is of a harder nature, but at the same time has a high percentage of fixed carbon. We have had good results also from a mixture of $\frac{1}{3}$ Desherghur and $\frac{2}{3}$ Bhowra. Latterly, we experimented with what is known as 11 and 13 seams Bhowra and Desherghur in the proportion of half and half, and obtained results hardly less favourable. No. 12 seam Kankanee, a coal very high in calorific value, which we have only recently commenced opening out, we have tried by itself and received a good report on it, and, as soon as we have mined a sufficiency of this seam to allow of more extended trials, we purpose mixing it with Desherghur. At the instance of Mr. Church, Mining Engineer, Railway Board, we also tried a mixture of Desherghur and 17 seam, from Messrs. Macneill & Co.'s Hurriladih Collieries, and also 17 seam Jamadoba in the proportion of $\frac{3}{4}$ Desherghur to $\frac{1}{4}$ 17 seam, and found this to be very satisfactory both as regards steaming and economy of feul. 17 seam from collieries working it on the western side of the Jharia field is not so good.

4. The foregoing experiments were made in connection with the company's fast mail steamers, which must be driven practically the whole time, and require to extract the very essence of the coal in order to keep their timing, more especially during the monsoon. These constitute very severe tests for coal. For the intermediate or slower mail service steamers, we supplied prior to the War a mixture of Equitable Desherghur, Bhowra 13 and 14 seams, and best Ghusick coal in more or less equal proportions, and had no reason to complain of the results obtained which were eminently satisfactory. As regards bunker coal for our cargo steamers, we find that a mixture of first class Jharias, other than selected, answers very well. We are averse to the mixture of the majority of coals from the Raniganj or Lower District for bunker purposes owing to the tendency of some of them to heat if stored for any length of time in the open, or if kept for any considerable period in a confined space such as bunkers.

APPENDIX F.

Information collected regarding Quantity of Sand available.

LIST OF PAPERS.

(1) To—The District Engineer, Manbhum, No. 28 C. C., dated 5th February 1920.

(2) From—The District Engineer, Manbhum, No. 3380, dated 14th February 1920.

(3) To—The Hon'ble Mr. F. A. A. COWLEY, Secretary, Government of Bengal, Public Works Department.
„ Mr. S. C. WILLIAMS, Vice-Chairman, Port Commissioners, Calcutta.
„ Mr. C. ADDAMS-WILLIAMS, Superintending Engineer, Public Works Department, Bengal.
} Nos. 29 to 31 C. C., dated 5th February 1920.

(4) From—The Hon'ble Mr. F. A. A. COWLEY, Secretary, Government of Bengal, Public Works Department, No. 413 I., dated 10th February 1920.

(5) From—Mr. S. C. WILLIAMS, Vice-Chairman, Port Commissioners, Calcutta, D. O. No. 34, dated 6th February 1920.

(6) From—Mr. C. ADDAMS-WILLIAMS, Superintending Engineer, Public Works Department, Bengal, No. 49, dated 13th February 1920.

(7) To—Messrs. H. V. LOW & Co.
„ „ BIRD & Co.
„ „ MACNEILL & Co.
„ „ ANDREW YULE & Co.
„ „ JARDINE SKINNER, & Co.
} Nos. 161-165 C. C., dated 19th February 1920.

(8) From—Messrs. H. V. LOW & Co.

(9) From—Messrs. BIRD & Co., No. C. C. $\frac{1989-20}{14}$, dated 28th February 1920.

(10) From—Messrs. MACNEILL & Co., No. C. 1877, dated 23rd February 1920.

(11) From—Messrs. ANDREW YULE & Co., No. G.—485, dated 23rd February 1920.

(12) From Messrs. JARDINE, SKINNER & Co., dated 25th February 1920.

(13) To—Mr. C. ADDAMS-WILLIAMS, Superintending Engineer, Public Works Department, Bengal, No. 166 C. C., dated 19th February 1920.

(14) From—Mr. C. ADDAMS-WILLIAMS, Superintending Engineer, Public Works Department, Bengal, No. 59, dated 23rd February 1920.

(15) Oral Evidence of Mr. E. L. GLASS, Executive Engineer, Public Works Department, Bengal.

(1)

No. 28 C. C., dated 5th February 1920.

To—The District Engineer, Manbhum District.

I have the honour to say that the Coalfields Committee recently appointed by the Government of India will be obliged if you will kindly let me know, as soon as possible, the general result of your boring operations in showing the depth of sand available in the Damudar River. It is understood that these borings were made by you in connection with a proposed bridge at Pupunki.

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(2)

No. 3380, dated Purulia, the 14th February 1920.

From—F. D. WELLWOOD, Esq., District Engineer, Manbhum District.

With reference to your No. 28 C. C., dated the 5th February, I have the honour to state that trial borings have been taken by me at two places in the Damudar River bed. At Pupunki Ghat, I found the maximum depth of sand to be 35 feet, average 25 feet, width of sand bed about 1,100 r. ft. At Kargali Ghat, the maximum depth was also 35 feet, average 26′ 9″, width of sand bed 1,800 r. ft.

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(3)

No. 29—31 C. C., dated the 5th February 1920.

To—
- The Hon'ble Mr. F. A. A. COWLEY, Secretary to the Government of Bengal, Public Works Departmet.
- S. C. WILLIAMS, Esq., Vice-Chairman, Port Commissioners, Calcutta.
- C. ADDAMS-WILLIAMS, Esq., C.I.E., Superintending Engineer, Public Works Department, Bengal.

The Coalfields Committee recently appointed by the Government of India has desired me to ask you whether you have any information as to the quantity of sand which is brought down by the Bengal rivers. The information is required in connection with the proposed introduction of sand-stowing in colliery working. The rivers more particularly concerned are the Damudar, Barakar and Adjai Rivers.

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(4)

No. 413 I., dated 10th February 1920.

From—The Hon'ble Mr. F. A. A. COWLEY, Secretary to the Government of Bengal, Public Works Department.

In reply to your demi-official No. 29-C. C., dated the 5th February 1920, I regret to say that we have no information on the question of the quantity of sand which is brought down by the rivers in Bengal. The subject is a very difficult one and has not been studied in any detail or with any attempt at accuracy, and it would perhaps form a more suitable problem for a physicist than an engineer.

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(5)

D. O. No. 34, dated 6th February 1920.

From—S. C. WILLIAMS, Esq., Vice-Chairman, Port Commissioners, Calcutta.

With reference to your demi-official No. 30-C.C., dated the 5th February, I think perhaps the most useful figures I can give you are those contained at the end of Chapter III (page 59) of

Mr. Reaks' note incorporated in Volume I of the recently issued "Report on the Hooghly River and its Head Waters;" these are—

Volume of Dry Silt carried in suspension.

(Silt charge taken as $\frac{1}{1028}$ by volume).

1st June to 30th November.

Bhagirathi	34	million cubic yards.	
Bhairab-Jalangi	17·5	„	„
Matabhanga Churni	8	„	„
Ordinary total volume of silt carried into Hoogly each season	54·5*	„	„

* (= a cube 1 mile square and 52¾ feet thick).

But you will of course understand that silt and sand suitable for your purposes are not necessarily the same thing. As a practical proposition, it would be necessary to find out where large quantities of suitable sand could be taken at the lowest possible price for transport to the coal mines, and I feel myself that the preparation of really reliable figures would mean a good deal of careful investigation. I think Mr. Addams-Williams would be a very useful person to consult in this connection. It is possible we might be able to be of some assistance by means of our dredgers, but I am not quite clear that this would be an economical arrangement.

(6)

D. O. No. 49, dated the 13th February 1920, Imperial Secretariat Buildings, Calcutta.

From—C. Addams-Williams, Esq., Superintending Engineer, Public Works Department, Bengal.

Your demi-official No. 31-C. C. of the 5th instant. I am afraid we possess no information regarding the quantity of sand brought down by the Bengal rivers as the few experiments that have been made in this Province do not differentiate between pure sand and alluvium: moreover, the experiments relate to material in suspension and take no account of the quantity of sand rolled along the bed, which composes a large proportion of the solids transported by a river.

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(7)

D. O. No. 161—165 C. C.-12, dated Calcutta, the 19th February 1920.

To—Messrs. H. V. Low & Co.
„ „ Bird & Co.
„ „ Macneill & Co.
„ „ Andrew Yule & Co.
„ „ Jardine, Skinner & Co.

I am directed by the Coalfields Committee to request that you will be good enough to let me know, as soon as possible, the general result of any boring operations your firm may have conducted in the Damudar River with reference to the amount and depth of sand available.

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(8)

From—Messrs. H. V. Low & Co.

Messrs. H. V. Low & Co. have submitted a plan (through the Hon'ble Mr. Pattinson) showing the results of several borings made in the Barakar River at their Begonia Khas Colliery. There were five bore holes (Nos. 6, 7, 8, 4 and 11) through sand showing respectively the following depths of sand:—

No. 6	Sand 89 feet.
„ 7	„ 53 „
	Coarse sand 17 feet.
„ 8	Sand 65 feet.
	Coarse sand 15 feet.

No. 4	Sand 43 feet.
	Coarse sand 13 feet.
„ 11	Sand 58 feet.
	Coarse sand 8 feet.

These bore holes covered an area of, approximately, 1,350 feet of the river bed.

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(9)

No. C. C. $\frac{1989-20}{14}$, dated Calcutta, the 28th February 1920.

From—Messrs. BIRD & Co.

In reply to your demi-official No. 162 C. C.—12, dated 19th February 1920, we beg to advise you that :—

Our boring in the Damudar River, Saltore is 132 feet.

Our boring in the Damudar River in the side of the bank directly S. W. of Bhulanbaree is 20 feet.

The depth of sand in the Barakar River, as per 4 centre wells in the Barakar Bridge plan are 40 feet, 100 feet, 90 feet and 50 feet.

The 100 feet depth is the well in the middle of the river.

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(10)

No. 1877-C., dated Calcutta, the 23rd February 1920.

From—Messrs. MACNEILL & Co.

In reply to your letter No. 163 C. C.—12, dated the 19th February 1920, we beg to inform you that we have not carried out any boring operations, such as referred to, in the River Damudar.

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(11)

No. 485 G., dated Calcutta, the 23rd February 1920.

From—Messrs. ANDREW YULE & Co., LD.

In reply to your No. 164 C. C.—12, dated the 19th February 1920, we beg to inform you that the Bengal Coal Company has not put down any bore hole in the Damudar River to ascertain the amount and depth of sand available.

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(12)

Dated Calcutta, the 25th February 1920.

From—Messrs. JARDINE, SKINNER & Co.

We are in receipt of your letter No. 165 C. C.—12, dated the 19th February 1920. Some time ago our Sutikdih Colliery manager put down a boring in the Damudar River 7 feet only in sand, but he could not proceed further as the process was not suitable.

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(13)

D. O. No. 166 C. C.—12, dated Calcutta, the 19th February 1920.

To—C. ADDAMS-WILLIAMS, Esq., Superintending Engineer, Public Works Department.

I am desired by the Coalfields Committee to enquire whether you will be good enough to send me figures for the last 15 or 20 years showing the rise of the bed of the River Damudar owing to silting up. In his evidence before the Committee to-day, Mr. Glass said that this information was available.

(14)

D. O. No. 59, dated Calcutta, the 23rd February 1920.

From—C. ADDAMS-WILLIAMS, Esq., Superintending Engineer, Public Works Department, Bengal.

With reference to your demi-official letter No. 166 C.C.—12 of the 19th instant, the only information I have obtained of a rise in the bed of the River Damudar is by a comparison of the bed levels in 1888 and 1913 at and below Burdwan, which show a rise of about 2½ feet in this period: the rise, though not large, was accompanied by a very considerable contraction in the width of the river, but these alterations probably do not extend for more than about 15 miles above Burdwan, as they are the outcome of the river obtaining relief in this locality by spilling over its right bank: the section taken in 1913 at Raniganj was almost identical with that taken about 50 years previously showing that the régime is steady and the bed unaltered.

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(15)

Oral Evidence of Mr. E. L. Glass, Executive Engineer, Public Works Department.

The Damodar Flood-Control Project includes proposals for two large reservoirs, one on the Barakar River just below the Usri Naddi junction, and one on the Upper Damudar River below Pupunki, where a bridge is now being built by the Bihar and Orissa Government. Provision has been made for dismantling this bridge and diverting the road over the proposed dam. I have drawn up the plans and estimates and have submitted the complete Flood-Control Project to the Superintending Engineer. It has not yet been submitted to Government. The dams are designed mainly as earthen embankments with masonry outlets unprovided with sluice gates, but of area sufficiently restricted for throttling the rate of flow of floods and thus reducing the heights of floods in the lower reaches of the Damudar. This will entail holding back temporarily in their reservoirs a portion of the water brought down by the floods and much of the silt carried by these floods. The total area of outlet openings provided in the designs are 2,070 square feet and 3,546 square feet for the Barakar and Upper Damudar Dams respectively. An alternative proposal for a single masonry dam on the Barakar River above the Usri junction is also being considered. This dam would of course have no effect on the sand flow in the Upper Damudar, and a smaller effect on that in the Barakar River, than a dam below the Usri junction.

2. As regards the quantity of sand brought down by the Damudar and Barakar Rivers, I have no definite information as no measurements have been made, and I therefore cannot say whether sufficient sand would always be available for replacing any very large quantity that might be regularly removed for any purpose. I have made soundings in the bed of the Upper Damudar below Pupunki and have found 20 feet of wet sand, while borings in the bed of the Barakar River near the junction of that river with the Damudar gave 40 to 60 feet of sand. Sand travels down the river mainly during the passage of large floods from the Chota Nagpur hills. The volumes of these floods average 60,000 million cubic feet, but may go up to as much as 200,000 million cubic feet. From observations and studies made by me, it is my opinion that the average proportion of water volume to that of fine silt in suspension is about 500 to 1 for the total monsoon flow, and about 100 to 1 during high floods. I cannot say definitely whether the volume of heavy sand moved along and near the bed is greater or less than that of the fine silt, but I am inclined to think it is considerably less for small floods and somewhat greater for large floods. The sand travels at a lower speed than the bulk of the water, and is deposited as the flood subsides, so that a given section of the moving sand is alternately carried forward and deposited by successive floods several times before finally reaching the mouth of the river or its spill area. The rate of this saltatory travel down the river depends on the frequency and violence of floods. I am unable to say to what depth below river-bed sand is liable to be moved by floods, but even during large floods the depth is undoubtedly small compared with the total depth of sand.

3. The sand deposits along the bed of the Damudar are certainly a source of trouble as there is evidence of the bed rising steadily, and I agree that the periodical removal of sand in large quantities would minimise flood difficulties and reduce damage to flooded areas, but such removal would not appreciably reduce the flood heights for the larger floods. The effect of the proposed dams on the sand movement would be that, for the first few years (probably about five), all sand brought down from above each dam would be held back in its reservoir until this silted up to the level of the outlets. Later on, sand would pass through these outlets, at first in smaller quantities than passes the site at present, but eventually something like the existing rate of passage of sand would be restored, probably about 10 years after the silt has reached outlet level. The deposits of sand above the dams would extend about 12 miles upstream along the beds of the main rivers and of their affluents in this length. I do not think that it will be necessary to use dredgers for removing silt from the reservoirs.

4. As regards the effect of considerably deepening the river bed for a stretch of three miles, I am of opinion that the excavation would trap the sand now brought down by the river from above the site, but would have little or no effect in increasing the present rate of sand movement. The excavation, being below spring level, would remain full of water and the slope of water surface would only be altered by the increased waterway in the excavated length. At present, the fall in river bed and water surface in a 3 mile sandy reach is about 10 to 15 feet. The sandy bed above the excavation would certainly scour back specially during low stages of the river's flow, but only for a short distance upstream, say one or two miles, and only to an average depth of about 3 feet.

APPENDIX G.

Manufacture of Coke.

LIST OF PAPERS.

(1) To—R. H. NICHOLS, Esq:
„ F. W. TUTWILER, Esq.
„ G. H. FAIRHURST, Esq. } Letter Nos. 37—39 C. C., dated 6th February 1920.

(2) From—G. H. FAIRHURST, Esq., dated 7th February 1920.

(3) From—R. H. NICHOLS, Esq., No. 1252 G.-M., dated 27th February 1920.

(4) To—The Agent, E. I. Ry.
„ „ „ B. N. Ry. } Nos. 45—46—2 C. C., dated 6th February 1920.

(5) From—The Agent, B. N. Ry., No. 2428, dated 14th February 1920.

(6) „ „ „ E. I. Ry. No. T. 5580, dated 20th February 1920.

(7) To—Messrs. KILBURN & Co., No. 50—C. C., dated 7th February 1920.

(8) From—Messrs. KILBURN & Co., dated 17th February 1920.

(9) To—R. W. CHURCH, Esq., No. 51 C. C., dated 7th February 1920.

(10) From—R. W. CHURCH, Esq., No. 14, dated 11th February 1920.

(11) To—The Agent, E. I. Ry., No. 59 C. C., dated 7th February 1920.

(12) From—The Agent, E. I. Ry., No. 4277, dated 10th February 1920.

(13) To—The Agent, E. I. Ry., No. 122 C. C., dated 16th February 1920.

(14) From—The Agent, E. I. Ry., No. 7544, dated 9th March 1920.

(15) To—C. S. WHITWORTH, Esq., No. 60 C. C., dated 7th February 1920.

(16) From—C. S. WHITWORTH, Esq., No. 48, dated 21st February 1920.

(17) Evidence of Mr. L. DIAMOND, MANAGER, LODNA BY-PRODUCT COKE PLANT.

(1)

Nos. 37—39 C. C., dated the 6th February 1920.

To—R. H. NICHOLS, Esq., General Manager, Bengal Iron and Steel Co., Ltd., Kulti.
T. W. TUTWILER, Esq., General Manager, Tata Iron and Steel Co., Ltd., Jamshedpur.
G. H. FAIRHURST, Esq., c/o Messrs. Burn & Co., Calcutta.

I am directed by the Coalfields Committee to the Government of India to send herewith a copy of Mr. Treharne Rees' report, to invite your attention to paragraphs 77 to 83, and to request an expression of your opinion on the general question raised. In particular, it has been represented to the Committee that the erection of by-product plant by a few companies will in itself put an end to the practice of coking coal in open ovens. The Committee will be glad if you will kindly inform it whether you share this view.

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(2)

Dated Calcutta, the 7th February 1920.

From—G. H. FAIRHURST, Esq.

I have the honour to acknowledge receipt of your letter No. 39 C. C., inviting my opinion on paragraphs 77 to 83 of Mr. Treharne Rees' report which I have pleasure in stating as follows:—

I am certainly of opinion that the completion of coking plants now being erected and under consideration will see the end of the practice of coking coal in open ovens. In fact, I would go so far as to say that, in five years time, the quantity of first class coking coal carbonized in this class of oven will be practically *nil*. Regarding also the use of the best coking coals for general purposes, I consider that this will be discontinued at a very early date in view of the demand for this quality of coal for metallurgical purposes.

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(3)

No. 1252 G.-M., dated the 27th February 1920.

From—R. H. NICHOLLS, Esq., General Manager, Bengal Iron and Steel Co., Ltd., Kulti.

In acknowledgment and reply to your letter No. 37 C.C., dated 6th February 1920, I was compelled by great pressure of business to hand your request to the Company's Colliery Superintendent for attention. I herewith submit his report.

Indian Coals.

Designation.	Colliery.	Fixed Carbon.	Volatile matter.	Ash.	Water.	Calorific value.	B. T. U.
Dishergarh	Sodepore	54·00	33·36	10 26	2 38	6,218	12,268
	Sanctoria	52·58	33·61	11·26	2·55	6,331	11,395
	Sitalpur	55·26	32·42	9·86	2·46	6 787	12,207
Ponati	Banksimula	53·10	35·05	8 65	3·20	6,790	12,222
	Damudapore	50 60	32·88	10 80	6·22	6,542	12,315
	Koithi	54·17	29·92	11·60	4·31	6,723	12,101
Mohuda	Bhatdee	57·23	31 33	10 00	1·44	7,209	12,976
	Murulidih	57·29	29·88	10 90	1·93	6,923	12,461
Chanch	Chanch	65·80	23·39	8 56	2·25	6,955	12,519
	Laikdee	63·12	26·21	9·22	1·45	6,679	12,022
Rajhara	Rajhara	62·00	21·70	12·20	4·10	7,282	13,107
Giridih	Giridih	66·80	23·48	9·08	0·64	7,857	14,142
	Raniganj	48·00	34 85	11·05	5·90	7,172	12,909

Analysis of Scotch Coking Coals.

No. of sample.	1	2	3	4	5	6	7
Moisture	4·9600	5·1000	3·9400	5·2000	4·6600	5·6000	5·1400
Volatile Matter	32·1400	34·2500	31·5900	33·3500	31·6900	32·2500	31·2100
Fixed Carbon	57·8287	58·5700	55·2237	58·9500	58·4000	54·1500	57·1500
Sulphur	0·5697	0·5800	0·9885	,,	...	...	...
Phosphorus	0·0016	Traces.	0·0078	0·0086	0·0073	0·0032	0·0053
Ash	4·5000	1·50	8·2500	2·4912	5·2427	7·9968	6·4947
	100·0000	100·0000	100·0000	100·0000	100·0000	100·0000	100·0000

Dated Kulti, the 27th February 1920.

From—WALTER WEIR, Esq., Civil and Mechanical Engineer,

To—R. H. NICHOLS, Esq., General Manager, Bengal Iron and Steel Co., Ld., Kulti.

I beg to submit herewith my report for favour of your information and transmission to the Secretary, Coalfields Committee.

R. I. Treharne Rees' Report.

COMMENTS ON PARAS. 77 TO 83 AS REQUESTED BY THE COALFIELDS COMMITTEE.

At the outset, I have to congratulate Mr. Rees on getting together such an excellent report in the short time alloted to him, and, although there are some points I don't quite agree with, still the bulk of the facts contained therein are worth very careful consideration. Many of the suggested improvements are long overdue, and it is to be hoped that the outcome of this report will be the means of bringing the larger coal owners and the Government of India to a better understanding.

As pointed out by Mr. Rees (para. 77), the resources of Indian coking coals are limited, and, if the development of the manufacture of pig iron and general foundry practice is to be encouraged, then the sooner the coking coal problem receives earnest attention, the better it will be for the country. The resources of first class iron ores in this country are enormous, and it would be a pity if the valuable coking coals were carelessly worked and wasted out before the ores.

I agree with Mr. Rees that the present method of carbonising the coals in India, especially the better class, is primitive and wasteful, and should without further delay be put an end to. The old original practice of carbonising coal in "Bee-Hive Ovens" over England, Scotland and Wales is gradually dying out in preference to the modern by-product plant. It took a long time to convince the manufacturers that the Bee-Hive practice was wasteful, simply because blast furnace managers were prejudiced against the by-product coke which they maintained was not so strong and clear in lustre, and could not stand the burden so well, as the Bee-Hive coke, and consequently did not keep the furnace burden open enough to allow the "gas reducing agents" a free passage. Fortunately such conservative ideas are steadily going, on the strength of the following figures.

	(By-Product Oven.)	(Bee-Hive Oven.)
Charge	8 tons.	5 tons.
Coke	63 per cent to 70 per cent.	40 per cent.
Time to carbonise	40 hours.	72 hours.
Breeze	2 per cent.	10 per cent. to 20 per cent.
Sulphate ammonia	32 lbs. to ton carbonised	Nil.
Tar, Pitch and Benzol	.....	Nil.

The loss must be greater in India, as in most cases the ovens are open on the top, and I agree with Mr. Rees that the loss must be in the neighbourhood of 40 per cent. (para. 78).

I am at one with Mr. Rees (para. 79) that the best quality of coking slack should not be used for steam-raising, and smithy work where the colliery is raising inferior classes

of coal at the same time, but, if the pit is limited to good coking coals, then there is no other ready alternative as it probably would not pay to purchase and transport coal for this purpose, but with the collieries good coking slack should not be sold to customers for steam raising.

By the centralisation of electric power, the percentage of boiler fuel could be greatly reduced, and an up-to-date scheme is long over-due in this country. At Home, many of the colliery owners are taking all their electric power from supply companies such as the "Clyde Valley Electri Supply Company." Some colliery owners used to say, "you are far better with the key of your own door," but they are gradually throwing in their lot and taking their current from outside. At the present time, owners are being forced to put down their own electric installation in India, because people in that line here are far too slow, and can give no definite data as to their intentions.

It would not pay to put down expensive by-product ovens and recovery plant to manufacture soft coke, as suggested by Mr. Rees (paras. 80, 81 and 82). Unless the coke would be used for blast furnaces, it would soon glut the market. At Home the soft or semi-coking coals are sold as house coal, railway steam coal and bunker coal for ships, and generally such coals belong to the upper carboniferous series. In Scotland, the best coking coals are mined from the lower "Carboniferous Limestone Series", and, being low in sulphur and phosphorus, are very suitable for the manufacture of hematite iron. Generally the most successful companies in the manufacture of coke are those that have collieries, coke ovens, and blast furnaces, but at Home a few colliery companies with coking coal seams have erected batteries of by-product ovens. As the erection of such plant means a big capital expenditure, the companies interested must make sure that they have the resources and quality of seams to warrant the expenditure. The preparation of the coal for the coke ovens might be further experimented with. Presently the charge to the coke oven in India is put in to the by-product oven unscreened, unwashed, and sometimes not stamped. A very prevalent opinion in India is, that it would not pay to wash Indian coals because of their "physical characteristics." They are described by Indian geologists as "laminated bituminous coals in which bright and dull layers alternate. It is said these dull and bright layers grow together, the bright bituminous layer sticking fast to the dull layer above and below it. The dull layers contain the poorer coal and practically all the ash, the whole forming a complete mass." Personally I have seen stone bands vary from ½ inch to 2 inches in thickness running through the middle of the seams. Such bands could be dealt with at the picking tables, before the coals reach the coal breaker and washery. Regarding the possibility of successfully washing the dull and bright layers this depends wholly on their specific gravity in relation to the better coal and dirt contained in the seam. When the coal and refuse approach one another in specific gravity, some difficulty may be experienced in washing. I have tested two Indian coking coals with Scotch coking coals and find the specific garvity almost indentical. Noonodih 1·30, Ramnagar 1·29, Scotch 1·29. The great drawback to coal washing is that the miner fills the dirt along with the coal and is paid for it. The washer gets rid of this which amounts to from 10 to 15 per cent. of the dross washed. All up-to-date coking plant at Home has its screens, breaker, washer and stamper. Testing coals in laboratories to decide whether they will wash or coke is in my opinion hopeless, and no one can say in India that the coals won't wash, until a real practical test has been made with a washer on a small scale. At Home, Luhrigg washing machines could be erected to deal with about 300 tons per day for less than £5,000 before the war. I would suggest that a real practical test should be made in India, the cost to be shared jointly by the larger firms with Government assistance. For up to date foundry light casting practice, the percentage of ash in our Indian coke is much too high, and experiments should be carried out to try and improve the calorific value of the coke for blast furnace and foundry practice.

In conclusion I would suggest to the Committee to recommend the introduction of legislation to prevent good coking coals being wasted in open ovens and ground heaps. As the companies interested will have a big outlay of capital to face, the price of coal and coke must immediately go up, and it is questionable whether people such as sweetmeat makers and householders, or even small foundries, would be prepared to pay this high price when they could get coke suitable for their purpose from the small firms that carbonise coke in bins and open ovens. The solution is to put a wholesale end to this practice, and make it worth while for companies interested spending large sums of money on by-product ovens and chemical plant.

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(4)

No. 45-46-2 C. C., dated Calcutta, the 6th February 1920.

To—The Agents, { East Indian Railway. / Bengal Nagpur Railway.

I am directed by the Coalfields Committee recently appointed by the Government of India to enquire whether separate figures are available of the amounts of hard coke and soft

coke carried by your railway. If so, the Committee will be obliged if you will kindly let me know, as early as possible, how much soft coke has been despatched by your railway from the coalfields during the last five years.

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(5)

No. 2428, dated the 14th February 1920.

From—The Agent, Bengal Nagpur Railway.

In reply to your letter No. 46—2 C. C. of 6th February 1920, I regret it is not possible to give the information required as separate records are not maintained for despatches of hard and soft coke. All despatches of coke are included under coal.

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(6)

No. T. 5580, dated Calcutta, the 20th February 1920.

From—The Agent, East Indian Railway.

In reply to your letter No. 45—2 C.C., dated 6th February 1920, I am desired to state that the figures asked for by the Coalfields Committee are not available as separate statistics are not maintained of hard and soft coke despatched by this railway.

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(7)

No. 50 C. C., dated Calcutta, the 7th February 1920.

To—Messrs. KILBURN & Co., Calcutta.

The Coalfields Committee appointed by the Government of India understand that you have at present an expert from Home making experiments in connection with the use of Indian coals in low temperature carbonization plants. I have been directed to forward the accompanying copy of paras. 80 to 83 of Mr. Treharne Rees' report, and to ask whether your expert would be good enough to give the Committee any information, as a result of his experiments, which would help in the consideration of these paragraphs.

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(8)

Dated Calcutta, the 17th February 1920.

From—Messrs. KILBURN & Co., Calcutta.

We have to acknowledge receipt of your letter No. 50 C. C. of the 7th instant, enclosing extracts from Mr. Treharne Rees' report on the manufacture of soft coke. We regret our inability to assist your Committee, but our technical expert has only recently arrived in this country and his experiments have not yet advanced sufficiently far to make the results of his investigations of any value to the Committee.

(9)

No. 51 C. C., dated Calcutta, the 7th February 1920.

To—R. W. CHURCH, Esq., Mining Engineer, Railway Board.

I shall be obliged if you will kindly let me have, as soon as possible, a statement of the quantities of hard coke actually consumed during the last three years in India and the adjacent countries such as Burma, Ceylon, Malay States, etc.

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(10)

No. 14, dated Calcutta, the 11th February 1920.

From—R. W. CHURCH, Esq., Mining Engineer, Railway Board.

With reference to your demi-official No. 51 C. C., dated the 7th February 1920, all consumers of hard coke do not take their supplies through my department. The figures I give in the attached statement therefore only relate to supplies arranged by me.

Hard Coke.

Consumer.	Quantity
INDIA.	Tons.
Ordnance Factories	7,920
Bengal Doars Railway	18
Surat Municipality	10
Government Salt Mines	40
Madras and Southern Mahratta Railway	5,000
Bombay, Baroda and Central India Railway (M. Gauge)	1,200
Hutti Nizam's Gold Mines	40
South Indian Railway	850
Barsi Light Railway	30
Jodhpur-Bikaner Railway	64
Oudh and Rohilkhand Railway	1,500
Telegraph Workshops, Alipore	500
Calcutta Mint	2,000
Delhi-Shahdara Light Railway	60
Kolar Gold Field Mining Board	960
Executive Engineer, 3rd Project Division, Delhi	100
Bombay Mint	3,000
Electrical Engineer, Delhi	70
Bengal and North-Western Railway	900
Royal Indian Marine, Bombay	600
Bombay Municipality	1,200
Madras Port Trust	125
Carried over	26,187

Hard Coke—contd.

Consumer.	Quantity.
INDIA.	Tons
Brought forward	26,187
Assam Bengal Railway	6,500
Rohilkund and Kumaon Railway	80
Karachi Port Trust	15
Bhavnagar Railway	100
H. H. The Nizam's Guaranteed State Railway	200
Bombay, Baroda and Central India Railway (Broad Gauge)	1,300
North-Western Railway (Signalling Department)	2,160
Junagad Railway	7
Eastern Bengal Railway	2,500
Bengal and North-Western Railway	900
North-Western Railway (Locomotive Department)	2,000
Do. do. do. (Carriage and Wagon Department)	4,000
Gwalior Light Railway	10
Howrah Amta and Sheakala Light Railway	66
Gwalior State Workshops	120
Dairy Farms	120
Ahmedabad Municipality	20
Remount Depôt	120
Director of Land Records, United Provinces	21
Ordnance Stores	700
Royal Indian Marine, Calcutta	360
Jessop and Company's Howrah Works	1,200
Military Works Services	31
Public Works Department, Bombay	81
Total India	48,798
BURMA.	
Burma Railway	300
Burma Mines	18,000
Shipments to Burma by Commercial Firms	450
Total Burma	18,750
CEYLON.	
Ceylon Government	200
Total Ceylon	200

(11)

No. 59 C. C., dated Calcutta, the 7th February 1920.

To—The Agent, East Indian Railway, Calcutta.

The Coalfields Committee to the Government of India will be much obliged if you will kindly send me for reference by the Committee a copy of Dr. Fermor's report on the East Bokaro coalfield.

(12)

No. S. 4277, dated Calcutta, the 10th February 1920.

From—The Agent, East Indian Railway.

With reference to your request dated the 7th February 1920, for a copy of Dr. Fermor's report on the East Bokaro coalfield, I am directed to enquire for what purpose the report referred to is required by the Coalfields Committee.

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(13)

No. 122 C. C., dated Calcutta, the 16th February 1920.

To—The Agent, East Indian Railway.

With reference to your No. S. 4277 of the 10th February, I write to say that Dr. Fermor's report is required in order to form an estimate of the quantities of coking coal available in the Bokaro-Ramgarh coalfield. It will be sufficient for the Committee's purposes if you will be good enough to inform me of the quantities of such coal available so far as has been proved.

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(14)

No. S.7544, dated Calcutta, 9th March 1920.

From—The Agent, East Indian Railway.

In reply to your demi-official letter No. 122, dated the 16th February 1920, I am directed to inform you that Dr. Fermor makes no mention of coking coal in his report. He estimates the quantity of coal available in the portion of the East Bokaro coalfield with which his report deals to be 365 million tons. Subsequent to his investigation, some experiments were made and it was found that good coke can be made from the coal from the East Bokaro field.

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(15)

No. 60 C. C., dated Calcutta, 7th February 1920.

To—C. S. Whitworth, Esq., Great Indian Peninsula Railway Colliery, Kargali, Bengal Nagpur Railway.

I am directed by the Coalfields Committee to ask if you will be good enough to send me details as to the coking qualities of the coal seams in the Bokaro-Ramgarh coalfield, and also an estimate of the quantities of such coal available, so far as has been proved.

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(16)

No. 48, dated 21st February 1920.

From—C. S. Whitworth, Esq.

I beg to acknowledge the receipt of your demi-official No. 60 C. C., dated the 7th instant, requesting me to furnish the Coalfields Committee with particulars of the coking coal in the Bokaro-Ramgarh coalfield.

The only seam which is known to be of coking quality in this field is that known as the Kargali, and which is at present being worked by the joint East Indian Railway and Bengal Nagpur Railway Colliery, by the Great Indian Peninsula Railway at their Kargali Colliery, and by the Bokaro-Ramgarh Co., Ltd., at their Dhori Colliery. All these collieries are situated on the east side of the Kunar River and, at a very conservative estimate, there is 200,000,000 tons (two hundred million tons) of the Kargali seam available here. The present combined outturn of the three collieries is just under one million tons yearly.

To the west of the Kunar River, Dr. Fermor reports having found the Kargali seam extending for several miles, but of its coking quality in this area I know nothing. The probability is that the Kargali seam in this area will also be of coking quality and, if this is the case, then there will be at least 650,000,000 tons of this coal available.

For the information of the Committee, I am sending under separate cover a piece of coke manufactured in an ordinary country oven at the Kargali Colliery and which was picked by me this morning at random from a stock. It is a good hard coke which has been found suitable for use in the workshops of the Great Indian Peninsula Railway and contains about 20 per cent. ash. The dust coal from which the sample was manufactured was not by any means clean as it came from an open quarry and no attempt had been made to pick it. Dust coal from shafts, where the greater portion of the 650,000,000 tons would be obtained, would be decidedly cleaner and coke manufactured from this should not have an ash content of more than 18·5 per cent.

Written reply of Mr. L. Diamond, Manager, Lodna By-Product Coke Plant, Jharia, on the questions discussed in paragraphs 67 and 77 to 83 of Mr. Treharne Rees' report regarding the manufacture of coke.

Para. 67.—Owing to the collieries being distributed over such a big area, it is not economically possible to erect very large central generating stations. In the Jharia coalfield, I should recommend by-product coking ovens either of the "regenerative" type with gas engines or of the "waste heat" type with turbo-generators.

In the Raniganj field, probably the best result would be obtained from non-coking coals by installing central generating stations supplied with power from gas producers and gas engines. Any steam required on the plant to be raised in boilers fired with coke breeze and supplied with forced draught.

Paras. 77 & 78.—Referring to the coking of good coals in open ovens, the percentage of coke appears to be as shewn in the Report, *viz.*, 40 per cent. By-product coke ovens would yield probably 73 to 75 per cent. depending on the amount of volatile matter contained in the slack.

Para. 79.—When sufficient by-product ovens are available to use all the coking slack made, it should then be compulsory for this slack to be sent to such plants, and non-coking and much inferior slack or coke breeze used in the few boilers which should be hand-fired after the central power stations are linked up. At the present time, colliery owners who have by-product coke plants are making this distinction.

Paras. 80 & 81.—Soft coke manufactured as described is certainly very wasteful.

Paras. 82 & 83.—The coal from which this soft coke is made appears to be a semi-coking coal and one high in ash. It could probably be used in by-product ovens after being "compressed" or "stamped", but would then yield a dense coke and a good quantity of tar, ammonia and gas. It would not be "soft coke." The coke produced from this poor quality of slack would be difficult to sell, so it would probably be better to use the slack in gas producers attached to the central power stations. I have no information regarding the amount of "soft coke" sold in India, but, unless the quantity is over 30,000 tons a year, it would hardly be worth while to erect special plant for this purpose.

Oral Evidence.

Paragraph 67.—By "large" central power stations, I mean something about 5,000 Kilowats. I think such a plant would be difficult to run in the coalfields for economic reasons. A power station of this size would necessitate a very large coking plant producing about 600,000 to 700,000 tons of coke per annum. It would be difficult, if not impossible, to sell such quantities of coke and to provide the enormous amount of water required on such a plant. Most of the big industrial concerns have arranged for their own coke from their own by-product coking plants. Large quantities of coke breeze are available in this country and are nearly all treated as rubbish. This coke breeze makes a very good fuel when burned in boilers with forced draught, especially on chain grates. It is also very useful in gas producers.

Raniganj coals are mostly non-coking and would be suitable for burning in gas producers. Such producers yield per ton of coal about 130,000 C. ft. of gas of about 140 B. Th. U. per C. ft. against 10,000 C. ft. of gas of about 480 B. Th. U. per C. ft. if coal is carbonised in by-product coke ovens. The reason for the increased yield of gas from gas producers is the large amount of air and steam used in this process, and the fact that, in producers, the coal is subjected to destructive distillation and nothing is left after taking out the gas but ash. The gas producer recovery plant would also produce about 70 lbs. of sulphate of ammonia per ton of coal. There is always a ready sale for this very valuable chemical manure and the profit on the quantity produced would more than pay for the coal consumed. About 3 to 4 gallons of pitch would also be produced per ton of fuel, and this could be used for making asphalte for paving roads, and for briquetting coke breeze or coal dust. This producer gas, like coal gas, can be conveyed long distances in steel mains. The Sheffield Gas Works obtain a supply from a colliery several miles away, the amount of gas so taken being equivalent to 50,000 tons of coal per annum. This quantity of coal was formerly taken by

rail to Sheffield and carbonised there. In America, gas mains of this kind deliver gas to distances of more than 100 miles. There is no reason why this should not be done between the Raniganj coalfield and Calcutta. Gas so delivered would liberate from 15,000 to 25,000 railway wagons per annum according to the amount taken. This producer gas or power gas could be used in large gas engines directly coupled to generators in electric power plants. The amount of power thus produced from coal would be 2 to 2½ times as great as that produced from steam in the most modern steam plants. Power gas can be carried in exactly the same way as illuminating gas and can be laid on to buildings. With an incandescent burner it also gives quite a good light. It can also be used for many industrial and domestic purposes such as annealing furnaces, forges, stoves, etc. It is a most elastic source of power as it can be stored in large gas-holders and made use of when and where required.

Paras. 81-82-83. Soft Coke.—The coals from which this kind of coke is made are very high in ash. The method adopted, as described by Mr. Rees, is very wasteful and could be remedied by the use of the mechanical stampers mentioned in his Report, but the resulting coke would then be a dense hard coke which would not answer the purpose of the partially coked fuel it is to replace. This dense coke would also contain an extremely high percentage of ash and would consequently be unsaleable. The quantity of this semi-coked fuel manufactured each month is said to be about 20 to 25,000 tons. A modern plant for low temperature carbonisation of this class of coal might be a sound proposition, but very careful experiments on a large scale would have to be made of the raw material before deciding definitely. From my experience of Indian coals, I fear that the yield of motor spirit (which is one of the main factors that make low temperature carbonisation an attractive proposition in some countries) would not amount to more than one gallon per ton of coal treated, and for the above quantity of fuel would probably not justify the expense of a modern plant.

Briquettes might be made, using pitch as a binder, but such briquettes, when made suitable for burning in a house grate, are generally smoky and would not suit the purpose of the sweetmeat makers. Briquettes made for industrial purposes are of course practically smokeless. Generally speaking, it does not pay to make briquettes if cheap coal is obtainable.

APPENDIX H.

Relevant Statistical Information (191[illegible]

Serial No.	Particulars required.	In Raniganj.	In Jharia.	Total colns. 3 and 4.	Remarks
1	2	3	4	5	6
1	Total number of collieries . .	305	335	640	
2	Number of collieries under development, but not raising coal.	44	9	53	
3	Number of collieries raising coal .	261	326	587	
4	Total annual output of collieries in serial No. 3.	6,800,844 tons.	12,036,137 tons.	18,836,981 tons.	
5	Number of collieries raising monthly—				
	(*a*) up to 1,000 tons . . .	137	151	288*a*	*a*. 49·06 p.c. } of total number of 587
	(*b*) over 1,000 and up to 5,000 tons.	92	121	213*b*	*b*. 36·28 p.c. } of total number of 587
	(*c*) over 5,000 tons . . .	32	54	86*c*	*c* 14·66 p.c. } of total number of 587
6	Amount of annual output of collieries in—				
	(*a*) serial No. 5 (*a*) . . .	540,721 tons.	651,192 tons.	1,191,913 tons *d*	*d*. 6·33 p.c. } of total output of 18,836,981 tons.
	(*b*) serial No. 5 (*b*) . . .	2,829,495 ,,	3,704,146 ,,	6,533,641 ,, *e*	*e*. 34·69 p.c. } of total output of 18,836,981 tons.
	(*c*) serial No. 5 (*c*) . . .	3,430,628 ,,	7,680,799 ,,	11,111,427 ,, *f*	*f*. 58·98 p.c. } of total output of 18,836,981 tons.
7	Number of collieries raising coal by—				
	(*a*) hand labour only or mainly hand labour.	98	153	251*g*	*g*. 42·76 p.c. } of total number of 587
	(*b*) steam power only or mainly steam power.	160	165	325*h*	*h*. 55·37 p.c. } of total number of 587
	(*c*) electric power only or mainly electric power . . .	3	8*j*	11*i*	*i*. 1·87 p.c. } of total number of 587 *j*. 5 more being installed.
8	Amount of annual output of collieries in—				
	(*a*) serial No. 7 (*a*) . . .	438,044 tons.	1,023,865 tons.	1,461,909 tons *k*	*k*. 7·76 p. c. } of total output of 18,836,981 tons.
	(*b*) serial No. 7 (*b*) . . .	6,044,141 ,,	9,900,836 ,,	15,944,977 ,, *l*	*l*. 84·65 p. c. } of total output of 18,836,981 tons.
	(*c*) serial No. 7 (*c*) . . .	318,659 ,,	1,111,436 ,,	1,430,095 ,, *m*	*m*. 7·59 p. c. } of total output of 18,836,981 tons.
9	Number of raising collieries worked by—				
	(*a*) Limited Companies . .	114	101	215	
	(*b*) Private Owners . . .	147	225	372	
10	Amount of annual output of collieries in—				
	(*a*) serial No. 9 (*a*) . .	5,241,860 tons	7,659,623 tons.	12,901,483 tons.*n*	*n*. 68·49 p.c. } of total output of 18,836, 981 tons.
	(*b*) serial No. 9 (*b*) . .	1,558,984 ,,	4,376,514 ,,	5,935,498 ,, *o*	*o*. 31·51 p.c. } of total output of 18,836, 981 tons.
11	Average daily number of persons working				
	(*a*) above and below ground	59,219	95,276	154,495	
	(*b*) above ground .	22,940	37,608	60,548*p*	*p*. 39·19 p.c. } of total number of workers.
	(*c*) below ground . . .	36,279	57,668	93,947*q*	*q*. 60·81 p.c. } of total number of workers.
12	Output per person employed—				
	(*a*) above and below ground . .	114·84 tons.	126·33 tons.	. . .	
	(*b*) below ground . . .	187·45 ,,	208·71 ,,	.....	
13	Number of collieries making coke in				
	(*a*) open ovens	95	204	299	*r* Is at the Bengal Iron and Steel Works, Kulti.
	(*b*) by-product ovens . .	1*r*	2*s*	3	*s* Two more plants being installed.
14	Number of collieries in which coal-cutting machines are used.	2	2	4	
15	Number of collieries in which screening plants are used.	2	4	6	
16	Number of collieries in which hydraulic stowing has been introduced for pillar recovery in old workings.	4	1	5	

SGPI—S28—8 SCC—21-5-20—1,200.