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VOLUME II

SERVANTS OF INDIA SOCIETY'S
No.....
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POONA 4.



DELHI: MANAGER OF PUBLICATIONS
1937

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Venkatasubban, A., Law Book-seller, Vellore.
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Statement of Questionnaires issued and witnesses examined.

Type of Questionnaire.	Total number of copies issued.	Number of witnesses addressed including local Governments, Associations, firms, etc.	Number of written replies received.	Number of witnesses examined orally on written replies.	Number of witnesses examined outside the questionnaire.
1. General . . .	195	64	56†	51	1
2. Landlords . . .	62	8	7	6	..
3. Iron and Steel . .	46	3	2	5	..
4. Railways . . .	54	3	2	2	..
5. Ropeways . . .	44	2	2	3	..
6. Commissioners for the Port of Calcutta, and The Irrigation Department, Bengal.	39	2	2	3	..
7. Special questionnaire addressed to Dr. C. S. Fox.	36	1	1	1	..
TOTAL .	476*	83	72	71‡	1

*Includes 162 copies sent to the Director of Public Information, Government of India.

†Including 11 not addressed.

‡Certain Associations sent two representatives but they have been treated as one witness.

ALPHABETICAL LIST.

Witnesses.	Firm, appointment or representative.	Serial number of witness.	Written evidence page.	Oral evidence page.
Anderson, Wright & Co., Messrs.	I. A. Clark . . .	10	68	69
Andrew Yule & Co., Ltd., Zamindaries of.	P. S. Keelan, C.I.E. . .	69	500	501
Archibald, D. M. .	General Manager, Lodna Colliery Co., Ltd.	29	201	206
Ashcroft, C. E. .	Agent, Sunkerpore Colliery	14	94	99
Baksi, K. K. . .	Manager, Kirkend Colliery	25	175	181
Banerjee, J. G. .	Manager, Radhamadhabpur Colliery.	44	391	..
Bell, J. A. . .	Agent, East Indian Railway.	66	521	524
Bengal-Nagpur Railway.	J. Wilson . . .	67	526	531
Bird & Co., Messrs. .	Agents, Burrakur Coal Co.	8	62	65
	Agents, Kumardhubi Engineering Works, Ltd.	69	537	540
	Representatives, F. W. A. Carpenter and E. O. Pearce.			
Bose, B. K. . .	Manager, Gonsadih Colliery	26	182	188
	Representative, Indian Mine Managers' Association.	2	..	18
Bose, P. C. . .	Representative, Indian Miners' Association.	4	..	35
Bose, Siva Kali .	Representative, Indian Colliery Labour Union.	3	..	31
Bose, S. K. . .	Representative, Geological, Mining and Metallurgical Society of India.	6	..	52
Bown, R. J. . .	Messrs. Gillanders Arbuthnot & Co.	12	..	74
Brook, J. . .	Representative, National Association of Colliery Managers (Indian Branch).	1	..	11

Witnesses.	Firm, appointment or representative.	Serial number of witness.	Written evidence page.	Oral evidence page.
Burch, W. M. . . .	Agent, Messrs. Equitable Coal Co., Ltd.	41	379	..
Burdwan Raj Estate	M. N. Dutt . . .	59	497	..
Carapiet, G. G. .	Manager, Bunsdeopur Colliery.	33	228	232
Carpenter, F. W. A. .	Representative, Messrs. Bird & Co., Agents, Kumardhubi Engineering Works.	8	..	540
Carver, G. A. . .	Superintendent, Kasimbazar Raj Wards' Estate Collieries.	22, 58	153, 490	161, 495
Central Provinces Government.	C. D. Deshmukh, C.I.E., I.C.S.	47	403	405
Chatterjee, M. M. .	Representative, Jharia Raj Estate.	62	..	506
Clark, I. A. . .	Representative, Messrs. Anderson, Wright & Co.	10	..	69
Commissioners for the Port of Calcutta.	Representatives, D. Kilford and Commander C. V. L. Norcock.	70	544	544
Cooksey, W. . .	Officiating Colliery Superintendent, State Railways' Colliery Department.	30	209	214
Cork, F. L. . .	Colliery Superintendent, Messrs. Macneill & Co.	17	114	121
Creet, A. T. . .	Consulting Engineer, Messrs. Martin & Co.'s Collieries.	42	383	..
Deshmukh, C. D. C.I.E., I.C.S.	Representative, Central Provinces Government.	47	..	405
Dholakia, J. K. .	Consulting Mining Engineer	32	221	225
Dutt, M. N. . .	Superintendent, Mineral Properties, Burdwan Raj Estate.	59	497	..
Duttson, R. D. .	Representative, Messrs. Indian Iron and Steel Co., Ltd.	65	..	516
East Indian Railway	J. A. Bell . . .	66	521	524
Farquhar, A. . .	Representative Mining and Geological Institute of India.	5	39	46

Witnesses.	Firm, appointment or representative.	Serial number of witness.	Written evidence page.	Oral evidence page.
Fenwick, R. . .	Agent, Messrs. Bird & Co., Sijua.	38	..	335
Forbes, C. A. . .	Representative, Nawagarh Raj Estate.	61	..	503
Fox, Dr. C. S. . .	Superintending Geologist, Geological Survey of India.	35, 72	242, 550	257, 555
Geological, Mining and Metallurgical Society of India.	Representatives, S. K. Bose and Dr. S. K. Roy.	6	47	52
Ghosh, N. . .	Manager, Muslia Collieries .	23	163	166
Ghosh, S. K. . .	Representative, Indian Mine Managers' Association.	2	..	18
Gillanders Arbuthnot & Co., Messrs.	Agents, The Nobel's Explosives Co., Ltd., & The British Ropeway Engineering Co., Ltd., W. F. Tuckett.	12, 68	75, 534	535
Harmer, W. T. V. .	Representative, Messrs. Indian Iron and Steel Co., Ltd.	65	..	516
Harrison, J. R. .	Chief Mining Engineer, Railway Board.	37	286	307
Hindley, C. W. G. .	Chief Mining Engineer, Messrs. Andrew Yule & Co., Ltd.	13	80	92
Indian Colliery Labour Union.	Representative, Shiva Kali Bose.	3	23	31
Indian Iron & Steel Co., Ltd., Messrs.	Representatives, R. D. Duttson, W. T. V. Harmer and H. V. Peeling.	65	514	516
Indian Mine Managers' Association.	Representatives, B. K. Bose and S. K. Ghosh.	2	13	18
Indian Miners' Association.	P. C. Bose . . .	4	33	35
Irrigation Department, Bengal.	Representative, P. C. Roy	71	544	547
Jacobs, L. A. . .	Chief Mining Engineer, Messrs. Shaw Wallace & Co.	21	141	151
Jardine, Skinner & Co., Messrs.	E. A. Paterson . . .	9	66	67
Jharia Raj Estate .	M. M. Chatterjee . .	62	504	506

Witnesses.	Firm, appointment or representative.	Serial number of witness.	Written evidence page.	Oral evidence page.
Kanotra, M. M. .	Manager, Junnardeo No. 2 Colliery.	56	478	..
Kasimbazar Raj Ward's Estate.	G. A. Carver . . .	22, 58	153, 490	161, 495
Keelan, P. S., C.I.E.	Chief Superintendent, Zamindaries, Messrs. Andrew Yule & Co., Ltd.	60	500	501
Kilford, D. . .	Representative, Commissioners for the Port of Calcutta.	70	..	544
Kirk, J. . . .	Colliery Superintendent, The Tata Iron & Steel Co., Ltd.	28	194	198, 510
Kolya, N. C. . .	Manager, Mahakali Coal Mine.	53	444	446
Lancaster, H. . .	Colliery Superintendent, State Railways' Coal Department.	24	167	172
Llewellin, G. . .	Manager, Hirdagarh Collieries, Ltd.	51	426	435
Mackay, A. G. . .	Agent, The Bengal Iron Co., Ltd.	16	108	113
Macneill & Co., Messrs.	Agents, Equitable Coal Co., T. Ord.	7	54	59
Martyn, J. K. . .	Manager, Barkui Colliery .	50	419	424
Mining and Geological Institute of India.	A. Farquhar . . .	5	36	46
Mitter, S. N. . .	Manager, Khas Sitalpur Colliery.	46	399	..
Mohatta Bros., Messrs.	D. K. Samanta . .	11	71	74
Mondal, Rai Saheb U. N.	Manager, Deoli Colliery .	18	124	127
Mukerjee, D. N. .	Manager, Hindusthan Lalpeth Colliery.	54	448	461
Mukherjee, B. . .	Panchakote Raj Estate .	57	..	489
Mukherji, M. M. .	Manager and Agent, Messrs. Martin & Co.'s Collieries.	15	100	106
National Association of Colliery Managers (Indian Branch).	Representatives, J. Brook and. R J. Pothecary.	1	8	11

Witnesses.	Firm, appointment or representative.	Serial number of witness.	Written evidence page.	Oral evidence page.
Nawagarh Raj Estate	C. A. Forbes and H. Sen Gupta.	61	502	503
Norcock, Commander C.V.L.	Representative, Commissioners for the Port of Calcutta.	..	..	544
Ord, T. . . .	Representative, Messrs. Macneill & Co.	7	..	59
Panchakote Raj Estate.	B. Mukherjee . . .	57	487	489
Pandya, P. H. . .	Manager, Jote Dhemo Colliery.	40	375	..
Parry, A. H. . .	Sales Agent, Messrs. Shaw Wallace & Co., Chhindwara.	49	414	418
Paterson, E. A. .	Representative, Messrs. Jardine Skinner & Co.	9	..	67
Pearce, E. O. . .	Representative, Messrs. Bird & Co.	8	..	65, 540
Peeling, H. V. . .	Representative, Messrs. Indian Iron & Steel Co., Ltd.	65	..	516
Penman, Dr. D., C.I.E.	Chief Inspector of Mines .	36	259	282
Penman, R. B. .	Agent, Gopalichuck West Colliery.	34	235	240
Penman, W. B. .	Manager, Samla Collieries .	19	128	132
Percival, Dr. F. G. .	Representative, Messrs. Tata Iron and Steel Co., Ltd.	64	..	510
Phelps, J. E. . .	Colliery Superintendent, East Indian Coal Co., Ltd.	39	338	--
Pothecary, R. J. .	Representative, National Association of Colliery Managers (Indian Branch).	1	..	11
Ramgarh Estate .	S. McLeod Smith . .	63	507	508
Rawal, G. S. . .	Agent, K. and N. Collieries	27	188	193
Rees, W. J. . .	Manager, Noondih Jitpore Collieries.	31	215	220
Robb, W. D. . .	Manager, Hurriladih Colliery.	45	394	...
Ross, J. B. . .	Representative, Messrs. Shaw Wallace & Co.	48	..	412

Witnesses.	Firm, appointment or representative.	Serial number of witness.	Written evidence page.	Oral evidence page.
Roy, M. B. . .	Manager, Guzdar Kajora Colliery.	43	386	...
Roy, P. C. . .	Executive Engineer, Irrigation Department, Bengal.	71	544	547
Roy, Dr. S. K. .	Representative, Geological Mining and Metallurgical Society of India.	6	...	52
Samanta, D. K. .	Representative, Messrs. Mohatta Bros.	11	..	74
Sen Gupta, H. . .	Manager, Nawagarh Raj Estate.	61	502	...
Sharpley, Prof. Forbes W.	Indian School of Mines .	..	557	..
Shaw Wallace & Co., Messrs.	Ross, J. B. . . .	48	407	412
Smith, McLeod S. .	Manager, Ramgarh Estate	63	507	508
Spark, E. . .	Colliery Superintendent, New Beerbhoom Coal Co., Ltd.	20	136	139
Tarlton, S. F. . .	Deputy Chief Mining Engineer, Messrs. Bird & Heilgers' Collieries.	38	312	...
Tata Iron & Steel Co., Ltd., Messrs.	Representatives, J. Kirk and Dr. F. G. Percival.	64	510	510
Thomson, J. . .	Superintending Engineer, The Ballarpur Collieries Co.	52	436	441
Tuckett, W. F. .	Representative, Messrs. Gillanders Arbuthnot & Co.	68	..	535
Warde, I. . .	Manager, Damua Colliery .	55	462	..
Wilson, J. . .	Mining Engineer, Bengal-Nagpur Railway.	67	..	531

QUESTIONNAIRE.

GENERAL.

I.—Safety.

(a) *Dangers from Underground Fires.*

1. What appointment do you hold, and how much experience have you of Indian coal-mining conditions and in what coalfield?

2. What, in your opinion, is the main cause of underground fires in coal mines in India? Has the number of fires increased in recent years? Have more fires been caused by premature collapses or by normal collapses, *i.e.*, after pillars have been extracted?

3. What seams do you consider most liable to spontaneous combustion in the coalfield or coalfields in which you have had experience? What is the period of incubation of each? Do you consider that any seam of commercial value is free from the risk of spontaneous combustion?

4. Do you agree that fires increase considerably the difficulties and dangers of extracting the remaining coal, *i.e.*, that they are prejudicial to the safety both of the miners and the mineral? Do these difficulties and dangers become greater at the final stage of pillar extraction, and as one seam after another lying close together is removed?

5. Are you in favour of new workings in seams known to be liable to spontaneous combustion being laid out in a system of panels? What percentage of the seam would have to be left in the barriers without stowing?

6. Do you consider that the Temporary Coal Mines Regulations (issued with Government of India Notification No. M. 955 of the 23rd May 1936, and No. M. 1055 of the 27th June 1936) are adequate against all possible dangers from fires?. If not, what additions or modifications do you suggest in the light of your experience?

7. Do you consider that all mines or seams in which there are sealed-off fires should be mechanically ventilated? If so, should the fan be exhausting or forcing?

8. Do you consider that the extraction of a section of a seam in such a way as to leave behind the remainder of the seam broken up in the goaf increases the risk of spontaneous combustion? Do you know of any fires that may be attributed to this cause?

9. Do you consider that provision for readily dealing with fires in the shape of taps on water mains and suitable lengths of hose, or portable water tanks, should be required by law in coal mines?

10. Are you in favour of telephonic communications being required by law between remote parts of mines (such as the ends of main haulage roads), and the surface? If so, beyond what limits in distance from the shaft-bottom or the entrance to the mine do you consider such a requirement should be enforced?

11. What other precautions are required in mines in which there are fires?

12. It is proposed to establish central mine rescue stations in the major coalfields. Do you consider that training in the methods of dealing with underground fires, and the dangers that may arise from them, should be given to all persons working at such stations in addition to the ordinary training in mine rescue work?

13. What are your views with regard to the use of breathing apparatus and gas masks in dealing with mine fires?

14. Please refer to Temporary Regulation No. 14 of Notification No. M. 955 of the 23rd May 1936 referred to above. Since, when a fire occurs, attention must first of all be directed to dealing with the fire itself, and there may necessarily be considerable delay in complying with the above Regulation, do you consider that the Regulation should be extended so as to make it apply to all mines in which the coal is known to be liable to spontaneous combustion in order that precautions may exist in advance of any actual occurrence of fire?

15. Do you agree that precautions against fires occurring at all are better than precautions after they have occurred? If so, have you anything to suggest in this connection as regards methods of working?

16. Do you consider that, from the point of view of safety, and in order to prevent fires in goaves, filling or packing with sand or other suitable material should be enforced during the extraction of pillars in seams which give off inflammable gas because of the danger of accumulations of such gas in the goaves being expelled into the workings by falls of roof? If so, in what seams should such filling or packing be enforced?

(b) *Dangers from Collapses of Workings.*

17. To what do you consider the premature collapse of workings mainly due?

18. What dangers may arise from such premature collapses and how can they best be prevented?

19. Are you in favour of minimum dimensions of pillars and maximum dimensions of galleries being laid down by law?

20. If so, what minimum sizes of pillars and maximum dimensions of galleries in first working would you suggest? What main factors would govern these sizes and dimensions in different seams and mines?

21. Are you in favour of the legal prohibition of "splitting" of pillars, reduction of pillars, or heightening of galleries, except immediately before the systematic extraction of pillars?

22. In seams which are too thick to be worked in one section, what in your opinion should be the restrictions on the number of sections, the dimensions of the pillars and galleries, and the minimum "parting" between the sections?

23. Are you in favour of a statutory authority having powers to give sanction to, or to withhold sanction from, a system of lay-out of workings, and are you in favour of all systems of lay-out in new workings being first submitted to such an authority?

24. Would you be prepared to agree to such a statutory authority having powers to require mine-owners to pack, or partially pack, the galleries in workings in which the statutory authority considered it necessary that such packing should be done, prior to the extraction of pillars, in order to ensure stability and prevent premature collapses?

(c) *Dangers from Floods or Irruptions of Water.*

25. Do you know of any dangerous irruptions of water into mines from the surface or elsewhere? If so, kindly give particulars with causes.

26. Do not such irruptions become highly dangerous if they enter fire areas, because the water then generates gases, and an inflammable mixture of gas and air penetrates the mine workings?

27. What precautions would you suggest against the above dangers, and would you enforce such precautions legally when necessary?

(d) *The Use and Issue of Explosives.*

28. What changes, if any, do you consider necessary in the Permanent and Temporary Regulations regarding shot-firing in order to ensure safety in the use of explosives?

29. Are you in favour of the extended use of "permitted" explosives on the lines in force in British coal mines?

30. Are you in favour of shot-firers in coal mines being certificated after examination?

31. Do you consider that the proviso to Regulation 106, which gives the Chief Inspector of Mines power to allow more than five pounds of explosives to be kept in one place at one time, should be retained or abolished? Kindly give your reasons.

32. Have you any suggestions to offer regarding the issue of explosives?

II.—WASTE.

(a) *Filling or packing the space from which coal is extracted.*

33. What seams are being worked in the colliery or collieries for which you are responsible? Kindly give particulars of the quality, thickness and inclination of each seam.

34. Is the whole of such seams being extracted or only sections? Kindly give particulars for such seam.

35. What proportion of your output is coming from pillars? What percentage of such pillar coal is actually being recovered?

36. Assuming that 120 million tons of coal are now standing in pillars in the Jharia and Raniganj fields, what proportion do you estimate will be recovered with existing methods of working?

37. Assuming that 200 million tons of coal are locked up under railways, rivers, buildings, bridges, etc., will not all this coal be lost for practical purposes without stowing? Do you know of any instances in which compensation for coal left under railway lines and sidings has been paid under the Land Acquisition (Mines) Act? If so, kindly give particulars.

38. If stowing were made compulsory in the colliery or collieries of which you have personal experience, what approximate effect would this have on the life and productivity of the colliery or collieries?

39. Are you in favour of the enforcement of a system of filling or packing by sand or other incombustible material simultaneously with the extraction of pillars or in the wholesale extraction of the seam?

40. If so, to what areas, seams and conditions should such enforcement be applied in your opinion?

41. Have you had experience at any mine you have managed or controlled in India of hydraulic or hand stowing? If so, can you give actual costs per ton of stowing material under the following heads:—

(*a*) Cost of extraction and loading (state kind of material).

(*b*) Cost of crushing, if done.

(*c*) Cost of transporting material to pit-mouth (state kind of transport and distance).

(*d*) Cost of transporting material from pit-mouth to point of stowing (state distance and means of transport or, in the case of hydraulic stowing, cost incurred for repairs, replacements, depreciation, operation and supervision).

(*e*) Cost of placing stowing material in position.

(*f*) If stowing was hydraulic, state the approximate cost of pumping water back to the surface?

What additional cost per ton of coal raised do you consider that a system of filling or packing would involve in:—

(*a*) workings in virgin coal,

(*b*) workings already formed into pillars?

42. If you are in favour of a compulsory system of stowing in certain areas, seams, or conditions, in what way do you consider the additional cost should be met?

43. Do you consider that, if compulsory filling is to be introduced, a statutory authority should be set up with power to define the areas or seams in which pillars should only be got by a process of filling? If so, how should that statutory authority be constituted in your opinion?

44. Should such a statutory authority also have power to give or withhold sanction to a proposed system of new working as suggested in question 23?

45. As an offset to the increased working costs of a system of stowing, what saving do you consider would be secured in:—

(*a*) timber costs,

(*b*) fire-stoppings,

(*c*) pumping,

(*d*) loss of coal, as, for example, in fire areas, barriers, coal under railways, etc.,

(*e*) compensation for buildings, land, accidents, etc.,

(*f*) ventilation,

(*g*) concentration of output, and

(*h*) the cost of getting coal?

Besides the above, are there any other heads under which saving might result?

46. Do you consider that the extraction of a section of a seam so as to render unworkable the remainder of a lower grade, but still of commercial value, should be prevented or controlled?

47. Do you consider that the extraction of a lower seam in such a way as to render unworkable an upper seam of commercial value should be prevented or controlled?

48. If your answers to the last two questions are in the affirmative, how would you define coal of commercial value?

49. Do you consider that pillars in a seam below a fire area in an upper seam, or below a goaf connected with such a fire area, should only be extracted by a system of simultaneous filling of the space from which the coal is extracted?

50. Do you consider that mine-owners should be required to remove coal under railway sidings, villages, rivers, etc., by a system of simultaneous stowing with incombustible material?

51. If, in the case of railway lines and sidings, your answer is in the affirmative, do you consider that the railway concerned should bear part of the cost and on what ground?

52. Do you consider that there are seams in which partial filling would be sufficient, or do you think complete filling should be insisted on in all cases? Can you give any instances in which partial filling has proved successful?

53. If a system of compulsory stowing is to be introduced, do you consider that it would be sufficient if the sand were delivered

free at the colliery, or do you consider that additional financial assistance in respect of the actual stowing would be necessary?

54. Generally speaking, do you consider that statutory control over mining methods in the interest of—

(i) Safety, and

(ii) Conservation of a national asset,

should be universal or limited to any particular field or fields? Please give your reasons in full.

55. Should compulsory stowing, if adopted, be restricted to the Bihar Fields to conserve supplies of coking coal, or should it be extended to the Bengal Fields also where the coal is more liable to spontaneous combustion? Do you agree that avoidable waste shall be stopped whenever it occurs?

(b) *Miscellaneous.*

56. Many coal-mining properties in the Jharia and Raniganj fields are too small or so badly shaped as to make it difficult to work them safely and economically. Do you consider that, in such cases, steps should be taken to compel the owners to amalgamate properties or readjust boundaries without having to pay *salami*?

57. Do you approve of one owner possessing the rights to, and working, a seam or seams directly above or below other seams being simultaneously worked by another owner, and lying within the boundaries of the same mineral leasehold? If not, to what dangers do you consider such an arrangement might give rise, and what remedy would you suggest?

58. At present, Regulation 53 does not appear to require the two shafts or outlets to every mine or seam at work to be within the leasehold of the mine nor does it require the manager of the mine or seam to have independent charge of the two outlets. Do you consider that the manager of each mine should have sole and independent charge of the two shafts or outlets?

59. Would you be in favour of mine-owners working adjacent properties being required by law to make and maintain joint surveys so as to secure a check on the barriers between such properties? Do you consider that, if a statutory authority is set up, that authority should have power to survey barriers between adjoining mines?

60. Do you consider that, in addition to being required to maintain a tracing showing surface buildings, etc., under Regulation 15 (3), mine-owners should also be required to show such buildings on the plan of the underground workings?

61. If inferior coal (*i.e.*, other than selected or first grade) could be used for purposes for which coal of good quality is now used, this would evidently increase the life of the available reserves of good coal. Have you any practical ideas on this subject? Are

there any practical possibilities in this direction in connection with the railway locomotives, industrial power, manufacture of soft coke, etc.?

62. What, in your opinion, has been the effect on methods of extraction of the Coal Grading Act of 1925? If you consider that the effect has been to increase waste, will you kindly give particulars of actual instances specifying the colliery and the seam?

63. We are informed that the number of notices and orders issued under Section 19 of the Indian Mines Act (as amended by Act XI of 1936) far exceeds the number issued in Great Britain under similar circumstances. Can you say why this should be so? Would it be correct to infer that the Mines Department has to interfere more because methods or practices dangerous to human life or safety or stability are more frequent in India than in England?

1. Written Evidence sent in by the National Association of Colliery Managers, Jharia.

Question 2.—(*a*) Spontaneous combustion in goaf and collapsed areas.

(*b*) Yes.

(*c*) The Association is not in a position to give actual figures.

Question 3.—It is impossible to name the seams most liable to spontaneous combustion. Any seam is liable to fire if conditions are favourable.

No specified time as incubation period.

Question 4.—Yes, fires increase the difficulties of extracting the remaining coal. A certain percentage of coal must be permanently lost in the extraction of the remaining coal. This percentage depends entirely on local conditions.

Dangers become greater towards the final stage.

Question 5.—The Association has no objection to laying-out panels in the first workings but it has serious objections to de-pillar in the ordinary way and losing coal in the barriers.

Percentage of coal in barriers varies according to local conditions, and may be a considerable percentage of the seam.

Question 6.—The Temporary Coal Mines Regulations have covered all known possible dangers. These are adequate.

Question 7.—Yes. Exhausting fans are preferable but forcing fans may be necessary in different conditions.

Question 8.—Yes, coal left in goaves increases the risk of fire.

No information.

Question 9.—(*a*) No.

(*b*) Not practical.

Question 10.—Yes, telephones should be installed in places difficult of access.

Question 11.—*Nil.*

Question 12.—Yes.

Question 13.—Breathing apparatus and gas masks should not be used unless by the trained mine rescue teams.

Question 14.—Temporary Regulation No. 14 should be extended to apply to all mines.

Question 15.—Yes, each mine must be left to settle its own method of working.

Question 16.—We agree that packing to prevent the breakage of the roof would be a safety measure, but in most cases this would be impracticable.

Question 17.—Premature collapses can only be due to an insufficient support for the roof being left during the time of first working.

Question 18.—Premature collapses may cause air blast, fire, and may affect shafts, surface, buildings, tanks, etc. The collapse can only be prevented by packing unstable areas or deliberately further reducing the support and inducing a controlled collapse.

Question 19.—We are not in favour of minimum dimensions of pillars and maximum dimensions of galleries, but we would favour a stipulated maximum percentage of extraction during the first workings.

Question 20.—See answer to *Question 19.*

Question 21.—Yes, with special permission possible from the Chief Inspector of Mines for special causes.

Question 22.—See answer to *Question 19.* Local conditions would govern this question.

Question 23.—No.

Question 24.—No.

Question 25.—This Association cannot know that.

Question 26.—We would not consider an irruption of water entering a fire as dangerous from the reasons stated.

Question 27.—No.

Question 28.—Manager should specify the minimum length of fuse in any shot-hole.

Question 29.—No.

Question 30.—Yes.

Question 31.—The proviso should be retained.

Question 32.—No.

Questions 33, 34 & 35.—Nil.

Question 36.—50 per cent. to 60 per cent.

Question 37.—(1) Yes, (2) No information.

Question 38.—Nil.

Question 39.—We could not agree to the packing of all seams.

Question 40.—Does not arise.

Questions 41 & 42.—Nil.

Question 43.—If compulsory filling is to be introduced, we believe a statutory authority necessary. This statutory authority should be distinct from the Mines Department and a competent Mining Board should be set up for appeal.

Question 44.—See answer to *Question 23.*

Question 45.—(*a*), (*b*) and (*c*) The total saving is negligible.

(*d*) Does not affect the cost—prolongs the life of the colliery.

(*e*), (*f*), (*g*), (*h*) Negligible.

Question 46.—This is controversial. Association not in a position to reply.

Question 47.—Same answer as *Question 46.*

Question 48.—*Nil.*

Question 49.—Each case should be studied separately. Where the seams are separated by thick strata and are of a normal thickness stowing might not be necessary.

Questions 50 & 51.—For owners to reply.

Question 52.—Partial filling would be successful in a number of cases.

No.

Question 53.—The total stowing cost should be met from some central fund if the stowing is to be compulsory.

Question 54.—If statutory control is necessary it must be universal. All coal is of national value and should be conserved. Some non-coking coals when mixed with coking coal, make a good hard coke.

Non-coking coals have a commercial value as well as coking coal and, therefore, should be conserved.

Question 55.—The answer to *Question 54* answers this question, but we agree that waste should be avoided where possible.

Question 56.—For owners to reply.

Question 57.—We do not approve of this, but we would agree to these conditions if one manager was in charge of the whole mineral leasehold.

Question 58.—Yes.

Question 59.—(*a*) Yes. (*b*) No.

Question 60.—Yes.

Question 61.—The Association is not in a position to answer.

Question 62.—(*a*) Increased waste.

(*b*) Not for this Association to answer.

Question 63.—There can be little or no comparison of mining methods between Great Britain and India. The very nature of the coal seams in India prohibits the use of methods used in Great Britain.

The original Indian Act was not as comprehensive as C. M. A., 1911 (British Act). We recommend that the sections of the Indian Mines Act should be collated and codified in one book.

Oral Evidence of Mr. J. Brook and Mr. R. J. Pothecary, Representatives of the National Association of Colliery Managers.

Question 3.—The better quality seams are more liable to spontaneous combustion than the poorer quality ones.

Question 5.—The panel system increases the factor of safety, but also increases avoidable waste. If the dimensions of pillars and galleries in first working by the pillar and stall method are satisfactory for purposes of stability, that method is generally less wasteful and enables the isolation of fire areas to be easily carried out. The average loss of coal in panel barriers would be from 20 to 35 per cent. assuming that the panel barriers have to be left entirely. The panel system of working is inflexible, whereas the pillar and stall method is somewhat flexible, but even with the pillar and stall method the percentage of coal lost in pillars supporting stoppings round a goafing area is likely to be 20 to 25 per cent.

Question 6.—There would be no objection to the Temporary and Supplementary Regulations being made permanent. The temporary legislation of 1936 should also be made permanent.

Question 9.—If any such provision was made by law, it would be necessary to state that intervals at which taps should be placed in the existing water mains and the length of hose that should be kept handy, and would suggest that 200 feet of hose would meet the case.

Question 10.—We would have no objection to telephonic communications being enforced in those cases in which the Chief Inspector of Mines considers them necessary for purposes of safety.

Question 14.—Temporary Regulation 14 should be amended to require the precautions against coal dust to be taken within a definite distance of the area sealed-off on account of fire and it should not require these precautions to be taken in the whole of the ventilating district. In our opinion, the term "naturally wet throughout" should be defined because in some parts of a mine roadways may be wet, the adjoining places may be damp and other places may be dry. The Regulation should be worded in such a manner as not to include those places which are sufficiently damp to prevent coal dust being raised into a cloud. We consider that a distance of 400 feet round an area sealed-off on account of fire within which precautions against coal dust should be taken would be reasonable.

In our written answer we have said that Temporary Regulation No. 14 should be extended to apply to "all mines". By this we mean all mines which are liable to spontaneous combustion except those naturally damp. We believe that the treatment of coal dust inside an area 600 feet from fire stoppings would be sufficient.

Question 16.—What we mean to say is that compulsory stowing of goaves in the circumstances contemplated would be economically impracticable, but it would be practicable if financial assistance were given.

Question 19.—In our written answer we have favoured a stipulated maximum percentage of extraction during first workings. We would now agree to a definite floor area and the height of the gallery to be governed by local conditions.

Question 21.—We are of the opinion that two pillar lengths ahead of the point of pillar extraction would be a reasonable limitation for splitting pillars and heightening of galleries.

Question 24.—After discussion with the Committee we are in favour of powers being given to require mine-owners to pack or partially pack in the circumstances contemplated, provided such powers were exercised by the Mines Department and not by a statutory authority. In all cases where sand-stowing was required compulsorily, whether as a measure of safety or conservation, financial assistance would have to be given to the extent of bringing the operation within practicable economics. Any orders in this respect should be subject to appeal.

Question 26.—This is a highly controversial question and we would prefer not to express any definite opinion regarding it.

Question 28.—We agree that if this recommendation were adopted, the minimum length would have to be varied with the number of shots that are being fired.

Question 30.—Yes. The examination should be based on the work of a shot-firer only. When a shot-firer is employed in a fiery mine such a certificate should be endorsed for gas testing. All shot-firers who have been employed as such for a period of two years should be granted a certificate without examination.

Question 39.—Our answer to this question is subject to the same modification as we have made in replying to *Question 24.*

Question 41.—As an Association we have no data with which to answer the question.

Question 42.—If compulsory stowing is introduced, we consider that the additional cost of compulsory sand-stowing should be met by a cess on all coal and coke carried by rail in or into British India, accompanied by an additional import duty of the same amount on foreign coal and by a drawback of the same amount on Indian coal export. The railways and the royalty receivers should also be required to contribute to such a cess in a form that would add to the funds of the cess.

Question 43.—If compulsory filling is to be introduced we believe a statutory authority necessary. This statutory authority should be distinct from the Mines Department and should be composed of full time men who are fully qualified mining engineers with no interest in mining.

Question 49.—The thickness of strata and the thickness of the seam determine whether a stratum will break through to an upper seam when pillars are extracted in the lower seam. There is some relation between the thickness of strata and the thickness of the seam, but what that relation is we are unable to express any opinion. From this it follows that, in our opinion, proviso to Temporary Regulation No. 10 is necessary in order to give the Chief Inspector powers to permit the extraction of pillars in a lower seam below a fire area in an upper seam.

The statutory authority should study each case separately and make a decision. We have heard of a case where the seam extracted from under a fire was separated from the fire by strata seven times the thickness of the seam being extracted and, no trouble was ever experienced from the fire. We also have heard of a case where the strata was ten times the thickness of the seam being extracted. The work had to be abandoned due to smoke from fire coming down.

Question 53.—By " total stowing cost " we mean the net stowing cost or the difference between the actual stowing cost and the saving effected.

Question 55.—We will agree to a definition of " avoidable waste " as all waste which is not incidental to the proper and efficient working of the system of mining that is being followed.

Question 59.—If checks of barriers between mines are to be made, we consider that it should be made by the surveying staff of the Mines Department, and if that staff is at present insufficient for this purpose, it should be increased.

Question 62.—We agree that it would be desirable to stop the extension of the grading system to the internal trade which was never intended originally.

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2. Written Evidence of the Indian Mine Managers' Association, P. O. Kusunda, Manbhum.

Question 2.—The main cause of underground fires is spontaneous heating of coal left in the goaf.

Yes. More fires have been caused after pillar extraction.

Question 3.—In the Jharia field we find:—

Nos. 14 and 15 seams most liable to spontaneous combustion.

Nos. 11, 12 and 13 seams—comparatively less liable to spontaneous combustion.

No. 10 seam and downwards—not generally liable to spontaneous combustion.

In the Raniganj field:—

Most seams of Selected Grade and No. 1 Grade are liable to spontaneous combustion.

Incubation period varies from 6 months to 2 years being generally higher for the Jharia seams and lower for the Raniganj.

Generally speaking coal of the lesser commercial value is less liable to spontaneous combustion.

Questions 4 & 5.—Yes.

Coal left in barriers about 20 per cent.

Question 6.—We think the Temporary Coal Mines Regulations are reasonably adequate against all possible dangers from fires. Some of the provisions requiring protective measures against likely outbreaks of fires in the future need not, however, be enforced in the case of collieries working lower grade coals, not generally liable to spontaneous combustion. It is further desirable that certain of the Regulations are modified and initiative left to the management to take such measures as may be necessary under particular circumstances.

Question 7.—Yes, if the natural ventilation is not adequate.

It is desirable to have exhausting fans with reversing arrangement.

Question 8.—Yes.

Yes—Such as Poniati, Kajora, etc.

Question 9.—No, but it should be left to the management to adopt wherever it is found necessary.

Question 10.—No, but additional code of signals may be adopted instead.

Question 11.—Storage of necessary materials for dealing with fire.

Question 12.—Yes.

Question 13.—Both have advantages but must be used by trained men only.

Question 14.—Temporary Regulation 14 (*a*) may be extended to all seams liable to spontaneous combustion but 14 (*b*) need not be so extended.

Question 15.—Yes.

The only known method by which the risk of fire occurring is entirely eliminated is to adopt sand-stowing but there is a limit to its application.

Working on the panel system would minimise the risk to this extent that the area under fire can in most cases be isolated.

Further, reduction or weakening of pillars over large areas should be prevented.

Question 16.—Yes, packing, either partial or full, with sand or other suitable material should be enforced, as far as practicable, in all seams which give off inflammable gases.

Question 17.—Premature collapse of workings is mainly due to the weakness of pillars.

Question 18.—This might lead to fire as well as injury to property and workman. Can be best prevented by lesser percentage of extraction in the first working and stowing around the weaker pillars in old workings.

Question 19.—No.

Question 20.—The factors governing the dimensions of pillars and galleries are the depth of workings, softness, or hardness of the coal, nature of the roof and superincumbent strata, inclination of the seam, natural disturbances and other circumstances.

Question 21.—Yes, except in special cases.

Question 22.—It would not be desirable to open out more than two sections at a time of reasonable heights with a parting in between of about ten feet, depending on the nature of the coal.

Question 23.—No.

Question 24.—Yes, the statutory authority may require mine owners to pack or partially pack the galleries prior to the extraction of pillars where it considers it necessary for the stability of the workings and the prevention of premature collapse, provided proper facilities for such operation are afforded to them.

Question 25.—Yes.

Irruption of surface water into the fire area at Bagdigi colliery also irruptions of water into Phularitand, Ramnagore and other collieries.

Question 26.—Yes.

Question 27.—Drains should be cut or embankments made to prevent any sudden irruption of water into the mine and specially into the fire areas. Also tanks above a fire area should be drained out as far as possible.

This may be enforced legally.

Question 28.—The Regulations are considered sufficient for the purpose of safety.

Question 29.—Not necessary.

Question 30.—Yes.

Question 31.—This power may be retained for use in special cases.

Question 32.—No further suggestions beyond the requirements of the law is necessary or called for.

Questions 33, 34 & 35.—*(Not answered.)*

Question 36.—No accurate answer possible but 50 per cent. of this coal may be possible to extract.

Question 37.—Yes.

There have been several cases of compensation having been paid for such coal locked under railways.

Lodna, Khas Jharia and Begunia collieries.

Question 38.—Both the life and productivity will increase but not necessarily the yearly output.

Question 39.—Sand-stowing may be enforced simultaneously with the extraction of pillars.

Question 40.—Sand-stowing or stowing with other non-combustible material, either partial or full, should be enforced—

(i) in all seams of Selected and No. I Grade quality which are liable to spontaneous combustion;

(ii) in all workings which are liable to be affected by premature collapse;

(iii) in all workings under a fire area and water-locked areas;

(iv) under railway lines, towns and villages, and rivers.

Question 41.—The following cost of stowing is given:—

(I) Hand stowing with ash and cinders—

Cost of 1 ton of ash to pack 60 cubic feet of coal space in situ.

	Rs.	A.	P.
(*a*) . .	0	7	6
(*c*) . .	0	1	6
(*d*) . .	0	2	3
(*e*) . .	0	4	6
Contingencies	0	0	3
	1	0	0 per ton of ash.

Surface lead 200 feet.

Underground lead 1,000 feet.

Transport in tubs by haulage.

(II) Hydraulic sand-stowing—

Average cost for 1 ton of sand to pack 20 cubic feet of coal space in situ.

	Rs.	A.	P.
(*a*) and (*c*) . .	0	2	0
(*d*) and (*e*) . .	0	2	0
(*f*) and Miscellaneous	0	1	6
	0	5	6 per ton of sand.

Surface lead less than one mile.

Underground lead 1,000 feet to 2,000 feet.

Transport by surface haulage and rope way and then through pipes.

(III) Additional cost per ton of coal raised by stowing.

(*a*) In virgin coal:—

(i) As. 8 to As. 10 per ton of coal for full stowing.

(ii) As. 4 to As. 5 per ton of coal partial stowing.

(*b*) In workings formed into pillars Re. 1 to Rs. 1-8 per ton of coal.

Question 42.—Cess on all coal despatched and royalties paid.

Question 43.—Yes.

Statutory authority should consist of—

(1) Representatives of colliery owners,

(2) Representatives of royalty receivers,

(3) Representatives of colliery managers,

(4) Representatives of railways,

and the Chief Inspector of Mines in India as Chairman.

Question 44.—No.

Question 45.—Certain amount of saving depending on conditions of the mine is possible under (*a*), (*b*), (*d*) and (*e*) but there will be loss under (*c*) and (*h*) while no saving is likely under (*f*) and (*g*).

Questions 46 & 47.—Yes.

Question 48.—All coal which can be worked at a profit under normal conditions of the trade.

Question 49.—Yes.

Question 50.—Yes, provided proper financial and other facilities are afforded.

Question 51.—The railways should bear a part of the cost as they would thus be saved from paying compensation for the coal locked.

Question 52.—For comparatively thin seams lying at the greater depths partial stowing should suffice.

Amlabad for instance.

Question 53.—Additional financial assistance would be required in respect of actual stowing.

Question 54.—Statutory control to the extent of requiring partial or full stowing to be done before pillar extraction should be universal over the major coalfields in British India from the point of view of safety and conservation of national assets.

Question 55.—As far as possible should be adopted in the higher class seams of both the fields to prevent avoidable waste of such coal.

Question 56.—Readjustment of boundary would be very helpful and should be undertaken, if possible.

Amalgamation of smaller properties, however desirable, would be difficult to achieve.

Question 57.—This is not a desirable arrangement, as the stability and security of the top seam workings would be affected by any unrestricted working in the bottom seam over which the former owner may have no control. But the arrangement can be made to work under certain restrictions, also if sand stowing is made compulsory.

Question 58.—Cases are very few where a manager has not charge of both outlets and no real difficulty has been experienced in the few existing cases which are entirely matters of mutual consent. No modification of the present law is therefore necessary.

Question 59.—The Department of Mines should request owners of adjacent properties to make a joint survey of the common barrier when the workings of either of the collieries approach the barrier. On their failing to do so the Department can undertake the survey itself and refer the matter to the statutory authority for necessary adjustment of barriers and other reliefs.

Question 60.—Yes.

Question 61.—For the larger use of the lower grade coal in place of higher grade at present being used the following suggestions may be considered:—

(1) Locomotives may be designed with a view to burn inferior coal with reasonably high efficiency.

(2) Railway freight and cess on inferior coal may be fixed on a reduced scale to give greater impetus to their use in the industries.

(3) High class coking coal like the Giridih coal, should be prevented from being used in the locomotives for steam raising.

Question 62.—Several seams all over the coalfields have been so graded as to leave out certain sections which are invariably lost and often increase the risk and difficulties of pillar extraction.

Question 63.—These notices and orders are of very recent growth and betray certain nervousness on the part of the Mines Department as a result of a series of big accidents in the coalfields.

We cannot accept the inference that the practices dangerous to human life or safety are more frequent in India than in England.

Oral Evidence of Mr. B. K. Bose and Mr. S. K. Ghosh on behalf of the Indian Mine Managers' Association.

Question 6.—We have the following suggestions to make with regard to the Temporary Regulations. In Temporary Regulation No. 6, we will suggest the insertion of the word "open" before the words "broken surface" in the last but one line. We would

also agree to the omission of the word "boiler" in the second line.

In Temporary Regulation 4 (3) the word "electrical" should be inserted between the words "underground" and "engine house" in the third line.

In the Supplementary Regulation 5 (*a*) we would suggest the addition of the words "or drenched with water" after the words "which is naturally wet throughout".

Our Association has no objection to the Temporary and Supplementary Regulations being made permanent with the suggestions made above. As regards the temporary legislation of 1936, our Association agrees to this being made permanent with the exception that we consider the new section 19 (1-A) (*b*) to be out of place in this section. We consider that it should be re-enacted in some other part of the Act or the Regulations in the form that will be discussed in dealing with *Question 19*.

Question 7.—We think that mechanical ventilation is very desirable in the circumstances contemplated, but we do not think that this should be generally enforced, more particularly in shallow mines. We would agree, however, provided steam was considered a means of mechanical ventilation.

Question 9.—What we mean is that the provisions suggested would be useful, though their practical application would be comparatively limited, but we do not think that they should be required by law.

Question 10.—We think that additional signals would be sufficient even in a big mine. There should be provisions for signals in the reverse direction.

Question 13.—We would like to add that gas masks may be used even by untrained people in case of necessity.

Question 14.—We would not object to Temporary Regulation No. 14 (*b*) being extended as proposed to seams which are greatly liable to spontaneous combustion.

Question 16.—The words "as far as practicable" relate to economic considerations. If sand was provided free and stowage underground assisted, our Association would agree to the proposal in this question. Some of our members consider, however, that this enforcement would not be necessary in thin seams. By "thin seams" we mean seams less than six feet in thickness. Our reply would not relate to workings in seams which give off only a small quantity of inflammable gas, or to workings in a gassy seam close to the outcrop.

Question 19.—We agree that much waste and damage has been caused by bad working in the past, but our Association is at present against any principle of first working being laid down by law or regulation, because—

(1) of the great variety of conditions from mine to mine,

(2) such legislation could not be fully enforced, and

(3) any such legislation would interfere too much with the initiative of the management.

We think that the discretion of the managers is already interfered with by the owners, but we are inclined to think that the proper remedy lies, not in legislation, but in increasing the powers or authority of the manager so that he can successfully withstand the demands of owners. In view, however, of the discussion which we have had with the Committee, we are willing to resubmit this question to the Association and will send in a further written reply which may be added to our answer to this question.

Question 20.—We wish to add the thickness of the seam to the other factors mentioned in our written reply.

Question 21.—We realise that our reply to this question is not quite consistent with our written reply to *Question 19.* The Association will therefore reconsider *Question 21* as well.

Question 22.—We realise that there may be exceptions to our written reply to this question. We are contemplating only seams dipping at a more or less normal angle, and not of extreme thickness.

Question 24.—By " proper facilities " we mean the supply of sand, transport of sand, and financial assistance in the underground stowing.

Question 29.—We say that the extended use of " permitted " explosives is not necessary because we consider that the Temporary and Supplementary Regulations, if properly enforced, are sufficient for all dangers which are likely to arise.

Question 30.—We will refer this question again to our Association for consideration of the following points:—

(1) What particular points the syllabus for shot-firers should cover.

(2) Whether it would be better to require all shot-firers to have sirdar's certificates.

(3) Whether it would be advisable to require that no shot-firer should be directly interested in the getting of the coal.

We will also suggest if necessary what period should be allowed for the shot-firers to get whatever certificate may be required.

Question 39.—Our answer may be taken as meaning that we would be in favour of the enforcement of the system of filling or packing either in the extraction of pillars or in the wholesale extraction of the seam, for example, by some modified longwall or modified pillar and stall system.

Question 40 (iv).—We will add to this public roads and bridges.

Question 41.—The figures given are based on average actual working in several collieries.

Question 42.—We would accept a cess on all coal carried by rail in or into British India. We think that the cess should be universal because it will have the effect of increasing the price of coal and all coal will therefore be benefited. Also, with an increase in price more comparatively inferior coal would probably be used. We would recommend the cess being paid by royalty receivers on a percentage basis as in the case of the Mines Board of Health. We think that the cess on royalty receivers should be higher than the percentage they pay in local cesses because they will be very much benefited by a compulsory system of sand-stowing. We think also that the railways should contribute to the cess in some form because they will be relieved of their legal liability for coal left under the railway lines and their traffic will also be increased by the coal which would not otherwise be recovered. There would also be the increased factor of safety because sand-stowing under the lines would take away the danger of fire being communicated from neighbouring collieries.

Question 43.—Our idea is that the statutory authority should control the collection and utilisation of the proposed cess, be responsible for all arrangements for the collection and distribution of sand, and also be the appellate authority from the Mines Department in cases where that Department requires stowing to be done as a measure of safety. Stowing for purposes of conservation would be under the control of the statutory authority. In order to maintain the connection between safety and conservation in matters of stowing, we would have the Chief Inspector of Mines on the statutory authority as a member, but not as Chairman as suggested in our written answer. We would have the Chairman elected by the representative members of the statutory authority. We would agree to representatives of railways being excluded and would be prepared to allow representatives of consumers.

Question 53.—We agree that a flat rate would be the best form of assistance in respect of the actual underground stowing.

Question 55.—We would accept a definition of "avoidable waste" as all waste which is not incidental to the proper and efficient working of the system of mining that is being followed.

Question 61.—We would agree to the proceeds of the cess already referred to being used for purposes of research. We would do this research by an institute of some kind in India, but we would also be agreeable to send samples to Great Britain or elsewhere for report.

As regards our reply to *Question 61 (3)* we now see, after discussion with the Committee, that it would be impracticable to prevent coking coal being used for any purpose other than metallurgical. The only remedy that we can see is to nationalize all mines including both coking and steam coal, that is, considering conservation not only as meaning conservation of resources, but also the utilisation of the different types of coal.

Question 62.—We would be in favour of some system being devised by which grading would be limited to export coal only and would not be applied to coal sold within India.

Question 63.—We agree that the Mines Department has been justified in erring on the side of safety in the light of occurrences within the last two or three years. We would probably do the same thing if we were in the same position ourselves.

General.—We are of the opinion that the best way of improving the methods of mining in the interests both of safety and conservation would be to give the qualified mine managers more scope for the display of their initiative and ideas. They do not have this scope at present because they are controlled by people who have no sufficient knowledge of mining and are liable to be dismissed if they were to refuse to carry out the orders of an owner even though the carrying out of those orders would mean unsound and unsafe working. We think therefore that the managers should be legally protected from this consequence, and we will suggest consideration of a provision that the dismissal of all managers should be subject to confirmation by the Chief Inspector of Mines.

Supplementary Note sent in by the Indian Mine Managers' Association.*

Question 19.—The main objection to the proposed legislation is that it would be extremely difficult to satisfy all the different conditions on which the size of pillars and galleries depend and that there would be too much interference in the working of a mine by the Mines Department. If, however, a formula could be evolved which would satisfy all the varying conditions to be met with in a mine and would leave the management complete freedom, consistent with safety, in the designing and laying out of the workings, my Council would have no objection to such law being enacted provided reasonable deviations from the rule is allowed by the Chief Inspector of Mines in special cases.

Question 20.—The height of galleries should ordinarily be allowed within the limit of 16 feet depending upon conditions, while the maximum percentage of extraction in the first working should be allowed up to 50 per cent. of the floor area depending upon conditions. These figures are for shallow depths and will gradually decrease as the mines get deeper.

With regard to the suggestion of 10 feet height of galleries made by the Subsidence Committee the following points should be noted:—

(1) That it is not a definite recommendation but merely a suggestion with a view to extreme safety.

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* Received subsequent to the oral examination of the representatives of the Indian Mine Managers' Association.

(2) That the Chief Inspector of Mines who is a member of the Committee is himself issuing orders to maintain height of galleries above 10 feet and several other members of the Committee are themselves allowing the galleries in their mines to be driven above 10 feet in height in spite of their suggestion in the report.

Question 21.—With regard to the splitting of pillars complete splitting may be allowed up to two pillars in advance prior to depillaring.

Question 30.—We prefer special training and examination of shot-firers. No restriction should be imposed at this stage with regard to their employment as coal getters.

General.—Since one of the objects of the Committee is to attain greater safety and more rational method of working for the prevention of the waste it is imperative that means should be devised to ensure efficient management of the mines. To attain this object full facilities should be given to the managers to discharge the obligations enjoined upon them by the statute properly. Generally speaking, this is far from the case. Further, the managers should be paid salaries commensurate with their responsibilities and position and given other reasonable amenities to remove all causes for discontentment which perhaps in a large number of cases prevent them from putting forth their maximum efficiency in the discharge of their duties. The present position is that in a large number of cases managers are employed without regard to their abilities and experience on the lowest salary that they can be made to accept.

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3. Written Evidence of the General Secretary, the Indian Colliery Labour Union, Jharia, Bhaga P. O., and the Tata's Collieries' Labour Association, Jamadoba, Jealgora P. O.

Question 1.—At present I do not hold any appointment in any mine but I am in intimate touch with all sorts of labour, both surface and underground, being the Founder, Organiser and the General Secretary of the Indian Collieries Employees' Association (Estab. 1920) (now Indian Colliery Labour Union) and the Tata's Collieries' Labour Association (Estab. 1930). I am in touch with the coalfield since 1899 and intimately connected with it since 1914, holding different jobs in collieries up to 1928. My experience relates to Jharia and Raniganj coalfields particularly, and Giridih and Bokaro coalfields generally. As an Assistant Labour Commissioner of the Royal Commission on Labour in India I toured round this field to enquire about the condition of colliery labour. I sat at Mudidih, Bagdigi, Joktiabad (Giridih) and Loyabad Court of Enquiries to watch the proceedings on behalf of the labour and to cross-examine the witnesses.

Question 2.—In my opinion the main causes of underground fires are:—(*a*) accidental, (*b*) spontaneous.

(*a*) Accidental fires may be due to variety of causes.

(*b*) Spontaneous due principally to oxidation of coal itself.

Oxidation of coal, again, takes place in the following circumstances:—

(i) Loss of coal during pillar extraction, *i.e.*, left in the goaf due to wasteful method of working.

(ii) Premature collapse of workings due to small sized pillars standing for long.

(iii) Leaving of portion of coal due to the rules framed by the Coal Grading Board.

Spontaneous due also to the presence of iron-pyrites. Yes. The number of fires has increased in recent years. More fires have been caused by normal collapses than by premature collapses. Indian condition of de-pillaring are quite different to European conditions, *viz.*, thickness, composition and erratic attendance of labour, etc., generally. Mining men trained under conditions different to Indian have less likelihood of adapting to Indian conditions at first, so far as de-pillaring is concerned. The method itself is wasteful.

Question 3.—Any seam upwards from XI seam in Jharia and the good seams of Raniganj are liable to spontaneous combustion. The incubation period of Jharia is 2½ years and that of Raniganj 12 months to 15 months. In extreme cases it may be even less. I consider seams below XI in Jharia (though of commercial value) to be free from the risk of spontaneous combustion.

Question 4.—Yes. Fire increases considerably the difficulties and dangers of extracting the remaining coal.

No doubt the fires increase the dangers at the time of final extraction of coal but it also endangers development if fire is in a neighbouring section.

As one seam after another is removed the strata above get broken and air can breathe through it. The gases from fire can rise up through cracks and even fire may creep up or down, as the case may be, through these breaks and cracks. So danger increases in this case also.

Question 5.—Yes. All new workings in seams liable to spontaneous combustion should be laid out in a system of panels as far as possible. The barrier should be 1½ to 2 times the size of the pillars. So percentage can be worked out on this basis.

Question 6.—The Rules, Regulations, Bye-laws and Temporary Regulations, if followed in proper spirit, are quite adequate. More useful rules can be framed but they are of no use, unless they are actually adhered to in reality than in paper. We hold that unless some Trade Union officials are allowed to inspect the mines and report directly to the Mines Department about the observance of

the laws, the Mines Department with their best efforts cannot humanly detect all the violations. They can at best investigate and come to conclusion after some catastrophe has happened. Nobody in owners' employ can have the audacity to report about any violation. It is apparent that *bonâ fide* Trade Union officials should be allowed to co-operate and inspect the mines for finding the condition of the mines so far as safety is concerned more or less on the line of the British Mines Act.

Question 7.—Not necessarily, *viz.*, in small mines, where there is no fire. Wherever fans are installed arrangements for reversal of air current must be made. Evidently mechanical ventilator will ensure more safety.

Question 8.—Yes.

I have heard of some such fire in the Benihir Colliery of Messrs. Standard Coal Company.

Question 9.—This should best be left to the management as when fires break out, of course these water taps or tanks are likely to be adequate to quench such fire. But the Chief Inspector of Mines should have such power to enforce it if he so requires.

Question 10.—No doubt this goes a step towards safety. It should be connected from the surface and should reach up to the working face. The telephone arrangement should particularly be made in a mine having a great area.

Question 11.—A special officer to watch the fire and to detect the likelihood of fire should be attached to the colliery particularly where there is fire.

As stated previously there should be some *bonâ fide* Trade Union Officials given legal powers to report direct to the Mines Department after investigation. Many more safety measures can be drawn, of course requiring a greater amount of financial help. Still in my opinion for the safety of the mine and labour we cannot help but do it. Such practicable steps should be enforced.

Question 12.—I consider that there should be two classes of rescue men. " A " class and " B " class. " A " class men should be trained in the method of dealing with fires, etc., and ordinary training in rescue work; while " B " class only in rescue work. " A " class men should have more general and academical qualifications with good technical and mining knowledge; whereas " B " class men may be ordinary men but with strong common sense.

My objection in having one of rescue men, *viz.*, " A " class is this that lessons and instructions may be more shallow and a large number of suitable candidates for " A " class are not likely to be available at all times.

Question 13.—As a Labourite, my opinion will certainly be in favour of breathing apparatus and gas-masks. Many lives have been lost for want of these simple apparatuses. To be of use these

must be maintained in perfect order and the rescue station must be properly equipped.

Question 14.—Evidently the more the precautions are taken the safer the conditions. But I do not consider that Temporary Regulation No. 14 should be extended to all mines liable to spontaneous combustion. If all other precautions are actually taken there should be no occasion for any accident.

Question 15.—Certainly prevention is better than cure. Panel system of working leaving solid barriers of coal, making sand barriers all round, etc. The sovereign remedy being stowing the void.

Question 16.—The danger of gas where present will always be there whether there is goaf or solid working. From all points of view stowing is desirable.

Any thick seam, XI seam and upwards about 20 feet in thickness should be stowed at first instance and seams of lesser thickness should be done in the light of experience.

Question 17.—With net work of galleries the small pillars become weaker as time goes on. Due to weathering, pieces of coal begin to fall off. Coal standing on pillars has to bear the pressure of the superincumbent strata and subsequently becomes weak. Sometimes pillars are robbed illegally by the miners as they can give greater amount of output within a very short time. This is sometimes done even in the knowledge of the management in order to get a good raising to cope with fluctuating market and this system results in the premature collapse of the pillars.

Question 18.—Apart from subsidence of the surface including *dhowrahs*, buildings, drains, and rivers, etc., such premature collapses result in spontaneous heating. If it is over a large area a heavy air blast may take place and may break down the air crossings, air doors and even the head gear, shaft bottom, and top arrangements may be damaged. If it is in the bottom seam then top seams evidently would be damaged at that place.

The best precaution in general is to have large size pillars with comparatively narrow galleries. When the thickness of the seam is very high the size of the pillar should be proportionately very great. If by chance a pillar becomes small supporting by cogs or bricks, stones or if possible stowing is the only practicable remedy.

In pillars where coal becomes very loose if it remains long, in spite of the great size of pillars, then stowing the galleries as soon as they are formed, unless the area is depillared within a short time.

Panel system of working also prevents that trouble.

Question 19.—No. The local conditions must be taken into account. Even the minimum dimension may be too inadequate.

Question 20.—No hard and fast rule can possibly be made regarding minimum size of pillars and maximum dimension of galleries.

The main factors governing these are:—

(1) Depth from the surface.

(2) Thickness of the seam.

(3) The nature of coal—soft or hard.

(4) The nature of strata, *i.e.*, whether the strata above are sand-stone, shale, etc., or loose sand, gravel, etc., *i.e.*, whether they have sufficient lateral tension.

(5) Geological disturbances—cut-off, fault, dyke, etc.

(6) Whether the roof is pervious or impervious.

(7) The time taken for development of a panel and the incubation period of the particular coal.

Question 21.—Legal prohibition may be called for in certain cases. So the Chief Inspector of Mines should have power to enforce compliance.

Question 22.—Up to 12 feet to 13 feet or 20 feet maximum thickness coal may be worked in one section. Above this it may be worked in two or more sections. No hard and fast rule can be given about dimension of pillars and thickness of parting, etc. They depend so much on local condition.

Question 23.—Yes. I have no objection of having such statutory authority being formed, provided it is not too officialised and does not become a miniature Government Department. It should be composed of mining experts, having experience of workings in smaller concerns with no up-to-date equipment as well as in modern and equipped collieries with large output; and Trade Union officials preferably with mining and technical knowledge and qualifications. All systems of lay-out of workings might be submitted to such authority, provided, however, the power of such authority should at first as an experimental measure be more or less of a "permissible" character and more for co-operation than for domination.

Question 24.—If properly constituted as suggested I would wish the said authority should have the power set forth at later stages after the authority has worked more or less as an Advisory Board for some time as an experimental measure. After going into feasibility and practicability of sand-stowing at all places and all positions, the power of compulsion should be given and not given now.

Question 25.—Loyabad, Bagdigi, also in a way Bhaskajuri, etc., are but recent occurrences.

Question 26.—Yes they are dangerous.

Question 27.—Strong and thick brick barriers should be kept between collieries to the rise to prevent water penetrating such fire

areas. Bunds (embankment) should be made near incline mouths. *Nullahs* should be made to divert the course of water on the surface. Where the coal is full of cracks and fissures, cement-gunmite should be used and the coal pillars made leak-proof. The fire-stoppings should be made very strong. Water may come through goaf of upper seams into fire area, but in such case it may be necessary to level up and blanket the surface to avoid water getting in. The conditions are so varying that no definite rule is possible. The Chief Inspector of Mines may enforce any precaution if he so desires.

Question 28.—Personally I think enough Regulations have been enacted and we should cry halt. Legislation has failed and education is required. If these were honoured more by observance than by breach most of the accidents due to shot-firing and explosives would not have occurred.

Question 29.—Yes. Extended use of " permitted " explosives should be encouraged but the mines having no chance of producing gas may be considered.

Question 30.—Certainly. A better type of shot-firer should be created. They should be certificated after examination. The shot-firer must be examined in the Regulation relating to shot-firing apart from practical demonstration.

Question 31.—I should prefer to have this retained. In stone drifts, heavy blasting is required. It will be advantageous to have more than 5 lbs. The constant coming and going with canisters of explosives in one hand and an open light on the other are more dangerous than having more than 5 lbs. explosives at a time. But this should be done, if allowed to carry more than 5 lbs., most carefully and may be kept in different vessels at the destination.

Question 32.—In face of so many existing laws regarding explosives, they are issued and kept in most unsafe conditions. The main magazine house at a point away from human habitation is very rarely, if not never, opened at night either for issue or for return of the explosives. The issued explosives are partly or wholly used underground. The balance, if returned in daylight, can be returned and kept in the main magazine. But this is very infrequently done as men return from underground ordinarily after the day's work at nightfall between 5 to 6 p.m. These unused explosives are returned to the attendance clerk (who is also authorised as a magazine store clerk) at the surface near the mouth of the incline or pit and are kept there and duly recorded. This relates to day-shift work or work in two shifts of 9 hours each. Where three shifts are at work the balance is given to the next shift man and accounted for. Under these circumstances I think strongest measures should be taken and a subsidiary magazine house for keeping these unused explosives should be erected at a safe distance from the shaft mouth.

There is nothing to improve upon the issue of the explosives. But there is no certainty that the issued explosives are actually taken underground. To prevent this practice the following procedure should be enforced.

The shot-firer's book should be certified by the Overman or the competent person in charge by putting his signature and the balance should be therein noted to be returned to the magazine house. Number of explosives and detonators used should be clearly stated.

Question 33.—In my case the question does not arise.

Question 34.—Ditto.

Question 35.—Ditto.

Question 36.—Maximum 80 per cent. may be recovered with the existing method of working, but including loss due to fire, collapses, etc., it may be even considerably less.

Question 37.—Yes. All this coal is likely to be lost. I do not know of any such case. But the railways should be compelled to give compensation. At the time of sanctioning sidings, the railways force on colliery proprietors to waive all claims under this head. So the purpose of the Land Acquisition (Mines) Act is frustrated.

Question 38.—In thick seams and seams liable to spontaneous combustion 20 to 25: more coal will be got and the life of the property will consequently be lengthened.

Question 39.—Enforcement of packing should be made simultaneously on extraction of coal from pillars but I do not mean it is necessary to stow when only gallery work is going on.

Question 40.—Jharia and Raniganj both should be included in the scheme at the first instance with power to include other fields as occasion demands in the light of further experiences.

Seams from XII to XVII should be included, specially XIV, XIVA and XV.

Condition.—Thick seams and seams liable to spontaneous combustion.

Question 41.—No.

Question 42.—In my opinion if Government and the railway authorities take the responsibility of supplying the sand required and also giving to the collieries a portion of the cess imposed on despatches, then this additional cost may be met.

Question 43.—Yes. A statutory authority should be set up.

Yes. The same authority should have the power to deal with *Question 23* and no separate authority need be created.

Question 44.—Yes.

Question 45.—Lighting system may be improved at less cost. Electric lighting may be taken up to the faces and cumbrous safety lamps, etc., more or less may be eliminated.

Question 46.—This should not be a question of controlling but total prevention. In no case should coal of commercial value be allowed to be lost for the sake of higher grade coal of same seam.

Question 47.—My answer is the same. We cannot allow national resources to be lost in this way.

Question 48.—My definition will be comprehensive and embrace any coal which can be used as fuel, to-day, to-morrow or any time to come. Even the rejected carbonaceous stones of Jharia are made into coke and sold as fuel for domestic consumption and stony coal of Mogma are also utilised as coke. The difficulty is with high volatile non-caking coal of Raniganj.

Ash—maximum 20 per cent.

Moisture—maximum 15 per cent.

Volatile—maximum 15 per cent.

Fixed carbon—maximum 50 per cent.

Question 49.—Yes.

Question 50.—Yes.

Question 51.—Yes. Railways should bear a part of the cost of stowing on the ground that they lock up a great portion of coal which should be raised at their cost.

Question 52.—Thinner seams may do with partial filling while seams above 6 feet in height should be totally filled.

I have heard of partial filling of higher seams even but I cannot remember the place.

Question 53.—Free supply of sand will not do. Some other financial assistance in respect of actual stowing would be necessary.

Question 54.—The statutory authority should be set up for all fields and thus universal. Only initial work should be started in Raniganj and Jharia coalfields at present and extended to other fields as experience will suggest.

We can ill afford to lose any coal,—Jharia and Raniganj coals should be conserved as well as the Giridih coals. These should be conserved for steel manufacturing, etc., as there is a considerably wide resource of iron ores in India.

Question 55.—Yes, compulsory stowing should obviously be enforced in Bihar and Bengal coalfields immediately.

Yes, avoidable waste should be stopped whenever it occurs.

Question 56.—Yes. Steps should be taken to amalgamate properties or re-adjust their boundaries. But it is debatable if the payment of *salami* should be altogether stopped. This is not so urgent at present.

Question 57.—Evidently it is not desirable to have different owners for different seams at the same locality, *i.e.*, same mineral leasehold. While the top seam is developing, bottom seam may have finished development, and pillar extraction might be in progress. Top seam in that case is unsuitable and collapses. Gas

from bottom seam through cracks may come to the top seam. Similarly water from top seam may endanger bottom seam.

The statutory authority should have power to enforce conditions on both owners to work the seams with safety and, if necessary, may delay, stop or expedite and thus regulate workings of the seams. Verticality of pillars and bigger sizes proportionate to depths and pumping, etc., should be enforced.

Question 58.—Yes. The manager should have sole and independent charge of both outlets. But it is not necessary to have them within the same leasehold. The statutory authority may be empowered to give necessary directions.

Question 59.—Yes. Making of joint survey may be legally enforced.

No need of giving so much work on the statutory authority. If thought fit by it, it should have the power to survey barriers, but this should only be done in cases of suspicion.

Question 60.—These will make the underground plan of course cumbrous. Still we should have some faint lines of the most important places of the surface plan in the underground one. Other unimportant matters of the surface plan may be got by placing the underground plan on the surface plan.

Question 61.—Inferior qualities of coal which are rejected as per Coal Grading Board may be used for manufacture of soft coke and used in mills and also the railway local locomotives may use inferior coals.

Question 62.—The Coal Grading Act of 1925 has succeeded in raising the price of coal to a certain extent and in capturing lost markets and laying down a uniform standard by which to judge coal and at the same time causing the inferior coal to be unworked for the sake of the higher grade coal.

There are many instances where only middle section of a seam is worked and the top and bottom layers of coal are left unworked and even there are many cases where bottom good coal seam is taken and some inferior coal at the top seam is lost for ever.

Question 63.—It is partly correct to infer that the Mines Department has to interfere more because methods or practices dangerous to human life, or safety, or stability are more frequent in India than in Great Britain.

Oral Evidence of Mr. Siva Kali Bose, General Secretary, The Indian Colliery Labour Union and The Tata's Collieries' Labour Association.

Question 1.—The Indian Colliery Labour Union has 8,315 members. The total labouring population of the Jharia coalfields is between 50 and 60 thousand. The Tata's Collieries'

Labour Association has 3,317 members, and the total labour strength of Tata's Collieries is about 6,000.

Question 6.—My Unions consider that the Temporary and Supplementary Regulations, and the temporary legislation of 1936, should be made permanent.

Question 9.—After discussion with the Committee, I agree that the legal provision suggested should be made where there are existing water mains and where water is available.

Question 10.—We think that the cases in which it is necessary to instal telephonic communications compulsorily should be left to the Chief Inspector of Mines to decide.

Question 14.—After discussion with the Committee, I now agree that Temporary Regulation No. 10 should be extended as suggested.

Question 19.—After discussion with the Committee, I now agree that general principles of first working should be laid down by regulation. These general principles would apply in the majority of cases. In the few cases where they were not suitable, the Chief Inspector of Mines should have the power to vary them and there should be an appeal from his decision if he refuses to a variation which the management thought was reasonable and safe. There should be an adequate and immediately enforceable penalty for any infringement of such first principles. A suitable penalty would be the restoration securely of the conditions to conform with the principles of first working, any working in that section of the mine being prohibited meanwhile.

Question 23.—I agree to a statutory authority separate from the Mines Department, but with the Mines Department represented on it. That statutory authority would be responsible for conservation generally, in the same way as the Mines Department is for safety. The statutory authority could also be the appellate authority in respect of orders passed by the Mines Department in connection with safety. The Chairman of this statutory authority should be independent and a man with mining experience especially of Indian mining conditions. There could be a panel of mining engineers and there should also be representative of labour. It would be sufficient if the Labour Union member was only co-opted when questions of safety were being discussed.

Question 28.—What we mean is that the regulations are not being fully observed. We agree that it would improve matters in this respect if the staff of the Mines Department was increased so as to be able to make more inspections and also our written answers to *Question 6* should be strictly adhered to.

General.—Section 21 (Court of Enquiry) of Indian Mines Act, 1923, should be amended in such a way that labour representative must be taken in the said Court of Enquiry as assessor.

4. Written Evidence of the Indian Miners' Association, Jharia.

Question 2.—The main cause of underground fire in coal mines in India is premature collapse and pillar extraction without packing, as in both cases sufficient quantity of coal remains underground under pressure of heavy weight of the fallen roof and heat and fire generate as a result of friction. Yes, the number of fires has increased in recent years. Premature collapse has caused more fire.

Question 3.—All seams in Raniganj Coalfields and all seams above No. 10 in Jharia Coalfields, are most liable to spontaneous combustion. The period of incubation depends on the character of coal as also on other conditions of the mines. All seams of commercial value are liable to spontaneous combustion.

Question 4.—Certainly it is so. Yes.

Question 5.—We are in favour of complete stowing arrangements in all workings new or old.

Question 6.—We are of opinion that without complete stowing, no method of working is adequate against all possible dangers from fire.

Question 7.—Fan is essential in such mines. Forcing fan.

Question 8.—Yes. Khas Jharia.

Question 9.—Provisions like these should be required by law.

Question 10.—Telephonic communication is highly necessary in extensive mines and should be required by law. 1,000 feet.

Question 11.—Stowing, constant watching, frequent analysis of underground air and recording of temperature, etc.

Question 12.—Training in all varieties of work should be given to all persons engaged in such work.

Question 13.—Useful.

Question 14.—To all mines.

Question 15.—Prevention is certainly better than cure. Complete stowing is the only method.

Question 16.—Filling or packing should be enforced in such cases in all seams.

Question 17.—Undersize pillars.

Question 18.—Premature collapse causes without warning, subsidence, air blast, fire and damage and danger to both underground and surface beyond the affected area leading to accidents involving loss of lives and properties. Where pillars have been already thinned, steps should be taken to support the roof by artificial means and the heights of the pillars should be shortened by partial packing.

Question 19.—Yes.

Question 20.—It depends on local conditions, such as dip, thickness of the seam and overlying burden, etc.

Question 21.—Yes.

Question 22.—Calculations in these respects should be made on the basis of local conditions.

Question 23.—We are in favour of an independent statutory authority.

Question 24.—We agree with the provision that complete stowing should be made compulsory.

Question 25.—Such cases of irruption of water took place at Loyabad, Jamadoba, etc.

Question 26.—Yes. Bagdigi.

Question 27.—Accurate and up-to-date plans and strict observance of the rules in force.

Question 28.—Shot-firers should be better paid and certificated men.

Question 29.—Yes.

Question 30.—Yes.

Questions 31, 32, 33, 34, 35 & 36.—(*Not answered.*)

Question 37.—Yes. E. I. Ry. has paid compensation to Upper-Lodna Colliery.

Question 38.—(*Not answered.*)

Question 39.—We are in favour of the enforcement of complete stowing in the wholesale extraction of pillars.

Questions 40, 41 & 42.—(*Not answered.*)

Question 43.—An independent statutory body should be set up for these purposes.

Question 44.—Yes.

Question 45.—(*Not answered.*)

Question 46.—Prevented.

Question 47.—Prevented.

Question 48.—All coal is of commercial value.

Question 49.—Complete stowing with other precautions.

Question 50.—Yes.

Question 51.—Railways ought to pay as they are saved from paying compensation.

Question 52.—Complete stowing in all cases is the best and safest course.

Question 53.—(*Not answered.*)

Question 54.—Statutory control should be made universal otherwise there will remain various loopholes and complications and the real purpose will be defeated.

Question 55.—Universal stowing for all coalfields.

Question 56.—Steps should be taken to amalgamate.

Question 57.—There should be one owner for one leasehold.

Question 58.—The manager of one mine should have independent charge of two shafts or outlets within the same mine or leasehold.

Question 59.—Yes.

Question 60.—Yes.

Questions 61, 62 & 63.—(*Not answered.*)

The Association besides submitting the above answers, beg to draw particular attention of the Coal Mining Committee to the fact that so long whenever there has been any economic pressure on the mining industry the mine owners have, without any consideration, reduced the wages of the mine workers so much so that the wages have now gone down below the minimum. The Coal Mining Committee is therefore requested to see that the interests of the miners are safeguarded and a minimum wage is fixed for them along with other adjustments of conditions in coal mines that may be necessary for the proposed changes in mining methods.

Oral Evidence of Mr. P. C. Bose, Secretary, Indian Miners' Association.

Question 6.—My Association is in favour of the Temporary and Supplementary Regulations and also of the temporary legislation of 1936 being made permanent.

Question 19.—Our answer may be taken as approving of any general principles of first working being laid down by law or regulation.

Question 23.—The statutory authority should be composed mainly of mining engineers. The owners should not be allowed to be represented on that authority. Nor should a mining engineer ordinarily on the authority be allowed to sit as a member when any question in which his company was interested was being discussed. As regards the Chairman, we are definitely in favour of an independent person not connected directly or indirectly with coal mining in India.

Question 24.—By "complete stowing" we mean the extraction of the coal from the solid accompanied by stowing.

Question 30.—My Association thinks that shot-firers should be required to have sirdar's certificates which contemplate a knowledge of shot-firing and of testing gas, etc., but these shot-firers should not also be working as sirdars at the moment in addition to their duties as shot-firers. Such shot-firers should be better paid in order to enable a better class of men to be obtained. Also,

the shot-firers should have no financial interest in the amount of coal won.

Question 52.—My Association would agree to partial stowing in cases in which this would be sufficient to secure the required degree of stability.

Question 55.—Our answer that there should be universal stowing for all coalfields contemplates primarily safety to labour.

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5. Written Evidence of the Mining and Geological Institute of India.

Copy of letter No. 1129/17/7, dated the 21st December 1936, from the Joint Honorary Secretary, Mining and Geological Institute of India, to the Secretary, Coal Mining Committee, Calcutta.

I have been directed to acknowledge the receipt of your letter No. 110, dated the 28th November 1936, and its enclosures.

With regard to the questionnaire to which my Institute has been asked to submit answers, I have been instructed to send to you a copy, in duplicate, of our letter No. 6160/43/14, dated the 8th August 1936, which was addressed to the Secretary to the Government of India, Department of Industries and Labour, and in which the views of the Institute regarding the coal mining problems have been expressed. My Council do not wish to make any further comments in this connection, at the present moment, but they hope that at a later stage in the deliberations of your Committee they will be given the opportunity of offering an opinion.

Further, my Council have appointed Mr. A. Farquhar, Amlabad Colliery, Jealgora P. O., Manbhum, to give oral evidence before your Committee, as desired in your letter No. 199 of December 3rd, 1936. He will answer any questions that may arise in connection with paragraph 7 of the letter mentioned above.

Mr. Farquhar has been requested to be present at the Circuit House, Dhanbad, on the 27th January 1937 at 9-30 A.M.

Copy of letter No. 6160/43/14, dated the 8th August 1936, from the Joint Honorary Secretary, Mining and Geological Institute of India, to the Secretary to the Government of India, Department of Industries and Labour.

With reference to Government of India, Department of Industries and Labour, Circular letter No. M. 955, dated Simla, the 17th June 1936, I have the honour to forward herewith the summarised comments of members of the Mining and Geological Institute of India in reply to the questions enumerated in paragraph 15 of the

above-mentioned letter, together with additional comments given in paragraphs 6 and 7 below.

Question 1.—Is further control over mining methods necessary to ensure safety, and if so what restrictions are desirable for this purpose?

Comments:—It is generally accepted that it is necessary to exercise a greater measure of control over mining methods in India but the means of doing so are not unanimously agreed upon. The majority of the members deprecate additional legislation, which might adversely affect the industry, and are of the opinion that, as far as the question of safety in mines is concerned, Sections 19, 29 and 30 of the Indian Mines Act (as amended up to April 1936), if freed from all ambiguity and rigorously applied by the Department of Mines, are quite adequate.

In addition, however, it is felt that royalty receivers, as the owners of the coal reserves of the country, have not realised their responsibilities and measures should be adopted to ensure that they exercise stricter control over their assets. As lessors of the coal properties they should exercise the right for economic and conservative working as is the practice in other countries. They have a remedy at common law for destructive practices, and they in turn should be responsible to a higher authority for the efficient supervision and protection of their interests.

Question 2.—Should methods of mining involving serious avoidable waste be prohibited generally?

Comments:—Methods of mining involving serious avoidable waste should obviously be prohibited. The maximum dimensions of galleries and the minimum size of pillars in the first workings should be controlled. This, however, is already provided for by Section 2 of the Indian Mines (Amendment) Act, 1936. It is also realised that a change in the Grading Board system of classification of coal is necessary in order to avoid the loss of the inferior portions of those seams of which only certain sections are now included within the present workable grades. In this connection it should be mentioned that, by leaving the ungraded coal in the mines, the dangers of fire due to spontaneous combustion are considerably increased. It has not yet been clearly established at what point a seam ceases to be of commercial, or economic value. This should be clearly defined, and no section of a seam should be left unworked in an effort to maintain a higher grade if that section conforms with one of the other (lower) grades of the revised classification above-mentioned. It should be left to the operator, however, to reject any section of a seam which does not come up to the standard of this lowest grade as defined in the reclassified system adopted for coal grading, and such should be treated not as coal but as waste matter of no commercial value.

It is also suggested that rationalisation of the coal industry should be enforced to eliminate small properties and unify systems of working in order to avoid waste in coal barriers which cannot

otherwise be subsequently recovered. This would tend to eliminate risks created along boundaries by inefficient and undercapitalised operators who are a potential danger to adjacent properties. Wherever possible, boundaries in general should be adjusted in order to conform with geological features such as faults, dykes, etc.

A survey of the valuable coals now locked up in railway barriers is also essential and the necessary steps should be taken for their recovery before they are ultimately lost through the abandonment of the surrounding workings.

Question 3.—Is it desirable that sand-stowing should be enforced and if so, to what extent?

Comments:—It is generally accepted that some scheme of compulsory stowing is essential. Universal adoption, however, is considered to be impracticable on account of cost. Packing should be restricted to special cases which could be decided upon by a conservation board of mining experts. To meet the demands of these special cases, ample quantities of stowing material are available in the principal coalfields.

Question 4.—Is a scheme for compensation essential or desirable in connection with compulsory sand-stowing?

Comments:—The question of compensation for sand-stowing is considered to be essential as hydraulic stowing in cases where it would be compulsorily applied by a conservation board would not, in practice, fall within the realms of economic working. It is realised however that with the other measures of control rigorously applied, wasteful and cheap methods of mining would be restricted and the competition of cheap coal would no longer tend to depress prices to the extent which it does at present. This in itself would tend to bring hydraulic stowing within economic limits. This alone could not, however, be relied on, and until market prices are able to bear the additional costs, a measure of assistance will be necessary.

The parties who will ultimately receive the greatest benefit from a scheme of conservation are the consumers, the railways and the royalty receivers. It is therefore only logical that the funds for a scheme of compensation should be raised from these sources, and not from the producers who are already overburdened in meeting their working costs. The consumers are interested as (except for the period of the War and for a few years following) they have been getting selected and first grade coals at abnormally low prices. The railways are also interested consumers of cheap fuel, as well as the cause of locking up huge reserves in barriers for the support of tracks. The royalty receivers are more interested, as any scheme adopted will result in the conservation of their assets and ultimately bring in additional royalties.

Question 5.—Should funds be raised for coal research to be directed towards securing the better use of coal?

Comments:—It is considered necessary that funds should be raised for the establishment of laboratories and equipment for

carrying out coal research in India, and that the research institution thus established should be independent of present scholastic or departmental Government bodies, so that its members will be free to devote their whole time to specialised research as in the case of the Fuel Research Board in England. It is also desirable that contact should be made with the Fuel Research Board in England for their assistance and reciprocation in connection with matters of general and common interest. The research work envisaged to be carried out in India should include an investigation of the conditions which would lead to the greatest degree of safety in mines.

Additional Comments:—

(6) This Institute is strongly of the opinion that any "Conservation Board" which may be appointed should be independent of the Department of Mines. The latter is primarily concerned with the safety of labour whereas the conservation board would be functioning in the interests of consumers, royalty receivers and operators. The board could be composed of certain members nominated by Government and others elected by interested parties. The Director, Geological Survey of India, and the Chief Inspector of Mines in India would *ipso facto* be representatives of the board as liaison officers between the board and the two Government Departments which they represent. The Department of Mines in India would carry out the decisions of the Board. It is felt that if the whole responsibility of the proposed conservation scheme is placed on the Department of Mines, it would tend to make that Department unwieldy and divert attention from its legitimate object, namely that of safety in mines. Whereas, if the scheme functions through an independent board and through increased vigilance on the part of royalty receivers, safety and conservation will both benefit.

(7) In replying to the enquiries contained in the above quoted circular it has been considered advisable to avoid technical details and explanations as far as possible. It is recognised however that if, and when, Government establishes an expert committee as envisaged in paragraph 8, a number of contentious problems will arise which it would be impolitic for a few experts to decide, no matter how well versed these experts may be in the particular problems. It is, therefore, the general desire that an opportunity will again be offered to this Institute to submit its opinions, with technical details, in support of the general opinions expressed above.

Personal Note by Mr. A. Farquhar.

No. M. 955, Government of India, Department of Industries and Labour.

(1) The application of control over mining methods in India is long overdue. Before, however, proceeding to further legislative control it perhaps would be advisable to explore what forms

of control are already available to Government under Section 19, Chapter V of the Indian Mines Act, 1932, which gives the Mines Department vast powers of control not alone concerned with safety but can also be applied to conservation measures. In fact the economic method of mining, which implies the ultimate recovery of the maximum of mineral mined ensures a conservative and safe method of working. In England and other countries a mine may continue working for 100 years or more thereby ensuring the ultimate recovery of assets. This in turn provides a lower rate of depreciation and return of capital at a smaller annual charge. In India the reverse is the rule and in many cases mines are exhausted in a few decades before the plant has been fully depreciated or the capital recovered with the consequent loss of much of the assets due to reckless systems. These do not coincide with safety either as they tend to produce unstable conditions in the mine with consequent danger to labour. Surely in these circumstances the powers vested in the Mines Department by Section 19, Chapter V, apply.

There is also the problem of the royalty receiver. In the absence of Government control this is the party with the vested interests and if coal reserves are considered to be a national asset then the royalty receiver is the authority in charge of them. It has been a matter to be deplored that this section of the community, connected with the industry, has been so apathetic to its own interests as to be content with merely temporarily prosperity and its ultimate ruin a certainty. With the purely temporary interests of some European operators and the appalling inexperience of Indian ones it is not surprising that advantage has been taken of the lack of interest of the royalty receivers, who in many cases have not even protected themselves in their leases against destructive operations on the part of the lessee. Or when protected originally have not maintained the proper supervision to ensure compliance with the terms of the lease. In other countries where the most economic, safe and conservative methods are in vogue their success is solely due to the constant supervision and pressure from the royalty receiver. It seems to me to be illogical to propose direct Government control for the adoption of conservative systems of mining and yet leave the position of affairs as they are regarding royalty owners. These people are equally interested with the operator and indeed should be more responsible to the country for the conservation of its economic wealth. If the royalty owners cannot be trusted to look after their interest and the ultimate interests of the country, and a measure of Government control is necessary in addition to the powers already vested in the Mines Department under the Rule already quoted, then the royalties should be nationalised without delay. Were this done and a clause enforced in all leases that the most economic and conservative methods of work be adopted, and proper steps to enforce this by the maintenance of adequate supervision on the part of the lessor, then I venture to say mining operations would come

into line with other countries. Wasteful methods would be checked immediately and the fact that the lessor has already a remedy at common law eliminates the necessity for further enactments. Mining men know the methods that must be adopted in other countries. They know the possible maximum extraction to be expected with the best methods under each set of circumstances. They also know that the long view is the most economic in the end but, for the apathy of the royalty receivers, who like the operators demand quick returns, wasteful and dangerous methods continue.

(2) My reply to this is in the affirmative. There seems, however, to be a general impression that waste is confined to the operations in thick or very thick seams which possibly could be avoided. This is not so. Much of the destructive working and consequent loss of coal has been done in seams which normally under economic methods could have been practically wholly extracted without sand stowing or any other means of support. The amount of coal lost in depillaring in an unsystematic manner is notorious and it is only in the few spectacular cases where fires have resulted that any notice has been attracted. With the inexpert material available for supervision in Indian mines it is perhaps difficult to get total extraction, but even in these circumstances 80 per cent. extraction should be attained if the mine has first been developed under the most economic mining principals. 80 per cent. extraction is quite up to modern practice in other countries with similar conditions and if the mine has been laid out with the proper regard to fire barriers these results should be attained instead of the 50 per cent. or so which seems to be the general practice. The remedy to me seems to be already clearly made out in paragraph (1), namely—rigorous enforcement of the provisions of Section 19, Chapter V of the Indian Mines Act, and nationalisation of the royalties if a method cannot be devised to enforce further control on the part of the lessors. Also a strict scrutiny of all leases and if necessary additional clauses added to ensure the necessary liability on the lessee for economic and conservative working.

(3) My reply is in the affirmative. This should be an economic question. Although it should be compulsory the degree of stowing should be left to the operator. As long as the operator is tied to the strict compliance of the terms of an intelligent lease he will work out for himself the method and extent of the stowing to be done. This operation of stowing is not a mysterious one. For example no lessee can raise the mineral without certain necessary plant such as boilers or power of some description and the necessary equipment operated by that power. In cases where sand stowing is necessary to extract the ultimate percentage of the coal laid down by the terms of the lease the latter must be considered as necessary an adjunct as the expenditure required for the provision of other items of plant and machinery. This should naturally be taken into account in the prospectus of a new company and in the case of an old company should be provided by a sinking fund.

In collieries which have been fully developed and the reserves now in pillars unprovided with the necessary fire barriers, sand barriers to form panels should be made compulsory. In many cases the extraction has been so extensive that the recovery of the balance of the coal is already beyond any scheme of sand stowing to be an economic success under any circumstances. A comprehensive survey of such mines on an offset plan is first of all necessary to find to what extent extraction has already proceeded. If the recovery is likely to be less than 50 per cent. then all hope may be abandoned for further extraction by the aid of a scheme of sand-stowing or otherwise except at the most fantastic cost. On the other hand if a reasonable recovery of more than 50 per cent. can be assured even then replacement or partial replacement by sand is likely to be beyond the economic limits. The only possible means to be adopted in such cases would be to form sand barriers round a group of pillars to enable the group to be extracted without transferring subsidence over a large area. The number of pillars in a group would be determined by local conditions such as (1) percentage extraction in first working, (2) nature of roof strata, (3) nature of surface. Again it is possible that coal may be locked up by railways, rivers and boundaries. Partial or total replacement by sand may be necessary to ensure stability. Here again the terms of the lease and the vigilance of the royalty receiver would guide the operator in the extraction of the pillars and the amount of support to be given in order to recover the percentage stipulated by the lessor.

(4) The reply is in the affirmative with qualifications. If we examine the balance sheets of some of the collieries, which are in difficulties to-day, for the past two decades it will be astonishing to find the large profits which have been made during the development or first stages of operation. That is, during the driving of the galleries immense profits were made from huge outputs and in many cases 50 per cent. of the coal has already been obtained at inflated profits during the past 20 years or so. In the logical sequence of events depillaring from certain parts should have proceeded contemporaneously with gallery driving in order to balance the average cost throughout the life of the mine. Alternatively a sinking fund should have been built up against the time when only pillar extraction with all its disadvantages would be available to maintain an economic output. That this has not been done does not affect Government. It has been an economic safeguard for which the companies themselves and the royalty owners are responsible. These two parties have already had quick and profitable returns and now desire State assistance to overcome difficulties of an artificial kind and of their own creating. On the other hand, however, there is a second class of operator who has worked under a more economic system at the sacrifice of inflated profits. This class has taken a longer economic view and refuse to benefit by a destructive method of working. There is yet a third class of operator who is not so vocal as the

first, who was not gifted with the splendid natural resources in the shape of valuable seams free from any natural difficulties. This operator has had natural difficulties to contend with throughout the life of his mine such as faults, dykes, gas and water. He may be struggling under the greatest hardships and rightly envious of the operator who has only difficulties of his own creating to trouble him. The coal locked up in this operator's colliery is as much a natural asset as that remaining on pillars in any other. The two latter classes of operators would very properly resist any attempt at the imposition of a cess which would penalise them to the benefit of the first. It may be said that the latter two classes would get the benefit later on when they commenced to extract their own pillars. This time might never come during this decade or the next and in any event their troubles are already overwhelming them in the present stage of operations due to the competition of cheaper coal from the mines producing on more destructive lines from clean areas free from natural difficulties. Moreover the second and third classes of operators may be producing from thinner seams which produce smaller returns but do not require sand-stowing for the extraction of the pillars. It would be grossly unfair to penalise these operators at this present stage of events. I am of the opinion therefore that compensation should be paid for sand-stowing subject to the collection of the revenue from the responsible quarters, and these are:—

(*a*) The operators whose mines require stowing.

(*b*) Royalty receivers.

(*c*) Consumers.

I include the consumers because, except for a short period during and subsequent to the war, they obtained and are obtaining first class coal at much below its potential value and are depleting the resources of metallurgical coal. I include the royalty receivers as this class has already had vast returns without any adequate supervision of their assets and will ultimately reap the advantage of any scheme of conservation. The operators obviously should be responsible for a certain amount of the cost as they have already had the returns from the gallery driving stage of their operations and will still have an opportunity of further returns from any scheme enacted. The fund could be supplemented by a duty on imported coal which is long overdue in the general interests of the Industry. It should not be lost sight of also that there are huge reserves of coal locked up by the railways which should be recovered and replaced by sand or other material. The railways should be held responsible for at least a substantial portion of the cost of such replacement.

(5) My reply is in the affirmative. In all progressive mining countries the high standards of economic working could not have been attained without research. There has been a tendency in India in recent years to apply the results of research in Britain and in America and this is evident in some of the more recent

enactments and special rules of the Indian Mines Act. The application of the findings of such research workers in other countries is fundamentally wrong in India. General principles of mining may be the same in all countries but variations in local conditions, natural and personal, present completely different problems. Indeed it may be totally wrong to presume that because certain determinations have been arrived at in England the same should apply to India. This is exemplified by the divergence of results in many cases between the Research Board in England and the National Research Department of the United States. Conditions in these two countries are much more similar than they are to those in India and it may be actually dangerous to accept results as laid down in either of these two countries to apply to India. A research department is therefore of first importance in the interests of the Indian mining industry.

In conclusion I should like to add my opinion concerning the proposed method of supervising and administrating any control over the Industry. I gather the Government is definitely of the opinion that such control can be established through the present Mines Department. If a scheme of conservation such as is foreshadowed in Government emanations and in the popular opinion of the day materialises, no Mines Department, however amplified, could hope to exert adequate supervision or control. As long as royalty receivers remain, control should be exercised through them provided the Government takes the necessary steps to compel them to recognise their responsibilities. In all mining districts in other countries there are numerous firms of practising mining engineers who are employed by the royalty owners to supervise their interests. It is solely through methods like this that dangerous exploitation is avoided. There is no parallel to this in India. In my opinion then a remedy to the present state of affairs can only be effected by—

(1) Royalty owners should be forced to maintain the necessary expert staff to ensure the compliance with the lease.

(2) All leases should be scrutinised and where necessary revised to protect the national interests.

(3) A supervisory board (which would include the Chief Inspector of Mines) should be established to arbitrate or settle disputes between the operator and the royalty owner.

(4) Since the royalty owner has a remedy at common law for reckless working and waste of assets he himself be responsible to the Government for failure to protect his interests. (This would place him in a similar position to the incumbent of an entailed estate.)

(5) The same board as referred to in (3) would allocate and administer the conservency fund.

There is here in these proposals an organisation at hand which places responsibility on the proper shoulders and releases

Government of the necessity of developing a department (Mines Department) to unwieldy proportions at enormous expense. At the same time Section 19, Chapter V of the Indian Mines Act, 1923, should be amended and more clearly defined so as to eliminate all doubt that conservency and safety of labour are not synonymous.

Regarding the committee of experts which it is proposed to form to deal with the situation I venture to suggest that the terms of reference of such a committee should be very carefully drafted in order to avoid repetition of work which has already been done. It is a fact that Government are prone to lose sight of the very valuable investigations that have already been made from time to time during the past two decades under official auspices—

(1) Treharne Rees's investigation and report, 1919.

(2) Coalfields Committee, 1920.

(3) Commission of enquiry into the condition of the Coal Industry in 1925 under Sir Frank Noyce.

There have also been the following investigations and reports under the auspices of the Mining and Geological Institute of India:—

(1) Committee of investigation into the dangers of coal dust in Indian Mines.

(2) Committee of investigation into subsidence and underground fires.

Both these committees completed their investigations and submitted very valuable reports.

In addition there have been numerous individual contributions (affecting the problems of the industry) to the various scientific bodies in India.

I venture to suggest that there can be obtained from these sources all the facts that can be desired without covering the ground once more.

It is now sufficient for the proposed committee of experts to consider the reports of all the work already accomplished and submit a concise summarised statement to an economic committee representing the various interests concerned. This economic committee in turn to report to Government as to the practicability of any scheme of conservation which may be worked out from the mass of information available from previous investigations. It will be a deplorable waste of time and effort if the conclusions of other workers in this field of investigation are to be ignored. In my opinion technical experts can go no further than they have gone and it only now remains for a truly representative committee of economic experts to make use of the material now available if presented to them in a concise and intelligent form.

It is worthy of note that some of the most carefully managed colliery groups in India to-day have for a considerable period of years adopted, in their own interests, schemes of conservation in the way of providing adequate fire barriers in the form of panels during the initial stages of working, and sand-stowing during the second, or depillaring stage.

It is not beyond the resources of Government, with the assistance of technical and economic experts to make statutory a general scheme of conservation which in some cases has already been applied by some of the most enterprising and conservative companies who through force of circumstance and experience were compelled to adopt measures to safeguard their assets. In many cases also it is solely due to the uncertainty of obtaining a steady economic return that has prevented these measures from being more generally applied.

It may be permissible at this stage to make a reference to the State Railway collieries. Government has perhaps lost sight of the fact that coal, especially good coking quality, is what may be termed a strategic mineral. This is exemplified by the fact that during the late war it was considered expedient to prohibit the export of all first class coals from India. Since 1914 the position of India's reserves has been greatly reduced by destructive consumption and destructive working. The best authorities to-day indeed hazard the opinion that the reserves of first class coking coals will be exhausted in 30 years at the present rate of production and destruction. It must not be lost sight of that the loss through destruction by the present methods of mining are bound to increase so that the potential reserves may be calculated to be eliminated before the end of the above period. It cannot be considered then that the Government of India will ever again be in such an independent position, in the event of another world crisis as it was in 1914 unless reserves are maintained for the essential services of the country and for munition making. It is extremely doubtful if any scheme of conservation will materially improve the position in Jharia as in the opinion of many, this field, the chief source of the coking coals, is irretrievably ruined if the reserves of the steel companies be left out of consideration. The fact that the steel companies are reserving their coking coals and taking their present requirements from outside sources perhaps indicates their alarm as well as their foresight. It is incumbent on Government therefore to reserve for a national emergency the considerable reserves of coking coals of the State Railway collieries.

Oral Evidence of Mr. A. Farquhar.

Question 1.—The Mining and Geological Institute would have no objection to the temporary legislation of 1936 being made permanent. The "ambiguity" referred to is with reference to the old Section 19 which, the majority of our members think, should

have been applied more often and more freely. We are of opinion that that section as it stood could have been used for purposes of prevention as well as of protection.

My Institute is in favour of the State exercising the control that royalty receivers should exercise over their properties as regards safety both of life and of property.

Question 2.—My Institute is in favour of general principles of first working in the pillar and stall method or panels being laid down by law or regulation. It is thought that these general principles should be subject to variation under the orders of the Chief Inspector of Mines in accordance with special circumstances and local conditions. There should also be a power of appeal from such decisions of the Chief Inspector of Mines. We would also be in favour of adequate and immediately enforceable penalties being applied to any deviation from these general principles. Such penalty might take the form of an order to restore conditions to the prescribed limits of first working and to stop production in that district of the mine while such restoration was being carried out.

My Institute is of opinion that the system of grading of coal to be sold in India has increased waste and danger from fire. We are of opinion that this should be stopped in some way.

Question 3.—My Institute contemplates that any scheme of compulsory stowing with compensation should be applied simultaneously and to the same extent to both the Jharia and Raniganj coalfields.

Additional comments (Paragraph 6).—The Institute is of opinion that the Chairman of the proposed conservation board should be independent in the sense that he should not be connected either directly or indirectly with coal mining interests in India. The Institute has not considered whether this independent person should be a Government official or a mining engineer brought over from Great Britain.

There are no other opinions or technical details which my Institute would like to submit in addition to what has been stated above, provided of course that the other opinions already expressed on behalf of the Institute in their reply to Government of India, Department of Industries and Labour, Circular letter No. M. 955 receive due consideration.

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6. Written Evidence sent in by the Geological, Mining and Metallurgical Society of India.

Question 1.—This Society was started in 1924 for protecting among other things, the interests of mining industry and of persons interested in geology, mining and metallurgy, pure and applied, in India.

Question 2.—(*a*) The main cause of fire in the coal mines in India is spontaneous heating of coal left in goaf.

(*b*) Yes.

(*c*) Normal collapses.

Question 3.—(*a*) All seams from No. 10 upwards in Jharia coalfield and practically all the better quality seams in Raniganj, more particularly those with high moisture content, are liable to spontaneous combustion. But among these some are more liable than others. Assam coals in general and some Central Provinces coals are also generally liable.

(*b*) The incubation period depends on a variety of conditions and generally varies from 6 months to 2 years.

(*c*) We consider that practically all coals of low grade are less liable to spontaneous combustion.

Question 4.—(*a*) & (*b*) Yes.

Question 5.—Yes. Generally 30 per cent. depending on thickness, depth and nature of seams.

Question 6.—Yes. They seem to be adequate. We have no special modifications to suggest.

Question 7.—(*a*) Mechanical ventilation is desirable in such cases, but this may be done by steam jet in small mines.

(*b*) Fan should be ordinarily exhausting but reversible. The question will depend on the position of the fire with respect to intake.

Question 8.—(*a*) Yes. (*b*) No knowledge.

Question 9.—Where water mains exist additional taps may be provided.

Question 10.—(*a*) Telephones do not seem to be very dependable in mines as they require constant attention. It would be preferable to have additional code of signals in both directions.

Question 11.—Necessary materials for building temporary stoppings should be stored and be available underground.

Question 12.—Yes. Yes.

Question 13.—Both are helpful according to circumstances.

Question 14.—May be extended as suggested.

Question 15.—Yes. We think that improved methods of work such as panel system and stowing are the only effective remedy.

Question 16.—Yes. Should be enforced in all seams giving off inflammable gases.

Question 17.—Inadequate support and bad roof.

Question 18.—Fires and danger to life and property. Best way of prevention will be low percentage of extraction in first working protecting the roof and restricting the width of galleries, dimension of pillars and if need be by stowing during extraction of pillars.

Question 19.—No. Because the conditions vary.

Question 20.—(*a*) The question does not arise.

(*b*) Factors: Depth of seam from surface, thickness of seam, nature of seam, condition of superincumbent strata, gradient of the strata, proximity to a large fault and the nature of floor and roof.

Question 21.—Yes.

Question 22.—Thick seams could be worked in sections with partings of 10 feet with a good factor of safety, but will be governed by local conditions and gradient. Thickness of sections can only be determined by the nature of coal.

Question 23.—(*a*) Yes. (*b*) No.

Question 24.—Yes.

Question 25.—Yes, at Phularitand, Ramnagar, Bagdigi, etc., both from surface and old workings.

Question 26.—Yes.

Question 27.—(*a*) Drains should be cut or embankments made to prevent any sudden irruption of water into the mine and specially into the fire areas. Also tanks above a fire area should be drained out as far as possible.

(*b*) These precautions may be enforced whenever necessary.

Question 28.—No changes seem necessary.

Question 29.—Extended use of "permitted" explosives does not seem to be necessary as accidents from explosives are adequately guarded against by present regulations, and accident rate from this cause is very low in India.

Question 30.—Yes.

Question 31.—The power should be retained, as cases do arise where the issue of a larger quantity of explosives is necessary, *e.g.*, shaft-sinking, stone drift, etc.

Question 32.—No.

Question 36.—Average 50 per cent.

Question 37.—(*a*) Yes, it will be lost without stowing.

(*b*) There have been several cases of compensation having been paid for such coal locked under railways: Lodna, Khas Jharia and Begunia collieries.

Question 38.—Life and productivity will be greatly increased by stowing.

Question 39.—Yes.

Question 40.—To all coalfields and to all coals.

Question 41.—The Society has no specific knowledge.

Question 42.—No compensation is necessary for the additional cost.

Question 43.—(*a*) Yes, for universal stowing.

(*b*) The statutory authority should be constituted as follows:—

(i) Representative of Mines Department . . .	1
(ii) Representative of Mining Geological Institute of India	1
(iii) Representative from Geological, Mining and Metallurgical Society of India	1
(iv) Representative from National Association of Colliery Managers (Indian Branch) . . .	1
(v) Representative from Indian Mine Managers' Association	1
(vi) Representative from railways	1
(vii) Representative from royalty receivers . . .	1
(viii) Representative from colliery owners . . .	2

There shall be non-official Chairman.

Question 44.—No.

Question 46.—Yes, should be prevented.

Question 47.—Yes, should be controlled.

Question 48.—All coals that can be marketed with profit at any time.

Questions 49 & 50.—Yes.

Question 51.—The Railways should not bear any cost, as compulsory stowing for all coal has been suggested under *Question 40.*

Question 52.—(*a*) Although we have suggested under *Question 40* that all coals should be stowed, in case of only thin non-gassy seams up to 8 feet at great depth we may have partial filling. Complete filling should be insisted on in all other cases.

(*b*) No specific knowledge.

Question 53.—Free sand may be delivered, but no financial assistance or compensation is necessary.

Question 54.—Should be universal throughout India for the sake of safety and conservation.

Question 55.—(*a*) Compulsory stowing should be universal throughout India.

(*b*) Avoidable waste should be stopped by all means.

Question 56.—Amalgamation is advisable but not feasible.

Question 57.—(*a*) No objection to this being worked if efficiently sand-stowed.

Question 58.—Yes. Both the managers should be in charge for both the shafts and outlets.

Question 60.—Yes.

Question 61.—For the greater use of the lower grade coals in place of higher grades at present being used the following ideas may be suggested:—

(i) Railway locomotives and other boilers may be designed with a view to burn inferior coals with reasonably high

efficiency. One of important ways being the burning of the low grade coals in pulverised condition. Such experiments have been successful in other countries.

(ii) Higher grade coking coals should be prevented from being used in the locomotives and other boilers for steam raising. They should be reserved for metallurgical operations only and the high volatile, high grade coals for chemical and gas industry.

(iii) Low temperature carbonisation process low-grade coal dust fired boilers, hydrogenation process and complete gasification of coal (Producer type), etc., etc. These are some of the important practical suggestions towards the better utilisation of inferior grade coals.

(iv) Central generating stations for preparing cheap gas and electricity as industrial power from low grade coals. Such power when generated may be transmitted to various centres of important industrial activity.

(v) Improvements in the existing methods of soft coke manufacture to be aimed at (such as by heating in chambers or retorts, etc.) so that better semi-coke of uniform quality may be produced with simultaneous recovery of some of the bye-products. Low temperature carbonisation industry will also produce high quality semi-coke.

(vi) Systematic research should be started in India to investigate into the above suggestions for better utilisation of coal for various purposes. Improvements in the quality of the lower grade coals by some process of cleaning, etc., should draw the attention of the research workers. The Society, therefore, advocates the immediate formation of a fuel research board to undertake the work. This Society also suggests that intensive research work in these directions can be economically effected by co-operation and co-ordination of the various Government laboratories and other recognised laboratories in India.

(vii) In the interest of conservation it is absolutely necessary that a regular survey of India's coal resources should be made with a view to ascertain the best purposes for which different coals of India may be efficiently utilised. This can only be achieved by adequate and systematic research.

Question 62.—(*a*) Several seams have been so graded as to leave out certain sections which are invariably lost and often increase the risk and difficulties of pillar extraction. This ultimately leads to increased waste. We quote here the statement of the late Mr. Starks-Field, Agent of Messrs. Bird & Co.'s collieries.

"There are cases where a lower seam has been graded as selected while a thick seam above, which was one of

the favourite seams in the Jharia coalfield before days of the Grading Board and was extensively worked in the first working, falls just below the Grading Board's requirements for first class coal. Yet this obviously valuable coal is being ruthlessly wasted by the goafing of the seams below. Thus, to satisfy the requirements of the Grading Board many valuable coal seams had to be stopped or they had to be under-mined."

(*b*) Examples are too numerous to be cited.

Question 63.—On comparing the accident rates in India, England and other countries, it may be safely stated that methods of practices dangerous to human life or safety or stability are not at all more frequent in India than in other countries.

Oral Evidence of Dr. S. K. Roy and Professor S. K. Bose of the Indian School of Mines, Dhanbad, Representatives of the Geological, Mining and Metallurgical Society of India.

Question 6.—Our Society agrees to the Temporary and Supplementary Regulations being made permanent. Also the temporary legislation of 1936.

Question 19.—After discussion with the Committee, our present opinion is that general principles of first working are essential and should be laid down by regulation. We think that a suitable basis for such general principles would be percentage of floor area *plus* a maximum height of gallery. There should also be provision for the Chief Inspector having power to vary the principles either way in accordance with local conditions or special circumstances, and there should be an appeal from any such orders of variation to the same authority as hears appeals under section 19. As regards the maximum height of gallery, we would agree to 10 feet as has been suggested by the Second Subsidence Committee.

Question 42.—The opinion of our Society now is that funds to finance compulsory sand-stowing will have to be provided by a universal cess levied on all coal and coke carried by rail in or into British India, accompanied by an import duty of the same amount on foreign coal, and a drawback of a similar amount on export of coal. Our idea is that everybody should be placed in the same relative position that they were in before. We would not have a differential rate on coal of good quality and coal of inferior quality. We are also of opinion that an import duty should be imposed on all foreign fuel imported into India. We think also that royalty receivers and railways should contribute directly to the cess. As regards the landlords, we agree that it would be a good plan to assess all of them on the assumption that

the royalty they receive amounts to 4 annas a ton, and to take a percentage of the amount so worked out from each landlord. As regards the railways, we think that they should also contribute because they will receive more traffic eventually, not have to pay, as at present, the expenses of diverting the lines and protecting the surface, and also escape their present legal liability for compensation for coal left under the lines.

We also think that the Government of India should allot a part of the proceeds of the protective duty on iron and steel to the statutory authority controlling the cess to finance sand-stowing. This protective duty enables the iron and steel trade to sell their products at a fairly higher price than they sell the same products to foreign purchasers. For example, pig iron is sold in the Bengal market at about Rs. 60 a ton, while the same pig iron is sold to Japan at from Rs. 25 to Rs. 30 a ton.

We also think that all machinery imported by the statutory authority or ropeway companies working for the statutory authority in connection with sand-stowing should be exempted from import duty.

Question 43.—We agree that the representation for labour should also be added to the representations suggested by us. We now think that the Chairman will have to be a Government official of considerable administrative and judicial experience and that he should hold office in the first instance for five years at least. The statutory authority should in our opinion also hear appeals from the decisions of the Mines Department as regards safety and other orders under the proposed regulations.

Question 48.—We agree that it will not be possible to define coal of commercial value in any general way on account of the different points of view and various factors involved. We agree, however, that any statutory authority controlling conservation should be able to say at any given moment whether the particular coal concerned in any one case is of commercial value or not. If they decide that the coal concerned is of commercial value, the statutory authority should be able to direct that it must be recovered along with any more valuable coal and arrange to sell it separately, or that it must be left in such a condition by means of stowing or otherwise that it can be recovered at some future date when market conditions improved.

Question 51.—Our reply to this question is modified in accordance with our answer to *Question 42.* We now think that the railways should contribute towards the cess to finance sand-stowing.

Question 53.—The written answer is the opinion of our Society, but our personal opinion is that further financial assistance towards the cost of stowing underground will also have to be given out of the cess. We think that this assistance should be given in the form of a flat rate per ton of coal recovered by the sand-stowing operations.

Question 54.—We should like to add to the Society's answer that our personal opinion is that as, under present conditions, profit making in the coal trade is based on rule breaking, exploitation of labour and avoidable waste of coal, nothing really satisfactory will be achieved unless the strength of the Mines Department is very considerably increased in order that the Inspectorate may be able to see that the underground stowing done with the assistance out of the cess funds is done properly and efficiently. We think that, in order to achieve any really useful results, it is absolutely necessary either to tighten up state control to a degree very much greater than what exists at present, or to nationalise the mines. We think that the state control should be on the German lines covering all aspects of production, distribution and consumption.

As regards nationalisation, we think that a fair basis of valuation would be the present rupee value of the shares multiplied by the capital.

Question 55.—We agree that a definition of " avoidable waste " would be all waste which is not incidental to the proper and efficient working of the system of mining that is being followed.

Question 56.—The answer to this question is based on present conditions. We agree that if state control were introduced as suggested by us in *Question 54*, that control would have to cover amalgamation, adjustment of boundaries and compulsory acquisition of abandoned mines; in other words rationalisation generally.

Question 61.—As regards the suggestion in paragraph (ii) that higher grade coking coals should not be allowed to be used for other than metallurgical purposes, we agree that this could not be done without nationalisation.

Another additional item of research might be enquiry into the Russian idea of manufacturing gas from coal burnt underground with control.

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7. Written Evidence of Messrs. Macneill & Co., Managing Agents of Messrs. Equitable Coal Co.

Question 6.—Section 19 of The Indian Coal Mines Act reads as below:—

19. (1) If, in any respect which is not provided against by any express provision of this Act or of the regulations, rules or bye-laws or of any orders made thereunder, it appears to the Chief Inspector or the Inspector that any mine, or any part thereof or any matter, thing or practice in or connected with the mine, or with the control, management or direction thereof, is dangerous to human life or safety, or defective so as to threaten, or tend to, the bodily injury of any person, he may give notice in writing thereof to the owner, agent or manager of the mine, and shall state in the notice the particulars in which he considers the mine, or part thereof, or the

matter, thing or practice to be dangerous or defective and require the same to be remedied within such time as he may specify in the notice.

We submit that this Section of the Act gives the Chief Inspector of Mines unlimited powers in regard to safety in mines, both in regard to fires, threatened collapses, inadequate sizes of pillars and all other dangers of any nature whatsoever. Furthermore, it is our opinion that any measures designed for the conservation of coal are inextricably bound up with measures designed for safety, so much so that if the Chief Inspector of Mines is vested with adequate powers in regard to safety, as he obviously is under Section 19 of the Act, no additional legislation or powers are necessary or desirable in respect of the conservation of coal. It may possibly be argued that Section 19 of the Act gives no power to the Chief Inspector to insist upon sand-stowing in such cases as he may deem essential in the interests of safety. The Section gives the Chief Inspector power to stop the working of a mine until a threatened danger is removed, therefore if the threatened danger can only be removed by sand-stowing, the Chief Inspector has full power to stop the working of a mine until sand-stowing is effected. In our opinion this position is exactly as it should be so long as mines are privately owned and not nationally owned, as it leaves the decision to sand-stow or to close down, with the owner of the minerals. A point we would interpolate here is that in the majority of mines where sand-stowing is now deemed to be necessary, the percentage of extraction in the first working has been much greater than that dictated by sound mining methods, and also the general methods of mining adopted have been unsound. Because of such practices, the owners have reaped during their continuance, larger profits than would have accrued from sound mining methods, therefore in our opinion the cost now necessary of putting their house in order must be borne by themselves. There is no reason obvious to us why an owner who has worked his Mines in an efficient and workmanlike manner, refusing to sacrifice their future welfare for temporarily enhanced profit, should contribute in any way whatsoever to the costs now to be incurred by the negligent owner. It may be argued that as certain of such owners have dissipated or disposed of their profits, and are therefore not now financially capable of incurring the expenditure necessary to put their mines in order, it is in national interests that they should be provided with funds. To our mind this is a wrong view and one wholly unnecessary in the circumstances existing. Any such owner unable to provide the required funds, should be compelled to close down—the coal remaining in his mines would thereby be conserved until such time as the demand for it would enable the owner to mine it at a profit sufficient to provide the necessary funds for remedial measures in respect of previous bad mining. The remaining collieries in the coalfields are quite able to meet all demands for coal as fuel.

If, however, the final decision of the Government is in favour of universal sand-stowing, the only possible practicable method of putting it on sound economic lines, in our opinion, would be to impose a cess on buyers, that is, a cess to cover the cost to be added to rail freights and collected by the railways. In this connection, however, we would stress the importance of excluding coal for shipment from such a cess, owing to the importance of the export trade and the highly competitive conditions existing in outports.

We would end our remarks in respect of this question by stating that the powers vested in the Chief Inspector of Mines by Section 19 of the Act are of such comprehensive and autocratic a nature as to make it imperative for owners to be given the right of appeal to an expert Mining Board.

Questions 23 & 24.—As explained above, the powers already vested in the Chief Inspector of Mines are so comprehensive as to make any statutory authority wholly unnecessary.

Questions 46 & 47.—No producer of coal, or of any other commodity, should be compelled by law to produce material or goods not required by buyers, and not saleable at a profit. Therefore coal owners should be allowed to continue to mine in India such seams and sections of seams as they find marketable, as is done in every coal-mining country in the world.

To give any permanent definition of coal of commercial value is impossible, as coal as a whole may possibly lose much of its importance for industrial purposes within a comparatively short time, owing to scientific development and the increasing use of alternative sources of energy. In this connection we would point out that until a few years ago the Dishergarh seam was considered to be perhaps the most valuable seam in India, and considered by railways as an essential fuel for locomotives. It has to-day lost practically the whole of its value as a locomotive coal owing to railways changing over to coal of Jharia quality as their essential fuel—and this at a time when the Government of India is apparently greatly concerned at the serious depletion in the coking coal reserves in the Jharia coalfield.

Question 54.—For reasons already given in our answer to *Question 6*, we do not consider a statutory authority necessary either in respect of safety or conservation of coal. So far as the conservation of coal as a national asset is concerned, we submit that so long as the coal resources of the country are privately owned, and not nationally owned, conservation must only extend within strictly commercial limits, and in this respect the powers vested in the Chief Inspector of Mines by Section 19 of The Indian Mines Act meets requirements.

Question 61.—It seems to us that the statement forming the first part of this question, followed to its logical conclusion, is inconsistent with sound reasoning, for if inferior coal were made

to substitute good coal for all purposes, the reserves of good coal would last *ad infinitum*, until possibly their value would be lost because of scientific development.

It would appear to us from indications given, that one of the primary concerns of Government at the moment is the conservation of coking coal. In view of this, it seems remarkable to us that certain of the Iron and Steel companies should dissipate their resources of coking coal by sales to railways, and it seems even more remarkable that they are aided and abetted in this by the Government of India itself, the Railway Board Department of the Government of India being the chief purchaser of such coking coal.

We would also represent that the coal areas owned by the Government of India, and also by the Indian railways, produce over 1,000,000 tons of coking coal per annum, the whole of which is used for steam raising. It would seem only sound conservation for the Government of India and the Indian railways to stop this needless waste of coking coal, and substitute therefor supplies of the excellent steam coal available from the Raniganj coalfield. The coking coal thus conserved should eventually be of great value as a national asset, and surely the Government of India should not ignore its great responsibilities in this respect.

Certain of the Iron and Steel companies produce coking coal from their own collieries for their own requirements, and we understand certain of them are engaged in the sinking to, and development of, new seams. From a coal conservation point of view, it would seem highly desirable for such companies to purchase coking coal from the market and to stop meantime these new developments, thereby holding their own coal in reserve and facilitating more rapid extraction from the privately owned collieries in the Jharia coalfields. In view of the position at certain of the collieries in the Jharia coalfields, rapid extraction of the remaining coal would seemingly minimise coal losses and reduce the danger risk.

Question 62.—The effect of the Grading Board has been to improve the quality of coal for export, thereby enabling India to recapture business lost in the past because of the poor quality of the coal shipped. The Grading Board was formed with this object and it has carried out its duties very satisfactorily. The Act has not resulted in increased waste, inasmuch as it has not at any time prohibited an owner from working any seam or section of a seam desired. It has merely graded the seam or section worked by the owner, and the owner's choice in this respect has been guided solely by the requirements of buyers, a state of affairs existing in every coalfield in the world.

General.—The urgent need of the Industry is for higher prices for coal. Prices for coal for internal consumption depend in very great measure upon the prices paid by the Indian railways, as industrial concerns generally refuse to contract at rates higher than the contract rates of the Railway Board. Unfortunately,

the definite policy of the Railway Board during recent years has been to force down the price of coal to such a level as to make it most difficult for any owner determined to work his mines on sound mining methods, to continue to operate. Their methods to obtain this end have been surreptitious and full of guile. Unofficial threats to increase considerably the output from their own collieries—coking coal—in the event of tender prices being higher than they thought they should be, have been common. When owners, desperate in their need for economic prices, have endeavoured to secure co-operation amongst owners in the fixing of economic prices for tender to railways, unofficial threats have been made to certain owners that if they participated in any price agreement, no contracts would be placed for their coal. The Railway Board by their policy of dividing their contracts in greatly increasing proportions over the very small collieries, to the increasing neglect of the large collieries, have forced the prices of coal from the latter down to a level wholly uneconomic, and only made possible by their struggle for existence. A Minister of the Government of India, intimated to a deputation of the Indian Mining Association, that his policy was definitely to assist the small collieries with railway contracts, leaving the larger collieries to look after themselves. By such an attitude, he deliberately ignored the value as a national asset, of a large mineral holding, and seemingly considered the innumerable small holdings, capable of no future of any consequence whatever in the industrial future of India, as more worthy of support in the general interests of the country.

We would hasten to add that no tactics such as those represented above have been attempted by the present Chief Mining Engineer to the Railway Board, nevertheless the policy of the Railway Board, to depress the market continues. The present Chief Mining Engineer has always adopted a most reasonable and fair attitude to the coal trade.

A great need of the mining industry is for a reversal of this policy, and for means to be adopted whereby the prices to be paid by the Railway Board will be true economic prices.

Accumulations of slack coal underground are a source of potential danger. Heavy stocks of this quality on the surface are also a source of potential danger, owing to the risk of spontaneous combustion. It is a quality difficult to dispose of regularly, the main demand for it being a seasonal one, for brickmaking. The Railway Board purchase only steam coal for locomotive purposes, sized over 1″—in actual practice the larger producers deliver to them coal sized over 2″, owing to the impracticability of changing colliery screens from the 2″ sizing required for shipment coal. There would not seem to be any good reason why run of mine coal should not be quite suitable for locomotive purposes, and if the Railway Board would purchase this quality instead of steam coal, it would assist collieries to dispose of slack coal and thereby reduce

the danger from spontaneous combustion, both underground and on the surface.

Prices received by owners in respect of coal shipped to the western side of India are wholly uneconomic, owing to the threat of imports from Africa. Little if any coal is being imported from Africa, but any increase in the prices of Indian coal would result immediately in importations from Africa. Many requests have been made to the Government of India by the Indian Mining Association for an increase in duty on foreign coal entering India, so as to enable the Indian product to be sold at a remunerative price, all without effect.

In addressing your Committee on the subject of coal prices, we do so in the firm belief that safety and conservation are firmly bound up with the question of the price received for coal, and that the coal industry in this country, to function efficiently, must receive such assistance from Government as will ensure adequate prices being received sufficient to pay for such efficiency.

Oral Evidence of Mr. T. Ord of Messrs. Macneill & Co., Calcutta.

I am a partner in Messrs. Macneill & Co., and have been in charge of their coal interests since the beginning of 1925. The written evidence of my firm and my oral evidence should be taken as relating to the Dishergarh and Poniati seams of the Raniganj field. Conditions in the Jharia field are not contemplated at all.

General.—Average raising costs, excluding depreciation and Calcutta charges, are about three rupees a ton for the Dishergarh seam. I know that the Indian Coal Committee of 1925 gave raising costs of the Raniganj field generally at Rs. 6 a ton. The decrease is, in my opinion, due entirely to increased outputs. The wages of labour are only slightly less than they were in 1925.

In laying a cost sheet* on the table covering a recent month of low output, I would point out to the Committee that the costs therein for the Dishergarh seam coal, excluding depreciation and Calcutta charges, are considerably over Rs. 4 per ton.

Question 6.—What we really meant in our oral evidence regarding Section 19 (1) of the Indian Mines Act is that Section 19 (1) and Section 19 (2), together with the new Section 19 (2) (1) introduced in 1936, give the Mines Department all necessary powers to control safety and conservation. I think that all these powers should be continued and made permanent, even though they allow of the control of mining operations, provided a right of appeal is allowed from the orders and decisions of the Mines Department. The appeal now contemplated in Section 19 (5) of the Act is to a Committee as constituted under Section 11. I would prefer that the appellate body should contain only one Government official as

* Not printed.

Chairman (namely, either the Chief Inspector of Mines or the Chief Mining Engineer to the Railway Board) the other members being mining experts actually engaged in the coal industry. There would be a panel of such mining experts and the members to consider any particular case would be selected from this panel excluding those members who were directly or indirectly interested in the particular mine or mines concerned. It is also important that there should be as little delay as possible over the taking up and decision of such appeals. If there is to be any delay at all, the mine owners concerned should be allowed to carry on work as they were doing pending the hearing of the appeal. It is not my idea that this appellate body should be able to control directly the working of privately owned mines.

If the Chief Inspector of Mines considered sand-stowing necessary in any particular case, and his decision was upheld by the appellate authority, the colliery concerned should then be compelled to stow at its own cost. If it could not afford to stow, it would have to close down. There would be no compulsion other than the force of circumstances. If such a colliery did close down, the neighbouring proprietors should take precautions at their own expense against any dangers that might arise from the closing down.

It is common knowledge that there is a large number of mines in which the percentage of extraction in first working was much greater than would now be approved by sound mining methods. This was due sometimes to bad work in the interests of speedy profits, and sometimes, in the case of very old workings, to the then accepted methods of mining practice being different from modern practice. It is true that there are mines now being worked on sound lines which contain old workings worked on unsound lines. At Jamuria Nos. 5 and 6 pits, inspected by your Committee, certain rise areas, worked very many years ago on the then accepted methods of mining, have had the maximum coal extracted possible from such methods, and it will not be economical to extract pillars in such areas because no method of extraction known to me would make it pay to take out those pillars.

I am still definitely of the opinion that any cess imposed to provide funds for sand-stowing, whether universal or under particular conditions, should be paid by the consumers by means of a cess on rail freights payable by buyers, leaving it to buyers and sellers to adjust selling prices exactly as they do at present. Shipment coal should be excluded from such a cess because of the highly competitive nature of the export market.

Questions 46 & 47.—I think that the private owners of mines in India should be allowed to continue to mine as they please in accordance with market demands irrespective of the consequences to the property, but not irrespective of the consequences to life. The huge investments in respect of collieries in the Dishergarh and Poniati area are a sufficient reason for their owners not to

permit any work likely to prejudice such investments, or to work their properties irrespective of consequences.

I do not think that it would be possible or useful to define " coal of commercial value " because the matter is entirely in the hands of the buyers. This applies also to a definition of " coal of economic value ". We have said that it is impossible to give any permanent definition of " coal of commercial value " as coal may possibly lose much of its importance for industrial purposes within a comparatively short time owing to scientific developments and the increasing uses of alternative sources of energy. I admit the equal cogency of the opposite argument that scientific development may increase the possible uses of coal for industrial and other purposes.

Question 54.—The Mines Department is, I agree, already a statutory authority for the purposes of safety, and it has also become a statutory authority for the purposes of conservation under the temporary legislation of 1936. That Department can now control and direct practical mining operations in the interests of safety or conservation, and I have no objection to these powers being continued and made permanent provided there is also legal provision for appeals as I have already suggested.

Question 61.—In our written evidence, we have said that it would appear from indications given that one of the primary concerns of Government at the moment is the conservation of coking coal. By " indications " we were referring to what has been said by responsible Government officials, such as Sir Lewis Fermor, Mr. Barraclough and others.

We have not suggested that iron and steel companies should be " compelled " to purchase coking coal from the market and stop development of their own collieries. We have only said that this course is highly desirable, and it is so desirable in the interests of the whole coal trade and of the iron and steel industry itself. My idea is that the iron and steel companies should first be approached and that the situation should be explained to them. If they do not agree to follow the course suggested, other methods of achieving the same results should be considered. This further consideration need not necessarily be in the direction of compulsion as there may be some other way of dealing with the matter. I prefer at present not to say anything about ultimate compulsion.

If Jharia coal were utilised only for metallurgical purposes, I agree that the result would be to cut down outputs very considerably, and that this is against my further point that the rapid extraction of the remaining coal in the Jharia field would minimise losses and reduce dangers. I think that, after supplying all the demands of the iron and steel and other industries which require coking coal, the Jharia people would have to be allowed to sell the rest of their output for steam purposes. I am still of opinion, however, that the suggestions we have made would ease the situation considerably though they might not meet it entirely.

Question 62.—I think personally that the Grading Board should deal only with coal for shipment. From a commercial point of view, it is undesirable that the grading system should have been extended to the internal trade.

General.—By "run of mine coal", I mean unscreened coal as it comes up from the pit. Stocks of slack are accumulated during the rains when no bricks are being burnt. The position as regards slack coal is certainly better now, but this has nothing to do with better demand, and is due entirely to the shortage of labour following good crops.

My firm is one of the biggest exporters of coal to foreign and other Indian ports. We handle annually about 26 or 27 per cent. of the trade. The coal is entirely from the Dishergarh and Poniati seams, and is graded throughout the seams. I cannot state what the proportion is of Jharia coal exported. The prices received for coal shipped to the west coast of India are uneconomical owing to the threat of imports from South Africa. In the middle of 1936, Natal coal was quoted in Bombay at Rs. 11-5 a ton c.i.f. Indian coal was offered and sold at the same time at Rs. 11-4 a ton which gives a pit-mouth price of Rs. 2-8 only. It was then that the Mining Association suggested to the Government of India that a duty should be put on South African imports of coal. The Government of India did not reply till December that they could not do anything in the matter. In South Africa, the Government works very closely with the trade. Recent prices in South Africa are—domestic coal—9*s.* 6*d.* per ton; bunker coal—8*s.* 8*d.* per ton; railway coal—6*s.* 3*d.* per ton; coal for power houses—4*s.* a ton; and export coal 3*s.* 1*d.* a ton. These figures indicate the extent to which the export trade is subsidised. The prices are in respect of standard qualities of Natal coal.

I think that "true economic prices" means taking the costs that have to be incurred by respective producers into consideration.

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8. Written Evidence of Messrs. Bird & Co., Managing Agents of Messrs. The Burrakur Coal Co., Ltd.

Although we have not been specifically invited by you to reply to the General Questionnaire, yet we have been invited to do so by the Indian Mining Association from whom we understand the necessary permission has been granted by you to make the invitation.

We have pleasure therefore in attempting to reply to certain questions in the General Questionnaire which we consider affect, the commercial side of mining. We have confined ourselves to this aspect particularly as all the technical questions have been replied to direct to you by our Deputy Chief Mining Engineer.

Question 37.—Except in the case where it is possible to divert existing railways or sidings, the coal locked up thereby will certainly be lost for practical purposes unless complete stowing is undertaken in those portions of the seams which lie under railways.

As regards rivers, stowing should certainly be practised if it is required to extract the coal lying underneath. This will depend, of course, upon the depth at which the particular seam in question lies beneath the river as at a sufficient depth stowing should not be necessary.

As regards buildings, this must depend upon the nature of the building and the terms of the mining lease under which the property is being worked. In the case of a public utility building coal lying underneath should be extracted by sand-stowing.

As regards bridges, if they are to be permanent the coal lying underneath can only be assumed to be lost for all practical purposes, as even if stowage were practised a slight subsidence is possible to occur which might seriously disturb the bridges foundations.

We know of only two instances where the railways have paid compensation for coal locked up, namely, (*a*) in March 1927 the East Indian Railway paid Rs. 1,81,000 to Mr. B. B. Bose for coal locked up under the land they required for the extension of the Jharia Damodar branch of that railway. This was computed at 9·03 acres, locking up 256,000 tons of coal; (*b*) we understand that the Sub-Judge at Dhanbad last September decreed Rs. 94,000 as compensation to the Estate of the late Khora Ramji for coal locked up in his Khas Jharia colliery under the Jharia railway yard. We are not in a position to say whether or not the Railway Company has appealed against this judgment.

Question 42.—We have no objection to a compulsory system of stowing where undue waste would result without stowing; but each case would have to be taken on its merits as we are of opinion it would be impossible to legislate for all conditions. On the assumption that, in certain circumstances, compulsory stowing is enforced, we think that there is only one method by which the additional cost could be met, and that is by a universal cess on coal despatches.

Question 46.—In theory all coal of a commercial value should be mined, or if left in the ground should be left in such a way as to render its extraction possible at a later date.

Whether the above result could be obtained by an Act of Legislature, is not so easy of reply, as in practice it may prove to be a financial impossibility to mine in such a way as to produce the desired result.

Market conditions at the present time render only the mining of the better portion of certain seams of coal an economic proposition and in very many cases this means the abandonment of the inferior portions of the said seams. If by an Act of Legislature the extraction of a section of a seam so as to render unworkable the remainder

of a lower grade were prevented, the recourse would be sand-stowing and this in principle brings up the question of financial aid produced by a universal cess on despatches referred to under *Question 45*.

Question 47.—We consider the reply to this question should be the same as for that given to *Question 46*.

Question 48.—We consider that it is impossible to define a coal of commercial value and our reason for saying this is:—

Coal which is now considered of no commercial value may in the future be able to be used economically by the introduction of improved methods of combustion.

To attempt to define coal of commercial value as such coal that will satisfy a certain analysis we consider to be impracticable in view of the reason given above, as we are given to understand that even now rejected shale is being burnt in specially designed boilers.

Question 50.—We consider that it is desirable that mine owners should be required to remove coal under railway sidings, villages, rivers, etc., by a system of simultaneous stowing with incombustible material, but subject, of course, to the necessary financial aid being available.

Question 51.—Under the existing law the State as represented by the railways is liable to compensate owners of coal which lies longer required by the railways, and the actual practice in the Act being withdrawn and therefore if a method can be devised to win the coal locked up under railways without disturbing the surface, then the cost of so doing should be borne by the railways in such a way as to meet the additional expenditure incurred by the mine owner in extracting the coal by the special method employed to obtain the above result provided the necessary financial aid is not available from other sources.

Question 53.—If compulsory sand-stowing is to be introduced, we do not consider that delivering stowing material free to the colliery would be sufficient. From our experience the conveyance of stowing material from the source to the colliery is approximately half of the total stowage cost and the total stowage cost is approximately the extra expense incurred in extracting coal by means of stowage over the ordinary existing methods. As the ordinary existing methods only just allow coal to be raised as an economical proposition, we submit it follows that the whole cost of stowage should be free.

Question 56.—Theoretically coal mining properties which are too small or so badly shaped as to make it difficult to work them safely and economically should have their boundaries readjusted without the question of *salami* being raised, provided of course each owner is compensated fairly by the readjustment of boundaries. However, this is a question which involves much legal study and the time for this has not been available.

Question 59.—We are certainly in favour of mine-owners working adjacent properties being required by law to make and maintain joint surveys so as to secure a check on the barriers between such properties. If a statutory authority is set up with power to survey barriers between joint mines, then there should be available a means of appeal.

Question 61.—We think we have given adequate answers to this question in our replies to *Questions 46, 47 and 48.*

Oral Evidence of Mr. E. O. Pearce of Messrs. Bird & Co., Calcutta.

Question 42.—I accept a definition of "undue waste" as any waste which is not incidental to the system of mining which is being followed.

The cess to provide funds for sand-stowing should be universal on all coal despatches, and should be paid by the producers along with the railway freights. Producers will add the cess to raising costs and recover at least part of the additional cost from the consumers. The main difference between raising costs and selling prices is the item of freight. Prepayment of freights is no longer required by the railways, and the actual practice in the trade varies.

The cess should be imposed on coal coming from Native States. I accept the formula for the imposition of the cess on all coal and coke carried by rail in or into British India.

Questions 46, 47 & 48.—The effect of the Grading Board operations has been to create a tendency to work in smaller sections, other sections which are not so good being left in the mine and usually lost. The extension of the grading system to the internal trade has enabled commercial selling to be done, but I agree that coal may also be sold by the name or number of the seam. It would, however, be difficult to revert generally to this system as even internal buyers have got used to buying by grading values. It is true that the railways do not go by the certificates of the Grading Board, but rely on their own tests.

All coal is not of commercial value at present, but even inferior coal has a value when consumed at or near the sources of supply. For example, coal of commercial value in the Central Provinces could contain 30 per cent. of ash, whereas coal with more than 20 per cent. of ash would be unsaleable in Raniganj or Jharia. I am still of the opinion that the definition of "coal of commercial value" would not only be very difficult, but almost impossible, but that on the supposition that it can be defined then it would only be useful from a commercial point of view inasmuch as it would strengthen the producer's hand in dealing with any claim by the landlord for the destruction of any seam or part of a seam.

Again on the supposition of a definition being possible, it would be very difficult to revise the definition every few years, as the protection it may give against the landlord might be reduced, owing to the fact that seams of no value under the original definition might be classified as of commercial value under a revised definition and the damage already done.

Question 53.—I consider it essential that the collieries required to stow should be given free sand and the cost of stowage underground. I would have no objection to a flat rate for the underground stowing on an economic basis.

Question 56.—In such cases, there would have to be a fair adjustment covering everything, *i.e.*, not only *salami*, or transfer fee, but also wayleave and royalties.

Question 59.—Both for the conservation of coal and safety of life, there should be one controlling statutory authority, namely, the Mines Department. There must be a right of appeal from the orders and decisions of that Department. The appellate body should have an official Chairman and the remaining members should be technical experts with one commercial member to consider cases from the financial point of view. I agree that there could be no appeals as regards orders about barriers because the size of barriers is defined in the Regulation.

General.—A party of seven consisting of our Deputy Chief Mining Engineer, Electrical Engineer and five Mining Engineers arrived at the Kolar Gold Fields on the 30th December, 1936, to undergo a month's training in rescue work under the tuition of Colonel Benn White who is in charge of all the rescue stations in Kolar and which are probably some of the best organised rescue stations in existence.

We have constructed a training shed at Loyabad and also set aside accommodation for a rescue station there. We have imported twenty sets of the latest proto-type self-contained breathing apparatus, and twenty-four sets of gas masks complete with every accessory with which to make a completely equipped up-to-date rescue station.

We have also obtained the services of a station superintendent from England with very considerable experience in rescue work and fully qualified for the appointment.

On the return of the party from Kolar, the training of Indian personnel will be taken in hand to complete three rescue parties of six or seven men each.

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9. Written Evidence of Messrs. Jardine Skinner & Co., Calcutta.

While we have not been asked directly to reply to the questionnaire, we have received a copy of it from the Secretary, Indian

Mining Association, and we would like to be allowed to comment on some of the questions of commercial interest. This letter will be forwarded to you by our Colliery Superintendent, Mr. J. E. Phelps, along with his replies to your questionnaire.

Questions 46 & 47.—From the commercial point of view we consider that prevention would be too drastic. We suggest that control of these practices be given to the statutory authority.

Question 48.—What is coal of commercial value varies from year to year with the laws of supply and demand and we do not see how the term can be defined. As regards the definition of coals of economic value we would refer you to our Colliery Superintendent's reply to *Question 40.*

Question 50.—While much must depend on the individual circumstances governing each case there at present appears little, subject to our answer to *Question 51,* to be said against simultaneous stowing, after first workings, under railways. As regards rivers we consider that very strict control is necessary.

Question 51.—As the removal of coal from under railways will relieve them of their obligation to pay compensation on coal locked up, we consider they should pay the total extra cost paid by the colliery due to stowing.

Question 56.—We suggest that power should be given to the statutory authority to do this.

Question 57.—We do not consider this practice harmful provided control of workings in both seams is in one hand.

Question 59.—We would prefer the statutory authority to have the power to survey barriers between adjacent mines. There would then be no chance of a mine-owner, who did not wish his boundary surveyed delaying matters.

Question 62.—We do not consider that the Coal Grading Act has been responsible for the working of sections. We think this would have happened in any case as it seems that the proportion of good quality coal sold to the total quantity of coal sold varies inversely with the average market price of coal. The Grading Board has done much to fulfil the purpose for which it was created—that is to promote shipment business.

Oral Evidence of Mr. E. A. Paterson of Messrs. Jardine Skinner & Co., Calcutta, Managing Agents of the East Indian Coal Co.

Questions 46 & 47.—The statutory authority referred to must have legal powers and be able to enforce their decisions. I agree that " control " would include " prevention " in some cases.

Question 48.—As regards the definition of " coal of commercial value ", I do not like the word " commercial ". I would have

no objection to a definition of " coal of economic value " because this would be necessary in order to enable the statutory authority to operate to practical advantage.

Question 57.—I think that the practice referred to should be controlled by the statutory authority suggested. I am definitely of opinion that the practice is harmful unless the working of both seams is controlled by the same person.

Question 62.—I do not think that the Grading Board is entirely responsible for working coal in sections. This used to be done before the Grading Board operated, and its general extension is due to market conditions. These conditions are also responsible for the extension of grading to the internal trade. The consumer has the whip hand and the producer has to satisfy him. It will therefore be difficult now to revert to a system of selling coal by the name or number of the seam.

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10. Written Evidence of Messrs. Anderson, Wright & Co., Calcutta.

With reference to your Circular No. 128-R. of the 5th instant, enclosing a copy of the General Questionnaire issued by the Coal Mining Committee, we do not wish to answer questions which obviously are addressed to qualified mining engineers but there are a few questions to which we desire to submit replies as follows:—

Question 23.—We are not in favour of a statutory authority having powers to give sanction to, or to withhold sanction from, a system of lay-out of workings.

Question 24.—If a statutory authority is given powers to require mine-owners to pack, or partially pack, galleries in workings in which the statutory authority considers it necessary that such packing should be done prior to the extraction of pillars, such statutory authority should be entirely separate from the Mines Department and provision should be made for the right to appeal to a competent Mining Board.

Question 42.—If compulsory filling, whether complete or partial, is to be introduced, the cost should be met by a central fund raised by a cess on all despatches of coal from all collieries in India. Any other method of meeting the cost would be grossly unfair to those collieries in which stowing was made compulsory.

Question 43.—If compulsory filling is to be introduced a statutory authority constituted as stated in our answer to *Question 24* should be set up.

Question 44.—*See Question 23.*

Questions 50 & 51.—Mine-owners might be required to remove coal under railway lines by a system of simultaneous stowing but, as this would relieve the railways of their obligation to pay

compensation for coal locked up, the railways should bear the whole cost in cases of main and branch lines (including siding lines crossing one colliery to another) but in the case of a colliery siding the cost might be met from the fund referred to in Answer 42.

Question 53.—The whole cost should be met from the central fund.

Question 55.—If compulsory stowing is adopted it should not be restricted to coking coal. It should be made applicable to all coal.

Question 56.—Amalgamation of certain small properties might have resulted in safer and more economical working if such amalgamation had been effected before development had proceeded to the present extent. Most properties are too far developed now to make any improvement possible.

Question 61.—It may be possible to use Grade II coal for some purposes for which good quality coal is now used but only with loss of efficiency to the consumer. Unless India continues to market coal of good quality she will lose those markets where competition is possible from coal produced in other countries.

Question 62.—We do not consider that the Coal Grading Act of 1925 has caused waste of any coal of commercial value.

Oral Evidence of Mr. I. A. Clark of Messrs. Anderson Wright & Co., Calcutta.

Question 23.—If powers are given to the statutory authority to sanction, or withhold sanction from, a system of lay-out of workings, it will be restricting individual rights. I admit that, if the system of lay-out is good, we would have no interference, but my own experience is that Government methods are very slow and development would be held up while sanction was awaited. I would not object to a law or regulation laying down the general principles of first working, such as the sizes of galleries and pillars, etc. In fact, it would have been better if this had been done from the very beginning.

Question 24.—The statutory authority should be separate from the Mines Department. I do not think that the Mines Department as at present constituted, can possibly deal with the question of conservation. The statutory authority should be in the nature of a Board, whereas in effect the Mines Department consists of only one man, the Chief Inspector of Mines, whose orders are final. Of course, the Mines Department would have to be represented on the Board. I am, personally speaking, inclined to agree that, provided there was a right of appeal, safety and conservation could be looked after by the Mines Department, but the Indian Mining Association prefers to have a Board for the control of conservation

with the Chief Inspector of Mines as a member. I am inclined to agree with the Association.

Question 42.—Any cess should be collected by the railways with the freight. The producer will pay it in the first instance, if the freight is prepaid, but in effect it will have to be paid by the consumers. When I say that the cess should be imposed on all despatches from all collieries in India, I mean from all collieries in India, including those in Native States.

There are collieries which do not send coal by rail but by cart and a system of cess collection by the railways on despatches would result in a small loss of revenue but, so far as I am aware, the percentage of coal exported from collieries other than by rail is very small. A system of cess collection on raisings is more likely to lead to evasion than a system of collection on despatches.

Questions 50 & 51.—My argument is based on the fact that the railways are already legally bound to pay compensation for the coal left under their lines. They should therefore pay for the stowage. There is no reason why the railway collieries should be exempted from payment of cess on their despatches. They would also get the benefit of the central fund if stowing was necessary in their collieries.

Question 53.—The cost of stowing will be heavier in some mines than in others owing to the high percentage of extraction in first working. What would not be economical to the owner would not be economical to the central fund, and the statutory authority in such cases would probably consider that the cost of stowing would be too heavy to justify the extraction of the remaining coal. This would not necessarily prevent the extraction of the coal at a later date, if stowing were then considered an economical proposition. Every case will have to be considered on its merits.

Question 55.—If compulsory stowing is adopted, it should not be restricted to coking coal only. I do not see why the iron and steel industry should be singled out for preferential treatment. If the justification for compulsory stowing is the public interest, it must apply to all coal.

Question 56.—In our reply we have said that most properties are too far developed to make any improvement possible. I am prepared to modify this by saying that there may be cases in which the amalgamation of small properties would be justified in the interests of conservation and safety.

Question 61.—" Coal of commercial value " is coal that can be sold at a profit. The definition of an ore in metal mining is " a rock which contains sufficient metal to pay for its extraction at a profit ". It ceases to be an ore if it does not pay. This proposition, in my opinion, applies equally to coal. Theoretically a definition will be useful, but practically it is impossible.

Question 62.—The Grading Board came into being because the quality of Indian coal at that time was so bad that it was losing the export markets. Officially the Grading Board does not say

that a seam has been graded for purposes of internal trade but in practice coal of a seam graded, say, as selected is sold as such whether for export or for internal trade. In some cases the introduction of grading may have tended to increase sectional working but in many cases the coal which is left behind is not of commercial value. Since the Grading Board was introduced consumers have been educated to a higher standard and it is doubtful whether they would now be prepared to use such inferior coal as would result from a reversion to the old system. This is particularly doubtful in the case of consumers situated at a long distance from the coalfield, as the freight is the same whether the coal is good or bad.

Sales for export are not confined to particular collieries and sales for internal trade to others. A colliery which sells coal for export also sells for internal consumption and it is not practicable to mine one section for the former class of demand and another section for the latter.

General.—It would be reasonable for landlords to agree to a lower rate of royalty on coal which could not be extracted without compulsory sand-stowing. In my capacity as a Director of Bokaro and Ramgur, Limited, however, I wish to make it clear that that Company are only royalty receivers in the sense that they receive royalty from the railway collieries and in turn pay royalty to the Ramgarh Wards Estate and the Company, of course, could only consent to a reduction in the royalty paid by the railway collieries if similar consent were given by the Ramgarh Wards Estate.

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11. Written Evidence of Messrs. Mohatta Brothers, Calcutta.

Question 23.—It will be good for future mining if "lay-out" of all new workings be submitted for sanction by a statutory body. There should not be any general rule for every mine, as workings of each mine have to be governed according to respective conditions, such as (1) thickness of seam, (2) nature of coal, (3) inclination and depth, etc.

Question 36.—We do not expect that more than 40 per cent. will be recovered under the existing method of depillaring.

Question 37.—All of this coal will certainly be lost unless the railway lines can be diverted over ground where there is no coal. In most places this diversion over barren land will not be possible in Jharia and Raniganj fields. So to recover this coal, except under bridges, complete stowing will be necessary. We know only of two instances where railways have paid compensation for locked up coal. One is to Upper Lodna colliery owned by Basu Santan and the other is to Jharia Khas colliery. As regards rivers and important buildings, we believe, stowing will also be necessary to recover the coal underneath.

Question 38.—If stowing is made in the collieries with which we are concerned the lives will be nearly doubled.

Question 42.—We are in favour of compulsory stowing in all cases where extraction is not possible without wastage of over 15 per cent. But each case has to be decided on its own merit. The cost in our opinion should be met by:—

(1) On a cess on all coal and coke despatched in British India and Native States to be realised by railway along with freight.

(2) From royalty owners, as they will be benefited greatly as more coal will be available from the same leasehold.

(3) From railways, as they will not have to pay for locked up coal under railways and ultimately they will be assured of getting traffic for longer period in future.

(4) By a contribution from the central revenues as a sort of bounty as has been given to steel industry previously and these days, in the shape of a protective custom duty, as conservation of coal will benefit the community as a whole.

Question 43.—If compulsory stowing is introduced, a statutory authority should be set up, comprising chiefly of mining engineers of the field with a Chairman elected amongst themselves, provided the safety side is left to the Mines Department. There should also be an independent appellate body consisting of two mining engineers and one Chairman—preferably a retired High Court Judge—in which, neither the Mines Department nor the owners shall have any representation.

Questions 46 & 47.—We are of opinion that working only the best portion of a seam and rendering the other portion of " commercial value " unworkable should be prohibited. This also is applicable to a lower seam being worked and thereby wasting the upper seam of inferior grade. Such cases should be judged individually, on their own merits. For an instance, a seam of 18 feet having 3 feet inferior coal is quite differently placed in relation to a seam of 35 feet having only 10 feet good coal and 25 feet inferior coal but still of commercial value. In the first case it may be permissible to work the good portion only but in the latter case it should not be allowed.

Question 48.—It is not easy to define coal of " commercial value " because a seam may not be possible to work economically to-day when the prices are at a very low level but it may be possible to work quite profitably in future when market rises or when some improved method of combustion is found out or these coals might be utilised, in a different way such as extraction of oil. Roughly, we can take coal up to Grade III to be of commercial value.

Further, a seam which is not of commercial value in Bengal or Bihar, is quite profitable to work in the Central Provinces or

the Punjab because of the geographically advantageous position in terms of railway freights.

Question 50.—The mine-owners should be required to extract coal under railways, villages and rivers by stowing, provided financial aid is given.

Question 51.—Where railway is concerned they should bear the major portion of the stowing cost for the obvious reason that they will not have to pay for the locked up coal. But if they subscribe to the general cess they may be exempted from paying for the locked up coal.

Question 53.—For compulsory stowing we do not consider that free delivery of sand at the colliery will be sufficient. Our opinion is that some extra payment over and above free sand, on flat rate basis, should be given to the colliery for the coal recovered from depillaring by stowing. Nevertheless we consider it inadvisable to make the " whole cost " of stowing free for the simple reason that in this case mine-owners will not try wholeheartedly to do the thing economically, and secondly, because it would place all mines on same advantage. For an instance, an owner, who has taken out half the coal in the first working leaving half in the pillars and the other owner, who has worked only, say 30 per cent. and left 70 per cent. in the pillars, will be on par with each other.

Questions 54 & 55.—We consider, it will be to the interest of India and to safety, to have statutory control over mining methods. This control should not be limited to only one field such as Jharia or Raniganj. If conservation of Jharia coal is necessary for iron and steel industry, Raniganj coal or other non-caking class will be necessary for steam raising purposes. We should not lose sight of better utilisation of the Raniganj class coal in future by taking out oil from these, for which purpose we believe this will be very suitable. Oil resources of India is indeed very poor—in view of Burma's separation—and India will possibly have to look to this class of coal for her future oil supply. So we consider all these coals to be a national asset of great value and should not be permitted to be worked wastefully.

Question 56.—Coal mining properties which are too small or badly shaped and cannot be worked economically or safely, should be amalgamated with the adjoining properties or the boundaries should be readjusted. Although it will be a complicated problem but we think that if an institution of " Coal Mines Improvement Trust " is created on the lines of " Calcutta Improvement Trust " such problems can be solved with great simplicity, under such scheme, as " The Tribunal " of the suggested " Improvement Trust " shall be competent to fix the value of " badly shaped plots ", and acquire it for the Trust compulsorily, if the parties involved do not amicably settle between themselves.

We also very strongly feel that recovery of coal from the existing pillars by stowing to prevent collapses, further fires, and for conservation is so great that collieries who like to start stowing

even before it is made compulsory by legislation, should be encouraged to do so by assistance, financial and otherwise, from the cess fund so created, even before the arrangement for supply of sand could be made. If this assistance is given, then, we are confident, a large number of collieries will immediately start depillaring by stowing and they will arrange their own stowing material.

Oral Evidence of Mr. D. K. Samanta of Messrs. Mohatta Brothers.

General.—My firm received a copy of the Committee's questionnaire from the Indian Mining Federation. We have replied to it in our individual capacity as a commercial firm and not as representing the Indian Mining Federation.

My firm are the managing agents for Sitanala colliery, Kohinoor Coal Property, Pathardih Sudamdih colliery, East Nandi colliery, and Bonbistopur colliery, the first three being in the Jharia field and the last two in the Raniganj field.

Questions 19 & 23.—After discussion with the Committee, I agree that general principles of first working should be laid down by regulation. Such principles could be made to cover at least 80 per cent. of ordinary cases, and the remaining 20 per cent. of the cases would be provided for by a proviso allowing the statutory authority power to vary the general principles in accordance with local conditions or special circumstances.

Question 53.—We will prefer the proposed flat rate given as assistance towards the cost of underground stowing to be based on the tonnage of coal recovered by means of the sand-stowing. There would have to be a measurement of the pillars before sand-stowing and depillaring operations were started.

Questions 54 & 55.—Our information, based on technical advice, is that Raniganj steam coal is more suitable for hydrogenation than coking coal from Jharia.

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12. Oral Evidence of Mr. R. J. Bown of Messrs. Gillanders Arbuthnot & Co., Agents of the Nobel's Explosives Co., Ltd.

I have a personal preference for one shot only under all conditions in firing coal shots. In mines which are not gassy, there is coal dust danger after each shot, but this danger can be lessened by dusting or watering after each shot. Of the two, I would rather have universal dusting. If dusting is done properly, the conditions with successive shots should be safer than with simultaneous firing. Even with "permitted" explosives, one shot of several may hang fire.

Question 30.—In open-lamp mines in England, the manager can authorise anyone to fire shots and such a person need not have a certificate. It would be beneficial to safety in India to require all shot-firers to have certificates. In the case of " permitted " explosives in England, no person whose wages depend upon the amount of coal to be gotten can be appointed to fire shots. Such a requirement might meet the conditions in India.

Written Evidence of Messrs. Gillanders Arbuthnot & Co., Agents of the Nobel's Explosives Co., Ltd.

Do you consider simultaneous firing of more than one shot in a dry and dusty mine is more dangerous than firing single shots?

We have given considerable thought to this question and our final view is that on the whole we do not favour simultaneous firing on longwall coal faces and would restrict it to three shots elsewhere where " permitted " explosives have to be used. Our reason for this restriction is the difficulty of ensuring absence of miss-fires with approved exploders firing a number of shots, coupled with the desirability of avoiding blown out shots. The difficulty of applying it to longwall working is bound up with the need to make a number of connections in poor light, and secondly with the question of roof support. We do not however consider that there is any greater danger from the point of view of possible ignitions of coal dust.

Question 28.—We suggest that the following additions and alterations might be made to the existing Coal Mines Regulations:—

Reg. 101.—Should read, " Explosives and detonators shall be issued only to competent persons appointed in writing by the manager, and no unauthorised person shall have explosives or detonators in his possession ".

Reg. 102.—Should read, " Explosives shall not be issued for use in blasting operations in a mine or used in a mine except in the form of cartridges ".

Reg. 106.—Suggest explosives canisters be provided with locks.

Reg. 107.—*Add,* " only one description of explosive in any one hole ".

Reg. 109.—Suggest substituting, " The person firing the shot shall before doing so see that all persons in the vicinity are taking proper shelter and shall take steps to prevent anyone approaching the shot. He shall himself take proper shelter ".

Reg. 112.—*Add,* " and a second charge shall not be placed in the same hole ".

Reg. 113.—*Add,* " and it shall not be deemed a contravention of the foregoing Provision in the case of a shaft being sunk

from the surface or deepened if the primers for charges are fitted with detonators on the surface before taking them into the shaft, provided that the primers are so fitted in a suitable workshop.

Reg. 114.—Add, " and any hole shall be of such diameter as to allow a clearance of at least $\frac{1}{8}$" over the diameter of any cartridge of explosive to be used for the charge ".

Reg. 115.—Add, " No shot shall be fired unless the explosive is one of the permitted explosives allowed to be used by an Order under the Coal Mines Act, 1911. An examination for gas shall be made by the shot-firer over the same radius with a locked safety lamp and if any inflammable gas is detected the shot shall not be fired ".

In addition we think it would be advisable to add the following Regulations:—

(*a*) Where permitted explosives are prescribed under Regulations 115 and 116, shots must be fired electrically with an approved type of exploder, and a shot shall only be fired by a shot-firer authorised in writing by the manager, and before loading any shot-hole it shall be examined for breaks.

(*b*) Where shots are fired electrically the authorised person shall not use for the purpose of firing a cable which is less than 20 yards in length. He shall himself couple up the cable to the fuse or detonator wires and shall do so before coupling the cable to the firing apparatus. He shall take care to prevent the cable coming into contact with any power or lighting cables. He shall also himself couple the cable to the firing apparatus. Before doing so he shall see that all persons in the vicinity have taken proper shelter.

(*c*) Where permitted explosives have to be used no detonator shall be used other than an electric detonator in which the explosive is contained in a copper capsule.

(*d*) Before any shot-hole is charged the direction of the hole should, where possible, be distinctly marked on the roof or other convenient place.

Question 29.—Yes. Gunpowder should not be used in mines where inflammable gas is found or where the conditions are dry and dusty.

To define the conditions under which the use of permitted explosives should be compulsory, we would suggest conditions similar to those laid down in the Coal Mines Act in Great Britain.

Question 30.—We think it eminently desirable that any man who is to fire shots, particularly in gassy and dry and dusty mines, should be the holder of a certificate of competency which would include gas-testing.

The examination of a candidate for certification as a shot-firer should ensure that:—

(1) He is competent to test for gas with a safety lamp.

(2) His eyesight and hearing are normal.

(3) He is at least 23 years of age and has had at least five years underground experience of coal mining, or holds a colliery manager's or under-manager's Certificate of Competency.

(4) He has a working knowledge of the character of explosives, detonators, etc., and can show that he is capable of preparing and firing a shot safely and efficiently.

Question 31.—We think it advantageous to retain the proviso empowering the Chief Inspector of Mines to modify the regulation limiting the amount of explosives in any one place to 5 lbs. This is particularly desirable for shaft sinking and tunnel driving, where 5 lbs. of explosive may not be sufficient for charging a complete round of shot-holes. In addition, if this regulation applied to quarries the limiting of the amount of explosive to 5 lbs. would be impracticable.

Question 32.—The Rules given in the Indian Explosives Rules regarding magazines seem to us to be adequate. If the question includes the storage of explosives in a magazine, we should be glad to offer further suggestions.

Written Statement sent in by the Imperial Chemical Industries, Limited.

In submitting this statement we would like to say at the beginning that Imperial Chemical Industries, Limited, maintain close association with the coal mining industry in many parts of the world and are familiar with most of the problem that arise in connection with the use of their products, chief of which is explosives. Through the information we obtain from our agents in India and from our technical representatives who have visited the coalfields from time to time, we have a general knowledge of the problems confronting the Committee in relation to explosives. We would like to say, however, that we do not have the intimacy of contact that exists in our home market and, on that account, we are confining our statement to a brief outline. We should be pleased, however, to reply, orally or in writing, where we can, to any questions the Committee may raise on this subject.

The climatic conditions of India cause deterioration of certain of the more popular explosives used in Great Britain. For this reason, Imperial Chemical Industries developed and have imported special explosives of varying characteristics covering the requirements of the Indian coal mines and capable of standing up to transport and storage in the somewhat difficult natural conditions.

For opencast workings in naked light and non-fiery mines there is a range of gelatinous and powder type explosives available. These compositions are capable of dealing with the hardest of rock, existing as over-burden in the open or ripping underground. The lower powered compositions can also be used in the coal when firing to a free face or from the solid.

For fiery mines two explosives have been available for many years, both of which have passed the stringent United Kingdom Mines Department Permitted Test, which requires the firing of five shots from the testing gun of 8 ozs. unstemmed and five shots of 28 ozs. with 1 inch of stemming into 9 per cent. methane/air mixture and five shots of 28 ozs. with 1 inch of stemming into coal dust, all without producing an ignition. These two explosives, namely, Stonobel and A2 Monobel, have been in use now over a long period of years and have given very satisfactory service. Both produced specially to meet the difficult storage conditions and little or no trouble has been experienced with them on this count. Moreover, very few ignitions of gas or coal dust have occurred where they were in use. (Our records show only two in the last ten years.) The Stonobel is designed for stone work, drifting, ripping, etc., and has the attribute of fairly high density (1·23), good strength and the requisite sharpness of action. The A2 Monobel is of lower density (0·98) and has proved to be suitable for most coal work.

Recently two further permitted explosives, which are very popular in the home market, have been added to the list of explosives imported. One of these is a low density explosive (A1 Rounkol), which gives exceptionally good results in machine mining work. The advantages of low density explosives were discussed in a paper entitled "Low Density Permitted Explosives" by J. E. Lambert, B.Sc., given before the Mining and Geological Institute of India (Volume XXIX of Transactions of the Institute).

In the case of the low density explosives the charge is spread over a greater length of shot-hole than in the case of the ordinary density types and this, combined with low velocity of detonation, gives the good spread and softness of action associated with these compositions.

The fourth permitted explosives now available is Polar Dynobel No. 2. It is rather stronger than the other compositions, although not quite so dense as Stonobel. It is used extensively for stone rippings and in anthracite collieries for blasting the coal from the solid.

The Committee will be familiar with the evidence presented before the Royal Commission on Safety in Coal Mines, which is sitting in London at the present time. Our views on the development of explosives from the safety aspect are stated in full in Minute No. 26. We would respectfully ask that what appears there should be accepted by your Committee as representing our views on the safety side. We would emphasize that explosives, as they exist at the present time, continue to render a very great service to the

coal mining industry and they are not the source of danger popularly supposed. There has not been an opportunity of tabulating the statistics for India, but we think a useful guide to the risks from explosives is obtained from the attached table, which was given to the Royal Commission in London, supplementing the table in paragraph 2 of our evidence.

Explosives manufacturers have not regarded the satisfactory situation as a reason for neglecting research. Steps forward are continually being made, either in regard to the explosives themselves or the accessories.

On the explosives side, the most important recent development has been the introduction of sheathed permitted compositions. This step is probably as important as the first introduction of permitted explosives into fiery coal mines. Lemaire in Belgium in 1913 developed the idea of surrounding a cartridge with some quenching material. His sheathed explosives received little support until after the war. During the last ten years, sheathed explosives have been extensively used in Belgium and over half of the permitted explosives sold there are in this form.

During the last three years we have offered on the market in the United Kingdom permitted explosives sheathed with sodium bicarbonate, and it may interest you to know that about 40 per cent. of the permitted explosives are now taken, entirely voluntarily, in the sheathed form.

The results of tests show that the safety factory of permitted explosives is increased at least three times by sheathing.

Experience in Great Britain has shown that the increase in cost due to the higher price of sheathed explosives is roughly 1*s*. 8*d*. to $\frac{1}{4}d$. per ton of coal won.

For some time now all electric detonators supplied to coal mines in the home market have been made up from non-inflammable components wherever possible. Electric detonators of this type would, as far as can be judged, stand up to storage in India and will be supplied in the near future.

We feel that we should mention some of the more essential points to be considered in the safe and efficient use of explosives. For instance, the placement of holes is of prime importance both with regard to efficient blasting and the prevention of blown-out shots, especially where the practice of blowing off the solid is employed, in which case it is necessary to take great care that the burden on shot-holes is not excessive and is in correct relation to the length of the holes.

The use of sufficiently good stemming material is also of assistance in the prevention of blown-out shots and it is of interest to note that considerable use is being made in Great Britain of sand/clay mixtures, to which attention was drawn by a circular from the Chief Inspector of Mines in India to owners, agents, and managers in 1934. The Safety in Mines Research Board Technical Paper No. 84

on Stemming Materials deals fully both with the methods of preparation and the advantages to be gained by the use of this material.

In recent years much attention has been drawn to the position of the primer cartridge in the charge and it is now generally accepted in Great Britain that direct initiation should be used where permitted explosives are employed. This method makes for greater certainty of propagation of the complete charge and also reduces the possibility of blown out shots.

We respectfully submit that the practice of making powder at collieries is not in the best interests of safety nor is the product of such a quality that it contributes to the most efficient extraction of the coal—a subject, we understand, of major interest to your Committee. We would claim that, in so far as it is possible, the explosives we import, made as they are under very strict supervision and in compliance with the stringent regulations obtaining in Great Britain, should commend themselves to the Committee.

*Causes of fatalities and serious injuries in Coal Mines.**

	Percentage.			
	1934.	1933.	1932.	1922-1931.
Falls of ground	42·4	47·4	44·6	42·7
Haulage	20·6	23·3	24·4	24·9
Surface	8·7	9·4	9·9	10·4
Explosives	4·8 †(0·13)	4·1 (0·11)	4·2 (0·12)	5·0 (0·13)
Explosions (All causes) . . .	9·4	2·9	4·38	4·52
Explosions (Explosives) . . .	0·72	0·21	0·71	0·62

13. Written Evidence of Mr. C. W. G. Hindley, Acting Chief Mining Engineer and Agent, Messrs. Andrew Yule & Co., Ltd.'s Collieries.

Question 1.—Acting Chief Mining Engineer and Agent of Messrs. Andrew Yule & Co., Ltd.'s collieries as follows:—

Messrs. Bengal Coal Co., Ltd.—

(1) Damooderpore colliery.

(2) Banksimula colliery.

* The following classes of accidents are included:—

(a) Accidents causing fracture of head or limb or dislocation of limb, or any other serious personal injury.

(b) Accidents caused by explosion of gas or dust or any explosive, or by electricity, or by overwinding and causing any personal injury whatever.

† NOTE.—The figures in brackets refer to the percentage of fatalities and injuries involving disablement for more than three days, attributed to explosives.

(3) 7 and 8 Pits Banksimula colliery.
(4) Poidih colliery.
(5) 9 and 10 Pits Sodepur colliery.
(6) Sitalpore colliery.
(7) Perbelia colliery.
(8) Chanch colliery.
(9) Rajhara colliery.
(10) Murulidih colliery.

Messrs. Deoli Coal Co., Ltd.—(1) Deoli colliery.

Messrs. Burra Dhemo Coal Co., Ltd.—(1) Burra Dhemo colliery.

Messrs. North-West Coal Co., Ltd.—
(1) Ena colliery.
(2) Huntodih colliery.

Messrs. Bengal Nagpur Coal Co., Ltd.—(1) Bhuggutdih colliery.

Messrs. Seebpore Coal Co., Ltd.—(1) Pretoria colliery.

Messrs. Katras Jherriah Coal Co., Ltd.—(1) Seebpore colliery.

Messrs. Adjai Coal Co., Ltd. (in liquidation).—(1) Nandi colliery.

Messrs. Kalapahari Coal Co., Ltd.—(1) Damra colliery.

Messrs. Girimint Coal Co., Ltd.—(1) Girimint colliery.

Messrs. Adjai Collieries, Ltd.—(1) Adjai Second colliery.

Messrs. Adjai Valley Coal Co., Ltd.—(1) Adjai Valley colliery.

Messrs. Bengal Bhatdee Coal Co., Ltd.—(1) Bhatdee colliery.

Messrs. Bengal Giridih Coal Co., Ltd.—(1) Dhobidih colliery.

I have over 13 years' experience of Indian coal mining in the Raniganj and Jharia coalfields as Assistant Manager and Manager at Nos. 9 and 10 Pits Sodepore, Chanch, Murulidih, Bhatdee, Ena and Deoli collieries, in the Survey, Engineering and Zemindary Departments and for the last three years prior to the above appointment acted as Personal Assistant to Chief Mining Engineer.

Question 2.—Spontaneous combustion in goaves inadequately ventilated but open to the passage of air through galleries or cracks to the surface in subsided areas.

The existence of fires has been brought into greater prominence during recent years but I am unable to express an opinion as to whether this means an actual increase in the number of fires.

In my opinion premature collapse is more likely to conduce to spontaneous heating on account of the greater quantity of coal left in the goaf and its crushed state due to weight preceding the

collapse. As far as I am aware, however, the majority of fires existing at present have followed normal collapses.

Question 3.—Raniganj Field.—The term "incubation" is a misleading one as heating is largely dependent on the conditions in which coal has been lost in a goaf. In the absence of accurate information about old workings opinion can only be speculative as the only fires of which I have personal experience have spread from older districts. With adequate ventilation it has been found possible to work panels without indication of heating for over 18 months in the Poniati seam and two years in the Dishergarh seam.

No definition can be given of seams of commercial value but in general thin seams are less liable to spontaneous combustion as there is less likelihood of coal being abandoned in goafs. Given sufficiently favourable conditions, however, it is doubtful if any seam is entirely free from this danger.

Question 4.—Underground fires are liable to add to the difficulties and dangers of extracting coal from adjoining districts and their effects increase in the conditions described. Such dangers can, however, be largely eliminated by the early closing off of the areas affected.

Question 5.—Yes. Conditions vary in different mines and different seams but in general, it would be found satisfactory to lay out the workings with panel barriers forming 20 per cent. of the coal in seams up to 18 feet in height. In many cases it has been found possible to thin down some of the barriers or remove them altogether particularly where the goaf can be flooded within the panel after the pillars have been extracted.

Question 6.—I consider that the various regulations in force do not require any additions.

Question 7.—Mechanical ventilation is not essential in mines where fires have been securely built off with masonry stoppings and no openings from the surface exist provided that adequate ventilation as required by the Indian Mines Act and Regulations is properly coursed through the workings. In cases where natural ventilation is sluggish during certain periods of the year or liable to reverse a mechanical ventilator is of assistance. Pressures required in this country are, however, so low that the question of exhausting or forcing is of little moment, exhausting fans being preferred for convenience in constructing suitable outlets to the atmosphere.

Question 8.—Yes, on account of the large quantity of crushed coal produced at points where ventilation is inadequate. Presumably most fires occurring due to spontaneous combustion can be attributed to the coal left behind in the goaf.

Question 9.—In my opinion such treatment could only be efficacious in cases of small accidental outbreaks and would be liable to create a sense of false security particularly when water supplies in large quantities are not readily available at all times.

I do not think there is any need to enforce their provision by law.

Question 10.—I am not in favour of legislation of this kind as the great majority of underground employees including junior officials are incapable of using such instruments to any advantage.

Question 11.—I do not think further precautions are necessary in addition to the points already raised.

Question 12.—Such training would be useful as an addition to the general knowledge of those working at rescue stations but local knowledge of the mine affected is essential when dealing with an outbreak.

Question 13.—Efficient maintenance of breathing apparatus and gas masks in tropical conditions presents difficulties and the carrying out of useful work with such equipment requires strong physique, long training and self control of a high order. These matters will, however, fall within the scope of the Central Rescue Station organisation. Gas masks do not appear to be of much use by themselves.

Question 14.—Methods of dealing with coal dust should be applied to all mines where dry and dusty conditions exist.

Question 15.—Yes. Systematic lay-out of workings in panels so arranged that wherever possible goaves can be flooded if necessary. Insistence on adequately coursed ventilation, the prompt closing off of areas from which pillars have been extracted and when surface breaks occur the blanketting of all cracks and subsidences through which air is likely to pass. In back workings the building of masonry stoppings to isolate suitable areas before pillar extraction is started and the provision of materials on site for closing any service openings in case of emergency. As much coal as possible should be cleared out before collapse of roof takes place.

Where seams are worked in close conjunction one above the other panel barriers should be superimposed so as to prevent a possible fire from spreading from one seam to an unprotected part of another.

Question 16.—Where pillar extraction is being carried on at considerable depth so that breaks to the surface are long delayed or may not occur at all the cavity above the goaf will contain gas and the only means of ensuring that such cannot be expelled into the workings is to support the roof during coal extraction by solid stowing or partial packing in sufficient quantities. Conditions at individual mines form separate problems apart from the actual seams being worked.

Question 17.—Insufficiently large pillars and high galleries during the first working or caused later either by deliberate robbing or weathering and subsequent filling out of fallen coal. Other factors are the splitting of pillars prior to extraction too far ahead of the latter work thus weakening support close to the working faces and the leaving of large stooks and barriers in the goaf

preventing immediate falls of roof and throwing weight back on the remaining pillars.

Where seams are to be worked one above another with a thin parting the superimposing of pillars is advisable to prevent breaking through the parting.

The existence of faults and dykes affect the stability of a system which might otherwise be strong enough to prevent collapse.

Question 18.—(*a*) Underground. (1) Danger from falling roof and sides to workmen engaged at a distance from the actual coal faces or to men in course of withdrawal from the district affected. (2) The effects of the blast of air from the collapsing district passing into other adjacent workings with interruption of the ventilation system. (3) Damage to fire stoppings and protective barriers.

(*b*) Surface. Collapse of tenanted buildings, roads and important drainage schemes.

Collapses of any magnitude are likely to be presaged by conditions giving warning and the effects may be mitigated by the timely withdrawal of workmen, provision where possible of alternative defensive stoppings and the evacuation of surface buildings overlying the area. Although the actual collapse may be sudden the contributing causes cannot be produced in a short time. Maximum possible extraction during pillar-cutting operations with due regard to local line of roof break will minimise the danger of overriding and consequent rapid weakening of previously strong pillars. In old workings where pillars have been left too small and sand is easily available the stowing of galleries to form strong points of support is advocated.

Questions 19 & 20.—I do not consider it possible to lay down any rule with regard to safe dimensions of pillars as although greater support is in general required as the depth from the surface increases, the inclination and resistance to crush of different seams coupled with requirements of ventilation and haulage have also to be considered. With several seams close together the matter becomes still more difficult and the requirements of every mine thus become individual problems.

Question 21.—No, on account of special requirements in each mine involving changes of policy from time to time with regard to ventilation, handling of coal, drainage, occurrence of intrusions or stone bands and varying hardness of different portions of coal seams.

Question 22.—In general, galleries in such conditions should be driven as low and narrow as practicable having regard to ventilation and requirements for handling coal. The lay-out in each section should be arranged so that as far as possible, pillars in the upper sections overlie those in the lower and pillars should be larger than those normally formed in seams of thickness similar to that of the sections worked. The actual size of the pillars and the thickness of parting left must depend on individual conditions of depth from the surface, inclination and hardness of the coal and

existence of stone bands in convenient positions. The number of sections to be worked is dependent also on the foregoing.

Question 23.—I do not consider such an authority necessary as the Mines Department already possess adequate powers subject to appeal.

Question 24.—From the point of view of safety of workers only, packing to ensure stability should come into the province of the Mines Department and Mining Boards. For the purposes of conservation I do not think any statutory authority should be given such arbitrary powers.

Question 25.—In August, 1935, the level of the Damodar river rose rapidly to an unprecedented height at Murulidih and the flood water caused a collapse of the surface overlying old goafed workings close to the river bank. A large area of the workings was flooded but as all workmen were withdrawn on standing instructions when the water reached a pre-arranged permanent surface mark low down on the river bank no danger was anticipated or occurred to any employee of the colliery.

The subsidence has since been filled in, the whole level of the adjacent surface raised and revetted with stones along the river bank and surface drainage diverted while dams have been built in communicating galleries underground between the old and new workings, these dams being fitted with pressure gauges.

Question 26.—I have no personal experience of this but have heard this theory advanced on the analogy of producer gas plant. Conditions in my opinion would have to be specially favourable for such an eventually. In any case differentiation must be made between actual fires and areas efficiently closed off in the early stages of heating.

Question 27.—Suitable embankments, drainage and adjustment of surface levels when practicable. Legal enforcement of such measures is not necessary beyond the existing powers of the Mines Department for the prevention of dangerous working.

Question 28.—No further legislation is necessary but Supplementary Temporary Regulation No. 5 requires amendment to permit of the artificial treatment if necessary of conditions where ordinary explosives are used to enable more than one shot to be fired at a time.

Question 29.—I do not consider this necessary in view of the regulations already in force with regard to dry and dusty conditions.

Question 30.—It would be preferable for all shots to be fired by the sirdar responsible for the district in order to obviate dual responsibility and control, but a separate certificate for shot-firers would be of advantage.

Question 31.—As far as I am aware in present conditions in the Jharia and Raniganj fields the statutory quantity of 5 lbs. is adequate but where very extensive blasting operations are necessary

it seems to me that a large number of employees in charge of small quantities of explosives at numerous points is likely to be more dangerous than the handling of larger quantities by a few selected and experienced individuals. For this reason I would suggest the retention of the proviso to Regulation 106, or modification to permit the Manager discretion to increase the quantity by written order if necessary.

Question 32.—No.

Questions 33 & 34.—

Name of Seams.	Colliery.	Quality.	Thickness.	Inclination.	Section worked.
Seebpore/ Poniati.	Damuderpore .	Selected .	13 ft. .	1 in 10 .	Full thickness.
	Banksimula. .	Do. .	18 ft. .	Do. .	Do.
	Seebpore .	Do. .	16 ft. .	1 in 12 .	Do.
	Pretoria .	Do. .	15½ ft. .	1 in 10 .	Do.
	Nandi . .	..	15 ft. .	Do. .	Do.
Koithi .	Banksimula .	Grade I .	9 ft. .	Do. .	Bottom 8 ft.
	Seebpore .	Do. .	12 ft. .	1 in 12 .	Not now worked.
	Pretoria .	Do. .	10 ft. .	1 in 6 .	Do.
Dishergarh	Poidih* . .	Selected .	15 ft. .	Do. .	Full thickness.
	9 & 10 Pits Sodepur.	Do. .	17 ft. .	1 in 5·5 .	Do.
	Sitalpur . .	Do. .	14 ft. .	Do. .	Do.
	Parbelia .	Do. .	15 ft. .	1 in 7 .	Do.
	Deoli . .	Do. .	16 ft. .	1 in 4 .	Do.
	Burra Dhemo .	Do. .	10 ft. .	1 in 5·8 .	Do.
Sanctoria .	Sitalpore .	Do. .	10 ft. .	1 in 5·5 .	Do.
Chanch .	Chanch . .	Do. .	10 ft. .	1 in 6 .	Do.
Rana Pariharpore.	Adjai Second .	Grade I .	8 ft. .	1 in 10 .	Top 6 ft. 6 in.
Ghusick .	Damra . .	Do. .	12 ft. .	Do. .	Full thickness.
Mohuda Bottom.	Murulidih .	Selected .	Average 7 ft.	1 in 6 .	Do.
	Bhatdee .	Do. .	Do. .	1 in 4·5 .	Do.
No. 11 .	Bhuggutdih .	Grade I .	22 ft. .	1 in 10 .	Bottom 12 ft. 9 in.
	Ena . .	Do. .	24 ft. .	Do. .	Bottom 13 ft.
No. 12 .	Bhuggutdih .	Do. .	12 ft. .	Do. .	Full thickness.

* Temporarily closed.

Question 35.—At the following collieries the whole of the output is being obtained from pillar extraction or preparatory work preceding this operation:—

Damooderpore, Banksimula (Seebpore/Poniati seam), Nandi, Pretoria, Seebpore, Damra, Deoli.

The proportion of output obtained from pillars in the following mines is approximately as shown:—

	Per cent.	
Burra Dhemo . . .	60	
9 and 10 Pits Sodepur .	90	"All pillar-cutting suspended pending sandstowing arrangements."
Sitalpore	40	Sanctoria seam 75 Dishergarh seam 5
Chanch	10	
Ena	90	
Bhatdee	40	

At Murulidih, Adjai Second and Bhuggutdih, development work only is in progress. Banksimula 7 and 8 Pits are in course of sinking and Parbelia, Girimint and Dhobidih are temporarily closed down.

In the collieries working the Poniati seam and at Sodepore 9 and 10 Pits the percentage of pillar coal extracted amounts to 90 per cent., at Burra Dhemo, Chanch and Damra, over 90 per cent. and in the Sanctoria seam at Sitalpur where simultaneous sandstowing is carried on practically total extraction. At Ena conditions are very difficult and only the lower portion of 11 seam is graded so that anything like an accurate estimate cannot be given.

Question 36.—Without knowledge of the special conditions pertaining to every mine no estimate can be given.

Question 37.—As far as main lines important buildings and bridges and rivers are concerned in most cases the coal will be lost. Even if stowing were resorted to, however, a large proportion of such pillars will be irrecoverable as access is already closed. I do not know of any case in which compensation has been paid for coal under railway lines.

Question 38.—Sandstowing plants are already in operation at Sodepur 9 and 10 Pits, Sitalpore and at Parbelia while at the other collieries in general the introduction of sandstowing would limit productivity in proportion to the speed of sand supply. Little if any advantage would be gained in the matter of recovering coal in view of the small percentage lost by ordinary methods where the lay-out is properly planned.

Questions 39 & 40.—I am not in favour of any such general enforcement from the conservation point of view. The interests of royalty receivers and coal-owners and the conditions of mining

leases together with provisions under the Indian Mines Act against dangerous practices should be sufficient. Where sand is easily available the exigencies of the individual conditions dictate policy and elsewhere practical difficulties intervene.

Question 41.—Hydraulic solid stowing with sand is carried on in the Sanctoria seam at Sitalpore colliery simultaneously with pillar extraction and up to the present at 9 and 10 Pits Sodepur hydraulic stowing has been used to form barriers.

The costs asked for are as given below:—

	Sitalpur.	9 and 10 Pits Sodepur.	Remarks.
	As.	As.	
(*a*) Loading sand into tubs in river bed	·6	·8	
(*b*)	...	...	
(*c*) 1. By direct electric haulage from river bed and thence by endless rope haulage to bunker at pit mouth—total distance 4,000 feet	·8	...	The surface endless haulage also deals with coal.
2. By direct electric haulage from river bed and thence by aerial ropeway to bunker over bore-hole—distance 4,000 feet .	...	·9	
(*d*) Hydraulic stowing	...	...	Including pipes,
(*e*)	6·2	10·1	stores, labour and
(*f*)	3·1	3·25	plant depreciation.
	10·7	15·05	

The additional cost per ton of virgin coal I estimate to be annas 11 and that for coal from pillars already formed annas 13.

Question 42.—If a compulsory system of stowing were adopted the cost should be met by a cess on despatches levied on all coal.

Question 43.—If compulsory filling is introduced for purposes of conservation only a statutory authority will be necessary and its composition should include representatives of the royalty receivers, mine-owners and technical experts in the coalfield. In the case of safety measures only, the existing machinery of Mines Department and Mines Board is adequate.

Question 44.—As already stated in the answer to *Question 23*, no statutory authority is considered necessary for this purpose.

Question 45.—(*a*) Little or no saving as roof must be supported prior to stowing and the timber is not recoverable.

(*b*) With solid stowing fire stoppings are not required but partial stowing must for the present be experimental and as local falls of shale may be considered potential sources of danger panel barriers and stoppings of masonry or sand cannot be eliminated. In new workings laid out in panels the number of stoppings required as so small as to make any saving negligible.

(*c*) It should be possible to prevent further main roof breaks by stowing but in all the older properties now being worked existing goafs and surface breaks are the chief sources of water while the effects of dykes and faults penetrating porous and water logged strata cannot be greatly mitigated.

(*d*) In general no estimate can be given while in the particular collieries listed in this note a special survey would be required of the conditions in each mine to arrive at an accurate figure and this cannot be carried out in the time at my disposal. Access is already lost to some areas and others will be similarly affected before any suggested scheme of stowage can be put into operation but with the careful attention now given to the laying out of panels and the rotation of extraction, future losses are likely to be a very small proportion of the resources.

(*e*) Compensation for buildings and land not already damaged will not be incurred but the effect on working policy of such expenditure is dependent on the thickness, and quality of the seams involved so that the actual saving cannot be computed.

(*f*) As ventilation arrangements are governed largely by the lay-out of the workings and rotation of extraction of panels, stowing is not likely to have any material effect on expenditure.

(*g*) In normal conditions where existing pillars are of adequate size and sand can only be supplied to one limited district at a time output is likely to be reduced and any saving by concentration will be off-set by the effect of standing charges on lower production. In virgin ground with a lay-out specially designed for simultaneous extraction and stowing it would appear possible to arrange advantageous concentration but this is an individual problem for each property.

(*h*) No saving would be effected in actual winning costs.

Questions 46, 47 & 48.—In view of the uncertain future of the uses of coal no definition of coal of commercial value can be stated. Consumers may be presumed to be alive to their own interests and purchase the quality which suits their purposes to the best advantage. Restrictions imposed upon the working of seams for which there is current demand will have serious effects on royalty receivers and coal-owners whose capital investments will be indefinitely locked up without return.

Question 49.—This involves a definition of a fire area. Where active fire exists and cannot be efficiently dealt with thin strata between it and a seam in course of extraction below should not be disturbed and in such cases stowing of the lower seam may be necessary if working expenses are low enough to justify extraction of pillars by such methods.

Where comparatively small districts, however, have been adequately isolated on account of incipient heating and no actual fire exists stowing of the lower seam would not be necessary provided adequate lines of isolation stoppings are maintained in both

seams to enable any subsequent heating to be completely isolated. Where the parting between the seams is thick no danger is apprehended.

Question 50.—I do not consider this justifiable. At great depths no serious damage is likely to occur where seams are not thick and at shallower depth the cost of operations should be the deciding factor.

Question 51.—If it is made compulsory to remove coal from under railways and sidings by means of stowing in future operations a contribution should be obtained from the railway companies. At present they enjoy uninterrupted service and freight receipts and as public carriers they have duties towards freight payers from areas not immediately concerned with coal extraction. In the case of assisted sidings also the land has been acquired at the coal owners' expense and if the method of support is to be arbitrarily laid down the railway organisations will be relieved of all question of compensation for coal locked up and should be called upon to assist in bearing the cost.

Question 52.—Where there is sufficient thickness of superincumbent strata partial filling should be adequate but there are practical difficulties in devising suitable methods.

I understand that successful partial stowage has been carried out at Amlabad but have no first-hand experience of it.

Question 53.—Financial assistance will also be required with regard to actual stowing and all operations connected with it as the cost of pumping and provision and maintenance of pipes especially when distances are great constitute a very large proportion of the expenditure.

Question 54.—Any additional provisions made in the interests of safety should be universal but as the future uses of coal can only be conjectural statutory control if applied at all should be confined to conservation of only those limited resources at present considered essential to particular key processes, such as coking coal for iron and steel manufacture.

Question 55.—As far as I understand resources of coking coals are the only object for consideration of immediate importance and provision against the effects of spontaneous combustion in other seams should be left to the application of methods devised to meet each case under existing legislation.

The term "avoidable" is ambiguous but the prevention of waste is an object to be desired. As already explained, however, the future importance of various classes of coal cannot be foreseen and arbitrary powers with regard to mining policy vested in a small body of control cannot but adversely affect the industry.

Question 56.—Provision whereby boundary adjustments could be carried out without incurring the payment of *salami* to superior landlords would be of advantage but this might entail legal difficulties with the terms of mining leases granted by the original holders

of mining rights in respect of outstroke working. I do not think that compulsory amalgamation is practicable and in any case such interference with individual rights cannot be justified.

Question 57.—Where the seams are close together this practice is not to be commended as the ignorance of one owner of the policy and operations of another may result in damage to valuable property and danger to those working in one seam from collapse, fire or flood in others. Where seams are separated by thick strata no danger is likely to occur and in certain cases where boundaries require adjustment after working has already been started the condition is unavoidable. Existing legislation in any case gives the Chief Inspector of Mines access to the workings and plans and power to prohibit dangerous methods of working subject to an appeal to Mines Boards.

Question 58.—In principle it is advisable for a manager of a mine to have independent charge of the two outlets and more so that the outlets should at least be situated in property held by one owner.

Exception must, however, be made of existing mines where workings with a single shaft are connected to an adjoining colliery of large extent such that single management would produce a large and unwieldy unit while considerations of surface organisation and the position of railway sidings militate against economical and efficient working. Such exception presupposes common ownership, close co-operation between managers and preferably an agent for the connected mines. Whenever possible, however, additional shafts should be sunk to comply with the principle stated.

Question 59.—The Mines Department already has access to working plans and powers of inspection of underground workings and I do not think it necessary for any authority to be vested with further powers or for legislation to be extended on the lines suggested.

Question 60.—In my opinion the stowing of surface buildings, etc., on the working plan would eliminate all need for the separate tracing required by Regulation 15 (3) and would be preferable.

Question 61.—As necessity is the mother of invention considerations of economy and available supplies will bring their own developments in the more efficient use of coal. Forecasts of future requirements can only be speculative and the only practical solution is a fuel research board available for consultation but without powers of control over the policy of the industry.

Question 62.—As a result of the purchasing of coal largely on Grading Board certificates by the larger consumers certain seams falling slightly short of requirements for a particular grade may be left untouched if the current selling price of the lower grade does not justify the working expenses likely to be incurred. There is no certainty, however, that in the absence of grading such seams would have found any ready sale. As an off-set the standardising of products by ensuring the quality of supply has probably assisted

continuity of working in many collieries where shutting down would have involved permanent loss, and the operations of the Board have been of the greatest help to the industry in obtaining both foreign and domestic markets.

Question 63.—Coal mining at any depth from the surface on a large scale is a young industry in India compared with Great Britain while skilled, educated labour and supervision are not obtainable on a comparable scale.

Methods of working and their control have necessarily developed rapidly and this is in my opinion the reason for any apparent discrepancy between the need for interference by the Mines Department in the two countries.

Oral Evidence.

My evidence refers primarily to the Raniganj field.

Question 2.—The existence of fires has been brought to the notice of the public more in recent years, but I cannot say whether there have been more fires in recent years than in the past.

Question 3.—"Incubation" means "the period between the first heavy fall of roof in a goaf up to the first evidence of heating". The period of incubation varies with the amount of ventilation.

Question 5.—The panel barriers refer to information obtained from outside and are approximating 120 feet thick at 1,200 feet depth and the figure of 20 per cent. is from actual calculation. In the mines under my supervision the normal output from one panel is about 200 tons a day and at this rate the panels are designed to last about two years. The period of working is more important than the size of panels as the latter can be arranged for much larger daily output. Without stowing fire may occur within a panel. Between 15 per cent. and 30 per cent. of the available coal in a panel may be lost in the barriers if stowing is not adopted. The panel system makes for safety but not for conservation apart from the general protection of the property.

Question 6.—I have no modifications to suggest. As long as a right of appeal is upheld I have no objection to Section 19 (2) being made permanent.

Question 7.—I would prefer mechanical ventilation ordinarily, and that preference would increase with the presence of fire.

Question 9.—I agree that this would be desirable where it is practicable and also that it should be required by legislation in such cases.

Question 10.—I am of opinion that only senior men would be able to use these instruments, but I agree that the type of employees referred to by me could be adequately trained to use such instruments for all practical purposes.

Question 16.—Where breaks occur to the surface gas will escape through the break and stowing would not be necessary.

Questions 19 & 20.—As a mining engineer I would agree to general principles of working based on size of pillars, galleries, etc., being laid down by law or regulation, with provisions for exceptional cases.

Question 21.—I would now agree to this with provisions for special requirements.

Question 23.—This would be necessary only if no general principles of working were laid down as in answer to *Questions 19* and *20*.

Question 24.—My view as to the necessity for legal conservation is not based on a study of the Geological Survey Department's figures. The future of coal is so speculative that I do not think that any conservation is justifiable at present.

Question 26.—I have no personal experience of it, but my information is that this is what happened in Bagdigi.

Question 30.—I think that the shots should be fired either by a sirdar or by some one having special " shot-firer's " certificate.

Question 32.—There should be control where the manufacturer of the powder is on the colliery and the powder is issued in his store and not from the mines store.

Questions 33 & 34.—Coal remaining in Bhuggutdih and Ena is of lower grade and unsaleable at the moment. In Ena what is left is being lost.

Question 38.—If productivity means the amount of coal to be eventually won from the mine, then the introduction of sand-stowing would increase both productivity and life to the extent of the proportion now being lost.

Questions 39 & 40.—I consider that the interests I have mentioned have been sufficient in the past to secure conservation and will be sufficient in the future, as I do not find any case for general conservation.

Question 41.—The costs of 10·7 and 15·05 annas are per ton of sand. The cost of 13 annas for pillar coal is for areas from which 20 per cent. was taken out in the first working. The high cost of stowing for 9 and 10 pits Sodepur is due to the fact that the sand is used in building barriers in various parts of the mine requiring the transference of the underground plant.

Question 42.—The cess should be recovered along with railway freight.

Question 43.—I have no objection to representation of the Mines Department on the statutory board.

Question 45.—There will be a saving in pumping costs and in compensation for buildings in future workings if surface breaks do not occur.

Question 48.—It is impossible to define the term "coal of commercial value", and a definition if framed would be of no use for conservation or commercial purposes. If it was proved

that conservation was necessary in the national interests, the restriction contemplated in *Questions 46* and *47* would be justified.

Question 49.—A sealed-off fire area remains a fire area as long as it is not established that there is no fire.

Question 55.—I accept the definition of " avoidable waste " as all waste which is not incidental to the system of mining which is followed.

Question 62.—The advantages of grading exceed the disadvantages. Sectional working has increased and the coal left is usually lost. If there is no grading, there is no guarantee to the internal consumer that he is getting graded coal.

Question 63.—The necessity for control in India is greater than in England, because labour in India is less skilled and less educated and the industry has developed more rapidly.

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14. Written Evidence of Mr. C. E. Ashcroft, Agent and Manager of Sunkerpore Colliery, Burdwan District.

Question 1.—I am Agent and Manager of Sunkerpore colliery and Agent of Pottery colliery, Raniganj, and Gulfarbari colliery, Mugma, belonging to Messrs. Burn & Co., Ltd. I have had 25 years mining experience in the Raniganj coalfield.

Question 2.—In my opinion the main cause of underground fires in coal mines in India is spontaneous ignition of the coal. The number of fires has increased in recent years; more fires have been caused by normal than by premature collapses.

Question 3.—I am not in a position to state the liability of the seams in this coalfield to spontaneous combustion as I have only experience of fires in the Sunkerpore seam. The period of incubation varied from one year to one year and six months. I do not consider that any seam of commercial value is free from the risk of spontaneous combustion.

Question 4.—I agree that fires increase considerably the difficulties and dangers of extracting the remaining coal and that these difficulties and dangers become greater at the final stage of pillar extraction and as one seam after another, lying close together, is removed.

Question 5.—I am in favour of new workings in seams, known to be liable to spontaneous combustion, being laid out in a system of panels. The percentage of coal to be left in the barriers, without stowing, would depend on local condition.

Question 6.—I consider that the Temporary Coal Mines Regulations are adequate against all possible dangers from fires.

Question 7.—All mines or seams, in which there are sealed-off fires, should be mechanically ventilated and in cases where there

is a possibility of air getting to the sealed-off area from the surface, the fan should be forcing.

Question 8.—I consider that the extraction of a section of a seam, leaving the remainder of the seam broken up in the goaf, increases the risk of spontaneous combustion, but I do not know of any fires that have been due to this cause.

Question 9.—I do not consider that the provision of taps on water mains or portable water tanks should be required by law in coal mines.

Question 10.—I am not in favour of telephonic communication being required by law between remote parts of mines and the surface.

Question 11.—I do not consider any other precautions are required in mines in which there are fires.

Question 12.—Training in the methods of dealing with underground fires, and the dangers that may arise from them, should be given to all persons working at the proposed mine Rescue Stations, in addition to the ordinary training in mine rescue work.

Question 13.—Breathing apparatus is very useful in dealing with mine fires.

Question 14.—I do not consider that any extension of Temporary Regulation No. 14 is necessary.

Question 15.—Precautions against fires occurring are better than precautions after they have occurred.

Question 16.—From the point of view of safety and in order to prevent fires in goaves, filling or packing with sand or other suitable material should be enforced during the extraction of pillars in seams which give off inflammable gas, because of the danger of accumulations of such gas in the goaves being expelled into the workings by falls of roof.

Question 17.—I consider the premature collapse of workings is mainly due to insufficient support being left in the first workings.

Question 18.—Inrushes of water and gases may arise from such premature collapses and there is always the danger of injury and loss of life, both on the surface and underground. Such collapses may be prevented by leaving sufficient support in the first workings.

Question 19.—I am not in favour of minimum dimensions of pillars and maximum dimensions of galleries being laid down by law.

Question 20.—(*Not answered.*)

Question 21.—I am not in favour of the legal prohibition of "splitting" of pillars, reduction of pillars or heightening of galleries except immediately before the systematic extraction of pillars.

Question 22.—The restrictions on the number of sections, the dimensions of the pillars and galleries and the minimum "parting" between sections would depend on local conditions.

Question 23.—I am not in favour of a statutory authority being set up with powers to give sanction to or withhold sanction from a system of lay-out of workings and I am not in favour of all systems of lay-out in new workings being first submitted to such an authority.

Question 24.—The Mines Department have adequate powers to enforce the packing or partial packing of galleries in order to ensure stability and prevent premature collapses.

Question 25.—I do not know of any dangerous irruptions of water into mines from the surface or elsewhere.

Question 26.—Such irruptions may become highly dangerous, if they enter fire areas, by the water generating gases and an inflammable mixture of gas and air, which may penetrate the mine workings.

Question 27.—The removal of such dangerous accumulation of water from the proximity of mine workings should be enforced by law, if necessary.

Question 28.—I do not consider any changes necessary in the Permanent and Temporary Regulations regarding shot-firing.

Question 29.—I am not in favour of the extended use of "permitted" explosives on the lines in force in British coal mines.

Question 30.—I am in favour of shot-firers in coal mines being certificated after examination.

Question 31.—I consider that the proviso to Regulation 106, which gives the Chief Inspector of Mines power to allow more than five pounds of explosives to be kept in one place at one time, should be retained.

This permission is necessary in some cases in order to facilitate work.

Question 32.—I have no suggestions to offer regarding the issue of explosives.

Question 33.—The following seams are being worked in the collieries for which I am responsible—the quality in each case is Second Class:—

Sunkerpore seam, 33 ft. 6 in. thick, inclination 1 in 16.

Raniganj seam, 22 ft. thick, inclination 1 in 6.

Gulfarbari seam, 13 ft. thick, inclination 1 in 9.

Question 34.—In the Sunkerpore seam the bottom 17 ft. is being worked at Sunkerpore colliery.

In the Raniganj seam the bottom 17 ft. is being worked at Pottery colliery.

In the Gulfarbari seam the top 9 ft. is being worked at Gulfarbari colliery.

Question 35.—No pillars are being extracted from these collieries at present.

Question 36.—I regret I am not in a position to form an estimate in this case.

Question 37.—In my opinion all coal locked up under railways, rivers, buildings, bridges, etc., will be lost, for practical purposes, without stowing.

I do not know of any instances in which compensation for coal left under railway lines and siding has been paid under the Land Acquisition (Mines) Act.

Question 38.—In the collieries of which I have experience I estimate that about 30 per cent. more coal could be extracted with stowing than without it.

Question 39.—I am in favour of the enforcement of a system of filling or packing by sand or other incombustible material simultaneously with the extraction of pillars.

Question 40.—To areas where it is necessary to prevent surface subsidence and in seams being worked below seams already worked, in which dangerous conditions exist.

Question 41.—I have had no experience at any mine I have managed or controlled in India of hydraulic or hand stowing.

Question 42.—I regret I have no suggestion to offer.

Question 43.—I do not consider that a statutory authority should be set up with power to define the areas or seams in which pillars should only be got by a process of filling.

Question 44.—Nor with power to give or withhold sanction to a proposed system of new workings as suggested in *Question 23.*

Question 45.—I regret I am unable to give the details asked for in this question.

Question 46.—The extraction of a section of a seam so as to render unworkable the remainder of a lower grade, but still of commercial value, should be prevented.

Question 47.—The extraction of a lower seam in such a way as to render unworkable an upper seam of commercial value should be prevented.

Question 48.—I would define a seam of coal, which is of use for commercial purposes, as being of commercial value.

Question 49.—I consider that pillars in a seam below a fire area in an upper seam, or below a goaf connected with such a fire area, should only be extracted by a system of simultaneous filling.

Question 50.—I do not consider that mine-owners should in all cases be required to remove coal from under railway sidings, villages, rivers, etc., by a system of simultaneous stowing.

Question 51.—(*Not answered.*)

Question 52.—I do not consider that complete filling should be insisted on in all cases. I cannot give any instances in which partial filling has proved successful.

Question 53.—If compulsory stowing is introduced I consider financial assistance in the actual stowing will be necessary in addition to the free delivery of sand at the colliery.

Question 54.—Statutory control over mining methods should be applied to the working of all coking coal.

Question 55.—Stowing should be made compulsory for the conservation of coking coal. Avoidable waste should be stopped whenever it occurs.

Question 56.—Where properties are too small or so badly shaped as to make it difficult to work them safely and economically, steps should be taken to compel the owners to amalgamate properties or readjust boundaries without having to pay *salami*.

Question 57.—I do not approve of one owner possessing the rights to and working a seam or seams directly above or below other seams being simultaneously worked by another owner and lying within the boundaries of the same leasehold. Such an arrangement might give rise to collapses and inundations of water and the introduction of gases and fire from one seam to another. Amalgamation of interests might be a suitable remedy.

Question 58.—I do not consider it necessary for the Manager of each mine to have sole and independent charge of the two shafts, provided the two shafts belong to the same owner.

Question 59.—I am in favour of mine-owners, working adjacent properties, being required by law to make and maintain joint surveys, so as to secure a check on the barriers between such properties. I do not consider it necessary for such statutory authority, as referred to, to have power to survey barriers between adjoining mines.

Question 60.—In addition to being required to maintain a tracing showing surface buildings, etc., under Regulation 15 (3) mine-owners should also be required to show such buildings on the plan of the underground workings.

Question 61.—There are possibilities in the direction of adapting railway locomotives and industrial plants to the use of inferior coal and also for the use of such coal for the manufacture of soft coke.

Question 62.—I have no experience of working mines under the Coal Grading Act, 1925.

Question 63.—In my opinion the necessity for the issue of the number of notices referred to is due to the Indian Mines Act in its original form not being as comprehensive as the British Mines Act.

Oral Evidence.

All my evidence, both written and oral, is with primary reference to the Raniganj coalfield.

Question 5.—In my experience 20 to 25 per cent. of coal would have to be left in panel barriers. This refers to coal worked at a depth of at least 100 to 150 feet.

Question 6.—I would have no objection to section 19 (2) being made permanent.

Question 7.—My point about the fan being forcing is that the gas formed in the fire area in the case of leakage from stoppings would not be drawn into the mine; with the forcing fan the chances are the gas would not be in the mine when the fire is discovered.

Question 9.—I think that the provision of a supply of water in the manner contemplated would be desirable and should be enforced by legislation provided the application of that legislation was made discretionary.

Question 10.—I am in favour of the suggestion in this question within the limits of my reply to *Question 9*.

Question 14.—Assuming that Temporary Regulation No. 14 only applies where fires are already started, I agree that its operation should be extended to conditions before any fire has started.

Question 19.—I now agree to minimum dimensions of pillars and maximum dimensions of galleries being laid down by law or regulation under the control of the Mines Department, provided the Chief Inspector of Mines is given powers to vary these dimensions in special circumstances. I think also that there should be a right of appeal from any such decision of the Mines Department.

Question 21.—If regulations are introduced as suggested in my reply to *Question 19*, then provision may be made to allow the 'splitting' of pillars and heightening of galleries to a distance not exceeding two pillars ahead from the point of pillar extraction.

Question 29.—I have no experience of the use of 'permitted' explosives, but I object to their compulsory extended use on grounds of cost.

Question 30.—I mean after examination by the Mines Department.

Question 33.—The coal in the Sunkerpore and Raniganj seams would probably be on the border line between grade (I) and grade (II) of the Grading Board. The coal in the Gulfarbari seam would be grade (II). Most of our production is used in our own potteries and factories. About 20 per cent. is sold in the market. It is despatched to Calcutta and I do not know to what particular uses it is put. I would personally like to sell more of this coal, but think that we are selling up to the limit of the demand for the quality of coal.

Question 34.—We have always worked in the sections stated in order to get the best available part of each seam. The annual output from all the three seams is about 150,000 tons.

Question 38.—As regards the present expectation of the life of my collieries, I would expect this to be increased by sand-stowing by at least 50 per cent.

Question 50.—What I mean is that mine-owners should not be required to remove such coal unless this can be done as a commercial proposition, and not merely for purposes of conservation.

Question 54.—I think that statutory control should be limited to coking coal, because the reserves of that class of coal are comparatively small. If the industries or other consumers who at present use coking coal for steam purposes were not able to obtain coking coal, they would be compelled to use the inferior qualities of steam coal which so far as I am aware are very large. It is also of course possible that, when such reserves of coking coal approach exhaustion, the iron and steel industry would be compelled to look around for some other method of smelting iron ore than by using coking coal.

Question 55.—By " avoidable waste " I mean any waste which is not incidental to the system of mining which is followed.

Question 59.—I am in favour of the proposals in this question, but think that it is unnecessary to set up a statutory authority for the purpose and that the necessary checks should be done by the Mines Department.

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15. Written Evidence of Mr. M. M. Mukherji, General Manager and Agent, Martin & Co.'s Collieries (Kalipahari and Asansol Group).

Question 1.—(*a*) General Manager and Agent of Messrs. Martin & Co.'s collieries (Kalipahari and Asansol group).

(*b*) 29 years in Raniganj and Jharia coalfields.

Question 2.—(*a*) Large quantities of coal left in goaves.

(*b*) Yes.

(*c*) By normal collapses.

Question 3.—(*a*) Seams rich in volatile and low in " ash " such as—Dishergarh, Poniati seams in Raniganj and XIV seam of Jharia field.

(*b*) Very difficult to specify. May vary between 8 and 18 months, depending to a great extent on the quantity of coal left and that of air passing through the goaves.

(*c*) No.

Question 4.—(*a*) Yes. (*b*) Yes.

Question 5.—(*a*) Yes.

(*b*) Eventually about 15 per cent. to 25 per cent. of the seam has to be left in barriers—percentage varies with depth and thickness of seams.

Question 6.—(*a*) Provided that the working of the graded section or sections only of any seam and deliberately making the remainder irrecoverable be prohibited by legislation, I consider the Temporary Regulations to be adequate.

Question 7.—(*a*) Yes. (*b*) Forcing.

Question 8.—(*a*) Yes.

(*b*) Many of the fires in Raniganj and Jharia coalfields may be attributed to this cause.

Question 9.—(*a*) No.

Question 10.—(*a*) Yes, preferable. But should not be made compulsory.

(*b*) Beyond 2,000 feet from shaft bottom.

Question 11.—(*a*) Temperature, and the humidity of the mine air should be recorded once in every 24 hours, and immediate action should be taken, if they indicate anything abnormal. Additional materials for building stoppings should also be kept ready for strengthening or repairing old stoppings.

Question 12.—(*a*) Yes.

Question 13.—(*a*) These used by trained men should be of great help.

Question 14.—Almost all coal being more or less liable to spontaneous combustion this regulation cannot be extended with fairness to all mines in anticipation of fire.

Question 15.—(*a*) Precautions in advance are certainly better but the possibilities of fire should be the guiding factor.

(*b*) Panel system; stocking of materials for sealing the panels and retreating from the dip at the time of extraction followed by flooding wherever possible.

Question 16.—(*a* & *b*) Should be enforced in very thick seams with hard sandstone roof, where the local falls do not take place immediately after the extraction of pillars almost filling up the hanging goaves.

Question 17.—Due to too small pillars for the weight of the superincumbent strata, thickness of the seam, the nature of the coal and the main fall in large area not taking place in time.

Question 18.—(*a*) In addition to the loss of life and materials directly due to such collapses further damage may be caused, by air blast fires, and inundation and further collapses due to incomplete subsidence may also take place in the future.

(*b*) May be prevented by making and maintaining properly sized pillars and securing the too wide galleries by timbering or brick work.

Question 19.—No, because the conditions vary.

Question 20.—(*a*) In view of my preceding answer—it does not arise.

(*b*) Factors—Depth of the seam from surface, thickness of seam, nature of the seam (strength), the condition of the superincumbent strata and the seams above, gradient of the strata and the nature of roof and floor stones.

Question 21.—Splitting of pillars and unreasonable widening of galleries should not be allowed. But in the matter of heightening of galleries (to the extent they can be secured by props) there should be no interference.

Question 22.—There should be no restriction about the number of sections. The height of galleries in each section worked one above the other where it becomes necessary to work in sections) should not exceed 20 feet with a minimum parting of 5 feet.

Dimensions—of pillars and galleries—to be governed by the factors stated in *Question 20.*

Question 23.—Not necessary.

Question 24.—In view of my preceding answer this question does not arise.

As under Act XI of 1936, section 19, sub-sections 1 and 2, the Chief Inspector of Mines has sufficient powers to stop any dangerous thing or practice subject to the right of the mine owners to appeal to the local Government no special statutory authority for this purpose is required.

Question 25.—Yes; at Phularitand, Ramnagar, Bagdigi and Jamadoba. For correct details, the Chief Inspector of Mines' Annual Reports may kindly be referred to.

Question 26.—Yes—they do.

Question 27.—(*a*) Adequate arrangements should be made for prevention of collapse of such areas and sufficiently strong embankments should be raised well above the highest flood level. Cutting of drains and filling of cracks for preventing entry into the mine of rain water and the over-flow water from the ground tanks are necessary. Arrangements should be made for watching the embankments when the rivers start rising abnormally.

Question 28.—I am unable to suggest any addition.

Question 29.—No; the supplementary Regulations under Notification No. M. 1055 ensure enough safeguard.

Question 30.—Yes.

Question 31.—Should be retained; there may be special circumstances when it may be necessary to stock and carry more than 5 lbs. of other explosives.

Question 32.—Safeguards provided by the law appear to me to be enough.

Question 33.—(*a*) Ghusick and Nega seams.

(*b*) *Ghusick seam.*—In quality this is one of the few best in India—thickness 10 to 11 feet. Inclination 1 in 10.

Nega seam.—First grade—as per specification of the Grading Board—thickness 14 to 16 feet. Inclination 1 in 10.

Question 34.—(*a*) Whole of the seams except about 1½ feet of coal which has to be left for the protection of the shale roof.

(*b*) *Ghusick seam*—one characteristic band in the middle varying between 2 inches and 10 inches.

Quality—all through practically uniform.

Nega seam—3 to 5 shale bands of varying thickness.

Quality—top half is better than the lower.

Question 35.—(*a*) At present about 20 per cent.

(*b*) Under ideal conditions almost the whole of the seam can be extracted. Without taking into account the pillars already buried by falls of roof we are recovering about 90 per cent. of coal standing in pillars.

Question 36.—Without taking into account the losses in barriers, about 75 per cent. of the pillar coal may be recovered on average from seams up to 15 feet in thickness and about 50 per cent. from seams 16 to 30 feet thick. On the other hand, including losses in barriers only half of this quantity may be considered recoverable under the existing conditions of the mines. I do not find anything objectionable in the existing methods, specially in consideration of the present market conditions.

Question 37.—(*a*) Yes.

(*b*) Heard of 2 cases in Jharia in which the East Indian Railway had to pay about Rs. 1,80,000 as compensation to the owners of North Burrakar Coal Company, Limited, in addition to Rs. 84,000 to the royalty receivers and Rs. 96,000 to Seth Khora Ramji for coal lock under the railway yard, Jharia.

Question 38.—It would make no remarkable difference.

Question 39.—Simultaneously with the extraction of pillars.

Question 40.—(1) Where there is fire or water in the upper seam and the workings are liable to be affected by premature collapse.

(2) In very thick seams which cannot be worked except by "sections" and in which fire exists.

(3) In seams of coal suitable for manufacturing good metallurgical coke either singly or by suitable admixture.

(4) Where valuable or dangerous surface has to be protected.

Question 41.—I have no experience.

Question 42.—The actual difference of cost of stowing and that of the ordinary methods in vogue should be met by levying taxes on all coal despatched from Indian collieries at differential scale based on the qualities of the coal mined. This is necessary for

helping the sale of non-caking and inferior coal the reserves of which are enormous. Otherwise all consumers will want to have the best coal available in the market and thus hasten the exhaustion of this very valuable but limited national asset. On the other hand, the amount of tax should not be such as to make it impossible for the Indian coal to compete with the foreign coal or any other kind of fuel. The bulk of the leviable tax should be realised from the consumers along with the railway freight and a small proportion from the royalty receivers. The tax realised from the consumers will have the indirect effect of taxation on the colliery owners; so there is no need to tax them separately.

Question 43.—(*a*) Yes, a statutory authority should be set up with powers to define the areas or seams in which pillars should be got only by a process of filling and to grant adequate relief to the colliery owners affected thereby.

(*b*) The statutory authority should be constituted of the nominees of the Government, the colliery owners, the royalty receivers and the colliery managers' organisations in equal proportion with a nominated chairman other than an officer of the Mines Department.

Question 44.—No.

Question 45.—I have no experience.

Question 46.—Yes.

Question 47.—Yes.

Question 48.—It is difficult to lay down a permanent definition of "commercial value"; the coal regarded to be inferior and of no value to-day may be of very great value with the improvements of known methods or discoveries of new ones for the treatment and utilisation of all such coals and their bye-products in the future.

Question 49.—Yes.

Question 50.—Yes; but the mine owners should be compensated for any losses suffered on this account.

Question 51.—In cases of railway lines and railway-owned sidings the railway administration should be made to bear the extra cost for extracting the coal otherwise required to be left for the protection of all such lines.

Question 52.—Partial filling in 8 to 10 feet thick seams may do—but in thick seams this does not seem to be satisfactory. Records of Amlabad may be consulted.

Question 53.—Under favourable conditions only free delivery of sand at the colliery may balance the extra cost required to be borne by the owners for sand-stowing. But in some cases additional financial assistance will be necessary.

Question 54.—For the purpose of ensuring safety the existing Mines Act, Rules, Regulations, Bye-laws and special Regulations enacted of late, are sufficient and there is no need for any more statutory control. But for the purpose of conservation of coal

of the metallurgical quality (singly or as a mixture) statutory control should be exercised without delay. The control for this purpose should be universal.

Question 55.—(*a*) Stowing should be adopted both in Bihar and Bengal coalfields for avoiding any waste of caking coal down to No. 10 seam of Jharia and of the coals in Bengal which may be very helpful in manufacturing good hard coke from inferior grade caking coal of Jharia and Hazaribagh.

(*b*) Yes.

Question 56.—Amalgamation of small and badly shaped properties, if permitted by the " Laws of Equity ", would solve many of the unnecessary and uneconomic problems. In any case exchange of small areas or transfer of these on reasonable payment where the coal in such area has to be irretrievably lost (due to the presence of thick dykes or big faults) if not worked from the mines contiguous to such areas, should be made compulsory.

Question 57.—(*a*) No.

(*b*) The fault of one owner in such case is bound to affect the other and none of them is likely to take the same interest as one owner for all the seams would have done.

(*c*) If sand-stowing, amalgamation or adjustment of interests be not possible, the State should take over the control of such properties.

Question 58.—Both the outlets required for working each mine should be under the control of the manager of the mine. Two or more small contiguous leaseholds under separate ownership, may be allowed to be worked by at least two outlets if they are interconnected and are placed under the sole charge of one manager.

Question 59.—(*a*) Yes.

(*b*) Department of Mines should be authorised to do this.

Question 60.—Yes.

Question 61.—It is extremely desirable that coal best suited for any particular purpose should be allowed to be used only for such purposes. If it has been possible for Germany and Japan to run their express trains with coals equivalent in quality to the coals for cokemaking and other purposes there is no reason why by adequate researches, the suitability of the different varieties of the Indian coals cannot be ascertained and their utilisation regulated by a lawfully constituted authority.

Question 62.—(*a*) Extraction of only the Graded portion or portions of coal seams leaving the remainder in the mine to be lost for ever. This has also been the cause of many fires in both fields.

(*b*) For obvious reasons I am unable to mention the name of any colliery; but the instances of this will be found on enquiry, to

be many particularly in No. 10 seam of Jharia and in the Sathgram and Kajora seams of Raniganj coalfield.

Question 63.—Very hard to compare and explain. The chief reason perhaps lies in the difference of geological conditions of the coal measures in the two countries.

Oral Evidence.

Question 5.—15 to 25 per cent. will be lost.

Question 6.—I am agreeable to new section 19 (2) being made permanent with the exception of sub-section (*b*) relating to the dimensions of galleries.

Question 7.—I think the ventilation may be either forcing or exhausting with reference to the position of the fires.

Question 14.—What I mean is that the Regulation should not be extended to those mines in which the seams are less liable to spontaneous combustion.

Question 19.—I agree that the minimum dimensions of pillars and the maximums of galleries may be prescribed by law or regulation provided the Chief Inspector of Mines is also given discretion to vary those dimensions in special circumstances. There should also be a right of appeal.

Question 21.—I am now in favour of the legal prohibitions proposed provided that the words " beyond the prescribed limits " are added after the word " galleries " in the question.

Question 29.—I agree that the use of " permitted " explosives makes for safety, but I would not prescribe their use universally. My experience is that using " permitted " explosives adds Annas 6 per ton to the cost of coal as compared with ordinary explosives. In the particular case I have in mind, the blasting was being done of a stone band. Under the same conditions the cost of " permitted " explosives would always be double those of ordinary explosives.

Question 35 (*b*).—Taking into account the pillars lost by falls of roof, the average percentage of recovery of pillars would not be more than 60 per cent.

Question 36.—What my answer to this question means is that, taking into consideration losses in barriers, half of the total quantity of the coal standing in pillars will be recovered with the existing methods.

Question 38.—My answer refers only to the comparatively thin seams which are being worked in my collieries.

Question 40.—I should like to add to my answer to *Question 40* another condition namely " where there are workable seams of coal above ".

Question 42.—I do not think that there should be any difficulty in the railways collecting a cess along with railway freights at a differential scale based on quality. I think that royalty receivers should be required to contribute only in those cases in which the life and productivity of their collieries will be increased by sand-stowing. In my particular case, royalty receivers will not receive any more royalty than they are receiving without sand-stowing, but there are cases in which they will receive considerably more royalties. As regards foreign coal, I agree that if a countervailing import duty equivalent to the cess is imposed on foreign coal, this will meet the situation as it will leave Indian and foreign coal relatively in the same position as they are now.

Question 43 (b).—The nominated Chairman I had in mind was an administrative officer of the Civil Service. I think that there should be a representative of the Mines Department on the statutory authority as a member. I also think that the various diverse interests which I propose should be represented on the statutory authority would be sufficient to prevent any combination of the industry and trade to prevent anything useful being done.

I think that a representative of labour is not necessary for this purpose because it will be a technical committee.

Question 48.—I do not think that either a permanent or variable definition of "coal of commercial value" is possible. I regard all coal as being of commercial value taking into account the possibilities of its future use.

Questions 50 & 51.—I think that if such coal is required to be recovered, mine-owners should be given the extra cost of sand-stowing. I think also that the whole of this extra cost should be paid by the railways because they will escape their liability for compensation on coal which should otherwise have to be left behind. This would not apply to colliery sidings.

Question 55.—To define the coals of the latter category the result of the tests made by the staff of some private coke plants should not be taken as final.

Further development of solid areas of all good coking coals should be stopped as soon as possible and to meet the present needs of the country only those pillars which are likely to be lost by collapse or fire should be worked first.

Question 59 (b).—The surveying staff for Mines Department should be increased if necessary for this purpose.

Question 61.—My idea for the conservation of coking and other coal required for particular industrial purposes is that a Trust should be formed on the lines of the Calcutta Improvement Trust. This Trust would be empowered to raise loans in order to supply funds for buying out the interests of those collieries producing these qualities of coal. I do not think that the cost would be so great as most people seem to think.

16. Written Evidence of Mr. A. G. Mackay, Colliery Agent, The Bengal Iron Co., Ltd.

Question 1.—(*a*) I hold the appointment of Agent.

(*b*) I have 25 years' experience of mining in India.

(*c*) In Jharia and Raniganj coalfields.

Question 2.—(*a*) Spontaneous combustion.

(*b*) Yes.

(*c*) Premature collapses have contributed to the cause of underground fires where this has occurred before complete pillar extraction.

Question 3.—(*a*) The seams of the Raniganj coalfield are more liable to spontaneous combustion than those of the Jharia coalfield.

(*b*) The incubation period may vary from 18 months to 2 years or longer.

(*c*) No. To define the commercial value of a seam is difficult.

Question 4.—(*a*) Yes. (*b*) Yes.

Question 5.—(*a*) Yes. The lay-out of workings in a panel system has advantages.

(*b*) This would depend to some extent on the thickness of the seam. For average thick seam of say 14 feet it might be necessary to leave 9 to 10 per cent. for barriers.

Question 6.—Yes.

Question 7.—(*a*) Yes. In my opinion all mines should be mechanically ventilated.

(*b*) Exhausting Fan.

Question 8.—(*a*) I do. (*b*) Yes.

Question 9.—Yes.

Question 10.—No. I am not in favour of telephonic communication being required by law. In my opinion few of the mines in either coalfield are extensive enough to warrant their introduction.

Question 11.—Observance of sections 29 and 31-A of the Indian Mines Act, 1923 (IV of 1923), as amended by the Indian Mines (Amendment) Act, 1936 (XI of 1936), Temporary Regulations for Coal Mines, and every part of a mine in which there is a fire or in which there is believed to be a fire should be effectively sealed or dammed off both below ground and as far as practicable also on the surface, from any working part of the mine.

The area sealed or dammed off should include all goaves or broken strata connected with the fire, whether in the same seam or another seam.

Question 12.—Yes.

Question 13.—At all mines where there is any likelihood of underground fires a supply of breathing apparatus and gas masks should be available. All persons employed in the sealing off or the buildings of fire stoppings adjacent to any fire area should be in possession of such safety appliances as a protection.

Question 14.—Yes.

Question 15.—(*a*) Yes.

(*b*) "Efficient Mining" underground workings to be laid out in such a manner that each area will be isolated from each another by panels in the form of coal barriers or by fire stoppings, this will prevent underground fires spreading.

Question 16.—(*a*) No.

Question 17.—(*a*) To insufficient support.

Question 18.—(*a*) Loss of life due to surface subsidence.

(*b*) Loss of coal due to pillars being over-ridden.

(*c*) Underground fires arising from spontaneous combustion due to coal being buried under the roof fall.

(*d*) Perhaps property (surface).

(2) Premature collapse may be prevented by leaving sufficient roof supports in the form of good sized pillars in the first working or barriers of sufficient size in panel areas or by sand-stowing when depillaring.

Question 19.—No. I am of the opinion this should be left to the management. The Inspector of Mines can always act if he considers there is not sufficient support being left.

Question 20.—No hard and fast rule can be laid down as condition vary so much, what might suit one colliery would not suit another. My own opinion is that only good sized pillars should be left in all seams, and no galleries should be driven more than 12 feet x 10 feet maximum in any seam.

Question 21.—Yes, in all except the heightening of galleries, this should be omitted in my opinion.

Question 22.—At one of the collieries under my charge we are working a 40 feet seam, at present we work only two sections, one on the top and one on the floor of the seam. Size of pillars 100 feet x 100 feet with galleries 8 feet x 8 feet.

Question 23.—(*a*) Yes. (*b*) Yes.

Question 24.—Yes, but only in conserved areas containing coking coals.

Question 25.—No.

Question 26.—Yes. There is always that danger.

Question 27.—(*a*) Wherever there is a danger of water entering a mine in abnormal quantities all precautions should be taken and no miners or labourers should be in the mines during heavy floods or abnormal rainfalls.

(*b*) It might be necessary to have legal powers to enforce this, should ordinary persuasion prove ineffective.

Question 28.—The Permanent and Temporary Regulations are in my opinion adequate.

Question 29.—I favour the use of " permitted " explosives in all mines or seams that are dry and dusty throughout.

Question 30.—Yes.

Question 31.—(*a*) This should be retained.

(*b*) Larger quantities being necessary during sinking operation.

Question 32.—No. Present rules are adequate if observed.

Question 33.—The seams worked at the collieries under my charge are as follows:—

	Seams worked.	Thickness.	Inclination.
Jeetpur Colliery—			
Jharia Coalfield .	17 seam . .	7′	1 in 8
	18 „ . .	11′	1 in 8
Ramnagore Colliery—			
Raniganj Coalfield .	Ramnagore seam .	12′	1 in 6
	Laikdih seam .	40′	1 in 6

Question 34.—At Jeetpur colliery the whole of XVII seam is being extracted. The bottom 7 feet of XVIII seam is being extracted. At Ramnagore Colliery 23 per cent. of the seams is being extracted.

Question 35.—At Jeetpur colliery the total output at present is being got from pillar extraction. Extraction 90 per cent. in both seams.

Question 36.—With existing methods of working especially where thick seams are concerned, and the parting between such seam often a few feet only, and taking into consideration the size of pillars left in many collieries, I am of the opinion a very small percentage of the coal standing in pillars could be recovered.

Question 37.—(*a*) No. (*b*) No.

Question 38.—If sand-stowing were made compulsory the life of the colliery or collieries would be prolonged and the productivity increased as instead of keeping large areas standing on pillars depillaring could be following up the developing work, thereby saving likely loss.

Question 39.—Simultaneously with the extraction of the pillars. Unless in the case where long-wall methods of working are in force.

Question 40.—In the Jharia coalfield in all seams of good coking coals.

Question 41.—No.

At one of the collieries at present under my charge a small area was sand-packed previous to my taking over.

From figures available, the total cost was approximately annas 12 to Re. 1 per ton. It must be understood that the river is

adjacent to this colliery, and the most favourable conditions prevail, at the same time it is only people who have had actual experience of hydraulic stowing in India that will be able to answer the queries in this question with any degree of accuracy. Conditions vary considerably at different places. For instance at Ramnagore colliery the estimated figure was different for each incline, the further away from the source of supply up went the estimate.

Question 42.—Where compulsory stowing is enforced financial aid should be given. Government and the Indian steel producers are the ones most concerned in the conservation of coking coal. They should provide something for the additional cost, also royalty receiver by allowing a reduction in royalty on all depillaring areas of seams of good coking quality where sand-stowing is being enforced.

Question 43.—(*a*) Yes.

(*b*) If a statutory authority be appointed it should be composed of a number of mining engineers and geologists, who are not colliery owners with practical knowledge of the coalfields and conditions prevailing in mining in India. Such authority to function on the question of coal conservation only and be separate from the Department of Mines with the right to appeal to a competent Mining Board.

Question 44.—No.

Question 45.—In many cases none.

Here again it is only those who have had actual experience of the saving in costs that could reply to the queries under *Question 45* with any degree of accuracy. One might be apt to guess and give figures that would be misleading.

At Jeetpur colliery where our output is got from pillars only:—

(*a*) Timber cost Anna ½ per ton.

(*b*) Fire-stopping Anna ½ per ton.

(*c*) Pumping cost increased after depillaring.

(*d*) We lose 5 per cent. in each panel area.

(*e*) Compensation for building, etc., in the last 2 years Rs. 1,000 only.

(*f*) *Nil.*

(*g*) ——

(*h*) No saving.

Question 46.—Yes.

Question 47.—Yes.

Question 48.—It is difficult to define when a seam is of commercial value. Any seam that is gettable to profit at the present

prices obtainable for that class of coal to-day might be said to be of commercial value.

Question 49.—Yes. But each individual case will require to be considered.

If the strata between has to be kept intact as per Regulation No. 10, Temporary Regulation for Coal Mines, the space must be filled.

Question 50.—No.

Question 51.—(*a*) Yes.

(*b*) This will relieve railways of their obligation to pay for coal locked up under their railways.

Question 52.—(*a*) I am in favour of complete filling where possible.

Question 53.—(*a*) No. (*b*) Yes.

(*b*) Yes.

Question 54.—Statutory control should be limited to the coalfields containing coking coals or to such coalfields where conservation is in force.

Question 55.—(*a*) Compulsory stowing if adopted should in my opinion be confined to the Bihar coalfield.

(*b*) Yes.

Question 56.—Yes.

Question 57.—(*a*) I do not approve. As there is always the danger of the fellow working the lower seam leaving insufficient support and accidents might occur.

(*b*) Amalgamation.

Question 58.—No colliery manager can be held responsible for a shaft over which he has no control.

Question 59.—(*a*) Yes. (*b*) Yes.

Question 60.—Yes.

Question 61.—If it is imperative to conserve the reserves of coking coal in India I would suggest it be prohibited to utilise coking coal for steam raising or industrial power of any description if suitable steam coal other than coking coal is available, the whole of the lower Raniganj and Dishergarh coal could be used for steam raising, thus relieving the coking coal for metallurgical purposes.

Question 62.—The Coal Grading Board has served a useful purpose.

Question 63.—(*a*) I cannot say why this should be so, may probably be due to the difference in mining condition and the type of mining labour employed in India.

(*b*) I should say yes.

Oral Evidence.

Question 5 (*b*).—For an average thick seam of say 14 feet at a depth of 600 feet. The percentage would be greater in a thicker seam. I would say that panel system makes for safety, but does not necessarily involve more loss of coal as compared with ordinary methods of working.

Question 7 (*a*).—By "all mines" I mean all mines raising more than 2,500 tons a month.

Question 11.—I think that the temporary legislation and temporary regulations should both be made permanent.

Question 16.—My reply relates only to the collieries which I am myself working.

Questions 19 & 20.—I am of the opinion that good-sized pillars and galleries of the maximum size specified by me might be laid down by law or regulation for all collieries.

Question 21.—I now agree that the heightening of galleries should be included provided the regulation was sufficiently elastic to allow of variation in special circumstances to suit local conditions.

Question 33.—The top of the XVIII seam is very inferior.

Question 35.—The total loss is about 25 per cent. including losses in barriers.

Question 36.—I think that we should be lucky if we recovered as much as 50 per cent. of this coal, but the percentage is more likely to be nearer 30.

Question 38.—I would put the increased life and productivity of my collieries at about 25 per cent.

Question 41.—The majority of this 12 annas or Re. one per ton consisted of the cost of stowage underground.

Question 42.—The aid I contemplate from Government is by means of a cess on all coal carried by rail in or into British India. I say that the cess should be levied on other coal besides coking coal because my idea is compulsory stowing should be applied to coking coal for safety and conservation purposes, and to other coals for safety purposes only. As iron and steel companies will be the beneficiaries of conservation of coking coal, they should pay an extra cess on the coking coal they consume, but I realise the difficulties of collecting cess based on quality of coal. I realise after discussion that the practical difficulties of trying to conserve coking coal alone by means of a cess would be very considerable.

Question 43.—I would agree to one member of the Mines Department being on the statutory authority for coal conservation only. I would have a Government official as Chairman and the members should be selected in the way I have suggested.

Question 48.—I think " coal of commercial value " will be very difficult to define, and when you have defined it, it will not be of much practical use.

Question 55.—I would extend my answer to the effect that compulsory stowing should be adopted for all coking coals wherever situated for purposes of conservation and safety, and for other coals for safety only.

Question 61.—If coking coal was conserved and only allowed to be used for metallurgical purposes, the conservation of good quality steam coal might then become an equally important object of conservation.

We have tried mixing the Dishergarh seam " slack coal " with other good coking coals, but the results were not satisfactory. Our experiments were made with coal in bulk in coke ovens.

Question 62.—I mean that the Grading Board will serve useful purpose as regards the export trade only. The system of grading has caused considerable waste in the sections left and and has also increased dangers from fires. I think therefore that, if possible, the use of grading in the case of coal for the internal trade only should be stopped.

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17. Written Evidence of Mr. F. L. Cork, Collieries Superintendent of Messrs. Macneill & Co.

Question 1.—Colliery Superintendent—32 years' experience in the Raniganj and Jharia coalfields.

Question 2.—(1) The main cause is the leaving of coal in goaves, either in the form of " roof " coal or " stooks "—other causes are carelessness in the handling of open lights, etc.

(2) In the absence of records it is difficult to reply to this—certainly whatever fires have occurred over the last 2 to 3 years have been widely advertised.

(3) Without records being available this question cannot be answered, although it is reasonable to assume that the number of " heatings " reported in depillaring areas, would be greater than " fires " from premature collapses.

Question 3.—(1) I consider all seams being worked 5 feet and over in thickness, and even less than 5 feet if careful supervision is not given to the recovery of " small " coal, " stooks " or " roof " coal in goaves.

(2) The term is not understood, but in many cases, signs of " heating " have been detected within 1 to 3 days of main roof fall to the surface.

(3) Replied to under 3—(1).

Question 4.—(1) Yes, but the danger is considerably minimised if isolation is effective at the " heating " stage.

(2) Difficulties may become greater, unless each seam can be flooded with water or effectively sealed.

Question 5.—(1) Yes, and in well-managed collieries *all* seams are laid out on a system of panels.

(2) Barriers represent approximately 15 per cent. in the first working, of which 75 per cent. would be recovered on depillaring a seam dipping at 1 in 10 or steeper, and depending on the depth from surface and area depillared.

Question 6.—(1) The Temporary Regulations mentioned are adequate and *more* than adequate, and in many cases are far beyond anything required in the interests of safety, and unless amended will eventually lead to their being disregarded.

Question 7.—If natural ventilation is adequate and properly coursed, I do not consider a fan is necessary—where the ventilation is inadequate, the fan should be installed and capable of being used as a 'forcing' or an exhausting fan.

Question 8.—(1) Yes.

(2) I consider that practically every fire is due to this cause,—excepting of course, accidental fires caused by open lights, matches or smouldering cigarette ends, etc.

Question 9.—Usually water mains and taps are installed for watering haulage roadways, and I consider this is ample for all requirements.

Question 10.—I do not consider telephones necessary, as distances from the remotest parts to the shaft bottom in Indian mines are comparatively short.

Question 11.—None.

Question 12.—Yes, this training would be useful.

Question 13.—Gas masks and breathing apparatus may prove useful in the "closing off" of an area that is "heating" or where fire is in a known, limited, and accessible spot, otherwise, I consider their use gives a false sense of security and they should not be used.

Question 14.—I consider this Regulation should apply to all mines, whether liable to spontaneous combustion or not.

Question 15.—(1) I agree.

(2) Stoppings to be built before depillaring, minimum number of openings in a panel, the clearance of all coal from goaves, etc.

Question 16.—I do not consider stowing is necessary in any seam under the conditions stated, as ample safeguards are already fully provided for in the Mines Act, Regulations, and Bye-laws and that in any case an installation of electric safety lamps would meet the circumstances without stowing the goaves.

Question 17.—To comparatively small pillars, high galleries, thickness, and depth of seam from surface.

Question 18.—(1) Under certain conditions, premature collapses would cause no danger to persons or buildings on the surface.

(2) Underground the danger is from " air blasts ", which be eliminated by observance of conditions and withdrawal of workmen.

Question 19.—I am not in favour of gallery and pillar dimensions being laid down by law, as I consider it interferes with the rights of owners.

Question 20.—No reply required in view of reply to *Question 19.*

Question 21.—No, as I consider that in many cases, the size of pillars will allow of " splitting " or " reducing " without affecting the safety of the surface.

Question 22.—None of the Company's collieries are working under the conditions stated, and each case would have to be considered on its merits.

Question 23.—I am not in favour of a statutory authority for the purposes stated, as I consider it interferes with the rights of private property.

Question 24.—No. This is a question principally for the Mines Department and an appeal therefrom to an expert Mines Board or Committee.

Question 25.—No.

Question 26.—This is a matter of opinion, and before I could express an opinion, a " fire area " would need to be strictly defined.

Question 27.—See reply to *Question 26.*

Question 28.—There are no great changes required in the Permanent Regulations, but I consider Supplementary Temporary Regulation 5, should be amended to allow of artificial watering and so make it permissible to fire more than one shot at a time. The drenching of coal dust with water is allowed when " permitted " explosives are used, and I see no objection whatever why watering is not allowed in an open light mine, where ordinary explosives are used.

Question 29.—No, as I consider safety is amply provided for.

Question 30.—I am *not* in favour of shot-firers as such, and consider the duty of shot firing should only be entrusted to the sirdar, overman, or other competent person in charge of that part of the mine where shot firing takes place—this refers particularly to mines using safety lamps—there should be no divided responsibility between 2 persons in the same district of a mine.

Question 31.—I consider the quantity should be increased by a reasonable amount according to circumstances at each mine fixed by the management—I consider that 5 lbs. explosive accidentally fired will kill a person just as effectually as say 15 to 20 lbs., therefore there appears to be no point in unreasonably limiting the quantity.

Question 32.—None.

Question 33.—

	Thickness.	
Poniati Seam—Selected Grade . .	5′—14′	1 in 20
Dishergarh Seam—Selected Grade .	10′—17′	1 in 5
Sanctoria Seam—Selected Grade . .	7′ 6″	1 in 5
16 Seam—Selected Grade . . .	9′ 0″	1 in 8
17 Seam—Selected Grade . . .	8′ 0″	1 in 8

Question 34.—The whole section of seam is extracted in all cases except the lower 3 feet in 16 Seam, and the lower 3 feet in the Dishergarh seam and at Chowrassie colliery only.

Question 35.—(1) Kendwadih—whole output from depillaring.

Hurriladih—no depillaring.

Chowrassie—whole output from depillaring.

Dishergarh—90 per cent. from depillaring.

Bejdih—approximately 35 per cent. from depillaring.

Methani—approximately 20 per cent. from depillaring.

Dhemo-Main—about 35 per cent. from depillaring.

Jamuria—about 80 per cent. from depillaring.

West Jamuria—about 80 per cent. from depillaring.

Akhalpore—about 50 per cent. from depillaring.

Mundulpore—50 per cent. from depillaring.

(2) Present depillaring areas in Dishergarh seam varies from 90 per cent. to 95 per cent. and Jamuria district 85 per cent. to 90 per cent.

Question 36.—Not knowing the circumstances of *other* collieries in the Jharia and Raniganj coalfields, it is difficult to estimate what will be recovered. In these Companys' collieries I estimate approximately 85 per cent. to 95 per cent. of the coal in pillars will be recovered from workings developed during the last 20-25 years.

Question 37.—(1) I do not agree with this assumption—in many cases coal has already been left to support railways, rivers, etc., and entrance cannot now be obtained owing to depillaring operations—in other words, the question of support, diversion, etc., has been so long delayed that the coal locked up can be written off as a loss to the coal companies and landlords.

(2) No compensation has been paid to our coal companies under the Land Acquisition Act for coal locked up.

Question 38.—Probably increase the "life" of Dishergarh seam collieries 4 to 5 per cent. and Poniati seam collieries 6 to 8

per cent., *i.e.*, the difference between the "unavoidable loss" under the present system, and the "loss" that takes place with solid sand-stowing.

Question 39.—I am not in favour of the general *enforcement* of sand-stowing.

Question 40.—In view of above reply, no need for a reply to this question.

Question 41.—

	Cost per ton of sand. Annas.
(*a*) 0·75 anna per ton	0·75
(*b*) No crushing done.	
(*c*) 0·37 anna per ton	0·37
Endless haulage-rope system—	
Distances—	
No. 9 Pit : 1,800 feet.	
No. 11 Pit : 1,500 feet.	
(*d*) Repairs, replacements, etc.: 1·85 anna . .	1·85
Cost of pipe replacement underground : 0·55 anna.	
Cost of pipe replacement in shaft : 0·27 anna.	
Miscellaneous stores, surface, and underground: 0·26 anna.	
Miscellaneous labour, surface and underground: 0·77 anna.	
(*e*) 0·30 anna per ton	0·30
(*f*) 4·9 annas per ton	4·90
Total . .	8·17

Question 42.—2nd Part—The increased cost per ton of sand-stowing of workings already formed into pillars will be directly proportional to the percentage of extraction in the first workings.

It should be noted that the costs given above refer to a colliery situated on the bank of a large river, in a particularly favourable situation for sand-stowing.

Question 43.—I do not think a statutory authority necessary—if the Chief Inspector insist on stowing from a safety point of view, then the mine owner must have the right of appeal to an *expert* Mining Board or Committee.

Question 44.—No.

Question 45.—(*a*) Timbering—In practice there is little or no saving in timbering costs.

(*b*) Firestoppings—The number and cost of firestoppings depends on the general "lay-out" of a mine, with a panel system of working the number of stoppings and therefore cost to the coal recovered is infinitesimal.

(*c*) Pumping—In " first " working there would be no saving, and the amount of saving in depillaring would vary so considerably according to depth, thickness of seam, presence of faults, dykes, etc., that it is impossible to give figures.

(*d-h*) Any savings under these headings are problematical and would depend on conditions existing at *each* particular colliery.

Question 46.—I consider that wherever coal in a seam is of " commercial value " it is worked and not left, and therefore the question of control does not arise.

Question 47.—I am of opinion that this is not the case.

Question 48.—In view of above 2 replies, no need for an answer to this question, but I would define coal of " commercial value ", being coal which on sale (at the time it is raised) gives to the producer a profit over the cost of production, and furthermore, is a coal for which there is a demand by buyers.

Question 49.—Under certain circumstances yes.

Question 50.—Not in every case—at shallow depths, if the mine owner considered the removal of the coal was commercial proposition, he would pay for stowing—if not, it should be left. At greater depths, the coal could be removed without any great risk to railway sidings and villages—the question of removal under a large river is a different matter.

Question 51.—I consider the railway companies should if at all possible, divert their lines at their own cost, and leave the coal free for extraction.

Question 52.—I doubt if partial stowing would be a success, except in very exceptional circumstances.

Question 53.—I consider that if compulsory stowing is insisted on, the whole cost should be paid—in many cases the cost of dumping the sand at the pit top represents less than one-half of the total expenditure incurred in stowing.

Question 54.—(1) Safety in mining methods, should be universal and is already provided for under the Mines Act, Regulations and Bye-laws, and it is up to the Mines Department to enforce the law.

(2) Coal is undoubtedly a natural asset, but conservation should be *limited* to " unavoidable losses ", so as to bring it within commercial possibilities.

Question 55.—I consider that compulsory stowing should be restricted to *certain areas only* and not indiscriminately to the whole area of the Jharia coalfields, and *if necessary*, to certain areas in the Raniganj coalfield working under similar conditions to Jharia—the question of spontaneous combustion does not arise, as all *good* coals are liable to spontaneous combustion if conditions underground are *made* favourable for its propagation.

I agree that *avoidable waste* should be stopped, if an agreed definition of " unavoidable waste " can be arrived at—*perfection*

in mining methods is a question of expenditure, and therefore depends greatly upon an adequate selling price.

Question 56.—If it is a question of safety, the remedy is in the hands of the Mines Department who should prohibit the working of mines in a dangerous manner, on the other hand, if properties are small and cannot be made an economical or commercial proposition as they exist, then the sooner they close down the better, and until the small owners voluntarily come to a working arrangement with themselves and their landlords.

Question 57.—I approve of the arrangement stated in the question.

Question 58.—I consider that the manager of each mine should have independent charge of the 2 shafts or outlets.

Question 59.—I consider the checking and keeping intact or barriers between mines should be a duty of the Mines Department as also checking of boundaries that they agree, between two properties. If the staff of the present department is unable to cope with the work involved, then it should be added to in preference to having a statutory authority.

Question 60.—I consider the tracing referred to in Regulation 15 (3) is of little use to any one and should be abolished, and all buildings marked on the plan of underground workings.

Question 61.—This is a question principally for the consumer who in recent years appears to appreciate that it is a better commercial proposition to purchase selected or first grade coal from an efficiency point of view, in preference to 2nd grade coal with ash contents 100 per cent. more than 1st grade.

The available reserves of good 1st class coal would be considerably *increased* and *conserved* if the largest consumers, *i.e.*, the State Railways controlled by Government stopped the use of coking coal and used non-coking coal for locomotives.

Question 62.—The effect of the Grading Act has been to improve the quality of coal for export, thereby enabling India to recapture business lost in the past, because of the poor quality of the coal shipped. The Grading Board was formed with this object and it has carried out its duties very satisfactorily. The Act has not resulted in increased waste, inasmuch as it has not at any time prohibited an owner from working any seam or section of a seam desired. It has merely graded the seam or section worked by the owner, and the owner's choice in this respect has been guided solely by the requirements of buyers, a state of affairs existing in every coalfield in the world.

Question 63.—I suggest the inference is not correct, and until the more recent orders issued under Section 19 are put up to an independent Mines Board or Committee for approval or otherwise, then the orders recently issued stand simply as the opinion of the Mines Department and therefore do not represent a true appreciation of the position.

There will always be in this and in every other country a number of owners and managers, not only in coal mining, but in other industries, who are prepared to go to the utmost limit, to achieve their end, at the same time, I consider the majority of owners and managers do give very serious consideration and attention to safety of human life and property, and I think the question of a comparison of "dangerous practices" between India and England should not have been made when the circumstances of the application of Section 19 were known.

Oral Evidence.

General.—The principal reduction in working costs has been due to increased output, and also reduction in rates, *i.e.*, wages both for the miners and the superior staff. The reduction has been Annas 4 a ton roughly on labour charges.

There is no doubt that we can get down to a depth of about 3,000 feet in the Raniganj field. There are actually pits projected down to a depth of 2,000 feet, and good quality coal has been proved up to 2,500 feet depth in our own properties.

Question 3.—Signs of heating before falls of roof are comparatively rare.

Question 4.—I have on many occasions been enabled to recover coal from sealed-off areas when the sealing-off has been done sufficiently early.

My reply to *Question 4* (*2*) should be taken as referring to the Raniganj field.

Question 5.—My experience is that average losses in barriers in panel working are about 4 per cent. The size of panels increases with the depth. I agree that panel working improves the factor of safety, but I do not agree that it increases loss of coal. I have never had a case in which heating has occurred before all the coal within the panel has been extracted. This applies to workings 1,000 feet and over. A panel of 900 feet in length and 600 feet in width was totally extracted during the course of three years. What I have said would I think apply generally to all seams up to 20 feet thick. In general circumstances the likelihood of fire occurring depends upon the amount of coal left behind, particularly, roof coal.

Question 6.—I think that the Supplementary Regulation No. 6 goes too far. If the quantity of gas is very small, I think it is unreasonable to have to remove the workers from the return side of that place. I agree that the leaving of the gas in the mine is dangerous, and also that there should be regulation requiring its removal as quickly as practicable, but I think that the present regulation is too stringent.

I would have no objection to the new part of Section 19 introduced in 1936 being made permanent provided that there is a right of appeal. I have hitherto been under the impression that there was no appeal under Section 19 (5) against orders passed under the new part of the section. Assuming that there is such right of appeal to a Committee constituted as in section 11, I think that the constitution of that Committee should be altered so as to include at least three qualified mining engineers. I approve of an independent Chairman with no connection either with the Mines Department or the coal industry or trade.

Question 7.—After full discussion of the point, I would prefer to leave my answer to this question as it is.

Question 9.—In my opinion if pipes 1 inch to 1½ inches in diameter are used on the haulage roadways for watering purposes, they would be quite adequate for dealing with fires.

Question 10.—I think that if the signals were added to, this would have an equally good result in the withdrawal of workers from a distance as the institution of telephones. I think that it would be a good idea to require signalling arrangements in the reverse direction for the above purpose.

Question 14.—This is an instance where I consider Temporary Regulation No. 14 does not go far enough.

Question 19.—I would *not* agree to general principles of first working being laid down by law or regulation unless the Chief Inspector of Mines could vary those principles in accordance with local conditions and special circumstances, and provided also that there was a right of appeal from the decision of the Chief Inspector. What I have said refers only to pillar and stall working.

Question 20.—I am inclined to think that the best basis of such general principles of working should be the percentage of the floor area.

Question 21.—My reply to this question is based on the assumption that the pillars left are already more than sufficient to support the workings. I would add to my answer also the words " and without affecting the safety of the mine ".

Question 24.—I think that the Mines Department should have the power to require the mine owner to pack in such circumstances provided there is a right of appeal.

Question 26.—I would define a " fire area " as an area in which there is actually fire. I would not include as a " fire area " an area which has been sealed off after heating has been discovered, but which has never been re-entered to ascertain whether there is actually fire or not.

Question 28.—I agree to Supplementary Temporary Regulation (5) being retained provided that relaxation is given in respect of shots fired in the face of an ordinary gallery and also provided

that a new sub-section (*d*) is added to the Regulation worded as follows:—" have been drenched with water or dusted to such an extent that there will be no danger of the coal dust being raised into the air by the shot or shots ".

Question 29.—I think that the increased cost of using " permitted " explosives as compared with ordinary explosives would be at least Annas 4 per ton of coal recovered.

Question 31.—Regulation No. 106 should be amended to allow the manager to use his discretion as to the maximum quantity of explosives which is to be carried.

Question 35 (1).—Speaking roughly, I should say that the proportion of output from pillars in my collieries is 50 per cent.

Question 35 (2).—These figures do not take into account the coal left in panel barriers.

Question 37.—In many cases of coal under railway lines which is still recoverable, the coal could be recovered if the railway adopted a reasonable attitude, diverting their line over areas in which depillaring has already been done and no further subsidence was likely. This would be possible in the majority of cases.

Question 41.—Approximate costs for pumping sand and for excavating sand with a drag line are twice and one and a half times respectively compared with that of hand labour.

Question 46.—I would modify my reply to saying that wherever coal in a seam is of commercial value it should be worked and not left. I agree that if, in such circumstances, coal of commercial value is being left, steps should be taken to prevent this.

Question 47.—I agree that, if damage is actually being done to an upper seam of commercial value by such working, this should be prevented or controlled.

Question 49.—By " circumstances " I am referring to the thickness of the strata in between the seams. In my opinion, the minimum thickness should be 300 to 400 feet.

Question 54 (2).—I agree with the definition of " avoidable losses " as all loss which is not incidental to the proper and efficient working of the system of mining that is being followed at the moment.

Question 57.—I would only approve of such arrangement where the parting between the two seams was such as to make it very unlikely that the working of one seam would affect the other.

Question 62.—I am not prepared to express an opinion as to whether it would be a good thing to stop the system of grading so far as the internal trade is concerned. I agree that there are differences in this connection between the export trade and the internal trade, as long as the internal trade is not subject to competition from foreign coal.

18. Written Evidence of Rai Sahib U. N. Mondal, Manager, Deoli Colliery, Burdwan District.

Question 1.—Mine Manager, 38 years' experience, mostly in Dishergarh coalfield and sometime in Jharia and Raniganj coalfields.

Question 2.—(i) Spontaneous combustion and explosion of firedamp.

(ii) Yes.

(iii) By premature collapses.

Question 3.—(i) Dishergarh seam and almost all the seams in Raniganj coalfield are liable to spontaneous combustion.

(ii) Period of incubation:—

Dishergarh seam—2 years.

Some Raniganj seams—1 year.

The deeper the seam the shorter is the period of incubation.

(iii) Yes.

Question 4.—(i) Yes.

(ii) Yes.

Question 5.—(i) Yes.

(ii) 15 per cent.

Question 6.—Yes.

Question 7.—Yes—exhausting if the fire area is close to the upcast shaft (forcing if it is remote).

Question 8.—Yes—at Sodepore colliery.

Question 9.—The arrangement will cause much hardship to the management.

Question 10.—Yes—beyond 600 yards.

Question 11.—The precautions laid down in the Temporary Regulation are, I think sufficient.

Question 12.—Yes.

Question 13.—Breathing apparatus and gas masks should be used.

Question 14.—Yes.

Question 15.—Yes—panel system of work should be adopted. Large underground areas may also be separated by barriers.

Question 16.—Legal enforcement for filling or packing will not be necessary if proper ventilation is maintained.

Question 17.—It is mainly due to disproportionate widening of galleries.

Question 18.—Air blast and fires may be caused by premature collapses. The place where such collapses are expected, should be secured by filling or cogging.

Question 19.—Yes.

Question 20.—Maximum width of galleries—15 feet.

Minimum size of pillars—50 feet (centre to centre). The size of pillars will increase according to the depth of the mine, the inclination of the seam and the nature of coal.

Question 21.—Yes.

Question 22.—For a thickness of 20 feet there should be one section. The pillars of the lower section should be a little larger than those of the top section.

Minimum " parting "—8 feet.

Question 23.—Yes.

Question 24.—Yes.

Question 25.—In Phularitand (Jharia) colliery one incline was over-flooded by water rushing into the mine from neighbouring *jore* during heavy rains. The island pit of Saltore colliery was inundated when the river Damodar was in high flood. Murulidih colliery was also similarly inundated by Damodar.

Question 26.—Yes.

Question 27.—In the case of mines with streams running close to the opening or the subsided area, proper embankment should be erected to prevent water rushing into the mine. Such precautions should be legally enforced.

Question 28.—The regulations are, I think, sufficient to guard against the dangers from explosives.

Question 29.—Yes.

Question 30.—Yes.

Question 31.—It should be abolished—accumulation of greater quantity in one place might increase the danger.

Question 32.—A responsible officer should be entrusted with the issue of explosives. They should be issued only to the appointed shot-firers under the order of the manager.

Question 33.—Dishergarh seam:—

Quality:—First Class.

Thickness:—15 feet to 18 feet.

Inclination:—1 in 5.

Question 34.—The whole thickness of the seam is being extracted.

Question 35.—At present the whole output is coming from pillars; percentage of coal actually recovered:—85 per cent.

Question 36.—80 per cent.

Question 37.—(i) Yes.

(ii) Not to my knowledge.

Question 38.—No practical advantage will be derived in the colliery where I am working.

Question 39.—Yes, where stowing is necessary it should be done simultaneously with the extraction of pillars.

Question 40.—In all seams of good coal lying under river-bed, railways, valuable buildings and bustee areas.

Question 41.—Yes, of hydraulic stowing (done 23 years ago).

(*a*) As. 6 sand from river-bed—100 cubic feet of sand.

(*b*) *Nil.*

(*c*) As. 4.

(*d*) As. 3.

(*e*) Anna 1.

(*f*) As. 2.

Additional cost per ton—

(*a*) As. 8 from workings in virgin coal.

(*b*) Re. 1 from workings already formed into pillars.

Question 42.—By Government aid.

Question 43.—Yes—with the officials, the mining engineers and mine owners.

Question 44.—Yes.

Question 45.—(*a*) 2 pice per ton.

(*b*) 2 pice per ton.

(*c*) *Nil.*

(*d*) 2 annas per ton.

(*e*), (*f*), (*g*) & (*h*) Practically *nil.*

No.

Question 46.—Yes.

Question 47.—Yes.

Question 48.—I would define coal used for locomotives, mills, and domestic uses as coal of commercial value.

Question 49.—Yes.

Question 50.—Yes.

Question 51.—Yes—because when land is acquired for the Railways, the value of the underlying coal is not taken into account.

Question 52.—(i) Complete filling should be done.

(ii) No.

Question 53.—Both sand and financial assistance will be necessary.

Question 54.—Should at first be limited to particular fields. The desire to get the maximum output with a minimum cost accounts for dangerous conditions in many mines.

Question 55.—(i) Yes. (ii) Yes.

Question 56.—Yes.

Question 57.—No. As it would give rise to many difficulties and dangers in the workings of the mines by two different owners.

Question 58.—The manager of each mine should have independent charge of the two outlets.

Question 59.—(i) Yes. (ii) Unnecessary.

Question 60.—Yes.

Question 61.—Inferior coal is now used in Railway locomotives, mills and in the manufacture of soft coke. This will save a large amount of good coal.

Question 62.—Not to my knowledge.

Question 63.—Yes it would be correct to infer this.

Oral Evidence.

Question 11.—I have no objection to the Temporary and Supplementary Regulations and the temporary legislation introduced by the 1936 Act being made permanent.

Question 16.—In my reply to *Question 16* I would like to add that partial packing might obviate the danger. I have had the experience of having stoppings round a goaf being blown down when a fall of roof inside the goaf has occurred and inflammable gas has been expelled. I know of no other means of guarding against the danger from inflammable gas than sand-stowing.

Question 20.—I would make the maximum height of galleries 10 feet.

Question 22.—What I say about the pillars of the lower section being a little larger than those of the top section means that the two lots of pillars should be superimposed over one another, the gallery in the lower section being a little narrower.

Question 32.—I contemplate that a more responsible officer than at present should be entrusted with the issue of the explosives.

Question 36.—My percentage of 80 contemplates only cases in which adequate pillars have been left. I have not very much knowledge of the conditions of the standing pillars in the Jharia Field.

Question 41.—All the figures in this answer are for 100 cubic feet of sand.

Question 42.—By "Government aid", I mean a cess imposed by Government on all coal and coke and paid by all who derive any benefit from conservation, namely, not only the coal industries, but also the iron and steel industry, railways and other consumers.

Question 54.—By "particular fields" I mean the Jharia field and those parts of the Raniganj field which produce coking coal.

Question 55.—My answer to *Question 54* will apply to the first part of this question.

Question 62.—What I mean is that I do not know what effect the Coal Grading Act has had on methods of extraction.

General.—I am a representative of labour on the Bengal Mining Board. From 1921-1924 women labourers used to get 4 or 5 annas and men about 9 annas. Now women are getting about 2½ annas to 3 annas while men are getting between 5½ and 6 annas. These figures relate to the surface work. For underground work, the miners used to get about 9 annas a tub. They are getting now about 6 to 7 annas.

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19. Written Evidence of Mr. W. B. Penman, General Manager, Samla Collieries, Ltd., under the Managing Agency of Messrs. Martin & Co.

Question 1.—(*a*) General Manager, Samla Collieries, Ltd., and Trans Adjai Collieries, Ltd.

(*b*) 17 years. 2 years Jharia, 15 years Raniganj.

Question 2.—(*a*) Coal being left in the goaf.

(*b*) Yes.

(*c*) Normal collapses.

Question 3.—I cannot give comparative statements but the Samla seam is very liable to spontaneous combustion.

The period of incubation varies greatly and it also varies even in the same seam as conditions vary.

Not entirely. Practically any seam will fire if conditions are suitable.

Question 4.—(*a*) Yes. (*b*) Yes.

Question 5.—(*a*) This is a debatable question in which local conditions play a large part. In the case of very friable seams or thick seams it is very doubtful whether the panels are of much service as the thickness of the barrier must be greatly increased and the percentage coal left in the goaf becomes so great that in some cases it would be better to work in the ordinary way and recover just so much of the coal as is possible without causing collapse.

(*b*) Without sand-stowing at least 30 per cent. of the coal must be left in the barriers.

Question 6.—Yes.

Question 7.—(*a*) Yes. (*b*) Exhausting.

Question 8.—(*a*) Yes. Undoubtedly.

(*b*) A fire which broke out while depillaring work was in progress in Samla seam in Chatrisgonda No. 1 incline was in my

opinion caused by leaving 3 feet of the coal to support the weak shale roof. This 3 feet of coal was left in the goaf and caused fire to break out.

Question 9.—No. In nearly every case of fire the out-break occurs in such a position that it would be impossible to get to it with such apparatus.

Question 10.—No. I do not think that telephones would have lessened the number of casualties in any accident which has occurred. Nor do I think that it is possible to always maintain telephones in good condition at places such as the ends of main haulage roads. They might be useful if installed at stations not too far in-bye, such as haulage engines or pump rooms, where an operator might be found and where workmen might collect. They would always be useful from the pit bottom to the surface.

Question 11.—Regular sampling and analysis of the air.

Question 12.—Yes. This should form part of the course of training.

Question 13.—Such apparatus might be useful in the final sealing of an area which has been built up or in getting to the seat of a small fire but its use would be very limited.

Question 14.—In answering *Question 3* I have stated that in my opinion, no coal is entirely free from the risk of spontaneous combustion and I therefore say that if any extension is made all mines must be included.

Question 15.—(*a*) Yes.

(*b*) No. This depends on local conditions.

Question 16.—No. If the precautions necessary for gassy mines are being observed there is little or no danger to be feared.

Question 17.—To the removal of too much coal in preliminary working.

Question 18.—(*a*) Fire, inundation, collapse of shafts and surface plant, collapse of housing.

(*b*) By leaving sufficient coal in preliminary working. Where too much coal has been removed in the preliminary working and the danger of collapse actually exists only stowing or partial stowing can help.

Question 19.—No. I would however favour the enforcement of a minimum percentage of coal being left after galleries are driven.

Question 20.—(*b*) The main factors governing the sizes and dimensions of pillars and galleries are:—

Depth of seam, crushing strength of seam, thickness of seam, nature of overlying and underlying strata, stability of overlying and underlying strata, presence of fire in overlying or underlying goaf, thickness of strata between seams worked or to be worked, nature of surface, use to which surface is put, inclination of seam,

Question 21.—Splitting of pillars: yes.

Reduction of pillars and heightening of galleries: No, so long as the percentage coal left is not less than the percentage necessary to satisfy *Question 19.*

Question 22.—I would place no restrictions on the number of sections, provided (1) that the workings of all sections were symmetrical, (2) that the thickness left between sections be at least equal to the height of the galleries driven, (3) that the percentage coal left in each section be at least equal to that necessary to satisfy *Question 19*, (4) that sand-stowing be adopted while depillaring.

Question 23.—No. But I would not object to a statutory authority consisting of practical mining men being formed as a board of appeal, to which board disputes could be referred. Such a board should be entirely separate from the Mines Department and free from any influence thereof.

Question 24.—Please refer to answer to *Question 23.*

Question 25.—No.

Question 26.—I do not agree that such irruptions cause the water to generate gas but I believe that the very large volume of steam generated does, because of its inability to escape by the ordinary channels, rush out into the workings and carry with it inflammable gas. The sudden generation of steam may even break down fire stoppings. Where there is natural ventilation it may stop ventilation for quite a time and the workings can then become charged with an explosive mixture.

Question 27.—Keep surface as well drained as possible, and have danger spots isolated by dams. Keep fires as well isolated as possible. Employ mechanical ventilators. Observe every possible precaution while approaching old workings.

(*b*) Please refer to answer to *Question 23.*

Question 28.—Shot firers should do no other work than shot-firing with its accompanying duties such as inspection, etc.

Question 29.—No.

Question 30.—Yes.

Question 31.—Abolished. There is no necessity for it to be retained as different canisters of explosives can be kept at regulation distances.

Question 32.—A receipt should be given by any person who receives explosives from a magazine and a receipt should be given to such person when he returns explosives.

Question 33.—Samla Collieries, Ltd.:—Samla seam. 17 feet thick, bottom 13 feet, good grade I, remainder slightly inferior, Inclination 1 in 10.

Trans Adjai Collieries, Ltd.: Kasta seam. 30 feet thick. Bottom 8 feet 6 inches, selected grade. Upper section grade I and grade II. Inclination 1 in $2\frac{1}{2}$.

Question 34.—Samla seam: At present in gallery driving the bottom 9 feet is being worked. During pillar cutting 2 feet of roof coal will require to be left to support weak shale roof.

Kasta seam: Galleries are being driven in the selected grade portion only.

The ultimate section recovered will probably depend on the state of the coal market at the time when gallery work is finished.

Question 35.—Nil.

Question 36.—60 million tons.

Question 37.—(*a*) Yes. (*b*) No.

Question 38.—Life and Productivity would be increased by 35 per cent.

Question 39.—No. No case has yet been made out to warrant enforcement, unless in respect of coking coals.

Question 41.—No.

Question 42.—Not in favour.

Question 43.—No. If compulsory filling is to be introduced it must be universal.

Question 44.—No.

Question 45.—(*a*) 30 per cent. of timber cost.

(*b*) Nearly all.

(*c*) *Nil.* This cost would probably be increased.

(*d*) *Nil.*

(*e*) Buildings and Land, *nil* accidents, certainly some.

(*f*) Little or none.

(*g*) & (*h*) *Nil.*

Questions 46 & 47.—No.

Question 48.—(*Not answered.*)

Question 49.—Yes.

Question 50.—Not unless compensated for the extra cost of the operation.

Question 51.—In the case of main and branch lines the cost should be borne by the railways as the operation is required to enable railways to carry on their work. In the case of sidings the cost should be borne by the collieries.

Question 52.—There are seams in which I think partial filling would be sufficient.

Question 53.—Further financial assistance would be necessary in respect of the actual stowing.

Question 54.—If control is necessary or desirable it should be universal.

(1) There is no field in which mining work is so safe that it might not be safer.

(2) National assets are equally national assets in all fields.

Question 55.—(*a*) As the supply of coking coal is limited and as this coal is of vital importance to the industry of the country it is essential that steps be taken immediately to conserve such coking coal.

(*b*) Please refer to my reply to *Question 39.*

(*c*) Avoidable waste cannot be defined as under present condition what may be avoidable waste in the view of one person is not avoidable waste in the view of others.

Question 56.—I would be in favour of the compulsory re-adjustment of boundaries.

Question 57.—No. Fire, Flooding, Collapse.

Question 58.—Yes.

Question 59.—(*a*) Yes. (*b*) Not unless required to by appeal.

Question 60.—Yes.

Question 61.—Evidently but I do not see how you can force or persuade buyers to buy such inferior coals.

Question 62.—In my opinion the effect has been to increase waste.

In Poriapur collieries which mined the Kasta seam the bottom 12 feet of coal which is selected grade has practically all been recovered and the remaining 18 feet has been left in the goaf.

Question 63.—In the past there were numerous small mines under the charge of underpaid and irresponsible persons who took little or no interest in their work. This undoubtedly led to abuses which have caused many accidents and necessitated the issue of such notices.

In my opinion this has caused the Mines Department to interfere more than is necessary in Britain.

Oral Evidence.

Question 3.—Friability of the coal is one of the chief factors, I should say the greatest factor, in varying the period of incubation. Ventilation also is another factor. Depending mainly on friability and ventilation, the period of incubation varies from 6 to 18 months.

Question 5.—On the whole panel system is an improvement on pillar and stall method for purposes of safety, but not so far as waste of coal is concerned.

Question 6.—I would be in favour of the Temporary and Supplementary Regulations being made permanent. I would also agree to new Section 19 (2) (A) being made permanent as it provides for a right of appeal.

Question 9.—I now agree that, where water mains are available, fittings should be required by law.

Question 10.—I agree to telephonic communications being required by law at suitable places more than half a mile from shaft bottom, or other entrance to the mine. Such suitable places will be haulage engine rooms, pump rooms, main signalling stations, where an intelligent person is usually at work.

Question 14.—What I intended to convey by my answer to this question was that the proposed extension of Temporary Regulation No. 14 should not be confined to mines in which coal is known to be liable to spontaneous combustion, but should be extended to all mines.

Question 16.—I agree now after discussion with the Committee that in the circumstances stated filling or packing with sand or other incombustible material should be enforced to provide absolute safety. I think that flame safety lamps are the greatest danger in the hands of ignorant and illiterate miners in India.

Question 18 (b).—I agree that the condition in which too much coal has been removed in the preliminary working and the danger of collapse actually exists is one which is present in a large number of mines in these coalfields.

Question 19.—I am in favour of general principles of working being laid down by law or regulation based on a minimum percentage of coal being left in the first working together with a maximum height of 10 feet for galleries.

Question 21.—I am in entire agreement that the practices referred to should not be allowed beyond the limits to which I have agreed in my answer to question 19 except just before the systematic extraction of pillars. I would only allow such practices two pillars ahead of the pillar being extracted.

Question 23.—I would have no objection to a representative of the Mines Department as a member on the board contemplated in my answer in view of the fact that the Committee contemplated in Section 11 of the Act allows one member to be nominated by the owner, agent or manager of the mine concerned. I would like to have a business man as the Chairman of such a statutory authority.

Question 27 (b).—What I mean is that I would not object to such precautions being enforced provided there was a right of appeal to a statutory authority constituted as suggested in my answer to *Question 23.*

Question 28.—What I think is that shot-firers should be certificated as proposed and that Sirdars should never be allowed to do shot-firing as they cannot then attend to their proper duties.

Question 29.—My idea in objecting to the extended use of "permitted" explosives is that the cost should not be increased unnecessarily.

Question 31.—I now agree that the proviso to Regulation 106 should be retained.

Question 33.—The Kasta seam is 30 feet thick. Both seams have been graded by the Grading Board.

Question 38.—In the Kasta seam which I am working I think that the life and productivity would be increased much more than 35 per cent. This only applies provided we are able to mine the whole seam and not only the selected grade portions as the present market demands.

Question 39.—I now agree that, if it is necessary for purposes of conservation, sand-stowing should be enforced both in respect of coking coals and steam coals of good quality and in all fields.

Question 42.—Assuming that a compulsory system of stowing is necessary in the interests of conservation, I agree to a cess being imposed on all coal and coke carried by rail in or into British India. I also think that the royalty receivers should contribute towards the cost.

Question 43.—The statutory authority for working the conservation arrangements should be the same statutory authority as I have referred to in my answer to *Question 23.*

Questions 46 & 47.—My answers to these questions do not contemplate a state of affairs in which sand-stowing is made compulsory. If this is not done, I do not think that the State can prevent any private individual from working his coal as he pleases without giving him compensation, even though the result of such working may be to increase dangers from fire. I think that each mine-owner should be allowed to judge for himself whether he will take the risk or not.

Question 49.—I would include in "fire area" not only an area in which are actually exists, but also an area which has been sealed-off after heating has been found, but which has not been re-entered in order to know whether an actual fire has occurred there or not.

Question 53.—I would prefer financial assistance in respect of the actual underground stowing to take the form of a flat rate, rather than the actual total cost or the actual net cost. I think that a flat rate would be economical so far as the Fund is concerned, and would be fairer to those people who have done their first workings properly. It will tend to prevent bad working in future. It would also be an incentive to the people required to stow to arrange to do that stowing as cheaply as possible.

Question 55.—On the Geological Survey Department's figures which had been cited to me by the Committee, I now agree that the conservation of steam coal of good quality is of equally vital importance.

(*c*) I agree that, from a mining and national point of view, "avoidable waste" might be defined as all waste which is not incidental to the efficient working of the system of mining that is being followed. This definition would not, however, apply from a commercial point of view, as the mine-owner has to work his coal in accordance with market conditions or shut down his mine. Another factor in the situation would be the waste which is at present caused by the differences in railway freights.

The Kasta seam is 30 feet thick and at Poriapur colliery the bottom 12 feet of the seam is selected grade coal while in the top 18 feet more than half is of grade I coal.

The coal has been worked into pillars in the selected grade portion of the seam and almost all the pillars have been extracted leaving the top 18 feet of coal in the goaf.

This waste of coal was found to be necessary to keep the colliery working as it was quite impossible for us to sell the grade I coal.

The colliery is situated at the west end of the Kasta branch line and the chief market for the coal is the Calcutta market.

To despatch the coal to the Calcutta market, however, a freight of Rs. 3-14-6 *plus* 12½ per cent. surcharge per ton has to be paid and the coal has to compete in the market with Kajora district coal of the same class bearing a freight of only Rs. 3-5-6 *plus* 12½ per cent. surcharge per ton. For Kasta seam coal therefore annas 10 per ton extra freight has to be paid to get it to Calcutta market and with selling prices as they have been for the past few years, the coal simply could not be sold without incurring very heavy losses.

With a group system of freights such as the Jharia coalfield has the grade I coal of Kasta seam would compete with the Kajora coals on equal terms on the Calcutta market and very little of the seam would be wasted.

Question 56.—I would also be in favour of the compulsory amalgamation of properties which cannot be economically and efficiently worked in their present sizes and shapes.

Question 59.—I would prefer to have the check of surveys referred to made by the Mines Department. If necessary, the surveying staff of the Mines Department should be increased.

Question 62.—In my opinion though the effect of the operation of the Grading Board has been to increase waste, I do not think that anything can be done about it now owing to the consumer having the whip hand and the coal trade not being united.

As regards the 18 feet of the Kasta seam referred to in my answer to this question, at least 9 feet of it is grade I.

20. Written Evidence of Mr. E. Spark, Colliery Superintendent of New Beerbhoom Coal Co., Ltd., Managing Agents, Messrs. Balmer Lawrie & Co.

Question 1.—(*a*) Colliery Superintendent. New Beerbhoom Coal Company, Limited.

(*b*) 12 years.

(*c*) Mostly in Raniganj coalfield.

Question 2.—(*a*) Premature collapses caused by the crushing of pillars, and the leaving of coal in the goaves in course of pillar extraction.

(*b*) I believe so.

(*c*) No certain information, but I think by normal collapses.

Question 3.—Raniganj coalfield.

(*a*) Poniati and Dishergarh, and seams in the Kajora Group.

(*b*) Period varies within wide limits. For Dishergarh seam eighteen months to two years is I believe about the average. As regards the Poniati in the writer's own experience the period has been as short as six months.

(*c*) Yes, there are such seams.

Question 4.—(*a*) Yes. (*b*) Yes.

Question 5.—(*a*) Yes.

(*b*) This depends on conditions; probably 25 to 30 per cent. at ordinary depths.

Question 6.—(*a*) Yes.

Question 7.—(*a*) Yes.

(*b*) Forcing when there is a possibility of a vent to the surface through the goaf.

Question 8.—(*a*) Yes. (*b*) Yes.

Question 9.—No.

Question 10.—I see no necessity in mines with which I am acquainted.

Question 11.—I am aware of none.

Question 12.—Yes.

Question 13.—In a general way the use of either is impracticable. In exceptional circumstances breathing apparatus might prove efficacious, but I do not favour gas masks.

Question 14.—No.

Question 15.—(*a*) Yes.

(*b*) See answer to 5 (*a*).

Question 16.—(*a*) No, as existing regulations are adequate to ensure safety.

Question 17.—Excessive extraction in the first working.

Question 18.—(*a*) Danger to life and property.

(*b*) By forming pillars of sufficient size in the first working.

Question 19.—No.

Question 20.—Question does not arise.

Question 21.—No.

Question 22.—Restrictions depend on conditions which are too variable to lay down any general rule.

Questions 23 & 24.—No.

Question 25.—Those that I know of have been fully reported on by the Mines Department.

Question 26.—Yes.

Question 27.—Existing regulations require that precautions should be taken and these are enforceable.

Question 28.—I do not consider any changes are necessary.

Question 29.—I am not conversant with the latest requirements in British coal mines.

Question 30.—Yes.

Question 31.—(*a*) Retained.

(*b*) Facilitates work in certain cases without increasing danger.

Question 32.—No.

Question 33.—

Name of seam.	Quality.	Thickness.	Inclination.
(1) Jharia, 10th	Grade II	45 feet	1 in 12.
(2) Top, Ramnagar	Selected Grade	9 feet to 14 feet	1 in 8.
(3) Bottom, Ramnagar.	do.	35 feet to 50 feet	1 in 8.
(4) Dishergarh	do.	12 feet	1 in 6.
(5) Toposi	Grade I	28 feet	1 in 13.
(6) Samla	Ungraded	15 feet	1 in 9.

Question 34.—(1) Whole.

(2) Whole excepting at Victoria West where bottom 9 feet is being worked.

(3) Top 10 feet.

(4) Whole.

(5) Bottom 19½ feet.

(6) Bottom 9 feet.

Question 35.—(*a*) 60 per cent.

(*b*) 90 per cent.

Question 36.—No means of estimating quantity.

Question 37.—(*a*) Probably 75 per cent. will be lost.

(*b*) I know of one case in Jharia, but I am not able to give full details.

Question 38.—Impossible to estimate.

Question 39.—No.

Question 40.—Question does not arise.

Question 41.—No stowing has been done at collieries of which I have had charge.

Questions 42, 43 & 44.—I do not favour a compulsory system of stowing, but I consider that owners should be encouraged to adopt the system by being given financial assistance by way of an allowance per ton of coal removed by this method under a voluntary scheme. The fund would be created by a levy on all despatches of coal and coke, and administered by a statutory authority comprising representatives of the mine owners, and mining experts appointed by Government.

Question 45.—I am not in a position to give details, but it is apparent that the saving in cost of production per ton of coal removed under the heads mentioned would be small in comparison with the cost per ton of stowing.

Questions 46 & 47.—In neither case would the question seem to arise as presumably no owner would be so neglectful of his own interests as to abandon coal of commercial value.

Question 48.—Coal that can be raised and sold at a profit.

Question 49.—Yes.

Question 50.—No, as mine owners would remove such coal by a system of stowing were it commercially practicable to do so.

Question 51.—Yes, because the railway would be relieved of liability for the payment of compensation.

Question 52.—(*a*) Yes, partial. (*b*) No.

Question 53.—(*a*) No. (*b*) Yes.

Question 54.—I do not favour statutory control.

Question 55.—(*a*) If made compulsory should be general.

(*b*) Yes.

Question 56.—No.

Question 57.—(*a*) No. (*b*) I am unable to suggest a remedy.

Question 58.—No.

Question 59.—(*a*) Yes. (*b*) No.

Question 60.—Yes.

Question 61.—(*a*) No. (*b*) Not at the present time.

Question 62.—Certificates are granted irrespective of whether the seam or section graded is intended for export or not. The

situation thus created has caused owners to concentrate their attention on best quality coals to the detriment of others. This is specially noticeable when relatively thin sections of thick seams are allowed to be graded.

Question 63.—I think the explanation is that the original Indian Mines Act is not nearly so comprehensive as the British Act. However, it is impossible to make any fair comparison of two countries in which the mining conditions are so different.

Oral Evidence.

Question 3 (b).—In the particular case in the Poniati seam to which I have referred, the period was only six months possibly because the mine had been flooded for some time and the introduction of moisture into the coal made it combust spontaneously and more quickly.

(*c*).—I am of the opinion that there is no seam of commercial value at the moment, which is not liable to spontaneous combustion under favourable conditions. My answer referred to individual areas in the Company's collieries only.

Question 5 (*b*).—The 25 to 30 per cent. to which I have referred might be lost in the barriers by flooding the goaves the barriers would be recovered. This refers to depths up to seven or eight hundred feet, in my own experience.

Question 6.—I would agree to the Temporary and Supplementary Regulations being made permanent. I also agree to the temporary legislation introduced by the Act of 1936 being made permanent.

Question 9.—I agree to these provisions being required by law so far as the existing water mains are concerned.

Question 14.—I agree to the extension proposed to all mines during depillaring operations in which the seam is known to be liable to spontaneous combustion.

Question 16.—I would agree to this being enforced only if other safety measures were inadequate during the extraction of pillars provided the sand-stowing was either paid for or adequately assisted and provided there was a right of appeal from the decision of the Chief Inspector.

Question 19.—I am now definitely in favour of some general principles of first working being laid down by law or regulation provided the Mines Department has also the discretionary power to vary those principles under special circumstances or special local conditions and also provided there was a right of appeal from the decision of the Mines Department. This will only apply to pillar and stall methods of working. I consider it essential that the law or regulation should also provide for speedy and adequate

penalty for contravention and for adequate supervision to see that the principles are being carried out.

Question 20.—I would prefer these principles of working to be based on a percentage of floor area *plus* maximum height of galleries.

Question 21.—In view of my revised answers to *Questions 19 & 20*, I now agree to this proposal. Mines Department to have discretionary powers as in *Question 19*.

Question 24.—I agree to the proposed powers being given with the same limitation as in my answer to *Question 16*.

Question 29.—I am in favour of the use of "permitted" explosives being required in a mine or in any ventilating district of a mine which is not naturally wet.

Question 33.—Grade II coal in Jharia 10 seam is being used for the manufacture of soft coke.

The ungraded coal of the worked section of the seam at Samla would be equivalent to Grade I, but we have never had it graded because we have not the intention of exporting it. We are selling it to Indian consumers at the same prices as are obtained for graded coal from the same seam.

In none of the seams which we are working in sections is any loss of coal being involved.

Question 35 (b).—This recovery of 90 per cent. of the pillar coal refers only to seams between 9 feet and 13 feet which we are working. When we get on to the thicker seams the percentage of recovery cannot be as high with the present methods of working.

Question 38.—At the bottom seam at the Victoria colliery I think that the life and productivity will be increased by 25 per cent.

Question 39.—My reply is subject to the same modification as I have already made in my answers to *Questions 16 & 24*.

Question 40.—Such enforcement of packing should be applied in the first instance only to coals of good quality.

Question 50.—My reply to this question has also to be modified on the same lines as my replies to *Questions 16 & 24*.

Question 54.—I agree that we have already statutory control so far as safety is concerned. So far as conservation is concerned, provided the increased cost is either paid for or adequately assisted, I agree that conservation should be introduced and would have to be put under a statutory authority.

Question 56.—I agree with these proposals in principle though I think that they may interfere with private rights.

Question 62.—I agree that the extension of the grading system to coal for internal sale was never intended and also that its results have been undesirable.

21. Written Evidence of Mr. L. A. Jacobs, Chief Engineer to the Collieries under the Managing Agency of Messrs. Shaw Wallace & Co.

Question 1.—Chief Mining Engineer to the collieries under the Managing Agency of Messrs. Shaw Wallace & Co., 31 years' experience in the Jharia, Raniganj, Giridih, Pench Valley, Nazira (Assam) and Sohagpur and Umaria (Rewa State) coalfields.

Question 2.—Spontaneous combustion of coal.

Yes, as might be expected from the greatly increased extent of mine workings developed and exhausted.

If in the category "premature collapses" are included those involving a few pillars or portions of pillars only, it is possible that they are the more frequent cause. But the frequent intentional leaving of inferior roof or floor coal in the goaf makes it difficult to answer the question with authority.

Question 3.—The inherent moisture content of a coal is an index to its liability to fire spontaneously; the higher this is, the more liable it is to go on fire. The period of incubation may be from a few weeks only upwards. No coal can be said to be entirely free from the risk.

Question 4.—Not always. If a fire is confined behind stable barriers or well-made stoppings in pillars not liable to collapse, and is cut off from air supplies through holes or cracks to the surface, it may present little or no difficulty to further operations in that seam.

Question 5.—In all cases yes, but with due regard to conditions in individual cases. 15 per cent. of the whole area in the first working would be an average quantity, but this need not necessarily be left in the second working.

Question 6.—Yes.

Question 7.—No. But where it is known or suspected that the fire is or may become active and liable to break through, means for regulating the quantity and direction of air currents should be established. This nearly always would involve mechanical ventilation.

As means are to be provided under the Mines Act Regulations to convert at short notice an exhausting to a forcing fan or *vice versâ*, the matter of its initial function is not of prime importance. A fire which is liable to be fed by air from surface breaks or through stoppings is probably better controlled by means of a forcing fan.

Question 8.—Yes, in all probability. Not definitely.

Question 9.—I am of the opinion that there should be facilities for readily taking connections from rising mains, but I would not go further than that except to lay pipes to a definite fire-area. To agree with and carry out the suggestion generally would involve

the laying of an unnecessary network of pipes throughout the mine. I cannot conceive portable water tanks as being of any utility.

An exception would be justifiable in a mine liable to outbreaks in roadways and pillars; these conditions can hardly be said to exist in India.

Question 10.—No.

Question 11.—I can suggest none.

Question 12.—Yes.

Question 13.—In the absence of practical experience, I am unable to express any authoritative opinion but there can be little doubt that providing the apparatus is used by trained persons it may serve on occasion very useful purposes.

Question 14.—The extension of the Regulation as suggested in the question would make it applicable to all mines in which there were any districts not naturally wet throughout. I do not consider such extension necessary.

Question 15.—Yes, compulsion is justifiable for the taking of all reasonable steps to isolate a district in the event of an outbreak of fire in a goaf. While such compulsion is not justified in first working, fires during the second working being much the more frequent, collieries should be required to safeguard the position during depillaring, or before any proposed depillaring commences. Provision at the present time exists in sub-section (1-A) (*a*) of Section 19 of the Indian Mines Act, 1923, for the enforcement of such steps and some form of permanent application should be made, by embodying that portion of the sub-section permanently in the Act or by issuing new Regulations.

Question 16.—I do not find this question very clear, but on the assumption that it is suggested that goaves should be packed to prevent them becoming receptacles for fire-damp I would say that such action would not be justified by the conditions in Indian mines. If a goaf subsides up to the surface it is likely that all the gas would escape and if any danger such as the question presupposes is likely to be present, it would certainly be more economical to drill bore-holes for tapping the gas until surface breaks do occur.

Question 17.—Insufficient support being left in first-working.

Question 18.—Immediate dangers are:—

From the falls under ground.

Cutting off of exit from the mine and possible damage to the exits and machinery.

Air blasts.

Damage to the surface resulting in inundations of the workings by water from streams or large tanks and the collapse of inhabited buildings with consequent danger to their occupants, and the principal danger arising subsequently is that of fire within the collapsed area.

Question 19.—No.

Question 20.—(*Not answered.*)

Question 21.—No.

Question 22.—My experience of very thick seams being small, I shall not answer this question.

Question 23.—I am not in favour of such interference with the discretion of mining engineers.

Question 24.—I am not in favour of any authority having general powers, but I consider that Section 19 (1-A) of the Indian Mines Act should be adapted so as to permit the Mines Department, failing the existence of some other statutory authority, and assuming that there are reasonable facilities for the carrying out of such operations, to pass orders for compulsory stowing under certain circumstances.

As the Mines Department would be empowered to pass such orders only in the event of more or less immediate danger to life being in question, it is preferable that a statutory body unconnected with the Department of Mines should assume powers on which they may act taking a longer view of the situation than is possible under the Indian Mines Act.

Question 25.—I have had personal experience of one only. I need only say that such an occurrence now would involve a breach of Temporary Regulation No. 9.

Question 26.—Such a position might arise.

Question 27.—Dangers from irruptions of water from old workings are amply provided for in the Regulations. I would recommend that Temporary Regulations No. 9 when embodied in its permanent form should include precautions where large tanks are involved.

Regarding the danger from large volumes of gases being generated suddenly behind stoppings and within fire areas due to irruptions of water, iron doors in certain of the stoppings on the return side could be arranged to open outwards by means of the pressure generated provided that the roadways between them and the upcast were not used normally for the working of the mine, except for ventilation and inspection purposes.

Question 28.—I suggest that the ban on firing more than a single shot of non-permitted explosive in a ventilating district not naturally wet throughout [S(T)R. 5] should be modified and the firing of a round permitted, subject to the restrictions imposed under [S(T)R. 4] only. When a large number of shots is to be fired singly and consecutively the difficulty in complying with the inspections required under the Regulations after the firing of each shot is great and the dangers from insufficient inspection may outweigh all other dangers.

Question 29.—No. As matters stand at present, no explosive other than a permitted one may be used in mines where locked

safety lamps are required under any regulations and this requirement is subject to exemptions being granted by the Chief Inspector of Mines. While it is admitted that the regulations (though in this respect only) do not provide for possible dangers arising from dry fine coal dust, the record of mines generally in India is such as to indicate that the necessity for the extension of the use of " permitted " explosives has not arisen. As against the higher degree of safety, which " permitted " explosives may conceivably give in some few mines where non-permitted explosives are used, there must be offset the extra danger involved in their use in mines in which the consumption of large quantities of explosives is essential. I refer to the use of detonators the dangers attending the use of which are recognised in the Regulations controlling their use, and particularly to the presence of misfired shots with detonators.

My contention is that in Indian mines generally the balance from the point of view of safety is on the side of the continued use of non-permitted explosives.

Question 30.—Yes, but subject to the issue of certificates of service over a specified period.

Question 31.—It should be retained, and moreover exercised as it was intended that it should. This is stated to be " in special cases ". I consider that a mine in which a comparatively very large amount of explosive is regularly used is a " special case " and if the authorities have contrary views on that point, such as may cause them to withhold exemptions, the wording of the proviso should be altered so that they may in the interests of safety as against a too rigid application of the proviso, readily grant the necessary exemptions.

Question 32.—I have no suggestions, but I would observe that the issue of explosives and the return of unused explosives in the prescribed manner is rendered more difficult if it is done in the small quantities entailed by refusals of exemption under Regulation 106. And such difficulty is apt to lead to issues, etc., being made in a manner other than that prescribed.

Question 33.—In the Coalfields covered by the enquiries of your Committee:—

(*a*) No. 15 Seam Jharia. Thickness 7 feet 9 inches. Gradient 1 in 6. The coal is " Selected " grade quality, low in moisture content.

(*b*) Bharatchuck or Patmohna Seam in Raniganj coalfield. Thickness 9 feet of which the middle 5 feet only of selected grade is worked. Gradient 1 in 6 to 8. It has high percentage of volatile matter with medium moisture content.

(*c*) Kajora seam in Raniganj coalfield. Thickness 21 feet of which 9 feet is worked and is of No. 1 grade quality with high volatile and fairly high moisture content. The gradient is slight say 1 in 20.

(*l*) Jambad seam in Raniganj coalfield which is in two sections of 23 feet and (below) 19 feet respectively separated by a hard stone band 4 feet in thickness. Of the 23 feet section 14 feet 10 inches of No. 1 grade is worked. Of the 19 feet section 7 feet of No. 1 grade is worked. Gradient is slight 1 in 20 or under. Quality similar to (*c*).

(*e*) Barkui seam in the Pench Valley coalfield, Central Provinces. Thickness of the working section varies from 3 feet 10 inches to nearly 8 feet with an average of under 6 feet and above it, is a varying thickness of coal bands and shales in which deposits of pyrites exist which with those in the overlying sandstones, disintegrate in the goaves and form with water free sulphuric acid. The quality of the seam is comparatively poor though the calorific value is fair. Gradients vary from 1 in 5 to 1 in 16 and under. The seam is exceptionally hard requiring undercutting and explosives throughout and is expensive to work as compared with seams in the larger coalfields. No application for grading has ever been made.

Question 34.—Please refer to the answer to *Question 33*—

(*a*) The whole thickness is worked.

(*b*) The 2 feet above and 2 feet below the working section is left unworked, it being of very poor quality below Grade II.

(*c*) The 3 feet above and 9 feet section below the working section are very poor in quality and much banded. The upper 3 feet is also required for roof support as owing to shallow depth there is little or no hard strata above.

(*d*) The 8 feet 2 inches section above the 14 feet 10 inches section worked is much banded and very poor in quality. There is a thickness of 9 feet 3 inches above and 2 feet 3 inches below the 7 feet graded section also of poor quality. A recent analysis of the 2 feet 3 inches section showed 23 per cent. of ash and it is probably better in that respect than any other of the unworked sections under (*d*).

(*e*) The shale and coal bands above the working seam are worked to some extent to make height and are used in the colliery boilers.

Question 35.—In (*a*) to (*d*) (see previous answers) no depillaring is being or has been done. In (*e*) about 16 per cent. at present which is a higher percentage than for several years. Practically 100 per cent. of depillaring in (*e*) is being recovered, the greatest seam thickness in depillaring sections being 6 feet.

Question 36.—I can give no opinion of value.

Question 37.—A large quantity is left for the support of railway lines the diversion of which either temporarily or permanently in many cases must be quite feasible, and such operations properly carried out would release much of the coal. Rivers are not so easily divertable if of any size, while the cost of repairing or replacing a considerable bridge would exceed the value of the coal left for its support. Many buildings including whole villages could be re-built for less than the amount that would be required to stow beneath them. On the whole it might be said that a substantial proportion of the 200 million tons would be lost without stowing, though apart from what could be saved by the diversions of railways I think the amount of support required by the authorities is frequently excessive and could be reduced with safety.

I have no personal knowledge of cases where compensation has been paid under the Land Acquisition (Mines) Act.

Question 38.—I would say that in all cases the productivity of all the collieries could be or could have been increased and their life prolonged. The increase must be very variable from a small percentage, *i.e.*, nothing beyond that involved in the amount of coal locked up under railway lines, main roads, and nullahs and a few of the more important buildings. In other cases the amount of loss without stowing will be considerable from causes other than those mentioned above. It can be said that the loss may be as high as 50 per cent. In the cases enumerated under *Question 33* the maximum loss of coal under (*d*) in the working sections would be approximately 35 per cent, if no depillaring at all were attempted, *i.e.*, that amount of coal properly disposed in pillars would permit of the remaining 65 per cent. being extracted without danger. In (*e*) less than 5 per cent. from all causes would be left ordinarily without stowing.

Question 39.—"Wholesale extraction of the seam" I take to mean extraction without previous formation of pillars. Where, as is often the case in deep mines with large pillar centres it is difficult to get sufficient output in first working, this method of working has advantages and may in fact avoid premature depillaring in the ordinary way without packing. Generally speaking, this method has much to recommend it and with facilities for stowing it would probably be extensively adopted in time in many varieties of circumstances.

Question 40.—In selected areas of the Jharia coalfield.

Question 41.—I have had no considerable experience of stowing or its cost; hence I leave this question unanswered.

Question 42.—Mainly by a levy on all coal despatched from or used in British India to be paid by the consumer; and partly by a tonnage payment on coal or sand from royalty receivers and colliery owners affected, the latter in addition would bear the cost of actual stowing operations apart from the supply of the material for stowage.

This answer assumes that stowing material will be provided either through a licensed company, or by a statutory authority administered by a Board under Government auspices.

Question 43.—Yes, the statutory authority would be essential with either of the alternative schemes mentioned above. The Board should contain representatives chosen by the interests involved, *i.e.*, those who pay for the work, but Government should nominate one or more mining engineers preferably with no interests in the areas affected. The authority would have to employ an inspectorate the senior members of which should be mining engineers of standing and experience. If the railways are to be employed in the carriage of sand, their representation would be necessary.

Question 44.—No. It is very likely that the existence of facilities for reasonably cheap sand stowing will in themselves react favourably on methods of working a colliery and that interference which it is desirable to avoid, will not often be required. It may be desirable to transfer the powers, at present temporary, of the Mines Department under section 19 (1-A) to the statutory body and to make them permanent, in the areas affected by compulsory stowing schemes.

Question 45.—This question involves so many factors as to make it impossible to answer in detail. But it can be said that the savings under the heads mentioned may be considerable and with favourable conditions for the supply of packing material this may outweigh the outlay on stowing, in certain cases where expenditure or loss under the heads is ordinarily high. At the collieries at which sand packing is voluntarily carried out, it must be assumed that these advantages do outweigh the cost of such packing. All such collieries are favourably placed for packing, and usually much of the coal being under the river it would have to be left otherwise, and to that extent they must be regarded as exceptional. But it is fair to assume that there are many other collieries which would in the long run save on the process if only they were assured of sand at their pits mouth at low cost.

Question 46.—The owner of a colliery is the best judge of what is commercially valuable and his ability to work and sale at a profit any particular coal should be the criterion of its value at any time. I consider it is quite impracticable to assess the future commercial value of coal and the present can only be considered. Moreover the extent of the resources of the quality of coal now left behind is so vast that its conservation is not at all important.

No attempt at control is advisable in my opinion. It is not difficult to visualise cases where such interference would lead to the closing down of mines and possibly to their permanent abandonment and loss of their contained coal.

Question 47.—The case for consideration of this question is perhaps rather stronger than in the one preceding, for the reason that it is conceivable that an owner for sav lack of capital is unable to exploit an upper seam not perhaps much inferior in quality to

the one being worked, or owing to the thinness of the former or for other reasons being more expensive to work. But I would advocate interference only on clear evidence being forthcoming that the seam can be profitably worked at the time and no considerations of the future position should be permitted to enter.

Question 48.—I should define "coal of commercial value" as "coal which can be mined and used or sold profitably". Without those qualities it has no commercial value and as the conditions have changed in the past and probably in the future even greater changes may take place in the use of coal, it is not possible to say that any coal or seam is of commercial value beyond its present day position.

Question 49.—I would not like to answer this question in a general way but would say that each case should be judged on its merits. If the fire above is localised there may be no necessity to restrict ordinary working except vertically underneath the fire with a margin to cover the area of subsidence. Also if the fire is of small intensity and isolating facilities exist in the lower seam there may be little danger in permitting its ingress into the lower seam.

Question 50.—Yes. In the areas of compulsory stowing. Elsewhere mine owners should be given the alternative of supporting the sidings, etc., by stowing but should not be required to do so.

Question 51.—In availing themselves of the alternative (see previous answer) they should be assisted if the case is one for support of railways and sidings by the railway company bearing part of the cost of simultaneous stowing, at least in cases whereby the railway company is by those means relieved of its obligation to pay compensation for the coal which would otherwise be locked up. This should apply to any area whether stowing there is compulsory or not.

Question 52.—As I have had no experience I can only say that it appears likely that in many cases partial filling would be sufficient for full support of the strata.

Question 53.—I am inclined to think that almost any colliery having sand delivered at its pit-head free of charge would be at an advantage as compared with a colliery with similar conditions in which no stowing was attempted. It is probable that in most cases the savings enumerated in *Question 45* would work out to the advantage of the colliery and generally there should be no need of assistance further to the provision of free sand at the mine mouth.

Question 54.—(i) Safety. The Indian Mines Act up to date effectively controls mine methods from the point of view of safety and there is no pressing call for drastic innovations.

(ii) Conservation of a natural asset. There is no case for any intervention anywhere in India except in the Jharia coalfield and only in certain sections of that field. If any Government action is taken in this connection, it should be for those areas alone,

and only to the extent of providing facilities for stowing and enforcing their use, when advantage of them is not voluntarily taken.

My reason for recommending that these steps be confined to the Jherria field is in view of its special conditions of mining and holdings, which do not apply elsewhere.

Question 55.—Compulsory stowing should be restricted to portions of the Jharia coalfield. It is desirable to minimise avoidable waste but compulsory sand-stowing and other drastic methods would be best limited to comparatively small areas for a long time to come. I do not consider that there is case for Government action outside the Jharia field. The avoidable wastage in the Raniganj coalfield is small compared with the ultimate resources of that field.

Question 56.—I do not agree with general compulsion being applied. I think that compulsory arbitrations should be set up to meet cases where two or more colliery owners jointly put up an application based on grounds of economy or safety for adjustment of boundaries or amalgamation of properties or where a single owner of two or more adjoining properties under different landlords requires the amalgamation of the properties to form a single working unit. The arbitrating body to assess *salami* or other payments to compensate the respective royalty owners where there is a case for compensation.

Similarly cases put up by interested landlords for like adjustments could be dealt with to compel colliery owners to adjust boundaries or amalgamate properties.

Question 57.—I do not think there need always be grounds for disapproval to the arrangements described; that would depend on the methods of working and the restrictions imposed on the leases. In practice the arrangement must necessarily be less favourable for good and continuous working compared with sole ownership of all the seams. The dangers are such as might be expected through ignorance of or indifference to what was taking place in the over- or under-lying seam, and the lack of full control.

Question 58.—Yes, it is very desirable he should have such charge, but in the case of two managers' charges having common outlets under the same Agent, it should be possible to come to an arrangement to the satisfaction of the Department of Mines.

Question 59.—Yes. Adjacent collieries should be required to make and maintain surveys and to lodge joint plans for record with the Mines Department. Where there is uncertainty, *i.e.*, when the common boundary cannot be agreed upon this should also be recorded on the same plans for the subsequent proper application of Regulation 76.

For the purpose of maintenance of the surveys a notice or application from either owner should be made the grounds for a continuance of the original survey.

I do not consider any statutory authority is necessary for the above procedure; the Mines Department should have the control and also the power to order the continuation of the joint survey at any time, or to maintain the survey themselves.

Question 60.—Yes.

Question 61.—Inferior coal can be used for nearly all purposes for which superior coals are in ordinary use and it is only a question of adapting an industrial plant for its use, whether for steam raising or for other purposes. Obviously in a great many cases such adaptation would have to be very far-reaching.

The only practical suggestion I have is for the encouragement of the use of inferior coals from distant fields in which there are no better qualities. Railway freight rates must play a large part in such a scheme. By "distant fields" I mean those far from the Bengal and Bihar fields and with regard to these latter there is no inducement for consumers except those in or very near to them, to use their inferior coals so long as their cost at destination approximates to that of the better class coals.

Question 62.—The effect has been to ensure a more uniform and better class of output from collieries with graded seams and it has assisted the inland buyer as well as the shipment business which it was intended to do.

Another effect has been the non-extraction of quantities of unwanted coal some of which has been or will ultimately be lost for good. It being of a quality of which there are almost unlimited supplies the loss from the point of view of conserving is not very material. In the collieries with which I am connected no such seam sections have yet been lost, but it so happens that even without the Grading Board these sections would not be worked in the ordinary course.

I would suggest that the Board relax the ban on working graded and ungraded sections, or two sections of different grades in the same mine where it is shown the sections can be mined, and despatched separately.

Question 63.—The conditions in Great Britain are so dissimilar as to render comparisons of little value.

A better test is the number of such orders and notices issued recently as compared with the past, and let it be assumed that more are now being issued. It will be admitted that methods or practices are not worse than formerly and that there are more restrictions by means of the Mines Act. Therefore either conditions have become more dangerous and unstable in the course of working over years or the Department of Mines is displaying more zeal or in fact are over-zealous.

The former is admitted to be the case at least in the Jharia coalfield and it is a question of how far and to what extent action by the Mines Department has been taken to meet the circumstances

If the steps taken do exceed actual needs the circumstances are understandable after recent happenings and it can be hoped that matters will ultimately adjust themselves.

Oral Evidence.

Question 5.—My answer contemplates an average working depth of about 500 feet.

Question 6.—I would have no objection to the Temporary and Supplementary Regulations being made permanent with the modification referred to in my answer to *Question 28*. I would also have no objection to section 19 (I-A) of the Act being made permanent with the addition contemplated in my answer to *Question 24*. This answer, however, contemplated stowing for conservation purposes only.

Question 7.—I agree that positive ventilation is desirable in all such cases whether by means of a fan or any other means.

Question 10.—I would only be in favour of telephonic communications being required by law beyond a distance of one mile from the shaft bottom or other entrance to the mine.

Question 14.—Provided the bye-laws regarding coal dust applicable to fiery mines were extended to all mines by making them into a regulation, I should be prepared to agree to the extension of the Temporary Regulation No. 14 as proposed provided also the Mines Department had sufficient staff to see that the precautions required were actually being carried out. The dangers are so remote in many mines that the managers could not be left to take these precautions without being properly supervised.

Question 16.—I now understand the question clearly, but after discussion with the Committee I am not prepared to alter the opinion expressed in my written answer. I agree that sand-stowing would prevent the accumulation of gas and therefore make for safety.

Question 19.—I would agree to some general principles of first working being laid down provided they were sufficiently elastic to cover the varying conditions that obtained and were framed so as to be applied with reasonableness.

Question 20.—If the limits were laid down as contemplated in my answer to *Question 19*, I would agree to the legal prohibition of the practices referred to beyond these limits except immediately before the systematic extraction of pillars.

Question 29.—"Permitted" explosives are more expensive than other high explosives because relatively more of that has to be used to produce the same result. I should say that, where coal is concerned, additional cost per ton of coal extracted would be at least 4 annas.

Questions 33 & 34.—The coal being left behind in all my seams is of very poor quality. It is not good enough to be used in the

colliery boilers, and, if it were given to the miners, the quantity would not make much difference to the amount that is left. Actually the danger from fire of leaving this poor quality coal has not arisen because we have not done much depillaring.

Question 36.—I cannot speak from personal knowledge, but the general opinion seems to be that no more than 50 per cent. of this coal will be recoverable with the existing methods of working.

Question 37.—I agree that my alternative remedy of diverting lines will not be feasible in most parts of the Jharia coalfields.

Question 40.—I say that the compulsory stowing should be limited to selected areas in the Jharia coalfields having in mind those areas in which the pillars could not be recovered without such stowing.

Question 42.—I would agree to the cess being levied on all coal carried by rail in or into British India.

Question 43.—I think that the Chairman of the statutory authority, I contemplate, should be a Government official of standing, especially if that statutory authority is also to be the appellate authority from orders of the Chief Inspector of Mines under section 19. The Mines Department should also be represented on the statutory authority.

Question 46.—I agree that, if the coal left is saleable at the time, the sectional working contemplated in question should be controlled.

Question 47.—I agree to the control contemplated provided 'commercial value' means saleable at the time.

Question 49.—My answer is superfluous provided Temporary Regulation No. 10 is interpreted as prohibiting work under that part of another seam which is actually on fire. I am inclined to think that the wording of Temporary Regulation No. 10 is somewhat ambiguous and might be cleared up with advantage.

Question 55.—After discussion with the Committee, I am inclined to agree that compulsory stowing should be started in those portions of the Jharia field to which I have referred and should be extended later to those portions of the Raniganj field, where necessity will arise when the pillars are extracted.

Question 56.—After discussion with the Committee I now agree to compulsion being applied in the type of cases contemplated in the question, which are understood to be extreme cases.

Question 57.—I agree that there is a case for controlling such working in cases where the two seams are not under single control.

Question 61.—I agree that highly preferential rates on second class coal would have the effect of restricting the use of first class coal and therefore in conserving it, but I would not be in favour of such preference.

Question 62.—I agree that the Coal Grading Act and the Board were intended originally for the benefit of shipment business only.

22. Written Evidence of Mr. G. A. Carver, Consulting Mining Engineer to the Bengal Court of Wards, and Superintendent of Kasimbazar Raj Wards' Estate Khas Collieries.

Question 1.—Consulting Mining Engineer to Bengal Court of Wards, and Superintendent of Kasimbazar Raj Wards' Estate Khas Collieries.

Approximately 11 years.

Chiefly Jharia and Raniganj coalfields but also Karanpura, Bukaro, Giridih, Central Provinces and Rewa State coalfields.

Question 2.—(i) (*a*) Premature collapse.

(*b*) Bad methods of workings.

(*c*) Unavoidable loss of coal in goaf without stowing.

(*d*) Avoidable loss of coal in goaf, *i.e.*, working restricted section of seam.

(*e*) Accidental means.

(ii) Yes.

(iii) Premature collapse.

Question 3.—(i) Most seams of commercial value from experience have proved liable to spontaneous combustion, and those that have been mined most extensively show the greatest susceptibility.

Nos. 14, 14A and 15 seams in the Jharia field, Poniati, Dishergarh, Ghusick and Kajora seams in the Raniganj field.

(ii) It varies considerably due to condition and I am of opinion no hard and fast rule can be laid down.

In seams such as Poniati and Dishergarh generally speaking we do not allow commencement of depillaring in an area that completion will entail a period of longer than 1½ years.

(iii) Most seams of commercial value are liable, but there are quite a number which have so far shown no signs.

Question 4.—(*a*) Fires underground are always a potential danger to safety and minerals, but in many instances that danger can be controlled and reduced to such a minimum that they can be safely allowed in parallel with the other dangers of mining.

(*b*) During the final states of pillar extraction and as one seam after another is extracted the dangers and difficulties increase.

Question 5.—(*a*) Yes.

(*b*) Varies according to depth, inclination, thickness, character, etc., of the seam, but up to a depth of 1,500 feet in a seam like Poniati or Dishergarh with an inclination of not more than 1 in 6 approximately 15 per cent.

Question 6.—I consider they are adequate.

Question 7.—Provided there is adequate natural ventilation, mechanical is not necessary, but it is essential to have fire areas separately ventilated which is difficult in mines with natural means only.

Question 8.—(*a*) Yes.

(*b*) Yes, an instance is the following:—

S. E. Baraboni Khas Colliery, working bottom 8 feet section leaving 4 feet 6 inches of inferior coal in roof during pillar extraction fire formed in goaf after a period of months. This seam was mined and depillared extensively at this colliery without leaving any roof coal, and no fire or heating was ever observed.

Question 9.—Yes.

Question 10.—Would be an advantage, but, I am of opinion, unnecessary as a compulsory measure, except in mines with high inclination, and extensive workings underground.

Question 11.—(*a*) Adequate materials *in situ* for building up fire stoppings which are partly opened due to passages of ventilations, or materials, etc.

(*b*) Adequate materials near at hand in case of emergency.

(*c*) Protection of fire stoppings.

(*d*) Adequate supply of safety lamps in case of emergency.

Question 12.—Yes—but that training should be of a practical nature.

Question 13.—For rescue work, and very temporary work to deal with ventilation.

Question 14.—Should apply to all mines.

Question 15.—Yes.

(*a*) Panel system.

(*b*)Isolation of de-pillaring areas.

(*c*) Depillaring areas to be of such a size that they will be completed within certain period of time.

(*d*) Restricted height of galleries prior to de-pillaring.

Question 16.—No.

Question 17.—Bad mining methods.

Question 18.—(*a*) Fires.

(*b*) Air blast.

(*c*) Inundation of water, or gas.

(*d*) Collapse of surface, buildings, etc.

(*e*) Danger to life.

(*f*) Disturbance of ventilation, etc.

In all cases premature collapse is due to inadequate support, and the remedy is proper lay-out, with proper supervision to see that the mine is not being endangered, as also stowing.

Question 19.—Sizes of pillars and of galleries should be regulated by law, but am of opinion superficial percentages according to depths a good basis.

Question 20.—No maximum, and minimum law can be laid down, as circumstances alter cases. The following are percentages I have laid down in the cases mentioned:—

	Percentage of superficial area of seam. Per cent.
(1) Where the vertical depth from the surface is less than 300 feet	45
(2) Where the vertical depth from the surface exceeds 300 feet but does not exceed 400 feet	40
(3) Where the vertical depth from the surface exceeds 400 feet but does not exceed 500 feet	35
(4) Where the vertical depth from the surface exceeds 500 feet but does not exceed 600 feet	30
(5) Where the vertical depth from the surface exceeds 600 feet	25
(1) Where the vertical depth from the surface exceeds 500 feet but does not exceed 600 feet	30
(2) Where the vertical depth from the surface exceeds 600 feet but does not exceed 800 feet	25
(3) Where the vertical depth from the surface exceeds 800 feet	22

(*a*) Depth from surface.

(*b*) Thickness of seam.

(*c*) Inclination of seam.

(*d*) Nature and character of seam and overlying strata.

(*e*) Method and section of seam to be mined.

Question 21.—No, provided the superficial area of the seam as laid down in Question 20 is not exceeded.

Question 22.—Circumstances alter each individual case.

Question 23.—No.

Question 24.—I am of opinion the Mines Department have this power at present.

Question 25.—None, other than those officially reported.

Question 26.—Theoretically that must be correct but practically have had no experience.

Question 27.—(*a*) Proper and adequate support for surface accumulation of water.

(*b*) Proper drainage of surface over goafed areas.

(*c*) Present legislation I am of opinion adequate for mining operations in the vicinity of old workings.

(*d*) Appointment of competent surveyors.

(*e*) Proper drainage of fire areas, underground.

All precautions should be enforced legally if considered necessary for safety.

Question 28.—None, except shot-firers to be qualified men having passed a practical examination.

Question 29.—Yes.

Question 30.—Yes.

Question 31.—Should be retained. 5 lbs. in the majority of cases is adequate but there are cases where it is not, and a few places having a larger quantity would be safer than a large number of places with 5 lbs.

Question 33.—Ekra Colliery—

	Quality.	Thickness.	Inclination.
15 Seam . .	Grade I . .	10′ 6″	1 in 3·2
14 „ . .	Selected Grade .	28′	1 „ 6
13 „ . .	Do. .	22′	1 „ 6
12 „ . .	Do. .	13′	1 „ 6
11 „ . .	Grades III and II	18′	1 „ 6

S. E. Baraboni Colliery—

Koithi Seam .	Selected Grade .	13′ Working bottom 8 ft.	1 „ 6
Poniati Seam .	Do. .	18′	1 „ 6

Chapui Colliery—

Nega Seam .	Grade I . .	16′ 3″	1 „ 12

Question 34.—Ekra Colliery—

No. 11 Seam, North area, working bottom 16 feet, leaving 2 feet in roof.

No. 11 Seam, South area, working bottom 10 feet 8 inches, leaving 7 feet 4 inches in roof.

Also top 10 feet being mined leaving bottom 8 feet.

No. 12 Seam—Bottom 8 feet 4 inches leaving 4 feet in roof.

No. 13 Seam—Full thickness.

No. 14 Seam—Full thickness.

No. 15 Seam—Bottom 7 feet 2 inches leaving 3 feet 4 inches in roof.

S. E. Baraboni—

Poniati Seam—Bottom 8 feet leaving 10 feet. (Full thickness during de-pillaring.)

Koithi Seam—Bottom 8 feet 6 inches leaving 4 feet 6 inches. (Full thickness during de-pillaring.)

Chapui Colliery—

Nega Seam—Working full section of seam in two sections of 8 feet.

Question 35.—Ekra Colliery.—For the last six months 35 per cent. of output from pillars at times it has been as high as 70 per cent.

S. E. Baraboni.—All gallery coal.

Chapui.—All gallery coal.

Ekra Colliery—

Nos. 14 and 13 Seams approximately 85 per cent. of seam recovered in de-pillaring, excluding barriers.

No. 12 Seam where stowing is being done 97 per cent. of section worked.

Question 36.—Approximately two-thirds.

Question 37.—The words " locked up " can only apply when the coal has been mined, and the maximum quantity extracted without in any way endangering the surface in which case all the coal will be lost unless stowing is resorted to, or the object moved.

Following known geological characteristics, centralising despatching depôts, etc., would contribute towards recovery under railways.

Diversion of small rivers, and in many cases straightening of their courses, would relieve considerable areas which are locked up.

Am conversant with two cases where the Estate has obtained compensation for coal locked up under sidings or branch lines:—

(1) Ekra/Loyabad was settled under the Land Acquisition (Mines) Act, 1885, and the neighbouring colliery company paid.

(2) Radhamadabpur siding—compensation was paid to the Estate by Martins for coal locked up by amicable settlement.

Question 38.—This has been dealt with by me in *Question 14* of the Landlord's Representatives Questionnaire.

Question 39.—Either way depending on circumstances. If circumstances permit should favour stowing in the wholesale extraction of seam.

Question 40.—Stowing should apply in my opinion to—

(*a*) areas, seams, etc., where it is essential for the support of surface or overlying strata during de-pillaring operations,

(*b*) thick seams,

(*c*) highly inclined seams,

(*d*) badly worked properties where there is danger of collapse and subsequent high loss of coal and fire,

(*e*) safety.

Question 41.—Ekra Khas Colliery.—Hydraulic stowing in No. 12 Seam working bottom 8 feet 4 inches section of coal, 25 per cent. of seam having been extracted in first workings, inclination of seam 1 in 6.

Stowing commenced six months ago from the dip boundary of seam.

(a) Cost of extraction and loading with kind of material used—

Material used.	Cost of extraction (Rs. per 1,000 cubic feet).	Cost of loading (As. per tub of 30 cubic feet).
Ash	*Nil.*	1-3
Earth	5	*Nil.*
Stone (soft)	6	*Nil.*

(b) No crushing is done.

(c) As the stowing shaft is situated in the quarry itself, and within a short distance no transport charge is being incurred.

But later on when the distance increases a cost for transport may be necessary.

(d) Cost incurred in repairs, replacements, depreciation operation and supervision—

Repairs—

	Rs.	A.	P.
A mild steel hopper at top of stowing shaft, cost	120	0	0
Estimated cost of annual repairs	40	0	0
Mild steel stowing troughs length 1,600 feet, cost Rs. 1,828, estimated cost of annual repairs	914	0	0
Total	954	0	0

Replacement per annum—

M. S. hopper at top of stowing shaft	120	0	0
Flushing pipes in stowing shaft 109 feet 7 inches of 6 inches diameter M. S. pipes with 6 inches flanges for joints	227	3	0
4 C. I. bend pipes 6 inches diameter at bottom of stowing shaft at Rs. 20 each	80	0	0
M. S. troughs for conveying stowing material to point of stowing, length 1,600 feet	1,828	0	0
20 feet of 4 inches diameter armoured rubber hose pipe for pump section	109	9	0
Total	2,364	12	0

Depreciation operation—

Old Lancashire boiler shell used for storing the flushing water at surface 28 feet by 7 feet	600	0	0
Water pipes for carrying flushing water to water tank, and from water tank to hopper at surface—			
2 inches W. I. pipes, 210 feet 6 inches	65	12	6
2 inches flanges for same, 2	0	14	6
2 inches G. M. wheel valve, 1	5	11	3
1½ inches G. I. pipes, 78 feet	36	9	0
1½ inches G. M. wheel valve, 1	3	15	0
Total	712	14	3

	Rs.	A.	P.
Depreciation on this at 10 per cent. per annum	71	0	0
One Supervisor at Rs. 35 per month, salary for the year	420	0	0
(*e*) Cost of placing stowing material in position, 2 coolies at As. 7 per day each, wages for the week	5	4	0
(*f*) Approximate cost of pumping water back to surface per hour of stowing	0	12	0

5 cubic feet of debris are stowed per minute, the ratio of water : debris being 2 : 1. The vertical head the water is pumped to the surface is 450 feet.

Hand stowing—

(*a*) Cost of extraction and loading with kind of material used—

Material used.	Cost of extraction (Rs. per 1,000 cubic feet).	Cost of loading (As. per tub of 30 cubic feet).
Ash	*Nil.*	1-3
Earth	5	*Nil.*
Soft stone	6	*Nil.*
Medium stone	8-8 labour. 5 explosives used	*Nil.*
Hard stone	12 labour. 12 explosives used	*Nil.*

(*b*) No crushing is done.

	Per tub. Rs.	A.	P.
(*c*) Cost of transporting material to incline mouth	0	0	6
(*d*) Cost of transporting material from incline mouth to point of stowing	0	1	3

Tubs loaded with stowing material are lowered down incline haulage road on haulage rope a distance of 2,300 feet. The loaded tubs are then hand trammed along the loading level a distance from 100 feet to 500 feet to point of stowing.

(*e*) Cost of placing stowing material in position	0	1	3
2 coolies per day at As. 7 each, wages for the week	5	4	0

(*a*) Above system hydraulic stowing would be approximately As. 7-3 per ton of coal extracted in workings in virgin coal.

(*b*) Do. do. cost-per-ton on coal extracted from pillars already formed with 75 per cent. of seam remaining would be approximately As. 9 per ton.

Question 42.—(*a*) Safety—By the mine-owners.

(*b*) Conservation—By Government—Cess on all coal, Tariffs, and Co-operation of Landlords.

Question 43.—If compulsory stowing is to be introduced it is essential that a statutory authority be set up with the powers to define the area or seams in which pillars should only be extracted by stowing process.

The statutory authority should consist of an independent chairman, preferably a person with at least the status of Commissioner, a representative of the Mines Department and a quorum of three mining experts, of which one should be a landlord's representative. The committee of mining experts would be so formed that any individual would not have to express an opinion about a question concerning his own interests.

Question 44.—No.

Question 45.—Have no figures available.

Question 46.—Controlled.

Question 47.—Controlled.

Question 48.—Coal which is on demand as a trading commodity now, or likely to be in the not distant future, in the light of present knowledge and can be put on the market as such.

Question 49.—Yes.

Question 50.—If the coal so locked up is of commercial value.

Question 51.—In cases where the coal is in possession of the railway company, I am of opinion they should grant some concession in royalty in parallel with the landlords.

If sand stowing is made compulsory in the interests of conservation then the railway company should co-operate in view of the increased traffic and release from compensation.

Question 52.—Yes—there are certain seams under certain conditions where partial filling would suffice to prevent fires.

Question 53.—I am of opinion sand free at pit head would suffice, but of course the whole question centres on the selling price of coal, and whether it is for safety or conservation.

Question 54.—(*a*) Safety—Universal—It being essential that the mining community is safeguarded as far as it is possible.

(*b*) Conservation of a National asset—only apply to the coalfields possessing coking coals, as are at present known. The prospects of demand for coals other than coking does not warrant that expensive methods should be put into operation to conserve inferior seams.

Question 55.—Answered in *Question 54.*

Avoidable waste should be prevented as far as practicable.

Question 56.—Answered under Landlord's Questionnaire—*Question 7.*

Question 57.—Answered under Landlord's Questionnaire—*Question 9.*

Question 58.—Every case should be decided by the Department of Mines.

Question 59.—(*a*) Yes.

(*b*) Yes.

Question 60.—Yes.

Question 61.—Research on the use of Indian coals on their railways has led to increased popularity of the semi-inferior coals, and although pit head price is a small concern in buying Loco coal for long distances, it should be universal for railway in the near vicinity of the coalfield.

Question 62.—Has had no effects on methods of extraction other than would have been brought about by the prevailing economic conditions.

What has been in many cases wrongly turned waste is entirely due to the economic conditions prevailing, and the practice of working restricted sections would have been just as prevalent without the Act.

The practice of working restricted sections of a seam to meet the demand was in vogue prior to the inauguration of the Indian Coal Grading Board.

Question 63.—The information must be over a stated period of time and should imagine that this period is short.

From my limited personal knowledge it appears that section 19 of the Indian Mines Act has only quite recently been interpreted for apprehended danger, which would suddenly increase the notices, and orders.

Oral Evidence.

Question 3.—What I mean by saying that seams that have been mined most extensively show the greatest susceptibility to spontaneous combustion is that these seams have been mined by bad methods. The tendency has also been to work good seams first.

Question 5.—Generally speaking, I think that panel system of working is an improvement over the pillar and stall system both as regards safety and waste. My figure of 15 per cent. for loss in barriers is based on actual working in one mine.

Question 6.—I consider that the Temporary and Supplementary Regulations, and the temporary legislation introduced by the Amending Act of 1936, should be made permanent.

Question 7.—I have never had to deal with a fire when the ventilation has been by natural means. I prefer to have mechanical ventilation when dealing with fires.

Question 8.—The seam referred to is the Koithi seam. The reason for working only the bottom 8 feet section has been the state of the market and the fact that only the bottom 8 feet was graded as selected.

Question 10.—I mean that in all cases where the workings extend to more than 1,500 to 2,000 feet beyond the shaft bottom, there should be telephonic connections.

Question 16.—I agree that sand-stowing would prevent the dangers referred to in this question, but I do not think that such stowing should be enforced even taking into consideration the ignorance of the labour force employed. I think that it would be better to train that labour force in the proper use of safety lamps, etc., rather than enforce sand-stowing. Combining safety with conservation I agree that sand-stowing should be enforced with adequate safeguards.

Questions 19 & 20.—I agree that it would be a good thing to lay down some general principles of first working by regulation. My own preference would be for a system of superficial percentages of floor area. The percentages I have given are on the full thickness of the seam and would be suitable for seams up to about 16 feet. For thicker seams I would also limit the height of the galleries.

Question 21.—What I mean is that, where limits of first working have been laid down by regulation, splitting and reduction of pillars and heightening of gallery should be prohibited except immediately before the systematic extraction of pillars. In such systematic extraction no splitting, etc., should be allowed more than three pillars length ahead of the extraction.

Question 24.—I think that, if the Mines Department have not already got the power under section 19 (1-A), they should be given the power of requiring sand-stowing in the interests of safety to life whether under ground or on the surface. Any order passed under this power should not carry a penalty unless the order is countervened.

Questions 33 & 34.—Coal worked from our Grade II seam in No. 11 seam is sold for the manufacture of soft coke entirely.

We are stowing completely in No. 12 seam in order to prevent the danger of fire from the four feet left in the roof and from possible danger from the depillared area of 13 and 14 above. I am trying to get the Grading Board to agree to the grading of the whole of the Poniati and Koithi seams together in order that I may be able to recover the top four feet of the Koithi seam along with the Poniati seam. The two mixed together should still be of selected grade, because the Poniati seam quality is so good. It would be difficult to extend this system generally because of the difficulties of proportionate mixing of the output from separate seams.

Question 35.—Including the loss in barriers in seams 13 and 14, approximately 80 per cent. of the seam is being recovered.

Question 39.—What I mean to say is that I am in favour of the enforcement of a system of sand-stowing for purposes of conservation within the limits of my reply to *Question 40.*

Question 43.—I would be prepared to revise the latter part of my answer and agree that the persons interested in any particular question should be represented on the statutory authority provided that authority is also to hear appeals from orders under section 19.

Question 54 (b).—After discussion with the Committee I would now like to withdraw my statement that the conservation of coal as a national asset should be restricted to coking coals only. I think that conservation should cover all coals of commercial value, whether for steam purposes or for coking purposes.

Question 55.—I agree that "avoidable waste" may be defined from a mining or national point of view as "all waste which is not incidental to the proper and efficient working of the system of mining in use". If, however, part of such "avoidable waste" was not of commercial value at the moment, it will cease to be avoidable waste from the commercial point of view.

Question 62.—Assuming that there is "avoidable waste" caused by the Grading Board in respect of coal sold within India, I do not know of anything that can be done to remedy that situation. I think that the situation has been brought about entirely by economic conditions and is not due to the operations of the Grading Board as such. My own opinion is that, if conservation of all kinds of coal is introduced by legislation, the reduction in output will send up the price of coal and will make it profitable to work coal which is now being wasted by the present system of working.

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23. Written Evidence of Mr. N. Ghosh, Manager, Muslia Colliery, Burdwan District.

Question 1.—Manager, Muslia Colliery.

I have Indian mining experience of seventeen and a half years (including Lecturer, Indian School of Mines, and Bengal Coalfields for seven and a half years). I have experience of both Raniganj and Jharia Coalfields.

Question 2.—Main cause of underground fires of coal mines in India: by flame, by some form of external heat higher than the ignition point of the combustible present and by spontaneous combustion or self-heating through oxidation at first slowly, then more rapidly. Yes, the number of fires has increased in recent years. It has increased by premature collapses accompanied with normal collapses.

Question 3.—Dishergarh, Sanctoria, Kajora, Poniati, Niga, Ghusick, Jote-Janaki, Jemihari, Nimcha, etc., at Raniganj and nearly all seams of Jharia above No. 9. Incubation period—6 months to two years average. It was also found that fire broke out

in a Kajora seam within three months and in a Toposi seam within three weeks. Seam of commercial value is generally not free from spontaneous combustion.

Question 4.—Yes.

Question 5.—Certainly. About 20 per cent. to be left for barriers.

Question 6.—Adequate under the present condition.

Question 7.—Provided the natural ventilation is not adequate, mechanical ventilation should be adopted. I prefer exhaust fan but it depends much on the position of the fire.

Question 8.—Yes, the fire of Kajora is due to this.

Question 9.—Yes, it is necessary wherever possible.

Question 10.—No legislation is required but where necessary and convenient it is better to have telephonic communication. Matter should be left at the discretion of the management.

Question 11.—In addition to the requirements as per regulation and circulars fire extinguishers will be much helpful.

Question 12.—Yes, it should have been started immediately after the Loyabad accident.

Question 13.—They are essentially necessary.

Question 14.—Yes, precautions in advance are certainly better.

Question 15.—Panel system of working with sufficient materials in stock for stopping at convenient places and all other possible precautions.

Question 16.—Yes, in seams giving off large quantity of inflammable gas.

Question 17.—Weak pillars, friability of coal.

Question 18.—Serious accidents, fire, inundation, damages to properties. It can be prevented by stowing or adequate supporting.

Question 19.—It is not possible—depending mainly on different circumstances.

Question 20.—Does not arise—it depends on the depth, nature of strata, thickness of the seam, inclination, nature of coal, etc.

Question 21.—No. But robbing to such an extent to help premature collapse should be prohibited.

Question 22.—Depends on circumstances.

Question 23.—Should be left to the management.

Question 24.—Does not arise. Section 19-A covers everything.

Question 25.—Ramnagar through Barakar River, Fularibad through a fissure. Loyabad through adjoining water locked area. Tetulmari due to obstructing adjoining Jore by Railway Company in course of repairing a bridge.

Question 26.—Yes, they do. This was the cause of Bagdigi accident.

Question 27.—Embankments, bands, record of highest flood levels, cutting of drains, blanketings, proper watching, draining out of accumulated water at the surface. Yes, legally wherever necessary.

Question 28.—None.

Question 29.—No, it is already covered under Regulations.

Question 30.—Yes.

Question 31.—Should be retained. This may be relaxed in special cases as sometimes practical difficulties are felt in travelling long distances.

Question 32.—No.

Question 33.—Ghusick seam, 1st grade, 11 feet, 1 in 10.

Question 34.—Whole.

Question 35.—First working in progress, no pillar-cutting.

Question 36.—Not more than 40 per cent.

Question 37.—Yes, Rs. 1,80,000 paid to North Barakar Coal Company by East Indian Railway *plus* 84,000 to royalty owners. Rs. 96,000 has been decreed in favour of Khora Ramjee for coal locked under East Indian Railway, Jharia Station Yard extension. Mahratta of Kasimbazar has been awarded about one lac of rupees from Public Works Department for coal locked under Grant Trunk Road and Barakar Bridge.

Question 38.—More percentage of coal will be available with minimum chance of accidents and damages.

Question 39.—Simultaneously with the extraction of pillars.

Question 40.—Fire-area, water logged area, having good upper seams, selected grade coal, coal liable to spontaneous combustion, under important surface features. But stowing mainly depends upon the cheap availability of stowing materials.

Question 41.—I have no detailed cost in record but the average cost for hydraulic stowing varies from annas twelve to rupee one and annas four per ton of coal extracted.

Question 42.—Yes, I am in favour of stowing in certain conditions, I suggest that the cost may be met from—colliery, royalty owners, cess on despatches, rebate on railway freight and countervailing import duty.

Question 43.—Yes, I agree for constituting a statutory authority. It should consist of representatives from different bodies connected with the industries. They should be experienced mining engineers. It should include the Chief Inspector of Mines or an Inspector as *ex-officio* member.

Question 44.—No.

Question 45.—There will be saving in all the items excepting the cost of getting coal, further there will be no interruption of workings due to roof-weights.

Question 46.—Yes, to be controlled wherever possible.

Question 47.—Yes, to be controlled wherever possible.

Question 48.—Any coal that gives high calorific value or can be sold in the market.

Question 49.—Yes.

Question 50.—Yes.

Question 51.—Yes, they should, as they will be saved from paying compensation and will earn extra revenue by freight.

Question 52.—Yes, partial filling is sufficient in cases of thin seams. It was successfully adopted in Amlabad.

Question 53.—Additional financial assistance may be required in some cases.

Question 54.—Statutory control is not desirable, but advice from Mines Department is welcome.

Question 55.—It should be adopted in both the fields considering the economical side of the trade. Yes, the avoidable waste shall be stopped where possible.

Question 56.—Yes, wherever possible.

Question 57.—I do not approve of this as sometimes it is very difficult to hold others responsible and restrictions may be imposed so as not to make the other seams dangerous.

Question 58.—No objection provided if both the shafts or outlets are under one management, otherwise difficulties may arise concerning the facilities in having two shafts. There may also be difficulties in ventilation and other matters.

Question 59.—Joint survey to be made. In case of differences it should be surveyed and settled by the Mines Department.

Question 60.—Yes, it is already required by regulations.

Question 61.—Railway freight should be reduced for inferior coal. Locomotives to be designed to burn inferior coal. Mixture of inferior caking coal with good non-caking coal to produce cokes. Mixture of good and inferior coal to produce soft coke.

Question 62.—Grading Board is responsible for the waste of inferior section of coal. Leaving of un-graded coal in goaves causes fire, as was the case in Kajora and many other seams.

Question 63.—This is no doubt due to series of recent accidents and partly nervousness on the part of the Mines Department.

Oral Evidence.

Question 5.—This average percentage of 20 per cent. is for a depth of 1,500 feet. The whole of it would be lost.

Question 6.—I agree to the Temporary and Supplementary Regulations being made permanent. I also agree to the temporary legislation of 1936 being made permanent with the exception of sub-section (*b*) of section 19 (1-A) empowering the Mines Department to limit the dimensions of galleries. I give this opinion even though I know that the Second Subsidence Committee has recommended that no gallery should in future be allowed to be driven more than 10 feet high.

Question 19.—I have no objection to the general principles of first working being laid down by law or regulation provided the varying conditions are taken into consideration.

Question 21.—After discussion with the Committee, I now agree to the legal prohibitions proposed.

Question 24.—After discussion with the Committee, I now agree that section 19 (1-A) should be extended so as to give powers to require mine-owners to pack in the circumstances stated.

Question 29.—After discussion with the Committee, I am now in favour of the extended use of "permitted" explosives as proposed.

Question 38.—I think that the life and productivity of my colliery would be increased by about 20 per cent.

Question 43.—I think that the Chairman should be elected by the members of the statutory authority. I would have no objection either to the Chief Inspector of Mines or to a mining engineer being the Chairman.

Question 54.—I agree that we already have statutory control as regards safety. As regards conservation, I would agree to statutory control by an authority constituted in the manner stated in my reply to *Question 43.*

Question 62.—I do not think that the system of grading should have been extended to the internal trade. I agree also that some means should be found for limiting grading to the export coal only.

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24. Written Evidence of Mr. H. Lancaster, Colliery Superintendent, State Railways' Coal Department.

Question 1.—Colliery Superintendent, State Railways' Coal Department. 24 years. As Inspector of Mines, Mines Department, Government of India, experience of all the coalfields in British India and as Colliery Superintendent 14 years' experience of the Giridih and Bokaro coalfields.

Question 2.—The main cause of underground fires in coal mines in India is the incomplete extraction of pillars resulting in spontaneous combustion. This may have been due to the premature

collapse of pillars of insufficient size in some instances and in others to the crushing of barriers of insufficient strength, and these factors are accentuated where seams are superimposed one above the other as is the case in the Jharia coalfield.

The number of fires has increased in recent years. Probably more fires have been caused by premature collapse and crushing than otherwise.

Question 3.—The better class seams appear to be most liable to spontaneous combustion although fires do occur in inferior seams. The period of incubation varies. The minimum period is probably from three to four months but the average period is longer. No seam of commercial value is free from the risk of spontaneous combustion.

Question 4.—Underground fires obviously increase the difficulties and dangers of extracting coal, particularly during pillar extraction where seams superimposed are worked simultaneously. The panel system has many advantages but experience has proved that fires can penetrate the barriers of panels of insufficient width and strength and are unable to withstand crush.

Question 5.—The percentage of the seam to be left in barriers where stowing is not done varies according to the nature and thickness of the coal seam, the quality of the roof and whether more than one seam has been or is being worked.

Question 6.—Yes. The Temporary Regulations are adequate for the time being. I have no alternatives or modification to suggest.

Question 7.—Mechanical ventilation of all mines and seams where fires exist is certainly a great advantage.

Fans should be of the exhaust type, and, as required by Regulation 136, should be capable of being reversed when necessary.

Question 8.—Yes. I know of fires which have been caused by this.

Question 9.—Where water under pressure is available water mains for dealing with fires should be installed but legislation is not necessary or practicable.

Question 10.—I am strongly in favour of telephonic communication being required by law between remote parts of mines and the surface. These were installed some years ago in all the underground workings of the mines under my control.

Question 11.—Other precautions necessary are an adequate supply of materials for the immediate building of temporary and permanent stoppings in pillaring areas, and in the case of mines worked with open lights, an adequate number of safety lamps and torches for use in emergencies. Necessary precautionary measures exist under the Permanent and Temporary Regulations.

Question 12.—A Rescue Brigade is to be formed at Giridih collieries. It is proposed to train the rescue brigade staff in the

methods of dealing with underground fires in addition to mine rescue work.

Question 13.—I consider that breathing apparatus and gas masks would be of invaluable service in dealing with and extinguishing underground fires with safety provided the staff are properly trained in the use of such apparatus.

Question 14.—It would be an advantage to extend Temporary Regulation 14 to make it apply to all seams in mines which are known to be liable to spontaneous combustion, whether a fire has occurred or not.

Question 15.—Yes. The question is too complex to call for any definite suggestions. Conditions in mines differ so considerably that methods of working must vary according to circumstances and conditions.

Question 16.—The stowing of goaves during pillar extraction in order to prevent fires from a safety point of view is an advantage, where more than one seam is being worked and where inflammable gas exists.

Any seams where such conditions exist and where it is economically practicable.

Question 17.—Premature collapse is due either to forming pillars of insufficient size to support the superincumbent strata or to the reduction of the size of pillars subsequently and rendering them unsafe.

Question 18.—The principal danger following premature collapse of workings is an outbreak of fire due to spontaneous combustion. The only remedy to prevent premature collapse of unsafe workings is to stow them.

Question 19.—In the interest of coal conservation the fixing of minimum dimensions of pillars and the maximum dimensions of galleries by a competent authority appears to be a necessary precaution.

Question 20.—The minimum size of pillars and the minimum width and height of galleries would depend on several factors, *viz.*, thickness of the seams, proximity of superimposed seams to one another, nature of roof, and depth from surface. The dimensions laid down for workings under railway lines and sidings might be accepted as reasonable restrictions in such cases.

Question 21.—Yes.

Question 22.—Such restrictions would vary according to conditions prevailing. As a guide the dimensions and conditions providing for workings under railway lines and sidings might be accepted in the first instance.

Question 23.—Yes. But the authority should not be an individual.

Question 24.—Yes.

Question 25.—I know of many dangerous irruptions of water into the workings of mines due to flooding from rivers during the monsoons, collapse of barriers underground and subsidences due to pillar extractions.

Question 26.—Yes. In some cases.

Question 27.—The keeping of correct plans of the surface and underground workings, showing all surface features, contours, etc., leaving adequate barriers or pillars under or in dangerous proximity of rivers and nullahs, compelling mine owners to leave strong barriers on the boundaries of their properties to prevent water from breaking through them. The statutory authority should be legally responsible.

Question 28.—I consider that all shot-firing should be done between shifts, when the minimum number of persons is working underground, otherwise the Permanent and Temporary Regulations now in force are sufficient.

Question 29.—The extended use of "permitted" explosives would obviously result in greater safety and reduce the possibility of coal dust explosions in non-gaseous mines, where gunpowder and flaming explosives are being used at present.

Question 30.—They should certainly be properly trained and experienced officials and should possess a sirdar's certificate.

Question 31.—The Regulation should be retained, as it is a precaution against storing an excess quantity of explosives underground.

Question 32.—No.

Question 33.—The Karharbari seam.

Karharbari—This seam is classed as Selected Grade. The thickness varies from 9 feet to 26 feet. The inclination varies from 1 in 3 to 1 in 10.

Question 34.—The whole of the seam is extracted, except where a thick middle stone separates the seams into two sections where section is worked separately.

Question 35.—At Giridih collieries 85 per cent. of the output is being extracted from pillars.

The percentage of pillar coal extracted averages 90 per cent.

Question 36.—I am not in a position to answer this question.

Question 37.—I am not in a position to reply to the first part of this question. Compensation has been paid in several instances for coal under railway land, lines and sidings. Particulars can be obtained from the Agent, East Indian Railway.

Question 38.—Compulsory stowing, where necessary, would certainly lengthen the life and increase production at many mines.

Question 39.—Where filling and packing is necessary and economically practicable it should be carried out.

Question 40.—I am not prepared to give an opinion on this important issue.

Question 41.—No. But a scheme has been drawn up for sand stowing at one of the collieries under my control.

I am not in a position to answer questions (*a*), (*b*), (*c*), (*d*), (*e*) and (*f*) or (*a*) and (*b*).

Question 42.—This is an economic question. Small collieries would certainly not be able to bear the cost of stowing and it would be an additional burden on the cost of the larger collieries. A cess on output would probably be the most practicable way of meeting the cost of compulsory stowing.

Question 43.—A statutory authority would have to be set up and it should consist of a Board representative of all branches of the coal industry.

Question 44.—Yes. But with the right of appeal to arbitration.

Question 45.—(*a*) Timber costs would certainly be reduced.

(*b*) A saving would result.

(*c*) A reduction in pumping charges might be possible in some cases.

(*d*) A very large quantity of coal would be recovered.

(*e*) A saving would be effected.

(*f*) Would be improved in many cases.

(*g*) Would be possible in some collieries.

(*h*) Doubtful.

Questions 46 & 47.—This question is one which will require investigation by the statutory authority if one is formed with the necessary powers.

Question 48.—The definition of coal of commercial value appears to depend entirely on whether it is of any value for fuel purposes and if it can be sold at a profit.

Question 49.—This would be the only way of extracting the lower seam under the circumstances.

Question 50.—In the interests of coal conservation this appears to be a reasonable proposition.

Question 51.—Yes, because the railway concerned gets the benefit of traffic over such lines and sidings.

Question 52.—Complete filling should be insisted upon where stowing is considered necessary.

Question 53.—A free supply of sand for stowing purposes would in all probability be sufficient in some cases without any financial assistance. Each individual case should be decided on its merits.

Question 54.—Should be applied only to the Bihar and Bengal Coalfields, where necessary, in the first instance, as conservation is

a most important issue in these two fields at the present time, particularly in the case of the Jharia coalfield.

Question 55.—Avoidable waste should be stopped wherever it occurs.

Question 56.—I agree that steps should be taken to compel owners in such cases to amalgamate properties or re-adjust boundaries.

Question 57.—I do not approve of such an arrangement, as each owner would certainly develop and work the seam or seams as he pleased, possibly to the detriment of the other. Result—probable collapse, outbreak of fire and inundation of the working, with resultant loss of coal. Seams in such cases should be worked by one owner.

Question 58.—The provisions of Regulation 53 are satisfactory in the case of most mines. At the more important collieries the number of instances where the outlets of one mine are on the property of the other mine must be very few. In the case of small mines adjacent to one another it does not seem necessary to alter the existing practice.

Question 59.—The answer to both questions is in the affirmative.

Question 60.—Yes.

Question 61.—In future inferior coal will have to be consumed as the reserves of good quality coal become exhausted. Necessity will then produce, as it has done in other countries, methods of utilizing inferior coal for fuel purposes.

Question 62.—I am not in a position to reply to this question.

Question 63.—The assumption that the Mines Department in India has to interfere more than the Mines Department in Great Britain is correct, for the reason that methods and practices more dangerous to human life and stability exist in India. The ignorance and lack of education and training of the illiterate subordinate supervising staff and the labour force to a large extent also makes such interference necessary at the present time.

Oral Evidence.

Question 3.—I agree that the three main factors varying the period of incubation are friability, ventilation and moisture. The Bokaro seam is the most liable to spontaneous combustion of any seam that I know. It is that seam I am referring to in saying that the minimum period is probably from 3 to 4 months. The Karharbari seam is also liable to spontaneous combustion; the period of incubation is longer. I think that the fire in the Karharbari seam need not have occurred if the coal had been extracted more completely and if larger panel barriers had been left. In practising the Giridih dropping system wherever the main roof proved insecure, a certain amount of coal had to be lost and it was the coal left in the goaf which caused the fires. If the coal had

been worked by the system which is now being practised, the fire would not have occurred.

Question 4.—I agree with the view that, without sand-stowing in either case, the panel system increases the factor of safety, but involves comparatively more avoidable waste. I agree that where panel barriers do crush, it is because they have not been designed of sufficient thickness.

Question 5.—I also agree that panel barriers should be designed in consideration of depth.

Question 6.—I agree that the Temporary and Supplementary Regulations should be made permanent. I also agree that the temporary legislation of the Amending Act of 1936 should be made permanent.

Question 7.—I am strongly in favour of mechanical ventilation in mines where fires exist or are likely to occur during the extraction of pillars. In my own mines I certainly would have mechanical ventilation when dealing with fires. In mines in which there are no steam pumps or steam pipes underground I consider that mechanical ventilation is necessary when dealing with fires. I agree that in such circumstances mechanical ventilation should be enforced.

Question 9.—I agree that, where water under pressure is available, the precautions suggested should be required by law.

Question 10.—I think that the best method of requiring telephonic communications by law in the interests of safety would be to say that the Chief Inspector of Mines should be able to direct telephones to be installed where he considers this necessary for this purpose. In the case of the Jogtiabad explosion, I am definitely of opinion that the existence of telephonic communications underground enabled me to arrive much more quickly at the spot than would otherwise have been possible. In this particular instance also, speedy arrival on the scene was a very important factor in enabling us to deal quickly with the injured people.

Question 12.—With regard to rescue work, I have already on hand six sets of self-contained proto breathing apparatus with all the necessary auxiliary appliances and spares. I propose to establish a Central Rescue Station at Beniadi and send a team consisting of my most intelligent young Indian assistant as the captain and five picked men for training.

Question 16.—I am of the opinion that the introduction of electric safety lamps in a mine where pillars are being extracted and gas is likely to be expelled from goaf cavities is a measure of safety, but it should not be considered to be the ultimate safeguard against this danger. The ultimate safeguard is stowing to prevent the formation of goaf cavities.

Question 17.—It is within my experience that, even in otherwise well-worked mines, the reduction of the size of the pillars has taken place in order to increase output.

Question 19.—I agree that the general principles of first working should be laid down by law or regulation, and I think that the best way would be to base those principles on percentage of floor area *plus* the maximum height of 10 feet for the galleries.

Question 20.—I consider it definitely undesirable to allow any of these practices more than two pillars length ahead of the pillar that is being extracted or from the point at which pillar extraction is about to commence.

Question 22.—I think it is reasonable to require the thickness of the parting between workings in various sections of the seam to be equal to the height of the galleries in sections.

Question 23.—I agree that the statutory authority should be the controlling authority for conservation and should also be the appellate authority from the decisions of the Mines Department as regards safety. I think that the Chairman of that authority should be a mining engineer not connected in any way with the Mines Department nor with any commercial or industrial mining interest in India. There may be four other members, one of whom would be a representative of the Mines Department, one a mining engineer representing the particular mining interest concerned in the case, and the other two mining engineers selected by the Chairman from a panel of mining engineers maintained for the purpose.

Question 28.—After discussion with the Committee, I am prepared to modify my opinion to saying that all shot firing for purposes of getting coal should be done between shifts in the interests of safety wherever reasonably practicable.

Question 29.—Excluding gun-powder, the "permitted" explosives being used at Giridih is entirely satisfactory and does not appreciably cost more than other high explosives. The explosive used is Rounkol which is one of the new low intensity explosives.

Question 35.—The 90 per cent. of extraction refers to the actual coal being got in pillars and does not take into consideration coal left in internal barriers. High average is due to the good roof.

Question 36.—I think we will be lucky to get 50 per cent. of this coal outstanding in pillars in the two fields.

Question 39.—I think that filling or packing in the interests of conservation should be enforced if accompanied by some form of compensation.

Question 40.—I agree that such compulsory filling or packing should be enforced by the statutory authority to which I have referred where they consider it necessary.

Question 41.—The scheme referred to is in the interests both of safety and conservation.

Question 42.—I agree to a cess being imposed on all coal carried by rail in or into British India with an import duty on foreign coal and a draw-back of the same amount on export. This fund should be used to assist stowing where it is directed.

I think that royalty receivers should contribute to the cess funds. I think that the railways also should contribute to the cess funds.

Question 45.—I agree that one contingent advantage of compulsory stowing would be a very appreciable decrease in ultimate pumping charges.

Questions 46 & 47.—I agree that my answer means that such practices should be investigated and controlled where necessary, and also that control in some instances would involve prevention.

Question 52.—I am prepared to accept the opinion that in some instances partial stowing might be sufficient.

Question 55.—I agree to a definition of "avoidable waste" from a mining and national point of view as all waste which is not incidental to the proper and efficient working of the system of mining that is being followed. "Avoidable waste" from a commercial point of view might be differently defined, but I think that commercial considerations should be subordinated to mining and national considerations.

Question 58.—After discussion with the Committee, I agree now that Regulation 53 should be amended as proposed to cover the comparatively few cases in which its extension would be applicable.

Question 61.—I agree that a research organization into the possible uses of inferior coal and other allied questions should be set up and paid for out of the cess referred to in my answer to *Question 42*. I think that in the first instance research could be done by sending samples to the research organization in Great Britain.

Question 62.—I agree that the working of a seam in sections and leaving a part of the coal increases both waste and danger from fire. I agree also that the system of grading has intensified the methods of working seams in sections.

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25. Written Evidence of Mr. K. K. Baksi, Manager, Kirkend Colliery of Kirkend Coal Company, Manbhum.

Question 1.—Managership of the Kirkend Coal Company's Kirkend Colliery.

Twenty-two years' experience in the Raniganj and Jharia Coalfields but mainly in the latter field.

Question 2.—Spontaneous combustion of coal and shales.

Yes, but all are not due to the main cause.

Accidental causes also played a great part in some instances.

Premature collapse, by which I mean to include all collapses where coal could not be extracted fully and had to be left in the goaf.

Question 3.—Most of the Selected and Grade I Coal, and some of Grade II Coal in both the fields.

(*a*) Sanctoria, Dishergarh, Poniati, Jamehari, Kajora in Raniganj.

(*b*) XV, XIV, XIV-A, XIII, XII and XI in Jharia.

No, but seams of lower commercial value are not easily affected.

No fixed period, but it is not earlier than six months as far as is known, all depending on the conditions prevailing in the mine favourable for such combustion.

Question 4.—Yes.

Question 5.—Yes, but it is not always possible in small collieries by which I mean those of less than 400 *bighas* and without long strike lines.

Not less than 20 per cent. depending on the depth from the surface, nature and height of the seam to be worked.

Question 6.—Yes. But some additions are desirable as suggested below:—

(i) Regular recording of mine temperature, pressure of ventilation of all workings, as any likely danger from spontaneous combustion could be timely detected from careful examination of the records;

(ii) Also regular testing of mine gases in seams liable to spontaneous combustion, and in seams already on fire should be made.

Some modifications of the Regulations are also necessary, relaxing stringency.

Question 7.—Yes. The fans should be exhausting with reversing arrangement, but auxiliary forcing fans underground would be helpful in certain cases.

Question 8.—Yes. No particular case is known but there is little doubt that some fires were generated by this cause.

Question 9.—Yes, but with exceptions in very wet mines or part of mines, and also in mines less liable to spontaneous combustion.

Question 10.—No; additional codes of signals should suffice.

Question 11.—(i) Employment of trained men in rescue operations should be enforced.

(ii) Sufficient materials should be stocked underground to deal with fire.

Question 12.—Yes.

Question 13.—They are considered very necessary and most helpful in dealing with fires but must be used by trained men only.

Question 14.—Yes, as regards (*a*), but (*b*) is not necessary in all mines.

Question 15.—Yes. Stowing with incombustible materials the space from which pillars are extracted, in combination with a system of panel working, if possible.

Indiscriminate reduction of pillars before final extraction should be prohibited.

Question 16.—Yes. In seams liable to spontaneous combustion and in seams already on fire.

Question 17.—Weakness of pillars from various causes, and also weak superincumbent strata.

Question 18.—(i) Sudden air blast, (ii) expulsion of noxious and inflammable gases from goaves, (iii) irruption of water, (iv) fires and (v) consequent loss of property and human lives.

(i) By proper laying out of the workings with bigger sizes of pillars of suitable height and (ii) by full or partial stowing with incombustible materials.

Question 19.—Yes, after consulting with the manager and examining the local conditions as in the cases under Land Acquisition Act.

Question 20.—(*a*) (i) Minimum size of the pillars should be 50 feet square.

(ii) Maximum dimensions of galleries should be 12 feet × 12 feet with exceptions for air crossings, haulage lines, etc.

(*b*) (i) Thickness and nature of the cover and floor.

(ii) Inclination of the seam.

(iii) Nature of the coal.

(iv) Disturbances in the seam.

(v) Position of surface buildings, villages, towns, roads, rivers, tanks and railways.

(vi) Workings of the top seams, including old goaves and accumulation of water and fires.

Question 21.—Yes, with certain exception, *e.g.*, necessary crosscuts, etc.

Question 22.—(i) Not more than two sections should be opened out at a time.

(ii) No gallery should be normally more than 12 feet × 12 feet, and no pillar should be less than 50 feet square, with minimum parting of 10 feet, more or less depending upon the nature of the coal.

Question 23.—No.

Question 24.—Yes.

Question 25.—Yes. Phularitand, Loyabad, Bagdigi, etc.

(i) Breaking of embankments on surface (Phularitand, Angarpathra, Bagdigi).

(ii) Giving in of the river bed (Pandedih).

(iii) Sudden approach to water logged workings (Loyabad) not correctly shown on the plans.

Question 26.—Yes.

Question 27.—Drains and embankments round overlying and adjacent areas connected in any way with fire areas.

Yes.

Question 28.—None.

Question 29.—No.

Question 30.—Yes.

Question 31.—Should be retained.

Question 32.—Should be issued to certified men only.

Question 33.—XV, XIV, XIII, XII and XI Seam—

No. of seam.	Quality.	Thickness.	Inclination.
15	Selected Grade	19′ 6″	1 in 10
14	Un-graded but of superior quality .	26′ 0″	1 in 8
13	Selected grade leaving 1′ above floor	19′ 0″	1 in 8
12	No. 1 Grade leaving 8″ below roof .	12′ 0″	1 in 8
11	Selected grade leaving 6″ above floor	18′ 0″	1 in 8

Question 34.—XV seam:—Whole section of the seam is being extracted. The coal is fairly hard and does not weather soon. The seam has two shale bands. The roof is bad.

XIV seam:—Only 22 feet section from the floor upward is worked as the remaining portion is burnt. The seam is infested with bands of shales. The coal is hard and does not weather soon.

The roof and floor are both hard.

XIII seam:—Only 18 feet 6 inches section from the roof downward is worked leaving 1 foot on the floor. There are many bands in this seam.

The middle portion of the seam is softer and friable than the other portion. There are more bands near the roof than elsewhere.

The roof and floor stones are fairly hard but the roof breaks easily when the props are withdrawn.

XII seam:—Whole section is worked, leaving 8 inches near the roof. Fairly hard coal.

Roof stone is infested with cleavages and would come down even before the whole of the pillar of 70 feet × 70 feet size could be extracted.

The floor creeps at places.

XI seam:—Whole of the section leaving on 6 inches above the floor is worked.

The coal is harder than that of other seams.

Roof is strong though infested with cleavages.

Question 35.—66 per cent.

70 to 80 per cent.

Question 36.—Not more than 50 per cent. It might be less, due to fire and premature extensive collapse.

Question 37.—Yes. As far as I know one colliery in the Jharia and one in the Raniganj field have got some compensation from the railways.

Particulars are not known.

Question 38.—Life of the colliery will be prolonged but productivity would be less without machine cutting and other proper facilities.

Question 39.—Simultaneously with the extraction of pillars.

Question 40.—In all areas under railways, main roads, rivers, *nullahs*, undrainable tanks, towns and villages, under and round fire areas.

In all seams of commercial value liable to spontaneous combustion and in all workings liable to premature collapse.

Question 41.—I have experience of hand stowing.

Actual cost per ton of stowing material with details is given below:—

Item.	Cost per ton. Rs. A. P.
(*a*) Old boiler ash	0 7 6
(*b*) *Nil.*	
(*c*) By tubs of 30 cubic feet. Within 100 feet	0 1 6
(*d*) By haulage engine in tubs to a distance of 1,500 feet	0 2 3
(*e*) Ditto. ditto. .	0 4 6
(*f*) *Nil.*	
(*g*) Contingencies	0 0 3
	1 0 0

Question 41.—1 ton of this material will cover about 60 cubic feet of space underground. 3 tubs of ash=1 ton.

Additional cost per ton of coal raised:—

(*a*) Annas 4 to annas 10 according to conditions prevailing.

(*b*) Re. 1 to Rs. 1-8 according to conditions prevailing.

Question 42.—Yes, cess on all coal despatched, and royalty, etc., levied on the property.

Question 43.—Yes. Statutory authority should consist of:—

(1) Representatives of colliery owners.

(2) Representatives of royalty receivers.

(3) Representatives of managers' Association.

(4) Representatives of railways.

(5) Government nominee as Chairman.

Question 44.—No.

Question 45.—Certain amount of saving from 10 to 25 per cent. depending on the conditions of the mines under (*a*), (*b*), (*d*) and (*e*), none is likely under (*f*) and (*g*), but there will be loss under (*c*) and (*h*).

Questions 46 & 47.—Should be prevented.

Question 48.—All coal which can be worked profitably at normal trade conditions.

Question 49—Yes.

Question 50.—Yes, but not until pillar extraction is actually done leaving sufficient passages where necessary.

Question 51.—Yes, because they will be saved from paying compensations and will have the lines open for longer periods.

Question 52.—(i) Yes.

(ii) No.

(iii) Amlabad colliery is reported to be successful.

Question 53.—Not only additional financial assistance would be required in respect of actual stowing but loans for capital costs may be necessary.

Question 54.—Not over actual mining methods, but on general principles of (i) safety and (ii) conservation of a national asset, statutory authority should be universal.

Question 55.—Should be extended to all coalfields.

Yes.

Question 56.—Amalgamation is desirable but there are not only colliery owners' interests to be considered but those of the royalty receivers as well will have to be taken into account.

Readjustment of boundaries is the second best course.

Question 57.—Yes under certain restrictions and conditions imposed on all concerned.

Question 58.—Desirable, but not necessary if proper arrangements are made.

Questions 59 & 60.—Yes.

Question 61.—Yes.

(1) Locomotives and industrial boilers may be designed to burn inferior coal in various forms.

(2) Soft coke manufacture is certainly possible.

(3) Manufacture of briquetts may be undertaken.

(4) Scientific researches to recover bye-products, etc., should be undertaken.

Question 62.—Certain portions of almost every seam graded have to be left out.

1 foot on the floor of my XIII seam.

8 inches near the roof in XII seam.

6 inches near the floor of XI seam.

Question 63.—Because all concerned generally fail to do all things in proper spirit without outside pressure.

No.

Oral Evidence.

Question 6.—I am agreeable to the Temporary and Supplementary Regulations, and also the temporary legislation of 1936, being made permanent.

Question 14.—I agree to the extension of Temporary Regulation No. 14 as proposed.

Question 19.—After discussion with the Committee, I agree that general principles of first working may be laid down by regulation as such principles would apply in the large majority of cases. Exceptional cases should be provided for by giving the Chief Inspector power to vary the general principles. Further, if the Chief Inspector and the management disagree regarding any proposed variation, there should be a right of appeal to the same authority as hears appeals under the Mines Act. I agree that it is not of much use laying down general principles unless the penalty for infringing them is adequate and immediately enforceable. A suitable penalty would be to require the workings to be restored securely to the limits required by the principles and the all work in that section of the mine should be stopped in the meantime.

I think that the most suitable general principles of first working would be a percentage of floor area with a maximum height of 10 feet for galleries, but there should be provision for variation by the Chief Inspector of Mines to suit local conditions.

Question 30.—I am in favour of shot-firers having sirdar's certificates specially endorsed for gas testing and shot-firing.

Question 33.—All the coal which is being left in seams XI, XII and XIII on the floor and below the roof is of Grade II quality. This coal could be used for manufacturing soft coke, but we are not allowed by the Grading Board to work it at the same time as the graded section unless we surrender our grading certificate.

Question 42.—I see the justification of requiring mine-owners to contribute to the cess. The same reasons would apply to them as would apply to royalty receivers who I suggested should pay towards the cess. I think the railways should contribute in the form of repaying to the authority controlling the cess the cost of stowing under railway lines.

Question 43.—I agree that a statutory authority which contained representatives of all the people interested would be unwieldy. I agree therefore that the statutory authority should

consist of a Government nominee as Chairman who should be a senior Government official, the Chief Inspector of Mines, and 3 mining engineers selected by the Chairman for each meeting or series of meetings out of a permanent panel of 10 mining engineers actually working in the Indian coalfields.

Question 53.—If it were possible to give loans for capital expenditure to collieries to carry out sand-stowing directed by the statutory authority, the services of such loan should be the first charge on the colliery irrespective of any previous first charges that may be in existence.

Question 62.—I am definitely of opinion that the system of grading has increased waste and danger from fire. I would therefore be in favour of any measures which restricted, as was originally intended, the grading system to export coal only. One possible remedy would be to say that, where coal was being sold internally, the Grading Board should allow the graded and the ungraded section to be worked together without the grading certificate being withdrawn leaving it to the producer to supply the grade of coal required by the consumer and leaving it also to the consumer to see that he gets the grade of coal that is ordered.

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26. Written Evidence of Mr. B. K. Bose, Manager and Consulting Engineer of Gonshadih Colliery, Kusunda P. O., Manbhum.

Question 1.—Colliery Manager and Consulting Engineer to a group of collieries, 22 years' experience, of which 4 in the Raniganj field and 18 in the Jharia field.

Question 2.—The main cause of underground fires is spontaneous heating of coal left in the goaf.

Yes. More fires have been caused after pillar extraction.

Question 3.—In the Jharia field I find:—

XIV and XV seams most liable to spontaneous combustion.

XI, XII and XIII seams—comparatively less liable to spontaneous combustion.

X seam and downwards—not generally liable to spontaneous combustion.

In the Raniganj field:—

Most seams of Selected Grade and No. 1 Grade are liable to spontaneous combustion.

Incubation period varies from 6 months to 2 years being generally higher for the Jharia seams and lower for the Raniganj.

Generally speaking coal of the lesser commercial value is less liable to spontaneous combustion.

Question 4.—Yes.

Question 5.—Yes. Coal left in barriers about 20 per cent.

Question 6.—I think the Temporary Coal Mines Regulations are reasonably adequate against all possible dangers from fires. Some of the provisions requiring protective measures against likely outbreaks of fires in the future need not however be enforced in the case of collieries working lower grade coals, not generally liable to spontaneous combustion. It is further desirable that certain of the Regulations are modified and initiative left to the management to take such measures as may be necessary under particular circumstances.

Question 7.—Yes, if the natural ventilation is not adequate.

It is desirable to have exhausting fans with reversing arrangement.

Question 8.—Yes. Such as Poniati, Kajora, etc.

Question 9.—No, but it should be left to the management to adopt wherever it is found necessary.

Question 10.—No, but additional code of signals may be adopted instead.

Question 11.—Storage of necessary materials for dealing with fire.

Question 12.—Yes.

Question 13.—Both have advantages but must be used by trained men only.

Question 14.—Temporary Regulation 14 (*a*) may be extended to all seams liable to spontaneous combustion but 14 (*b*) need not be so extended.

Question 15.—Yes. The only known method by which the risk of fire occurring is entirely eliminated is to adopt sand stowing but there is a limit to its application.

Working on the panel system would minimise the risk to this extent that the area under fire can in most cases be isolated.

Further, reduction or weakening of pillars over large areas should be prevented.

Question 16.—Yes, packing, either partial or full, with sand or other suitable material should be enforced, as far as practicable, in all seams which give off inflammable gases.

Question 17.—Premature collapse of workings mainly due to the weakness of pillars.

Question 18.—This might lead to fire as well as injury to property and workman. Can be best prevented by lesser percentage of extraction in the first working and stowing around the weaker pillars in old workings.

Question 19.—No.

Question 20.—The factors governing the dimensions of pillars and galleries are the depth of workings, softness or hardness of the coal, nature of the roof and superincumbent strata, inclination of the seam, natural disturbances and other circumstances.

Question 21.—Yes, except in special cases.

Question 22.—It would not be desirable to open out more than two sections at a time of reasonable heights with a parting in between of about ten feet, depending on the nature of the coal.

Question 23.—No.

Question 24.—Yes, the statutory authority may require mine owners to pack or partially pack the galleries prior to the extraction of pillars where it considers it necessary for the stability of the workings and the prevention of premature collapse, provided proper facilities for such operation are afforded to them.

Question 25.—Yes.

Irruption of surface water into the fire area at Bagdigi colliery also irruptions of water into Phularitand, Ramnagore and other collieries.

Question 26.—Yes.

Question 27.—Drains should be cut or embankments made to prevent any sudden irruption of water into the mine and specially into the fire areas. Also tanks above a fire area should be drained out as far as possible.

This may be enforced legally.

Question 28.—The Regulations are considered sufficient for the purpose of safety.

Question 29.—Not necessary.

Question 30.—Yes.

Question 31.—This power may be retained for use in special cases.

Question 32.—No further suggestions beyond the requirements of the law is necessary if called for.

Question 33.—IX seam—12 feet—Grade II quality.

X seam varies from 28 feet thick to 43 feet thick. Middle section No. I Grade quality, rest inferior.

XI seam—21 feet to 24 feet—Grade I.

XII seam—12 feet—bottom 8 feet—Grade I.

XIII seam—14 feet—bottom 10 feet Selected Grade.

Inclination varies from 1 in 8 to 1 in 10.

Question 34.—X seam mostly top 16 feet to 18 feet is extracted in 1 section.

XI seam—Whole section extracted.

XII and XIII seams—Top 4 feet of ungraded coal left in goaf.

Question 35.—About 50 per cent. of output from pillars.

XI and XII seams are contiguous seams and are extracted simultaneously—

in XII seam pillars recovery: 60 per cent. excluding loss in roof coal;

in XI seam pillars recovery: 80 per cent.;

in XIII seam pillars recovery: 80 per cent. excluding loss in roof coal.

Question 36.—No accurate answer possible but 50 per cent. of this coal may be possible to extract.

Question 37.—Yes.

There have been several cases of compensation having been paid for such coal locked under railways.

Lodna, Khas Jharia and Begunia collieries.

Question 38.—Both the life and productivity will increase but not necessarily the yearly output.

Question 39.—Sand-stowing may be enforced simultaneously with the extraction of pillars.

Question 40.—Sand-stowing or stowing with other incombustible material, either partial or full, should be enforced—

(i) in all seams of Selected and Grade I quality which are liable to spontaneous combustion;

(ii) in all workings which are liable to be affected by premature collapse;

(iii) in all workings under a fire area and water locked areas;

(iv) under railway lines, towns, villages and rivers.

Question 41.—The following cost of stowing is given:—

(I) Hand stowing with ash and cinders—

Cost of 1 ton of ash to pack 60 cubic feet of coal space in situ.

	Rs.	A.	P.
(*a*) . .	0	7	6
(*c*) . .	0	1	6
(*d*) . .	0	2	3
(*e*) . .	0	4	6
Contingencies	0	0	3
	1	0	0 per ton of ash.

Surface lead 200 feet.

Underground lead 1,000 feet.

Transport in tubs by haulage.

(II) Hydraulic sand-stowing—

Average cost for 1 ton of sand to pack 20 cubic feet of coal space in situ.

	Rs.	A.	P.
(*a*) and (*c*) . .	0	2	0
(*d*) and (*e*) . .	0	2	0
(*f*) and Miscellaneous	0	1	6
	0	5	6 per ton of sand.

Surface lead less than one mile.

Underground lead 1,000 feet to 2,000 feet.

Transport by surface haulage and rope-way and then through pipes.

(III) Additional cost per ton of coal raised by stowing—

(*a*) In virgin coal:—

(i) As. 8 to As. 10 per ton of coal for full stowing.

(ii) As. 4 to As 5 per ton of coal for partial stowing.

(*b*) In workings formed into pillars Re. 1 to Rs. 1-8 per ton of coal.

Question 42.—Cess on all coal despatched and royalties paid.

Question 43.—Yes.

Statutory authority should consist of—

(1) Representatives of colliery owners,

(2) Representatives of royalty receivers,

(3) Representatives of colliery managers,

(4) Representatives of railways,

and the Chief Inspector of Mines in India as Chairman.

Question 44.—No.

Question 45.—Certain amount of saving depending on conditions of the mine is possible under (*a*), (*b*), (*d*) and (*e*) but there will be loss under (*c*) and (*h*) while no saving is likely under (*f*) and (*g*).

Questions 46 & 47.—Yes.

Question 48.—All coal which can be worked at a profit under normal conditions of the Trade.

Question 49.—Yes.

Question 50.—Yes, provided proper financial and other facilities are afforded.

Question 51.—The railways should bear a part of the cost as they would thus be saved from paying compensation for the coal locked.

Question 52.—For comparatively thin seams lying at the greater depths partial stowing should suffice.

Amlabad for instance.

Question 53.—Additional financial assistance would be required in respect of actual stowing.

Question 54.—Statutory control to the extent of requiring partial or full stowing to be done before pillar extraction, should be universal over the major coalfields in British India from the point of view of safety and conservation of national assets.

Question 55.—As far as possible should be adopted in the higher class seams of both the fields to prevent avoidable waste of such coal.

Question 56.—Readjustment of boundary would be very helpful and should be undertaken, if possible.

Amalgamation of smaller properties, however desirable would be difficult to achieve.

Question 57.—This is not a desirable arrangement, as the stability and security of the top seam workings would be affected by any unrestricted working in the bottom seam over which the former owner may have no control. But the arrangement can be made to work under certain restrictions also if sand-stowing is made compulsory.

Question 58.—Cases are very few where a manager has not charge of both outlets and no real difficulty has been experienced in the few existing cases which are entirely matters of mutual consent. No modification of the present law is therefore necessary.

Question 59.—The Department of Mines should request owners of adjacent properties to make a joint survey of the common barrier when the workings of either of the collieries approach the barrier. On their failing to do so the Department can undertake the survey itself and refer the matter to the statutory authority for necessary adjustment of barriers and other reliefs.

Question 60.—Yes.

Question 61.—For the larger use of the lower grade coal in place of higher grade at present being used the following suggestions may be considered:—

(1) Locomotives may be designed with a view to burn inferior coal with reasonably high efficiency.

(2) Railway freight and cess on inferior coal may be fixed on a reduced scale to give greater impetus to their use in the industries.

(3) High class coking coal like the Giridih coal, should be prevented from being used in the locomotives for steam raising.

Question 62.—Several seams all over the coalfields have been so graded as to leave out certain sections which are invariably lost and often increase the risk and difficulties of pillar extraction.

Question 63.—These notices and orders are of very recent growth and betray certain nervousness on the part of the Mines Department as a result of a series of big accidents in the coalfields.

We can not accept the inference that the practices dangerous to human life or safety are more frequent in India than in England.

Oral Evidence.

Question 33.—The Grade II quality coal in No. 9 seam is used for manufacturing soft coke and for small coal. The Grade I coal in XI and XII seams is also used for manufacturing soft coke, but the greater part of it is sold to the railways for locomotive purposes.

Question 34.—The top 4 feet of ungraded coal in XII and XIII seams is of a lower grade quality in my opinion, but which was not graded in case it put down the whole seam into Grade II. The leaving of this top four feet involves avoidable waste and also increases the danger from fire.

Question 35.—The percentages of recovery mentioned by me are all averages. I have no protective barriers. In XII and XIII seams I am leaving about a third of the seam in roof coal and the percentage of recovery from pillars will therefore have to be considerably reduced.

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27. Written Evidence of Mr. G. S. Rawal, Agent, K. & N. Collieries, Kusunda.

Question 1.—Agent of a colliery company.

About 20 years, mostly in Jharia coalfield.

Question 2.—Main cause of fires underground is the spontaneous heating of coal left in goaves.

Yes.

More fires occurred after pillar extraction.

Question 3.—In the Jharia coalfield XIV and XV seams in general, XI, XII and XIII in some cases.

X seam and downwards generally believed free from the risk of spontaneous combustion.

In the Raniganj coalfield almost all the coal seams of selected and first grade quality are believed to be liable to spontaneous combustion.

Incubation period is longer if ventilation is good. It varies at different places in different seams from 8 months in some case to 2 years in others.

Question 4.—Yes.

Question 5.—Yes.

This varies with the thickness and depth of the seam and incubation period.

From 15 to 20 per cent.

Question 6.—I think that the Temporary Coal Mines Regulations are reasonably adequate against possible dangers due to fires. At the time of consideration of making some or all of them permanent, some of them may be safely restricted for mines liable to spontaneous combustion only and low grade coal mines may be saved from unnecessary expense.

Question 7.—If natural ventilation is not adequate it is desirable to have a mechanical ventilator with reversing arrangements.

Question 8.—Yes, if the seam is liable to spontaneous combustion. Many fires in Jharia and Raniganj coalfields may be attributed to this cause.

Question 9.—No. This should be left to the discretion of the managements.

Question 10.—No.

Question 11.—Storing of necessary materials for dealing with fires.

Question 12.—Yes.

Question 13.—I have no experience of these safety appliances.

Question 14.—No. 14 (*a*) may be applied.

Question 15.—Yes, the mines believed to be liable to spontaneous combustion should be laid out on panel system and sufficient sealing material should be kept ready underground before pillar extraction is commenced.

Question 16.—Yes, this should be enforced in case of mines or seams having any record or susceptibility of giving off any inflammable gases in working them.

Question 17.—Pillars of insufficient sizes to support the area in question.

Question 18.—This may cause fire if coal is liable to spontaneous combustion, and enormous harm to person and property. In old workings this can be prevented by adequate stowing and supporting as the case may require. In new workings (first) less percentage of coal be extracted than what is being done at present in many cases.

Question 19.—No.

Question 20.—This depends on thickness of seam, depth of the seam, nature of coal, roof, floor, inclination of the seam, disturbances and surface structures if any.

Question 21.—Yes, splitting for maintaining the output should be stopped but I do not agree to the other part of the question.

Question 22.—No section should be higher than 30 feet. Number of sections should be as few as possible, say 2. Intervening parting should be 8 feet to 12 feet depending on the nature of coal bands, etc., in the parting to be left and other factors.

Question 23.—No.

Rather it is more essential to empower the Chief Inspector of Mines with powers of 1st class magistrate to deal with the surface questions when premature collapses or similar dangers are apprehended.

Question 24.—No such authority is necessary. The Chief Inspector of Mines has got power to meet the necessities of such cases which I support reserving right of appeal to the local Government or Mining Boards.

Question 25.—Yes.

Bagdigi, Loyabad and few more.

Question 26.—Yes.

Question 27.—By drains or embankments entry of water in the fiery area should be stopped as far as practicable.

Question 28.—*Nil.*

Question 29.—No.

Question 30.—Yes. Certificated sirdars also should be permitted to work as shot-firers.

Question 31.—Should be retained as no abuse of the power is known.

Question 32.—Nothing.

Question 33.—10 seam only, good second class quality, 46 feet thick, rate of dip 1 in 10.

Question 34.—This seam is generally worked in two sections, top section of coal is 25 feet to 28 feet thick and bottom section is 15 feet to 18 feet thick with intermediate shale band of 3 feet. At one incline pillar extraction is done in the top section of 25 feet to 28 feet.

The main development work is done in the bottom 7 feet 6 inches of the top section just above the shale band leaving about 18 feet in the roof.

Question 35.—At present 25 per cent. of the output is coming from pillars. About 85 per cent. of pillar coal has been recovered since the commencement of depillaring.

Question 36.—Roughly 50 per cent. can be recovered.

Question 37.—Yes.

In certain cases railways had to pay compensations. East Indian Railway paid such compensation to North Burrakur Coal Co., Ltd., and Khora Ramji.

Question 38.—If the stowing is made compulsory, it will increase the life and ultimate total production of the colliery but the annual output in small mines will necessarily decrease.

Question 39.—I am not in favour of enforcement of stowing in general as I consider it uneconomical. I have great doubts about the availability of sand at economic cost at the colliery in ample quantity and the capacity of the railways to handle the same without inconvenience and hindrance to the mine owners. If however in particular cases the stowing be enforced it should be done while extracting the pillars.

Question 40.—This should be enforced in gassy mines and pillar extraction under fire area, water logged area, railway lines, towns, rivers and public roads.

Question 41.—I have no experience of stowing and therefore cannot give correct idea about the cost of stowing.

Question 42.—Additional cost may be made available by a cess derived from—

(1) Iron and steel industries.

(2) Railway companies as far as support of railway lines is concerned.

(3) Royalty receivers who will get more coal to assess than what they will get under existing system of working.

(4) Contribution from general revenue as the scheme adopted will benefit the whole nation.

Question 43.—Statutory authority for this purpose if set up, should consist of:—

(1) Four representatives of mine owners.

(2) Two representatives of colliery managers.

(3) One representative of royalty receivers.

(4) One representative of iron and steel industry.

(5) One nominated by Railway Board.

(6) The Chief Inspector of Mines in India.

Question 44.—No.

Question 45.—As an offset to the increased cost of a system of stowing some saving will be possible depending on the condition of the mines in the following items:—

(*a*) Timber costs.

(*b*) Fire stopping.

(*d*) Margin of profit on extra quantity of coal that can be recovered.

(*e*) Compensation for land, buildings and accidents.

Ultimate gain under the head pumping is doubtful as there will be extra pumping on account of hydraulic stowing. Other items of cost will not vary appreciably.

The savings mentioned above may be out-done if output cannot be maintained as the overhead charges will affect adversely on smaller output.

Questions 46 & 47.—Yes.

Question 48.—Commercial value of a commodity is very difficult to be defined. The kind of coal considered valueless to-day may be considered valuable after some research or scarcity of better class of coal. Generally a commodity meeting its cost of production and giving some margin of profit can be considered a commodity of commercial value.

Question 49.—Yes.

Question 50.—For the restricted workings below railway sidings, villages, rivers, etc., there should be no necessity of stowing but if all the coal below the above-mentioned area is to be recovered, stowing should be enforced and compensation should be granted to meet the cost.

Question 51.—Yes, they will be saved from their liability of paying compensation under the Land Acquisition (Mines) Act.

Question 52.—I have no experience. I understand it is quite successful at Amlabad. I think it will be successful in thin seams.

Question 53.—No. Over and above the free sand all the additional cost should be settled in each case and paid to the colliery for complete stowing operation.

Question 54.—Any control desired for safety and conservation of national asset should be universal. One mine may not be put to a disadvantageous position from the other on account of the suggested control. As mentioned in reply to *Question 39.* I do not think that the general enforcement of stowing will be practicable. It should be however applied to all the fields to a certain limit.

Question 55.—No body is serious about the conservation of coking coals. If conservation is really desired and needed in the interest of the whole nation, the railways and iron industry owning coal mines should close down their mines producing coking and semi-coking coals.

All the high grade coking coal producing mines should be worked by stowing system and raise coal just enough to meet the needs of iron industry.

The coal companies required to restrict their output or close down should be suitably compensated.

Question 56.—Compulsory amalgamation is not possible.

Necessary help to persuade the landlords for adjustments be given if some parties solicit the same and thus encourage voluntary amalgamation.

Question 57.—This practice should be discouraged as far as possible. Wherever this state exists it should be under the same manager with necessary under-managers.

Question 58.—Such cases might be very rare and no real difficulty has been experienced on this account and therefore no amendment is necessary.

Question 59.—Yes. The Mines Department should have power to do the same if owners fail to comply with the order.

Question 60.—Yes.

Question 61.—Railways near the Central Provinces coalfields use coal much inferior than railways near Bengal and Bihar coalfields and therefore they will be in position to throw some light on this point.

Question 62.—Coal Grading Board has helped collieries to a great extent in the present depression. As for the waste the Grading Board cannot be blamed. After the first working in graded section the certificate may be cancelled and whole section or remainder may be worked out before pillars are extracted. I have no knowledge of the waste due to Grading Board Act.

Question 62.—These notices are of very recent date and I do not agree that issue of such notices proves that more dangerous methods are prevailing in Indian mining. Accidents and death rates in India are not higher than what they are in England.

Oral Evidence.

Question 6.—I would agree to the Temporary and Supplementary Regulations being made permanent provided they were restricted to mines liable to spontaneous combustion. As regards the legislation of 1936, I would agree to that being made permanent provided section 19 (1-A) (*b*) is excluded.

Question 19.—I agree, after discussion with the Committee, that it is desirable that some general principles of first working should be laid down by law or regulation, but I think it would be difficult to determine such principles owing to the great variety of conditions.

Question 21.—Assuming that the principles of first working were laid down, I would agree to the proposed prohibitions being legally enforced except immediately before the systematic extraction of pillars and excepting also the heightening of galleries.

Question 23.—What I mean by my answer to this question is that land acquisition proceedings should be speeded up in cases in which there is immediate danger to the buildings on the surface from probable premature collapses.

Question 33.—The good second quality coal is used for making soft coke and is also sold to the railways and the Bombay Port Trust. The coal is sent to Bombay by sea.

Question 39.—I would have no objection to the compulsory enforcement of stowing for safety purposes if the operation was brought within economic limits by supplying sand free and giving the cost of underground stowing.

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Question 42.—I am not in favour of the mine-owners being made to contribute in any way towards the cess intended to finance compulsory sand-stowing.

Question 45.—I agree that in most of the cases the ultimate gain under the head " pumping " will be considerable.

Question 53.—I am still in favour of all the additional cost being paid in each case. If, however, a flat rate were adopted, that flat rate should be on each ton of sand to be put into the mine.

Question 54.—My idea is that while the control should be universal, it (stowing) should be applied only to the better classes of coal and to conditions which are dangerous.

Question 55.—My idea in suggesting the conservation of coking coal in the first instance is that probably most of the other coal occurring in India may be cleaned as to be made available for steam raising purposes, whereas coking coal will be absolutely necessary for metallurgical purposes.

This would seem possible only by nationalizing all the coking coal mines.

Question 56.—I consider that compulsory amalgamation is desirable, but think that it would be very difficult practically.

Question 62.—I agree that the operations of the Coal Grading Board should have been restricted to export coal only and should not have been extended to the coal sold internally.

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28. Written Evidence of Mr. J. Kirk, Superintendent, Coal Department, The Tata Iron and Steel Co., Ltd., Jamshedpur.

Question 1.—Superintendent, Coal Department, The Tata Iron and Steel Company and Agent of their collieries.

28 years in India and experience of the Jharia and Raniganj coalfields.

Question 2.—Thick seams and the leaving of large quantities of coal in the workings either due to premature subsidences or pillar extraction.

Yes.

No detailed information is in my possession.

Question 3.—All seams over 15 ft. thick are liable to spontaneous combustion.

This varies.

No.

Question 4.—Yes.

Question 5.—Yes. 20 per cent.

Question 6.—No. I leave this to the Mines Department.

Question 7.—Yes. The fan should be capable of either exhausting or forcing.

Question 8.—Yes.

No.

Question 9.—Yes. In seams which have been proved to be liable to spontaneous combustion.

Question 10.—I have tried this in Indian mines, but the staff could not maintain the equipment in working order.

Question 11.—This is covered by emergency regulations.

Question 12.—Yes.

Question 13.—No experience, but they should prove useful under certain conditions.

Question 14.—Yes. To all mines working seams where spontaneous combustion has occurred in the underground workings.

Question 15.—Yes. Methods of working should be left to the colliery manager subject to rules to govern size of galleries and pillars.

Question 16.—No. Where such dangers occur, safety lamps and all other precautions regarding gassy mines should be enforced.

Question 17.—Inadequate support.

Question 18.—Loss of life and fires.

Leave sufficient support.

Question 19.—Yes.

Question 20.—This should vary according to the thickness of the seam and the depth from the surface.

Question 21.—Yes.

Question 22.—I am not in favour of working thick seams in two or three sections.

Seams of this description should be worked lift by lift and sand packed or hydraulically stowed as the coal is removed.

Question 23.—No. This can be covered by rules as per *Questions 19* and *20*.

Question 24.—The Chief Inspector of Mines already has this authority if he cares to use it.

Question 25.—No.

Question 26.—I am personally not aware of any case where this has occurred.

Question 27.—Such irruptions from the surface generally occur through abnormal rainfall, the mining, or the extraction of pillars too close to water courses or rivers.

This should be prohibited by Law.

Question 28.—None.

Questions 29 & 30.—Yes.

Question 31.—Abolished.

Question 32.—No.

Question 33.—XV, XVI, XVII, XVIII seams.

Thickness—Varies from 27′ to 4′-6″.

Quality—Selected to Grade I.

Inclination—Varies from 1 in 1 to 1 in 20.

Question 34.—So far the whole of such seams are being extracted.

Question 35.—40 per cent.

85 to 90 per cent.

Question 36.—I am not aware of the general conditions of all such workings, so I can give no opinion.

Question 37.—There is nothing lost when we know where it is. It is all a question of whether it is a commercial proposition to recover it.

No.

Question 38.—As the seams being pillared at present have a maximum thickness of 12′ stowing would not increase the output or appreciably increase the percentage of recovery. All it would do would be to increase the costs, but when seams over 12′ thick are being pillared, sand packing or stowing should be enforced.

Question 39.—Yes.

Question 40.—Yes. In seams over 15′ thick.

Question 41.—No.

Question 42.—The additional cost should be met by the colliery company and charged as any other colliery expenditure is, namely to Revenue Account.

If colliery companies cannot carry on mining operations by methods which will prevent fires, floods, premature subsidences due to high cost, then they should close down until such times as the price of coal can pay for correct mining methods.

Question 43.—This is a matter of which the Chief Inspector of Mines and his staff should have the necessary experience and authority to decide.

Question 44.—This should be decided by the Chief Inspector of Mines.

Question 45.—I am not in a position to give such detailed information.

Questions 46 & 47.—Yes.

Question 48.—Any seam of coal over 4′ thick which has previously been mined and sold in the open market.

Question 49.—This depends on the thickness of the strata between the two seams, the thickness of the seam itself, but generally speaking even taking the above facts into consideration no pillar extraction in a seam below another one which is on fire should be allowed unless hydraulic stowing is enforced, as even the breaking of the strata to such an extent that hot water can percolate freely into a lower seam is a definite danger due to spontaneous combustion.

I have personally seen coal piles set on fire through the waste water from a boiler injector being allowed to run into the coal stocks.

Question 50.—Yes. Under main lines and rivers.

Villages—These could probably be purchased and the houses demolished before pillar extraction was undertaken.

Question 51.—No. The railways are a necessity and must be supported.

Question 52.—Partial filling would be sufficient in most cases.

Question 53.—Yes.

No financial assistance should be given.

Question 54.—Universal.

Question 55.—I agree that avoidable waste should be stopped wherever it is liable to occur.

Question 56.—The bulk of the small properties have either been mined, standing in pillars or certain areas subsided, so that it is for all practical purposes too late to do much good, but where the lower seams are virgin compulsion should be enforced.

Question 57.—No.

The dangers with such a system are evident to any mining engineer and do not require to be mentioned in detail.

Questions 58, 59 & 60.—Yes.

Question 61.—This is a commercial proposition and should be left to the consumers.

Question 62.—Yes. If pillars are extracted in a graded section it would undoubtedly lead to waste.

Regarding instances:—

Gopalichuck—XII, XIII, XIV, XV seams.

Noonoodih-Jitpur—XVIII seam.

Question 63.—The principal reason for this is the number and thickness of coal seams in India, and that so far no provision has been made in the Act to control the width and the height of the galleries or the percentage of coal which may be extracted in the first working.

This combined with the class of labour and subordinate officials are in my opinion the principal reasons why it is necessary for the Mines Department to interfere with colliery operations.

My own opinion is that the Mines Department have not interfered as they should have done in the past. Pillars of coal are after all only props left to support the strata, and it is just as necessary for the Mines Department to see and insist on these being left of ample size to support the roof and prevent so-called premature subsidences as it is for them to insist on sufficient props being put in where pillar extraction is going on, or where bad roof conditions are met with in gallery driving.

Oral Evidence.

Question 3.—My answer relates only to seams in the Jharia field.

Question 6.—I have no objection to the Temporary and Supplementary Regulations, and the temporary legislation of 1936 being made permanent. All the provisions made in these Regulations and the Act are such as should be observed by a well-managed colliery.

Question 9.—I agree that the provisions should be limited to existing water mains.

Question 10.—The trial of telephonic communications referred to took place about 12 years ago. I agree that equipment has improved considerably since, but I think that if telephonic communications were insisted on arrangements should be made to place all the telephones in all the mines under common expert supervision. As regards the distance from the shaft bottom or entrance to the mine, I would suggest wherever the main haulage station or main pumping station is situated. These are usually about a thousand feet from the working faces.

Question 14.—I have no objection to the extension as proposed in the questionnaire, that is, I would extend it to all mines in which the coal is known to be liable to spontaneous combustion, even though such combustion may not have actually occurred.

Question 16.—My answer to *Question 16* was submitted before the Poidih disaster. There are certain seams in the Jharia and Raniganj coalfields which give off large quantities of inflammable gas and in which safety lamps are required to be used. There are also seams in which safety lamps are required to be used, but in which the quantity of inflammable gas is very small. In such cases as the Dishergarh seam the usual precautions against inflammable gas appear to be insufficient, and in order to prevent accumulations of gas being blown out of goaves stowing of goaves will be necessary and should be enforced. I am of the opinion that stowing should not be enforced in all seams in which safety lamps are required to be used. In the majority of seams in which safety lamps are required to be used, the quantity of gas is small and it should be possible to prevent accumulations in the goaf by adequate ventilation. In my opinion, in such seams it should be left to the Chief Inspector of Mines to decide whether stowing in order to prevent accumulations of gas in goaves is essential or not.

I do not consider that electric safety lamps are more safe than flame safety lamps. In one of my mines I have found magnetically locked flame safety lamps had been opened by drilling a hole at the side of the magnetic plunger. This is not only common in India; in Scotland I have found frequently indications of smoking in dangerous gassy mines.

Question 19.—I am definitely in favour of some general principles of first working being laid down by law or regulation, and I do not think that this would interfere with the initiative of managers. With such a system it would be essential to provide also for proper and periodical supervision and check by the surveyors of the Mines Department. I am in favour also of any departure from such principles being punished adequately and immediately. I would therefore agree to a penalty which required that the minimum required conditions should be securely and properly restored and that in the meantime no more work should be done in the particular gallery or pillar affected.

I agree that the best general principle would be to fix the percentage of floor area with a maximum height of gallery. This percentage would vary with the thickness of the seam and the depth from the surface.

Question 21.—I would define "immediately before the systematic extraction of pillars" as being a maximum distance of 50 feet from the outer edge of the pillar which is being extracted or about to be extracted. What I have said applies to seams up to 15 feet thick. As regards thicker seams, the conditions would be different but I would not allow pillars in such seams to be extracted without simultaneous sand-stowing.

Question 22.—My opinion as to the working of thick seams would have to be varied by the Chief Inspector of Mines in the case of thick seams which were steeply inclined.

Question 24.—If the Chief Inspector of Mines has not got this power already. I would agree to him being given the legal power to require or order mine-owners to pack under the conditions stated.

Question 30.—I think that all shot-firers should be required to have sirdar's certificates as well as shot-firer's certificates, or that their sirdar's certificates should be endorsed for shot-firing after a further test as is now done in the case of endorsements for gas testing. I am also of opinion that shot-firers should not be allowed to have any financial interest in the winning of coal. Within a period to be allowed all the present sirdars should be required to have their certificates endorsed specially for shot-firing.

Question 31.—After discussion with the Committee, I agree that Proviso to Regulation 106 should be retained.

Question 33.—We are actually working at present Nos. 15, 16, 17 and 18 seams up to a maximum thickness of 12 feet 6 inches.

We are working one seam 28 feet thisk, but have only got as far as driving galleries 8 feet high and 10 feet wide.

Question 36.—As things are going now, I am inclined to think that the percentage of recovery would be considerably less than 50 per cent.

Question 37.—I agree that where the recovery of coal under railway main lines is possible this should be done with stowing. As regards the colliery sidings, it would usually be more economical to pack on the surface rather than underground. This would depend, however, on the depth and the thickness of the seam.

Question 40.—My answer to this question is of course qualified by my answers to *Questions 46* and *47*. Stowing should be required in seams less than 15 feet thick where the conditions contemplated in *Questions 46* and *47* are present.

Qeustion 42.—I am not in favour of compulsory stowing either for safety or conservation being financed by a cess collected on all coal and coke carried by rail in or into British India.

Question 43.—What I mean is that any additional legal measures that may be taken either in the interests of safety or conservation should be under the control of the Mines Department. If necessary, the staff of that Department should be suitably increased in order to be able to do all this work.

Question 48.—I do not consider that ash percentage would be a suitable basis for a definition of coal of commercial value. I am of opinion that even Grade III coal is coal of commercial value.

Question 50.—Where a colliery siding passes over say four properties of A, B, C and D, and where A, B and C make no use of the siding which is generally used by D, the expense of providing the necessary support for it in the properties of A, B and C should be paid for by D.

Question 55.—I would define " avoidable waste " as all waste which exceeds 15 per cent. of the coal in the pillars. This percentage does not include coal left in external or internal barriers.

Question 56.—After discussion with the Committee, I now agree to the proposal in this question.

Question 62.—I have had considerable experience in testing samples of coal purchased from various collieries and I have found that the ash percentage is invariably up to 2 per cent. higher than that shown on the Grading Board certificates. As an instance, we find it practically impossible to buy coal which " taking samples from actual wagon-loads of despatches as a basis " complies with the Grading Board certificates, so that in actual practice we, in buying coal, allow 2 to 2½ per cent. above the Grading Board analyses before exacting penalties for high ash contents.

29. Written evidence of Mr. D. M. Archibald, General Manager, Lodna Colliery Co., Ltd., Jharia.

Question 1.—I hold the appointment of General Manager of the Lodna Colliery Co., Ltd., and have had 16 years' experience of Indian coal-mining conditions, 14 years in the Raniganj coalfield and 2 years in the Jharia coalfield.

Question 2.—I consider the main cause of underground fires in coal mines in India is spontaneous combustion.

The number has increased in recent years. More fires have been caused by premature collapses.

Question 3.—I consider all the seams of commercial value are liable to spontaneous combustion, the liability varying with the local conditions and system of working.

The period of incubation is again a matter of the local conditions and varies accordingly. In the Poniati seam I have known it vary from 9 months to 7 years.

No seam of commercial value in my opinion is free from the risk of spontaneous combustion to a greater or lessor degree.

Question 4.—I do agree that underground fires increase considerably the difficulties and dangers of extracting the remaining coal.

The difficulties and dangers do become greater at the final stage of pillar extraction, and as one seam after another lying close together is removed.

Question 5.—I am in favour of new workings in seams known to be liable to spontaneous combustion being laid out in a system of panels. The thickness of the barriers would depend on a number of factors (1) depth of seam, (2) thickness of the seam, (3) the nature of the coal, etc., and (4) be of such thickness as to permit of their extraction at a later date in safety.

Question 6.—I do consider that the Temporary Coal Mines Regulations notifications Nos. M. 955, dated the 23rd May 1936, and M. 1055, dated the 27th June 1936, are adequate against all possible dangers of fires.

Question 7.—I do consider a mechanical ventilator should be available at all mines or seams where there are sealed off fires.

Whether forcing or exhausting must depend entirely on conditions and circumstances.

Question 8.—I do consider that coal left behind in the goaf increases the risk of spontaneous combustion.

I am not aware of any particular fire that may be directly attributed to this cause.

Question 9.—I do not consider that the provision, for readily the Grading Board certificates, so that in actual practice we, in buying coal, allow 2 to 2½ per cent. above the Grading Board by law in coal mines.

I recognise their value in keeping roads drenched with water as a safeguard against coal dust.

Question 10.—I am in favour of telephonic communication being required by an order in writing from the Chief Inspector of Mines between remote parts of the mine and the surface provided such an order is considered necessary for the safety of the mine and the miners working therein.

Question 11.—I do consider the Temporary Coal Mine Regulations fully meet all precautions that are required in mines in which fires exist.

Question 12.—I consider the management and the staff of any mine where fires exist or may occur should be trained in the method of dealing with underground fires and the dangers that may arise therefrom.

With an underground fire immediate action is necessary to minimise and localise the dangers and such action can only be taken by the colliery staff.

The need of energetic and prompt action is all important and I do not consider that persons working at rescue stations would have the knowledge of the mine and its conditions, and valuable, in fact, vital time, would be lost in calling on them, as the first to take action.

All such action, should be under the immediate direction, of the manager in charge of the mine.

Question 13.—My view is that such apparatus is of only a limited value and that for the rescue of persons believed to be in danger.

In dealing with mine fires and the sealing off of same I have found a portable fan with suitable air pipes giving 10,000 cubic feet of air per minute at 6″ W. G. of very great value as a protection to those engaged. The fan is electrically driven and naturally requires electric power available.

To be able to reverse the main ventilating fan, if necessary, to protect the persons engaged, is of great value.

Question 14.—I consider that in all mines accumulations of coal dust should not be permitted and all precautions necessary should be taken against the risk of a coal dust explosion.

Question 15.—Certainly, precautions against fires occurring at all, are better than precautions after a fire has occurred.

The method of working will depend on varying factors, but speaking generally a panel system should be adopted, the size of galleries limited, the pillars of adequate dimensions, and wherever practicable extraction of pillars carried out retreating from the boundary of the property.

Question 16.—I consider that the filling or packing of goaves in all seams which give off large quantities of inflammable gas is desirable and should be undertaken if economically practicable.

Question 17.—I consider that the premature collapse of workings is mainly due to the size of pillars being too small and the size of the galleries too large. In other words due to much too high a percentage of the seam being won in the first working.

Question 18.—The dangers from premature collapse lie in the fact that the collapse is out of control and may extend beyond what is considered safe in the mine and consequently on the surface.

Fires may result and important surface features destroyed involving loss of life.

The dangers may best be prevented by limiting the percentage of coal taken out in the first working and limiting the size of galleries.

Question 19.—No, I am not in favour of minimum dimensions of pillars and maximum dimensions of galleries being laid down by law.

Question 20.—I am not.

The main factors governing the size of pillars and galleries are:—(*a*) depth of seam, (*b*) thickness of seam, (*c*) nature of the coal, (*d*) the nature of the roof and floor.

Question 21.—I am not in favour of the legal prohibition of splitting pillars, reducing pillars, or heightening galleries at any time whether before or during the extraction of pillars.

It is a practice to be discouraged but legal prohibition is too drastic and limits the initiative of the management.

Question 22.—In thick seams worked in section the dimensions of pillars and galleries and the minimum " parting " between the sections are entirely a matter of conditions and circumstances.

The galleries and pillars should be in the same vertical coincidence.

Question 23.—I am not in favour of a statutory authority having such powers.

Question 24.—No, I am not.

Question 25.—I have no personal experience of such irruptions.

Question 26.—In the first instance there is danger from the inflammable mixture of gas and air being thrust into the mine workings if the underground fire covers a large area. If the fire area is small and the quantity of water large no such danger would ensue.

Question 27.—I suggest, and practice, careful daily supervision of surface drains, *bunds*, etc., especially during the monsoon period. The relative position of surface accumulations of water, or accumulation in the mine, to underground depillaring operations and underground fires require careful routine inspection.

The machinery for enforcing such precautions are adequate under the existing Coal Mines Regulations.

I consider all surface features should be shown on mine plans as this would be an added safeguard.

Question 28.—I do not consider that any changes are necessary in the Permanent and Temporary Regulations regarding shot-firing in order to ensure safety in the use of explosives.

Question 29.—I am not in favour of the extended use of " permitted " explosives beyond that required under the present Regulations.

Question 30.—I am not in favour and consider more regard should be paid to experience rather than ability to pass an examination.

Question 31.—I do not consider this proviso should be retained for reasons given in reply to the next question.

Question 32.—I consider it desirable to reduce the number of persons carrying explosives in the mine by permitting more than 5 lbs. in one canister.

By increasing the quantity to 10 lbs. I consider the dangers are being halved.

Question 33.—In Lodna Collieries:—Nos. 14, 14-A and 15 seams, all Selected Grade, 28 feet, 7 feet and 25 feet respectively, Gradient 1 in 10. Nos. 11, 12 and 13 seams, Grade 1, 28 feet and 12 feet respectively, Gradient 1 in 8.

Sripur Collieries:—Sripur Bottom Seam, Selected Grade, 14 feet 6 inches thick, Gradient 1 in 12.

Question 34.—Yes—the whole of all the seams are being extracted.

Question 35.—Lodna Colliery:—100 per cent. output from pillar extraction with 80 per cent. extraction.

Lodna Colliery Nos. 4 and 5 Pits:—55 per cent. output from pillars with 70-80 per cent. extraction.

Nos. 11, 12 and 13 seams:—No pillars are being extracted.

Sripur Collieries:—20 per cent. output from pillars with 90 per cent. extraction.

Question 36.—If the conditions are similar to Lodna collieries some 70-80 per cent.

Question 37.—Not necessarily all the coal; dependent on the conditions and circumstances, a considerable portion of this coal could be extracted without endangering the surface features.

The Indian Mining Association can give instances and particulars.

Question 38.—The stowing of the workings of the collieries under my charge would I estimate extend the life of the collieries by some 20 per cent. provided such stowing was economically practicable.

Obviously if stowing was made compulsory and was not economically practicable production would cease.

Question 39.—I am not in favour of the enforcement of stowing the goaves of the mine simultaneously with the extraction of the pillars.

Question 40.—See previous answer.

Question 41.—I have had experience of hydraulic stowing in instances where special support was required underground under exceptional circumstances.

Actual costs are available from those collieries engaged in systematic hydraulic or hand stowing and must necessarily vary according to the distance stowing material has to be handled.

Question 42.—I am not in favour.

Question 43.—I do not consider a statutory authority should be set up with powers to define the areas or seams in which pillars should be got by a process of filling.

Question 44.—My reply to *Question 23* also applies here.

Question 45.—I have no data available.

Question 46.—I consider the colliery owner should decide this and work his colliery to the best advantage. I am not in favour of any such prevention or control.

Question 47.—My reply to *Question 46* applies here.

Question 48.—My replies are in the negative.

Question 49.—Yes.

Question 50.—I do not, see my reply to *Question 46.*

Question 51.—Reply in the negative.

Question 52.—See reply to *Question 39.*

Question 53.—Additional financial assistance in respect of the actual stowing would certainly be necessary up to the point of making such stowing economically practicable.

Question 54.—I consider that the present Mines Acts, and Temporary Regulations cover all measures necessary in the interests of safety and proper mining and statutory control is unnecessary.

Had the present Temporary Regulations been adopted, for example, as a result of the Treharne Rees Report, the conditions obtaining in the coalfields to-day would not have called for investigation by your Committee.

The Mines Department, whose function is that of safety, is now well equipped to carry out that function, and with increased safety in working methods coal is conserved.

Question 55.—Compulsory stowing if adopted, should be extended to all coalfields.

The colliery owner is quite alive to the necessity of avoiding waste in his own interests.

Question 56.—I am in favour of the adjustment of boundaries but only to the mutual benefit of the parties concerned by voluntary agreement.

It is at times desirable and advantageous for owners of small properties adjacent to each other to amalgamate but I do not favour compulsion.

I consider compulsion would be an interference with the rights of property owners.

Question 57.—I approve of such an arrangement provided the direction and the methods of working the whole mineral leasehold is under the control of the mining engineer representing the immediate lessor who should be agent of all the leasehold under the Mines Act.

Question 58.—Yes—I consider that the manager of each mine should have sole and independent charge of his mine and all shafts and outlets in connection therewith.

Question 59.—I am not in favour and consider that the obligation placed on each mine owner in this connection by the present Regulations is sufficient.

I do not consider that a statutory authority, if set up, should have powers to survey barriers, and draw attention to the fact that the Mines Department have that power under clause 7 of the Indian Mines Act, 1923.

Question 60.—Yes—all surface features should be delineated on the plan of the underground workings of the mine.

See my reply to *Question 27* last paragraph.

Question 61.—I do not consider this a practical suggestion.

It is not economic to carry long distances, coal of inferior grade.

Consumers are already paying heavy freight charges on coal with an ash content of 15 per cent.

Question 62.—I have no knowledge of the effect of the Coal Grading Board increasing waste and if it has this has been more than offset by an increased export business for which purpose the Board was created.

Question 63.—The reason, I consider, is that the dangers inherent in working the thick seams in India are very much greater than working the comparatively thin seams in Great Britain.

Oral Evidence.

Question 6.—I am in favour of the Temporary and Supplementary Regulations, and also the temporary legislation of 1936, being made permanent.

Question 10.—I would leave to the Chief Inspector of Mines to determine what are "remote parts" of mines. He should be

able to require telephones to be installed where he considers them necessary.

I have personal experience of telephonic communications installed in my Sripur collieries. They have been there for about two years now, and have given no trouble. They are inspected in the course of their duties by the electrical staff. Where a mine is very wet it would be quite possible to take measures to protect the telephone. The telephones referred to are approved by the Home Office in Great Britain for use in gassy mines.

Question 12.—My idea is that, in addition to the rescue stations for training and additional help, there should be a team trained in rescue and fire prevention work at each colliery. This team should be under the immediate control of the manager. The necessary apparatus could be provided for groups of contiguous collieries under the same agent.

Question 19.—The only limitation on methods of first working which I would agree to is fixing the maximum dimensions of galleries at 8½ feet high and 12 feet wide. Beyond this I would prefer the system contemplated in *Question 23* and say that the Chief Inspector of Mines should have the power of approving or disapproving the lay out of first workings. When the Chief Inspector had approved of the lay-out, if that lay-out was altered in any way without his sanction, or if the galleries were made larger than the dimensions stated above, I would certainly enforce an adequate and immediate penalty. I agree that a suitable penalty would be to require that the conditions should be securely restored to those required by the law and the orders of the Chief Inspector and that, in the meantime, no coal-getting should be allowed in that section or district. In the event of a disagreement between the Chief Inspector and the management over the projected lay-out, there should be an appeal to whatever body is hearing appeals from orders under section 19 (1-A).

Question 23.—As already stated, I am in favour of the Chief Inspector of Mines having these powers.

Question 24.—I would be in favour of the Chief Inspector of Mines having powers to require mine-owners to pack or partially pack provided the merits of each case were considered and the compulsion was only applied to conditions which are definitely unsafe or where the coal is otherwise irrecoverable with safety.

Question 27.—My suggestion about all surface features being shown on mine plans as an additional safeguard refers to Regulation 15 (ii) where I think that the examples of "all important features within the boundaries" should be enlarged by adding buildings, village sites and tanks.

Question 28.—I would suggest that a minimum length of fuse should be laid down, that length being varied according to the number of shots that are being fired.

Question 29.—Cost is the main factor on which my opinion is based. I consider that the additional cost would be from 4-4½ annas per ton of coal extracted.

Question 30.—What I mean is that provided previous practical experience was provided for I would have no objection to an examination. Such experience should consist of at least one year's underground working in connection with shot firing.

Question 32.—My answer means that the limit of 5 lbs. in Regulation 106 should be raised to 10 lbs. and the proviso to that Regulation be done away with.

Question 35.—I should like to add that at Lodna the actual average percentage of extraction of pillars during the last three years has been 86 per cent. The average depth is 200 feet, and the strata up to the surface is fairly strong. The figure of 90 per cent. extraction in the Sripur colliery includes any losses in panel barriers. The barriers have been left so big that they can be recovered.

Question 39.—Within the limits mentioned in my answer to *Question 24*, I would approve of the enforcement of stowing simultaneously with the extraction of pillars or in the wholesale extraction of the seam if any such modified system of working was introduced.

Question 42.—With compulsory stowing within the limits of my answer to *Question 24*, I would make the collieries concerned pay the whole cost of such stowing.

Question 43.—I think that all control in the interests of safety should be under the Mines Department and I do not consider that any case has been made out for any form of control in the interests of conservation. I have studied the figures of reserves of good quality coal and of coking coal, but I do not think that these figures take all the factors into consideration, and I am not prepared to accept that as stating the case for conservation.

Question 53.—My answer may be taken as meaning that additional financial assistance would only be necessary in respect of compulsory stowing which went beyond the limits contemplated in my answer to *Question 24*.

Question 54.—As already stated, I am against control for purposes of conservation only. But, if such control were established, it should be applied not in the interests of any particular industry or trade, but in the national interest as a whole, and should therefore cover all kinds of coal. If the iron and steel industry wish to ensure the reserves of coking coal sufficient to enable them to utilise their reserves of iron ore, they should acquire the necessary coal properties for the purpose.

Question 59.—As I have said, the Mines Department has the power to survey barriers under Section 7 of the Act. I agree that, if necessary, the surveying staff of the Mines Department

should be increased in order to be able to do this work more effectively. I consider the surveying of barriers between the adjoining mines as most important and would advocate it being done generally.

Question 62.—I agree that the Grading Board was originally intended to confine its operations to export coal only, and I think that the extension of the grading system to coals sold internally should be stopped if possible as it has certainly led to increased waste.

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30. Written Evidence of Mr. W. Cooksey, Offg. Colliery Superintendent, State Railways' Coal Department.

Question 1.—Officiating Superintendent of Collieries. I have had 24 years of experience of Indian coal mining, chiefly in the Giridih coalfield, the remainder has been in the Bokaro field.

Question 2.—In my opinion the main cause of underground fires in coal mines in India is caused by spontaneous combustion set up by the pillars of coal being crushed by the superincumbent strata; the cause of which in most cases is, the pillar being left too small. In Giridih the fires in Serampore colliery were set up originally by leaving barriers of coal round goaves which had not collapsed, with a view of avoiding damage by air blasts when large areas of roof did collapse. The barrier of coal in many cases were left too large and the roof could not come down all at once, but was kept weighting on the pillar of coal gradually crushing them and setting up spontaneous combustion. In districts where no barrier of coal was left no fires have occurred. The number of fires has increased during recent years in the Jharia field but not in Giridih where they are gradually getting less.

Question 3.—The Kargali seam in the Bokaro field is probably more liable to spontaneous combustion than the Karharbari seam in the Giridih field. The period of incubation in the Kargali seam is not known to me. I know of no case of underground fire in this seam. The stacks of small coal on the surface have shown signs of heating after a few weeks. In Giridih there are some stacks of small coal which have been lying on the ground for 2 or 3 years without heating; others have got a fire after a few months. I do not think any seam of coal of any value can be said to be free from all risk of spontaneous combustion.

Question 4.—Yes.

Question 5.—Yes.

The percentage of the seam left in barriers without stowing would depend very much on the nature of the coal, the thickness of the seam, the dip and the condition of the roof. I do not see how it is possible to say what proportion would be left without knowing the condition; the condition will probably vary in each mine.

Question 6.—Yes, if properly carried out.

Question 7.—If the fires are properly sealed off, mechanical ventilation is an advantage. I should prefer an exhausting fan.

Question 8.—Yes. I do not know of any actual cases personally.

Question 9.—It would be an advantage.

Question 10.—Yes, I should prefer to have the telephone at least to the in-bye end of each mechanical haulage road and at the entrance to each district.

Question 11.—I would suggest that in each ventilating district or panel, a sufficient supply of non-inflammable material such as bricks, and sand in bags, or otherwise be kept in readiness so that in the case of fire temporary dams or stoppings could be built and isolate the district while the permanent stoppings are being built.

Question 12.—Yes.

Question 13.—There are no doubt many cases where men wearing breathing apparatus can render very great help in dealing with fires provided they are properly supervised but the great danger is of men trying to do too much individually. A man wearing breathing apparatus is already living abnormally and only very short spells of work should be undertaken. A sufficient number of relief gangs should be kept ready before any start is made.

Question 14.—Yes.

Question 15.—Yes.

The suggestion as regards method of working could only be made in specific cases. Each mine, would, however, have to be considered as a separate case. If it is possible to take out the pillars completely this should be done; if pillars are to be left, they should be of a sufficient size to withstand the crush and allow the roof to break off round them.

Question 16.—In some of the older mines I do not see how it would be possible to enforce packing all the goaves. Partial packing would not be of much use.

Question 17.—This is due in many cases to pillars being too small or pillars being robbed; in others to pillars not being systematically extracted.

Question 18.—Damage to surface buildings, roads, etc., by subsidence danger to people in the mines by air blasts and in some cases danger of inundation by water if the subsidence occurs under or close to a river or accumulation of water. In some cases the danger can be minimised by systematically extracting the pillars and replacing with strong cogs or by leaving pillars of sufficient size. This means a wastage of coal.

Where it can be done, hydraulic stowing is the most satisfactory method.

Question 19.—Yes. Provided the condition of the different mines are taken into consideration.

A hard and fast rule so far as dimensions are concerned may create difficulties.

Question 20.—A very usual practice is for pillars not less than 60 feet square with galleries not more than 12 feet wide and 8 feet high but these must be governed by the local condition.

(*a*) The thickness of seam, depth from surface, nature of the coal, nature of the roof and the dip of the seam would all have to be considered.

Question 21.—No.

This may hinder work in some cases. In cases where underground conditions have changed since the work was laid out and it may be necessary to re-align haulage roads and ventilation roads.

Question 22.—This would be governed by conditions as in my reply to *Question 20* (*a*).

Question 23.—No.

There are many cases where the lay-out of the mine has to be altered after the work has been developed for some distance.

The seam being distorted or interrupted by faults and the alteration of the dips may cause the original lay-out to have to be altered.

Question 24.—Only on a limited scale.

The owner should have some court of appeal if he disagreed with the statutory authority.

Question 25.—Yes. A case occurred at Sigdadih colliery in Giridih some years ago. I believe about 1914 but am not quite sure of the date. The mouth of an incline was near the junction of two small rivers and during a heavy flood the water over-flooded the banks and ran down the incline; some lives were lost.

Question 26.—The irruption becomes dangerous if it drives the gas into the mine workings, but I am not prepared to give an opinion on explosive nature of a mixture of saturated gas.

Question 27.—The precaution to be taken should include, protection to the mouth of inclines either by walls or *nullahs* and leaving sufficient support under rivers, *jheels* and tanks or any other place where large accumulation of water may occur.

Question 28.—The present regulation should be sufficient if properly carried out.

Question 29.—Yes.

Question 30.—Yes. I consider all shot-firers should have a sirdar's certificate endorsed for gas testing.

Question 31.—The Chief Inspector should be allowed to retain this power as cases may arise when it would be any advantage for him to do so. Each case should be referred to him and not a general permit given.

Question 32.—The issue of explosives from the licensed magazine should only be on the voucher signed by the manager. This would be done after the officials of the various parts of the mines have made out their requests and submitted them to the Manager.

The report of shot-firers in each district should be checked up against the issues.

Question 33.—Kargali Colliery—the Kargali seam which varies from 30 feet to 90 feet in thickness. The whole of this is being worked in some of the quarries. In the pits the present workings are being driven in the bottom of the top 30 feet section. Average dip about 1 in 6 or 7.

The Bokaro 12 feet seam which lies above the Kargali seam is also being worked. The workings are being driven out in the bottom 8 feet of the seam. Dip about 1 in 9.

Jarangdih Colliery.—The Jarangdih seam 18 feet thick is being worked. The workings are being driven out in the bottom 8 feet of the seam. Average dip 1 in 6.

Bhurkunda Colliery.—The Kurse seam 13 feet thick is being worked. Workings are being driven out in the bottom of the seam. Average dip 1 in 5.

The upper Simana seam 12 feet thick is being worked. Galleries are being driven out in bottom of seam. Average dip 1 in 5 or 6.

The Sirka seam is also on this colliery and is in the early stage of development. 1 Incline is already into the coal.

Question 34.—The whole of the seam is being taken in Kargali colliery where the coal is quarried. The underground workings are all in the development stage and are being laid out in such a manner that when it will be necessary to extract the pillars hydraulic stowing can be carried out fairly easily.

Question 35.—At present all the output is being obtained from galleries. No pillars have been extracted at Kargali colliery. There are some surface quarries.

Question 36.—I have not sufficient knowledge of these coalfields to give an opinion.

Question 37.—Presumably yes.

Yes, there was a case where compensation was paid. Particulars of this may be asked from the Agent, East Indian Railway.

Question 38.—The life of the collieries would in all probability be trebled with an equal, or possibly, increased output.

Question 39.—Yes, in some of the newer mines where conditions are favourable.

Question 40.—Most of the newer mines in the Damodar valley could be hydraulically stowed.

Question 41.—I have had no such experience.

Question 42.—By some form of coal cess spread over the whole of the coal trade. Otherwise those collieries which are not in a position to stow would be able to produce a cheaper coal than those which are compelled to, and, at the same time, shortening the life of their pits to a greater extent. The royalty-owner should also be assessed.

Question 43.—Yes.

I would suggest a Board for each coalfield composed of representatives of owners, managers, and royalty-owners who are interested in that field with an independent chairman from another coalfield.

Question 44.—No. They may be consulted on an advisory capacity if necessary.

Question 45.—I have no figures available from which I can give any opinion.

Question 46.—It should be at least controlled.

Question 47.—Should be controlled.

Questions 48.—A seam containing anything up to 25 per cent. of ash is of some commercial value if only for lime and brick burning. Coals with ash contents up to 30 per cent. are being used in pulverised fuel plants.

Question 49.—Yes. Wherever possible.

Question 50.—Yes if extracted at all.

Question 51.—The only grounds on which the railways would be likely to benefit would be carrying the extra amount of coal. I believe they have not accepted responsibility for compensation for coal locked up under railways.

In Bengal where the railway owns the coal (A Class land) they would in all probability, require to be paid for all coal extracted from under their land.

Question 52.—I know of no case where partial filling would be likely to be of much use.

Question 53.—In some cases yes, considerable additional cost would be entailed in providing the necessary pipes and additional pumping plant.

Question 54.—If adopted at all, it should apply to all coalfields, as otherwise the collieries in the controlled areas would, in many cases, be put to considerable expense which uncontrolled collieries would not have to meet and their production cost would be affected unfairly.

Question 55.—If adopted, it should be general. I do agree that avoidable waste should be stopped where possible.

Question 56.—Yes.

Question 57.—I do not approve. The danger would be one owner not knowing where the other parties workings were. Where cases of this sort occur, compulsory amalgamation could, with advantage, from safety point of view, be enforced.

Question 58.—In my opinion a manager should be responsible for all shafts and entrance into the mine of which he has charge.

Question 59.—Yes. I am in favour of such legislation. I consider the survey of barriers should be checked by the Department of Mines, not any other authority.

Question 60.—Yes. I consider this would be a means of safety.

Question 61.—The question of the inferior grades of coal will have to be considered in the very near future. If a statutory authority is set up they should have power and funds provided for a research department. The question of pulverised fuel and hydrogenation of coal for industrial purposes should be gone into.

Question 62.—There has no doubt a considerable amount of coal not selected grade been left unworked owing to the part of the seam not being of the required standard.

Question 63.—The large number of notices and orders issued under the present Mines Act is no doubt due to the different condition of mining in India as compared with England. The seams are, generally speaking, much thicker and more numerous, nearer to the surface and in many cases worked by many small concerns who are only interested in very small areas.

It would be a great advantage if a new revised Mines Act could be printed incorporating all the new notices and orders and revision into one volume.

Oral Evidence.

Question 6.—I agree to the Temporary and Supplementary Regulations, and the temporary legislation of 1936 being made permanent.

Question 16.—My answer may be taken as referring primarily to the Giridih and Bokaro fields. I agree that in the circumstances contemplated in the question packing of the goaves would be a good precaution where practicable.

Question 21.—I would be in favour of "immediately before the systematic extraction of pillars" being defined as not more than two pillar lengths ahead of the pillar that was being extracted. This implies that I would be in favour of the legal prohibition proposed within the above limits.

Question 24.—I would be in favour of mine-owners being required to pack or partially pack in the circumstances stated either in the interests of safety or conservation provided they were given financial assistance to the extent of making the operation economically possible.

Question 30.—I agree that there would be no harm in having another endorsement on the sirdar's certificate for shot-firing as well.

Question 37.—In the Giridih colliery the railway line runs over a goafed area in one particular place which is about 450 feet below. No sort of packing has ever been done and no visible subsidence has occurred.

Question 38.—My estimate of increased life has reference mainly to very thick seams.

Question 39.—My answer refers to the wholesale extraction of the seam as I think this would be possible in new workings with sand-stowing where the conditions are favourable.

Question 42.—I agree that the railways should contribute to the cess either directly or in the form of specially low rates for the conveyance of sand. I think that the best plan would be to put the cess on all coal despatched by railway in or into British India and also on the coke manufactured at a colliery out of coal raised at that colliery on the assumption that 1½ tons of coal go to one ton of coke.

Question 43.—After discussion with the Committee, I think I should prefer the independent Chairman proposed to be a Government official of standing. This would be better than bringing out a mining engineer from Home even though the latter was not directly connected with any coal interest in this country. I would have a representative of the Mines Department on the proposed Board, but think that he should only be there in an advisory capacity.

Question 55.—I would accept a definition of "avoidable waste" as all waste which is not incidental to the proper and efficient system of mining that is being followed.

Question 61.—Kargali coal is being used on mail and passenger locomotives on many State railways.

Question 62.—I agree that the extension of the grading system to coal sold within India has led to avoidable waste and increased danger from fire. I think therefore that if grading could be restricted to export coal only, this would be an advantage. I am inclined to agree also with the argument that the extension of the grading system to the internal trade is due largely to market conditions and that, if market conditions improved, grading would automatically disappear.

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31. Written Evidence of Mr. W. J. Rees, Manager, Noondih Jeetpur Collieries of Messrs. The Bengal Iron Co., Ltd.

Question 1.—Manager, 30 years in Raniganj, Jharia, Giridih and Palamau fields.

Question 2.—Spontaneous combustion.

Yes.

By premature collapse.

Question 3.—Dishergarh seam in the Raniganj field and No. 15 seam in Jharia field, Chora seam in the Raniganj field. The latter seam I have known a fire to break out in 3 weeks owing to an oleaginous shale on the top of the coal which does not come away with the coal but falls afterwards.

Question 4.—Yes.

Question 5.—Yes.

This would depend on the thickness of the seam, 15 to 25 per cent.

Question 6.—Yes.

Question 7.—Yes, by exhaust fan.

Question 8.—This depends on the quality of the section left behind, if of very poor quality the risk would be *nil.*

No.

Questions 9 & 10.—No.

Question 11.—Constant and close supervision.

Question 12.—Yes, if there are any fixed methods known.

Question 13.—Had no experience.

Question 14.—Yes.

Question 15.—Prevention is better than cure.

The panel system would certainly minimise if not entirely stop spreading of fires.

Question 16.—In flat or moderately inclined seams it would be impossible to stow or pack near enough to the goaf edge to prevent falls of roof expelling any gas which may accumulate above the falls. I am of opinion that sand or any other stowing on a big scale is out of the question except at collieries on the banks of a big river.

Question 17.—Pillars originally too small or splitting and reducing before final extraction.

Question 18.—Sudden subsidence, with air blasts and ultimately fire.

Pillars to be of suitable size and not to be reduced or split until systematic extraction.

Question 19.—Yes, provided these dimensions are settled by a committee of mining engineers or colliery managers.

Question 20.—Size of pillars would vary according to seams worked. If soft and friable, larger pillars would be required than in a hard and banded seam. The nature of the roof must also be taken into consideration.

Galleries 12 feet wide by not more than 10 feet high would, I think, be a reasonable size.

Question 21.—Yes, but in mine not properly laid out or through any unforeseen circumstances, cross cuts through pillars for haulage or any other reasonable purpose should be allowed.

Question 22.—This depends on the thickness of the seam and whether there are any stone or hard coal partings. 10 feet in height and a parting of 2 to 3 feet between sections but as remarked, it depends on the nature of the seam and roof.

Question 23.—No.

Question 24.—Yes, if such statutory authority is set up and provided compulsory stowing is in force, but as before stated, I think that packing on a big scale is impossible.

Question 25.—A mine in the Jharia field was flooded during the rains caused by heavy rain and at the same time the bund of a near-by tank broke. Further on, at an adjacent colliery there was a tram line which crossed the water course by a culvert. This culvert formed a bottle neck and prevented the extra water getting away quickly enough and caused the water to back up and overflow the incline banks and so down the mine.

Question 26.—If water on a fire generates inflammable gas why is water used in quenching big mill and town fires? Sudden irruptions of water in an underground fire if in a very large quantity, would probably generate steam so rapidly and at so high a pressure as to cause stoppings to be blown out and the fire projected into the adjoining workings and so cause a dust explosion.

Question 27.—So far as possible take precautions to prevent large bodies of water getting into a fire area suddenly.

Precautions should be enforced where possible.

Question 28.—None.

Question 29.—No.

Question 30.—I consider that if shot-firers are examined on the colliery by the manager or experienced officials, the certificate granted by them should be sufficient for that particular colliery only.

Question 31.—Retained. In deepening a shaft from one seam to a lower one where all operations of sinking (except winding) are conducted from the upper seam 5 lbs. explosives would not be sufficient to be kept underground. Similarly, if a pair of stone drifts are being simultaneously driven 5 lbs. of explosives may not be sufficient.

Question 32.—No.

Question 33.—XVII and XVIII seams in the Jharia field.

XVII seam is Selected Grade, 7 feet thick and inclination 1 in 8.

XVIII seam 11 feet thick, bottom 7 feet Selected Grade, inclination 1 in 8.

Question 34.—Whole of XVII seam is being extracted and the bottom 7 feet of XVIII seam.

Question 35.—100 per cent.

90 per cent. after allowing for pillars left as fire barriers but not allowing for barriers along-side boundaries rivers, etc. This can be verified by an inspection.

Question 36.—(*Not answered.*)

Question 37.—Yes.

No.

Question 38.—No effect whatever except to increase cost.

Question 39.—Generally speaking I believe it to be, in the majority of collieries impracticable, owing to the difficulty in getting stowing material in sufficient quantities.

Question 40.—See above.

Question 41.—No.

Question 42.—Not in favour of compulsory stowing.

Question 43.—If compulsory stowing is introduced (which it will not be) a committee of about six members should be set up—1 officer of Mines Department and 4 or 5 mining engineers and experienced colliery managers.

Question 44.—No.

Question 45.—(*a*) *Nil.*

(*b*) In mines laid out in panels the saving would be considerable, otherwise *nil.*

(*c*) *Nil.*

(*d*) Doubtful if any.

(*e*) Doubtful, as with stowing buildings would at least crack and cultivated land would also sink and upset water levels in paddy fields.

(*f*) Very little if any.

(*g*) Retard output.

(*h*) Increase.

No.

Question 46.—No. It would in many cases stop a colliery working a good seam for years until an inferior seam was developed and extraction of pillars about ready to start. Again the upper seam may be of commercial value yet unsaleable for years during a slump.

Question 47.—Same as above.

Question 48.—Any seam that can be got and sold at a reasonable profit is of commercial value.

Question 49.—This depends on the thickness of the strata between the seams. Where seams are fairly close together, simultaneous filling should be done.

Question 50.—From under sidings, yes, where practicable but in the majority of cases this is impossible as while extraction was going on the sidings would have to be closed or temporary sidings put in which would be expensive and in many cases impossible.

Question 51.—The railways should bear a very large proportions of the cost. They have to pay compensation for passing over surface land, why should they not have to pay for coal they pass over and lock up.

Question 52.—Partial stowing is of little or no value.

No.

Question 53.—If compulsory stowing is introduced additional financial assistance would be necessary. Expensive plant would be required and in many cases it would be necessary to supply water in the dry weather, also compensation for stoppage of colliery while sand is being supplied. I am of opinion that a constant supply of sand will not be available at a very large number of collieries.

Question 54.—(i) No.

(ii) Should be universal, as coal is necessary for industrial purposes, no matter which coalfield it comes from.

Question 55.—Compulsory stowing, if adapted, should be extended to all coalfields, for reasons given above.

Yes.

Question 56.—Yes.

Question 57.—No.

There is the danger of the lower seam being pillared and so causing the seams above to drop and so become unworkable.

Remedy would be to make both owners amalgamate or one of them to sell their right to the other owner.

Question 58.—How can a manager have independent charge of shaft which does not belong to him?

Question 59.—Yes.

Question 60.—Yes.

Question 61.—Railways could use a lot more, 2nd or 3rd class coal. Soft coke might be confined to inferior coals.

Question 62.—In cases where seams are in 2 or more sections, one section being of Selected Grade and the other Grade I, it has meant that the inferior grade has been left behind.

Question 63.—Condition in India are very different to conditions in England. Here we have very much thicker seams. Spontaneous combustion is much rarer in England than in India and labour more intelligent.

Oral Evidence.

Question 6.—I am agreeable to the Temporary and Supplementary Regulations, and the temporary legislation of 1936, being made permanent.

Question 9.—I would agree to the legal requirements suggested in connection with existing water mains and where water was available.

Question 16.—I would be agreeable to the proposal in this question provided it is possible to pack so securely as only to allow roof to settle down gradually and not form any cavities.

Question 19.—I agree with the principles of first working being laid down, the principles being based on percentage of floor area extracted in galleries and with a limiting height of galleries of 10 feet. The principles would only apply to systems of working such as the pillar and stall and the panel system. Provision should be made for the variation of these principles by the Chief Inspector in accordance with local conditions and also for a right of appeal where the Chief Inspector did not agree to variation. I would also agree to the penalty for any infringement of these principles in the absence of a varying order from the Chief Inspector being adequate and immediately enforceable. A suitable penalty would be requiring the manager concerned to restore securely the conditions to come within the limits of the first principles, all working in that section or district of the mine being prohibited meanwhile.

Question 21.—I would agree to a definition of "immediately before the systematic extraction of pillars" as two pillars lengths ahead of the pillar or pillars that is or are being extracted.

Question 24.—What I have in mind mainly in saying that packing on a big scale is impossible, are the difficulties of distributing, maintaining and storing supplies of sand.

Question 43.—My answer may be taken as modified on the lines of my answer to *Question 24.*

Questions 46 & 47.—I would agree to the prevention and control suggested in these questions as a mining engineer. The position is different from the point of view of commercial considerations, but I do not think that commercial considerations should be allowed to be superior to sound mining or national considerations.

Question 49.—I agree that Temporary Regulation No. 10 should be made more elastic by allowing considerations of thickness of seams and thickness of strata between the seams to be taken into consideration.

Question 51.—I think in addition, royalty receivers should also bear part of the cost.

Question 62.—I agree that grading has increased avoidable waste and dangers from fire. I think that grading should be restricted to export coal only.

32. Written Evidence of Mr. J. K. Dholakia, Consulting Mining Engineer.

Question 1.—I work as Consulting Mining Engineer and held post as agent, Ballihari colliery, till the end of March 1936. My experience in mining is 32 years, 25 years in the Jharia and 7 years in the Raniganj coalfields.

Question 2.—(*a*) The main cause of underground fires in India is spontaneous heating of coal.

(*b*) Yes, the number of fires has increased in recent years.

(*c*) More fires have occurred after pillars have been extracted.

Question 3.—Seams most liable to spontaneous combustion are Nos. 15, 14, 14A, Dishergarh and selected grade seams. Also Jharia seams Nos. 13, 12, 11 and Raniganj, Grade I, are liable to spontaneous combustion.

Incubation period varies from 1 to 2½ years.

Regarding any coal of commercial value being free from spontaneous combustion. "Commercial value" is a vague term. Before many years seams No. 10 and above were of commercial value, now many more seams are accepted to be of commercial value and the time will come when all combustible coals will be of commercial value. The coals of lower grade at present appear to be free from spontaneous combustion.

Question 4.—Yes, fires increase the difficulties of extracting coal.

The difficulties become greater at the final stage of pillar extraction and also while removing one seam close to another.

Question 5.—Yes, I am in favour of new workings being laid out in panels. The percentage of coal left in barriers without stowing is entirely dependant on the depth, nature of coal and also the incubation period which will decide the size of panels and the size of barriers. Smaller the panel greater the percentage and bigger the panel smaller the percentage. I consider that the percentage will not be less than 33 per cent.

Question 6.—Yes.

Question 7.—Yes, all mines where there are sealed off fires should be mechanically ventilated.

The fan, with reversible arrangement, should be so utilised as to be forcing and exhausting according to circumstances.

Question 8.—Yes.

Question 9.—No, it should be left to the management to be in readiness for emergency.

Question 10.—If the distance of the end of the haulage road to the pit is over a mile then the telephonic communication should be arranged.

Question 11.—Recording air-pressures and temperatures, trained officials to use smoke helmets and breathing apparatus and other safety appliances to bring into use in emergency.

Question 12.—Yes.

Question 13.—(*Not answered.*)

Question 14.—Yes.

Question 15.—So far methods of working are concerned, they should be in panels with due regard to ventilation.

Question 16.—Yes, in seams most liable to spontaneous combustion safety zones of non-inflammable material barriers after regular intervals may be incised. The distance between each to be aided by incubation period for the place and these barriers should possibly be put in before de-pillaring.

Question 17.—(*a*) Insufficient size of pillars. (*b*) Pillars standing for a very long period. (*c*) Soft nature of coal, resulting in heavy side-falls and widening of galleries. (*d*) Disturbed coal and roof near large faults or between the faults. (*e*) Splitting of pillars by human agency. (*f*) Slack supervision while working.

Question 18.—As the result of premature collapses fire might arise. It can be prevented by stowing but the expense to be incurred will not be justified for the old workings.

Question 19.—I am not in favour of fixing the minimum size of pillars and maximum size of galleries by law. It should best be left to the experienced mining engineers, under whose advice and guidance the collieries must be made to work.

Question 20.—The dimensions are in regard to (*a*) depth of coal, (*b*) nature of coal, (*c*) height of seam, (*d*) inclination of seam, (*e*) nature of roof or floor, (*f*) proximity or near a large fault or dyke and nature of the disturbed area.

Question 21.—Yes.

Question 22.—Minimum parting to be 10 feet and the number of sections to be, with respect to adherance of such parting. This parting is dependant on the nature of coal and therefore height of galleries between such partings is a matter to be considered. Height of gallery too should be a convenient height for purpose of testing, supervision and working. The dimensions of pillars and galleries to be maintained with the maximum of safety. It will be best if sand-stowing is adopted generally and a seam worked out from bottom upwards maintaining small barriers and stooks if necessary and filled up with sand all-round.

Question 23.—I am not in favour of a separate controlling authority but I reproduce hereunder the reply I submitted to the questionnaire issued by the Coalfields Committee under *Question No. 2* on page 82 of the report:—

"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 the 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.....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".

Question 24.—This could be done by the Chief Inspector of Mines after discussion with the colliery management, and it is desirable that this should be done.

Question 25.—Irruptions of water at Bagdigi colliery and also at Loyabad, Bhaskajuri and practically at a colliery where due to subsidence near a large fault on the adjoining small weak pillars, allowing water from adjoining worked out seam.

Question 26.—Yes.

Question 27.—Dangerous accumulation of water on surface to be avoided and left to the management to do it.

Question 28.—Rules and regulations enforced appear satisfactory.

Question 29.—Not beyond where it is necessary.

Question 30.—Yes.

Question 31.—It may be retained.

Question 32.—No.

Questions 33, 34 & 35.—*(Not answered.)*

Question 36.—It is entirely dependant on the age and size of pillars. On the average 50 per cent. can be taken.

Question 37.—Yes, it will be lost without stowing. I know of Lodna and Khas Jharia having been paid compensation.

Question 38.—The life and productivity will be greatly increased by stowing.

Question 39.—Whole-sale extraction by stowing will be cheaper than stowing at the time of pillar-cutting alone. But partial stowing is advisable while extracting the pillars.

Question 40.—The question of applying these is entirely dependant upon sand and water being available. Isolated efforts by those in proximity of large rivers are being made and this condition must be fulfilled before considering the application or otherwise and with the facility available, the sand-stowing should be made applicable by law where necessary by Chief Inspector of Mines.

Question 41.—*(Not answered.)*

Question 42.—The additional cost can be met by reducing the railway freight on carriage of coal making it possible for collieries

to obtain higher price of coal from the consumers and making arrangements to supply sand free to the collieries leaving it for individual collieries devising their own ways for filling. The expense in supplying of sand to be also met by the railways who will ultimately gain by carrying more traffic in coal by releasing the otherwise locked or wasted coal in working. This will absolve the railway from paying compensation and the collieries should be made to completely stow under the railways. The price is regulated by the consumers being able to sell the finished articles in the market in competition with imported goods hence the increase in price of coal to the consumers will be detrimental to the interest of the industry. The stowing is to be done from safety and conservation point of view, increasing the working costs of the colliery, to balance which, the railway as carriers who are charging high rates of freight, not known in other countries, should be made to reduce the railway freight.

Question 43.—No statutory authority is necessary as this could be efficiency done by the Chief Inspector of Mines by strengthening the department with few more inspectors.

Question 44.—My reply to *Question 23* covers the reply to this since it will be subject to the appeal being preferred before the Mining Board.

Question 45.—(*Not answered.*)

Question 46.—It should be prevented. Nature is bountiful in giving us reserves of coal good or bad and as national asset it must be worked to its utmost. Therefore any seam thick or thin must be efficiently worked out with maximum of quantity.

Question 47.—It should be prevented and controlled and the lower seam should only be allowed to work if it is properly stowed.

Question 48.—I define every coal is of commercial value, for the reasons stated above in reply to *Question 3.*

Question 49.—Yes.

Question 50.—Yes.

Question 51.—Railways under such an event should not pay but I have discussed that under reply to *Question 42.*

Question 52.—By filling it should mean either complete filling or partial (by maximum) filling and therefore it should be adopted according to the conditions prevailing on the colliery.

Yes, Amlabad is partially filling.

Question 53.—I consider that supplying sand and water, where needed free on the colliery will be enough. Bhowrah, Dishergarh, Bhulanbararee, Amlabad, and Saltore are all filling themselves at their own costs.

Question 54.—Simply for sake of conservancy of coal, the procedure as I suggested in reply to *Question 61* should be followed.

Question 55.—This should be made applicable to both the fields and avoidable waste should be stopped whenever occurs.

Question 56.—This does not appear possible because the different royalties have to be considered and the alteration of existing leases will be very difficult.

Question 57.—Yes.

They should be only permitted to work by stowing or filling the space entirely.

Question 58.—Not necessarily. If the control over the two shafts so far ventilation and winding arrangements is exercised by both the managers in a way that it belongs to one and the same owner. The use of shafts for ventilation and winding men and material in emergent cases and other safety purposes are agreed to for mutual use.

Question 59.—The mutual joint survey should be carried out by the adjoining properties, in the event of no common boundary line being agreed upon, the decision will always rest with the legal authorities.

Question 60.—Yes.

Question 61.—The quality should be improved before despatch by preparation and treatment by way of sizing, cleaning and washing if suitable, but the test has to be carried out for plants suitable for Indian coals. This will help towards conservation of higher class coals. The fire-grate, the hot air supplied to the boilers and other changes in the locomotives of the railways and boilers of industrial power can find more use of these coals.

Question 62.—The effect in the methods of extraction has been to hurriedly work out the graded portion of the seams and leaving to waste the ungraded seams or portions of seams and thus causing enormous waste in the working. I do not wish to mention the names of the collieries but I do know that the waste has been considerable.

Question 63.—I consider that the issue of more notices and orders are the efforts of the Mines Department drawing attention towards safety but in ordinary course of working mines, all-round vigilance has to be maintained irrespective of them by the manager and the Chief Mining Engineer or the agent and hence they can never be taken as the index to infer that the methods are more dangerous than England which cannot bear comparison with the Indian mining conditions.

Oral Evidence.

Question 6.—I have no objection to the Temporary and Supplementary Regulations, and also the Temporary Legislation, 1936, being made permanent.

Question 9.—I would agree to the legal requirement proposed on existing water mains and where water is available.

Question 10.—Telephonic communications should be required by law above distances of one mile from the shaft bottom. As regards distances up to one mile, additional signals would be sufficient.

Question 16.—In seams which give off large quantities of inflammable gas the most satisfactory way of avoiding the danger of gas being expelled from goaf cavities is by stowing.

Question 19.—After discussion with the Committee, I agree that general principles of first working should be laid down by regulation based on percentage of the floor area with a limiting height of galleries. Power should be given to the Chief Inspector to vary the principles so laid down in accordance with special circumstances or local conditions. There should also be an appeal to the usual appellate authority where the Chief Inspector does not agree to any variation which the mine-owner considers reasonable.

Question 21.—I agree to the practices referred to *Question 21* being extracted or the point at which pillar extraction is about practices should be allowed from the point where the pillars are being limited by regulation, and the distances up to which these to commence should not exceed two pillars lengths ahead.

Question 24.—I would allow the power to require mine-owners to pack in the circumstances stated to be given to the Chief Inspector under Section 19 (1-A).

Question 30.—I think that it would be sufficient to have a special certificate for shot-firing and gas testing. No one should be allowed to have this certificate without at least one year's actual experience underground. Further, no shot-firer should be allowed to have any financial interest in the getting of the coal.

Question 42.—My idea about freight is based on the fact that there are at present differential rates on coals from different fields. For example, the Central Provinces coal pays the following rates of freight:—

	Pies per maund per mile.
Up to 200 miles	·1
201 miles to 500 miles	·06
501 miles and over	·045

The Jharia and Raniganj coal on the other hand pays the following rates:—

	Pies per maund per mile.
Up to 200 miles	·165
201 miles to 400 miles	·13

If the distance coal is carried is 401 miles and over, the following scale applies:—

	Pies per maund per mile.
For the first 200 miles	·15
For distances over 200, up to 400 miles . . .	·06
For distances over 400 miles	·05

The net result is that the Central Provinces coal pays about Rs. 2-13-9 per ton up to 200 miles and Jharia field pays Rs. 4-8-6 *plus* 12½ per cent. for lesser distance. Though the above basic rates for distance over 200 miles for the Central Provinces coal have been somewhat increased lately, my point is that the same lower basic rates should apply to Raniganj and Jharia coals as apply to the Central Provinces coals.

As regards the general question, on the additional cost of stowing, I now agree, after discussion with the Committee, to a cess being imposed on all coke carried by rail in or into British India in order to provide the necessary funds. There should be direct contributions to this cess from the railways and from the royalty receivers. There should also be a countervailing import duty of an equivalent amount on foreign coal and a drawback of an equivalent amount on Indian coal exported.

I may add that since the lower basic rate for Central Provinces coal was considered possible to help the growing industry, it may, similarly be applied for conservation and other points of view to the Coalfields of Bengal and Bihar.

Question 43.—If a cess is to be imposed as I have agreed above, then a statutory authority will be necessary for administering the cess funds. I agree that the Chief Inspector of Mines should be a member of the statutory authority in order to link up safety and conservation. I do not think that the Chairman should be independent in the sense that he should have no connection with any mining interest in this country. I would allow the Government a representative on the statutory authority, and the remaining members would be selected from a panel of mining engineers. All these members should then elect their own Chairman from amongst themselves. The statutory authority should also be the appellate authority in respect of orders under the Mines Act. It should also do the work of the mining boards and courts of enquiry.

Question 51.—If the railways contribute directly to the cess and also pay the cess on the coal won from State railway collieries, then they should not be required to contribute anything towards the actual cost of stowing under their lines.

Question 53.—I agree, after discussion with the Committee, that a flat rate as a contribution towards the cost of underground stowing would be suitable.

Question 62.—I agree that the effect of grading and working sections of seams has been to increase waste and danger from fires.

I would therefore be in favour of any measures that restricted grading to export coal entirely. Even as regards export coal, if it is worked in sections, I would require the mine-owner concerned to leave the section unworked in such a condition that it can be recovered later.

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33. Written Evidence of Mr. G. G. Carapiet, Manager, Bansdeopur Colliery of New Bansdeopur Coal Co., Ltd., Manbhum.

Question 1.—I am the Manager of Bansdeopur colliery. I have 28 years' experience in Indian coal-mining, both Jharia and Raniganj coalfields, mostly Jharia.

Question 2.—Main cause in underground fires is coal left in the goaves, mostly slack. Yes. Fires in underground are controlled by many factors; there are instances of premature collapses causing spontaneous fires and also normal collapses causing fires and also there are instances when no fire occurs in either case.

Question 3.—Any coal given favourable conditions are liable to spontaneous combustions. Period of incubation depends on the quality of the coal and also various conditions.

Question 4.—Yes.

Question 5.—Yes. Various factors are to be considered in leaving barriers; 30 per cent. may be taken as normal.

Question 6.—Adequate.

Question 7.—Yes. Exhaust fan preferable.

Question 8.—Yes. No.

Question 9.—No. Provision of taps on water mains will not serve any useful purpose.

Question 10.—Yes. (The word remote should be defined.) If the shaft is more than 600 feet deep or the haulage over 2,000 yards, the gradient also should be considered.

Question 11.—Adequate precautions are provided by the Mines Act.

Question 12.—Yes.

Question 13.—The rescue party should be trained in the use of breathing apparatus and gas masks in dealing with mine fires.

Question 14.—Not necessary.

Question 15.—Precautions already in force are ample.

Question 16.—Yes. All seams giving inflamable gas and where the local fall precedes the main fall for some considerable time.

Question 17.—Insufficient support, gradient and the composition of the coal and the nature of the superincumbent strata.

Question 18.—May cause spontaneous combustion, loss of life and property.

Question 19.—No. All seams are not alike and each individual seam has to be considered on its merits. This should be left to the management to decide. The Mines Department has ample power to intervene and to stop the work if they find the pillars and galleries are not kept to a size ensuring safety.

Question 20.—This is to be decided after local conditions of each coal seam has been examined by the management. The factors to be decided are the thickness of the seam, depth of the seam from the surface, gradient of the seam, friability, etc.

Question 21.—Yes.

Question 22.—The number of section to be worked will depend on the thickness of the seam, gradient and other local conditions. The parting in any case should not be less than 10 feet and the pillars should be one directly under the other.

Question 23.—No.

Question 24.—I would, if the statutory authority would provide financial aid.

Question 25.—No.

Question 26.—No.

Question 27.—The condition of each mine should be considered separately taking local conditions into consideration. The management could judge best what precautions are necessary.

Question 28.—The length of safety fuse to be specified.

Question 29.—No.

Question 30.—Yes.

Question 31.—The proviso to Regulation 106 should be retained.

As the present Regulation does not cause any undue hardship on the labour or delay of work, I think the restriction required by the above Regulation, if removed, may cause a great deal of illicit possession of explosives leading to many accidents.

Question 32.—No.

Question 33.—We have been working from X seam to XIV—

X seam is not graded, very little work done. 36 feet thick, gradient about 1 in 4·5.

XI seam not graded, some work done. 22 feet thick, gradient about 1 in 4·5.

XII seam 1st grade, about 12 feet thick, gradient about 1 in 4·5.

XIII seam bottom 10 feet 1st grade, thickness of the seam 18 feet old workings full thickness worked, gradient about 1 in 4·5.

XIV seam selected grade, but is placed in 1st grade as XIII and XIV seams are raised by the same mine. The pillars of almost the whole of 14 seam extracted and most of XIII seam. The same seams of our neighbours after extraction, spontaneous combustion has taken place, we have been free of fires although we have had fires on the surface of the same seam. Thickness 26 feet. Gradient about 1 in 4·5.

Question 34.—The whole section of XIV seam is extracted.

XIII seam old workings, the entire section extracted but after the seam was graded, the ungraded portion was left in the goaf.

Question 35.—For several years almost 75 per cent. of the output has been from pillars.

XII seam over 95 per cent. is recovered.

XIII seam, owing to several places XIV seam puncturing through the intervening strata about 40 to 50 per cent. is recovered. This represents the workable seam, *i.e.*, about 40 to 50 per cent. of the seam was extracted when the full height of the seam was worked, but when the roof coal had to be left behind the percentage of the seam was appreciably reduced.

XIV seam 70 to 75 per cent. is recovered.

Question 36.—The quantity to be extracted depends entirely on local conditions. Under normal conditions and with the same results as we have had here not less than 65 per cent. should be extracted.

Question 37.—My reply to the first part of the question is affirmative and second part negative.

Question 38.—The life may be lengthened but the quality of the small coal will be deteriorated to a great extent probably rendered more or less useless.

Question 39.—It would be advisable to stow some seams simultaneously when extracting pillars, but not all seams.

Question 40.—Seams giving off inflamable gas and those seams which are very thick and pillars unstable should be governed by any enforcement applied.

Question 41.—I have had no experience.

Question 42.—The additional cost in stowing should be met by the consumer, particularly the railways and the iron and steel trade. This should be realised by the railways with the railway freight.

Question 43.—Yes. The statutory authority should constitute by representatives of the trade and those bodies directly interested will increase and not decrease. The quality of slack, if not turned Mining Board against any order of the statutory authority, should the owner disagree with the orders of the statutory authority.

Question 44.—No.

Question 45.—I have no experience but I am inclined to think that the effect on costs on most of the items from 45 (*a*) to 45 (*h*) will increase and not decrease. The quality of slack, if not turned useless, will be deteriorated considerably and rendered of little value.

Questions 46 & 47.—Yes.

Question 48.—Coal is of commercial value if you can get a market for same at a price.

Question 49.—The conditions vary in many cases and as the parting between the two seams plays an important part, each case should be considered separately.

Question 50.—The mine owners should be required to remove coal under railway sidings, villages, rivers, etc., by systematic stowing with incombustible materials, provided they are given financial aid for the purpose.

Question 51.—If they are required to remove under the railway sidings, villages, rivers, etc., the railways should pay the whole cost of stowing as the railways derive their revenue from these lines.

Question 52.—Under certain cases partial filling may be sufficient. I do not know of any partial filling.

Question 53.—If compulsory sand-stowing is introduced, the supply of sand free at the colliery will not be sufficient, some financial assistance also must be given.

Question 54.—If statutory control over mining methods is introduced, it should be universal. As the risk of danger to life and property exists in every mine and the conservation of non-coking coal is as important national asset as the coking coal, therefore, both should be conserved.

Question 55.—Compulsory stowing, if adopted, should apply to all the coalfields. Yes. All avoidable waste should be stopped.

Question 56.—Steps should be taken to amalgamate but not without *salami*. Some arrangement must be made to compensate each owner to give away his right.

Question 57.—I do not approve of one owner possessing the rights to, and working a seam or seams directly under or above another seam being simultaneously worked by another owner. Many dangers and working complications may arise, such as, the mine being inundated by the water of the workings of another mine, fire of one mine will affect the other, or collapses occured by mismanagement or otherwise will endanger the life and property of the other.

The remedy for such properties is for the owners to amalgamate and work as one company.

Question 58.—Yes.

Question 59.—My answer to both the queries are in the affirmative.

Question 60.—Yes.

Question 61.—Undoubtedly if inferior coal was used instead of selected or first grade the life of the available reserves of good coal would increase. The research committee could do useful work in this direction.

Question 62.—The effect on methods of extraction of the Coal Grading Act of 1925 has been to increase wastage and danger to life and property. In our XIII seam working we have had to take about 10 feet coal from the floor and leave the remaining coal in the goaf. This is not only an irrecoverable loss but is always a potential source of danger, both during the pillaring operation and after.

Question 63.—The condition of working in India cannot be compared with that of Great Britain. As the coal worked in India is, generally speaking, much thicker than that of Great Britain. Hence far bigger number of accidents. Also that the labour employed in India are by far of much lower standard to those employed in England.

Oral Evidence.

Question 6.—I would agree to the Temporary and Supplementary Regulations, and the temporary legislation of 1936, being made permanent. I would suggest, however, that Temporary Regulation No. 3 should be restricted to mines which are mechanically ventilated.

Question 9.—I would agree to the requirements contemplated in this question provided they are limited to existing water mains and where water is available.

Question 10.—I agree to telephonic communications being required by law in mines with a gradient up to 1 in 4 beyond a distance of 1,000 yards from the shaft bottom. If the gradient is greater, the distance of 1,000 yards should be decreased proportionately. The actual distance for any greater gradient should be fixed at the discretion of the Chief Inspector of Mines.

Question 14.—After discussion with the Committee, I would agree to the extension proposed in this question to seams in a mine in which a fire has ever occurred at any time.

Question 16.—I agree that the proposed enforcement of stowing should be limited to those mines where the gas is given off in considerable quantities.

Question 19.—I would agree to general principles of first working being laid down by regulation under the control of the Mines Department. Such principles would apply in the majority of cases, but there should be a discretionary power with the Chief Inspector of Mines to vary those principles in accordance with special circumstances or local conditions. If the Chief Inspector did not agree with the management in respect of any such proposed variation, there should be an appeal allowed from his decision.

I agree that the penalty for an infringement of any such general principles should be adequate and immediately enforceable. A suitable penalty would be a requirement that the conditions as they should have existed under the principles of working should be securely restored and that, in the meantime, no work should be done in that section of the mine.

I agree that the most suitable basis on which the general principles should be framed would be a percentage of floor area *plus* a maximum height of 10 feet for all galleries.

Question 21.—I would define "immediately before the systematic extraction of pillars" as extending to a maximum of 2 pillars lengths ahead of the pillar which is being extracted or of the point at which pillar extraction is about to commence.

Question 28.—My idea is that there should be a minimum length of fuse of 3 feet; this length to be required for the last shot to be ignited in one series.

Question 30.—I am in favour of a special shot-firer's certificate which should also cover knowledge of gas testing. I agree that all shot-firers should not be allowed to have any financial interest in the getting of the coal, in other words, the remuneration of shot-firers should not depend on the amount of mineral got.

Question 33.—The 8 feet which is now being left in No. 13 seam is inferior in quality to the bottom 10 feet which is in Grade I.

As regards XIV seam which is actually Selected Grade, the Grading Board gives us a certificate as Grade I, because it is being raised along with XIII seam.

I have been forced to work XIII and XIV seams together simultaneously because the parting between them is very thin. It is only about 8 feet of shale. I would get a better price for XIV seam coal if it could be raised separately and sold as Selected Grade. As coal both for export and for internal use is sold in accordance with grading, it follows that the operations of the Grading Board have done me some harm in this respect.

Question 35.—In XIII seam when pillars were extracted when the full height of the seam was worked, the percentage of extraction was from 40 to 50 per cent. When the graded section of 10 feet only was worked, the percentage of extraction from the pillars was only about 28 per cent.

Question 36.—Taking all the seams in the Jharia field into consideration, I would say that the percentage recoverable with the existing methods of working will not be more than 35 to 40 per cent.

Question 38.—I have no personal experience of sand-stowing, but I agree on general principles that the life and productivity of my collieries would be increased with sand-stowing, though there may be some loss for the reason stated in my written answer, that is to say, small coal being deteriorated.

Question 40.—By " very thick seam " I mean any seam over 15 feet in thickness.

Question 42.—After discussion with the Committee, I agree to a general cess on all coal carried by rail in or into British India. Where coal raised at a colliery was manufactured into coke on the same colliery, and then despatched by railway, that coke should pay the cess at the rate of 1½ tons of coal to one ton of coke. I think that a better workable formula would be that the cess should be put on to all coal and coke (except the coke which has already paid the cess on the slack consumed).

I agree that the railways and the royalty receivers should also contribute directly to the cess, also that the cess should be accompanied by an equivalent countervailing import duty on foreign coal and an equivalent drawback on Indian coal exported.

Question 43.—If the statutory authority is to administer the cess funds for purposes of financing sand-stowing in the interests both of safety and conservation, I agree that the Chief Inspector of Mines should be a member of that authority. As regards the Chairman, I think that he should be independent, and would prefer a mining engineer from home who is not interested directly or indirectly in any mining concern in this country. If the statutory authority is also to hear appeals from the orders of the Chief Inspector of Mines as regards safety, I agree that it would be necessary to have some one with legal knowledge and judicial experience on the statutory authority. In that case, it would be best to have a barrister or other lawyer as a legal member of the statutory authority. The remaining members should be provided by a panel of about 10 selected mining engineers actually working in the Indian coalfields. Out of this panel three mine members would be selected by the Chairman for each sitting of the statutory authority, making a total of five members for the statutory authority at any one time. I think it important that the Chairman should be appointed for a period of five years in the first instance and that the mining engineers on the panel should be there for three years only and not be re-elected.

Question 48.—What I mean is that coal is of commercial value even though you may not be able to sell it at a profit at the moment.

Question 49.—I think that the present Temporary Regulation No. 10 should be amended so as to allow the Chief Inspector to take into consideration the thickness of the strata between the two seams together with the thickness of the lower seam.

Question 51.—This may be added to my written answer:—" It is not only to their interest to keep the lines intact, but it is their duty to maintain same in the same manner as any surface embankment is attended by them."

Question 53.—The further financial assistance to cover the cost of stowing underground should take the form of a flat rate on the coal raised from the sand-stowing area.

Question 55.—I would agree to a definition of "avoidable waste" as all waste which is not incidental to the proper and efficient working of the system of mining that is being followed. I agree that, where commercial considerations would affect the question of avoidable waste by mining and national standards, commercial considerations should always be subordinated to mining and national considerations.

Question 56.—I understood *salami* to mean that amalgamations would be enforced without any payment equivalent to the difference in the value of the two properties. I agree that in such cases no mutation or transfer fees should be leviable by the landlords concerned.

Question 62.—It is correct to say that most of the exported coal comes from the Raniganj fields. This is because of the advantage in freight rates to Calcutta which that field enjoys.

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34. Written Evidence of Mr. R. B. Penman, Agent, Gopalichuck West Colliery, Kusunda, Manbhum.

Question 1.—Agent of a group of collieries with 15 years' experience in the Jharia and Bokaro coalfields.

Question 2.—(*a*) Spontaneous combustion in goaf and collapsed areas.

(*b*) The number of fires has increased in recent years due to the greater amount of pillar extraction now being done and due to the greater depth at which pillars are being extracted. Premature collapses have, I believe, caused about 50 per cent. of the coalfield fires.

Question 3.—It is impossible to name the seams most liable to spontaneous combustion. Any seam is liable to fire if conditions are favourable. The period of incubation varies according to conditions and may range from 2 months to 1 year.

Question 4.—Fires increase the difficulties of extracting the remaining coal, and must result in the loss of a percentage of that remaining coal. With good organisation there should be little increased danger to the workers in extracting a pre-arranged safe amount of the available coal. With a well-organised plan the danger should not increase.

Question 5.—In first workings there can be no objection to laying out the workings in panels, but a number of factors would have to be considered before I would agree to de-pillar in the ordinary way inside these panels and so lose the coal in the barriers.

The percentage of the seam to be left in the barrier would vary according to conditions but might be 33 per cent.

Question 6.—The Temporary Coal Mines Regulations have, I consider, covered all known possible dangers and I consider them adequate.

Question 7.—Yes, mechanical ventilation should be used where there are sealed-off fires. The direction of the fan can only be settled after knowing the conditions, but I am of the opinion that most fans will be exhausting.

Question 8.—All coal left in goaves must increase the risk of fire.

No.

Question 9.—No, these would be futile as fires originate in areas to which no access can be got. The provision of sand buckets near electric apparatus is sufficient.

Question 10.—Telephones between the surface and shaft bottom and in-by haulage and pump rooms might be a safety measure.

Question 11.—All necessary precautions are covered by the Coal Mines Act.

Question 12.—Yes, training in the methods of dealing with and the dangers that may arise from underground fires should form part of all rescue team training.

Question 13.—Breathing apparatus and gas masks should not be used unless by the trained mine rescue teams.

Question 14.—Temporary Regulation No. 14 should be extended to apply to all mines where the seams are liable to spontaneous combustion.

Question 15.—Yes, precautions against fires occurring are best. Each mine must be left to settle its own methods and no hard and fast rule can be made due to the different conditions met with in each mine.

Question 16.—Where a seam is liable to fire and where inflammable gas is present it may be desirable to pack with sand or other suitable material when pillar extraction is being carried on. This would not mean packing the whole area but only packing enough to support the roof. Where de-pillaring is done from the dip boundary it may be possible to keep the goaf submerged in which case packing would not be necessary.

Question 17.—Premature collapse can only be due to an insufficient support for the roof being left during the time of first working.

Question 18.—Premature collapses may cause air blast, fire, and may affect shafts, surface, buildings, tanks, etc. The collapse can only be prevented by packing unstable areas or deliberately further reducing the support and inducing a controlled collapse.

Question 19.—I cannot see how hard and fast rules can be made by law as there are so many factors to be considered, such as thickness of the seam, distance between seams, and the thickness of the over-burden.

Question 20.—See *Question 19.*

Question 21.—Yes, with special permission possible from the Chief Inspector of Mines for special cases.

Question 22.—Not more than two sections of one seam should be worked at once. Pillars should be formed vertical under each other and not more than 35 per cent. extraction in each section should be allowed in first working. The actual lay-out should be in the manager's hands but a definite maximum amount of extraction in first workings should be stated.

The parting between the sections would be governed by the local conditions.

Question 23.—I do not consider it necessary to have the lay-out of any workings approved by a statutory authority but as said in previous answers the maximum percentage of coal to be extracted in first workings should be fixed by some competent body.

Question 24.—This is a question which can only be answered by mine owners.

Question 25.—No.

Question 26.—I would not consider an irruption of water entering a fire as dangerous from the reasons stated in the question.

Question 27.—No legal enforcement necessary.

Question 28.—I would not suggest any change in the present regulations.

Question 29.—No.

Question 30.—Yes.

Question 31.—This proviso should be abolished. Regulation 106 as it now stands places no undue hardship on explosive users and the Chief Inspector cannot possibly see the changing conditions underground while explosives are being used. As canisters need only be 30 feet apart there is no need to burden the Chief Inspector of Mines with the extra responsibility.

Question 32.—I would suggest that the person taking explosives from the magazine gives a receipt for the explosives.

Question 33.—Kargali seam Bokaro varying from 40 feet to 80 feet thick with sections selected grade and other sections of inferior quality, gradient 1 in 9.

XV seam, Jharia, 20 feet thick with 14 feet selected grade and the remaining 6 feet inferior.

XIII seam, Jharia, 20 feet thick with 13 feet selected grade and the remaining 7 feet inferior.

XII seam, Jharia 12 feet thick with 8 feet selected grade and 4 feet inferior.

XVI seam, Jharia, ungraded but giving about 16 per cent. ash, 10 feet thick.

All these Jharia seams are at a gradient of 1 in 6.

Question 34.—Only the selected grade sections of the above seams are being extracted. The whole of XVI seam is being extracted.

Question 35.—Approximately 100 per cent. of output is coming from pillars. Approximately 85 per cent. of the working section of the pillars is being recovered but this figure varies slightly due to local conditions.

Question 36.—If the 120 million tons are in the working sections, I would expect 65 per cent. of this amount to be recoverable with existing conditions.

Question 37.—The major portion of the 200 million tons referred to will be lost unless stowing is done.

No.

Question 38.—Stowing would little affect the life or output of these collieries. Coal now locked up under railways would be recovered which would of course prolong the life.

Question 39.—I could not agree to the packing of all seams.

Question 40.—Only to seams where conditions are likely to cause fire.

Question 41.—No.

Question 42.—Cost should be met by a central fund raised by a cess on all despatches of coal from all collieries in India.

Question 43.—A statutory authority would be necessary if compulsory filling is introduced. This authority must be separate from the Mines Department and the right of appeal to a mining board must be provided for.

Question 44.—A statutory authority should not have power over the lay-out of new workings. The authority should be empowered to state the maximum extraction permissible in first workings. (See answer to *Question 23.*)

Question 45.—(*a*) This might be ¼ anna per ton.

(*b*) A very small amount and very difficult to calculate.

(*c*) At any depth over 250 feet the saving would be very little.

(*d*) This would not affect the actual cost so much as prolong the life of a seam.

(*e*) This depends on the terms of the colliery lease. Where surface rights are held no compensation is payable for land or buildings. A small saving would be got under the head of "removal of colliery buildings"; this might be ½ anna per ton on the coal recovered.

(*f*), (*g*) & (*h*) *Nil.*

No.

Question 46.—If extraction of a section of a seam be prevented a very large part of the coalfield would come to a stop. Under present conditions, I think it impossible to prevent or control the extraction of sections. All coal now unworked in these sections is, under present conditions, of no commercial value.

Question 47.—The same answer as given to *Question 46* applies to this question.

Question 48.—The consumer is really the person to define coal of commercial value. When coal is not required because a better product can be got, that coal has no commercial value.

Question 49.—Each case should be studied, this being one of the duties which might be allotted to the statutory authority as mentioned in *Question 43.*

Question 50.—It would be impossible to make this compulsory if the cost of stowing was to be borne by the colliery. In a great many cases the colliery would rather close than do this at a loss.

Question 51.—The railways should bear the cost when it is a question of support for main and branch lines. (Branch lines including siding lines crossing one colliery to another.) For actual colliery sidings the cost should be borne by the central fund as referred to in *Question 42.*

Question 52.—I consider that partial filling would be successful in a number of cases.

No.

Question 53.—The total stowing cost should be met from the central fund if the stowing is to be compulsory.

Question 54.—If statutory control is necessary it must be universal. To conserve say the coking coal only and allow the non-coking coals to be squandered would only lead to, at some future date, a shortage of non-coking coal. It is also known that some of the so-called non-coking coals, when mixed with coking coals, make a good quality coke.

Question 55.—The answer to *Question 54* answers this question, but I agree waste should be avoided where possible.

Question 56.—I consider that it is now too late to save any large amount of coal from the properties mentioned. In a number of cases the dividing barriers could be extracted without danger. This would be a large saving.

Question 57.—There should be no objection to these conditions if one manager was in charge of the whole mineral leasehold.

Question 58.—Regulation 53.

Section 15 (1). The Indian Coal Mines Act, 1923, along with section 3 (*f*) of the same Act requires one manager to be in charge of all outlets.

Question 59.—Yes, adjacent mine owners should be compelled to make and maintain surveys of the barriers between their properties. If a statutory authority is set up it should be an appeal

court in case of boundary disputes, but not necessary that this authority should survey the barriers unless appealed to.

Question 60.—Yes, outlines of blocks of buildings being all that would be necessary in the plans.

Question 61.—Inferior coal in this case should mean coal only slightly higher in ash than 1st Grade Coal. A percentage of railway consumption and industrial power consumption could be of the slightly inferior coal. The most of soft coke could be made from this coal also.

If inferior coal is of very poor quality it could not be used for any purposes for which good quality coal is now used.

Question 62.—The Coal Grading Act of 1925 has not caused the loss of any coal of commercial value.

Question 63.—There can be little or no comparison of mining methods between Great Britain and India. The very nature of the coal seams in India prohibits the use of methods used in Great Britain.

Oral Evidence.

Question 5.—I would agree with the opinion that generally speaking the panel system increases the factor of safety, but also increases waste.

Question 6.—I would agree to the Temporary and Supplementary Regulations, and the temporary legislation of 1936, being made permanent.

Question 9.—I would agree to the legal requirements suggested provided they were limited to existing water mains and water is available.

Question 10.—My opinion is that telephones should not be enforced though they might be useful where the time factor was of importance.

Question 19.—After discussion with the Committee, I agree that general principles of first working should be laid down by regulation with a proviso empowering the Chief Inspector to vary those principles to suit special circumstances or local conditions, provided also that, if the Chief Inspector refuses to vary those principles the management should have a power of appeal to the same authority that hears appeals against orders made under section 19.

As regards the nature of those general principles, I agree to a system based on percentage of floor area *plus* a maximum height of gallery, the percentages varying with the depth and thickness of the seam.

I agree also that a penalty for any infringement of these first principles should be adequate and immediately enforceable. A suitable penalty would be to require the conditions required

by the general principles to be securely restored, all work in the section of the mine being prohibited meanwhile.

Question 21.—I agree that " immediately before the systematic extraction of pillars " might be defined as a maximum distance of two pillars lengths ahead of the pillar which is being extracted, or a point at which pillar extraction is about to begin. There should be a power of variation with an appeal similar to that suggested in my answer to *Question 19.*

Question 24.—I would be in favour of the power being given to require mine-owners to pack in the interests of safety provided sufficient financial assistance was given to make the operation an economic proposition.

Question 26.—The part of the question to which I do not agree is " because the water then generates gases ".

Question 30.—I think that all shot-firers should be required to have sirdar's certificates specially endorsed for gas testing as well as shot-firing. Such shot-firers should be paid a definite wage and should be considered part of the supervising establishment.

Question 33.—Our 16 seam has never been offered for grading. It would be of Grade II quality if worked throughout as it is in fact being worked. The seam is leased by us to others who can get a market for it. This is a seam of which the coal in my opinion could be improved by crushing and cleaning.

Question 35.—The figure of 85 per cent. does not include coal left in barriers.

Question 36.—If the 120 million tons is standing in pillars and roof and floor coal have to be left because of working in the graded sections only, the percentage recoverable will not in my opinion be more than 40 per cent.

Question 40.—I would agree to sand-stowing being enforced for purposes of conservation provided sufficient financial assistance was given to make the operation an economic one.

Question 42.—I agree to a cess on all coal and coke (except such coke which has already paid the cess on the slack consumed in manufacturing the coke) carried by rail in or into British India. I do not think that railways should be required to contribute directly to the cess. If the sand for stowing is to be carried by railway, those railways should allow a preferential freight rate for such sand and this would constitute their contribution towards stowing. As regards coal under the railways themselves, I would make the railways pay for the stowing done under branch and main lines, but not for the stowing done under colliery sidings. The latter should be paid for or assisted out of the cess funds.

Question 43.—After discussion with the Committee, I am of opinion that the statutory authority contemplated by me should consist of a comparatively few whole-time people who would have to work with the Mines Department, but would otherwise be independent of that Department. There should be no one over

the statutory authority except the local Government. The Chief Inspector should not be a member of the statutory authority. The three whole-time men should all be technical men not interested at the time in any mining concern in India.

Questions 46 & 47.—I would agree to the prevention or control in the circumstances contemplated in these questions provided the authority deciding such questions was able to assist towards the cost of stowing.

Question 49.—What I mean is that Temporary Regulation No. 10 should be amended so as to allow the Chief Inspector of Mines to vary the Regulation with reference to the thickness of strata between the seams and the thickness of the lower seam.

Question 53.—By "total stowing cost" I mean of course the cost said to have been incurred and then checked by the statutory authority.

Question 56.—I have no objection to compulsory amalgamation of small and badly shaped properties and adjustment of boundaries provided the settlement is on a commercial basis.

Question 62.—I agree that the Coal Grading Act was only intended to be applied to export coal and that the extension of the grading system to coal sold internally has increased avoidable waste and danger from fires. It will therefore be desirable to stop grading being applied to coal sold for internal purposes only.

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35. Written Evidence of Dr. Cyril S. Fox, Superintending Geologist, Geological Survey of India.

Question 1.—I am a Superintending Geologist, Geological Survey of India, but I hold an English University Diploma in Coal Mining and Degree of B.Sc. in Metal Mining. As a student I worked in the Ten Yard coal seam at Sandwell Park Colliery, South Staffordshire. As post-graduate student I worked for over a year successively as Shot-firer, Overman and Surveyor in the Cannock Chase Collieries, South Staffordshire. Later, for a year, I was Lecturer, Mine Surveying and Demonstrator in Coal Mining in the University of Birmingham. During this period I made many blood tests of birds and mice which had been used in gas testing in mines in the Midlands. With Sir John Cadman I also assisted in experiments with coal dusts for explosive effects in a specially designed apparatus. In India I have been surveying the coalfields since 1924—personally having surveyed the Jharia and Pench Valley fields and supervised the survey of the Raniganj field. I have visited almost every coalfield during the period of my service in India from Assam to Baluchistan as well certain fields in Afghanistan and Burma. I have not visited the Kashmir fields. During these surveys and visits I have seen Indian coal-mining conditions in a manner which is probably exceptional.

Question 2.—It has not been possible to make a careful scientific study of the problem of underground fires in Indian coal mines as they are so late discovered and so quickly sealed-off, but in most cases of so-called spontaneous combustion the cause is due to the direct oxidation of fine coal in a warm, humid and badly ventilated place. The fine coal may be either discarded slack in old workings, it may be fine coal produced by collapses in de-pillared areas, or it may be dust produced in a pillar by crush due to the pillar being unable to support the superincumbent weight of roof strata. In rare cases fires arise from accident—the upsetting of a lamp, the fusion of electric wires or heat therefrom or some similar human oversight. Coal which is warming up eventually gives off a curious "gob stink" but this subtle warning appears apparently to be detected too late or fires break out more rapidly in Indian coal mines than elsewhere, seeing that so many cannot be put out. The number of outbreaks of fire which require sealing off appear to have been more frequent in the busier Damodar valley coalfields lately. I do not know whether fires are more common after pillar extraction or before, as I have no data.

Question 3.—Judging first as a geologist from direct observation of "burnt outcrops" on the surface all coals of good quality with a volatile percentage above 18 are liable to fire by spontaneous combustion, especially when their moisture content is above 4 and below 8 per cent. (without the coal being damp and perhaps initiated by the material becoming warmed locally either by the direct heat of the sun or the oxidation of iron pyrite) and the place being sheltered from air movements—such as during a period of sultry weather. Seams IX upwards in the Jharia coalfield, especially X, XI, XII, XIII and XIV and to a less extent the Raniganj stage seams in this Jharia field, are liable to spontaneous combustion, that is if the correct physical conditions are also present. There are "burnt outcrops" in Bokaro, Karanpura, Korea, Kanhan, and of course Raniganj, as well as in some of the Tertiary coalfields—Upper Assam, Upper Burma, Kashmir, etc. The only evidence available in regard to a period of incubation is that supplied by the brochure on Bunker Fires on Ships issued by the Fuel Research Board, London. I do not consider very low volatile coal entirely free from risk by such fire.

Question 4.—The fact that there is a sealed-off fire underground in adjacent workings improves vigilance as it is accepted as a potential danger. So far as normal extraction is involved, the difficulties and dangers remain potential, but such a sealed-off fire may cause the management to modify their plan of extraction. A smouldering fire in a sealed-off area must have serious consequences in the event of subsidence in an adjacent working (due, say, to de-pillaring) so fracturing the barriers that air can enter or gases discharge from the fire area. The fire may spread laterally in the same seam in old workings and threaten vital places in the mine, or it may start fires in a seam or above or

even in one below if the ventilation or air movement from the fire area takes that course. To obviate such possibilities it may be necessary to leave so large a barrier round the fire that a considerable loss of coal is involved thereby until the fire is extinguished.

Question 5.—If, as appears probable, that, practically all the good quality coal seams in India are liable to spontaneous combustion under suitable conditions, and it is thought that the existing method of dealing with underground fires cannot be improved then the present system of working should be overhauled. It is not possible to give a safe estimate of the thickness of coal barriers for fire areas—if this is what it comes to. The vagaries of a smouldering fire cannot be determined and may lead the heat unsuspectedly along some path where air can filter, and so, the smouldering fuel might eat through a thick barrier. A very great deal will depend on the accuracy of the plans which show barriers between different properties, as, with the best of intentions, the method of surveying may cause inaccuracies to occur and what was thought a thick barrier may prove to be quite thin.

Question 6.—These regulations are suitable for the existing conditions, but they cannot prevent the occurrence of fires in goaves which are partly fallen—in or those pillared areas which have been lost and become inaccessible by premature collapses and where coal may heat up and take fire. I do not think regulations are desirable, but some plan of ascertaining evidence of heating in abandoned goaves or subsided areas is worthy of consideration. In shallow mines a thermometer can be lowered in bore-holes placed at certain critical points; in deep workings some electrical device for recording temperature may be placed at regular points in the normal course of working. These suggestions must appear pedantic, but they are put forward simply to draw attention to a necessity.

Question 7.—Much depends on local circumstances such as depth of workings and absence of shafts, but where the mine is deep and the workings extensive and a shaft is present there are advantages in mechanical ventilation which give a means for reversing the air current should this procedure become necessary. The exhausting type of fan is generally adopted and it has become the custom to place the fan at the surface. I agree with the exhausting fan, but I think in many cases an electrically driven fan of this class should be at the bottom of the shaft (or between the shafts where there are two) for greater ease of reversing the air current and freeing both shafts for regular use either for raising coal or lowering the labour.

Question 8.—Seeing that spontaneous combustion in mines is well-known to occur in broken coal, particularly fine coal, and that gob fires are well established occurrences, it seems certain that any broken coal left in the goaf is a danger. Where this

broken coal is likely to decrepitate or contains much fair quality slack coal the danger is greater, and where the warmth and humidity is higher than elsewhere, as it may be in unventilated goaves the danger is still more. There may not be agreement, in some cases of fire, between myself and the manager of the colliery involved, but seeing how late fires are discovered, it would seem obvious that most underground fires, due to spontaneous combustion, occurred in goaves. It is a question whether the origin is in crushed pillars or in the broken coal left behind. I incline to the view that it is the waste coal, slack, which results from broken roof coal, or pillars, or which has been simply discarded in extraction and left behind.

Question 9.—I think that insurance companies should insist on fire-fighting appliances being installed in coal mines which they cover. If fire extinguishers are found necessary in surface buildings and fire brigades are maintained to put out accidental surface fires the simple precaution of having water under pressure near at hand underground in coal mines would appear to me a matter of common sense. The fact that such means are not everywhere available in Indian coal mines suggests that these precautions need to be enforced by law. A combination of hydrants and pump-fitted water-tanks is probably more likely to be the best practical arrangement.

Question 10.—It is my opinion that telephonic communication between the surface and the workings underground is necessary in most coal mines. In large collieries there would be considerable convenience and usefulness in being able to speak from the office to the shaft bottom as well as to every area or section which is controlled by a shift overman or sirdar. No part of the workings should be more than 15 minutes distance from the shaft bottom or an inbye telephone. A telephone is much more suitable for signals from inbye to the shaft bottom for haulage stops or starts, than the clapper or bell devices, and the same is also true for communication between the pit bottom and the winding engineman provided a sort of automatic " line clear " signal is given for lowering or raising.

Question 11.—If the fire is smouldering it is clear that sufficient air is getting to it to maintain combustion so that the fire is not truly sealed-off. An effort might be made to analyse the air in the " return airway " to discover whether any of the gases from the fire area are entering the workings where men travel. The condition of the fire should be ascertained from time to time, and an analysis made of the air within by taking periodic samples through a long pipe if this can be done. These extra precautions should have as their objective the putting out of the fire at the earliest opportunity, either by drowning the fire area with water or filling it with carbon dioxide. None of these precautions may be feasible in some coal mines fires, but the fire should be kept under observation and attacked and put out at the earliest possible opportunity.

Question 12.—Yes, I agree that when rescue brigades are established and training for "after-explosion rescue" is begun the method of dealing with underground fires can be added. At first such methods would largely apply to accidental fires and such work as is done by fire brigades on the surface, but later, if means are arrived at for fighting fires in sealed-off workings or in goaves which are accessible, these cases would be best dealt with by those trained in the use of breathing apparatus.

Question 13.—I think that where a fire or heated coal underground cannot be approached with the air current, or where the air current might aggravate the fire, it may not be possible to get near the spot without a gas mask or some form of breathing apparatus. In many cases the loss of half an hour in getting to a fire, or heated place, may mean either the loss of a valuable working area or the whole of a colliery. This half hour could be saved by a rescue brigade getting straight to the fire and putting it out by some recognised efficient means.

Question 14.—I think on the outbreak of a fire all attention should be devoted to fighting the fire and protecting the miners and property. At such times the management should be free of attending to regulations of a nature which do not directly assist in combating the fire. In my opinion all collieries should come under a regulation which affects coal liable to spontaneous combustion and introduces precautions in advance of any actual occurrence of fire.

Question 15.—Yes, I think precautions against fires, either accidental or due to spontaneous combustion should be introduced to guard against fires, but the regulations or methods to be adopted must be of an efficient and yet reasonable kind so as not to hamper the mining operations. As regards the type of precaution to be adopted much depends on local circumstances, but if it be agreed that fine coal, either as discarded slack or formed by crushing of pillars, is a factor in spontaneous combustion, then such coal must not be left without being rendered harmless by the addition of sand, and such pillar movement should be prevented by leaving larger pillars or by buttressing them in some suitable manner with stone packing. The horizontal shearing, known as overriding, of pillars is probably the cause of the formation of much fine coal, and as this is a common movement during pillar collapses and subsidence special attention is directed to it. The horizontal shearing of strata generally occurs along seams of coal, and especially along vitrain laminæ, as these materials have practically no resistance to shear. The movement is easily started in inclined seams during de-pillaring or due to subsidence in the dip workings as the slope of shear is increased thereby. It would thus appear most important that de-pillaring should not begin in dip workings, and should, wherever possible, be begun at the rise. By doing this any subsidence will decrease the dip of the strata and so reduce the tendency to slid—under gravity there is a natural tendency for the upper strata to slid to the dip over the lower

along the plane of some zone of weakness, *i.e.*, bright coal in a seam, and, in so doing, reduce this bright coal (vitrain) to a dangerous dust.

Question 16.—I think underground fires due to spontaneous combustion would never become troublesome if some form of filling of inert material were introduced into goaves to support the roof and cool the coal. Subsidence would not occur, upper seams and the surface would escape damage, slack coal left behind would be rendered harmless, and pillar movements, either by crushing or shearing, need not take place. For the above points to be met sand packing with hydraulic stowage is the most efficient, and where sand and water are available it is probably the cheapest method when dealing with thick seams of coal. This method was being gradually introduced into the better coal seams when the price was good. The same principle should be followed for simple efficiency now.

Question 17.—Insufficient strength of supporting strata, *e.g.*, a weak coal pillar, the presence of a fault along which movement begins, over-riding due to slid towards dip where de-pillaring may be being carried out or due to pillars in a lower seam not being correctly under those of an upper seam. The plane of a dyke contact may be treated as a fault plane as slipping may occur along it and allow a sudden collapse in a working under such a plane of weakness.

Question 18.—A collapse due to pillars in two seams, one close under the other, not being in the same vertical column has led to serious surface subsidence and loss of life. Collapses off a fault or dyke face are generally small, but they may be sudden and permit the entry of large volumes of water and thus endanger lives. Subsidence due to over-riding of pillars to the *rise*, as a result of de-pillaring to the dip, may lead to very serious loss of coal. If the geological features are recognised care can be taken in approaching dykes and faults. In the case of de-pillaring to the dip the practice should be discouraged. In the case of pillars in a lower seam being misplaced the cause is due to faulty surveys or to inaccurate draughtsmanship.

Question 19.—This is probably one of the most controversial points in Indian coal mining where the method of working thick seams involves a system of pillar and stall plan. So much depends on the thickness of the seam worked, the dip of the strata, the depth from the surface and rate of extraction (demand for coal) that any enforcement by law may prove both troublesome and wasteful at one time and yet be a great safeguard at another period. It should not prove difficult to work out a systematic method of estimating pillar sizes at various depths for flat lying seams, but it is unlikely that thick, inclined seams will be governed by any rule for arriving at an economic pillar size which is consistent with safe working.

Question 20.—Depth, *i.e.*, pressure on the pillar, thickness of coal, *i.e.*, height of pillar, and dip, *i.e.*, tendency to shear the coal laminæ in the pillar, are the chief factors as already stated. The first consideration is thus pressure, and if we assume coal up to 240 feet (strata load about 1/8th tons per square inch) is safely able to stand a load of 1 ton per square inch a 40-foot side, square pillar will carry an area, also square, of 110 feet sides. At 480 feet depth the strength of coal may be taken as $1\frac{1}{2}$ tons per square inch (the strata load is $\frac{1}{4}$ ton per square inch) so that a 60-foot side square pillar will hold an area of 150 feet sides, if square. At 960-foot the strength of coal *in situ* may be taken as 2 tons per square inch (the strata load is $\frac{1}{2}$ a ton per square inch). These figures may be put in the form of a table as below:—

Depth to Seam.	Approximate strata load on coal.	Compressive strength of coal.	Theoretical sq. pillar.	Area to be supported.	Percentage Extraction.
Feet.	Tons/sq. inch.	Tons/sq. inch.	Feet side.	Feet side.	
240	$\frac{1}{8}$	One	40	110	87·5
480	$\frac{1}{4}$	$1\frac{1}{2}$	60	150	83·3
960	$\frac{1}{2}$	2	90	180	74·4
1,440	$\frac{3}{4}$	$2\frac{1}{2}$	120	210	69·2
1,920	One	$2\frac{1}{2}$	150	240	60

These calculations refer to a flat seam of virgin coal which has not suffered any serious faulting. For seams or sections not more than 16 feet in inclined strata, the dip not exceeding 15° or about 1 in 4, the side of the pillar to the dip must be increased by at least *Side/cosine of dip.* However, it is doubtful if any two mining men will agree with any formula, or stipulation based on theoretical factors, which, only too often, require modification in practical cases.

Question 21.—No, I do not think any legal prohibition is required, especially in the case of workings below 1,000 feet from the surface. In the rough data given in paragraph 20 above I have shown pillars of 90 feet sides at 960 feet; 120 feet at 1,440 feet; and 150 feet at 1,920 feet. It may be permissible to have four pillars in each case instead of one big pillar, *e.g.*, nine pillars of 40-foot sides or 4 pillars of 60-foot sides instead of one of 120-foot sides at a depth of 1,440 feet. The "splitting" to initiate these pillars should be done at any time which seems most suitable to the colliery manager. I think, however, that details of the methods of working in the Jharia and Raniganj coalfields, and others, might be studied to see if the best practice is being followed in all cases.

Question 22.—The sizes of pillars or the sectional area of the supporting coal given in paragraph 20 were intended to meet the case of a seam 30 feet thick, but others may not agree with these sizes or sections. However, a ten yard coal is successfully worked in South Staffordshire by the system known as Square Work, and the same method could often be used in Indian mines. The system is described in Hughes' Text-Book of Coal Mining. Instead of getting the roof coal in the English manner some packing might be introduced and the upper sections got by standing on the packing. The stripping of the roof may be done in sections of 7 or 8 feet, *i.e.*, three strippings for a total section of 28 to 30 feet of coal. This method will not generally recommend itself as some of the sections might be of poor coal which is seldom brought to the surface when the price of coal is low. All coal, however, which at one time or another has been saleable should be brought to the surface and there sorted.

Question 23.—I think that the methods of coal extraction in use in Indian mines should be thoroughly examined. While I do not agree that legal action should be used to enforce a system of working I am of the opinion that there is room for a controlling authority to approve or otherwise of a method of working which is known to have proved useful or unsatisfactory in similar circumstances in India.

Question 24.—Yes, I think once a controlling authority was definitely thought advisable it should have power to enforce packing or partial packing. By controlling authority it may be taken that a recognised procedure has been arrived at by a select committee and their recommendations can be the controlling authority. The controlling authority would then become vested in the Mines Department who would see that the procedure was carried out. The system of mining; the mode of extraction; the splitting of pillars; and details of packing should, however, be threshed out by a carefully chosen committee of mining men and their recommendations discussed and adopted as normal mining practice for Indian conditions.

Question 25.—No, I am not acquainted with any particular case of a serious inrush of water into underground workings in an Indian colliery of which I possess details.

Question 26.—A heavy irruption of water into a fire area would be the best way of putting out the fire completely. The chief danger of water entering a fire area is that the amount may be small or arrive by percolation to coal which is in an incandescent condition. In such cases water-gas may be produced and be a potential danger, either by exploding when the fire revives on the cessation of the water, or by the poisonous gas finding its way into adjacent workings, where even small percentages of carbon monoxide may prove poisonous and large amounts would become explosive mixtures with air to open lights. It must be stated clearly that the generation of water-gas in the manner indicated above is largely a theoretical matter and that such cases are very

rare indeed. To be effective the water must impinge on incandescent coal in a thin spray or as steam, intermittently, so as first not to put out the fire and then permit it to recover itself before more steam or water is applied.

Question 27.—The danger from flooding an underground working is usually after a subsidence which liberates a large volume of water which may have accumulated in old workings to the rise or in a seam above or in an adjacent colliery. In some cases the collapse of a river bed may let in a large quantity of water suddenly, or a heading, which runs into a fault, may free water which is stored in a heavily watered stratum. Most cases are thus due to subsidence and if subsidences could be avoided and care taken in driving headings towards old workings or faults the danger from flooding could be greatly reduced. The broken surface of a subsided area forms a good entry for rain water and in times of heavy rain serious amounts of water may enter the workings, fill old workings or saturate porous strata. In periods of steadier rain there is the possibility of water getting to the workings and entering a fire area in just the manner which will permit of the generation of water-gas. This gas may be exploded in the fire area itself and blow out the seals or fire-dams and thus discharge poisonous fumes into the workings. If the surface had not been broken by subsidence perhaps even this potential danger from water-gas might be eliminated. The simplest way of preventing subsidence is to leave enough coal in pillars to support the overlying strata or to pack the workings so as to attain the same end.

Question 28.—The surface storage, issue and underground storage of explosives are all sufficiently well controlled already. I think the use of explosives should be carried out only by shot-firers appointed by the manager. Actual shot-firing, in my opinion, should only be permitted by persons directly responsible to the manager or his deputy. No contractors' man or collier who is paid by tonnage for getting coal should be normally permitted to fire his own shots.

Question 29.—Colliers or stallmen on contract to cut coal bring in their own explosives to the mine working place in England, but fill and ram the charge in front of an overman or shot-firer appointed by the colliery company. The shot-firer previously tests for gas and then fires the shot or shots. Perhaps some restrictions may be necessary in India, say with regard to detonators, but otherwise the British practice could be followed on the above general lines.

Question 30.—No, I do not think it necessary to have examinations and certificates for shot-firers. As already stated they should be selected and employed by the manager of the colliery and the manager should be held responsible for all shot-firing by persons selected by him. It is presumed that such persons will hold some certificate of competency, but even this may not be essential in the case of some very carefully chosen employees of a colliery,

company. Shot-firing should not be carried out by contractor's employees.

Question 31.—The Regulation permitting the keeping of 5 lbs. of explosive in one place at one time is necessary for normal working purposes. It may happen after days of undercutting when no money has been earned that the coal does not fall when the sprags (supports) are knocked away. To blow down all the undercut coal in a satisfactory manner may require even more than 5 lbs. of explosives. Once the coal is down loading away could continue without stop until all had been credited to the contractor. If there was insufficient explosive to hand a little coal would be dropped and loaded; then would follow a wait until the next charges could be fired, etc. This is not helpful to the contractor nor to the output of the colliery when the demand is brisk.

Question 32.—No.

Question 33.—I am not responsible for any colliery, but the particulars of most of the seams in the Jharia coalfield are given in my monograph on this field (published as Volume 56, Memoirs, Geological Survey of India).

Questions 34 & 35.—(*Not answered.*)

Question 36.—I have no detailed particulars of the various workings where all this coal is locked up; but if none of it is able to stand de-pillaring without risk of subsidence or fire I do not see how any of it will be recovered. If the price of coal improves the extra expense required for de-pillaring with the help of packing might be adopted and thus a large proportion of this locked-up coal might be recovered.

Question 37.—Much depends on the condition of the workings adjacent to these barriers of coal. If they consist of de-pillared areas which have subsided new entrances to the unworked coal will be required and entail extra expense. If the adjacent areas consist of coal standing in pillars then pillar forming could be continued under the railways, rivers, etc., provided large enough pillars were left for the safe support of the surface. In virgin ground operations could be initiated for laying out workings with large pillars for the surface support. In the best cases it is doubtful if it would be prudent to remove 50 per cent. of the coal in a given area, and on the whole perhaps only 25 per cent. of the 200 million tons could be recovered without stowage of rock or sand, *i.e.*, by present day methods.

Question 38.—(*Not answered.*)

Question 39.—The wholesale extraction of seam without packing must lead to subsidence. It could only be done by the method known as *long-wall* and this could not take more than a section of 6 to 8 feet at a time without much trouble and would need steady extraction in a methodical way. A seam 24 feet thick would thus have to be worked in three sections starting with the top section. After the roof strata have settled down it may be several years

before the next section can be taken, and perhaps a still longer interval before bottom section could be safely extracted. If Square Work was the system employed it is likely 30 to 40 per cent. of the seam would be lost under the most favourable conditions in a 24-foot seam. The loss would be greater at greater depths and a larger percentage of small coal would come from the deeper workings owing to the greater pressure. The danger of fire would also increase from this cause and also from the fact that the deeper mines are generally drier. If packing were adopted the percentage extraction would improve; if sand-stowing was used and hydraulically stored the percentage extraction may be further improved and all danger from fires and subsidence could be eliminated.

Question 40.—Those seams which yield coal of a quality which is specially valued by consumers—for example coals giving a high heat yield in steam raising, or those of value for some special property such as yielding coke of good quality, or for any other use such as gas-making, high tar yield or low phosphorus content—all these should be conserved if the supplies (reserves) are strictly limited. Such seams will stand the expense of sand-stowing by hydraulic methods and the consumers should, as previously did, pay more than they do at present for these coals. These remarks apply also to the State Railways' collieries at Giridih in connection with the Lower Karharbari seam. In the Damodar valley fields the above remarks apply to seams of better quality than Grade II.

Question 41.—No, I have only seen the sand-stowing in progress at old Gotitoria (Mohpani) and at Ramnagar and Saltore in the Raniganj field besides a little of those places in the Jharia coalfield, Bhowra, Bhulanbararee and Amlabad, where this mode of packing has been found useful.

Question 42.—I am of the opinion that packing is an essential means of conserving coal and should be adopted in those seams from which coal of better Grade than II is obtained; also that seams of Grade II, etc., should not be worked so as to endanger the better seams until the superior seam has been worked out. It is my opinion that if supplies of sand are made available at the collieries working the superior quality coals all charges for the sand and its stowage should be met by the colliery company. The vendor should, however, recover all these expenses from the consumer who, if the quality of the coal is truly appreciated, will pay the price as has been done in years when the price was reasonable.

Question 43.—No, I do not think a statutory authority is necessary to introduce sand-stowing into any seam. The fact that a colliery claims to supply any coal of superior grade renders that colliery subject to introduce sand-stowing, but an organisation is wanted to supply the sand to any colliery which is obliged to adopt sand-stowing (say, in the Jharia and Raniganj coalfields as a start). The Coal Grading Board could be sufficient authority

for the purpose of reporting on qualities of coal coming from various collieries.

Question 44.—I agree that a careful investigation of the methods of working coal seams in India is required and that definite conclusions should be arrived at by this means and an authoritative body set up to see that a recognised practice is adopted in Indian collieries. This body would have to consider questions of simple pillar working in seams of inferior coal as well as packing in the seams of good quality coal, but they would arrive at the best methods of extraction in different cases. I think, however, a special case is present in connection with seams where coal is standing in pillars now. This is a matter where an authority may be given power to define the mode of working.

Question 45.—I have no particulars from any case. There should be as a first consideration a larger and safer extraction from a colliery concession. The freedom from fire and surface subsidence will reduce insurance and improve the conditions of the workmen. The avoidance of subsidence will save pumping water which finds its way down each year during the rains. However, so much damage has been done already by subsidence that it is doubtful if much economy can be expected under this consideration except in a few cases. As regards matters of actual saving it may be possible to attack and put out most of the existing fires and thus reduce potential dangers from poisonous gases or explosive mixtures. It may even be possible to fill goaves to the rise and thus reduce fear of floods from a water-filled old working.

Question 46.—It is the custom to estimate the reserves in a coal seam by the total thickness and extent of the seams, and yet when such seams are actually worked it often happens that barely a half of the thickness is extracted. In so doing the reserves even of a single seam are immediately halved, and of the remainder that is the section worked, it is rare that 50 per cent. is extracted. Thus the total extraction is only 25 per cent. This I have shown in the case of several coalfields in my memoir on the Lower Gondwana Coalfields of India (Memoirs, Geological Survey of India, Volume 59). It is a difficult matter to decide outside the limits of the Damodar valley and Giridih coalfields, but in these areas enforcement of packing in the good quality seams will lead to conservation of the poorer grade coals also. It means that the whole section of commercial quality coal will be brought to the surface and there picked or otherwise sorted into quality grades. In the case of collieries in the Central Provinces, where the saleable coal is frequently inferior to the better grades of Bengal and Bihar coals, a close investigation of the methods of working might yield information which may subsequently be utilized for preventing unnecessary waste in working.

Question 47.—Yes, my remarks in *Question 46* were partly directed to this case also. In the Singareni collieries the extraction of the King seam has largely rendered unworkable the upper seams.

It is true they appear not to be of such good quality as the King seam, but the consequence has been that the company found it necessary to open a new coalfield. They tried in the Kotagudem area east of Singareni, and, after considerable expense, gave up the attempt and tried another area, and thus the Tandur field has come to be opened. I think that the method of working a lower seam under another seam of workable quality should be under control by some authority other than the managing agents of a colliery company.

Question 48.—Geologically we apply the term coal to a carbonaceous rock which contains 50 per cent. of combustible material which consists partly of volatile matter and the rest of so-called fixed carbon. Such low grade material would be designated shaley coal. If there was no volatile matter it might be a graphitic rock, while if there was little fixed carbon the material might be an oil-shale. It is known that coal in the sense defined above is saleable when the ash percentage is 25 per cent. and in some cases even higher. Coal with an ash percentage of 25 per cent. is saleable for brick-burning and might be useable for steam raising, lime burning and cement making if utilized in powdered form provided the ash is of high fusibility, *i.e.*, relatively infusible. The proportion of fixed carbon to volatile matter in commercial coals varies from 0·8 and 1·8 to 1, in high volatile types, to 1·8 and 3·6 to 1, in low volatile types, in India. Workable anthracites are almost unknown in this country.

Question 49.—I think if de-pillaring under a fire area is contemplated it would perhaps be best to fill the fire area with sand by hydraulic stowing and thus put out the fire. Afterwards the lower seam can be de-pillared with or without sand-stowing according as the coal is of good or fair quality as discussed in *Question 40*.

Question 50.—I think they should be permitted to do so if the geological considerations are suitable. If such areas are more conveniently workable from an adjacent company's workings arrangements might be made with them. The question of packing will depend on the quality of the coal as already suggested in *Questions 40 and 44*. In the case of inferior coals, *i.e.*, Grade II and under, the pillars left must be of generous dimensions, but this would be settled by the authority that investigates the Indian systems of coal extraction.

Question 51.—No, it is a gift to the colliery company unless the coal belongs to the railway as owner of the minerals. In this event the cost of extraction *plus* a royalty or commission is due to the colliery company for working and giving the coal to the railway. If the coal is retained by the colliery company an agreed price is presumed, otherwise it is a true gift to the colliery.

Question 52.—I think after a close investigation of working methods in Indian colliery practice has been made, that it will be found that partial stowage will be quite sufficient in most seams, particularly in so-called virgin workings. I think most of the

collieries in India that adopted sand-stowing only did partial stowing, but I am not quite certain. I am at present in camp away from literature and unable to refer to anyone.

Question 53.—It would be very generous to supply any sand free, but the sand should be supplied at a cost price estimate. The only cases where a special consideration is desirable is where depillaring is overdue or where coal cannot be safely recovered without sand-stowing. In such cases the cost of getting the coal should be met by Government and the coal taken over as payment. A small commission may be paid if difficulties were encountered, but in most cases this action would render workable other coal, such as that under railways, etc., and thus real assistance would be rendered to the colliery.

Question 54.—I think the whole subject of mining methods should be examined and the results of that enquiry would provide an answer to this question. Control seems to me necessary both from the point of view of safety and conservation. If the principles of Indian colliery practice in working seams of different thicknesses, at different depths, and with different inclinations were clearly established there could not be such sudden subsidences as that of Rawanwara in the Pench area, or Mudidih in Jharia; also underground fires, due to spontaneous combustion (the result of oxidation of crushed coal in pillars), would be almost unknown; and floods, due to irruptions of water for streams, from old workings, etc., the result of subsidence, would also be practically eliminated. This safety would be got if large pillars were the agreed size in fair quality coal seams and packing was employed in seams with good quality coal. In each case the method of mining would be on the basis of the controlling authority's approved principles.

Question 55.—I think compulsory stowing should be adopted in all cases of good quality coal in the Bengal and Bihar coalfields without exception and that the subject of caking or coking coals should not be allowed to confuse the issue. Although coke is necessary for iron smelting in mammoth blast furnaces, because of the weight of the furnace charge, such material is not essential in smaller blast furnaces. Also, by using raw, hard coal of good quality in small blast furnaces, where the waste gases are utilized, these furnace gases will be far more valuable from the coal fed blast furnaces than from the coke charged mammoth furnaces. Spontaneous combustion is generally due to oxidation of small or slack coal or crushed coal in pillars, so that if large pillars are used the danger from crushed pillars is avoided, while if the slack coal is mixed up with sand it is rendered harmless, and so in both ways the potentialities of spontaneous combustion are reduced. Yes, I agree that avoidable waste should always be stopped, but a little flexibility is necessary in defining the term avoidable waste. Some managers may consider the size of safe pillars of a controlling authority too large and thus locking up coal uselessly; others may regard as waste the leaving

of barriers in seams where sand-stowing is to be enforced. These, however, are matters which the controlling authority could decide.

Question 56.—I am against any action against small owners unless it can be very clearly shown that they are working good coal in a wasteful manner and that by amalgamation a scheme can be devised which is more efficient and profitable for each of the concessionaires. If such can be done and the concessions are being separately badly worked then the whole should be worked as a joint concern.

Question 57.—I do not think that the simultaneous working of one seam, in a single area, under another seam should be permitted without the sanction of a controlling authority at any time. In the case of separate owners of the successive seams even greater consideration is desirable where the workings of one may come below the workings or virgin areas of the upper seam. Where the seams outcrop and the workings in the lower seams never come under or endanger workings or virginal areas in upper seams it is probable that arrangements could be made for simultaneous working on suitable lines without risk or confusion. It is to be understood that in such a case where conditions can permit simultaneous working the controlling authority would be the court of appeal.

Question 58.—Yes, I am of the opinion that the manager of every mine should have control of two outlets from the workings under his charge, and that these outlets must be to the surface and not into workings in another seam under the management of some other manager. In the case of a lower seam the outlets may be through an upper seam provided the workings in both seams are under the same management.

Question 59.—Yes, the controlling authority may have the power to order joint surveys or be independent to make such surveys. A very important part of the equipment of a controlling authority will be the maintenance of a mine survey department to make check surveys and other duties such as recording underground points on surface plans.

Question 60.—It is imperative that there should always be a plan which shows both the surface buildings, roads, etc., as well as underground workings on the same sheet of paper. Where there are more than one seam involved each underground plan should have a corresponding plan showing both the surface and underground details. If the maps with surface and underground features are on tracing cloth, and to the same scale, it will be possible, by superposing the drawings, to study the relative positions of both seams and surface details at one time. In many cases it is advantageous to have the surveys of two or more workings in different seams shown on the same plan. The controlling authority must have a ready means of studying the superposition of surface features on underground workings no matter how many seams are

involved. This information should be available at once and in a convenient form for study and carrying.

Question 61.—In many cases the insistence on good quality coal by buyers is based on its low price and the fashion of the day. During the "boom" of the post-war period coal with over 20 per cent. ash was freely used, and to such an extent that one of the pilot vessels was bunkered with coal so poor that they had difficulty in keeping up steam at sea. A sample from the bunkers gave over 25 per cent. ash and some pieces were simply shale. Coal with ash varying from 14 to 17 per cent. ash, but with moisture less than 3 per cent., could, in my opinion, be used for most locomotive purposes in India. It could certainly be used for power purposes, and if the ash was infusible (light coloured) the coal, in powdered form, could be used for factory purposes even if the ash were 18 to 19 per cent., provided the fuel was moderate in price. Much of the so-called soft-coke sold in Calcutta averages 26 to 30 per cent. ash and must therefore be made from coals averaging nearly 20 per cent. ash. There are some lower Barakar coals in the Jharia coalfield with ash 20 to 22 per cent. and volatile content of only 16 per cent. which could be used raw as smokeless fuel. To use good coal in inferior boilers, *i.e.*, those fitted with grates which are not specially suited to certain kinds of coal, is a simple waste of good coal. All brick burning and like kilns could be supplied with inferior coal provided the ash was not too readily fusible. A great deal of attention is required for an investigation of coal ash, as on this factor much industrial economy may be effected if the right type of coal is provided.

Question 62.—This Act has led to collieries trying to have as much of their seams graded in the highest class possible. In consequence sampling and working has been restricted to those sections which include the coal which satisfies the high grade. The result is that the entire section of a seam is not worked, and what is not worked is chiefly discarded. Nearly any colliery working so-called selected grade coal will prove to supply an example of this selective working.

Question 63.—The number of notices and orders issued recently appear to be partly due to the conditions prevailing during the past year, when the collieries were reaping a harvest of fires and subsidences—the results of the methods of working that had been sown on the plea of economy during the past few years of trade depression.

Oral Evidence.

Question 1.—Information regarding the Pench Valley and Chanda coalfields of the Central Provinces is available in my Memoir on the Lower Gondwana Coalfields of India, in Volume LIX of the Memoirs of the Geological Survey of India.

Question 19.—I am definitely of the opinion that it would be an excellent idea to lay down general principles of first working

by regulation on the lines that have been described to me by the Committee.

Question 21.—My answer to this question contemplates conditions just before depillaring where such depillaring is to be done even without sand-stowing, and conditions where no general depillaring is possible but sufficient support has to be left for the surface.

Question 30.—After discussion with the Committee, I now think that it would be safer to have all shot-firers specially certificated by an examination conducted by the Mines Department.

Question 42.—My idea is that the working of coals of Selected and Grade I should be controlled both in the interests of safety and conservation. As regards coals of Grade II and lower, I would only control them in the interests of safety because the reserves of this class of coal are practically unlimited.

After discussion with the Committee, I think that there should be a universal cess on all qualities of coal in order to finance compulsory sand-stowing; if, however, the effect is not to encourage a larger consumption of second class coal with relatively better prices, the cess should be revised and imposed only on the classes of coal which it is intended directly to benefit.

Question 48.—I agree that it is practically impossible to define "coal of commercial value" because of the various conditions that have to be taken into consideration. I also agree that any controlling authority should be able to decide at any given moment whether the particular coal concerned in any case before them was coal of commercial value. If such coal which a mine-owner proposed to leave was of commercial value at the moment, the controlling authority should be able to say either that it should be worked along with the better coal in the same seam and sorted on the surface for sale to purchasers who could use it, or that it should be left in such a state that it could be recovered later on when market conditions improved.

The same principles apply both to section working and to rotation of working in different seams.

Question 51.—After discussion with the Committee, I agree that if the railways have not obtained by contract under the Assisted Siding Agreements a definite right to vertical and lateral support, they should contribute towards the cost of sand-stowing in order to recover coal under the railway lines. This contribution should not take the form of a direct payment, but the railways might well agree to collect the cess along with railway freights without making any charge for commission for cost of collection.

Question 54.—I have said that control seems to me necessary both from the point of view of safety and conservation. My idea is that this control, so far as conservation is concerned, should extend to making available safely the maximum quantity of extractable coal. I do not think that this control should extend

to the uses of coal except in so far as a particular user of coal, such as the railways, is already under Government control.

Question 55.—I think that the subject of caking or coking coal should not be allowed to confuse the issue of conservation because it is my definite opinion that non-coking coals can at present be used for metallurgical purposes, either directly or by being rendered coking and coked, and that the Iron and steel makers know that this can be done. I refer particularly to the use of such coal or coke in small furnaces, but I think that even in larger furnaces, if the furnace is started with coking coal, certain non-coking Grade I and some Grade II coals could be used provided its moisture was less than 4 per cent., and its volatile content more than 16 per cent. Furthermore, the direct use of powdered fuel firing at the twyers of blast-furnaces also awaits trial. The position is therefore that, if the reserves of coking coal were approaching exhaustion because they were being used for other than metallurgical purposes, the iron and steel companies would be compelled to turn their attention to non-coking coals and to use them in some such manner as I have indicated.

I would accept a definition of "avoidable waste" as all waste which is not incidental to the proper and efficient working of the system of mining that is being followed.

I am of opinion that, owing to the large supplies of good quality coking coal being available for metallurgical purposes, the iron and steel makers have not really tried to see how far good quality non-coking coal could be used equally efficiently for metallurgical purposes.

Question 56.—After discussion with the Committee, I am now agreeable to compulsion being applied as regards amalgamation and readjustment of boundaries within the limits of the question, namely, where the present conditions of working are such as to be definitely unsafe or uneconomical.

Question 61.—I think that it is essential there should be provision for scientific research as regards coal in all its aspects. If the authority administering the universal cess had to provide the funds for a fuel research board, that authority should be able to indicate to the research board the particular points on which research was necessary, but the research itself should be done by whole-time scientific men solely.

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36. Written Evidence of Dr. D. Penman, C.I.E., Chief Inspector of Mines in India.

Question 1.—Chief Inspector of Mines in India: sixteen years' experience in the inspection of coal mines in all parts of India.

Question 2.—The main cause of underground fires in coal mines is spontaneous combustion, but at least one disastrous fire has been

caused by the dumping of heated rejections from the manufacture of soft coke on the face of workings in a quarry.

Fires due to spontaneous combustion have followed mostly on premature collapses. But there is no sharp line of division between premature collapses and normal collapses. Even in systematic extraction, parts of pillars of roof coal, or sometimes whole pillars are lost and such conditions, though less likely to cause spontaneous heating than premature collapse due to crushing of a group of pillars, are not free from the risk of fire.

Instances of fires in the last five and the previous ten years are given in Statement I.

Question 3.—In the Jharia coalfield the seams most liable to spontaneous combustion are Nos. 15, 14, 13, 11 and 12, and all steep and thick seams of similar grade.

In the Raniganj coalfield the seams most liable to spontaneous combustion are Dishergarh, Poniati, Jotejanaki, Toposi, Chora and Kajora seams, also the thick Laikdih seam.

The period of incubation varies in the different seams from as low as eight months to about 2 years, 12 to 18 months being about an average.

In the Jharia coalfield the " fire " belt ranges from Chasnalla on the south-east to Gaslitan on the west. I do not consider that any thick seam of commercial value is free from the risk of spontaneous combustion. I shall define a thick seam as one over 12 feet thick. This is purely arbitrary. No fires have, however, yet occurred, so far as I know, in the Jharia coalfield in seams below No. 11, nor in seams above No. 15.

Question 4.—There is no doubt but that an underground fire, even though sealed off, in most cases greatly increases the difficulties and dangers of extracting the remaining coal. I am not clear what is meant by the final stage of pillar extraction. A sealed off fire may be less of a menace when pillar extraction has receded a long way from the actual seat of the fire than when extraction is taking place near the fire.

The extraction of any seam under another seam which is on fire is always fraught with danger unless as is required by the Temporary Coal Mines Regulations the strata between the seams is maintained unbroken.

Question 5.—The workings of most coal mines in which the system of extraction is pillar and stall should, in my opinion, be laid out in districts or panels with isolating barriers of nearly solid coal or lines of specially large pillars. Such barriers serve as a prevention of crushing and premature collapse over large areas and enable quick and effective isolation of a district or panel in the case of fire to be achieved.

The percentage of the seam to be left in barriers will depend on (*a*) the thickness of the seam, (*b*) the nature of the coal as regards friability, and (*c*) the depth from the surface. The size of the

districts or panels should be such that the coal within them can be extracted within, say, twice the period of incubation and will enable a roof break to the surface within the panel to take place. Where possible, all barriers should be removed.

Question 6.—I have not found any serious defect in the Temporary Coal Mines Regulations (No. M 955, dated the 23rd May 1936). The Supplementary Temporary Coal Mines Regulations (No. M 1055, dated the 27th June 1936) do not refer to fires and I shall deal with these later.

I have, however, one suggestion to make with respect to Regulation 4 (1). The " tops " of shafts should be defined. I suggest that the " top " of a shaft should be defined to mean any part of surface super-structure within 50 feet of the shaft.

I think also it should be extended to require all fan-drifts at the surface to be constructed throughout of non-inflammable material. It is important that not only the covering of all shafts sealed off or covered for ventilation purposes but also the fan-drift should be free from the risk of fire.

I consider that the distance specified in Regulation 7 (2) should be increased to 40 or 50 feet. 20 feet is too near the shaft.

Question 7.—I am entirely in favour of all mines or seams in which there are sealed off fires being mechanically ventilated. Without a mechanical ventilator there can be no control of direction in which gases from a fire in case of a break-down of stoppings shall travel. It is distinctly in the interests of the management that the ventilation of the mine should be under definite control as in the case of an outbreak of fire or gases from a fire it will in most cases be found that it is difficult to deal with the outbreak without mechanical control of the ventilation.

I consider that the law should require all owners of mines in which there are fires and of all large mines to instal mechanical ventilators.

I am not so much concerned as to whether the fan is exhausting or forcing but I should insist that the air should circulate so that in the case of a break-down of or leakage of gases from fire stoppings the smoke and gases shall not be carried round the working faces or foul the outlets to the mine.

The effect of a forcing or an exhausting fan will depend to a large extent upon the lay-out of the mine and the position of the fire relative to the shafts or inclines and the workings of the mine. For example, if the fire is near what is to be the upcast shaft the fan should be " forcing " at the other shaft, so that in case of an outbreak of gases from the fire the gases will be conducted straightway up the upcast shaft—the assumption here being that the fan shaft is the normal outlet for the miners. On the other hand if the fire is near the shaft at which the fan is to be placed the fan should be exhausting as otherwise the gases would be passed through the workings.

The ideal arrangement would be three shafts or outlets with an exhausting fan at one of them, the other two being downcasts and providing the two outlets for men. If the fire is situated at an equal distance from both shafts it is immaterial whether the fan is forcing or exhausting, and the effect on the fire would be the same in each case. In any case the effect on the fire or the effect on the fan (if on the surface) are secondary considerations, as the fan and fan-drift should be constructed of non-inflammable material. The main consideration, as I have already stated, is the safety of the men in the mine. Once the men are out of the mine the fan can be slowed down or reversed as the circumstances require. (In this connection it should be noted that all fans may be made forcing or exhausting at will.)

The fan should be on the surface and the ventilation should not depend solely on fans installed underground as these may be involved in an efflux of gases so as to be inaccessible. On the whole I should leave the question of a forcing or exhausting fan to the discretion of the management.

Question 8.—I consider that there is always a risk of fire where a section of a seam is extracted in such a way as to leave behind the remainder of the seam broken up in the goaf.

Question 9.—I consider the suggestion in this question a useful one and am in favour of it.

Question 10.—I am in favour of such telephonic communication between remote places in the mine and the surface. The only objection I have heard offered is that such telephones are very apt to get out of order and not be available when needed. This objection can be met by suggestion that the telephones should be put under the charge of a competent person who should test them every day.

I should put the limit of distance at 3,000 feet, which is the distance in force in British mines, *i.e.*, where the distance from the bottom of the shaft or the entrance to the mine to the end of the main haulage road is over 3,000 feet there should be telephonic means of communication.

Question 11.—I consider that in all mines in which there are fires a person who holds a first or second class coal mine managers' certificate should be in charge underground during the night time.

Question 12.—It is eminently desirable that training in the methods of dealing with underground fires and the dangers that may arise from them should be given to all persons undergoing training at such stations—and not only, as the question indicates, those actually working at the stations.

Rescue apparatus is likely to be of most general use in connection with underground fires and for that reason training in the methods of dealing with fires should form an integral part of the courses given at the rescue stations.

Question 13.—My view is that a fully trained rescue corps should be requisitioned during the operations of dealing with a fire and the corps should either be engaged on the fire or standing by in case of need. If a rescue corps is actually dealing with a fire there should be another rescue corps standing by in readiness in case of need.

I also consider that persons working in the vicinity of an active fire should be equipped with self-rescue appliances, *i.e.*, gas-masks.

Question 14.—I fully agree with this suggestion. As the Regulation stands the precaution does not need to be taken until a fire actually exists. It is much wiser to have the haulage and tramming roads protected against the dangers from coal-dust ahead of the actual occurrence.

In Great Britain precautions against the dangers of dry coal-dust have to be taken in all dry coal mines. While it might not be practicable to go so far in Indian mines I consider that stone-dusting or watering should be done in all *dry* haulage roads or tramming roads or parts of such roads whether there is an underground fire or not.

Question 15.—Prevention is always better than cure and the Temporary Coal Mines Regulations (No. M 955, dated the 23rd May 1936) are designed to prevent fire. Also many of the questions which follow relate to precautions designed to prevent fire and I shall deal with them as they appear.

Question 16.—I consider that the complete filling of the space from which the coal is removed is the only adequate method of dealing with this problem. When the extraction of pillars takes place in a gassy seam, cavities are formed when the local roof collapses which constitute traps for accumulations of inflammable gas. When a more extensive fall of roof occurs this gas is forced out into the workings and may bring about a situation of great danger.

It is practically impossible to examine these roof cavities for the presence of inflammable gas—it is difficult to get up high enough to test and it is often also dangerous to do so. Nor is it practicable so to ventilate such cavities that the gas is diluted and carried off as it gathers.

There have been accidents due to this circumstance as follows:—

At Aldih colliery, Dishergarh seam in 1933, gas expelled from goaf and ignited by naked light—3 killed and 6 injured.

At Dishergarh colliery, Dishergarh seam in 1918—gas ignited in a goaf by a naked light—14 persons injured of whom 10 died.

At Dishergarh colliery, Dishergarh seam in 1916—explosive in goaf—18 persons burnt of whom 14 died. Gas expelled by fall in goaf. Naked lights used.

In addition there have been recent cases in which gas has been driven out into the working places and an ignition has been narrowly averted.

I should require all seams in which inflammable gas is given off in dangerous quantities to adopt complete filling or packing. I would particularly mention the Dishergarh and Sanctoria seams.

Question 17.—Premature collapse is almost invariably due to pillars of inadequate size and to galleries which have been made too high.

Question 18.—The dangers that may arise from premature collapses are:—

(i) accidents underground due to the shedding of pillars, falls of side and roof and crushing of pillars;

(ii) accidents due to collapse of buildings on the surface due to the extent of the collapse being incorrectly estimated. There have been numerous accidents due to this cause;

(iii) air-blasts. There have been numerous accidents due to this cause.

There is also the loss of coal and the fires caused by such premature collapses; also the destruction of barriers between collieries.

A brief record of accidents due to collapses of workings from 1913 to date is as follows:—

(a) *Accidents due to collapses of surface buildings.*

Jharia coalfield.—Fourteen involving 55 deaths; one involved 24 persons; one 6 persons; two 4 persons, one 3 persons, two 2 persons, and ten one person.

Raniganj coalfield.—Three accidents involving 4 persons.

Central Provinces.—Two accidents involving 11 persons.

Giridih.—One involving one person.

(b) *Accidents due to collapses producing air-blasts.*

Jharia.—Three involving 8 persons.

Central Provinces.—One involving 16 persons.

Raniganj.—Two involving 2 persons.

Giridih.—One involving one person.

Questions 19, 20 & 21.—These questions cover the prohibition of methods of working which are objectionable in every way—the neglect of the precautions indicated brings about a condition of things which renders the mine or part thereof unsafe and causes great loss of coal.

At present restriction of workings may be imposed by the Inspectorate on workings under railways, roads and rivers.

Section 19 (1-A) of the Act as amended in 1936 also empowers the Inspectorate to restrict the dimensions of galleries, etc., in general. The need for the powers given to the Inspectorate is shown by the fact that although they have been in existence for a little over six months in the Jharia coalfield, restrictions on the dimension of galleries and limitations on the minimum dimensions of pillars have been issued on no less than 35 collieries. The powers under Section 19 (1-A) have recently been extended to the Raniganj coalfield.

While these powers serve a very useful purpose and their use will undoubtedly tend greatly to reduce the number of cases in which premature collapses may occur I look upon them mainly as a temporary or make-shift arrangement until something better has been put forward by the Coal Mining Committee and accepted.

The conditions in Indian mines are such that the pillar and stall method of mining is inevitable. The stability of the workings in that system depends on the following factors:—

The thickness of the seam;

The nature of the coal;

The nature of the roof;

The depth from the surface;

The dimensions of the pillars and galleries.

An important factor is the height of the galleries. As an example, take a seam 30 feet thick. Consider two cases with the same size of pillars and at the same depth from the surface. In one case, say, the galleries are made the full height of the seam, while in the other they are only made 10 feet high. It is unnecessary to point out that the stability of the workings in the latter case greatly exceeds that of the workings in the former case (*i.e.*, high galleries). Moreover, it is practically impossible to examine properly the sides of pillars in high galleries.

In my view the minimum sizes of pillars and the maximum dimensions of galleries should be fixed by regulations, and as a basis for discussion I suggest the following:—

(*a*) No pillar to be less than 1,600 square feet after galleries have been driven, whatever the depth from the surface.

(*b*) Sizes of pillars to be graded as follows:—

(i) All depths up to 300 feet not less than 55 feet centre to centre, both ways, or pillars not less than 1,600 square feet in area.

(ii) Depths from 300 feet to 600 feet—pillars not less than 70 feet centre to centre, both ways, or pillars not less than 3,000 square feet in area.

(iii) Depths from 600 feet to 800 feet—pillars not less than 100 feet centres or pillars not less than 7,000 square feet in area.

(iv) Depths above 900 feet—pillars not less than 120 feet centres or pillars not less than 10,000 square feet in area.

(*c*) No gallery to exceed 140 square feet in cross-sectional area.

(*d*) No gallery in first working to exceed 10 feet in height.

(*e*) No increase of dimensions of galleries or reduction in sizes of pillars except immediately prior to regular depillaring.

A proviso to be added that the Chief Inspector of Mines and the Inspector of the Circle may approve of modifications of the above if he is satisfied that the workings under the proposed modification will be sufficiently strong to prevent crushing of pillars when depillaring or premature collapses and also that in any case in which, in his opinion, the requirements of the regulations are insufficient to provide stability—*e.g.*, in the case of a particularly soft coal—he may require larger pillars or smaller galleries.

I do not suggest that the above dimensions of pillars and galleries are the best that could be suggested and I should not cavil at the particular sizes that might be decided on provided that they ensured stability under all conditions of working, but I am firmly of the view that Regulations of the nature I have suggested are essential for safe working in Indian coal mines, and that it would be no hardship but a great gain even from a commercial point of view if all mines were put on the same footing. Much of the price cutting that has brought down the prices of coal may have been due to less scrupulous owners robbing pillars while others continued to practice sounder methods of working. The Coalfields Committee of 1920 recommended that the dimensions of pillars and galleries should be laid down by law and if their recommendation in this respect had been adopted then, the mine would to-day have been in an immensely better condition than they are now.

To the possible argument that the powers at present possessed by the Inspectorate, *viz.*, Section 19 (1-A) are sufficient for the purpose of ensuring stability of workings I should reply that these powers do not fully cover the requirements and besides in my opinion that is the wrong way to deal with the problem. A set of simple regulations covering the average cases and powers to deal with abnormal cases is the proper way to tackle the problem. The Statutory Regulations under any Act should be such that it is only necessary to apply special powers in exceptional cases and not as things stand under the Indian Mines Act to-day to a vast number of mines. Besides such a procedure tends to transfer the burden of responsibility for the control, direction and management of the mine from the manager of the mine to the Inspector which is directly contrary to Section 15 of the Mines Act.

Question 22.—It should not normally be permissible to work any seam however thick in more than two separate sections. The

dimensions of pillars and galleries should be restricted as suggested in my reply to *Questions 19, 20 and 21* and the minimum parting should be 15 feet. The workings in the two sections should be vertically coincident, *i.e.*, pillar above pillar and gallery above gallery. A regulation should be framed requiring this and there should be a proviso to enable the Chief Inspector of Mines and the Inspector to grant modification.

Question 23.—If a statutory authority is constituted it is essential that they should have such powers as the question suggests, but the prescription of regulations as suggested in my replies to *Questions 19, 20, 21 and 22* would remove in a large measure the necessity for the use of such powers.

Question 24.—A statutory authority should undoubtedly have such powers. They are being exercised at present by the Inspectorate.

Question 25.—There have been many accidents in Indian coal mines through irruptions of water. A few of the more serious are as follows:—

	Lives lost.	
Loyabad Colliery, Bihar, 1936	11	Underground water.
Bhaskajuri Colliery, Bengal, 1928 . .	7	Ditto.
Jotijanaki Colliery, Bengal, 1913 . .	13	Surface water.
Jamadoba Colliery, Bihar, 1913 . .	7	Ditto.
Bhatdee Colliery, Bihar, 1913 . . .	8	Ditto.
Phularitand Colliery, Bihar, 1912 . .	23	Ditto.
Murulidih Colliery, Bihar, 1910 . .	6	Underground water.

The main causes of flooding are:—

(1) Openings into mines in dangerous proximity to rivers.

(2) Inadequate barriers and insufficient care regarding them.

(3) Inaccurate plans.

The danger of irruptions of water is one which seriously engages the attention of my department every year and many mines are closed either entirely or for night work every year by the orders of the Inspectorate. In 1936 no less than 51 orders under Section 19 (2) were issued against dangers from this cause.

Question 26.—Yes.

Question 27.—Regulations 73, 74 and 75 cover most cases of dangers from irruptions of water.

But the necessity for orders under Section 19 (2) will continue to remain so long as owners and managers of mines do not themselves exercise sufficient forethought.

Question 28.—I have no change to suggest.

Question 29.—I am wholly in favour of a more extended use of "permitted" explosives. In British coal mines in 1935 the approximate percentages of explosives used were:—

	Per cent. of total.
"Permitted" explosives	72
High explosives (not "permitted")	14
Gunpowder (not "permitted")	14

In coal mines in India in 1935 the proportions of the same explosives used were:—

	Per cent.
"Permitted" explosives	3
High explosives	3
Gunpowder	94

"Permitted" explosives are explosives which have passed tests in the presence of dry coal-dust and firedamp and their use adds very greatly to safety in the use of explosives in mines.

I consider that the use of "permitted" explosives should be extended to all seams of high volatile coal and low volatile coals of selected and first grade.

Question 30.—Yes.

Question 31.—I have an open mind on this. Indeed I think it is necessary that the proviso should be retained but I consider the permission should be given sparingly and that in no workings in a coal seam should permission be given to keep more than 5 lbs. in one place at a time. I should be prepared to allow in certain cases up to two canisters to be carried by one person into the mine on condition that the canisters are stored and used in separate places.

Question 32.—I would suggest that Regulation 106 should be revised to require all cases or canisters containing explosives to be provided with a lock and such cases or canisters to be kept locked when explosives are being taken from or returned to the canister.

Questions 33 & 34.—These do not apply to me.

Question 35.—This also does not apply to me but the following particulars obtained from a number of the largest mines in the Jharia coalfield may be of interest:—

	Tons.
Output from 21 collieries in 1935	3,400,000
Quantity got from pillars	1,750,000
Quantity got from galleries	1,650,000
Percentage of total output got from pillars	51·5

Question 36.—About 50 per cent. if there are no fires.

Question 37.—Much of the coal locked up under railways, rivers, buildings, bridges, etc., will be lost unless stowing is adopted.

The Chief Inspector of Mines has now powers under Temporary Regulation 9 to prescribe the method of extraction of coal under rivers and it may be taken that he will not, in many cases, allow the extraction of pillars under rivers or within 50 feet of the bank of a river without stowing.

In many instances the seam has been goafed on either side of a railway so rendering the coal under it in most cases irretrievably lost.

The cases in which compensation has been paid for coal left under railway lines and sidings are:—

Jharia coalfield—

Lodna Colliery.

(North Burrakur Coal Company, Limited).

Ekra Colliery.

Central Tisra Colliery.

Question 38.—I can only answer this question in a general way. In some cases a system of stowing would double or treble the life of the colliery, and it would increase the life of all collieries in which it is applied.

Question 39.—I am entirely in favour of the enforcement of a system of filling. In many mines it is high time that this was done, and I am of the opinion that a reasonable measure of safety and the elimination of fires cannot be secured in many mines, without a system of filling.

Question 40.—I should enforce filling or packing in all selected grade and first grade seams in the Raniganj and Jharia coalfields, and particularly in non-gassy seams over 15 feet in thickness and in gassy seams of any thickness.

The general enforcement of a system of filling will, however, have to be done gradually and in my opinion once the principle is accepted the system should first of all be established in selected areas. For example, I would suggest that the following areas should be tackled first:—

IN THE JHARIA COALFIELD.

As a group.

Collieries.	Output in 1935. Tons.
Bhulanbararee	120,497
Barari-Jealgora	275,414
Standard	312,590
Lodna and Bhaga	553,451
Total	1,261,952

Out of this quantity of coal 940,000 tons approximately were obtained from pillars. The quantity obtained from pillars in the

last two collieries was 780,000 tons. It may be taken that the quantity obtained from pillars in the first two collieries will increase in the future. For the present we may take 1,000,000 tons got from pillars in this group, 80 per cent. of which comes from the last two collieries in the group.

To replace this quantity of coal would require, say, 2,500,000 tons of sand annually. Two aerial ropeways each conveying 300 tons of sand per hour for, say, 15 hours a day on 6 days a week all the year round would deal with this quantity. It will be noticed that the present output from pillars at Lodna and Standard collieries is very great, while that at Barari and Bhulanbararee is relatively small. It would have to be worked out what would be the best positions for termini for the two suggested ropeways and whether subsidiary ropeways from a central dumping station would not be the best arrangement.

These four collieries are situated in the eastern portion of the Jharia coalfield on a line running almost north and south. Bhulanbararee is about 3 miles from the Damodar river—the source of the sand—while Standard colliery is the furthest from the river—about 6 miles. They all produce excellent coking coals —superselected; they are all troubled with fires; the seams are thick and all of them are at the stage when in the best seams most of the coal has to be got from pillars.

At present there is an aerial ropeway of 100 tons per hour capacity bringing sand from the Damodar to Bhulanbararee colliery. This ropeway might be used for that colliery, but it might be better to instal a ropeway of larger capacity to drop sand at convenient places for all four collieries and dismantle the smaller ropeway.

Single collieries.

Collieries.	Output in 1935. Tons.
Bhowra	205,401
Chasnalla	78,228
Amlabad	88,634

These collieries would perhaps be best taken singly. Amlabad is at present provided with a means of conveying sand. Bhowra used also to be provided through the ropeway is in disuse at present. Besides if sandstowing were to be adopted on a large scale at Bhowra a ropeway of larger capacity would be necessary and it would have to be extended so as to carry sand to other parts of the colliery which is somewhat scattered. It might be, however, that the old ropeway—if re-conditioned—would suffice for Bhowra for some years. The agent could perhaps give some forecast of this. In any case it seems to me that Bhowra colliery could and should be treated as a single and separate unit. Chasnalla colliery could also be treated as a single unit obtaining its supplies of sand perhaps from an old river bed near the colliery.

Another group of collieries which should be considered at an early date is the Kirkend group workings XIII, XI and XII seams (Motiram Roshanlal Coal Company, Limited, Sethia's Kirkend collieries and Kirkend Coal Company). The total output from these collieries in 1935 was about 120,000 tons of which, say, 80,000 tons may be taken to have been from pillars. Quantity of sand required per annum, say, 200,000 tons. Distance from river about 6 miles.

IN THE RANIGANJ COALFIELD.

I would suggest that a scheme for sandstowing should, in the first instance, be applied to the following collieries in the Raniganj field:—

As a group.

Collieries.	Output in 1935. Tons.
Equitable Coal Company—	
Methani	186,102
Aldih	38,208
Bejdih	151,341
Bengal Coal Company—	
Poidih	148,202
Total	523,853

It may be taken that about three-quarters of this output comes from pillars, say, 400,000 tons per year. This quantity would require about 1,000,000 tons of sand annually. One ropeway of 300 tons per hour capacity could deal with this, dropping sand at each colliery, or at some central point suitable to all.

The colliery furthest from the river is about 3 miles away and the others are within this distance, the nearest being 1½ miles away. The approximate cost of an installation would be Rs. 4,35,000.

Single collieries.

	Output in 1935. Tons.
Sitalpur	273,355

Distance from river, say, 1 mile. There is at present an installation in operation. Quantity of coal got from pillars, say, 200,000 tons. Quantity of sand required annually, say, 500,000 tons. Capacity of ropeway or other installation, say, 150 tons per hour. Cost of ropeways installation, say, Rs. 25,00,000.

	Output in 1935. Tons.
Sodepur (9 and 10 Pits)	219,940

Say, 150,000 tons from pillars. Quantity of sand required per annum 375,000 tons. Distance from river one mile. Capacity of

a ropeway installation, say, 120 tons per hour. Cost, say, Rs. 1,75,000.

If any colliery is to be tackled first, I should select this one.

	Output in 1935. Tons.
Dishergarh West	144,027

Say, 100,000 tons from pillars. Quantity of sand required per annum, say, 250,000 tons. Rope haulage is used at this colliery. Distance from river, say, ½ of a mile.

	Output in 1935. Tons.
Saltore	146,756

Say, 100,000 tons got from pillars. Quantity of sand required per annum, say, 250,000 tons. Distance from river, say, ½ of a mile.

Parbelia.—At present closed. Installation already in existence. Distance from river, say, ½ of a mile.

	Output in 1935. Tons.
Begunia	47,177

No coal got from pillars at present, but extraction or splitting of pillars not allowed by this department since working under a river. Distance from river, say, ½ a mile. Rope haulage could be installed.

The above notes are for the collieries in the Jharia and Raniganj coalfields at which, in my opinion, a start might be made with a scheme of standstowing. They need not all be served at once and when served, the scheme could be extended to other groups or other single collieries. The point I wish to make is that it would appear that a system of sandstowing must be introduced gradually and I suggest that the collieries mentioned are the most suitable on which to make a start.

The figures and estimates I have given are in several cases only very approximate and more accurate details would have to be obtained before embarking on concrete schemes. I would add a further remark to the effect that control of methods of working should be established on all collieries—particularly in the Jharia and Raniganj coalfields—from the very outset so as to reduce the amount of damage that might be done at the mines by present methods until a scheme of compulsory filling could be more generally applied.

Question 41.—I have given costs at various collieries in a note which is, I understand, in the hands of the Committee, but details will, I presume, be obtained by the Committee in evidence.

Workings in virgin coal—12 annas a ton.

Workings already formed—Rs. 1-4 per ton, into pillars.

(Average figures in both cases.)

I would not have it thought that this means that it would be cheaper to extract the coal wholesale with packing than by the

ordinary method of forming pillars in the first instance. I have shown in my note mentioned above that in a new area the total cost for sandstowing will be the same whether the coal is taken out longwall or by the present system of pillar and stall and I should allow mine owners to choose the method they consider most suitable.

Question 42.—By a cess on despatches on all coal produced in British India, and a duty on all coal imported into British India whether from foreign countries or Indian States.

Question 43.—It is essential that a statutory authority should be set up and that they should have such powers. I think the statutory authority should be constituted as follows:—

(i) An independent Chairman.

(ii) The Chief Inspector of Mines.

(iii) Three mining engineers of experience.

The members of the board need not be wholetime servants as such but should meet at stated intervals to deal with general principles and special cases, routine cases being dealt with by the executive head.

The executive work should be entrusted to the Department of Mines and a separate Conservation section of the Department should be established with a mining engineer of the rank and pay of an Inspector of Mines should be in charge under the Chief Inspector of Mines. Under the mining engineer there should be a cadre of junior and assistant mining engineers and surveyors. This section of the Department should have a separate surveying staff and one or more of the junior and assistant mining engineers should have had a mechanical training. Part of the staff should reside at Sitarampur but the headquarters should be at Dhanbad. It might later be necessary to have a mechanical staff but in the early stages the upkeep and repair of ropeway installations might be entrusted to the mechanical staff of large collieries with a suitable allowance. Additional clerical staff would also be necessary in the Department of Mines.

One point I wish to make is that if a separate Conservation department is established with a Head independent of the Chief Inspector of Mines, no decision of such a Head which was at variance with the views of the Chief Inspector as regards safety could stand as the Chief Inspector's powers in that regard are subject only to appeals to Government. Much of the underground inspection work as to the methods of carrying out the orders of the Board could be entrusted to the ordinary Inspectorate. The Statutory Board should administer the cess fund.

There would need to be a Conservation Act with powers to frame and establish regulations and/or bye-laws.

I would suggest also that there should be an arrangement under which the Chief Inspector could obtain the advice of the Board on major questions of safety.

Question 44.—If regulations were framed laying down minimum sizes of pillars and maximum dimensions of galleries, there would be little need for a statutory board to see ordinary lay-outs. Special methods might be reviewed by the board.

Question 45.—It is difficult to estimate the saving that might be achieved by a system of stowing but I should put it at half the actual cost of the system.

Question 46.—Yes.

Question 47.—Yes.

Question 48.—Coal which has under 20 per cent. of ash or has a calorific value of not less than 6,000 calories. I am aware that a practical definition of coal of commercial value is "coal that can be mined and sold at a profit"; but it is necessary in the interests of the coal reserves of the country to choose some definite standard; hence my definition.

I should not, however, compel mineowners to actually raise coal which they could not sell, but rather compel them to so work the section of the seam or the underlying seam that it would be practicable to win the coal left in at some future time.

Question 49.—Undoubtedly. No other system is safe.

Question 50.—Yes.

Question 51.—Yes, as the saving to the railways under the law as it stands at present would be enormous.

Question 52.—I am in favour of complete filling in most cases, such as seams over 15 feet thick, seams under fire-areas, and gassy seams. There may, however, be cases in which partial filling might be successful, but the statutory authority should decide this.

Partial filling has been so far successful at Amlabad colliery.

Question 53.—I consider that in most cases additional financial assistance in respect of actual stowing would be necessary.

Question 54.—I should have statutory control to deal with general principles but I should deprecate any further interference with the management than is necessary. The Indian Mines Act places the responsibility for control, direction and management of the mine wholly on the manager (Section 15) and this principle should be infringed as little as possible. Any other policy would run counter to the fundamental principles on which the Mines Act has been framed. I should have general control and interference throughout British India and particularly in the Jharia and Raniganj coalfields only in the interests of safety and avoidable loss of coal and my firm conviction is that that can best be achieved by sound and well-considered regulations, the details of working being left as much as possible to the management.

Question 55.—I do not consider that it is necessary or expedient to restrict compulsory stowing to the Bihar fields to conserve supplies of coking coal. Stowing is, in my opinion,

absolutely essential to a fair and reasonable measure of safety, mainly perhaps in the Jharia coalfield, but definitely also in the Raniganj coalfield.

Avoidable waste should be stopped—but within limits—in any mine.

Question 56.—My principal objection to small and badly shaped properties is the difficulties introduced in such cases in the leaving of barriers. If the property is badly shaped the length of the barrier to be left is greater than if it is well shaped. Moreover, in depillaring, say, in a narrow corner of a property the roof may not be able to break down properly and so a hanging goaf may be created which may throw weight on the barrier and produce crushing.

In narrow properties—of which there are many in the Jharia coalfield—it is extraordinarily difficult to prevent the barrier from becoming so attenuated that it is of little use in protecting the mine from fire or flooding.

I consider that one of the powers of a statutory board should be to compel amalgamations where it considered it should be done in the interests of safety and avoidable waste. In such cases the law should permit of amalgamations without additional payments to royalty holders.

Question 57.—I do not approve of this. There should only be one mineowner working in a given area at a time. It may be argued that if there is one manager for all the seams the provisions of the Mines Act and the Regulations are met, and since he has full control it is up to him to work the various sections or seams in a safe manner. But the manager seldom has full control. He is constantly under instructions from the owners and if he has to work to the dictates of two or more owners he may have often to disregard sound practice. For example, the owner of a lower seam may require him to split pillars while an upper seam is also being worked. This might conceivably result in a dangerous condition of things. A mineral property should be worked as a whole and that can only be done satisfactorily if it belongs to one owner. It is a favourite practice for owners of good quality seams to sub-let poorer seams to other owners. As an example, I might cite one colliery in which two upper seams and one lower seam have been sub-let to an owner while the principal owner works two intervening seams. There are many similar cases.

Question 58.—I consider that it is essential in the interests of safety that the manager of every mine should have sole and independent control of two outlets to every seam or mine in his charge. At present the law appears to permit of two managers of adjacent mines using a common second outlet. This involves dual control which I consider fundamentally wrong and unsafe. I

think the law should be altered so as to make it obligatory on the manager having sole control of the two necessary statutory outlets to every seam or mine under his charge.

Question 59.—Yes, it is very important for safety that this should be prescribed by law.

Question 60.—Yes, this would be desirable.

Question 61.—This is perhaps a question for the research bureau which I have advocated elsewhere.

Question 62.—The effect of the Coal Grading Act of 1925 has been to accelerate a process which, in my opinion, was inevitable. Where there exist thick seams of varying quality it is inevitable that the state of the market for the commodity should influence the quality of the product raised from the mine. A mineowner will raise only that quality of coal which he can sell—it would, I think, be unreasonable to ask him to raise coal which he cannot sell.

The grading of coal was necessary and as a simple and effective means of grading, the present system has much to commend it. At the same time I do not think that mineowners should be allowed to work a section of a seam so as to render the remainder of it unworkable at some future time. There is also the question of risk of fire by leaving broken coal in the mine.

The solution to this problem which, I should suggest, is that a Statutory Board, if appointed, should have powers to determine in each case—and there are not a great many since a particular seam can, in some cases, be handled as a distinct unit—what parts of the seam should be worked and what may be left or, alternatively, to compel sandstowing so that the coal unworked at present may be recoverable later.

The Grading Board's list will show many of the seam in which only sections of the seam are worked.

Question 63.—The number of orders issued under Section 19 of the Indian Mines Act during 1936 and up to the 20th February 1937 is 173, and particulars of them are given in Statement II. Such orders are seldom issued in British mines. The primary reason why so many orders are necessary is closely bound up with the special nature of the deposits of coal in Indian coalfields, and the nature of the seasons in India.

Most seams are very thick, necessitating the adoption of the pillar and stall method. This method, in the absence of a system of packing, results in collapses, premature and legitimate. There is a great temptation to short-sighted owners to take out as much coal as possible before removing the pillars—so delaying the difficult and troublesome operation of depillaring as long as possible.

Many mining men in the past have looked upon robbing or reduction of pillars as a legitimate form of mining—indeed some

old leases specifically prohibited the removal of pillars so encouraging, reduction and robbing of same. Many mines fill up partially with water in the monsoon and small concerns not having the necessary pumping plant allow their dip workings to fill with water—hoping that the water will drain away in dry season—and commence the reduction and splitting of pillars or the removal of roof or floor coal in the workings clear of water.

Some mines are so narrow that an adequate barrier cannot be left between the properties. In many mines before 1926 no barriers were left at all. In many mines there are fires, introducing difficulties and danger. A fire in a British mine can very often be smothered in the goaf. That is not easy in a thick seam without sandstowing.

There has been a great deal of carelessness in placing inclines and shafts in the past in such a situation that the mine is liable to inundation from rivers in the monsoon. Workings have been formed under rivers with little regard to the possibility of fire spreading to such workings. Goaves have been formed too close to rivers.

In some mines work has to be done in a seam below another seam which is water-logged or alongside water-logged workings. In many places in the coalfields there are huge reservoirs of water —due to the nature of the seams and the method of working them— which may be a menace to neighbouring collieries.

Some mineowners are reluctant to spend the necessary money —even when they have it and sometimes they don't—to make adequate safety provisions in their mines.

The above are some of the circumstances which necessitate the issuing of so many orders.

The number of orders which it is necessary to issue would be greatly reduced if permanent regulations existed, such as I have suggested in my reply to *Questions 19, 20, 21 and 22.* For example, with such regulations, orders under Section 19 (1-A) would hardly ever be necessary. If such regulations had been framed 10 or 15 years ago not only would orders under Section 19 (1-A) have been unnecessary but many of the orders under Section 19 (1) and 19 (2) would also have been unnecessary—*e.g.*, those orders referring to " danger of collapse ".

Regulations such as I have suggested are the proper way to tackle dangers. Whenever a possible danger can be guarded against by regulation, that should be the method applied. The primary duty of the Inspectorate in Great Britain as it should be the primary duty here is to see that regulations are carried out.

The reason why it is hardly ever necessary to issue orders in Great Britain is that the Regulations there cover very fully the

known dangers in British mines. The Regulations at present in force in this country do not cover all the known dangers nor do they guard against the fundamental cause of bad working. I would plead very strongly for the early introduction of regulations, such as I have suggested in my replies to the various questions, as without them the position of the Inspectorate in this country is an unenviable one. It is, in my opinion, an absurd position at present that so many orders are considered by the Inspectorate to be necessary and the fact that they are deemed necessary cries out for additional regulations which will reduce that necessity very considerably.

I do not suggest that any of the powers under Section 19 (1), (2) and (1-A) should be removed or curtailed. They are all necessary and will be necessary as long as mining goes on but the necessity for the exercise of them should be reduced to a minimum by the introduction of Regulations for known dangers wherever possible.

Additional Point.—I consider that a small part of the funds collected by a cess on despatches should be ear-marked for the establishment of a Research Bureau which would undertake work on the better utilisation of coal and on safety measures. The Research Bureau should work under the Statutory Authority or Board and should be attached to the Indian School of Mines, Dhanbad.

STATEMENT I.

List of fires in the Jharia Coalfield during the years 1932-1936.

Serial No.	Mine.	Owners.	Seam or seams in which fire exists.	Date of fire.	Remarks.
1	Ena . .	North-West Coal Co., Ltd.	11 and 12 .	4th April 1933 .	Seen on surface.
2	Anil Kusunda .	All-India Collieries, Ltd.	11, 12 and 13 .	17th February 1933.	Seen on surface. Mine closed.
3	Kusunda-Nayadee.	Kusunda-Nayadee Collieries, Ltd.	11, 12 and 13 .	17th February 1933.	Seen on surface. Only 10 seam being worked on outcrop.
4	New Kusunda .	Central Bank of India.	11, 12 and 13 .	August 1933 .	Seen on surface. Mine closed.
5	East Kusunda .	Kusunda-Nayadee Collieries, Ltd.	11, 12 and 13 .	17th February 1933.	Seen on surface. Mine closed.
6	Kusunda . .	K. M. Selected Coal Co.	11, 12 and 13 .	?	Seen on surface. Mine closed.
7	Gaslitand .	New Manbhum Coal Co., Ltd.	15 . .	12th September 1936.	No. 15 seam, top and bottom section, No. 14 seam also sealed off.

List of fires in the Jharia Coalfield during the years 1922-1931.

Serial No.	Mine.	Owners.	Seam or seams in which fire exists.	Date of fire.	REMARKS.
1	Bhulanbararee .	Bhulanbararee Coal Co., Ltd.	14, 14-A and 15	1922 . .	One seen on surface.
2	Bagdigi . .	Bank of Baroda, Ltd.	14, 14-A and 15	22nd June 1925	Seen on surface. Mine closed. No work in 13 seam at present.
3	Bhaga (Lodna) .	Lodna Colliery Co. (1920), Ltd.	14 . .	?	Not seen on surface.
4	Standard (Benahir).	Standard Coal Co., Ltd.	14, 14-A and 15	?	Not seen on surface.
5	Khas Jharia .	Khas Jharia Colliery Co., Ltd.	11-12 . .	?	Not seen on surface.
6	Jharia Khas .	Standard Coal Co., Ltd.	15 . .	?	
7	Sowardih .	D. N. Dass .	11-12 . .	26th September 1927.	Seen on surface. Closed.
8	East Sowardih	J. N. Supacar and Brothers.	11-12 . .	2nd January 1928.	Seen on surface. Closed.
9	Khas Jharia .	Khora Ramji .	11-12 . .	21st July 1931 .	Seen on surface. Mine closed.
10	Kendwadih .	East Indian Coal Co., Ltd.	13 and 14 .	?	Not seen on surface.
11	West Gopalichuck.	Gopalichuck Coal Co., Ltd.	13, 14 and 15 .	?	Not seen on surface.

List of fires in the Raniganj Coalfield during the years 1932 to 19th November 1936.

Serial No.	Mine.	Owners.	Name of seam in which fire occurred.	Date of fire.	REMARKS.
1	Kajora . .	K. C. Pal Choudhury.	Lower Kajora .	1923 . .	No. 5 Pit.
2	Poniati . .	H. K. Nag . .	Poniati . .	1932 . .	Drowned out.
	Poniati . .	H. K. Nag . .	Poniati . .	1935 . .	Same area as above afterwards drowned out.
3	Victoria . .	New Beerbhum Coal Co., Ltd.	Laikdih (Top sec.).	1932.	
4	Aldih . .	Aldih Coal Co., Ltd.	Dishergarh .	1932 . .	
	Aldih . .	Aldih Coal Co., Ltd.	Dishergarh .	1934.	Probably under water now (Discontinued).
5	East Kajora .	K. C. Pal Choudhury (Receiver).	Upper Kajora .	1932.	
6	Jamuria . .	Equitable Coal Co., Ltd.	Poniati . .	1933 . .	No. 5 Pit.
7	S. E. Baraboni	Maharaja S. C. Nandi.	Koithi . .	1933 . .	No sign of heating (No. 10 Pit).
8	Poniati . .	H. K. Nag . .	Poniati . .	1933 . .	No. 4 incline. Worked out and sealed off.

List of fires in the Raniganj Coalfield during the years 1932 to 19th November 1936—contd.

Serial No.	Mine.	Owners.	Seam or seams in which fire exists.	Date of fire.	Remarks.
9	S. E. Baraboni	Maharaja S. C. Nandi.	Poniati . .	1935 . .	Fire from No. 10 Pit suspected to have broken through. Stoppings are cold now.
10	Sripur . .	Lodna Colliery Co., Ltd.	Poniati . .	1935.	
11	Joyramdanga .	New Beerbhum Coal Co., Ltd.	Poniati . .	1935 . .	No. 5 incline. Worked out.
12	Pretoria . .	Seebpore Coal Co., Ltd.	Poniati . .	1936 . .	Stink from old fire broke through on 1st January 1936 (C Pit).
13	Jairamdanga .	Jairamdanga Coal Concern.	Poniati . .	1936 . .	No. 2 incline workings close to fire area of New Beerbhum Coal Co.'s, Jairamdanga.
14	Pure Kajora .	Pure Kajora Coal Co.	Upper Kajora .	1936 . .	Sealed off.
15	Jamuria . .	Equitable Coal Co., Ltd.	Sibpur . .	1st August 1936.	Slight trace of gob stink from No. 6 pit rise pillar area. Sealed off.
16	Chora . .	Ondal Coal Co. .	Chora . .	1st September 1936.	Abandoned.
17	Saltore . .	Burrakur Coal Co., Ltd.	Dishergarh .	7th November 1936.	Traces of gob stink in No. 1 pillar area main dip section. Sealed off.
18	Jamuria No. 8 Pit.	Equitable Coal Co., Ltd.	Poniati . .	19th November 1936.	Indication of heating in the return airway of rise pillar section. Sealed off.

List of fires in the Raniganj Coalfield during the years 1922-1931.

Serial No.	Mine.	Owners.	Name of seam in which fire occurred.	Date of fire.	Remarks.
1	Akhaipur .	Hurriladih Coal Co., Ltd.	Sibpur . .	1917 and 1922 .	Sealed off.
2	Sripur . .	Lodna Colliery Co., Ltd.	Poniati . .	1919 . .	Sealed off.
	Sripur . .	Lodna Colliery Co., Ltd.	Poniati . .	1923 . .	Sealed off.
	Sripur . .	Lodna Colliery Co., Ltd.	Poniati . .	1926 . .	Sealed off.
3	Jote Janaki .	P. H. Chatterjee .	Jotejanaki .	1920 . .	This spread to Jotejanaki West, Barsutchak and S. Chondrya's Jotejanaki. Abandoned.
4	South Baraboni	S. Baraboni Coal Concern.	Baraboni . .	1922 . .	Broke out several times. Abandoned.
5	Madhabpur .	Chandanmull Indrakumar.	Lower Kajora .	1923 and 1927 .	No. 1 Pit has been closed down and sealed off. No fire in 11 Pit now.
6	Bankola . .	Burrakur Coal Co., Ltd.	Bankola . .	1923 . .	Stoppings now cold.

List of fires in the Raniganj Coalfield during the years 1922-1931 —contd.

Serial No.	Mine.	Owners.	Name of seam in which fire occurred.	Date of fire.	Remarks.
7	Narsamuda .	Seetarampur Coal Co., Ltd.	Narsamuda .	1923 . .	Closed.
8	Chattrisgunda .	Samla Kenda Collieries, Ltd.	Samla . .	21st March 1924 (approx.)	Sealed off.
9	Nandi . .	Bengal Coal Co., Ltd.	Sibpur . .	1924 . .	Sealed off. Stoppings are cold at present.
10	Aldih . .	Aldih Coal Co., Ltd.	Dishergarh .	1924 . .	Fire in this area has broken out several times.
	Aldih . .	Aldih Coal Co., Ltd.	Dishergarh .	1928 . .	The mine has been discontinued.
11	Dishergarh East	Equitable Coal Co., Ltd.	Dishergarh .	1924 . .	Closed down.
12	New Baraboni	New Baraboni Coal Concern.	Baraboni Bottom	1924 . .	Abandoned.
13	Sanctoria .	Bengal Coal Co., Ltd.	Dishergarh .	1924 . .	Worked out.
14	Joyramdanga .	New Beerbhum Coal Co., Ltd.	..	1925 . .	Fire still active along outcrop. Abandoned.
15	Jotejanaki West	Banerjee Santan	Jotejanaki .	1927 . .	Broke through from neighbouring Colliery. Abandoned.
16	Toposi . .	Banara Coal Co., Ltd.	Toposi . .	1928 . .	Afterwards flooded out.
17	Dobrana . .	J. G. Galstaun .	Dobrana . .	1928 . .	Abandoned.
18	Singaran . .	Singaran Coal Synd., Ltd.	Toposi . .	1929 . .	Fire through barrier in North Singaran. Stoppings erected in 1929. Stoppings are now cold but warm water flows through the pipes of two stoppings.
19	Haripur . .	Sircar & Dutta .	Chora . .	1929 . .	Fire broke through from old outcrop workings. Abandoned.
20	Dishergarh West	Equitable Coal Co.	Dishergarh .	1929 . .	No. 5 Pit Closed.
21	Nandi . .	Nandi Coal Association.	Sibpur . .	1929 . .	Abandoned.
22	Banksimula .	Bengal Coal Co., Ltd.	Poniati . .	30th June 1930	
	Banksimula .	Bengal Coal Co., Ltd.	Poniati . .	29th July 1930	Stoppings reported cold on 21st January 1933.
23	Sitalpur . .	Bengal Coal Co., Ltd.	Dishergarh .	1930.	
24	Kajora . .	Guzdar & Kajora Coal Co.	Lower Kajora .	1930 and 1931 .	Sealed off.
25	Kajora . .	K. C. Pal Choudhury.	Lower Kajora .	1931 . .	Sealed off.
26	Haripur . .	B. N. Mondal .	Chora . .	1931 . .	Abandoned.
27	Barsutchak .	Equitable Coal Co., Ltd.	Jotejanaki .	?	Abandoned.
28	Chora . .	Sircar & Dutt .	Chora . .	?	Abandoned.

STATEMENT II.

Analysis of Orders issued under Section 19 of the Indian Mines Act in 1936 and up to 20th February 1937.

—	Danger of collapse.	Danger of collapse (surface buildings).	Dangers from water (under ground).	Dangers from water. (surface).	Danger from fire.	Danger from inflammable gas.	Inadequate second outlet.	Requiring "permitted" explosives to be used.	Miscellaneous.
Orders under 19 (1).	8	19	1	..	..	4	7	5	8
Orders under 19 (2).	12	1	25	28	5	5	4	..	1
Orders under 19 (1-A).	Total to date 50. These restrict dimensions of galleries, require protection against fire, prohibit reduction or splitting of pillars, etc.								
	GRAND TOTAL . . . . . 173.								

Oral Evidence.

Question 5.—I agree with the opinion that the panel system increases the factor of safety, but I do not agree that it necessarily increases wastage. A further advantage is the protection against coal dust because each section of the mine can be isolated and protected. In my opinion it is fundamentally unsound to lay out large areas of a mine in pillars and galleries without panel barriers particularly in seams which are liable to spontaneous combustion, or where gas is known to exist and where precautions against coal dust have to be taken. This is an opinion which I have arrived at on the basis of my experience in the last few years.

Question 6.—Subject to the changes which I have suggested and will suggest, I am definitely of opinion that the Temporary and Supplementary Regulations should be made permanent. Also the temporary legislation of 1936.

I would not object to a distance of 25 feet from the shaft being fixed in my suggested definition of the "tops" of shafts.

Question 9.—I think that there should be a regulation requiring taps to be provided on existing water mains or other existing pipes containing water under pressure with distance between the taps equal to twice the length of the hose pipes maintained. Where there are no existing water mains or other pipes, or where water is not available, I would insist on portable water tanks with hand pressure pumps. These should also be kept in the mine for use in parts of the mine which cannot be reached by the proposed taps on existing water mains and other pipes.

Question 12.—It is at present proposed to establish two rescue stations, one in a suitable centre in the Jharia field, and one in the Raniganj field. A scheme has been drawn up on the lines of the British Regulations with certain modification to suit Indian conditions, and has already been submitted by me to the Government.

Question 14.—I think that the proposed extension should be general, and that no particular mines nor coalfields should be exempted. I would, however, have no objection to the limitation of the operation of the Regulation, as extended, to seams in which fires have at any time actually occurred.

Question 19.—I agree that general principles of first working should be laid down by regulation with a provision that the Chief Inspector may vary those principles in special cases in accordance with local circumstances, and providing also that there should be appeal from any order of the Chief Inspector refusing to allow variation to the same authority as hears appeals under Section 19 of the Act. I agree also that the penalty for any infringement of these general principles should be adequate and immediately enforceable. I think an adequate penalty would be that the Inspector would have the power to require conditions to be restored or remedied to such an extent as may be considered necessary, and would also have the further power to prohibit work in that section of the mine until the conditions had been so restored. This would enable the Inspector who discovered the departure from the general principles to distinguish between cases in which the divergence had been more or less accidental and those in which the divergence had been deliberate and intended to enable more coal to be recovered. I think it will also have to be considered whether a regulation of this sort will not involve an amendment of the Act because it has hitherto been held that the general principle underlying the Mines Act is provision for safety of human life. Further, I would limit the powers referred to above to the Chief Inspector and the Inspectors in charge of circles.

As regards the particular general principles of first working, I agree that the Committee's idea that these principles should be based on percentages of floor area *plus* a maximum height for galleries.

I further think that the power of variation which would be given to the Chief Inspector as already suggested above should be a power which would act both ways, that is to say, he should be able not only to extend the general principles where he thinks this could be allowed, but he should also be able to restriet the principles where he considers this to be necessary.

The simpler the general principles, the better it would be for all concerned.

Question 21.—I agree to a definition of "immediately before the systematic extraction of pillars" as two pillars lengths ahead of the pillar that is being extracted or of the point at which pillar extraction is about to begin.

Question 22.—I would be inclined to deal with this question of section working by laying down in a regulation that the lay out of workings in all seams which are to be worked in more than one section should be submitted to the Chief Inspector of Mines for previous approval. I suggest this course because the conditions vary so much in different thick seams and even in different parts of the same thick seam. I also think that any other method might permit the mine owner to work in too many sections.

Question 28.—After discussion with the Committee, I do not consider that there should be any exception in favour, say, of the Pench Valley mines as regards the present restriction of the number of shots to be fired to one. I may add that the British Regulations not only require the use of " permitted " explosives in all gassy mines and mines that are not wet throughout, but also require that not more than one shot at one time of such " permitted " explosives should be fired in coal in such mines.

Question 29.—I do not wish to press my view in favour of the generally extended use of " permitted " explosives, but I certainly would like to see their extended use to the extent which I have stated in my written answer.

Question 32.—I would like to suggest in addition that Regulation 109 should be amended so as to make shot-firers responsible to see that all persons are removed to a safe position. I think this would be better than specifying any particular distance.

Question 35.—I think that taking over both the Raniganj and Jharia fields as a whole the percentage of output from pillars is anything between 50 and 60 per cent.

Question 40.—After discussion with the Committee, I agree that the gradual enforcement of stowing might be done in the following way instead of definitely selecting certain collieries or groups of collieries in which the work might be started. It will perhaps be better to say that compulsory sand-stowing should be begun in

(*a*) collieries in which safety is of immediate importance, such as the Dishergarh group in the Raniganj Field, and

(*b*) collieries in which the pillars cannot be recovered without sand-stowing, as for example, Bhulanbararee, Bararee, Standard, Lodna, Bhowra and Chasnalla collieries in the Jharia field.

I think that, with these general limitations, a reasonable estimate of the annual amount of sand likely to be required at first would be 3 million tons from the Jharia field and 2 million tons in the Raniganj field. As regards the collieries which are already stowing, I think that, from the date on which the cess is imposed, they should receive assistance to the extent of their actual cost of conveying sand to the pit mouth *plus* a flat rate for the stowing underground. As regards collieries who wish to start sand-stowing on their own after the cess is imposed, they should be required to submit their plans and estimate to the statutory authority and the latter should decide whether they will assist the colliery or the

colliery should arrange for the stowing itself. In all these cases, of course, the particular colliery wishing to stow would have to come within one or both of the categories referred to above, that is to say, safety or conservation.

Question 42.—I think that the cess should be on all coal from any field, and not only on the coal which could expect any benefit from the sand-stowing operations. I say this because any other system would give a competitive advantage to those collieries in which sand-stowing would not be considered to be necessary either at the moment or even in future. If there was any differentiation according to the benefits to be received, there would also be several collieries with thin seams in the Raniganj and Jharia Fields where sand-stowing would not be absolutely necessary, and it would be impossible in practice to differentiate these from the other collieries in which sand-stowing was necessary. Further, even as regards those collieries where sand-stowing is evidently necessary either sooner or later, it is only those coming within the limits which have been suggested in my answer to *Question 40* which would get any benefit out of the cess at once, and it would be obviously impossible to collect the whole cess from those collieries only. There is the further point also that the demand for inferior coal would go up as compared with superior coal with any increase in prices.

I agree that the royalty receivers and the railways should also contribute to the cess.

Question 43.—The independent Chairman of the statutory authority whom I contemplate would be a Government official of standing and administrative experience. I agree also that the three mining engineers might be selected from a permanent panel of ten mining engineers selected by Government from experienced mining engineers in all the coalfields.

Question 53.—In my opinion the additional financial assistance in respect of the cost of stowing underground should take the form of a flat rate on each ton of sand put into the mine. I do not think that it is possible at this stage to determine what the actual average cost of stowing underground is, nor to say what proportion of that cost the flat rate should be. These would be matters for the statutory authority to determine on the basis of practical observations and which would enable them to fix a generally fair flat rate. There should also be power vested in the statutory authority of altering the flat rate from year to year if they considered it necessary.

Question 55.—I would not object to a definition of "avoidable waste" as all waste which is not incidental to the proper and efficient working of the system of mining that is being followed. I do not however consider the definition an entirely satisfactory one, because the methods that are being followed now in depillaring are objectionable in themselves and should be improved. The only way in which these methods can be improved is by stowing.

Question 56.—I agree that in addition to the statutory authority having power to amalgamate small and badly shaped properties

which were not being worked in the interests of safety and avoidable waste, and the power to compel adjustment of boundaries due to geological conditions or to waste of coal in barriers, the statutory authority should also have power to take over any mine which has been abandoned because the owner considers that, even with compulsory stowing assisted out of the funds of the cess, he would be unable to work his mine economically. In addition the statutory authority should also have power to deal with fires which were not being properly dealt by the owner of the property. Any expenditure incurred in this connection would be a first charge on the property and would be recoverable by the statutory authority by subsequent arrangements for the working of the mine after the fire had been dealt with.

Question 57.—I think that what I have said in this connection should be the general rule. I agree that there might be cases in which a departure from this general rule might be permissible, but I would not allow any such departure without the previous approval of the statutory authority.

Question 61.—I think that there must be a research bureau and that, as the funds will be provided by the statutory authority out of the proceeds of the cess, the research bureau should be under the general control of the statutory authority. The research bureau should have a separate full time scientific staff of its own and that staff should have nothing to do with teaching at the Indian School of Mines. It would be best for the research bureau to be located at Dhanbad.

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37. Written Evidence of Mr. J. R. Harrison, Chief Mining Engineer, Railway Board.

Question 1.—(*a*) Chief Mining Engineer (Railway Board), Government of India.

(*b*) 23 years.

(*c*) Practically all coalfields in British India and Indian States.

Question 2.—(*a*) Presence of coal left underground—

(i) in goafed areas,

(ii) in pillar areas where premature collapse has occurred due to pillars or barriers being of inadequate size.

(*b*) Yes.

(*c*) Probably by premature collapse not only in areas containing a number of pillars but also in incomplete recovery of all coal in individual pillars.

Question 3.—(*a*) Most of the thick seams in the Jharia, Raniganj, Bokaro and Karanpura coalfields.

(*b*) From 4 months to a period of several years.

(c) Yes, some of the thinner seams, but much depends on the method of working.

Question 4.—(a) Yes. (b) Yes.

Question 5.—(a) Yes.

(b) Depends entirely on the thickness of the seam, inclination, character of the coal and nature and thickness of overlying strata.

Question 6.—I consider the Temporary Coal Mines Regulations adequate for the time being, and at the moment am unable to suggest any additions or modifications.

Question 7.—(a) Yes.

(b) A mechanical ventilator should be installed at such mines and constructed so as to act as an exhausting or forcing fan.

Question 8.—(a) Yes. (b) Yes.

Question 9.—Yes, where practicable.

Question 10.—(a) Yes.

(b) Would depend on the class of mine. I do not consider it practicable to fix a distance. Common sense and judgment would have to be used in each case.

Question 11.—Provision underground of suitable materials for stoppings. Flame safety lamps and approved electric lamps or torches. See reply to *Question 13*.

Question 12.—(a) One Central Mine Rescue station situated at Dhanbad would in my opinion be sufficient at present.

(b) Yes, but all mine officials should have this knowledge whether members of a rescue team or not. Practical training of any use can only be got by actual experience in the mine.

Question 13.—Useful and in some cases very necessary.

Question 14.—Yes.

Question 15.—(a) Yes.

(b) Depends on the conditions and circumstances prevailing. See replies to other questions.

Question 16.—(a) Filling or packing with sand or other suitable material completely or partially would eliminate the risk of fires in goaves and would appear to be necessary on grounds of safety in some mines; but packing to prevent inflammable gas (fire damp) being expelled by falls of roof from goaves into workings is not necessary as safety lamps and other precautions are required in such mines.

Question 17.—Bad working due to pillars being left too small in the first instance or subsequently split or galleries being made too high or too wide after pillars have been formed.

Question 18.—(a) Loss of life and property both above and below ground from fires, inundation, air blasts.

(*b*) By proper lay-out and adequate support in the first instance or subsequently by packing.

Question 19.—Yes; if the colliery officials themselves are incapable of doing this.

Question 20.—(*a*) Entirely depends on the seam worked.

(*b*) Character of coal, thickness of seam, total section to be worked immediately or in the future life of the mine, inclination of seam, thickness of overlying strata.

Question 21.—Yes, unless the pillars have been left of sufficient size in the first instance, to allow of this being done or unless it is necessary to do so for specific reasons.

Question 22.—Entirely depends on the seam worked. The only safe way of working such seams is lift by lift or section by section and stowing hydraulically in each section as the coal is extracted.

Question 23.—(*a*) I do not consider this necessary as, in the interests of safety, the Chief Inspector of Mines has the power to reject or approve of a layout or system of working.

(*b*) No.

Question 24.—Yes, in the interests of conservation; but in the interests of safety, the Chief Inspector of Mines has the power, if danger is apprehended.

Question 25.—Yes; particulars may be obtained from the Chief Inspector of Mines.

Question 26.—I do not know of any such occurrence either in India or elsewhere.

Question 27.—(*a*) If mines are properly worked and adequate support left against surface collapse, and accurate plans kept, the dangers mentioned above would not arise.

(*b*) Precautions should be enforced by the Chief Inspector of Mines.

Question 28.—None.

Question 29.—Yes.

Question 30.—Yes, and the examination should be of a practical nature carried out underground.

Question 31.—(*a*) Should be retained.

(*b*) Convenience of working as such a rule if abolished would add to the cost of working without any increase in safety.

Question 32.—No.

Question 33.—Kargali Colliery (State-owned)—

Kargali Seam, 65 feet thick containing stone band in centre 2 to 10 feet thick.

Inclination: 1 in 6 to 1 in 10.

Full section, 2nd class coal, worked at quarries.

8 feet section, 2nd class coal immediately above stone bands worked from pits.

"Twelve Feet" Seam, 12 feet thick.

Inclination: 1 in 7. 7 feet bottom section.

2nd class coal, worked from incline.

Coal left in roof inferior and unsuitable for railway requirements.

Bokaro Joint Colliery (State and Company-owned)—

Kargali Seam, 70 to 90 feet thick.

Inclination: 1 in 6 to 1 in 10.

Full section, 2nd class coal, worked from quarries.

Sawang Joint Colliery (State and Company-owned)—

Kargali Seam, 40 feet thick.

Inclination: 1 in 3.

Full section, 2nd class coal, worked from quarries, and 8 feet section, 2nd class coal, worked at incline.

Jarangdih Joint Colliery (Company-owned)—

Jarangdih Seam, 14 feet thick.

Inclination: 1 in 6.

Bottom 6 feet 6 inches section, 2nd class coal, worked from inclines.

Coal left in roof inferior and unsuitable for railway requirements.

Bhurkunda Colliery (State-owned)—

Kurse Seam, 13 feet 5 inches thick.

Inclination: 1 in 7.

Bottom 6 feet section, 2nd class coal, worked at incline.

Coal left in roof inferior and unsuitable for railway requirements.

Upper Simana Seam, 12 feet 2 inches thick.

Inclination: 1 in 7.

Full section, 2nd class coal, worked from incline.

Giridih Collieries (State-owned)—

Kurabaree Seam varies from 8 to 25 feet thickness. Sometimes containing centre stone band 20 feet thick. Inclination varies from flat, to 1 in 3. Full section, 1st class coal worked. Where the stone band occurs top and bottom sections are worked separately.

Talchir Colliery (Company-owned)—

Bottom or main seam, 8 to 14 feet thick.

Inclination: flat.

Full section, 1st class coal, worked as far as practicable, from pits.

Top seam 6 feet thick.

Inclination: Flat. Full section, 2nd class coal, worked from pits.

Kurasia Colliery (Company-owned)—

No. 3 or main seam, 23 feet thick. First class coal.

Inclination: flat.

Bottom 11 feet section, worked from inclines.

Question 34.—See reply to *Question 33.*

Question 35.—(*a*) None except at Giridih where 85 per cent. is from pillars.

(*b*) Not definitely known but estimated at 90 per cent.

Question 36.—It is difficult to give any reliable figure, but in my opinion 50 per cent. might be recovered.

Question 37.—(*a*) Not all, as in many cases the railway can be diverted.

(*b*) Question should be referred to Agents, East Indian and Bengal-Nagpur Railways.

Question 38.—The life of the colliery would be prolonged and the maximum quantity of coal could be extracted. I would not expect any increase in output.

Question 39.—Stowing should be done where necessary, particularly in thick seams, as it is the only method known to the science of mining whereby thick seams can be worked with safety. Stowing simultaneously with the extraction of pillars or in wholesale extraction of the seam may be done.

Question 40.—In thick seams. See my *Note on Coal Conservation*, page 292.

Question 41.—Yes, but no figures of actual costs are available.

Question 42.—By the collieries themselves.

Question 43.—(*a*) Yes. See my *Note on Coal Conservation*, but as the primary reason is safety, the Chief Inspector of Mines also has this power.

(*b*) See my *Note on Coal Conservation.*

Question 44.—See replies to *Questions 23* and *24.*

Question 45. (I) (*a*) Would be reduced in certain mines.

(*b*) Would depend whether fire stoppings are required.

(*c*) None.

(*d*) No saving in cost but a maximum percentage of extraction would be obtainable.

(*e*) Buildings: saving doubtful; land and accidents: not known.

(*f*) & (*g*) Negligible.

(*h*) None.

(II) Do not know of any.

Questions 46 & 47.—I suggest it should be controlled and if necessary sand packing should be enforced during the second stage of working, *i.e.*, depillaring.

Question 48.—Coal which can be wrought and sold at a profit in any particular market. See my *Note on Coal Conservation.*

Question 49.—Yes, unless a sufficient thickness strata intervenes between the two seams.

Question 50.—Yes; if it pays to do so.

Question 51.—Question should be referred to the Agents of Railways.

Question 52.—(*a*) Yes.

(*b*) Complete filling would not be necessary in all cases.

(*c*) No.

Question 53.—(*a*) Yes. (*b*) No.

Question 54.—(i) Yes (of safety: universal). The Chief Inspector of Mines already has this control.

(ii) Yes (for coking coal areas).

(*c*) See my *Note on Coal Conservation.*

Question 55.—(*a*) Yes, where necessary.

(*b*) Yes, also where necessary for safety, particularly in thick seams.

(*c*) Yes, if the waste is of commercial value.

Question 56.—Yes.

Question 57.—I do not like this arrangement but as far as I am aware, at present there would be no objection nor would any danger arise provided the work is carried out in a proper manner and in accordance with the Mines Act Regulations.

Question 58.—Should be left to the discretion of the Chief Inspector of Mines.

Question 59.—(*a*) Yes. (*b*) Yes.

Question 60.—Yes.

Question 61.—For some years past Railways have been making every effort to use the cheaper and lower grades of fuel but usually it does not pay to use coal other than Selected or 1st Grade.

The Great Indian Peninsula Railway use large quantities of Low Grade fuel from the Central Provinces but only on account of the large saving in freight over Bengal coal.

In the case of railways far removed from the coalfields only Selected Grade coal is used as it is uneconomical to carry coal containing a high ash content over long distances.

The extent to which Second Class coal has replaced First Class or Selected Grade coal on three of the most important railways is shown in Statement I.

The same remarks apply to industrial concerns.

Regarding the manufacturing of soft coke from inferior coal every effort is being made by the Soft Coke Cess Committee to persuade the public to use this class of fuel instead of wood, charcoal or cow dung.

Question 62.—I do not consider the activities of the Indian Coal Grading Board have been to increase waste. As prior to the commencement of the Board only those sections of seams were worked which could be sold in any particular market.

In this connection see my *Note* on the subject, page 298.

Question 63.—It is difficult to draw a comparison, as the conditions of working and labour are so different.

Generally, the natural conditions here are much better than in England, and as long as mines are carrying out the first stage of working or development, mining is comparatively safe.

During the past 10 years, however, conditions have changed rapidly. Many mines have reached the second stage of working, and the dangers arising from depillaring in unusually thick seams lying close together are becoming more and more apparent.

It is for this reason that the Mines Department have now to interfere more, particularly so as the labour are as yet poorly educated and unskilled in the science and art of mining. The latter remarks also apply to the subordinate officials or supervising staff, who are by no means as skilled and experienced in practical mining as those in Great Britain.

There is moreover a lack of the strict discipline which prevails in mines in Great Britain.

In the past many collieries have been understaffed and too much work has been thrown on the colliery manager. The Mines Act should contain provisions for the complete organization, defining responsibilities and duties. It should provide for agents who have First Class Certificates and for an under-manager with a First or Second Class Certificate.

The number of officials in the Mines Department is, in my opinion, insufficient to see that the present regulations are enforced and properly carried out at all mines.

Note on Coal Conservation.

General Remarks on Coal Conservation.—From the latest figures on the quantity of coal available in British India it would appear that there are still huge areas containing seams of 1st and 2nd class coals to be developed; but these areas generally contain non-coking coals, in fact, the Jharia Field is the only one containing the valuable coking coals on which all Steel Works will have to rely in the future for the bulk of their coking coal requirements.

The reserves of coking coal in the Raniganj and Bokaro Fields and at the Giridih Collieries are comparatively small.

The conservation of India's coking coals is therefore a matter of extreme urgency and I am strongly of the opinion that immediate steps should be taken to prevent unnecessary loss and to enforce methods which will lead to a greater percentage of extraction, not only from " new workings " but also from mines which are already in an advanced stage of working. This applies especially to the Jharia Coalfield where it is estimated that over 100,000,000 tons of coal are standing in pillars.

Any Act to enforce conservation would have to cover " old " as well as " new " workings as if this is not done many owners will be encouraged to concentrate their activities on the old workings standing in pillars and lead to the complete destruction of areas at present developed and of numerous small areas which owners might consider not worth developing under the draft Act.

Many Collieries are now fully developed and if injudicious depillaring and " robbing ", generally are continued, coal will be won at the cheapest cost, regardless as to what might happen to the future life of the Colliery or to neighbouring Collieries.

It seems essential therefore that some attempts should be made to control the method of working in pillar areas and I had hoped that it might have been possible to embody rules to effect this in the present Coal Mines Act.

The introduction of legislation to reduce the present wastage which is daily becoming more and more apparent or at least to mitigate this evil without inflicting undue hardship on certain owners is extremely difficult, but nevertheless is a step in the right direction.

It may be considered inexpedient to enforce compulsory stowing at all the collieries at the present juncture, but the following rules could be applied to old workings to secure improved methods of working:—

(1) to require mine owners to prepare and submit a plan for the approval of a controlling authority and to satisfy that authority that:

(*a*) The area to be depillared has been accurately surveyed.

(*b*) The area or district to be depillared and order of pillar extraction can together be regarded as sound mining practice.

(*c*) Depillaring will not endanger areas undeveloped in the same mine or areas developed or virgin in an adjacent mine.

(*d*) The area to be depillared can be isolated immediately in the event of fire (here, it may be necessary to erect preparatory fire stoppings).

(*e*) The dimensions of barriers or rows of pillars to be left are adequate for safeguarding adjoining collieries or against general collapse and fire areas in the mine.

(*f*) An upper seam of recognised commercial value, whether such seam is developed or not, is not rendered unworkable by depillaring in a lower seam.

(2) To prohibit depillaring in a seam which underlies and is in close proximity to a fire area in an upper seam unless complete stowing (preferably hydraulic) is adopted.

(3) To prohibit pillar " robbing ", " splitting " or abnormally increasing the heights and widths of the present roadways particularly at collieries where it is not intended to depillar on sound mining lines or, at all.

(4) To require owners of shallow mines to fill in with *muttie* or other suitable debris though not necessarily up to the old surface level, such surface as has subsided or become broken owing to depillaring below.

Such rules could just as easily be applied to old workings as to new workings and I would suggest further as I did at the last meeting in Delhi on Coal Restriction, that these and the rules recommended in Dr. Penman's Note on Coal Conservation should be embodied in the Coal Mines Act or in any Act on coal conservation.

At all events from the experience gained in the past in working thick seams both in India and in Great Britain, and the loss of coal which has already occurred in the Jharia coalfield, even in the past year, it is obvious that the extraction of pillars cannot be continued on the present lines, as apart from the question of danger, many colliery owners are merely playing a game of chance and running the risk of losing their mines in toto, once the operation of depillaring is commenced.

The rules enumerated above are essential to good sound mining practice and as such are recognised by all mining engineers and if brought into force immediately would go a long way towards improving the present mining methods.

They would moreover form the nucleus of any coal conservation scheme and in introducing them I would on account of their simplicity anticipate very little opposition from either the colliery owners or the Coal Trade.

It is understood that steel manufacturers have as yet made no appeal to Government for the conservation of coking coal; in fact the impression conveyed is that the largest steel works, the Tata Iron and Steel Company, Limited, have acquired sufficient reserves of coking coal.

I am convinced that in the past those interested in the production of steel have not realised the position entirely. Since the publication of Sir Lewis Formor's Bulletin, the subject has been reviewed.

Messrs. Tata's have a reasonable reserve of coking coal undeveloped at their collieries but The Bengal Iron and Indian Iron and Steel Companies have a comparatively limited area of coking coal and both works, at present, draw practically all their supplies from collieries in the Jharia field.

These deeper areas will undoubtedly be exploited on sound mining lines and every attempt will be made to conserve future supplies and work them in the most economical manner. Extensive sand-stowing will be essential in seams over 12 feet in thickness.

It cannot be claimed, however, that very definite information is forthcoming as to the quality and quantity of coal available in the deeper and virgin areas of the Jharia field.

What is more important is that the development and operating of new areas, on account of depth, temperature of strata, water difficulties and necessity for stowing will be much more costly than at the collieries now working. These are factors which, I doubt, if all those interested in the manufacture of steel realise.

From the above it will be clearly understood how essential it is to introduce legislation immediately to control the method of working and eliminate the wastage at collieries past the first stage of development, and carrying on one of the most difficult of mining operations, i.e., depillaring.

As frequently mentioned during the many discussions on the subject of conservation the difficulties of coming to any understanding or settlement with the Trade and mineral holders seem insuperable but the fact still remains that if the present wasteful methods are pursued the best and most valuable coking coals will soon be exhausted and if collapses take place and fires are allowed to spread as they have done during the past few years, there will be little hope of saving what is left of the Jharia coalfield as there are now definite indications of the eastern section of the field where most of the valuable coking coals are found, being totally lost within the next 10 years.

I consider that producers of iron and steel should therefore be asked immediately what their views are on the subject and if they have any concrete proposals to put forward.

A solution might be for local Governments and the steel companies concerned to come to some arrangement and acquire the developed coking coal collieries which are now on fire or which are not being worked in a proper manner and in the country's interests. It might be considered if such a scheme is feasible in order to deal with a problem so vital to a basic industry like iron and steel production.

The proposal of Sir Lewis Fermor to restrict the use of coking coal for iron and steel manufacture would no doubt extend the life of the Jharia field and other minor areas but it would lead coal owners in other fields to benefit as the Trade and railways would be compelled to draw their requirements from these fields and the result would be a general rise in prices. This might possibly happen to some extent but any abnormal rise in prices would not be permanent.

There are still a number of closed collieries which could re-open or collieries not working to full capacity, which could increase their output and prices would find their own level, with the result that the law of supply and demand would again operate.

The real danger of such a policy however would be that the Jharia coalfield would be left with a sales off-take of only 2/3 million tons. This would lead to great competition for the steel companies' requirements of coal and their buying policy would be dictated by a position brought about by interference with private rights. In other words, the Jharia coalfield would be forced in every sense into the hands of the steel companies. Bankruptcy would follow for all but the strongest collieries and the steelworks by buying up the weaker collieries would then eliminate the stronger.

Out of this, the major question arises. Does the situation warrant such interference with private rights?

Practical difficulties of drafting rules to effect Conservation.

Definition of Commercial Coal.—This is most important, as so much depends on this definition for the working of any practical scheme for conservation and I anticipate much opposition will arise in this connection from all parties.

The Trade generally would oppose any definition which attempts to define coal on a maximum percentage of ash and minimum calorific basis.

Let us examine the result of applying a definition in practice to new workings or new mines. A portion of the seam proposed to be worked comes within the definition but is not of commercial value in the present market nor up to the present has it ever been so except for very short periods. The remainder of the seam is of good commercial value and comes within the definition. Obviously the present management will leave the coal that is not of value to-day. When, however, the boundaries of a property have been reached, the question again becomes of moment, as the same conditions prevail. (This is actually the condition in present areas standing on pillars in many mines.) If the present market conditions prevail, the inferior coal will still be unmarketable. This leaves the management to face the very unpleasant problem of either closing down or protecting (by stowing at a very high cost) this inferior coal for an unknown period whilst depillaring in that portion of the seam that has a commercial value.

The alternative would mean that all coal as defined by an Act would have to be raised from the mine immediately and the inferior coal would be either left to deteriorate on the surface; thus the effect of conservation would be lost or forced on an unwilling market.

This might send up the price of good coal from a few seams of uniform quality throughout to an exorbitant figure and it is conceivable that the introduction of a definition could disorganise the whole of the Coal Trade. Railways and steel works in particular would certainly feel this, and export trade would also be affected.

Further, if the sections to be worked are governed by inferior bands of varying thickness or, coal sections left intact, the problem of lay-out would

be even more difficult. Again seams less than 6 feet in thickness are generally more costly to work and it might be that a thing and upper seam would only just come within the definition and yet would have to be protected, when working a seam of better quality, immediately below.

It is conceivable that it would be possible to work a seam of very good quality coal, 4 feet in thickness as a commercial proposition, but it would be unfair to force an owner to work a 4 feet seam containing say, up to 20 per cent. of ash or with a calorific value as low as 6,000.

There is also the question of the expense involved in obtaining samples from a thick seam. This, I estimate, would be considerable as roads would have to be driven to complete the sampling and the results would not be accurate as it has been proved that to obtain correct results many samples of the seam must be taken over a large area at the same Colliery.

At one large colliery working a first class coal seam as many as 30 samples have been taken in the same seam in order to obtain normal results and the samples have varied from 14 per cent. to 20 per cent. ash.

Further, in many cases an upper seam has been sunk through in order to reach a lower seam and no openings have been left through which samples could be taken.

Some of the upper and unworked sections of thick seams have, as yet, never been examined or sampled.

Both railways and Grading Board have only examined the seams or sections of seams which the owners of collieries desire to work, and the Grading Board has been in existence since 1925. The railways have been sampling and analysing since the formation of the State Railway Coal Department in 1909.

From the above it will be understood that it would take years to examine each seam in detail.

Sampling from wagons to grade coals has also been considered and this method presents more difficulties and expense. The results moreover vary greatly over certain periods.

I very much doubt therefore if it is possible to lay down any hard and fast rule which could be applied to practical mining but it does seem that a rule is essential for the working of any scheme of conservation.

A rule which admits of wider interpretation based on coal of recognised commercial value might be possible. To do this it would be necessary to consider the geographical position of a coalfield and to have different rules for different coalfields or areas.

It might also be considered necessary (owing to practical difficulties) to draw up a list of seams at individual collieries as such seams or sections of seams have been worked over a period of years and have been recognised as being of commercial value.

Percentage Extraction.—The fixing of a definite percentage yield would be extremely difficult as by observation alone very little can be done.

The thickness of seam, nature of seam, and roof would have a bearing on the question.

Coal lost in collapse and "crush" would have to be considered and although it would appear on observation that a large percentage of coal has been lost it would be most difficult to verify this when taken over a large area over a period of very many years. The figures to be of any use must apply to the whole area and not to isolated examples.

The question of expense involved in attempting to obtain any reliable figures of extraction also arises as it would mean posting a conservation supervisor at each colliery when depillaring as the management would not undertake to do this, nor could any reliability be placed on any figures submitted by the management.

Even in British mines working thinner seams, the figures of recovery are very unreliable and the clause inserted in the majority of mining leases in this connection, both here and in Great Britain, is "in accordance with

the best mining practice of the district" or, "worked in a skilful and workmanlike manner".

The question of wastage in working and percentage extraction in mining the 10 yard seam in South Staffordshire and Warwickshire and the 22 foot seam in North Staffordshire, both of which are very liable to spontaneous combustion has presented some of the most difficult of mining problems and even in adopting special methods of working no accurate figures have been recorded of the coal lost though 40 per cent. to 50 per cent. has often been mentioned as an average figure.

It would therefore appear that the laying down of a definite figure of percentage extraction is out of the question even if complete sand-stowing were possible at all collieries.

Controlling Authority.—In this connection I would draw attention to the evidence given before the Coalfields Committee in 1920* and from this it would seem advisable to constitute a board consisting of at least representatives of the following bodies:—

Colliery owners.

Agents or managers.

Superior landlords.

STATEMENT I.

East Indian Railway.

(Bengal Coal.)

Year.	1st class—Selected.	2nd class—Grade I.	Total.
	Tons.	Tons.	Tons.
1933-34	510,000	691,000	1,201,000
1934-35	476,500	746,000	1,222,500
1935-36	309,700	940,000	1,249,700
1936-37	114,000	1,152,000	1,266,000

Eastern Bengal Railway.

(Bengal Coal.)

Year.	Selected.	Grade I.	Total.
	Tons.	Tons.	Tons.
1931-32	37,000	338,000	375,000
1932-33	45,000	285,000	330,000
1933-34	37,000	303,000	340,000
1934-35	37,000	383,000	420,000
1935-36	12,000	428,000	440,000
1936-37	25,000	435,000	460,000

* See pages 115, 116, 117, 179 and 180 (Simpson), page 179 (Lancaster) and 99 and 100 (Leach).

Great Indian Peninsula Railway.

(Central Provinces and Central Indian Coals.)

Year.	Selected—Bengal.	Grade I.	Grade II.	Grade III.	Total.
	Tons.	Tons.	Tons.	Tons.	Tons.
1931-32	189,000	500,000	128,000	88,000	905,000
1932-33	243,000	306,000	188,000	86,000	823,000
1933-34	173,000	240,000	169,000	166,000	748,000
1934-35	94,000	213,000	264,000	212,000	783,000
1935-36	152,000	211,000	249,000	219,000	831,000
1936-37	148,000	202,000	276,000	178,000	804,000

Note on activities of Indian Coal Grading Board.

The Grading Board Act does not enjoin that a seam or part of a seam at any colliery should be graded.

On application, a colliery can, under the Act, call for the grading of all or part of a seam.

The provision for grading a part of a seam under Section 4 (1) of the Act is essential. (In working even the finest coals in the Jharia and Raniganj coalfields the full section of the seam is seldom extracted.)

The framers of the Act fully understood the significance of Section 4 (1) and the rule was not inserted to cover the case where a seam deteriorates as one moves along it. Such a rule would be unnecessary as any lateral variation in the quality of a seam is covered by the fact that the sampling is carried out at each colliery and even on each colliery sampling is done over as wide an area of working as possible in order to obtain normal results.

In a previous note on the subject I pointed out that owners and managing agents have, in order to obtain the highest market price, always endeavoured to secure the highest Certificates of Grade and the sections of seams worked have, since the Grading Board commenced, been varied, cut down, or even entirely changed (very little change in the section worked is in most cases needed, to improve the grade) but, such changes are insignificant and it is not here that the real question of wastage and destruction of India's coal resources arises.

The enormous wastage which is daily becoming more and more evident is not due to the activities of the Grading Board but to other causes which existed long before the Grading Board Act was introduced and to clear up any misunderstanding which has arisen on the subject I append two statements which show conclusively that the Grading Board in grading only a section of a seam is not responsible for the wasteful methods of working. Again, the statement made that the Grading Board insists that the section graded should be adhered to is misleading. The section of a seam worked is entirely in the hands of the owners or managing agents who are entitled to have any seam or section of a seam graded.

When a seam or part of a seam has been graded the Grading Board does periodically observe that the section graded is adhered to and if this is not done a colliery is advised that a re-grading is necessary. If this is not agreed to the Certificate of Grade is withdrawn from the Graded List.

This procedure is necessary as it is from the Graded List that overseas buyers select their coal and provided the coal is graded (either as selected,

Grade I, II or III) the Grading Board cannot refuse to grant a Certificate of Grade for the coal shipped.

There are many instances where the Certificate of Grade has, at the request of the colliery, been amended or cancelled, and it is easy to conceive that, should the demand for coal suddenly increase, inferior sections to those graded would undoubtedly be worked and the Grading Board has no authority or wish to stop this. The Certificate of Grade would, however, be withdrawn and if ungraded coal were shipped no Certificate would be granted.

If a colliery works a graded section together with an inferior section in the same mine it would be impossible for the Grading Board to give any guarantee that the coal despatched as graded coal would actually be from the graded section of the seam.

Moreover, in a depressed market consumers are not interested in the poorer grades of fuel and the inferior sections of a seam are left unworked as it is useless to bring out of the mine, coal which cannot be sold particularly as the cost of production is the same for the best as for the poorer grades.

It has been suggested that owners should work a seam so that at least 60 per cent. of it is recoverable either immediately or prospectively. This might be possible with the thinner seams even without artificial stowing but I am convinced from practical experience (and I am not alone in this opinion) that even if 50 per cent. of a seam is to be recovered ultimately from thick seams where most of the wastage is now taking place hydraulic stowing is essential. It is, in fact, the only method whereby complete or reasonably complete extraction can be obtained immediately or prospectively. I am further convinced that unless this system is made compulsory in mining the thick seams the occurrence of underground fire, collapse and inundation from surface water or from areas already goafed will endanger not only the mines at present working but the virgin areas in the lower and deeper seams. These remarks apply particularly to Jharia field where coal at shallow depths has been and is still being easily won by cheap and wasteful methods of working.

This year in Jharia fires have spread with alarming rapidity and the recent fire at one colliery has resulted in the loss of 1½ million tons of some of India's finest coking coal.

During the past month the spread of fire in another valuable coal area is causing great anxiety and it is probable that many more millions of tons of coking coal will be lost.

There is no law to stop or control the present methods of working which must inevitably lead to enormous (and at present, incalculable) wastage and as long as easily won coal is available to meet the various demands of the trade, no efforts will be made by the majority of owners or managing agents to alter these methods.

The plea now put forward is that the selling price of coal is too low to admit of introducing methods which will lead to improved and safer working; but it must not be forgotten that when selling prices of coal were high the same wasteful methods of working were pursued and profits were taken regardless of the future; in fact most of the damage already done to coal properties occurred when coal was in great demand and prices were abnormally high.

Mineral-owners or lessors make little or no attempt to claim compensation for coal lost through bad mining.

In the Raniganj Coalfield many examples can be cited of seams of Grade I quality which, to-day, are being lost by the premature depillaring of a Selected Grade seam lying immediately below.

Reference has been made from time to time to the unsatisfactory grading of coals under the Indian Coal Grading Board.

The Grading of coals on chemical analysis and calorific value does not, unfortunately, show if a coal is entirely suitable for the work it is called upon to do.

It was for this reason that the Grading Board found it necessary to provide in the list of Graded Coals two distinct divisions, *viz.*, High Volatile and Low Volatile coals.

Other factors which can only be determined by practical tests, have also to be taken into account.

The classification has, nevertheless, served the purpose for which it was intended and a basis for consumers to work on.

In the absence of other data I cannot suggest any better methods of showing the qualitative value of Indian coals and even if a re-grading were carried out the results would be the same as both the sampling and analysis are carried out most carefully.

STATEMENT II.

Collieries Working.

Raniganj High Volatile Coals.

e of Inspection and sampling of Seam State Railways' Coal Department.	Name of seam worked.	Full thickness of seam.	Section worked prior to commencement of Grading Board.		Cycle of working and remarks by State Railways' Inspection Department.
		Ft. In.		Ft. In.	
h November 1922	Jambad	45 0	Top	14 0	In 1926 graded as No. 1 working Top 14′ 0″ Section and Bottom 12′ 9″ Section.
			Bottom	10 0	In 1934 working Top 7′ 6″ Section and Bottom 12′ 9″ Section, Grade I. Working in Top Section reduced to 7′ 6″ to keep Grade I coal in reserve.
h November 1922	Do.	42 0	Bottom	16 0	In 1926 graded as Grade I, working Top 12′ 0″ Section.
h September 1925	Do.	42 0	Bottom	12 0	In 1934 working Top 12′ 0″ Section, Grading Board Certificate withdrawn at the request of owner as Colliery changed its name.
h December 1922	Do.	42 0	Bottom	12 0	In 1926 graded as Grade I, working Bottom 12′ 0″ Section. In 1931 working Top 13′ 0″ Section, Grade I.
h July 1925	Do.	42 0	Bottom	17 0	In 1934 working Top 13′ 0″ Section and Bottom 12′ 0″ Section, Grade I.
h December 1922	Kajora	22 0	Bottom	13 6	In 1926 graded as Grade I, working Bottom 14′ 0″ Section. In 1934 working Bottom 14′ 0″ Section, Grade I.
Do.	Do.	22 0	Bottom	18 0	In 1926 graded as Grade I, working Bottom 13′ 0″ Section. In 1934 working Bottom 13′ 0″ Section, Grade I, Top coal very inferior, Bottom 3′ 6″ of graded Section not worked at present.
Do.	Nega'.	18 0		10 0	In 1926 graded as Grade I, working full 18′ 0″ Section. In 1934 working 15′ 0″ Section, Grade I.
h December 1922	Babisole	12 0	Middle	6 0	In 1926 graded as Grade I, working Middle 9′ 0″ Section. In 1934 working Middle 9′ 0″ Section, Grade I. Colliery closed, 1935.
Do.	Kajora	22 0	Middle	13 0	In 1930 graded as Selected, working Middle 13′ 1″ Section. In 1934 working Middle 13′ 1″ Section.

Inspection and sampling of Seam te Railways' Coal Department.	Name of seam worked.	Full thickness of seam.	Section worked prior to commencement of Grading Board.		Cycle of working and remarks by State Railways' Inspection Department.
		Ft. In.		Ft. In.	
uary 1923	Kajora	22 0	Middle	18 0	Not graded. Colliery closed.
ruary 1925	Do.	22 0	Middle	9 0	
uary 1923	Do.	18 4	Middle	9 0	In 1926 graded as Grade I, working Top 9′ 0″ Section.
uary 1923	Do.	18 0	Middle	10 0	In 1934 working Top 9′ 0″ Section, Grade I.
ril 1923	Do.	18 4	Middle	9 0	In 1932 1′ 6″ of graded Section left in roof.
tober 1923	Sathgram	12 0	Top	6 4	In 1923 best coal in Top Section worked due to bad trade. Colliery now closed. Never graded.
uary 1923	Kenda	28 0	Bottom	16 0	In 1933 graded as Grade I, Bottom 20′ 6″ Section worked.
rch 1923	Toposi	23 8	Middle	9 0	In 1932 graded as Grade I, Bottom 16′ 8″ Section worked.
tember 1923	Jambad	42 0	Top	12 0	In 1926 graded as Grade I, working Top 12′ 0″ Section. In 1933 working Top 12′ 0″ Section, Grade I. In 1934 working Bottom 10′ 0″ Section, Grade I.
bruary 1924	Bankola	22 0		16 0	In 1935 8′ 0″ Section worked. Not graded.
ril 1924	Koithi	11 6	Bottom	9 6	In 1926 graded as "Selected" Grade, working Bottom 8′ 0″ Section. In 1934 depillaring in 8′ 0″ Section roof coal 8′ 6″ is lost as it falls with roof and cannot be picked out.
ly 1924	Jambad	42 0	Top	14 0	In 1926 graded as "Selected" Grade, Working Middle 10 8″ Section. In 1934 still working 10′ 8″ Section, Grade "Selected".
vember 1924	Kajora	22 0		19 0	In 1926 graded as Grade I, working 11′ 6″ Section. In 1934 working 8′ 9″ Section, Grade I.
cember 1924	Salanpur (L. V.)	63 0		8 0	In 1929 full thickness of seam proved to be 35′ 0″ only and worked Middle 18′ 0″ Section. Seam never graded.
ly 1926	Do.	63 0		27 6	Colliery practically closed.
nuary 1925	Jambad	45 6 45 6	Middle Middle	13 8½ 11 6	Prior to 1925 Collieries worked good Sections and it is intended to confine working to these Sections for many years. In 1926 graded as Grade I, working Middle 14′ 6″ Sections. In 1933 working Middle Sections 14′ 6″, Grade I.
nuary 1925	Churulia	34 0		6 7	In early days full Section of Seam was worked. Later on a 13′ 0 Section was worked, now bottom 10′ 0″ Section is worked which appears to be good quality. Not graded.

3rd February 1925	Koithi	12	0		10	0	In 1926 graded as Grade I, working Bottom 8' 0" Section. In 1934 working Bottom 8' 0" Section, Grade I.
Do.	Do.	11	0		11	0	In 1926 graded as Grade I, working Bottom 8' 0" Section. In 1933 working Bottom 8' 0" Section, Grade I. Some depillaring done but Poniati now being depillared underneath and destroying Koithi above.
Do.	Do.	12	0		12	0	In 1926 working full 12' 0" Section, graded as Grade I. In 1933 working full 8' 0" Section, Grade I.
4th March 1925	Samla	18	0		11	0	In 1926 graded as Grade I, working 8' 6" Section. In 1934 working Bottom 9' 0" Section, Grade I.
17th June 1925	Koithi	4	0	Bottom	7	0	In 1926 graded as Grade I, working 8' 0" Section. In 1935 grade Certificate suspended with owner's consent as pillars are being extracted and Colliery finds it impracticable to keep to Graded Section.
4th July 1925	Sathgram	13	0	Top	6	6	In 1926 graded as Grade I, working Middle 6' 2" Section. In 1928 graded as "Selected" Grade, still worked Middle 6' 2", but more picking done. In 1934 still working 6' 2", "Selected" Grade.
16th July 1925	Do.	14	0	Middle	6	0	In 1926 Graded as Grade I, working 6' 0" Section. In 1934 still working Middle 6" 0" Section, Grade I.
30th August 1925	Jambad	42	0	Bottom	14	0	In 1926 graded as Grade I, working bottom 14' 0" Section. In 1934 still working Bottom 14' 0" Section, Grade I.
Do.	Kajora	21	0	Top	11	0	In 1926 graded as Grade I, working 9" 0" Section. In 1934 still working Top 9" 0" Section, Grade I.
10th September 1925	Sankarpur	28	0	Bottom	14	0	In 1926 graded as Grade I, working Bottom 12' 0" Section. In 1928 Grade Certificate withdrawn by owner.
11th September 1925	Chora	28	0		27	0	In 1926 graded as Grade II, working 28' 0" Section. In 1927 Grade Certificate withdrawn, still working 28' 0" Section.
8th October 1925	Kenda	27	0	Bottom	12	0	In 1926 graded as Grade I, working Bottom 14' 0" Section. In 1932 graded as Grade I, working 14' 0" Section. In 1933 working 19' 0" Section, Grade I.
4th August 1925	Benalee	13	0		10	0	In 1926 graded as Grade I, working 9' 0" Section.
2nd November 1927	Kajora	19	5	Bottom Section			Prior to 1927 workings mostly confined to Bottom Section of Seam. In 1927 Mr. Barnard stated that he wished to offer his coal to the Railways and at his request a 9' 0" Section leaving 3' 0" in roof was sampled by the State Railways' Coal Department and not by the Coal Grading Board. In 1929 Graded as Grade I, working 7' 10" Section leaving 4' 0" in roof and 8' 2" in floor.

STATEMENT III.

Collieries Working.

Jharia Low Volatile Coals.

Inspection and sampling of Seam by State Railways' Coal Department.	Name of seam worked.	Full thickness of seam.	Section worked prior to commencement of Grading Board.	Cycle of working and remarks by State Railways' Inspection Department.
		Ft. In.	Ft. In.	
vember 1923	Nos. 11 and 12 (combined)	40 0	Top . 12 0	"In 1916 work was started in Top 12' 0" Section. If colliery receive order we should be satisfied in every way that only th Section sampled is worked at both Collieries". Seam neve Graded.
bruary 1924	No. 17	14 0	9 0	"Prior to 1924 only 8 bighas developed. Colliery worked ful section of 14 feet but Section now reduced to 9' 0" to strengthe pillars." In 1927 graded as "Selected", working 14' 0" Section. In 1934 still working 14' 0" Section, Grade "Selected".
	No. 10	30 0	Top . 10 2 Bottom 9 10	In 1924 "Colliery can only work bottom section when working are dry". Never Graded.
bruary 1924	No. 12	12 0	Middle 6 6	In 1926 graded as "Selected", working Bottom 8' 0" Section. In 1934 still working, Bottom 8' 0" Section, Grade "Selected".
ne 1924	No. 10	47 6	Top . 17 9 Middle 7 6 (Usually).	In 1924 "In despatching to railways, I must insist o elimination of inferior coals representing samples I have taker The despatches of entire seam was not contracted for; th working should be in Top 17' 9" and Middle 7' 6" Section". In 1926 graded as Grade II, working full Section. In 1934 working Full Section, Grade II.
ovember 1924	No. 13	14 0	11 10	In 1927 graded as "Selected", working 10' 0" Section. In 1934 still working, Bottom 10' 0" Section, "Selected" Grade.

5th November 1924	No. 10	42	0		22	11	Prior to 1924 " workings were confirmed to 24 feet in Top Section. The Top 10' 0" of coal appears to be the best quality ". In 1926 graded as Grade III, working 23' 9" Section. In 1934 still working 23' 9" Section, Grade III.
Do.	No. 15	20	0	Middle	11	10	In 1926 graded as Grade I, working 10' 8" Section. In 1934 graded as " Selected ", working 14' 2" Section.
Do.	No. 12	12	2		7	2	In 1927 graded as " Selected ", working 8' 0" Section. In 1934 still working 8' 0" Section, " Selected " Grade.
Do.	No. 13	19	0		17	6	In 1926 graded as " Selected ", working 17' 6" Section. In 1934 still working 17' 6" Section, Grade " Selected ".
0th January 1925	No. 13	18	0	Top	15	9	In 1928 graded as " Selected ", working 18' 0" Section. In 1934 working Full Section, " Selected " Grade.
7th February 1925	No. 14	27	0	Top	25	0	In 1927 graded as Grade I, working 25' 0" Section. In 1934 working Full Section, Grade I.
Do.	No. 14	26	0	Top	19	6	" Prior to 1925 the 4 feet of floor coal is occasionally worked. Great care should be taken to see that this is kept out when despatching to Railways. The Colliery is depilliaring." In 1927 graded as Grade I, working Full Section. In 1934 working Full Section, Grade I.
2th February 1925	No. 11	24	0		10	0	" Prior to 1925 several attempts were made to work a 22' 0" Section of the seam, but as the coal was inferior development was stopped." In 1926 graded as Grade I, working 12' 9" Section. In 1934 working Bottom 12' 9" Section, Grade I.
Do.	No. 11	22	0	Bottom	6	11	" Prior to 1925 a small area of 11 seam 27' 0" thick has been worked." In 1926 graded as Grade I, working 9' 0" Section. In 1934 working Bottom 13' 0" Section. Grade I.
3rd July 1925	No. 10	46	6	Top	27	6	In 1926 graded as Grade II working Top 28' 0" Section. In 1934 still working Top 28' 0" Grade II at No. 2 Pit. In 1934 working Bottom 10' 0" Section, graded " Selected " at No. 3 Pit. In 1934 still working Bottom 10' 0" Section, " Selected " Grade.
3rd August 1925	No. 10.	40	6	Top	7	0	In 1927 graded as Grade III, working Top 10' 0" Section, and Bottom 11' 0" Section.
				Bottom	10	0	In 1934 still working Top 10' 0" Section, Grade III and Bottom 11' 0" Section, Grade III.

Inspection and sampling of Seam te Railways' Coal Department.	Name of seam worked.	Full thickness of seam.	Section worked prior to commencement of Grading Board.		Cycle of working and remarks by State Railways' Inspection Department.
		Ft. In.		Ft. In.	
ptember 1925	No. 14	22 0 to 23 0		17 10	In 1926 graded as "Selected", working 22' 0" Section. In 1935 still working 22' 0" Section, Grade "Selected".
Do.	No. 13.	17 9		6 9	In 1926 graded as "Selected", working Bottom 9' 0" Section. In 1935 working Full Section, Grade "Selected".
Do.	No. 12	13 5	Bottom	6 11	In 1926 graded as Grade I, working Bottom 7' 4" Section. In 1935 working 7' 4" Section, Grade I.
ptember 1925	No. 10	50 0	Top Bottom	14 8 15 0	Prior to 1925 "of the 32' 0" of Top Section worked 8' 0" is considered worth working. In seams of this thickness, there is a danger of inferior sections being worked and if a trial has been made great care would be needed to see that the workings are confined to the Sections contracted for. Very little Top Section has been worked but in the bottom section half the available area is already in pillars". In 1929 Bottom Section Graded as Grade I, working Bottom 16' 9" Section. In 1934 still working Bottom 16' 9", Grade I.
ptember 1925	No. 11 and 12 (Combined).	47 0	Top	11 0	Prior to 1925 "First workings were carried out in the Top 15' 0" which will be run for another 8 years but no guarantee can be made that the workings will keep to this Section". In 1930 Graded as "Selected", working Top 16' 0" Section. In 1935 Grade Certificate withdrawn at request of Owner, as he stated pillar extraction was being done and during this operation it was impracticable to keep to graded Section.
ne 1914	No. 13	19 0	Bottom	14 0	In 1927 only No. 13 Seam was Graded as "Selected", working 10' 0" Section. In 1928 Grade Certificate withdrawn at request of owners who entered into a 25 years' contract with Tatas' Steel Works.
Do.	No. 12	12 6	Bottom	8 0	
Do.	No. 11	18 0	Top	6 6	

Oral Evidence.

Question 6.—I agree that the Temporary and Supplementary Regulations should be made permanent, and also the temporary legislation of 1936.

Question 7.—I agree that mechanical ventilation should be enforced not only in mines in which there are sealed-off fires, but also in all gassy mines. Where a mechanical ventilator is required, it should also be required that the ventilator should be run continuously and natural ventilation should not be relied on. If the ventilator ever stops and there is no stand-by ready to fall back upon, the workmen should be withdrawn as quickly as possible.

Question 9.—I am of the opinion that the provision suggested should be required by law where water ranges and water under pressure are available.

Question 10.—I am of the opinion that there should be telephonic communication between the surface and the shaft bottom. As regards any further part of the mine, I agree to a regulation which requires telephones to be installed in all cases where the main haulage road extends 3,000 feet or more from the shaft bottom, but I would also suggest that the Chief Inspector of Mines should be given the power of prescribing a shorter distance from the shaft bottom where he considers it necessary.

Question 14.—I have agreed to the extension of Temporary Regulation No. 14 as suggested, but I suggest that the extension should only be applied to mines where the depillaring stage has been reached in seams which are known to be liable to spontaneous combustion.

Question 16.—With reference to my answer to *Question 16*, in consideration of the class of labour we have in India, I am of the opinion that electric safety lamps would give a greater degree of safety than the ordinary flame safety lamps. Stowing of goaves would obviously give a much greater degree of safety but I consider the stowing would have to be done with financial assistance, such as the supply of sand free at the colliery to make the extraction of those seams giving off large quantities of inflammable gas an economic proposition. I think that whatever precautionary measures are adopted, it is essential that the ventilating fan should be kept running continuously. The method of working would also enter into the question as at some mines it would be practicable to work on a retreating system from the dip, leaving the goafed area under water. Such a method would also eliminate the risk of fire.

Question 19.—I am of the opinion that the laying down of general principles of first working by regulation is essential. I agree that a suitable basis for such principles would be percentage of floor area *plus* an average maximum height of 10 feet and a maximum width of 16 feet for galleries, but as so much depends on the local conditions obtaining at each mine, the Chief Inspector

should have power to vary these principles either way, in accordance with circumstances or local conditions. There should also be an appeal from any order of the Chief Inspector regarding such variations to the same authority authorized to hear appeals from orders under Section 19. I agree that, if such first principles are laid down by regulation, the penalty for infringing them should be adequate and immediately enforceable. A suitable penalty would be giving power to the Inspector who discovered the infringement to direct that safe conditions should be restored in any manner that he considers necessary, and also the power to prohibit further coal getting in that district of the mine until the restoration work had been completed.

Question 21.—After my discussion with the Committee, I agree that the practices referred to in the question should be prohibited by regulation except within two pillar lengths ahead of the point where pillars are being extracted or when pillar extraction is about to commence. I am also of the opinion that the regulation should provide for the splitting of pillars for specific purposes such as making of cross cuts, or increasing the dimensions of galleries for haulage or ventilation purposes.

I consider that, in addition to general principles of first working, there should also be control over depillaring operations in areas in which it is not practicable to apply compulsory sand-stowing at first. In my *Note on Coal Conservation* attached to my written answers I have made certain suggestions in this connection.

Question 33.—By first class and second class coal, I mean Selected Grade and Grade I coal respectively.

The coal requirements of all State Railways and main Company-managed railways with the exception of the Bengal-Nagpur Railway are arranged for by me. In the case of the latter railway, the Agent sometimes calls for tenders and makes his own selections of the coal required. This was the procedure this year. The arrangement regarding the taking of only one-third from State Railway collieries applies only to the State Railways. In the case of the Company-managed railways, part of the requirements are taken from their own collieries and part from the market, but I am not aware that definite proportions of railway and market coal requirements have been laid down.

I do not think there would be any difficulty in collecting a universal cess on all coal carried by railways in the case of coal despatched from collieries for railway consumption, nor do I think there would be any difficulty in the case of coal despatched from the State and Company-managed collieries for the consumption of State or Company-managed railways.

The recent shortage of coal was due to shortage of labour which occurred about the beginning of December and still continues.

It is a fact that certain services on the following railways would have been suspended if the Bokaro quarries had not been

able to increase their output by about 60 per cent. The railways referred to are the Eastern Bengal, the North-Western, the Great Indian Peninsular, the Bombay, Baroda and Central India, and the Bengal and North-Western.

Question 39.—By ' thick seams ' I mean seams over 12 feet in thickness.

Question 53.—I agree that sand could not be delivered free to all collieries unless the means of acquiring and distributing sand is provided for by means of a cess to be paid by those interested in the coal trade including the consumers.

Questions 54 & 55.—With regard to *Questions 54 and 55*, I am of the opinion that safer methods of working, particularly in thick seams at the older collieries, should be enforced, and where necessary to effect this, sand-stowing would have to be introduced both at old and new mines, though not necessarily complete stowing. This would make for a certain amount of conservation, in both the Jharia and Raniganj coalfields.

Stowing, on an extensive scale for all collieries, would be impracticable, even if sufficient funds are forthcoming, as the difficulties of providing enough sand, transport and distribution facilities and storage accommodation seem insuperable.

Further conservation particularly in the Jharia field might be effected by a controlling authority who could lay down what seams or sections of seams are of recognised commercial value. In the Raniganj coalfield I would not expect any great amount of conservation in this direction as the best coals such as Dishergarh and Poniati are fairly uniform in quality throughout the full section of the seam (*vide* list of Selected High Volatile coals in Grade Board Publication).

Suggestions have also been made that the use of coking coal should be restricted to metallurgical purposes, but beyond advising Steel Works to conserve their reserves of coking coal I do not see that anything further can be done (*vide Note on Coal Conservation*).

The conservation of coking coal is however a matter of extreme urgency and special attention will have to be given to the Jharia field.

The present fire areas, which seem to be regarded as " No Man's Land " should be reclaimed and the spread of fire arrested.

Funds would have to be provided immediately to carry out the work of flooding and infilling with sand and it would perhaps be better to place the work in the hands of a competent mining engineer.

It might be necessary to carry out this work to adjust certain colliery boundaries in order to provide adequate barriers against present workings.

The area near Jharia station would be one of the first to be tackled, as valuable tracts of coking coal are endangered by the spread of fire in this locality.

I am of the opinion that practical difficulties and cost involved would not admit of applying further conservation to fields of non-coking coal apart from that brought about by safety measures. Even in the Jharia coalfield it could only be applied to the most dangerous areas and it is here that the question of conservation is of paramount importance.

The above are my reasons for stating that the conservation of coal as a natural asset should only apply to the Jharia coalfield.

Question 61.—I am aware of the contract made between the State Railway collieries at Giridih and the Bengal Iron and Steel Works at Kulti for the supply of hard coke at a price of Rs. 6-4 per ton f.o.r. Kulti. The price was arranged by the Railway Board with the Company. One of the considerations that determined this price was the fact that the Bengal Iron Company could manufacture hard coke from the slack from their own collieries at a rate lower than Rs. 6-4 per ton. The coke was previously offered to Tatas, but they refused it on account of the comparatively long lead to Jamshedpur. The hard coke at Giridih is manufactured from slack which would otherwise be surplus and could not be disposed of. The contract is for three years from about June 1936.

Question 62.—It is correct that the original idea was that the Coal Grading Board should be run by the Chief Mining Engineer and his staff for about two years. As far as I remember, the question of handing over the coal grading work to the trade has since been considered, but the trade preferred that this Department should carry on the work as it can be done far more cheaply and efficiently. The net average annual income is Rs. 55,000. There is no surplus at present and the expenses of the Grading Board are now met partly from the fees charged by the Board. The amount of the accumulated surplus on hand is Rs. 3,12,000. It has been suggested by the trade that the surplus should be given back to firms who have paid the fees in the first instance.

The practice of working the best section of a seam to meet trade requirements would have been carried out if the Grading Board had not been introduced. Indeed, prior to the introduction of the Grading Board Act, owners only worked sections which could be sold in any particular market and this will continue unless, in the interests of conservation, they are forced by law to work the whole of a seam or that section of a seam which can be regarded as coal of commercial value.

It is easy to say that grading should be applied to export coal only as was the original intention but there are practical difficulties, and to do this it would be necessary to strike out of the Act the words, " or of part of a seam " (which were inserted to suit owners who were working a certain section of a seam).

This would mean that only those collieries with seams of uniform quality throughout, would be in a position to ship coal, but as already explained any alteration in the Grading Board Act would not prevent owners from working any section of a seam they chose to work.

During the past few years a section of the trade has blamed the activities of the Grading Board for wasting coal reserves. Witnesses before this Committee have given the impression that the grading of a section of a seam leads to waste and fire.

These people have little knowledge of what was done in the past as prior to the introduction of the Grading Board few records were kept of the sections worked.

Working the best section in any seam ultimately leads to the waste of other inferior sections, and this will continue whether the section worked is graded or not.

The choice of the section worked lies with the owners and it is at their request that the Grading Board sample and grade such sections.

Owners are at liberty to change the section worked any time they wish and to ask for a re-grading but obviously if the graded section is not adhered to the Grading Board cannot guarantee to consumers overseas that the coal bought is shipped according to grade.

Within certain limits, as long as a colliery is carrying out its first working; *i.e.*, developing a section in the "solid" and forming pillars, no wastage or damage occurs. It is only when depillaring is carried out that the question of wastage of inferior sections either in the roof or floor, arises and if it is considered that coal of a commercial value is being lost or rendered irrecoverable, solution of the problem would be to prohibit depillaring (1) unless the whole of the coal of recognised commercial value in a seam is extracted in the process of depillaring or (2) unless the coal is left intact so as to be recoverable at a later date. In (2) those collieries which are not in a position to stow would have to close down until there is a market for the coal from the inferior sections.

It would of course be possible to restrict grading under the Grading Board Act to first working and to seams where the full section is being depillared.

We must not lose sight of the fact that the Grading Board classification has now been accepted by the trade, and consumers rely on it when making their purchases.

It is only natural that the trade should accept such a classification as it is the only authoritative classification from which consumers can obtain particulars as to the quality of coal worked at each colliery.

The adherence to certain graded sections has undoubtedly made for greater stability in the first working at many collieries.

38. Written Evidence of Mr. S. F. Tarlton, Deputy Chief Mining Engineer, Messrs. Bird & Heilgers' Collieries.*

Question 1.—Deputy Chief Mining Engineer, Messrs. Bird & Heilgers' Collieries. My experience extends over the Jharia, Raniganj and South Karanpura coalfields for the past 12 years.

Question 2.—I believe the main cause of underground fires to be spontaneous combustion in goaf areas and collapsed areas.

The number of fires has increased in recent years.

In the collieries with which I have had experience, the majority of fires has been due to normal collapses deliberately brought about by pillar extraction.

Jharia Coalfield.

Question 3.—Experience to-date has shewn that seams Nos. 13, 14 and 15 are particularly liable to spontaneous combustion with a definite trend for No. 15 seam progressing west-wards to become less liable in this respect. It should, however, be borne in mind that pillaring operations in the seams above-mentioned have been far more extensive than in those either above or below. It cannot, therefore, be said that the remaining seams are not also singularly liable to spontaneous combustion with the exception of Nos. 17 & 18, in which it is believed no heating has so far taken place in the areas depillared.

Raniganj Coalfield.

Experience has shewn that the Dishergarh and Poniati seams are most assuredly subject to spontaneous combustion, as also most others, but my experience of the remainder is limited.

South Karanpura Coalfield.

The Sirka seam judging by behaviour of stocks on the surface is particularly liable to spontaneous combustion, but this does not apply to the Argada seam, although no goaving operations have so far been conducted in either seam.

The period of incubation is a most variable factor and is subject to many influences including depth from surface neighbourhood of faulting, nature of the coal in the particular area, and ventilation. My experience shows that in the Dishergarh seam and in No. 15 seam towards the eastern extremity of the coalfield, heating can be expected after 18 months from the first main roof-fall, but this cannot be considered a period of immunity, but only of comparative immunity.

I do not consider that any seam is entirely free from the risk of spontaneous combustion, although certain seams in certain areas

* Messrs. R. Fenwick and R. Purdy of Messrs. Bird & Co., have adopted this evidence.

have so far shewn no signs of heating, whereas collieries in close proximity to such areas have definitely fired.

Question 4.—That fires considerably increase the difficulties and dangers of extracting the remaining coal is without question.

If the 2nd question under this item refers to the necessity for extraction of pillars lying close to sealed off fire areas, I agree that these difficulties and dangers become greater on account of the increased likelihood of blown-out stoppings or crush on those stoppings.

I also agree that the difficulties and dangers increase when successive removal of seams lying close together is undertaken.

Question 5.—I consider that a panel system is open to very serious objections provided that such panels are considered to be the security in fire troubles and an influential factor in mine stability, in so much as the laying out of the areas within such panels pre-determines the area of extraction before spontaneous heating takes place. It is believed that what has become to be known as "the period of incubation" is such a variable factor that it is impossible with any degree of accuracy to forecast what that period will be. Assuming this contention to be correct, one is faced with the fact that in all likelihood one of the following circumstances will arise:—

(*a*) Heating will take place when only a part of the area within the panel has been extracted, or

(*b*) The pillars within the panel will be completely removed without spontaneous combustion having arisen. In which case the mine owner is faced with the question of whether to extend the area into the next panel by removal of one fire barrier or to close the area and thereby lose all the coal forming these barriers.

If he adopts the first proposal, he thereby exposes the whole of the pillars within the second panel to the danger of being lost, should heating at a somewhat later date occur due to the goaving operations within the original first panel.

On the other hand if he adopts the second proposal, it may be that he has left behind coal unnecessary by since the area might not have fired for some considerable period after pillaring operations were completed within the panel.

It is, therefore, believed that the first workings should be so driven that an artificial barrier can be safely, quickly and satisfactorily formed in any line of pillars. To make adequate provision for such a system, it is necessary that comparatively small galleries be driven in the first working and that at the entrance to each gallery for a distance of not less than 10 feet the gallery should be driven of maximum dimensions 6 feet × 6 feet. The portion of the gallery lying midway between its two extremities may be of considerably larger dimensions but not excessively so.

Such a system allows of continued pillar extraction until the first indication of heating is observed. In executing such a system in collieries under my control and subject to the character of the first workings driven in the past, one line of temporary stoppings built of corrugated iron sheeting is always maintained one pillar length back from the line of pillar extraction.

Before this line of temporary stoppings is destroyed by extension of pillar extraction, a second line of temporary stoppings is completed one further pillar length out-bye of the previous line, such lines being of course provided with openings for ventilation, passage of men and material, etc.

Should a fire occur at any time with these provisions entrances through the temporary stoppings can be sealed with doors provided at a moment's notice, and work taken in hand immediately for erection of permanent stoppings. By such a method no more than one line of pillars is subject at any time to possible loss should heating occur, and one is not faced with the problem of determining what is considered to be an indeterminable problem.

In view of the above statements it is shewn that I am not in favour of a panel system except under special circumstances and that it is believed to be impossible to lay down reliable sizes of panels which are not subject to the dangers of excess wastage of coal.

Being of the opinion that reliable sizes of panels cannot be laid down, it is believed to have been shewn that percentages to be left in barriers forming such panels can also not be accurately determined.

Question 6.—It is believed that the two sets of the Temporary Coal Mines Regulations are on the whole sound, and that as additional precautions the replies to ensuing questions might be considered, but that at the same time Temporary Regulation No. 10 issued under Notification No. M. 955 bears with undue harshness in many cases. Two instances of this were pointed out to the Committee on its visit to Mudidih and it is felt that such a sweeping Regulation as this should be removed from the provisions of the Law. In its stead the Chief Inspector should exercise his powers under Section 19 with such amplification as the legal authorities may consider necessary, as each individual case must be judged on its merits, and at the same time leaving the mine owner the right of appeal to an independent body. Such action would render efficient support to the Mines Department but would nevertheless safeguard the owner from a too stringent interpretation of the word "Dangerous".

Question 7.—I am of the opinion that all mines or seams in which there are sealed-off fires should be mechanically ventilated. As a general principle the fan should be forcing, but such should not be embodied in the Law as circumstances and conditions do obtain whereby it is unnecessary and would involve the owner in unwarranted expenditure both Capital and Revenue on account of

plant already existing and secondly due to the predilection of one particular outlet to naturally upcast or downcast as the case may be.

Question 8.—It cannot be doubted that the extraction of a section of a seam in such a way as to leave behind the remainder of the seam broken up in the goaf increases the risk of spontaneous combustion, as apart from instances where the upper shales are the cause of heating, it is broken coal left in the goaf which fires spontaneously and any action whereby the percentage of broken coal not recovered is increased, must aggravate the possibility of heating.

I know of no instance where fires may be directly and wholly attributed to this cause, but I do feel that in the Dishergarh seam where a tender roof prevails and a small percentage of roof coal has an occasion to be left to enable pillar extraction to be continued at all, that this roof coal is at least a contributary cause.

Question 9.—That the suggestions under this item are desirable is not questioned, but that their universal application is practical politics is open to serious doubt. In many collieries, at least during the dry season, water is not available in reasonable quantity and in other cases the only available water is in the dips from which all men should be withdrawn when signs of fire are noticed. It is felt, therefore, that to provide any fool-proof system whereby water in quantity may be available at any point and at any time is impracticable and that the removal of the origins of fires can more readily be secured. The number of accidental fires as distinguished from those caused by spontaneous combustion is believed to be small, but apart from the dangers which have been removed by the Temporary Regulations such as the prohibition of the use of combustible material in and around pit shafts, the main danger is believed to be through the use of naked lights.

Two instances come readily to mind:—

(*a*) A man carrying an acetylene lamp tripped up and dropped his lamp which being insecurely clamped broke open and the carbide within the lamp became ignited. Water was at hand and the man in his ignorance threw water on to the carbide with the object of extinguishing the flame. The result might have been disastrous had not the manager by good fortune appeared on the scene and was able to extinguish the conflagration with the aid of his jacket.

(*b*) Timber-men were dressing props and un-noticed by them an open kerosene oil lamp was over-turned and had ignited the timber chips. This was noticed by an Inspector of Mines while passing and the flame was quickly extinguished. It is conceivable to say the least, that had no official been passing the fire having such readily ignitable material at hand might have

spread with such rapidity that the timber-men would take fright and flee.

Finally the Loyabad disaster has shown us the dangers which may be attributed to an accidental origin of this kind although this has not been and probably never will be proved, and it is felt that the compulsory installation of safety lamps throughout would remove a very real menace, and would go a long way to obviate the desirability of fire fighting provisions.

Question 10.—I am not in favour of telephonic communication being required by Law, but such may be enforced under Section 19 where considered desirable.

Question 11.—I have nothing further to add to the specific replies given to *Questions 1 to 16.*

Question 12.—I consider it is eminently desirable that rescue teams should be trained as suggested.

Question 13.—I believe that all men engaged in dealing with mine fires other than those wearing rescue apparatus should be equipped with gas masks as it is believed that in the majority of cases where carbon monoxide has taken its toll, an ample percentage of oxygen was present to support life, had the deadly poison been removed.

It is believed that in most cases of sealing fire areas caught in their embryo stage, the necessity for the presence of rescue teams does not arise, but if their attendance at all fires were to become law, the teams themselves would *ipso facto* receive well needed training whereby confidence in themselves and in their apparatus would be inculcated, and their aid in times of dire necessity thereby become invaluable.

Question 14.—It is felt that Temporary Regulation No. 14 should be extended as suggested and that it should be further extended to embrace all mines in which inflammable gas has been found and so obviate the necessity of the publication by local Government of special bye-laws to apply to each individual case. The present system is cumbrous and any clarification of the Act is desirable.

Question 15.—As stated in reply to *Question 9*, I do agree that precautions against the occurrence of fires is better than precautions for dealing with them and re-iterate my opinion that compulsory installation of safety lamps is a very desirable measure.

Question 16.—That filling or packing with sand or other suitable material is desirable under certain circumstances for the prevention of spontaneous heating in goaves and the consequent danger of an ignition of fire damp is agreed. It is however believed that very extensive security could be obtained in this direction by commencing pillar extraction from the dips and if possible flooding the goaf as one retreats. Even were flooding not possible the security by such a system would be enhanced by the

fact that the lighter and inflammable gases would rise and be carried away in the main body of the ventilation whereas the comparatively innocuous black damp would lie in the goaf.

The question relates to all seams where inflammable gas is given off, and I see no reason to distinguish one from another.

Question 17.—I consider the premature collapse of workings is mainly due to the excessive extraction in the first working but here again it should be remembered that conditions such as strength of coal and strength of the superincumbent strata play a most important part as during pillaring operations comparatively small pillars can be extracted successfully providing the main roof will come away readily and not throw excessive weight back on to the remaining pillars.

Question 18.—The dangers that may arise from such premature collapses are trapping of men underground, damage to men and shafts by air blast, collapse of surface buildings, rivers, roads, etc, and the ultimately increased likelihood of fire.

Prevention of such premature collapses can best be attained by stowage performed hydraulically if possible.

Question 19.—I consider the powers entrusted to the Chief Inspector under Section 19 as amended by Act XI of 1936 are adequate.

Question 20.—I consider that no minimum size of pillars and maximum size of galleries should be laid down by law except as provided under Section 19, and that every case should be treated on its merits.

Factors governing these dimensions are:—

(*a*) Strength of coal,

(*b*) Strength of superincumbent strata (often unknown until too late),

(*c*) Depth from surface,

(*d*) Inclination,

(*e*) Proximity of faults,

(*f*) Proximity of another seam either above or below,

(*g*) Provision for formation of fire barriers along any given line of pillars.

Question 21.—I am in favour of the legal prohibition of splitting of pillars, reduction of pillars, heightening of galleries except immediately before the systematic extraction of pillars with the proviso that where for any reason it is necessary to form a split, a corresponding amount of stowage shall be packed in the galleries on either side of the split and that main roadways should be exempted from the clause relating to the heightening of the galleries and reduction of pillars, as it is very often found necessary to adjust the grade and side-dress the gallery owing to the incidence of faulting bad ground, etc.

Question 22.—I feel it is impossible to express an opinion on this subject without assuming conditions and therefore believe each case should be judged on its merits, and that there should be no further formation of Regulations under such widely varying conditions as exist in the coalfields of India, unless they have a common application. The reply to *Question 19* also holds good in this case.

Question 23.—I am definitely of the opinion that no statutory authority with the powers as suggested should be appointed, as it is unwise to divorce these precautions and the functions of the Mines Inspectorate, and moreover feel strongly that under whatever authority orders are issued there should without question be the right of appeal.

Section 19 amplified if necessary forms a satisfactory medium for the execution of the proposals. The Mines Department who are the people regulating the safety in mines would have full power to impress their views, but would be prevented from display of excessive caution in the first place by the knowledge that there was provision for an appeal and secondly failing this the appeal itself. The mine owners would likewise be safeguarded.

It is felt that the laying down of gallery and pillar dimensions as replied to in *Question 19* would be adequate, and that submission of all proposals as to working would be entirely redundant and unnecessary.

Question 24.—Following *Question 23* the provisions of Section 19 might be enlarged to make specific mention of stowage, and that the Mines Department should remain the only authority subject to appeal. The personnel of the department should be increased to deal with these matters.

Below is a schedule of reasons showing why an independent authority should not be appointed:—

(*a*) To be independent of the various mining interests a whole-time authority would be necessary.

(*b*) It would in the nature of things, require to be in very close touch with the Department and unless it were to observe the wishes of the Department would quickly come into conflict with the Department in addition to the owners. This would entail the right of appeal from two sources and would therefore further complicate the issue.

(*c*) The right of appeal from whatever authority holds sway must be provided for. Thus if an independent authority were appointed a second Committee on the lines indicated in Section 19 would still be necessary. The whole machinery would thereby become most complex.

Question 25.—The following dangers from irruptions of water are known to me:—

(*a*) Flooding of Loyabad 6 Pit by bursting of pillars carrying pressure dams caused by the flooding of the neighbouring Ekta colliery who turned in the *jore* in the hope of extinguishing a fire.

(*b*) Bhaskajuri colliery was flooded by the bursting of a supposed barrier caused by the deliberate flooding of the neighbouring Joyramdanga colliery.

(*c*) Teetulmuti and Mudidih were drowned on account of the Railway culvert being of insufficient dimensions (owing to reconstruction) to carry away flood waters which backed up and overflowed into a quarry connected with underground workings.

(*d*) Loyabad No. 5 Incline was drowned through the inadvertent holing into old workings not shown on the plan.

The Mines Department have full details of all these cases.

Question 26.—It is agreed that such irruptions become highly dangerous if they enter fire areas, because the water generates gases which may be of an inflammable nature but which in any case displaces foul gases already in association with the fire area and forces them out into the mine workings.

Question 27.—I consider that the Regulations as they stand to-day supplemented by the powers possessed by the Chief Inspector under Section 19 are adequate. In extreme cases it is believed that suspension of work during the monsoon period is a full and satisfactory safeguard. The Inspectorate not only have these powers but have already used them.

Question 28.—Temporary Regulation 3 issued under Notification M. 1055 is incongruent when read in conjunction with Temporary Regulation 13 issued under Notification M. 955 and with Permanent Regulation 70, sub-section (4) as below:—

(*a*) Temporary Regulation 13 requires the use of safety lamps under certain conditions in a "ventilating district" whereas Temporary Regulation 3 prohibits the use of non-permitted explosives "in any mine" where safety lamps are required. Thus, open lights may be used in the districts other than the ventilating district concerned but "permitted" explosives are compulsory in all districts. We therefore have the anomaly of "permitted" explosives being required as a safeguard against a gas ignition whilst open lights are permissible in the same place.

It is suggested, therefore, that in Regulation 3 the words "in any mine" should be altered to read "in any ventilating district".

(*b*) Regulation 123 (*c*) restricts the necessity for the use of safety lamps to any " seam ". Regulation 124 requires the use of safety lamps as a precautionary measure in advance galleries " in every mine ".

Regulation 70 (*4*) requires inspections to be made with safety lamps " in any mine ". We may take it therefore that the provisions of Temporary Regulation 3 do apply to a seam where no gas as has ever been found, and where naked lights may be used throughout the seam with the above precautions. Again we are in a position that at the same place " permitted " explosives are required to provide against a danger of ignition, and naked lights may still be used.

It is suggested to overcome this paradox Temporary Regulation 3 should be further amended to read " in any ventilating district in which the use of naked lights is prohibited by any Regulations.....".

Question 29.—I am not in favour of the extended use of " permitted " explosives on the lines in force in British coal mines, as this would prohibit the use of any other explosives entirely except in mines which are not naturally wet throughout.

It is submitted that the Temporary Regulations issued under Notification No. M. 1055 are sufficient safeguard, especially Temporary Regulation 5. If these Regulations are assiduously carried out there should be little danger of a coal dust ignition. At the same time it cannot be denied that " permitted " explosives are safer.

Question 30.—I am in favour of the sirdars examination being so revised as to qualify shot-firers as well as sirdars, and that shot-firers should be required to pass this examination.

Question 31.—It is felt that the Chief Inspector should retain the right under the proviso to Regulation 106, as necessity does arise in shaft sinking and drifting whether through normal strata or through dykes whereby the shot-firer should have under his control more than 5 lbs.

Question 32.—I consider Regulations controlling the issue of explosives to be adequate.

Questions 33, 34 & 35.—Kindly refer to Statements IV and V. attached.

Question 36.—From information gleaned concerning a large number of collieries it is believed that not more than 50 per cent. of coal now standing in pillars can be recovered by existing methods of working other than by stowage.

Question 37.—It is felt that this is a question better answered by the owners who I believe are gathering, and will submit the necessary data.

Question 38.—I am not in a position to give detailed figures, but I estimate that throughout the Jharia and Raniganj coalfields

compulsory stowing either completely or partially as each individual case may require would extend the future life of the coalfields by 75 per cent.

Questions 39 & 40.—It is believed that conditions are so widely varying not only in each mine, but in each part of a mine, that the necessity for stowing either by total extraction of a seam or section of a seam, or during the extraction of pillars already formed in each individual case must be dealt with on its merits. The compilation of a Text Book or Text Books would be necessary to cover all contingencies.

Question 41.—Kindly refer to statements attached. It may be noted that in all cases cost per cubic yard of material stowed as opposed to cost per ton of stowing material or of coal won, is given. Thereby since one cubic yard of stowage after making the necessary allowance for shrinkage will occupy the space of one cubic yard of coal which in turn is the approximate equivalent of one ton of coal, the cost of stowage per ton of coal recovered can be readily calculated from the percentage of coal already extracted, and/or from the percentage area proposed to be stowed.

The cost of stowage per ton of coal won from virgin workings is as per schedule. The answer to question (*b*) depends entirely on the percentage extraction in the first working and the percentage area to be stowed. The basic figure as given in the schedule remains good.

Question 42.—It is felt that this is a commercial question and should be answered by the owners which I learn is being done.

Question 43.—As stated previously it is considered that no statutory authority other than the Mines Department be appointed and that it should function under an amplification of Section 19.

Question 44.—Kindly refer to reply given to *Question 23.*

Question 45.—The saving in costs with a system of stowing are given as below:—

(*a*) Negligible. If a long wall system of extraction with simultaneous stowing is adopted the timber cost for supporting the free side of the stowage will replace the timber used in pillar extraction without stowage.

If a system of partial stowage is adopted, pillar extraction in the normal way will follow and timber costs will therefore show no reduction.

(*b*) The saving on fire stoppings will not be appreciable expressed in cost per ton of coal extracted.

(*c*) It is quite impossible to gauge what saving in pumping charges would accrue as in one of our largest collieries from which two thick seams have been extracted over a very wide area, the pumping costs in the monsoon are comparatively insignificant. At other collieries where

no de-pillaring has been done the pumping charges are excessive.

(*d*) It is unquestionable that the saving in national and individual assets would be enormous, but in actual working costs the saving would be negligible.

(*e*) Saving would be considerable, but except in particular cases would not appreciably lower the cost per ton.

(*f*), (*g*) & (*h*) Negligible.

It is believed that the principal saving would result by rendering available coal which cannot without stowing be otherwise recovered and so extend the life of a colliery thus increasing the number of years during which provision must be made for repayment of capital.

Questions 46, 47 & 48.—It is considered that these are commercial questions and should be answered by the owners.

Question 49.—Reference to the answer given to *Question 6* will show that in my opinion there are many cases where it would be unnecessary to stow in a lower seam lying directly below a fire area or a goaf connected with such a fire area in an upper seam. As an instance of the impossibility of making a Regulation or in fact even a statement covering all cases, extreme conditions may be assumed.

A fire exists in a seam 200 feet from surface.

It is proposed to extract pillars in a 6 feet seam at a depth of 1,600 feet. Can it be seriously contended by any mining man that there is the slightest danger of gases being forced down from the upper seam into the lower?

It is, therefore, contended that every case should be individually examined and the necessity or not determined as to whether stowage is necessary to accompany pillar extraction in the lower seam.

Questions 50 & 51.—It is suggested that these are commercial questions and should be dealt with by the owners.

Question 52.—It is firmly believed that in a large percentage of cases partial filling would be adequate. At one colliery a seam 28 feet thick extremely liable to spontaneous combustion has been extracted at a depth from surface of 600 feet over an area 500 feet × 500 feet. The pillars surrounding this area were strengthened by stowing of galleries with sand to within 6 feet of the roof, with the object of forming efficient resistance to carry the additional weight engendered by pillar extraction within the area, and to provide more readily suitable conditions for enclosing the area should the necessity arise. The function of this barrier has been entirely successful.

Within the same area an experiment has been tried with the object of preventing spontaneous heating or at least increasing the

period of incubation. This experiment has consisted of sand stowing a floor of 4 feet deep around the stook to be extracted, for receiving the broken coal which is lost during pillar extraction. The stook is then removed by normal de-pillaring operations, after which sand is again flushed into and over the coal lost and the fallen shales, so often as any falls occur. A high percentage of water is used to ensure as far as possible that the sand is well flushed in and over the coal and shales, thus forming a complete covering, the object being to exclude air and thus prevent oxidation. So far the section has been working for seventeen months with no sign of fire, whereas in similar areas without stowage heating was found within 12 months of the first fall.

The amount of sand flushed in comes to one cubic yard for 5 cubic yards of coal recovered. The percentage recovery of coal in the pillars has amounted to 80 per cent.

The surface has sunk one foot vertically in a very gradual manner with no defined break. It is probable that further sinking will occur as the area extends, and it may be that the presence of a dyke has reduced the depth of the subsidence.

Finally it is too early to say whether spontaneous heating has thereby been prevented, but it is unquestionable that its occurrence has been delayed.

Two other instances come readily to mind where dry packing of 13 and 14 seams has enabled a large percentage of pillar coal to be won from both seams by stabilising a weak area and preventing override.

Question 53.—It is felt that as this is a financial and commercial question it should be answered by the owners.

Question 54.—As explained in previous questions, especially as answered in *Question 23* it is considered entirely unnecessary for the establishment of any further statutory body, and that such control as is to be exercised should be by the Mines Department and should apply without distinction or discrimination to all the coalfields under his jurisdiction for the reasons as below:—

(i) *Safety.*—Where certain action is necessary to provide against a given danger, if that danger exists in any colliery in any coalfield the necessity for such action can under no circumstances be said to depend on geographical location.

(ii) *Conservation of a National Asset.*—That the coking coals of Jharia and Bokaro possess properties which perhaps render them of peculiar value as a National Asset, it cannot at the same time be denied that the remaining coalfields of India are also a National Asset, and that if coals of the present quality are not to be conserved, a time will arrive when it will be necessary to win other coals of inferior value, and/or coals from greater depth

and/or from more uneconomic geographical locations, all of which must increase the future burden of industry.

Question 55.—As stated in *Question 54* whatever measures are considered necessary for Bihar should apply equally to the remaining coalfields of India.

Question 56.—To give an adequate reply to this question intense legal study is required which it is believed can best be done by the owners.

Question 57.—In principle the working of different seams in the same property by different owners should be strongly discouraged, yet commercial considerations do arise where such practice cannot be avoided, but it is believed that such dangers as do exist can be provided against by the necessity for all workings in a given area in all seams lying no matter at what horizon to be brought under the control of one manager only. The dangers are many and include possibility of inundation, collapse of unstable areas and passage of fire and noxious gases.

Question 58.—It is considered eminently desirable that the Manager of a mine should have independent charge of all outlets, as without this he is not in a position to execute the responsibilities laid upon him by The Act, especially so in case of emergency.

Question 59.—The legal considerations to give an adequate reply to this question are considerable and it is felt this can better be supplied by the owners.

In principle such surveys would have many advantages.

Question 60.—I do consider that all surface buildings, etc., should be shown on the plan of the underground workings.

Question 61.—It is believed that this is essentially a commercial question and should be dealt with by the owners.

Question 62.—It is my belief that the classification of coals under the Coal Grading Act of 1925 has merely functioned as an embodiment of the values set upon such coals by the coal market itself. It is in my opinion quite unjustified to state that an inferior portion of a seam has had to be left on account of the Coal Grading Board's restrictions, as had the Board not been in existence that some inferior section would still have had to be left for the seam to have been sold as of the quality which has been the case under the Classification of the Board.

It is well-known that certain sections of seams could not be worked as a marketable product prior to the formation of the Board, and such instances have of course increased rapidly during the existence of the Board, because of the necessity to work inferior seams containing in many instances a section only of commercial value in the present market.

Further in recent years the practice of analyses of buyers has largely increased, and therefore the classification by the Grading

Board has in such cases only tended to help the producer by restricting him to the required standard to enable him to fulfil buyers' requirements.

Question 63.—I am of the opinion that the necessity for the issue of a greater number of notices and orders issued under Section 19 as compared with the issue of such notices in Great Britain, is due to the greater thickness of seams in this country than at Home. It is believed that where seams are thin (almost without exception) specific Regulations can be and are designed for mitigating a danger which is common to all. Now that the time has arrived when in the majority of cases extraction of coal in the first working has been completed, it is felt that the difficulties and in some cases dangers in the subsequent pillar extraction are individual and must be dealt with individually unless we are to be faced with a series of Regulations which will cover a danger existing in some cases, but where in other cases that danger definitely does not exist or at the worst is of so remote a character as to be no more than a normal mining risk, mining being an occupation which cannot be considered entirely free from danger.

In answer to the last paragraph of the question I would reiterate that in my opinion individual conditions and/or practices dangerous to human life or stability are more frequent in India than in England, and this must engender interference by the Inspectorate under Section 19, and due to the right of appeal embodied in Section 19, it is felt that no undue hardship arises or will arise by the extensive use of the section.

STATEMENT I.

Cost Statement of Stowing at Saltore showing both surface and underground costs.

JULY 1925—AUGUST 1927.

	Cost per cubic yard. As. P.
Surface—	
Running cost	1 5·2
Repairs dragline ropes, etc.	1 1·4
Depreciation at 10 per cent. per annum on Rs. 1,20,000	2 5·4
Interest at 5 per cent. per annum on Rs. 1,20,000 .	1 2·8
Total .	6 2·8
Underground—	
Underground labour stores, etc.	3 5·4
Pumping	2 0
Depreciation and interest on Rs. 65,000 . .	2 0·8
Total .	7 6·2

Total cubic yards stowed—170,036.

	Cost per cubic yards. As. P.
Total cost per cubic yard surface and underground included	13 9
Royalty on sand	0 3
Total	14 0

Cost Statement of Stowing at Saltore.

The Dragline was in operation over the period 10 June 1925 to September 1927 and a cost per cubic yard of sand stowed has been arrived at over a period of 26 months, *i.e.*, July 1925 to August 1927.

Total number of buckets raised during 1926	38,636
Total number of buckets Jan. 1927 to Sep. 1927	29,615
	68,251

Average number of buckets per month 3,250.
Each bucket=2 cubic yards of sand.

We have no records of buckets raised during the period July 1925 to December 1925 but taking an average of 3,250 buckets per month, or say 18,000 buckets over the six months, we arrive at the following figures:—

	Buckets.
Buckets of sand raised—	
July 1925 to December 1925	18,000
Jan. 1926 to December 1926	38,636
Jan. 1927 to August 1927	28,382
Total	85,018

or 170,036 cubic yards.

Revenue Expenditure from July 1925 to August 1927	Rs. 66,139
Stowing cost per cubic yard	As. 6
Capital Expenditure	Rs. 1,85,000

Depreciation at 10 per cent. per annum Rs. 18,500	or Rs. 1,541 per month.
Interest at 5 per cent. per annum Rs. 9,250	or Rs. 770 per month.
	Rs. 2,311

Stowing cost per cubic yard	As. 6-0
Depreciation and interest	As. 5-9*
Pumping Cost	As. 2-0
	As. 13-9

* On 6,500 cubic yards per month if 10,000 then cost will be As. 3-9.

STATEMENT II.

t statement of stowing both surface and underground costs in relation to comparative statement already submitted.

	Mid Loyabad. 11 months' actual period.		Burrouchuck. 4 months' actual period.		Bhulanbarabee. January 1936 to April 1936.		Sendra. 4th December 1935 to 5th May 1935.
	Cost per cubic yard.			Cost per cubic yard.		Cost per cubic yard.	Cost per cubic yard.
	As. P.			As. P.		As. P.	As. P.
Surface.							
ace	3 9			2 8		4 3	3 10
airing Rope	..			..		1 0*	..
reciation at 10 per cent. per annum on . 40,000 for 11 months = Rs. 3,650.	2 0	Depreciation at 10 per cent. per annum on Rs. 1,612-8-0.		0 1·8	Depreciation at 2½ per cent. per annum on Rs. 2 lacs for 4 months = Rs. 1,666-10-0.	0 8	Depreciation and Interest *nil* as material used up.
est at 5 per cent. per annum on . 40,000 for 11 months = Rs. 1,825.	1 0	Interest at 5 per cent. per annum on Rs. 1,612-8-0.		0 0·6	Interest at 5 per cent. per annum on Rs. 2 lacs. for 4 months = Rs. 3,333-4-0.	1 4	..
	..			..		..	..
Total .	6 9			2 9·9		7 3	3 10
Underground.							
rground labour, stores . . .	1 3·5			0 2·8		1 4·8	2 9
ping	1 3			1 9		2 6·4	1 0
eciation and Interest . . .	1 10·5			0 6·4		1 1	0 1
Total .	4 5			2 6·2		5 0·2	3 10
Cubic Yards stowed . . .	28,578 Cub. Yds.			7,147 Cub. Yds.		38,835 Cub. Yds.	38,518 Cub. Yds.
Cost per Cubic Yard Surface and derground Included.	11 2			5 4·1		12 3·2	6 10
LTY ON SAND	..			..		0 3	..
Total .	..			..		12 6·2	..

* This item is probably higher than average would be.

Comparative cost

Total Expenditure.	MID-LOYABAD (*a*). 11 months' actual period.	
	Rs. A. P.	Cost per cubic yard. As. P.
Estimate . . . . . No. 35/34	93,015 0 0	..
Spent up to April 1936	64,030 4 8	..
Depreciation at 10 per cent. per annum	6,403 0 7	..
Revenue Expenditure.		
Earth work	3,520 7 6	..
Stone work	126 2 6	..
Staff salaries	939 9 9	..
Sundry labour	1,924 14 0	..
Workshop Jobs	450 14 0	..
Stores	1,171 5 1	..
Electric Power	871 5 1	..
Reserve for Rope	..	..
TOTAL .	9,004 9 11	5 0·5
Pumping	..	1 3
Depreciation at 10 per cent. per annum 11 months	5,869 8 0	3 3
Interest at 5 per cent. per annum 11 months	2,934 12 0	1 7·5
Total cubic yards stowed (one tub =1 cubic yard)	28,573 cubic yards.	
TOTAL COST PER CUBIC YARDS .	..	11 2

(*a*) Present temporary arrangements for pumping at No. 4 pit cost during April 1936 As. 2 per cubic yard and during May 1936 As. 4 per cubic yard.

Material for crushing and stowing is being obtained from the strata overlying 15 seam in No. 2. Quarry Material is loaded into 27 cubic feet tube in the quarry and raised by means of a 45 H. P. Electric Haulage to the bandhead where it is dumped into the Gyratory Crusher. This Crusher produced a large percentage of oversized material above 2" in size and to reduce this a subsidiary crusher has been installed into which the Gyratory discharges. Water taken from a 55,000 gallons tank on the surface is led to the mixing chamber. When the bunker is full of water valve is opened and allowed to run for 2 to 3 minutes to flush the pipes after which the material valve is opened and material allowed to run. The mixture runs in 15 seam through 6" pipes to No. 6 Pit where the pipes are taken vertically down to the shaft in 14 seam and from the shaft bottom the pipes extend 2,800 feet to the point where the galleries are being stowed. At this point a gang of men have to be retained for building the necessary stoppings for retaining the stowing in the required area and also see the discharge end of the pipe does not become clogged.

Under existing conditions it requires 25 to 27,000 gallons of water per hour to carry the material without the pipes jamming. The water is obtained from the dips of No. 4 Pit to 12 seam where a 35 H. P. Turbo is installed pumping to a mid standage from where a 115 H. P. Turbo delivers the water to the surface. On the surface a third pump of 17 H. P. delivers the water from No. 4 Pit to the stowing tank.

MENT III.

statement of stowing.

Budroochuck (*b*).			Bhulanbararee (*c*).			Sendra No. 10 Incline (*d*).		
4 months, actual period.			January 1936 to April 1936.			4th December 1935 to 5th November 1936.		
	Rs. A. P.	Cost per cubic yard. As. P.		Rs. A. P.	Cost per cubic yard. As. P.		Rs. A. P.	Cost per cubic yrad. As. P.
No. 22/35.	6,756 2 0	..		..	..	No. 25.	13,952 0 0	..
	6,551 7 9	..		..	..		13,952 13 9	..
	655 2 6	..		..	..		..	..
	..	..		..	..		..	..
	1,007 14 0	2 7		4,449 13 6	1 10		..	..
	..			..	..		..	..
	172 8 0			2,427 5 8	1 0		10,042 15 9	4 2
	..	..		..	..		..	..
	142 10 0	9 3·8		7,332 4 8	3 0		3,909 14 0	1 7
	..	..		..	..		..	..
	..	..		2,000 0 0	0 9·8		..	..
	1,323 0 0	2 10·8		16,209 7 10	6 7·8		13,952 13 9	5 9
	800 0 0	1 9		6,158 5 0	2 6·4		2,407 6 0	1 0
	218 6 3 (4 months)	0 5·8 (4 months)		2,500 0 0	1 0·3		*Nil*	..
	109 3 0 (4 months)	0 2·5 (4 months)		5,000 0 0	2 0·7		290 10 0	0 1
	7,147 cubic yards.			38,835 cubic yards. (Stowed underground.)			38,518 cubic yards.	
	..	5 4·1		..	12 3·2		..	6 10

(*b*) The material used for stowing is ash, a large amount of which is available on the surface. The ash is loaded into tubs and trammed to No. 2 Pit top. Tubs are tipped here and ash loaded into the bunker on pit top. Over the bunker is a 2" mesh screen to stop over-size material going down. The ash is flushed down by means of a hose pipe, proportion of water to ash is 4 to 1. The ash and water are conveyed through pipes up to the point of stowing. After completion, the water is conducted down to a sump in the mine and pumped back to the surface.

(*c*) 2½ per cent. per annum Depreciation.

5 per cent. per annum Interest on Rs. 3 lacs capital.

The sand is brought over by Ropeway from riverside to site. The rate per tub is 9 pies.

Depreciation of 2½ per cent. is allowed as ropes and other movable parts are placed against revenue.

(*d*) Stowing material has obtained from old tramway embankment of 10-11 Inclines. This was loaded into side tipping tubs, trammed, then flushed into a 1,000 feet long trough line. Debris was also obtained from subsoil near 6 pit and from old No. 9/15 Inc. embankment. Water for flushing was obtained from 6 pit 12 seam shaft bottom Turbo pump, for the entrance to 10 Incline and at 6 Pit 14 seam inset. This water had again to be pumped up at a greater head to No. 2 Pit which is 600 feet deep. Galleries were hand packed by labour with hydraulic stowing debris which of course meant double work on account of the area being level the trough line could not be taken in.

STATEMENT IV.

Standard Colliery.—The full output is got from depillaring operations without stowing of which 83 per cent. is recovered from individual pillars.

Bhulanbararee.—42·8 per cent. of the output is obtained from depillaring with sand stowing and 80 per cent. recovered.

Sendra Colliery.—Output from depillaring without stowing 15·2 per cent. with 90 per cent. recovery.

Saltore Colliery.—Output from depillaring area 65 per cent. without stowing of which 90 per cent. is recovered.

Bhagaband Colliery—
Churulia Colliery—
Bankola Colliery—
Sirka Colliery—
} 100 per cent. from galleries.

Loyabad Colliery.—Depillaring is going on with stowing practically the whole of the coal is being extracted. Depillaring is only started and proportion of output coming from pillars cannot be ascertained now.

Mudidih Colliery.—85 per cent. of total output is coming from pillars. About 80 per cent. of this coal is being recovered. Loss in 12 and 15 seams is negligible.

Katras Colliery.—50 per cent. of the total output is coming from pillars. About 96 per cent. of this coal is being recovered.

Budroochuck Colliery—
Teetulmuri Colliery—
Choitodih Colliery—
} 100 per cent. from galleries.

It is estimated that about 60 million tons out of 120 millions can be recovered with existing method of working, *i.e.*, 50 per cent. of the coal standing in pillars.

STATEMENT V.

BURRAKUR COAL CO., LTD.

Statement referred to in Questions.

Name of Colliery.	No. of Seams.	Grade (Quality).	Full thickness of Seam.	Thickness being worked at present.	Inclination.	REMARKS.
			Ft. Ins.	Ft. Ins.		
bad Colliery	16 Top	Not yet Graded.	5 0	5 0	1 in 5	
	16 Bottom		5 0	5 0	1 in 5	
	15 Seam Top and Bottom (North and Mid Area.)	Grade I	17 0	One section Graded portion.	1 in 4 to 1 in 8	8'-8" of the top section and full thickness 6'-8" of bottom section is Grade I (one section of this is being worked at present).
	15 Seam, Top and Bottom (9 and 10 Pits Area.)	Selected	19 6	9 6	1 in 9 to 1 in 6.	
	14 Seam	Do.	27 0	10 0 to 14 0	1 in 2·5 to 1 in 9	Full section is being taken during depillaring operations.
	13 Seam	Do.	22 0	9 0	1 in 2·5 to 1 in 6	6'-6" from floor is Selected. (This seam is jhama at Nos. 9 and 10 Pits area.)
	12 Seam	Do.	13 0	6 6	1 in 4·25 to 1 in 9	Top 6'-6" is inferior coal.
ldih Colliery	15 Top	..	6 0 to 8 0	Full thickness.	1 in 4·5	Top 7'-10" and Bottom 9'-6" is Grade I. Full thickness is being worked.
	15 Bottom	..	9 0 to 9 6		1 in 4·5	
	14 Seam	Selected	26 0	16 0	1 in 5	At North Mudidih 22' Selected leaving 4' in floor and full section at South Mudidih. Full thickness is being taken during depillaring.
	13 Seam	Do.	16 0	9 0	1 in 5	Ditto Ditto.
	12 Seam	Do.	13 1	7 1	1 in 5 to 1 in 7	Top 6' is inferior coal and not being worked (Bottom 7'-4" Selected.)
	11 Seam	Not Graded	13 0	7 0	1 in 5 to 1 in 7	Top 6' is inferior coal and not being worked (Bottom 7'4" Selected). These seams are not being worked at present. In 10 Seam nearly full thickness was worked in the past.
	10 Seam	Do.	20 4	...	1 in 5 to 1 in 7	

Statement referred to in Questions—contd.

ne of Colliery.	No. of Seams.	Grade (Quality).	Full thickness of Seam.	Thickness being worked at present.	Inclination.	Remarks
			Ft. Ins.	Ft. Ins.		
uck Colliery .	15 Top Seam . .	Selected .	7 0	7 0	1 in 5·0	
	15 Bottom Seam . .	Do. .	9 6	9 6	1 in 5·0	
	14 Seam . . .	Do. .	26 0	11 0	1 in 5·0	22′ Selected leaving 4′ in floor.
	13 Seam . . .	Do. .	12 5	7 0	1 in 5·0	7′ from floor is selected.
	12 Seam . . .	Do. .	14 0	8 0	1 in 7	Top 6′ is inferior coal.
	11 and 10 Seams are virgin in this property.					
	16 Top . . .	Not Graded	5 0	5 0	1 in 8·75	This seam will not be worked any more in this Colliery.
	16 Bottom . . .	Do. .	10 0	10 0		
olliery . .	15-A Seam . . .	Not Graded	4 6	..	1 in 5	This seam is not being worked at present.
	15 Top . . .	Grade I .	8 0	8 0	1 in 6·75	
	15 Bottom . . .	Do. .	7 9	7 9	1 in 6·75	
	14 Seam . . .	Do. .	19 0 to 21 0	Full Thickness.	1 in 7	Section of 8′-4″ leaving 1′-0″ in roof and 9′-8″ in floor. One section where the coal is inferior quality is being worked full thickness.
	13 Seam . . .	Do. .	10 0	10 0	1 in 7	
	12 Seam . . .	Do. .	6 0	6 0	1 in 7	
	11 Seam . . .	Selected .	8 0	8 0	1 in 9	
h Colliery . .	15 Top . . .	Exhausted	..	..	..	Colliery is not being worked at present.
	15 Bottom . . .	Not being worked at present.	..	..	..	
	14 Seam . . .	Not Graded	18 0	18 0	1 in 7	
	13 Seam . . .	Grade I .	9 0	9 0	1 in 7	
	12 Seam . . .	Do. .	6 0	6 0	1 in 7	
urt Colliery .	15 Top . . .	Not Graded	6 0	..	..	Colliery is not being worked at present.
	15 Bottom . . .	Do. .	6 0	..	..	
	14 Seam . . .	Do. .	22 0	..	..	
	13 Seam . . .	Do. .	15 6	..	..	
	12 Seam . . .	Do. .	7 0	..	..	
	11 Seam . . .	Do. .	13 0	..	..	
	10 Seam . . .	Do. .	20 4	..	..	

Statement referred to in Questions—contd.

Colliery.	Seam.	Graded.	Full thickness of Seam.	Present thickness of Seam worked (Selected).	Inclination.	Remarks.
			Ft. Ins.	Ft. Ins.		
ıdard Colliery—						
'haria-Khas Section) .	..	Selected .	26 0	Full thickness.	1 in 10	The entire output from depillaring of which 83 per cent. is being recovered.
Ditto .	14-A	Do. .	6 0	Do.	1 in 10	The full section of the seam is being depillared.
Ditto .	14	Do. .	12 0 to 26 0	Do.	1 in 10.	
Ditto .	12	Not graded	12 0	Not worked	1 in 10.	
enahir Section) . .	15	Selected .	24 0	Full thickness.	1 in 10.	
Ditto . .	14-A	Do.	7 0	Do.	1 in 10.	
Ditto . .	14	Do. .	26 0	Do.	1 in 10.	
Ditto . .	12	Not graded.	12 0	Do.	1 in 10	Not working.
anbararee . .	16	Not graded	10 0	10 0	1 in 10	Not working. (Output from galleries 57·2 per cent. Output from pillar extraction 42·8 per cent.)
	15	Selected .	28 0	25 6	1 in 10	A Section of 25'-6" is being worked, leaving 2'-6" in roof.
	14	Do. .	28 0	28 0	1 in 10	The full section is being worked.
	13-B	Do. .	15 0	9 2	1 in 10	A section of 9'-2" is being worked leaving coal in roof and floor, inferior quality.
	11, 12 & 13	Do. .	50 6	18 7	1 in 10	Bottom section 6'-3" and top 12'-4" is being worked, the remaining portion is inferior.

Statement referred to in Questions—concld.

Colliery.	Seam.	Graded.	Full thickness of Seam.	Present thickness of Seam worked (Selected).	Inclination.	Remarks.
			Ft. Ins.	Ft. Ins.		
.....	....	..	..	..	..	The full output being worked from galleries.
	16	Selected .	14 0	9 10	1 in 8	A section of 10' is being worked leaving 1'-10" in roof and 2'-4" in floor, inferior quality.
	15	Do. .	22 0	20 0	1 in 8	A section of 20' is being worked leaving 2'-5" in roof, inferior quality.
	15	Grade I .	16 0	13 0	1 in 2·6	15·2 per cent. of output from pillar extraction and 84·8 per cent. of output from galleries.
	14	Do. .	26 0	26 0	1 in 2·6	Full section worked in galleries.
	13	Do. .	18 0	14 0	1 in 2·6	A section of 14' worked from floor leaving 4' inferior coal in roof.
	12	Do. .	18 0	6 0	1 in 2	A section of 6' worked from floor leaving 7' inferior coal in roof.
, . .	Churulia Seam.	Not graded	34 0	12 0	1 in 8·5	Entire output from galleries.
. . .	Dishergarh.	Selected .	16 0	16 0	1 in 5	Output from galleries 35 per cent. and output from pillar extraction 65 per cent.
. . . .	Bankola Seam.	Not graded	23 0	8 0	1 in 18	Entire output from galleries.
. . . .	Argada Seam.	Grade I .	80 0	8 0	1 in 2·5	Entire output from galleries.
	Sirka Top Seam.	Selected .	30 0	9 3	1 in 2·5	Selected 9'-3".
	Sirka Bottom Seam.	Do. .	20 0	10 0	1 in 2·5	Selected 14'-0".

Oral Evidence of Mr. R. Fenwick,* of Messrs. Bird & Co., Sijua.

Question 1.—I have 29 years' experience altogether of coal mining in India, of which 10 years were spent in the Central Provinces (Pench Valley) and the remainder in the Raniganj and Jharia fields.

Question 6.—I agree that the Temporary and Supplementary Regulations, and the temporary legislation of 1936 may be made permanent. As regards Temporary Regulation No. 10 referred to in my written answer, I think that the Regulation itself is sound, but the Chief Inspector should have power to vary it under special local conditions in much the same manner as he can under Regulation 9; also there should be an appeal from any refusal on the part of the Chief Inspector to allow such variation.

Question 7.—I prefer mechanical ventilation in dealing with fires because natural ventilation does vary considerably within 24 hours and at different seasons of the year. This means there is no control over it and controlled ventilation is essential in dealing with fires. Even if the fire is sealed off, there is always the possibility of leakages and there is always that danger of stopping being blown out by a fall of roof inside the sealed-off area.

Question 9.—I would be in favour of the use of water mains and appliances for readily dealing with the early stages of fires, existing delivery mains in many cases could be made use of with suitable connections for running off branch pipes or hoses.

In some cases where water is not readily available it would be a hardship to enforce such.

Question 10.—I would be in favour of telephonic communications being required by law or regulation in such cases as the Chief Inspector of Mines considered them to be necessary.

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* Mr. S. F. Tarlton accepts the oral evidence of Mr. Fenwick with the following remarks under *Question 43*:—

"Mr. Fenwick and I have discussed this matter further and he feels that his recorded evidence does not wholly convey the sense of the proposals.

We feel that all matters dealing with conservation as well as safety should primarily be settled between the Mines Inspectorate and the Management, at the instance of the Inspectorate, and that failing agreement the matter should be referred to the statutory authority.

The authority should be responsible for seeing that the proposals be executed in such manner that the disbursements it authorises should be well and truly spent, that cesses be collected and should generally act in an administrative capacity other than functioning as an appellate authority.

I myself still feel that much duplication would be avoided were the Mines Department to carry out all the functions of conservation (which is closely allied to safety) and that the statutory authority be constituted only as a Court of Appeal."

Question 15.—My answer amounts to this that safety lamps should be required by law or regulation in every mine in order to prevent serious results from accidental fires such as are referred to in my answer to *Question 9.*

Question 16.—My answer to this question was submitted before the Poidih disaster. I know of no method other than that of sand-stowing for preventing inflammable gases collecting in the goaf cavity of a thick seam in which large quantities of inflammable gas are given off. I would not go so far as to say that the introduction of electric safety lamps is an adequate safeguard against danger when gas is expelled from a goaf. I know of a case in a mine in England where an explosion occurred when no person was underground in the mine and there was no underground fire in that mine. It is believed that this explosion was caused by sparks from the stone falling from the roof and igniting the gas. In my opinion, therefore, the only way of dealing with this danger to give maximum degree of safety is by sand-stowing to prevent goaf cavities and the accumulation of gas in the goaf and also to get the highest possible extraction of the coal in pillars. The explosion at West Stanley colliery in England in 1908-1909 was believed to have been due to sparks resulting from haulage ropes rubbing on spindles of pulleys and or tubs rubbing on the guide skirting rails at a high speed igniting the inflammable gas.

I am not in favour of miner's electric lamps—

(i) on the grounds of cost,

(ii) their use leaves the miner ignorant of the kind of atmosphere in which he is working, for certain intervals between inspections, which may be of a few hours,

(iii) such allows an official to keep a miner working where there is gas,

(iv) a good type of flame safety lamps if properly used and kept in repair provides the safety required.

Question 19.—I approve of general principles of first working being laid down by regulation with a proviso that the Chief Inspector would be able to vary those principles under special circumstances or to suit local conditions, and provided also there was an appeal from such orders of the Chief Inspector. I think the basis of such general principles might with advantage be percentage of floor area *plus* a maximum height of galleries, the percentage of floor area to vary with the depth and thickness of the seam. I agree that the penalty for the infringement of any such first principles should be adequate and immediately enforceable. I think that an adequate penalty would be to require any infringement to be restored securely to the limits required by the general principles, all working in that section of the mine being prohibited meanwhile.

Question 21.—I would agree to "immediately before the systematic extraction of pillars" being defined as two pillars lengths ahead of the pillar that is actually being extracted or the point at which pillar extraction is about to begin.

Question 24.—I agree to the proposal in this question, but think that the power should rest with the Mines Department and not with any separate statutory authority. I think that the Mines Department alone should be responsible for all measures required in the interests of safety.

Question 30.—I am in favour of all shot-firers being required to have a sirdar's certificate specially endorsed both for gas testing and shot-firing.

Questions 33, 34 & 35.—All the seams shown in the Statement V as "not graded" are not worked now.

Question 43.—I think that it would be difficult in many cases to distinguish between measures required for safety and those required for conservation, but I agree that the control of conservation generally would have to be vested in a statutory authority separate from the Mines Department though the Mines Department should be represented on that authority. The statutory authority contemplated must have an independent Chairman and, of the possible alternatives, I would prefer a Government official of standing as Chairman. As regards the other members, I would consider suitable a panel of mining engineers actually working in the coalfields from whom the requisite number would be selected by the Chairman for each meeting. I would be in favour of such a statutory authority being the appellate authority from the orders of the Mines Department under section 19, and I think also that the statutory authority could do all the work which is now done by mining boards and courts of enquiry.

Questions 46 & 47.—After discussion with the Committee, I agree that the answer to both these questions should be in the affirmative from the standpoint of a mining engineer.

Question 49.—I would not object to a regulation laying down the requirements contemplated in the question provided the Chief Inspector had the power to vary that regulation in special cases.

Question 62.—I agree that the effect of grading coal sold internally has been to increase avoidable waste and dangers from fire. I think, however, that if market conditions improve the grading will tend to disappear automatically. I would not interfere with grading for purely export coal.

Question 63.—I would not object to regulations which covered the large majority of cases that arise provided those regulations were not hard and fast and allowed for variations under special circumstances to suit local conditions, and also provided there was a power of appeal.

39. Written Evidence of Mr. J. E. Phelps, Colliery Superintendent, East Indian Coal Co., Ltd.

Question 1.—Colliery Superintendent. 24 years in the Jharia coalfield, holding positions of Assistant Manager, Manager, Personal Assistant to the General Manager, and for the past 8 years Colliery Superintendent to Messrs. The East Indian Coal Co., Ltd. Have had close experience of pit fires for the past 18 years.

Question 2.—The basic cause of spontaneous underground fires in coal mines is the development of heat resulting from the oxidation of the carbon constituents of the coal—probably the ulmins. The propensity to spontaneous heating varies with different coal (largely according to the coal rank) and the chemical cause may perhaps only be eventually combated by the use of inhibitors. Scientific research, however, has not yet advanced far enough to help practical mining. The more practical aspect of the problem is resident in the physical conditions. The physical conditions necessary in the mine are:—

I. A gentle supply of air.

II. An accumulation of finely comminuted coal of type chemically satisfactory for heating.

III. Satisfactory heat insulation to permit of the heat as generated accumulating to the ignition point of coal or of any timber that may be lying contiguous thereto.

These physical conditions are generally available in de-pillared goaves and in collapsed areas of our mines. The number of fires have increased in recent years. There are more fires in normally collapsed areas—there are more of such areas—than in premature collapsed areas.

Question 3.—As far as my knowledge goes the seams that have fired in the Jharia coalfield are Nos. 10 and 11 (combined), 11 and 12 (combined), and 13 and 14 seams chiefly when the latter two are lying close together, *i.e.*, 10 and 11 combined (Sowardih thick seam), 11 and 12 combined (Khora Ramji) 13 and 14 (Kendwadih, East Indian Coal Co., Sendra and Mudidih). Also No. 15 seam.

I have not known Nos. 10, 11, 12 or 13 to fire when well separated by intervening strata. Nos. 14-A, 16, 17 and 18 have not fired as far as my knowledge goes, nor have any of the less exploited seams below No. 10. It will be noted that such seams or combinations that fire spontaneously are thick seams. It is well-known in English mining that seams of 4 feet and under do not fire, and it is probable that the less thick seams of Jharia are unlikely to fire. My view, however, is that no seam of value in the Jharia field except those of thickness below 6 feet may be considered as free from the risk of spontaneous combustion. The incubation period for gob fires at the Bararee Colliery is roughly nine to twelve months from the time of the first big fall.

Question 4.—Underground fires definitely do increase the difficulties of extracting the remaining coal.

With regard to the question of safety to labour, I wish to put forward the following point of view:—

Undoubtedly spontaneous fire underground is a threat to safety; I consider, however, that recently this threat to safety has been over-emphasised and that legislation may become a little out of focus. There are other causes of accidents underground that take a very much greater toll of human life and limb, and a due balance must be struck to assure that legislation designed to reduce one cause of accident does not increase the risk in another cause of accident.

Taking the period of the past 29 years from 1906 to 1934, I find that the total number of deaths underground from causes arising from fire stoppings averages to less than $1\frac{1}{4}$ person per annum of the total for that period, and 90 per cent. occurred in Assam.

If the total arising out of all causes from pit (spontaneous combustion) fires be taken the average would be less than $2\frac{1}{4}$ deaths per annum, and out of this total Assam accounts for slightly less than one-half, so that within the coalfields of enquiry of the Committee the average death rate for the period of the past 29 years is about one per annum for fatalities underground arising out of spontaneous combustion. For information it may be mentioned, inclusive of Assam, that during the first seven years of that period the deaths arising from spontaneous combustion amounted to nearly 6 per annum, and for the subsequent years—from 1913 to 1934 inclusive—an average of slightly over one. Excluding Assam these latter percentages are 2 against 6 and less than 1 against 1.

If it be agreed that Loyabad fire was initiated by spontaneous combustion, including Bagdigi but deducting Assam's figure, the average for 29 years would be less than three deaths per annum. Without Loyabad, less than two.

Bagdigi and Loyabad have brought up the figure of annual average, but the Temporary Regulation 10 prevents a reoccurrence of the Bagdigi accident and the Loyabad type of accident can be guarded against.

Excepting the unfortunate experiences of Bagdigi and Loyabad, and in earlier days of Kendwadih, accidents from spontaneous fires underground are relatively few. As to the likelihood of these increasing I would point out that experience and knowledge are rapidly increasing and that by reason thereof the hazards are being better recognised and guarded against.

Question 5.—Unless the voids are stowed I am in favour of laying seams out in panels.

The percentages of the seams likely to be left in the panel barriers cannot be assessed in exact figures, and depends upon the following factors:—

I. Size of panels which depends on—
   (*a*) Incubation period.
   (*b*) Speed of extraction.
   (*c*) The use or otherwise of false barriers within the panel.

II. Depth from surface which will influence the width of the barrier required.

III. Coal may be taken off the panel barrier when working.

IV. It is conceivable that the panel barrier may be removed, *i.e.*, perhaps one of the four sides.

However, taking two panels as measured off our plan (Bararee Colliery No. 15 seam) the projection if completely followed would give the following results:—

	In projected panel barriers. Per cent.
Panel with pillars of—	
65 feet centres	30
95 feet centres	25

Temporary Coal Mines Regulations.

Question 6.—Section 4 (1).—The top small bonnet which is lifted by the rope capel and which must be made of material easily broken, *i.e.*, wood to permit of ready access of the detaching hook to the detaching hook plate, must be excepted in the proviso.

Section 4 (2).—I regard airbridges as especially dangerous situations in respect to seams liable to spontaneous combustion in mechanically ventilated mines, and this is the view of experienced mining engineers at home. I would therefore suggest that the reference to Airbridges in this section should be tightened up to prevent as far as possible the leakage of air from the intake through coal to the return side. Airbridges are placed where two currents of air at different pressures are in close proximity and the chances of air leakage are great. Such air leakage often produces conditions suited to spontaneous combustion.

Section 6.—I suggest the word "boiler" be deleted. I have known ashes from the fires of a grog shop stills, etc., being thrown into a goaf. Such ashes may be arguable as not "boiler" ashes and therefore not covered by this section.

Section 9 (1).—This might be deleted. Section 9 (2) appears stronger and covers 9 (1).

A definition of the word "river" might be advisable.

Section 10.—This is acceptable for nearby seams, but with thin or moderately thin seams separated from the seams above, as may easily be, by a considerable thickness of strata some easement of this section should be permissible. An instance to illustrate this is described in the last paragraph of page 78 of the Report of the Second Subsidence Committee—see Plate 10. This describes how little was the disturbance of a seam of 12 feet by de-pillaring a seam of 7 feet lying 157 feet below. The upper seam certainly had not been worked but the evidence is available of the very little disturbance on the horizon of that seam by the de-pillaring of 7 feet of coal at 157 feet below. Had there been fire in the upper seam it definitely would not have affected the lower seam workings in this instance.

Section 15 (b).—I would make this more specific with regard to the surface. As it stands, stoppings may be considered as adequate to prevent passage of air from the mine. With an open surface it would be exceedingly difficult—in my opinion impossible —to provide "adequate" precautions. Further, passage of air through the goaf into the mine is just as much to be avoided. I therefore consider that in future it should be obligatory to Managers to effectively close all breaks and cracks on the surface caused by mining operations.

I would make this obligatory to all mines in coalfields where fires have been known, as otherwise conditions satisfactory to fires are provided.

Section 16.—I find nothing in the Regulations which makes it compulsory to inspect stoppings. All fire or preventive stoppings should be regularly inspected whether within the working area of the colliery or not, "shall be made with a locked safety lamp". My experience—extending over many years and of many stoppings —is that the first essential, in the interest of the safety of the mines and of the labour employed therein, is adequate lighting for the proper inspection of fire, or—preventive,—stoppings.

A flame safety lamp, even the combustion tube type does not give adequate lighting, neither does the three cells permitted electric torch, for tall stoppings.

I have never experienced inflammable gas coming off from fire stoppings and there has never been a case of fatal accident in the Jharia field from such. In 40 years there has only been 3 such accidents from ignition in India of inflammable gas from stoppings and these all occurred in Assam, and by reason of stoppings not having been kept in repairs. There has been no such accident for the past 10 years.

I have, however, seen fire come round the edges of otherwise intact stoppings, and the outbreak of fire into mines from old fire areas are probably chiefly brought about in this manner—and this resulting from stopping leakage.

The obligation to use only safety lamps in non-gassy mines robs the manager of the effective candle test for leaky stoppings,

and further has robbed him of the open name convenient means of black damp test by substituting the inconvenient safety lamp. It has robbed him of the main need, light.

It is my opinion that for non-gassy mines the possibilities of safety advantages resulting from the use of safety lamps for fire stopping inspection is so remote, as to be entirely outbalanced by the hazards to safety set up by their use which prevents the proper inspection of stoppings. With deference to other opinions, however, I willingly concur with the use of safety lamps for these inspections provided the Chief Inspector of Mines will permit the use of the ordinary 5 cells electric torch of approved make. The ordinary 5 cells torch is just as safe in our mines as the American approved type, and there should be no objection in the interest of safety to the 5 cells torch for fire stopping inspection.

The point is that only with adequate light can preventable leakage be guarded against, such as is required by 15-A, and such adequate light is debarred for use by section 16.

Schedule 1.—I suggest that the sign for Fire dams or Seals be altered to be a thick bar equal in width to the space between the two lines representing the ordinary stoppings. Such a thick bar is more convenient and more distinctive than the present sign given in the schedule. It may be pointed out that the width of galleries shewn on the ordinary plans of the mines is considerably less than as shewn on the schedule.

Supplementary Temporary Regulations.

Section 3.—In such mines where the use of safety lamps is required only for the inspection of stopping (16b) the compulsory use of permitted explosives should be absolved. The position is unduly harsh where the situation is that naked lights are permissible in the workings and permitted explosive compulsory in the same place.

Section 5.—In a non-gassy mine and in view of 4 (2) this section is unnecessarily vexatious, in that it interferes with the effective use of non-permitted explosives in machine cut places.

This Temporary Regulation probably originated out of the Giridih accident, which is the only accident from point of view of explosions in these coalfields that could be instanced in support of such a regulation. The explosive then used in Giridih is one which for a number of years has been known to be highly dangerous for use in mines and the use of which should not have been condoned in the mines at Giridih. Its use now is debarred by section 2.

Section 6.—The latter part of this Temporary Regulation should be deleted. It is not in common with Home practice where the occurrence of inflammable gas in gassy mines is far more extensive and serious than in Indian mines.

Further it contains this element of danger that the pit definition of dangerous quantity may be stretched to await the week-end for clearing, and so avoid withdrawal of output-getting labour, or the regulation may be ignored altogether and thus more honoured in the breach; it even might result in the suppression of reports of gas.

Question 7.—It is my belief that there would have been more fires in the Jharia field than now exist had it not been, almost without exception, the practice to ventilate the mines by natural ventilation.

I consider that fan ventilation, compared with natural ventilation, sets up conditions in the mines definitely conducive to conditions favourable to the initiation of spontaneous heating and consequently of fire.

The first physical requisite to the initiation of spontaneous heating of coal is a gentle supply of air. It is leakage that best supplies such gentle movement of air.

At the Bararee colliery we have barometrical records which prove that the atmospheric pressure of the atmosphere within a sealed area underground is closely the same, and that without perceptible time lag, as that of the outer atmosphere then prevailing in the mine. This shews that hermetical sealing—which is the ideal—is impossible. The strata are too porous, so are the stoppings.

We have proved by recording watergauge charts that the atmosphere within a sealed area is delicately sensitive to the slightest air pressure changes outside the area. Charts shew that the passage of tubs, the concussion set up by falls in depillaring areas (up to the extent of workings in this area amounting to 1,500 feet away) greatly affected the watergauge of the sealed area. The charts shew that high winds and storm conditions (*i.e.*, barometric jumpiness) quite considerably affects the watergauge pressure. Any surface subsidence, such as sometimes happens in an already subsided area generally in the monsoon, particularly when such opens the area to the surface atmosphere, very largely affects a sealed area—in one case to so much as 0·63 inch of watergauge.

The above is intended to shew that the density of the atmosphere within a sealed off goaf is very delicately balanced with the outside and these facts will be just as true to an unsealed goaf.

These charts—barometer and watergauge—were shewn and explained to the Coal Mining Committee during the visit to the Bararee colliery on the 4th December 1936.

Mechanical ventilation is effected by mechanically producing a difference in air pressures, either positive or negative, to that of atmospheric. I have shewn that proof is available that sealed off areas are most susceptible to air leakage (it may be remarked in passing that leakage does not comply with the square law, and consequently is easier of passage). The slightest difference in pressure is immediately reflected on the inside and mechanical

ventilation is likely to enhance that difference. Leakage, which is the feed of air, therefore is likely to be, and perhaps considerably, greater with fan ventilation to a sealed or unsealed area, and the danger of fire and from fires correspondingly more. It is my firm opinion that a recent fire in the Jharia field which so unfortunately resulted in the loss of valuable lives was due to spontaneous combustion caused by leakage of air through coal, such leakage being set up by differences in air pressure resulting from mechanical ventilation. The situation of origin of the fire was one such as is known to be specially liable to fire by spontaneous combustion, so much so, that an eminent mining engineer at home has as one of his fire precautions, the avoidance, as far as possible, of air crossings, and another mining engineer in an endeavour to keep the danger of fire as far as possible from working faces will not have an air crossing within 500 yards thereof, if such can possibly be avoided.

There are undoubted advantages with mechanical ventilation and particularly in emergencies. I would therefore quite agree, where there are sealed off fires, to the statutory requirement of the installation of mechanical means for producing ventilation to be kept constantly available for use, providing it is optional to the management whether such would be kept in constant use or not. Watergauge readings on stoppings shew some sealed areas to be positive and some negative—those nearer the crop seem mostly to be negative, so that the question of forcing or exhausting cannot be specifically answered.

My objection to compulsory mechanical ventilation is not based on the reason of cost, but arises from my strong conviction that natural ventilation is the best form of ventilation for non-gassy mines in this country liable to fire. The conditions conducive to fire are less likely with natural ventilation, and prevention, or a measure of prevention, is better than cure.

In support of the lesson to be drawn from Bararee fire area barometer and watergauge charts, I may mention that the Safety in Mines Research Board Report of 1929 says that " the influence of the movement in D. C. and U. C. shafts, opening of separation doors, movement of tubs, upon pressure (air) variation in the ventilation current has been proved ".

Also the Safety in Mines Research Board Report of 1932 says that " records from S. Derbyshire shew that sealed-off areas may be subject to air pressure impulses synchronising with movement of cages . . . . it may be enough to set up heating in crushed wastes ".

Respecting the latter part of this question my answer is framed from the point of view of " air balancing " at stoppings. If the question is meant in its more general form, I do not think it matters whether the fan be exhausting or forcing. This should be left entirely to the discretion of the management. My view is that

Regulation 121 requiring that an " adequate amount of ventilation shall be constantly produced ", etc., is sufficiently strong.

Question 8.—My answer to the first part of this question is in the affirmative. To the latter part, my knowledge of one probable occurrence is only hearsay, and therefore not evidence. I have had no experience of such in the mines under my control.

Question 9.—This question may be dealt with under two heads, *viz.*, fires by spontaneous combustion, fires by other causes.

Fires by spontaneous combustion.—A fire originating in a goaf from spontaneous combustion will be far too deeply seated within the goaf to be fought successfully by any of the appliances suggested. Fire falling from a seam above such as occurred at Bagdigi might temporarily be met by these methods, but such occurrences as at Bagdigi are now definitely guarded against by Temporary Regulation No. 10. Such appliances might be helpful against fire coming round stoppings but such occurrences are rare and the resulting steam might be a very distinct disadvantage. Throwing clay on such an occasion is much the better arrangement, or possibly, if the position permits, the use of sand. I definitely disfavour water in fighting ordinary goaf fire caused by spontaneous combustion as there is the well-known possibility of the water carrying away heat to give a fillip to the processes of oxidation, and so starting spontaneous heating, elsewhere. There is also the possibility, *when using water in small quantities*, of production of water gas and consequently of small explosion.

I mention some cases below which indicate the dangers that may arise from using water in small quantities. Such cases are of course rarely met with in mining experience and very little information is available in mining literature. Of a case cited in the Proc., S. W. I., Eng., Vol. LII (Part 2), C. J. Davis remarked that fire could be seen in 1 foot 6 inches of space between goaf and roof in a seam varying from 4 to 5 feet in thickness. A pipe line was run in to the seat of fire and water turned on. After a few minutes during which steam was freshly generated an explosion, not of serious dimension in this case, took place. The opinion was formed that the action of water on the fire generated water gas. (Obviously a small quantity.)

Also W. D. Woolley instanced the case of a Mines Inspector in America who had lost his life when as the result of a hose being turned on to a fire that steam and water were thrown back to such an extent as to severely scald himself and his companions. (Again a small quantity.)

Mr. T. J. Oakley in a paper read before the National Assosiation of Colliery Managers (*vide* I.C.T.R., dated the 9th November 1924) said that the application of water to fire should not be adopted unless a large stream was constantly applied, because *small* quantities made matters worse and water-vapour explosion might occur.

Fires from other causes.—It is impossible to take pipes everywhere in the mines and whereas fire may take place alongside a special pipe line, the overwhelming chances are that it would take place elsewhere. Fires from causes other than spontaneous combustion are extremely rare in our mines, and to insist on pipe lines underground for water supply for fire only would be an unwarranted price of legislation, and most likely to result in a pure waste of money. Further quite a strong section of opinion at home favours the use of sand or stone dust for tackling a fire.

Where pipe lines exist by all means put in occasional branches, and where water is thus available hoses may be provided. At the collieries under my charge we have hoses and hand pipes with nozzles stored on the surface available for pit tops, and, generally, pit bottoms and steam haulage engines houses, etc. We also store quantities of sand at all haulages and timber dumps underground. I consider the Temporary Regulations are generally sufficient for protection from outbreak of fire underground. I do not object to portable water tanks and even small hand pumps but consider their use limited, just as water pipe services are even more likely to be, to the roadways containing track, and the vicinity thereof.

Question 10.—As a matter of convenience perhaps, but as a matter of safety I fail to see much likelihood of practical advantage. After all the hazard to life and limb from fires underground in India is relatively small, and the likelihood is—unless some purely mining reason requires their constant use—that should occasion arise the telephone may be out of order. That is my experience of a telephone system at our biggest shaft at Bararee. Very interesting to everybody when first installed, but—

Question 11.—Careful and unremitting attention to stoppings, even to hair-cracks the avoidance of any but the smallest air ventilating pressures, the provision of best possible lighting for stopping inspection, and where a stopping temperature is above 100° F. a record to be kept of temperature on each shift taken with thermometer imbedded in the stopping at the highest point.

The provision of stoppings around an area before depillaring as per section 2 (1-A) (A) of Act No. XI of 1936, the provision in dip stoppings of satisfactory water-seals to permit of drainage of every sealed section. Such water seals to be plugged or kept filled with water during the dry season. All debris to be removed from against stoppings, and coal sides, roof and floor to be, and to be kept, lime or cement plastered for say 10 feet back. High stoppings to be provided with staging to permit of satisfactory inspection.

All surface breaks caused by mining operations to be at once closed, even the smallest hair-crack, and to be kept closed. All such areas to be provided with drains around them to run off as much as possible of the water of the rains.

Circulation of air in open working goaves should be discouraged as far as possible. The practice at Bararee is to build wax walls in all depillaring areas. Loss of timber, as far as possible, should also be discouraged. Timber in a goaf does not fire spontaneously but its ignition temperature is much lower than that of coal, and the presence of timber may hasten the processes from early heating to actual fire. This aspect, however, is difficult because the danger arising from roof falls is a factor of considerable importance.

Please also refer to page 108 of the Final Report of the Departmental Committee on Spontaneous Combustion in Mines. The greater danger of timber in goaves is the opportunity for the provision of the optimum gentle ventilation which a prop in a fallen goaf affords; it keeps open a passage.

Question 12.—I may be permitted to remark that there are quite wrong conceptions held in the public mind regarding the uses of rescue apparatus. The name is a misnomer, the apparatus would better be designated mines recovery apparatus. Its chief function can only be recovery work and as far as the use implied in the name " Rescue " goes, it may safely be said that very few men have been rescued from a mine disaster by rescue apparatus. Its use is for mines recovery after accident, and I speak from experience as a trained rescue apparatus man with practical experience of an explosion and a pit fire in South Wales, and I definitely feel that if ever rescue apparatus has any real use in India, it will be for recovery work, and training must, therefore, be aimed at such. Item (1) of the prescribed course of instructions of the Home Regulation for Rescue Corps is:—

Instructions as to—

(1) the general methods of dealing with underground fires and the recovery of mines after fires and explosion.

I would refer the Coal Mining Committee to the prescribed course of Instructions and Practice of the Regulations under the English Mines Act.

Question 13.—I have never, in my experience in India, had necessity to use breathing apparatus or gas masks in dealing with mine fires, and I feel that only in exceptional circumstances are such likely to be of advantage. In ordinary work when dealing with pit fires, breathing apparatus—unless absolutely necessary—would be a considerable disadvantage as the primary essential in dealing with pit fires is *speed*, and breathing apparatus might slow down work to such extent as may render all efforts abortive. Fire fighting, *i.e.*, from spontaneous combustion, in our mines consists entirely in stopping-building and for which building, large numbers of persons are needed. Dependence on trained rescue apparatus men in such situation in my opinion is, unless under unusual circumstances, likely to be impracticable.

Gas masks have been chiefly used in United States of America, and there quite a lot for exploration work in re-opened areas where

air has been permitted to penetrate. Gas masks are light in weight and have conveniences in wearing in their favour and training is not required.

They are not yet approved for use in British mines, but opinion is hardening in their favour.

Carbon monoxide is the dangerous gas to be kept in mind in pit fires. This gas is the result of incomplete combustion but it appears only to be present in dangerous quantities when the fire has some measure of activity. My experience is that well-sealed-off areas—*i.e.*, sealed both surface and underground—do not contain CO in dangerous quantities for any length of time, however active the fire may have been, as the CO originally in the area soon becomes oxidised to CO_2. Reference to the researches of the late Dr. Haldane will explain the reason thereof. Only once have I had experience of CO in the mines, and that was because of too-long-delayed sealing off of an area.

We have opened up the seals of, and recovered many, old fire areas in Bararee using always a Burrell's CO detector and small birds but have never found CO. We also have had air samples analysed, but with the exception of the instance cited above and that was in an unsealed area and had not CO.

Carbon monoxide is the gas most feared by mining men and it is far from my wish to belittle any possible dangers arising therefrom.

I therefore do not object to a number of gas masks, preferably of English make, being kept for emergency use at any mine where there is a fire or where the possibility of fire exists.

If it is a proposal to make the provision of breathing apparatus compulsory at mines where there is fire, I suggest such is impractical on the grounds that it is unnecessary and further, on the same grounds as the Home Mines Act has in view when it debars in its regulations the keeping of rescue apparatus at the mines.

Smoke helmets have only a limited sphere of operation and the air tubes make them almost impossible of application for building stoppings, etc., in this country, particularly for tall stoppings.

Question 14.—I have no objection to offer.

Question 15.—Definitely yes. Prevention is better than cure. And where fire has occurred precaution against the spread of fire, with the concomitant dangers of spread, etc., is better than precaution against the result thereof. A case of "a stitch in time" and it is for that reason, that I so strongly deplore the unnecessary limitation in non-fiery mines placed on light for stoping inspections. Regarding the concluding query, the only completely satisfactory solution to the problem of gob fires is to fill the goaves with non-combustible material.

Question 16.—It seems to me that ordinarily the provision of safety lamps should satisfactorily provide against the hazards resulting from possible inflammable gas being forced out of the goaf. It is, however, agreed that gas is likely to collect in the cavity over the goaf falls in a gassy seam before the surface is broken, and which gas may in part be forced out into the workings by further falls from above it, but the measure of danger will be a function of (1) the extent of gaseousness of the seam, *i.e.*, much or little, (2) whether the roof breaks easily and regularly—*i.e.*, the higher and more regularly the roof breaks the less the likelihood of gas being forced into the workings, (3) the height of the workings—*i.e.*, in tall workings any such gas (warm, and with a specific gravity of about one half of air) would cling to the roof and away from possible igniting causes.

I have no experience of other Indian coalfields, but I consider that danger is not likely to arise in the Jharia field from such cause, that could not adequately be met by safety lamps. In order to prevent fires in goaves I quite agree to the desirability of sand-stowing.

Question 17.—Premature collapses of workings are primarily due to the lack of sufficient support offered to superincumbent strata by the underground workings, often accentuated by the weakening effect of the presence of faults, and dykes, and also by the weakening effect of age.

The first lay-out of workings, the near proximity of other worked seams, the overloading of intervening strata by depillaring above, the presence of thick sills and generally, the nature of superincumbent strata, the contiguity of another seam or seams, the widening and heightening of galleries, patchy depillaring, unclean depillaring, the nature of the coal itself, the verticality of workings, the angle of dip and other causes may be cited as influencing stability of the mine.

The Subsidence Report required over 19 pages of printed matter and a number of illustrations to elucidate this question, and I may be permitted to refer the Committee to that report for fuller information.

Question 18.—The dangers arising from premature collapses are those:—

From collapse of inhabited surface buildings.

From collapse of public roads.

From collapse of surface water tanks or rivers, so flooding the mine.

From over-riding barriers into other properties where, by reason of the unexpectedness, ordinary precaution both surface and underground may not have been made.

Underground labour may be killed or injured by falls.

Underground labour may be killed or injured by air blast, even at mouths of openings.

Underground labour may be shut off from the means of escape and entombed.

Fires may result from spontaneous combustion of the coal buried by collapse.

The effective way of guarding against the above dangers is to get at the root cause. Collapse of mine workings is the result of unstableness. Stability may be regained by packing unstable areas.

Question 19.—I am in favour of minimum dimensions of pillars and maximum dimensions of galleries being worked to in the seams of a mine, but do not agree to such being detailed by Regulations.

The laying down of such dimensions I consider should be a function of the statutory authority as premised in question 43.

Question 20.—There are no generally established precise working laws deciding what should be the size of pillars. So many factors influence this.

A few examples may be of value.

English custom (Report of the English Conservation Committee) gives the following:—

Depth from Surface.	Area of pillars in square yards.
Below 100 yards	300
From 100—200 yards	500
200—300 ,,	800
300—400 ,,	1,100
400—500 ,,	1,400
500—600 ,,	1,700

A proposal which I understand was put before the Coalfield's Committee.

Depth.	Extraction before depillaring.
	Per cent.
Up to 300 feet	45
300—400 feet	40
400—500 ,,	35
500—600 ,,	30
600—700 ,,	25
700 and over	20

A Mine in Nova Scotia working under Sea.

Depth.	Size of pillar.	Percentage left in pillar.
	Feet.	Per cent.
200—300 feet	32 x 48	50·0
300—350 „	34 x 50	51·5
350—400 „	36 x 52	53·0
400—500 „	38 x 54	54·3
500—550 „	40 x 56	55·6
550—600 „	43 x 59	57·5
600—650 „	43 x 59	57·5
650 feet and over	47 x 63	59·5

At the Witbank colliery, Transvaal, in a seam varying up to 12 feet in height with depths varying from 60 feet to 250 feet, the pillars (square) sides vary from 14 feet long up to 26 feet with galleries of 13 feet in width. The extraction in first workings being from 75 to 88 per cent. The dimensions of pillars are worked out by means of formula.

In the Crown leases in New South Wales Australia a clause is inserted which requires the pillars to contain—

	Sides of pillars not less than	Coal left in pillars.
	Feet.	Per cent.
At Depth of—		
200 feet	...	50
200—500 feet	36	50 to 60
500—1,000 feet	66	60 to 70
1,000—2,000 feet	332	70 to 85

Size of the galleries shall not exceed bords 18 feet wide and cut-through workings 12 feet wide at all depths. Thickness of seams 3 to 35 feet.

In American practice the size of pillars vary considerably but their " rooms " are of average width of 24 feet.

It will be seen that there is considerable variation in practice in this matter of sizes of pillars and galleries.

The main factors as should govern the sizes of pillars are:—

I. Depth.

II. Crushing strength of the coal.

III. Solidity and hemogenity of the seam.

IV. Thickness of the seam.

V. Nature of the immediate roof and the superincumbent strata.

VI. The dip of the seams.

VII. The faultedness or otherwise of the area.

I would like to make the English Coal Conservation Committee answer my answer, *i.e.*:—

> " We are unable without hearing the circumstances of each case, to fix a standard minimum size of pillar, but we think careful consideration should be given at Collieries working upon the " Bord and Pillar " system to making the size of pillars left in the first workings proportionate to the depth of the working from the surface, and to other circumstances prevailing at the mine."

It may be remarked that the Subsidence Committee of the Mining and Geological Institute avoided this problem of laying down specific sizes for pillars contenting themselves by saying " that avoidance of destructive stressing is best possible by designing large pillars in the first instance ".

Question 21.—I agree to the need of preventing splitting of pillars, reduction of pillars, and heightening of gallieries but I consider the control of this should be a function of the statutory authority as premised in *Question 43.*

Question 22.—No arbitrary rules can be fixed in the matters of this question. So many physical factors influence this issue that this should be left to the statutory authority premised in *Question 43.*

Question 23.—Perhaps I may be permitted to draw attention to another aspect of the subject matter of this question and that is, how far is it advisable to supplant the authority and responsibility of the colliery manager. I may further perhaps be permitted to refer to the remarks of Sir Alfred Faulkner, Permanent Under-Secretary for Mines, when addressing the English Royal Commission on Safety in Coal Mines now sitting in London, who, at its First Meeting said " it was the view of the Mines Department (Home) that inspection should not be carried to a point of transferring responsibility of the management to the Inspector ".

I have, however, no personal objection to submitting plans of the principle of lay-out of new workings to the statutory authority as premised in *Question 43.* It should, however, not be lost sight of that projected plans of new workings are not often possible of complete compliance with, as mining problems have to be met and overcome largely as arising. Text book types of projections are rarely possible to sustain in actual mining. General principles, however, can be laid down and followed, but elasticity is essential.

Question 24.—Yes, again providing that the statutory authority is as premised in *Question 43* and also that a satisfactory Court of appeal is available.

Question 25.—After the exceptionally heavy rain of the 12th August 1935, water came into the workings of No. 13 seam, Bararee, through the roof in very large quantities flooding that seam and beating the pumps, rose in a connected shaft to the working of No. 14 seam above, overcoming the pumping capacity in two

pumping stations of that seam but eventually was overcome by the combined efforts of three pumping stations in 14 seam, *plus* a specially installed shaft pump, and water bailing through a 13 seam shaft.

Relatively only small quantities of water came through the coal of No. 13 seam, practically all through the roof thereof, and the pressure in several places was sufficient to break down the roof over the seam.

It was found that the flood of water in the Chatkori *Jore* had burst the East bank at a neighbouring colliery to the rise of Bararee, which was the opposite side of the *Jore* to Bararee Colliery. All their subsided workings were flooded to the level of the *Jore* flood, and also a connected quarry and the workings of an abandoned colliery to the south thereof.

At the locus of this flooding from the *Jore* the coal measures steepen rapidly. Tectonic movements in the geological past had caused differential movement of the strata, and the bedding planes were strongly slickensided. The water found passage along these slickensided bedding planes in the roof over Bararee No. 13 seam workings, and the pressure of the water found release into those workings, flooding them as described above.

Our neighbours would do nothing to close the breaches in the *Jore* bank on their property, and this repairing work had all to be done by the Bararee colliery. Immediately the breaches were closed the level of the waters in the flooded areas of our neighbours began to fall (drainage being into Bararee), and eventually we were able to dewater our mines. An adjacent Colliery on our side of the *Jore* also received much water from the same source. The trouble undoubtedly originated in the fact that the Colliery on the East of the *Jore* side had depillared too closely to the *Jore* and this had weakened the integrity of the *Jore* bank to such extent, that it failed in two separate places during the floods. These people have certainly worked under the *Jore* but what the conditions of the workings are, I have no means of knowing. I may also instance the threat of the Kari *Jore* at the eastern end of the Kusunda fire. Much money has been expended in an effort to stabilise the bed of this *Jore*, because if it should fail this *Jore* will flood a considerable area of the Jharia coalfield.

Question 26.—For the generation of water gas two primary sets of conditions are essential. (1) The presence of incandescent coke and (2) the passage thereover or through steam, preferably superheated. The temperature of reaction must not be permitted to fall below 1,000° C., otherwise big volumes of CO_2 are formed (Bone), *i.e.*, must be kept continuously up to the equal of about the working temperature in a modern by-product coke oven.

Only in an open fire area burning freely is incandescent coke likely to exist, so this requisite condition may be considered as not normal to the sealed fire areas of a working mine.

Continued high temperatures of (1) and (2) are essential to the production of inflammable water gas, if the temperature of either falls the amount of CO_2 produced renders the resultant gases progressively less inflammable.

To return to the conditions of the question, the influx of big quantities of water have such enormous cooling action that the steam is not superheated and the incandescent coke is quickly cooled below the requisite temperature. It is because of this that the experts agree that it is with *small quantities* of water playing on to a quantity of incandescent coke at a pit fire that inflammable water gas may be produced, and not with *big quantities* such as would be occasioned by a dangerous irruption of water. It should not be overlooked that a sealed fire area is full of blackdamp with a low oxygen content and also that even in the remote chance of inflammable water gas being produced by influx of surface water such gas would be exceedingly hot, and would rush to the surface through the goaf breaks.

In any case if the fire was burning so freely and openly as to permit of condition (1) the mines should not be working or if working certainly with safety lamps. It may be remarked that the flooding of fire areas was common in India in past years (see Chief Inspector of Mines Report of 1896) without dire results.

Regarding mining experience in the matter of the production of water gas by the contact of water on fires in mines, very little reference can be found in mining literature. Apart from the reference to small occurrences given in *Question 9*, the only references I know of, are those quoted by Seidl before the Departmental Committee on Spontaneous Combustion (*Question 219* of the Eleventh Day). Those two cases occurred in Upper Silesia and occasioned much discussion there, and opinion there was far from being unanimous. In cross examination it was shewn that there was an alternative explanation equally as good. The final Report of the Departmental Committee mentioned the fact but the Committee made no comment of their own, contenting themselves by repeating Mr. Seidl to effect that "while the flushing of waste had frequently been adopted for the purpose of drowning gobs which were on fire, these were the only two authentic instances where explosions have resulted".

In a discussion on fires reported in the I. & C. T. R. (12th April 1935) Major Humphrews, H. M., Inspector of Mines, said that in the past ten years there had been 112 cases of fires in Yorkshire, but he made no suggestion of occurrence of water gas in fighting them.

The Interim Report of the Joint Committee on Pit Fires [T. I. M. E., XCI (1) of 1936, discussing deep seated fires (accidental)] advises the use of water but makes no suggestion of danger from water gas. This Committee considered reports of 87 cases of which 36 were extinguished with water, but there was no mention of water gas.

The following American Government publication discusses fires and the use of water but makes no reference to water gas danger:—

U. S. A. Technical Papers Nos. 24, 330, 363,

U. S. A. Mine Circular No. 10, and

U. S. A. Bulletin No. 229—"Fifty mines Coal Fires" (at least one-half of these fires were fought with water).

The German text-book on "Recovery work after Pit Fires" by Lamprecht (a publication now rather old) remarked that at one time steam was used in fighting pit fires in Germany. Flooding was quite often employed in the fiery pits of South Hungary but there is no mention in his book of water gas.

Mr. J. Ivan Graham of the Executive Board Mining Research, Birmingham University, writing in the Colliery Engineering of March 1924, has said, that "where water is used it should be applied copiously. A *small* quantity of water played on to red-hot material will produce large quantities of hydrogen and oxides of carbon,—frequently sufficient to form an explosive mixture with air—thus rendering a dangerous situation more so".

In the U. S. A. there are large numbers of pit fires occurring annually but from their mining literature there appears to be no recognition of any danger by American mining engineers from water gas explosions arising from the flooding of pit fires. The German experience of two cases is doubtful and the British experience is so extremely meagre as to find no recognition in the enquiries that have lately been so much in the fore regarding fire, in the technical institutes.

The suggestion appears to be purely academical and as mining experience in exploiting all classes of coal over a very wide area and over a considerable period of time appears to be, for all practical purposes, negative. I suggest that the hazard of inflammable gases being generated in a fire area from irruption of water, which gases may penetrate the mine workings, is so extremely remote as to be non-existent (for all practical purposes).

Question 27.—I consider that danger arising out of the production of water gas is very remote in a sealed-off area. The influx of big quantities of water to a sealed-off fire area, however, contains elements of danger and should be guarded against.

Influx of water from rivers is guarded against for future workings by Temporary Regulation (Notification No. M. Q-55) No. 9 but this does not help in the matter of existing workings. All workings under rivers should be immediately stabilised, if at all unsatisfactory, either by complete or by partial stowing.

I consider the distance 50 feet in Temporary Regulation No. 9 is insufficient, as in the case of dykes or faults a draw of 50 feet is quite within the bounds of possibility, which draw would be sufficient to let in the river waters. A few "tensional cracks" running into the bank of a river is sufficient to give water every opportunity to burst the banks.

I consider that any mine depillaring near a *Jore*, should be held responsible for maintenance of the integrity of the bank.

It may be observed that Temporary Regulation No. 9 gives a definition respecting the bed of a river but not of the bank. There are places where the adjoining land may be flooded further than 50 feet from the apparent bank in times of exceptional floods. At such places the bank of the river should be walled, or otherwise protected.

As far as is practicable, all surface subsidences over a sealed-off area should be consolidated and the periphery of all such subsidences should be effectively drained and kept effectively drained.

Care should be taken that the level of water in any banked-up surface irrigation or other tank, lying at a higher level than a subsided area should be kept low enough by satisfactory overflows, as to prevent excessive water level bursting the bund during heavy rains.*

Main surface drains should be strongly and adequately bunded where subsided areas in proximity lie at a lower level.

Provision is not enough, maintenance also must be prescribed.

Regarding influxes of water from underground sources the existing law is satisfactory except where boundaries are concerned, in this latter, I consider, the prescribed minimum thickness of barrier (Regulation 76) of 25 feet is inadequate particularly bearing in mind the large thickness of some Jharia seams. I would double this at least and would not consider 60 feet to be kept on either side of the boundary line excessive. Regulation 74 prescribes that when approaching workings that contain or are likely to contain water, precautions (prescribed) must be taken, *i.e.*, danger likely at 100 feet away, and yet barriers between the workings of adjoining properties may only be 25+25=50 feet. One property may be to the rise of another, it may be abandoned and may be heavily charged with water. There is a property to the rise of Bararee colliery full of fire, containing some water and may later contain much water. Fortunately we have every reason to believe that a strong barrier does exist but the point is that the law does permit of a weak barrier of a total thickness of only 50 feet and this might easily have been the case with us. Errors of surveys can easily be of 50 feet, it might be say 45 feet giving an actual barrier of 5 feet only, whereas the plan would shew 50 feet.

The Final Report of the Home Departmental Committee on Danger of Water in Mines says "we wish to express our opinion that a barrier which may be subject to pressure of water left in a horizontal seam or in the direction of the dip in an inclined seam should not be less (though in many circumstances it should be

* In the event of such tank or tanks not being under the control of the colliery company, legislation should be framed to empower the colliery company to do such safety works. Possibly such powers also may be necessary in the case of rivers.

more) than 20 yards in width ". That is 30 feet on either side of a boundary line. This Committee further says " Inaccurate plans have been the primary cause in the largest number of cases (inrushes of water), or 20 per cent. of the total ".

I am agreeable to the enforcement by law of any reasonable precautions to prevent influx of dangerous quantities of water into fire areas, but the industry should have full opportunity of discussing the drafts of any such legislation.

Question 28.—I have no suggestions to offer.

Question 29.—This would mean the total extinction of the use of country gunpowder which is overwhelmingly the chief explosive employed in mines in India.

I wish to put up the following figures to the Coal Mining Committee collected from the Reports of the Chief Inspector of Mines in India over the inclusive period 1896 to 1934 (the latter being the last report available at the moment of writing).

The total number of deaths underground in coal mines from explosives for the past 39 years averages out to 4·2 per annum.

These Reports do not always define the type of explosive at accidents, but excluding shafts, stone drifts* and such other explosives as are defined, the average yearly death due to country gunpowder amount to 3 per annum.

Percentage of amount of gunpowder used in 1934 of the total of explosives used	91%
Percentage of amount of " permitted " explosives used 1934 of the total of explosives used . . .	3%
Number of deaths from explosions (all in past 12 years) due to " permitted " explosives (Parbelia, Dishergarh, Methani)	86
Number of deaths from explosions over a period of 39 years due to gunpowder	*Nil.*
Percentage of underground fatalities in coal mines due to gunpowder as against total underground fatalities in coal mines over a period of 39 years	2·3%

There is no argument whatsoever against the use of " permitted " explosives resident in the figure of 86, but I do suggest that the figure of *Nil* for gunpowder does definitely shew that the past history of Indian Mining has not produced any evidence to support the total abolition of the use of gunpowder from Indian Mines. I therefore do not consider it necessary to enforce the use of " permitted " explosives to the extent of the English Explosives in Mines Order. Conditions at home generally are much more dangerous.

* Which, it may justifiably be presumed, would use nitro-glycerine explosives and not gunpowder.

At Bararee we have used in the past ten years nearly 800,000 lbs. of mixed explosives, preponderantly country gunpowder, and during that period have had no fatal accident from the use of explosives underground.

The big recent accident at Giridih was due to the use of liquid oxygen, an explosive now very rigidly prescribed against for use in coal mines in India.

I would like to add a few further statistics about explosives culled from the Annual Reports of the Chief Inspector of Mines.

A detailed statement of explosives was first given in the above reports for the year 1927.

During the years 1927 to 1935 inclusive the total amount of explosives used in mines in India amounted to 23,858,307 lbs.

Total number of deaths from explosives during that period at and in mines. (9 years)	84
Number of deaths from explosives underground during that period (including sinkings)	57
Number of lbs. of explosives used per death from explosives during that period, in and about mines	280,000
Number of lbs. of explosives used per death from explosives during that period for the total number of deaths underground	418,000

Of the total of explosives used as given above 20,760,952 lbs. were of gunpowder, *i.e.*, 87 per cent. of the total.

For the period of the past 38 years burning fatalities have accounted for the biggest proportion of fatalities for explosives amounting for—

	Per cent. of the total due to explosive.
Surface and underground	about 42
Surface only	about 27
Underground only	about 16

Taking the last 9 years (the period for which quantities of explosives are available and assuming that all the burning (explosives) fatalities are due to gunpowder.

Deaths due to burning, surface and underground	35 in 9 years.
Surface	24 „ „
Underground	11 „ „
Gunpowder used	20,760,952 lbs.
Number of lbs. of gunpowder used per death in and about mines from burning	590,000 lbs.
Ditto for surface	860,000 lbs.
Ditto for underground	1,880,000 lbs.

In 1931 the Niga burning accident occurred, the special circumstances of which divorce it from the ordinary. Avoiding this and taking the last four years of which particulars are available, *i.e.*, 1932 to 1935 inclusive, the figures are as follows:—

Total amount of gunpowder used . .	8,992,333 lbs.
Total number of deaths due to burning from explosives in these 4 years	3
Number of deaths due to burning from explosives on the surface	1
Ditto underground . . .	2
Total number of deaths due to explosives in and about mines in these 4 years .	19
Amount of gunpowder used per death for total from explosives during last 4 years .	470,000 lbs.
Amount of gunpowder used for death from burning caused by explosives during last 4 years	2,997,000 lbs.

On the output basis the tons of coal raised per death from explosives, for the period of nine years over which full statistics of explosives are available, are shown below:—

All deaths from explosives, one for every .	2,200,000 tons.
All deaths from burning by explosives one for output of every	5,320,000 tons.

Taking the period of the last 4 years for which statistics are available the above quantities become 4,110,000 tons and 26,000,000 tons.

From these statistics it is clear that the average of the last four years the accident hazard from explosives has halved, and from burning by explosives has quartered as compared with the average of the past nine years. If these latter four years were compared with the preceding five years, the advantage would be much greater.

By the nature of things explosives are necessarily a dangerous commodity and the handling thereof must be hazardous. Accidents must occur, but with the level of incidence, as shewn above, of accidents from explosives, I feel justified in saying that no case can be supported on practical grounds for the extension of the compulsory use of "permitted" explosives to non-fiery mines, to the total exclusion of non-permitted explosives—of which latter gunpowder is the preponderant type in use (91·6 per cent. in 1935).

It must not be lost sight of that the use of "permitted" explosives to the exclusion of gunpowder will increase the raising cost of coal by about annas four per ton, and at a time when other heavy extra charges are impending.

My argument, however, rests on the practical side and that is that the proposed change cannot be justified by facts, which are that gunpowder has caused no deaths from explosions in Indian coal mines, and that during the past four years over 4 millions of tons were raised per death from explosives.

One class of explosive accident should receive attention and that is accidents arising out of injuries by exploding shots such as out of not taking shelter, returning to the shot hole too early, inadvertently being in the close proximity to an exploding shot. This is the principal type of fatal underground accident due to the use of explosives.

Question 30.—Definitely yes.

Question 31.—I suggest that the words "secure closed" in Regulation 106 should be extended to "securely closed and locked". I have no objection to the retention of the proviso but consider that it shall be strictly enjoined that no two such canisters shall be in contact, and further, that not more than one canister shall be unlocked at any time.

Question 32.—I have no suggestions to make.

Question 33.—The information requested is as follows:—

Bararee Colliery.

Name of Seam.	Thickness.	Quality.
13	16′	Selected grade for that section lying at 2′ 3″ from the roof and 5′ 3″ from the floor. Rest of coal poor.
14	27′	Selected grade.
14-A	7′ 9″	Selected grade.
15	27′	Selected grade.

Gradients vary from 1 in 10 to 1 in 12.

South Bulliaree/Kendwadih Colliery.

Name of Seam.	Thickness.	Quality.
10	29′	Ungraded.
12	12′	Selected grade for the lower section of about 5′ 6″ up to a band in the seam. Above this band the coal is very poor.
13	16′ 6″	Grade II.
15	19′/21′	Selected grade.
16	12′	Selected grade for bottom section of 6′ 7″. Rest of seam poor.

Gradients vary from 1 in 12 to 1 in 14.

Question 34.—*See Question 33.*

Question 35.—The average for the current year of coal won at Bararee Colliery from depillaring is 43·8 per cent. of the whole output and this percentage is increasing.

The percentage of coal won of the pillars actually worked averages for No. 15 seam 82 per cent.

Regarding the coal which may be left in panel barriers, refer to answer to *Question 5.*

Figures of coal for recent depillared and depillaring areas shew an average of 42 per cent. won in the first workings.

Question 36.—It is impossible to answer this question and any attempt at giving a proportion can at best be only a wild guess. I put forward the following extracts from the Second Subsidence Committee Reports to shew conditions in the Jharia field:—

> *Page 97.*—"Past experience in the Jharia coalfield also suggests that much of the existing whole workings have no great margin of stability and that depillaring would set up considerable collapses therein."

> *Page 105.*—"Very large areas are locked up (contiguous seams) and efforts to depillar such seams have in the past yielded indubitable evidence of their proneness to collapse."

My answer to this question can only be to the effect that very large losses of coal cannot be avoided in working such areas with existing methods of non-stowing.

Question 37.—Not all. Some of this 200 millions of tons of coal must yet be virgin and with first workings still to be made. As to the support of buildings and bridges there will be the economic factor. It might pay in cases to compensate for their value.

For all this, a large proportion certainly would be lost without stowing.

Regarding the latter part of this question I have no information other than that which has appeared in the public press.

Question 38.—Compulsory stowing must ordinarily considerably increase the life and total productivity of collieries, but there are uncertain factors which make it difficult to assess what is likely to be the extent of that increase in life. A very important factor is the market for the coal (controlling output), there are also hazards of mining particularly in old collieries, which hazards possibly may be implemented by old depillared areas.

Question 39.—This is a matter of local conditions, but in my view, sand-stowing can be more conveniently done when working the bord and pillar system rather than when working long wall. The English Royal Commission on Mining Subsidence appointed Major Hudspeth (then H. M. Inspector of Mines, now Mining Engineer to the English Safety in Mines Research Board) on special duty to investigate the practicability of universal hydraulic stowing at home. After investigations in France, Belgium, Germany and more particularly in Upper Silesia, he reported that hydraulic stowing was unsuitable for long wall workings.

Mr. K. Seidl, a German expert giving evidence before the English Departmental Committee on Spontaneous Combustion, also did not favour hydraulic stowing in long wall workings as a measure to combat fire.

An essential requirement of successful long wall working is regular face advancement. With irregularity of labour supplies

this primary condition may be difficult of continual maintenance in Indian mines.

This matter, I suggest, is one that may well be left to the statutory authority as foreshadowed in *Question 43*. As to " other incombustible material ", supplies of this are limited, and it makes a much poorer filling than sand.

Question 40.—The answer to this question is dependent upon how far the principle of conservation is to be accepted. The coking coals should be considered and so should the newer coals. The need of coke is with us, but for how long enormous quantities of coke will be required for the smelting of iron ores is much a matter of research.

Coals other than coking coals must also be conserved for the future needs of the country. The question of oil fuel supplies will be of increasing importance in very few years from now.

Considerable concern is being evinced regarding the future life of the oil wells outputs of the world, and this year important authorities have concluded that the life of such supplies, despite modern geophysical methods of location of new pools, is not likely to be more than 20 years.

The U. S. A. which consumes 60 per cent. of the oil fuels of the world, has already taken up measures to conserve its fields and to prevent waste.

The position is of importance to India, and the higher volatile coals of the Raniganj series and the lignitic coals have great prospective value and importance for the future supplies of oil and spirit-fuels by hydrogenation. Already in the East, Japan is producing oil by hydrogenation and the main research in coal in South Africa is almost entirely orientated to this line. Australia also is very interested and proposals have been put up to the Government there for the building of hydrogenation works. Even in America interest is being directed to hydrogenation of coal owing to the prospects of extinction of oil well supplies in the next 15/20 years. True there are large reserves of coal in India but no research has yet been made as to which are the best for hydrogenation, and in view of the fact that the future needs of coal for oil production may quite likely outlast the major requirements of coke for smelting, the need of conservation of the higher volatile coals and the lignites for oil, apart from other industrial and commercial needs, is quite pressing. It may not be out of place to mention that Germany in the very near future expects to be entirely independent of outside sources in the matter of oil fuels and that, largely, by hydrogenation of their brown coals (lignitic). Russia is basing its hydrogenation plans on a supposed life of petroleum supplies of 20 years.

Definitely, satisfactory supplies of oil fuels will be an industrial problem of quite the early future, and it need hardly be stressed that petroleum is the most important of the world's wasting assets.

Sir John Cadman, at the Third World Power Conference, September 1936, said, " it is disquieting to note that the general average of recent estimates would appear to indicate the existence of something less than 20 years consumption ". Further he said, " in recent years discoveries of new pools have not kept pace with consumption " and W. A. Selvig of the U. S. Bureau of Mines considered (June 1936) that the known oil reserves would last only 15 years.

C. H. Reed (June 1936), Illinois Geological Survey, U. S. A., has discussed the shortage of time to get the necessary information of Illinois coal for producing motor spirit for when the petroleum shortage *predicted to start in 1940 to 1945, arrives.*

It is said to take five tons of coal in England to produce one ton of motor fuel.

Want of oil fuel and petrol will be the fuel problem of the near future and—a big war would bring that time much nearer—the conservation of the higher volatile coals would appear to be just as imperative to future needs as the conservation of coking coals.

I am therefore not in favour of limiting conservation to areas or to types of coal.

A start, however, should early be made and I would like to suggest that in the Jharia field a main line of ropeway or ropeways from the Damodar at Sutikdih should proceed *viâ* Bhulanbararee, Bararee, Bhaga/Lodna, Standard, Gopalichuck, Kustore to Balihari.

In addition to these collieries this line could serve Jorapokhur, the collieries around Jharia and the Chatkori *Jore* if necessary, Hurriladih, Barragarh, Bhugutdih, Kendwadih, etc.

A second main line might proceed from the bend in the Damodar somewhere north of where the Kari Jore joins the river at Putia straight to Loyabad and Kankani and Jogta to Mudidih. From this main ropeway Jamadoba, Jitpur, Bhagaband, Pootkee, Kirkend, Ekra, Sijua, Gaslitan, Malkera and Bhelatand, etc., could easily be served.

Collieries near the river side would be best served independently direct from the river.

The most valuable area of coking coals is that served by the first main line described above. It is difficult to say in what seams stowing should be enforced. The upper seams in that area are the better. If in the future the lower seams are worked without filling large quantities of water are likely to come in *viâ* breaks through the stowed areas above to the surface, enhancing the big feeds likely at the lower depths; further any old fires as may exist in the old areas worked in the seams above may be resuscitated. Not only where old fires exist but when underworkings disturb a settled unstowed goaf free from fire above, danger of starting a new fire in

the upper seams may be present, as practical experience in the Jharia field has shewn.

Further to that, I do not consider any seam, except the thinner ones, free of possibility of spontaneous combustion. I do not like the idea of any piecemeal conservation of the Jharia coal but there certainly are areas that should be tackled at once. It is not for me to instance at what collieries.

I have no experience of the Raniganj nor of the Central Province coalfields to enable me to discuss those areas, but I am strongly of the view as remarked earlier in this answer that the higher volatile coals and lignitic should now be considered as most valuable assets of the future, and should be conserved. A long view must be taken and the likely oil fuel requirements of say 20 years hence, and earlier as the natural oil output drops off, calls for the Coal Mining Committee's most urgent thought in that coal will be the raw material for the production thereof.

I have mentioned above the possibility that the coke requirements of the Indian steel trade may be affected by research and I offer the following in support of that view, and also to indicate that important as coke is, it is not the whole question.

Sir Harold Hartley, F.R.S., before the Institute of Chemical Engineers, 1935, said as follows:—" Nearly 15 per cent. less coal is required to produce a ton of pig iron than in 1913. Fuel economy has been estimated to save the iron and steel industry (British) £4,500,000 a year, the cost of nearly 6 million tons of coal."

It may be mentioned that Indian Coal Statistics for 1934 gave 4,657,000 tons of coal used in India by the iron, steel and brass foundries* and workshops (21·4 per cent. of total Indian consumption), *i.e.*, about two-thirds only of the amount saved in the British iron and steel industry per annum as the result of about 20 years research and progress.

Report of the Indian Tariff Board regarding the grant of protection to the steel industry (page 13) says that it is conceivable that new discoveries may render it possible to utilize in the manufacture of iron coal which is at present classed as non-coking.

Dr. C. S. Fox in his paper on " The Raw Material for the Iron and Steel Industry " (*Trans. Min. & Geol. Inst., Ind., Vol. XX, Part 2, July 1925, page 139*) has made the following statements:—" If the Indian iron and steel industry assumes the position of a producer at all comparable in importance with the industry of Great Britain there is little doubt that a process will be devised for using the low grade Indian coal. In the Midland counties of England there were till recently several furnaces in which a mixture of raw bituminous non-coking coal, somewhat rich in oxygen, with two parts of metallurgical coke was employed.

* This description suggests foundaries and workshops only but it will be obvious on reference to source that this includes all iron and steel practice consumption including smelting.

Blast furnaces in the Clyde basin of Scotland still utilize the local splint coal in a raw condition alone.

The relative advantages and disadvantages of using raw coal as against coke were discussed in considerable detail nearly 40 years ago by Sir Lowthian Bell (*Jour., Iron and Steel Inst., Vol. I, 1884, p.13*). The subject is by no means closed and its re-examination may prove to be of *great importance to the Iron and Steel Industry of India* at some future date."

The contribution of Dr. Pascoe to the discussion on Dr. Fox's paper, Vol. XX, Pt. 4, June 1926, is quoted below:—

> *Page 412.*—" Throughout the whole discussion, no modification of our figures has been made in view of new inventions or of new processes of smelting iron. At the same time it is worthy of note that a great deal of good work is being done, and more than one process has appeared by which iron ore is smelted with powdered coal."

Some new discovery of science may at any moment entirely upset the economic balance in the matter of fuels and the uses of coal, just as science has so done in the past. We are only on the threshold of the subject and investigation into, and resulting knowledge of, the use of coal, is in its infancy. Dealing with the effect of increased knowledge of combustion, Dr. Sinnatt, Director of Fuel Research (Britain) at the Third World Power Conference said that " 11 per cent. less coal is required in Britain to do 9 per cent. more work in 1930 than in 1924. 20,000,000 tons more coal would have been required in 1930 (in Britain) if methods had not been more improved ".

Much may be expected from research in the near future and " startling developments may, at any moment, emerge from the vast amount of research now devoted to the chemistry or physics of coal, and it is a matter for the highest satisfaction that an increasing number of investigators are working in these fields on the lines of pure research. (*Colliery Engineering, January 1937.*) ".

Coal is the most valuable of all India's natural resources, and as conservation of resources, in other words wise spending, is surely an obligatory duty of the present. It would therefore appear to be imperative that India's coal should be conserved, irrespective of special purposes.

My remarks on oil are supplemented by the following extracts.

T. Dewhurst in his Presidential Address to the Institute of Petroleum Technologists, 1934, said that at present rate of consumption, the total proved reserves of petroleum would last 17½ years . . . . and . . . . the earth's stores of petroleum were irreplaceable (by nature).

Judge Ames, President of the American Petroleum Institute declared in December 1932, that the known national supply of oil would not last more than 12 years at the present rate of production.

Senator Guffey warned the U. S. A. senate (1933) that the U. S. A. would soon have to return to coal as its principal source of power.

An experimental hydrogenation plant has been put down in Pittsburg.

The Japanese Government is to establish a semi-state corporation with a capital of £5,000,000 for production of oil from coal, the Government to hold one-half of the shares. It is expected that ultimately the output will be 2,000,000 tons of synthetic petroleum. Production of oil is expected in 1937-38. (*Colliery Guardian, 11th December 1936.*)

Dr. Lategan, Fuel Technologist of the Transvaal Coal Owners' Association wrote, "As a potential oil reserve alone our coal is worth probably 400 times more than the value of the gold and diamonds which South Africa has produced to date. (*The Coals of the Witbank District, p. 167,* published by the Transvaal Chamber of Mines.)

Non-coking coals offer advantages and the lignites offer a much wider field for application of scientific treatment. (*Colliery Guardian, 23rd December 1936.*)

In support of my view that all types of coal should be conserved as most valuable assets for the likely expanding needs of the future, I wish to put forward the following two tables which shew how lowly is India's position in the industrial scale, which humble position *cannot* be contemplated as permanent and which lowly position indicates how very considerably it may increase the future requirements of coal for India's expanding industries:—

Country.	Consumption of coal per head of population (H. Meis: *Gluckauf, dated the 9th November 1936*).	Horse power generated by coal oil and water per head of population 1925 (H. M. Evenson: *Coll. Guar., dated the 14th May 1935*).
	Tons.	
Great Britain	3·61	1·03
Belgium	3·38	...
U. S. A.	2·87	1·65
Canada	2·39	...
Germany	2·04	0·66
France	1·75	0·47
Holland	1·54	...
Sweden	1·15	...
Japan	0·53	0·14
Russia	0·57*	0·05
Italy	0·32	0·10
Spain	0·30	...
India	0·06	0·01

* Quadrupled in past 20 years.

India's position is at the bottom of the table in both cases. In the one case her figures are one-sixtieth of the best and in the other one one/sixty-fifth of the best.

India has excellent reserves of iron, reserves of coal and some pretensions to industrial expansion. India cannot be expected to be always at the bottom of the above tables and if conservation for the needs of the future is to be established as a principle, it should be made a practical fact by embracing all coals, all of which India will need in the future.

Question 41.—Other than in a small way of both hydraulic and hand my answer is in the negative.

Some years ago the matter of hydraulic stowing at Bararee was very carefully investigated and a complete scheme was drawn out. It was then estimated that the cost of stowing the areas standing on pillars would be Rs. 2-5-6 per ton of coal so won, inclusive of all capital charges with the whole plant on the estimated output. The cost of plant was very expensive at that time and our view now is that sand-stowing would cost at Bararee inclusive of all charges not less than Rs. 2 per ton on the coal raised.

The cost at the colliery of putting sand into place underground, *i.e.*, exclusive of the excavation and of the transport of the sand from the river, or any transport on the surface of the colliery, is expected to be about annas 8 per ton of coal including capital charges.

Question 42.—If stowing is made compulsory a comprehensive scheme of sand supply would have to be planned. Large loading stations at the river and lines of transport feeding ranges of collieries would require to be erected and put into commission. It is necessary that no time should be lost. It may be expected that collieries will come on to the sand distributing systems one by one as those systems are extended.

From the commercial point of view the arising economic situation for those collieries as they come on to the sand transport systems, is of vital importance. Such collieries must not, in equity, be placed by law in an inferior trading position to their neighbours and, whatever ultimate position may eventuate, they must not be penalised by law because of their earlier start in conservation.

Until the full scheme is working the earlier collieries as they come on must unconditionally be compensated to the extent of the full costs of sand-stowing. If not, it is likely to cause the closing down of collieries as non-paying concerns until the resulting trading advantage of their competitive non-stowing neighbours is nullified. It should be kept in mind that the earlier—and so unexperienced—days of sand-stowing will be very costly to colliery working, much above what the average cost may eventually work out to. Collieries also will require a lot of new gear and will have to face much expenditure incidental to a radical change in mining systems.

As to the provision of funds, the conservation of coal is a national concern and the cost of sand-stowing should be borne by every ton of coal raised in India. The internal market will have to be protected against foreign coal and any such coal as may come into India must be taxed. The proceeds of such tax to be utilized to help in meeting the cost of conservation.

A cess on all despatches of coal of all sizes and of hard and soft coke (unless the coal for the making thereof has already paid cess) shall be levied and shall be collected as a terminal tax by the railways. The cess to be fixed by a conservation board year by year to meet the requirements of the yearly budget. All coal and coke for the iron and steel industry which industry, at present, has the greatest need for the conservation of coal, should pay a higher cess and the railways similarly up to the amount of coal locked up under their railway lands, whether the coal is worked from their own collieries (both iron industry and railways) or purchased on the open market.

The original capital required for the whole scheme should be provided by the Government and as money is now cheap, at a low rate of interest. Such money to be made available for the conservation schemes without profit to Government. The work is of first rate national importance and all machinery, plant, etc., required for the schemes should be admitted into the country free of tax.

I would also like to put up the following as an alternative point of view to that stated above.

Let it be granted that—

I. There is considerable avoidable waste of a valuable asset by the present methods of working coal.

II. This waste can be largely mitigated by sand-stowing.

III. Such stowing system will be very costly and which cost the coal industry cannot pay out of present level of earnings.

IV. That a cess on coal means an increased price for the country's general industry to pay for fuel.

V. That conservation would therefore become a tax on general industry.

VI. That it is axiomatic that cheap, and assured reserves of coal is a primary essential to permanent industrial expansion.

VII. That industrial expansion is of paramount social importance for raising the standard of life in India and that such expansion is, therefore, intimately intertwined in the major interests of the whole people.

VIII. That the furtherance of such expansion is essentially an obligatory duty of good Government.

IX. That costly coal is likely to retard industrial expansion.

X. Then in view of its enormous national importance the full costs of sandstowing should be a charge on the funds of Central Government and a tax, thus, on the whole population of the country and not on industry alone. The pithead price of coal then would be controlled by ordinary economic factors and no radical interference would be made with general industry.

A heavy tax on industry of costly fuel must react detrimentally to industrial expansion and consequently to social welfare. There is a social, as well as industrial and economic factor in this problem, and it would seem that at this phase of industrial recovery, it is of great importance that the economics of industry be interfered with in the least possible way, otherwise incalculable social injury is likely to result.

Question 43.—Definitely yes.

The problems to be solved and the work entailed in drawing out the schemes for excavation and transport, for the erection of necessary machinery and getting that machinery into commission, etc., for the economic side, for keeping the schemes properly and economically applied, and so on, together with the practical application to the mining problems which must arise at the collieries, are far too important and too large to permit of being tacked on to any existing Government Department.

I consider that a statutory authority should be set up and the problems of *Questions Nos. 19, 20, 21, 22, 23, 24, 39, 44 and 52* should be a necessary part of the work of that authority, as is outlined in paragraph 20 of the Coalfields Committee's Report.

I suggest that authority should consist of a Chief Mining Engineer who will, for operation purposes, be assisted by a Chief Engineer with special training in ropeways—, *i.e.*, providing ropeways are the accepted scheme of transport—with assistants as are required for both the mining and the mechanical sides of the work.

The Chief Mining Engineer shall be in charge.

He shall be assisted by a board of which he shall be the Chairman and which board shall be independent of the Mines Department, but the Chief Inspector of Mines shall be a member thereof. For other members of the board I would like to refer the Coal Mining Committee to paragraph 27 of the Report of the Coalfields Committee.

This board shall also be the board of appeal such as will be necessary to meet such difficulties as will arise out of the mining problems that have to be solved. For this reason it might be advisable to also have one mining engineer connected with the industry on the board.

The Chief Mining Engineer shall have the usual qualifications of a mining engineer (coal) and moreover shall be a widely experienced man and shall have had at least, but preferably more

than, ten years recent experience in the practical management or control of large coal mines, either as manager or of rank superior thereto. He should preferably have had much of his experience in the bord and pillar system of working.

The problems of this matter are far greater than that of getting out a scheme on paper. The main problem will be in practical application, and long practical association with the management of large Home collieries only will give the necessary experience in application and low costing, such as will be so necessary to the economic success of the principle of conservation by sandstowing. Only in this way will the confidence of the coal industry—an essential to success which cannot be ignored—be gained and held.

The coal industry should have the right of appeal to the board in respect to any decision by the Chief Mining Engineer.

Question 44.—Providing that the authority is as outlined above, I am agreeable to this, and providing also that the owners have the right of appeal.

Question 45.—(*a*) Timber now costs us at Bararee colliery 10 pies per ton of coal got from depillaring.

Timber will still be required with sandstowing and as our timber consumption is the result mainly of splitting of props by the continual nailing on of lids, I do not consider any very appreciable saving in timber is likely. As against any decreased consumption of timber must be offset the cost of brattice or bamboo matting, etc., as will be required to keep sand in place during stowing operations.

(*b*) Building fire stoppings costs us (average for two years) annas 2 per ton of coal depillared. The past 12 months, however, has been expensive and bearing this in mind the average probably will be under annas 2.

(*c*) There are so many variable factors influencing this that a definite answer is indeterminable. Packing will certainly reduce the income of surface water to the workings during the monsoon, on the other hand hydraulic stowing will entail pumping the whole year round.

(*d*) A lot of coal is locked up in panel barriers when depillaring under conditions of non-stowing where fire is liable, but as remarked on in my answer to *Question 5* some coal left in panel barriers may conceivably be removed, and the percentages of coal so locked up would be less than that given in answer to *Question 5*.

Regarding coal under railways an answer to this would require much calculation, and will vary because of depth, thickness of seams and conditions laid down by the declaration under the Land Acquisition Act.

This sub-head (*d*), however, seems to be outside the scope of the main question which is one of savings against increased costs, *i.e.*, one of moneys and not of tonnage.

(*e*) *Compensation for buildings* for us, *nil.*

Compensation for land depends on who holds the surface rights. The cost of acquisition before depillaring will vary from Rs. 100 per *bigha* to Rs. 60 per *bigha*. As to what this will mean per ton of coal would depend on the number and thickness of the seams and with the big thickness of the Jharia seams, cost per ton would work out to very little.

We own most surface rights at our collieries.

Compensation for accidents.—The premium for the accident policy for collieries is calculated on the basis of the total sum paid out to labour and is not affected by the accident rate of the colliery. Our experience is that the depillaring areas are no more dangerous from deaths due to falls than any other part of the mines from that cause.

Compensation for Ventilation.—To us *nil.*

(*g*) *Concentration of output.*—There is saving to be made in concentration of output but concentration is likely to be more applicable to newer than to older mines and the advantage in savings in cost in the older mines especially with tall workings may not be considerable.

(*h*) The cost of getting coal—and in view of the above questions I take this to be tubbage rates—will in no way be, reduced by working with a system of stowing.

If the use of coal-cutters is in mind this will increase costs of coal getting. All our depillaring coal is now got by explosives.

I do not consider that the possible offset of savings under the heads suggested in (*a*) to (*h*) in the aggregate as against the increased cost of a system of stowing is likely to be very appreciable.

Questions 46, 47 & 48.—I refer you to the replies* of the Managing Agents of Messrs. The East Indian Coal Company's Collieries.

Question 49.—I agree to the necessity of preventing fire dropping in a goaf from the seams above, but local circumstances should not be ignored, and the thickness of the lower seams and thickness of the intervening strata are factors that should be considered. Taking an extreme case, it would be absurd to limit the non-filling total extraction of a 12 feet seam with 1,000 feet of strata up to the seam above. The case shewn on Plate 10 of the Report of the Second Subsidence Committee and described on page 78 is a case in point where the non-filling total extraction of a 7 feet seam of coal disturbed very little a 12 feet seam lying 157 feet above. Had there been fire (which would have been sealed off) in the top seam before the bottom seam was depillared, such fire would not have affected the lower seam.

* Page 67.

Question 52.—This depends on the amount of stabilising necessitated by the existing conditions; obviously 100 per cent. stowing with sand will give the maximum stability practicably obtainable.

With partial stowing the problem is what is the dividing line of stability in terms of percentage of complete packing. The percentage of packing required would be a function of the existing stability of the mine, and will depend on the percentage of coal won in the first workings, the age of the workings, the height of the seam, whether seams have been depillared above, the contiguity of another seam or seams and verticality, the presence of dykes, faults, etc., and so on.

The ideal for mines such as in India is complete stowing. I suggest that as there are other considerations, not the least being the ready provision of sufficient packing material, and there is also the economic aspect, that this problem would best be answered by the statutory authority as suggested in my answer to *Question 43.*

Question 53.—This is partly dealt with in my answer to *Question 42.* I do not consider that delivery of sand free at the colliery is sufficient assistance against the additional costs of compulsory stowing.

Ordinarily in the older collieries the cost, after receipt of free sand, would likely rise to annas 8 per ton extra and more for complete filling, and in addition to this it is hardly likely that free delivery of sand would be made exactly at the points at the colliery where it would be most convenient for use and consequently the colliery would have to meet the further cost of surface transport at such collieries. Such annas eight extra per ton is a very weighty load against economic marketability in time of keen competition, and this too would likely be enough to cut out collieries operating on a stowing basis from the export trade also possibly from railway contracts. Further aid therefore is necessary. Perhaps a quota system similar to Home prescribed practice would be of advantage, but definitely further financial aid than free sand must be given. I have also discussed this matter in answer to *Question 42.*

Question 54.—I have briefly touched on the matter of statutory control over mining methods in my answer to *Question 23.*

I do not consider there is any need for further control other than as discussed over mining methods in the interests of safety, but am agreeable as far as my answers above go to control in the interest of conservation as a national asset. I cannot agree, as would appear from the suggestion of the question of control for reasons of safety, that Indian mining is so dangerous as to call for statutory control greater than is exercised by any country in the world outside Germany and Belgium. In Germany and Belgium the coal is State owned and the Inspectorate there are, to no little degree, virtually royalty owners agents.

The coal mines of India are probably the safest in the world if we take into consideration the matter of the big thicknesses of the

seams worked; even if this is not considered the coal mines of India are known to rank high amongst the coalfields in the world in safety. Unfortunately I have not all the figures by me, but the Coal Working Committee have the means of getting that information. I might, however, be permitted to point out that the death rate in Home mines per thousand persons employed is 1·16 and that for coal mines in India in 1934 it was 1·04 per thousand persons employed. By way of further comparison that of shipping per thousand employed is 1·08. It may be observed that two-thirds of the accidents in Indian mines are from misadventure.*

Safety in Indian mines will be found to rank much higher than in American mines and higher than the average of European continental coalfields.

It is known that the accident rate amongst "floaters" such as constitute a large percentage of India's underground labour, *i.e.*, persons who work for a period and then go to their villages is considerably higher than amongst regularly settled labour. At Home, H. J. Humphrys (H. M. Inspector of Mines in charge of Yorkshire, before the Royal Commission on Safety in Coal Mines now sitting) said the accident rate "amongst 'floaters' is four times as high as amongst settled labour". We have a very big proportion of "floaters" in Indian mines and the human element very considerably affects Indian mine-accident statistics, and consequently the accident rate per thousand.

Regarding falls in depillaring areas, it may briefly be mentioned that depillaring areas appear to be as safe from falls as other places in the mines.

After all, conservation will give protection against hazards by preventing fires and collapses. Added safety, therefore, may be considered as a natural sequence to conservation, and any further statutory control should be for conservation.

As to what fields compulsory stowing should be applied I refer the Committee to my answer to *Question 40*. I am in favour of the universal application of such control as may be prescribed, provided such be sufficiently flexible to satisfy varying local conditions.

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* The Annual Report of the Chief Inspector of Mines for India for 1935 is now to hand.

The death rate per thousand for 1935, was 1·66. 1935, however, was an exceptional year and includes the accidents of Bagdigi and Giridih.

We have recently had the Poidih disaster. These major accidents are most distressing and their lessons must be learnt and applied. Major accidents, however, by their greater appeal to sympathy, are liable to distort entirely the true perspective of the accident in mines problem and undue emphasis is likely consequently to be given to explosions. Taken over a range of years these are not the accidents that account for most deaths in our mines.

Rather, it is the classes of accidents that result in the deaths of ones and twos that accumulate to the higher totals and which carry much the greater risk to the individual worker.

I do not wish to labour the general theme of safety of Indian mines, but I may mention that in 1932 the accident rate in and about mines in and about Japan was 4·07 per thousand employed (*Colliery Guardian, 23rd July 1935*) and Dr. H. Foster Bain, Director of the Bureau of Mines, U. S. A., stated that their death rate was 4 per thousand of those who work underground (*Trans. Inst. Mining Eng., Vol. LXVII (4), 1924, p. 395*).

Question 55.—Please refer to my answer to *Question 40.*

I am agreeable to the prevention of avoidable waste.

Questions 56 & 57.—I refer to the replies* of the Managing Agents of Messrs. The East Indian Coal Company's Collieries.

Question 58.—I consider that ordinarily the outlets of a mine should be under the independent control of the Manager and they should most certainly be within the purview of the mine.

There is, however, a difficulty that might arise and that is with a large colliery—perhaps one mine within the meaning of the Act—where the area may be so large, or for other reasons, as may require two managers. In which case difficulty may be foreseen.

I may record that for one period we had two managers at Bararee colliery, which was one mine. The charges were known as Division No. 1 and Division No. 2, but none the less the colliery was one mine.

I prefer that the words "within the leasehold" of the mine should be omitted. Many collieries work areas under more than one leasehold. If the manager has control of both outlets that should be sufficient.

Question 59.—I refer you to the replies* of the Managing Agents of the East Indian Coal Company's Collieries.

Question 60.—The primary function of a colliery plan is the correct and plain delineation of the position of underground workings. I consider that it is inadvisable to overload a working plan with too much detail extraneous to the main function of the plan as defined above.

I agree that there are great advantages in having complete detail of the surface buildings, tanks, etc., shown on the working plan, but there are disadvantages in the possible overloading of a working plan to the extent of making it confusing. I am, however, in general concordance with the idea underlying the suggestion.

Question 61.—Combustion engineers have already made great advances in the use of inferior coals and there is no doubt that still further progress will be made. This, however, is a threat to the markets of the better coals and the greater the competition of the poor coals—and the resulting greater marketing difficulties for the better coals—the less the chances of sandstowing being an economic success. I hardly think Government should, in equity,

* Page 67.

interfere by law in the prevailing economic balance, which interference definitely would mean the direct mulcting of a large section of a large industry for the future needs of another industry, *i.e.*, the iron and steel industry, and which needs, so far as the blast furnaces coking coals go, may be in future reduced by the progress of technical research. Moreover, as far as the needs of the iron and steel industry goes the iron ore is of such exceptionally high grade that coals of grade lower than first grade may be used by blending.

Question 62.—I refer you to the replies* of the Managing Agents of Messrs. The East Indian Coal Company's Collieries.

Question 63.—Unless one knows all the facts, which the ordinary witness cannot, it is impossible to fully answer this question. I would, however, point out that—

(1) Many such notices may be those for which the Mines Department have been given newly prescribed powers under Act No. XI of 1936. Presumably the operation of a new Act giving such powers would be more active in the first year of its operation, in particular as the powers have reference principally to old workings which have had no such control previously. The accumulated position of years past is being liquidated in one year.

(2) The Mines Department are given very wide discretionary powers and the orders made under Section 19 of the Coal Mines Act and under Act XI are necessarily chiefly of *ex-parte* opinion based on the evaluation of possibilities which may eventuate.

(3) Some of these orders are probably made to meet possibilities as may arise from rapid and excessive flooding of rivers during the monsoon seasons. Such conditions are not prevalent in England.

As to safety of labour I have previously shewn how highly Indian mines rank with the mines of the world.

The coal mining industry is now subject to an activated Section 19, which Section has always been more or less dormant, and in my opinion the derogatory comparison with England as suggested by *Question 63* is illogical.

40. Written Evidence of Mr. P. H. Pandya, Manager, Jote Dhemo Colliery of Jote Dhemo Colliery Co., Ltd., Burdwan District.

Question 1.—I hold the appointment of Manager and Superintendent. I have eight years' experience of Jharia coalfield and eight years of Raniganj coalfield.

* Page 67.

Question 2.—Thick seams having vitrain bands, *i.e.*, bands of bright coal having low percentage of ash and of brittle nature which causes disintegration when exposed to air. Almost all good quality coal seams have these bands and are liable to spontaneous combustion when left out unworked in goaf.

Yes.

So far as I know, more fires are caused by normal collapses.

Question 3.—All coal seams of friable nature are most liable to spontaneous combustion, *e.g.*, Jharia Nos. 14-14A and 15 seams and Raniganj-Dishergarh, Sanctoria, Kajora, Jote Janki.

The incubation period varies from three months to eighteen months depending on the quantity and quality of coal left in goaf. No coal of commercial value is free from the risk of spontaneous combustion.

Question 4.—Yes.

Question 5.—Yes. About 20-30 per cent. of the seam.

Question 6.—They are quite adequate for minimising the possible dangers from fires.

Question 7.—Yes, if the natural ventilation is not adequate. Safer to be exhausting.

Question 8.—Yes. Kajora seam.

Questions 9 & 10.—No.

Question 11.—Sufficient sealing materials should be kept ready for dealing with emergency.

Question 12.—Training in the methods of dealing with underground fire and in mine rescue work should be given to all the persons working at rescue stations.

Question 13.—They are of no use in dealing with live fires. The use of breathing apparatus and gas masks are very necessary in dealing with the fire in its initial stage, *i.e.*, before the actual fire breaks out.

Question 14.—Yes.

Question 15.—Yes. Working should be on panel system and sufficient sealing materials should always be kept ready before actual depillaring is started.

Question 16.—Yes. Seam like Jairangdih.

Question 17.—In sufficient size of pillars.

Question 18.—Fires. Accidents due to air blast and inundation. By stowing.

Question 19.—No.

Question 20.—The main factors that would govern the sizes and dimensions of pillars in different seams are as follows:—

(1) Depth of the seam.

(2) Thickness of seam.

(3) Nature of coal.

(4) Nature of roof and floor.

(5) Inclination of seam.

(6) Method of working.

(7) Presence of faults and dykes.

Question 21.—No.

Question 22.—No, restrictions can be laid out as the condition varies.

Question 23.—No.

Question 24.—No.

Question 25.—Yes. Tisra, Bagdigi and Shampur.

Jore got into the mine in heavy monsoon.

Question 26.—Yes.

Question 27.—Closing up of all possible entrances into the mines by building embankments, bands, etc., after studying the highest flood level. Watchman should be kept on surface to give sufficient warnings to mine officials for withdrawing persons from mines when necessary.

Mines Department should be in a position to send warnings to all parties likely to be affected by inrush of waters whenever heavy floods are apprehended.

Yes. Whenever necessary.

Question 28.—None.

Question 29.—No.

Question 30.—Yes.

Question 31.—The proviso should be retained. In a special case like a long stone drift far away from shaft bottom it becomes very necessary to keep more than 5 lbs. at a time in one place.

Question 32.—No.

Question 33.—Jote Dhemo Top—Jambad seam. Quality good. Thickness varying from 8 feet to 35 feet. Inclination 1 in 20.

Jote Dhemo Bottom seam. Quality good. Thickness 15 feet. Inclination 1 in 13.

Gajdar Kajora Colliery—Kajora seam. Quality good. Thickness 18 feet. Inclination 1 in 20.

Question 34.—Only Sections are being worked—

Jote Dhemo Top—Jambad—8 feet to 20 feet from bottom.

Jote Dhemo Bottom—12 feet from bottom.

Kajora seam—13 feet from bottom.

Question 35.—The output is at present from gallery working. But if the depillaring is started, I do not expect more than 50 per cent. from the pillars.

Question 36.—In seams up to 15 feet thick about 75 per cent. In seams from 15 feet to 30 feet thick about 50 per cent.

Question 37.—Yes. North Barrakar Coal Co. from East Indian Railway. Maharaja Kasimbazar from Public Works Department. Khora Ramji of Khas Jharia Colliery from East Indian Railway. Particulars are not known.

Question 38.—Life and productivity will increase.

Question 39.—I favour the method of packing simultaneously with the extraction of pillars.

Question 40.—(*a*) In all workings which are likely to be affected by premature collapse.

(*b*) In all workings under fiery area and water area.

(*c*) Under important buildings, sidings, village, etc.

Question 41.—No personal experience.

Question 42.—In my opinion, it is for the Government to find out the means of additional cost.

Question 43.—Yes. It should be a representative body of expert mining engineers, owners, landlords and the Government.

Question 44.—No.

Question 45.—No personal experience.

Questions 46 & 47.—Yes.

Question 48.—Research works should be carried out to find out the proper uses of low grade coal to establish its commercial value.

Questions 49 & 50.—Yes.

Question 51.—Yes. The railway should bear the part of the cost on the ground that they have not to pay the compensation and they make earnings ffom sidings.

Question 52.—Partial filling may do in seams of less thickness and lying at great depth.

Question 53.—Additional financial help shall be necessary for the erection of plant.

Question 54.—No.

Question 55.—To both the fields. Yes.

Question 56.—Yes.

Question 57.—No. It may bring the following dangers:—

(1) Fire and gas penetration.

(2) Inundation.

(3) Premature collapse.

The remedy is that both the seams should be worked under one management.

Question 58.—Manager should have independent charge of both pits.

Questions 59 & 60.—Yes.

Question 61.—The Railway Board has shown the practical possibility of using more of good second class coal in place of high priced rich coal.

Question 62.—The effect has been to increase waste. Many instances will be found from the list of collieries having their coal graded.

Question 63.—In my opinion the Mines Department ought not to have issued such notices. I do not agree with the last part of the question.

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41. Written Evidence of Mr. W. M. Burch, Agent, Messrs. Equitable Coal Co., Ltd., Jamuria, Burdwan District.

Question 1.—(1) Colliery Agent for Messrs. Macneills' Poniati Group.

(2) 5 years in the Raniganj coalfield.

Question 2.—(1) The main cause is spontaneous combustion of coal left in the goaf.

(2) More fires I should think have been caused by normal collapses.

Question 3.—(1) I consider all equally liable.

(2) I am unable to state from my experience.

(3) None in India.

Question 4.—(1) I agree.

(2) Yes, unless goafs are totally packed, flooded with water or effectively sealed.

Question 5.—(1) Yes.

(2) 10 per cent. approximately for a 14 feet seam.

Question 6.—Adequate.

Question 7.—Generally I do not, each mine with a fire should be considered separately.

Question 8.—(1) Yes.

(2) Most fires can be attributed to this cause.

Question 9.—I do not.

Question 10.—I am not.

Question 11.—None.

Question 12.—Yes.

Question 13.—Breathing apparatus and gasmasks with trained men should be an advantage in dealing with fires under certain circumstances.

Question 14.—The regulation referred should apply to all mines.

Question 15.—(1) I agree.

(2) Panel system, with stoppings built before depillaring, maximum extraction and means of effectively sealing a panel with minimum delay.

Question 16.—I do not, for in any case electric safety lamps would meet the circumstances.

Question 17.—Too great a percentage of the seam taken in the first working.

Question 18.—(1).

(*a*) Collapse of surface buildings and mine outlets.

(*b*) Surface water entering mine.

(*c*) Risk of gob fires.

(2) Leaving adequate percentage of the seam for support in the first working.

Question 19.—I am not in favour.

Question 20.—Reply not needed.

Question 21.—I am not.

Question 22.—In my opinion, seams that are too thick, to be worked in sections. No definite restrictions can be made that would be satisfactorily applicable generally.

Question 23.—I am not in favour in each case.

Question 24.—This should be left to the Mines Department and provision should be made for right of appeal to a competent Mining Board.

Question 25.—(1) None, other than Loyabad and Bagdigi in 1935.

(2) Particulars generally known.

Question 26.—It is impossible.

Question 27.—The precautions necessary depend on circumstances and the Chief Inspector of Mines has already power to enforce such precautions legally when necessary.

Question 28.—None, except that Supplementary Temporary Regulation 5 should be amended to permit simultaneous shotfiring in the vicinity where coal dust has been treated in an approved manner.

Question 29.—No.

Question 30.—Yes.

Question 31.—(1) Retained.

(2) In certain circumstances it would be an advantage to have more than 5 lbs. of explosives in one place at one time.

Question 32.—None.

Question 33.—(1) Poniati seam only.

(2) Selected Grade.

(3) 5 feet to 14 feet thick.

(4) 1 in 20.

Question 34.—The seam is totally extracted in all cases.

Question 35.—(1) Jamuria and West Jamuria collieries 80 per cent. from depillaring and Akhalpur and Mundalpur collieries 50 per cent. from depillaring.

(2) 85 to 90 per cent.

Question 36.—It is impossible to estimate without knowledge of the circumstances at each colliery.

Question 37.—(1) All except coal already lost and coal at great depth where extraction will be possible without stowing.

(2) None.

Question 38.—Probably increase life 8 to 10 per cent. and reduction of output for similar length of working face.

Question 39.—I am not in favour.

Question 40.—No reply needed.

Question 41.—None.

Question 42.—I am not in favour.

Questions 43 & 44.—No.

Question 45.—(*a*) Timbering—In practice there is little or no saving in timbering costs.

(*b*) Fire-stoppings—The number and cost of fire-stoppings depend on the general " lay out " of a mine with a panel system of working the number of stoppings and therefore cost to the coal recovered is infinitesimal.

(*c*) Pumping—In first workings there would be no saving and the amount of saving in depillaring would vary so considerably according to depth, thickness of seam, presence of faults, dykes, etc., that it is impossible to give figures.

(*d*), (*e*), (*f*), (*g*) and (*h*) Any savings under these headings are problematical and would depend on conditions existing at *each* particular colliery.

Questions 46 & 47.—This is not usually done as most owners will conserve coal that can be sold.

Question 48.—Coal for which there is a market.

Question 49.—Yes, under certain circumstances.

Question 50.—This should be left to the discretion of the mine owner.

Question 51.—(*Not answered.*)

Question 52.—Possibly under certain circumstances.

Question 53.—Additional financial assistance would be necessary.

Question 54.—(1) Safety in mining methods, should be universal and is already provided for under the Mines Act, Regulations and Bye-laws and it is up to the Mines Department to enforce the law.

(2) Coal is undoubtedly a natural asset, but conservation should be *limited* to "unavoidable losses" so as to bring it within commercial possibilities.

Question 55.—(1) If adopted compulsory stowing should be restricted where the need is greatest for safety.

(2) Yes, for safety and where there is waste of coal for which there is a market.

Question 56.—Yes, if necessary for the total recovery of the coal in the property.

Question 57.—Yes, under certain circumstances.

Question 58.—The manager to have independent charge of the two shafts or outlets.

Question 59.—(1) and (2) I consider the checking and keeping intact of barriers between mines should be a duty of the Mines Department as also checking of boundaries that they agree, between two properties. If the staff of the present department is unable to cope with the work involved, then it should be added to in preference to having a statutory authority.

Question 60.—Yes.

Question 61.—(*Not answered.*)

Question 62.—The effect of the Grading Act has been to improve the quality of coal for export, thereby enabling India to recapture business lost in the past because of the poor quality of the coal shipped. The Grading Board was formed with this object and it has carried out its duties very satisfactorily. The Act has not resulted in increased waste inasmuch as it has not at any time prohibited an owner from working any seam or section of a seam desired. It has merely graded the seam or section worked by the owner, and the owner's choice in this respect has been guided solely by the requirements of buyers, a state of affairs existing in every coalfield in the world.

Question 63.—(1) Originally the Indian Act was not sufficiently comprehensive to provide against dangers primarily due to depillaring.

(2) No, it is impossible to compare Indian mining condition with those in England.

42. Written Evidence of Mr. A. T. Creet, Consulting Engineer to Messrs. Martin & Co.'s Collieries, Ghusick, Burdwan District.

Question 1.—Consulting Engineer to Messrs. Martin & Co.'s Collieries. 35 years in the Raniganj coalfield only.

Question 2.—Spontaneous combustion.

Yes.

Since there has been more pillaring, by premature collapses, as for normal collapses usually adequate safeguards are taken or can be taken in the way of stoppings, etc.

Question 3.—All Raniganj seams are liable to spontaneous combustion.

On the surface the Ghusick, Nega and Samla seams during 6 months of the year if stacked over 6 feet high and mixed with smalls, will go on fire in 2 to 3 months.

I do not consider any seam of commercial value is free from the risk of spontaneous combustion.

Have no experience of the incubation period in the mine and have no experience of Bihar fields.

Question 4.—Yes, to all questions in this number.

Question 5.—Yes.

Not more than 25 to 30 per cent. need be left according to thickness of seam, etc., if pillars and barriers are kept of proper sizes to start with. Panel working will not be of much use for stopping spontaneous combustion and fire into another seam immediately below or above the one, worked in panels.

Question 6.—I consider that the temporary coal mine regulations are good enough, but provision should be made against leaving too much combustible material in goafs when pillaring, in the way of smalls, roof coal, etc.

Question 7.—I think all mines having an area of say over 1,000 feet from either way from the shaft, in which there are sealed off fires, should be mechanically ventilated. Exhausting or forcing would depend on the distance of the sealed off area from the fan. It would be best to have the fan so arranged, as to work either way as required.

Question 8.—I consider it will increase the risk of spontaneous combustion. I do not know of any fire due to this cause.

Question 9.—Yes.

Question 10.—Yes. Telephonic communication should be fixed from over 2,000 feet from the surface.

Question 11.—The present regulations seem to be enough.

Question 12.—Yes.

Question 13.—Have no experience.

Question 14.—Yes, with modifications.

Question 15.—Yes. Panel working in the top seam also in the seam or seams below if the strata in between is thick enough to prevent fire from above getting to it. Otherwise stowing is the only way to prevent fires.

Question 16.—This danger certainly exists; but as seams giving off inflammable gas, would be working with safety lamps, they would not be as dangerous as the ones that just collected a pocket full, and had no signs of gas before.

Question 17.—Small pillars mainly. Often helped by faults.

Question 18.—The dangers from premature collapses are fire and often loss of life in seams already worked with small pillars. The one and the only way is stowing.

Question 19.—Yes.

Question 20.—In the first working, I would suggest 30 to 50 per cent. of the coal being taken out, depending on the thickness of the seam, the thickness of cover, whether any faults near-by, or any goafed area or river, etc., on top.

Question 21.—Yes.

Question 22.—I have no experience.

Question 23.—Yes.

Question 24.—Yes.

Question 25.—I have no experience.

Question 26.—Yes.

Question 27.—Adequate pillars to start with, stowing when pillars are being extracted. Yes.

Question 28.—No changes.

Question 29.—Yes.

Question 30.—Yes.

Question 31.—Yes. In case of sinking, and with gun-powder 5 lbs. at a time may not be enough for special purposes.

Question 32.—No.

Question 33.—(A) Ghusick seam, No. 1 Grade, 11 feet thick, dipping 1 in 8.

(B) Nega seam, No. 1 Grade, 18 feet thick, dipping 1 in 12.

(C) Samla seam, No. 1 Grade, 16 feet thick, dipping 1 in 10.

(D) Kasta seam, Selected Grade (the portion 11 feet 6 inches being worked), 30 to 40 feet thick, dipping 1 in 2.

Question 34.—Nos. (A), (B) & (C), as above, the whole section leaving about 1 foot inferior coal on the roof is being extracted. No. (D) only 11 feet 6 inches at the bottom is extracted.

Question 35.—At present we are not pillaring or only taking out the last few pillars left in one pit on Ghusick seam. In the

past we have done extensive pillaring in the Ghusick seam and recovered 60 to 70 per cent. of the pillars.

Question 36.—In the Jharia field about 30 per cent.; in the Raniganj field about 50 to 60 per cent.

Question 37.—Yes.

Don't know of any particulars of compensation being paid by railway companies but they have paid in a few instances.

Question 38.—The Ghusick, Nega, Samla and Kasta seams we are working in a semi-panel system, and pillaring could be done without stowing, specially as no other seams above or below are involved. In either of them, sand stowing would increase the quantity of coal recovered from pillars by about 25 per cent.

Question 39.—Have no experience of wholesale extraction.

Question 40.—No experience.

Question 41.—Not enough experience.

Question 42.—The additional cost should be levied as a cess on the total despatches. Some graduation should be made in the cess according to the selling value of the coal from different seams.

Question 43.—Yes, the statutory authority could be worked by the Mines Department.

Question 44.—Yes.

Question 45.—This would depend on the thickness of the seam and with what kind of pillars are left, the kind of pumping to be done and the quantity to be recovered from the barriers, under railways, etc., I should say anything from 3 annas to 8 annas a ton under all the headings.

Question 46.—Yes.

Question 47.—Yes.

Question 48.—Any coal having a calorific value of up to 6,000 calories.

Question 49.—Yes.

Question 50.—Yes where practicable. In some mines this can not be done now.

Question 51.—I think the railway concerned should bear part of the cost of extraction, as otherwise they have to pay compensation for leaving the coal behind.

Question 52.—Have no experience of partial filling and don't think partial filling would be successful.

Question 53.—I think it would be enough to deliver the sand in the colliery, this and the saving from items mentioned in *Question 45* should be enough to compensate the colliery against the cost for stowing.

Question 54.—I consider that statutory control over mining methods in the interest of (i) safety, should be universal. In the

interest of (ii) conservation of a national asset, should be for caking coals only, as there will not be any shortage of non-caking coals in India.

Question 55.—Compulsory stowing if adopted should be done in the Bihar fields also in the Bengal fields. In the latter field it should be limited to certain seams and areas only. I agree avoidable waste will be stopped wherever it occurs.

Question 56.—Yes.

Question 57.—No. The dangers are in case of wasteful working of one, endangering the other. I would suggest same as in No. 56 compel the owners to amalgamate.

Question 58.—I consider the manager of each mine should have sole and independent charge of the two shafts or outlets.

Question 59.—Yes to both questions.

Question 60.—Yes.

Question 61.—The G. I. P. Railway have remodelled their locos and seam to be able to use Pench Valley coal with success, which has a calorific value of about 6,000 only, so other railways could do the same.

Question 62.—The Coal Grading Act of 1925 has restricted most of the seams to a good section of the seam, to enable that section to be placed into Selected Grade or Grade I and the rest of the seam is wasted. In Kasta seam which is 30 to 40 feet thick, we are working only 8 feet 6 inches to 11 feet 6 inches at the bottom and the rest most of which will have over 6,500 calories is, and will be finally wasted.

Question 63.—I think it would be correct to infer that the Mines Department has to interfere more because, methods and practices dangerous to human life, etc., are more frequent in India than in England. The reason being that it will take many more years to instil responsibility and intelligence in the Indian labour, equal to the men doing the same jobs in England.

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43. Written Evidence of Mr. M. B. Roy, Manager, Guzdar Kajora Colliery, Kajora, Burdwan.

Question 1.—I hold the appointment as Manager of Guzdar Kajora Colliery and possess experience of Indian coal mining for 27 years, 15 years, in Raniganj field and 12 years in Jharia field.

Question 2.—The main cause of underground fires is oxidation of coal left in the goaf.

The number of fires has increased recently as more collieries are now working in the " broken ".

More fires are caused by normal collapses.

Question 3.—In Jharia field—seams Nos. 15, 14, 13, and 12.

In Raniganj field—Kajora, upper and lower, Jemahari or Raniganj Ponjati and Jot Janaki.

The period of incubation differ in each case under different conditions, ranging from 4 to 8 months.

No seam of commercial value is free from the risk of spontaneous combustion.

Question 4.—Certainly yes. If the roof hangs over the goaf in a large area, the danger is certainly greater, as also in case of contiguous seams.

Question 5.—Yes, if pillar extraction is at all desired. Coal left in barriers approximates 20 per cent.

Question 6.—The compulsory use of safety lamps in mines where there was once fire, but being sealed up, it evidently died out, appears superfluous.

A minimum quantity of air passing into the mine should be stipulated and a daily record of this should be maintained. Notice should be sent to the Chief Inspector of Mines, before extraction or reduction of pillars.

Question 7.—In shallow mines and not very extensively worked fans may not be necessary provided the minimum quantity of air and watergauge is maintained by other means; otherwise an exhaust fan is preferred, having reversing arrangements.

Question 8.—This is the most fruitful source of spontaneous combustion. In my experience, P. K. Chatterjee's Jote Dhemo Colliery fire in 1920 and K. Warah's Khas Jharia fire in 1932 may be directly attributed to this cause.

Question 9.—This will be quite useless.

Question 10.—Not necessary.

Question 11.—A good stock of bricks, brattice cloth, props, corrugated sheets and a set of competent men to use them should be always maintained.

Question 12.—Yes.

Question 13.—The use of breathing apparatus and gas masks should form a part of the first aid to the injured examination, so that all overmen and under-managers will have to pass this. They should also be required to attend periodically practical training at the rescue stations.

Question 14.—Not necessary.

Question 15.—Of course, precautions beforehand are much better.

The workings should be laid out in panels each containing not more than 20 pillars and barriers about 50 feet thick.

The pillars should then be quickly extracted and the entrances to the panels built up. The barriers to be left intact.

Question 16.—Yes, in special cases.

Question 17.—The premature collapse of workings is mainly due to leaving weak pillars and subsequently robbing them.

Question 18.—Dangers from premature collapse:—

(1) Underground fire.

(2) Accidents to persons living above.

(3) Accidents due to air blast.

Prevention:—

(1) Leaving pillars of sufficient size.

Question 19.—This should be left to the discretion of the colliery manager. No rule can be framed for general application.

Question 20.—Vide Question 19.

Question 21.—No.

Question 22.—There cannot be a standard rule applicable to every case.

Question 23.—Yes, but the process should be simple, as it is often necessary to change a system of workings in a short time. The sanctioning authority should be some one other than the Inspector of Mines, having both commercial and technical knowledge. An appeal should lie to the Mining Board.

Question 24.—Yes, provided it is economically possible.

Question 25.—(1) *Phularitand Colliery.*—The incline mouth was very near to a jore and was protected by a dam of insufficient size. In high flood the dam gave way and the water rushed in with terrible force and filled up the whole mine in no time.

(2) *Loyabad Colliery.*—By following an inaccurate plan and a defective system of management one gallery unexpectedly holed into an old working containing water. This water rushed down to the dip galleries and drowned the men working there.

Question 26.—Yes.

Question 27.—The fire area must be separated from the working mine by strong double stoppings with sand filling between. Should be of approved construction.

Question 28.—Nothing.

Question 29.—No.

Question 30.—Yes.

Question 31.—It should be retained, as in heavy blasting operations it is often necessary to use more than 5 lbs. at a time.

Question 32.—Nothing.

Question 33.—Kajora, lower seam.

Quality—Grade 1.

Thickness—21 feet.

Inclination—1 in 20.

Question 34.—The full thickness of the seam is 21 feet out of this the top 8 feet is of inferior quality and left in the roof. The

rest is made up of 7 feet 6 inches good coal, 2 inches shale band, 1 foot good coal 1 inch shale band then 4 feet 3 inches good coal.

Question 35.—We are working " in the whole ".

Question 36.—About 50 per cent. maximum.

Question 37.—The compensation paid by the E. I. Railway to North Barakar Coal Company, Limited, and the royalty owners for the coal locked up under railway line was Rs. 2,64,000 (two lacs, sixty-four thousands).

Similarly to Khora Ramji, proprietor of Khas Jharia colliery Rs. 96,000 (ninety-six thousands).

And to Jharia Raj Rs. 16,000 (sixteen thousands). The last case is under appeal.

Question 38.—Productivity and the life would be doubled.

Question 39.—I favour sand stowing in special cases and before pillar extraction only.

Question 40.—In most of the collieries in Jharia field, working contiguous seams.

Question 41.—No.

Question 42.—By preferential treatment at the State Railway's Coal Contract.

Question 43.—Yes, apart from the Department of Mines.

Question 44.—Yes, *vide Question 23.*

Question 45.—Unknown.

Question 46.—It must be prevented.

Question 47.—It must be prevented.

Question 48.—There cannot be any hard and fast definition for coal of commercial value, as it differs with time and market conditions, but generally speaking " the coal having pit mouth value exceeding the cost of raising and royalty may be called having commercial value ".

Question 49.—Yes.

Question 50.—Yes, but it must be properly done.

Question 51.—The railway company should bear part of the cost, because they will earn more freight on the coal that had otherwise been lost, and for the benefit of not having to pay heavy compensations.

Question 52.—In thin seams at great depths partial filling would be sufficient, but in thick seams at low depths complete filling would be necessary. It also depends upon the degree of safety of surface required.

Question 53.—Financial help would be necessary in most cases.

Question 54.—If such control is to be introduced it must be universal, because it means an additional cost per ton. If it is introduced in one field alone that field will not be able to compete in the open market with other fields.

Question 53.—It should be enforced at first to the collieries of Behar field, because they are so closely situated and the transport facilities so well and also because the caking coal being much more valuable it should be preserved first. Upon the result of Bihar field it may be introduced to Bengal in special case. All avoidable waste should be stopped.

Question 56.—The idea is very good, but it would require a very stern action on the part of the Government who have to overcome various legal obstacles and oppositions from the coal trade.

Question 57.—It is not desirable at all that different seams in the same area should be worked by different owners.

The dangers from such system:—

(1) There will always be a jealousy and one will try to harass the other in every way.

(2) If the top seam owner keeps his mine closed and full of water the bottom seam owners will not be able to extract pillars.

(3) The top seam owners may construct such surface works and tram lines on places most suitable for the bottom seam owners to start pillaring.

(4) The bottom seam owners may keep insufficient pillars that may endanger the top seam.

The remedy,—

(1) There should be one manager for both the seams appointed jointly by both the owners, or the works should be conducted under another disinterested mining engineer strictly according to the proposed plan sanctioned by both the owners.

(2) Sand-stowing is essential in such cases for both the seams.

Question 58.—The two shafts must be under the control of one manager and belonging to the mine.

Question 59.—This is absolutely necessary. The check by a statutory authority would give more security. Under the present law the Department of Mines already possess that authority.

Question 60.—Yes.

Question 61.—From my experience of the use of various types of land boilers, I am of opinion that by suitable adjustment of fire-grates and feed air draught coal of Grade II can be successfully used for all ordinary steaming purposes.

The railway locomotives except for the mail trains or fast passengers may be run with inferior coal. This would effect a great saving for the railway and preserve the good coal for other purposes.

The coal of Grade II may also be used for soft coke making and for various domestic purposes, *e.g.*, brick and tiles burning, etc.

Question 62.—The introduction of the Coal Grading Board Act has considerably increased the wastage of coal other than the best. In Kajora seam the top 8 feet is of Grade II, and in pillar extraction this whole thickness is left in the goaf.

Example:—Messrs. Roy and Dutt's Kajora Colliery.

Question 63.—This is regrettable, and should not be.

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44. Written Evidence of Mr. J. G. Banerjee, Manager, Radhamadhabpur Colliery, Burdwan District.

Question 1.—I am a Colliery Manager I have 23 years experience of Indian coal mining conditions in Raniganj coalfield.

Question 2.—The cause of underground fires in coal mines in India is chiefly due to the large quantities of inferior or irrecoverable coal left in goaves. Yes. The number of fires have increased in recent years. More fires have been caused by normal collapses.

Question 3.—The coal seams rich in volatile matter and poor in ash are most liable to spontaneous combustion. The period of incubation is very difficult to particularise. It varies from 6 to 20 months. I do not consider that any seam of commercial value is free from the risk of spontaneous combustion.

Question 4.—I agree. Yes. These difficulties and dangers become greater at the final stage of pillar extraction.

Question 5.—Yes. About 8 per cent. of the seam has to be left in barriers, percentage, however, varies with depth.

Question 6.—I do not consider that the Temporary Coal Mines Regulations are adequate against all possible dangers from fires. In depillaring district of a seam liable to spontaneous combustion, the operation shall be carried on in such a manner as to leave as little combustible material in goaf as the safety of the mine demands. The surface above a fire area underground shall be kept fenced and no person shall be allowed to live in such area or surface.

Question 7.—Yes. The fan should be exhausting.

Question 8.—No.

Question 9.—No.

Question 10.—Yes. I am in favour of this—beyond 2,000 feet from shaft bottom.

Question 11.—Barometric pressure, temperature and the humidity of the mine air should be recorded at least once in every 24 hours and action should be taken immediately, if this indicates any danger.

Question 12.—Yes. I am in favour of this proposal.

Question 13.—I have no experience.

Question 14.—In my opinion, it is not necessary.

Question 15.—Yes. I agree. Retreating from the dip followed by flooding will eliminate the risk.

Question 16.—I think, this should be enforced in thick seams only.

Question 17.—This is due to keeping pillars of too small size for the thickness of the superincumbent strata, that of the seam and the nature of the coal itself.

Question 18.—Fires and possibly further collapses may occur. This can be prevented by keeping and maintaining properly sized pillars.

Question 19.—I am not in favour of this, because the conditions vary.

Question 20.—In view of the preceding answer it does not arise.

Question 21.—I am in favour of this.

Question 22.—In my opinion, the height of gallery in each section worked one above the other should not exceed 15 feet with a minimum parting of 5 feet, if it is coal.

Question 23.—I am not in favour of this.

Question 24.—No.

Question 25.—Yes. The Chief Inspector of Mines' Annual Reports may be consulted. I have no personal experience.

Question 26.—Yes.

Question 27.—Against this danger I would suggest complete or partial stowing of goaf so as to keep the superincumbent strata undamaged.

Question 28.—I have no suggestions to offer.

Question 29.—I am not in favour of this suggestion.

Question 30.—Yes.

Question 31.—I consider that the proviso should be retained. In case where gun powder is used or in sinking shaft more than 5 lbs. of explosive may be required at one time in one place.

Question 32.—Each shot firer should furnish separate account of the explosives issued to him and used by him during his shift.

Question 33.—Ghusick seam is being worked in the colliery, where I am working. The thickness is 10 feet 6 inches. Inclination—varying roughly 1 in 25. Quality—first grade.

Question 34.—The whole seam is being extracted in one section except 1 foot 6 inches (inferior coal) at the roof.

Question 35.—*Nil.*

Question 36.—I think about 60 per cent. may be recovered with existing methods of working.

Question 37.—Yes, this coal will be lost. I do not know of any such instance.

Question 38.—This, I think, would not make considerable difference in the Ghusick seam.

Question 39.—I am in favour of a system of a filling or packing simultaneously with the extraction of pillars.

Question 40.—Where there is fire or water in upper seam. In very thick seams, which cannot be worked except by sections or in which fire exists and where valuable surface has to be protected.

Question 41.—I have no such experience.

Question 42.—The additional cost should be met by the royalty owners, because they would get more royalty in the long run and by the consumers.

Question 43.—Yes. The statutory authority should be constituted of the nominees of the Government, the colliery owners, the royalty receivers and the organisation of mining engineers in equal proportion.

Question 44.—No.

Question 45.—I have no suggestions to offer.

Question 46.—Yes, I think so.

Question 47.—Yes.

Question 48.—It is difficult to lay down a proper definition of the term. The coal which we call to-day "bad" may be commercially suitable later on.

Question 49.—Yes.

Question 50.—Yes.

Question 51.—The railway administration should bear part of the cost because they have acquired the land by the Land Acquisition Act and the Indian Mines Act has protected the railway against damage which may be caused by the mine working. It would be fair if the railway concerned pay partly for the stability of the surface along with the mine owners instead of blocking so much coal.

Question 52.—I am unable to give any definite opinion.

Question 53.—If sand is delivered free at the colliery, I think the colliery should bear the rest of the cost.

Question 54.—The control should be universal for the conservation of coal. For safety—the existing legislation, I think, is sufficient.

Question 55.—Compulsory stowing, if adopted, should be extended to the Bengal coalfields also. I agree that avoidable waste should be stopped whenever it occurs.

Question 56.—Yes. I am in favour of this proposal.

Question 57.—No. The fault of one owner in such case is liable to affect the other. If more than one seam is worked by different shafts, the owners should be bound to keep the strata undamaged.

Question 58.—Yes.

Question 59.—I am in favour of this suggestion. The statutory authority should have power to survey barriers between adjoining mines.

Question 60.—Yes. It is necessary.

Question 61.—I have no practical ideas on this subject.

Question 62.—I think it has increased the waste but I am unable to give particulars of actual instances specifying the colliery and the seam.

Question 63.—The geological condition of the coal measures in India is quite different from that of Great Britain and this condition is chiefly responsible for the methods of work for which the Department of Mines had to interfere under Section 19.

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45. Written Evidence of Mr. W. D. Robb, Manager, Hurriladih Colliery of Messrs. Equitable Coal Co., Ltd., Jharia.

Question 1.—Agent and Manager of group of collieries in Jharia. 18 years in the Raniganj and Jharia coalfields.

Question 2.—Spontaneous combustion. Regarding the number of fires in recent years, this can only be answered by those who are informed of such occurrences and keep statistics. Premature collapse would tend to increase the likelihood of fires on account of unworked coal being left in the subsided areas. In cases of normal collapse all roof coal has been taken down and small coal removed from the goaves.

Question 3.—(1) I consider all seams being worked 5 feet and over in thickness, and even less than 5 feet if careful supervision is not given to the recovery of "small" coal, "stocks" or "roof" coal in goaves.

(2) The term is not understood, but in many cases, signs of heating have been detected within 1 to 3 days of a main roof fall to the surface.

(3) Replied to under *Question 3 (1)*.

Question 4.—(1) Yes, but the danger is considerably minimised if isolation is effective at the "heating" stage.

(2) Difficulties may become greater, unless each seam can be flooded with water or effectively sealed.

Question 5.—(1) Yes, and in well managed collieries *all* seams are laid out on a system of panels.

(2) Barriers represent approximate 15 per cent. in the first working, of which 75 per cent. would be recovered on depillaring a seam dipping at 1 in 10 or steeper, and depending on the depth from surface and area depillared.

Question 6.—The Temporary Coal Mines Regulations would appear to adequately give protection from the possibility of danger arising from fire.

Question 7.—The reply is in the affirmative. The situation of the workings in relation to the existing fires would be the guiding factor as to whether a fan should be exhausting or forcing. With compulsory reversing arrangements the alternative exists.

Question 8.—The reply is in the affirmative. No knowledge of any fire.

Question 9.—The adoption of water mains is not warranted as far as accidental fires are concerned and would serve little purpose in the case of spontaneous combustion, but would be beneficial where dusty haulage roads exist, provision for same is made under Rule 13 (b) of the Temporary Coal Mines Regulations.

Question 10.—In Indian mines the general conditions are such that the ends of haulage roadways are not remote, so that the telephone connection is not necessary.

Question 11.—None.

Question 12.—The training of brigades in the methods of dealing with underground fires, etc., is essential as they are more likely to be engaged in this class of work than rescue operations.

Question 13.—Breathing apparatus and gas masks should be maintained at the central mine rescue stations and made available for use by teams of workers sent from collieries for instruction so as they can be made acquainted with their use, and if necessary, be available at call from any colliery so requiring them.

Question 14.—I consider this Regulation should apply to all mines, whether liable to spontaneous combustion or not.

Question 15.—Mines which are properly managed do take precautionary measures to ensure safety against fire and all other occurrences. Methods of working are given first consideration.

Question 16.—I do not consider stowing is necessary in any seam under the conditions stated, as ample safeguards are already fully provided for in the Mines Act, Regulations and Bye-laws and that in any case an installation of electric safety lamps would meet the circumstances without stowing the goaves.

Question 17.—Premature collapse is more or less due to bad management, whereby pillars are formed too small or reduced by pillar robbing, making the stability of the pillars as a means of support unsound.

Question 18.—(1) Under certain conditions, premature collapses would cause no danger to persons or buildings on surface.

(2) Underground danger is from "air blasts", which can be eliminated by observance of conditions and withdrawal of workmen.

Question 19.—I am not in favour of gallery and pillar dimensions being laid down by law, as I consider it interferes with the rights of owners.

Question 20.—No reply required in view of reply to *Question 19.*

Question 21.—The Chief Inspector of Mines has ample powers to prevent the splitting of pillars if he considers same unsafe so that the legal point does not arise.

Question 22.—None of the Company's collieries are working under the conditions stated and each case would have to be considered on its merits.

Question 23.—I am not in favour of a statutory authority for the purposes stated as I consider it interferes with the rights of private property.

Question 24.—No. This is a question principally for the Mines Department and an appeal therefrom to an expert Mines board or committee.

Question 25.—No knowledge of any such occurrence.

Questions 26 & 27.—This is a matter of opinion, and before I could express an opinion, a "fire area" would need to be strictly defined.

Question 28.—There are no great changes required in the Permanent Regulations, but I consider Supplementary Temporary Regulation 5, should be amended to allow of artificial watering and so make it permissible to fire more than one shot at a time. The drenching of coal dust with water is allowed when "permitted" explosives are used and I see no objection whatever why watering is not allowed in an open light mine, where ordinary explosives are used.

Question 29.—No, as I consider safety is amply provided for.

Question 30.—I am *not* in favour of shot firers as such, and consider the duty of shot firing should only be entrusted to the sirdar, overman, or other competent person in charge of that part of the mine where shot firing takes place—this refers particularly to mines using safety lamps—there should be no divided responsibility between 2 persons in the same district of a mine.

Question 31.—I consider the quantity should be increased by a reasonable amount according to circumstances at each mine fixed and by the management—I consider that 5 lbs. explosive accidentally fired will kill a person just as effectually as say 15 to 20 lbs., therefore there appears to be no point in unreasonably limiting the quantity.

Question 32.—The existing regulations are adequate.

Question 33.—Nos. 14, 16 and 17 Seams—

14 Seam—Not Graded—26 feet thick—1 in 9.

16 Seam—Partly Graded—13 feet thick—1 in 9.

17 Seam—Selected Grade—7 feet 6 inches thick—1 in 9.

Question 34.—14 seam only formed into pillars and workings discontinued at present. 16 seam, a selected grade section of 7 feet is being worked leaving 10 inches roof coal. The lower portion is of no commercial value.

17 seam, the whole seam is being worked.

Question 35.—The whole output from 17 seam and 90 to 95 per cent. is actually recovered.

Question 36.—No reply.

Question 37.—Large quantity of coal are unnecessarily locked up under railways due to inconsiderate reasoning of prevailing conditions by those who enforced restrictions. Seams lying a normal depths and thin seams could be extracted without stowing, provided the railway companies packed up their lines when subsided and relieve the collieries of any liability for damage or demurrage. There are also cases of coal under villages being locked up where it could be taken out without materially damaging property.

Question 38.—If stowing were made compulsory the life of the collieries would not be materially extended by the recovery of barriers, but it certainly would be extended by reducing the productivity, owing to insufficient supply and means of providing stowing material. In fact such compulsion might mean the collieries closing down as economically unsound.

Question 39.—No. The whole problem is of such a magnitude that no practical means is possible of carrying same out and in addition such a proposal from a financial point of view could not under any circumstances be borne by the collieries.

Questions 40 to 42.—No reply.

Question 43.—I do not think a statutory authority necessary—if the Chief Inspector insist on stowing from a safety point of view, then the mine owner must have the right of appeal to an *expert* Mining board or committee.

Question 44.—No.

Question 45.—No reply.

Question 46.—I consider that wherever coal in a seam is of "commercial value" it is worked and not left, and therefore the question of control not arise.

Question 47.—I am of opinion that this is not the case.

Question 48.—In view of above two replies, no need for an answer to this question but I do define coal of "commercial

value ", being coal which on sale (at the time it is raised) gives to the producer a profit over the cost of production, and furthermore, is a coal for which there is a demand by buyers.

Question 49.—Under certain circumstances yes.

Question 50.—The mine owners should not be subject to any compulsion and it should be left to them to decide if removal of coal from under a railway siding can be carried out economically with or without stowing and at the same time not cause a dislocation of railway working.

Question 51.—I consider the railway companies should if it all possible, divert their lines at their own cost, and leave the coal free for extraction.

Question 52.—I doubt if partial stowing would be a success, except in very exceptional circumstances.

Question 53.—I consider that if compulsory stowing is insisted on, the whole cost should be paid—in many cases the cost of dumping the sand at the pit top represents less than one-half of the total expenditure incurred in stowing.

Question 54.—(1) Safety in mining methods, should be universal and is already provided for under the Mines Act, Regulations and Bye-laws and it is up to the Mines Department to enforce the law.

(2) Coal is undoubtedly a natural asset, but conservation should be *limited* to " unavoidable losses " so as to bring it within commercial possibilities.

Question 55.—I consider that compulsory stowing should be restricted to *certain areas only* and not indiscriminately to the whole area of the Jharia coalfields, and *if necessary*, to certain areas in the Raniganj coalfield working under similar conditions to Jharia—the question of spontaneous combustion does not arise, as all *good* coals are liable to spontaneous combustion if conditions underground are *made* favourable for its propagation.

I agree that *avoidable waste* should be stopped if an agreed definition of " unavoidable waste " can be arrived at—*perfection* in mining methods is a question of expenditure, and therefore depends greatly upon an adequate selling price.

Question 56.—If it is a question of safety, the remedy is in the hands of the Mines Department who should prohibit the working of the mines in a dangerous manner, on the other hand, if properties are small and cannot be made an economical or commercial proposition as they exist, then the sooner they close down the better, and until the small owners voluntarily come to a working arrangement with themselves and their landlord.

Question 57.—I approve of the arrangement stated in the question.

Question 58.—I consider that the manager of each mine should have independent charge of the 2 shafts or outlets.

Question 59.—Rule 76 (1) (2) if exercised by the Chief Inspector of Mines is sufficient.

Question 60.—One plan showing the workings in relation to all surface buildings, etc., should suffice.

Question 61.—This is a question principally for the consumer who in recent years appears to appreciate that it is a better commercial proposition to purchase selected or first grade coal from an efficiency point of view, in preference to 2nd grade coal with ash contents 100 per cent. more than 1st grade.

The available reserves of good 1st class coal would be considerably *increased* and *conserved* if the largest consumers, *i.e.*, the State Railways controlled by the Government stopped the use of coking coal and used non-coking coal for locomotives.

Question 62.—The effect of the Grading Act has been to improve the quality of coal for export, thereby enabling India to recapture business lost in the past because of the poor quality of the coal shipped. The Grading Board was formed with this object and it has carried out its duties very satisfactorily. The Act has not resulted in increased waste in as much as it has not at any time prohibited an owner from working any seam or section of a seam desired. It has merely graded the seam or section worked by the owner, and the owner's choice in this respect has been guided by the requirement of buyers, a state of affairs existing in every coalfield in the world.

Question 63.—I suggest the inference is not correct and until the more recent orders issued under Section 19 are put up to an independent Mines board or committee for approval or otherwise, then the orders recently issued stand simply as the opinion of the Mines Department and therefore do not represent a true appreciation of the position.

There will always be in this and in every other country a number of owners and managers, not only in coal mining, but in other industries, who are prepared to go to the utmost limit, to achieve their end, at the same time, I consider the majority of owners and managers do give very serious consideration and attention to safety of human life and property, and I think the question of a comparison of "dangerous practices" between India and England should not have been made when the circumstances of the application of Section 19 were known.

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46. Written Evidence of Mr. S. N. Mitter, Manager, Khas Sitalpur Colliery, Burdwan District.

Question 1.—Colliery Superintendent and Manager. I have experience of more than 20 years in coal mine within Jharia, Raniganj and Pench Valley coalfields.

Question 2.—(*a*) Spontaneous heating of coal left in goaves; (*b*) possibly; (*c*) by normal collapses.

Question 3.—(*a*) Jharia:—Seams Nos. 18, 17, 15, 14, 13, 12, 11.

Raniganj:—Dishergarh, Sanctoria, Poniati, Koithi, Kajora, Jambad, Jote Janki, Ghusick.

Pench Valley:—Ghorawari, Datla, Burki, Ghogri.

Seams of selected grade and Grade I are liable to spontaneous combustion.

(*b*) Depends upon the quantity of coal left in the goaf per unit area and the condition of ventilation (6 months to 2 years as it depends on circumstances).

(*c*) No.

Question 4.—(*a*) Yes. (*b*) Yes. (*c*) Yes.

Question 5.—(*a*) Yes, certainly. (*b*) about 20 to 25 per cent.

Question 6.—Quite adequate at the present time.

Question 7.—(*a*) Yes, provided the natural ventilation is not adequate; (*b*) Exhausting safer.

Question 8.—(*a*) Yes. (*b*) Kajora, Poniati.

Question 9.—Not necessary.

Question 10.—No. Legislation is not necessary.

Question 11.—None. Except sufficient sealing materials should be kept ready at the mine.

Question 12.—Yes. All persons working at the central mine rescue stations should be given such training.

Question 13.—Both are advantageous.

Question 14.—Yes.

Question 15.—Yes. Working should be made on panel system and sufficient sealing materials should be kept ready before actual depillaring is started.

Question 16.—Only in the seams which give off inflammable gas in great quantity and the seams are thick.

Question 17.—Due to insufficient size of pillars.

Question 18.—(*a*) Dangers to life and property, possibly fires and inundations.

(*b*) By stowing or adequate supporting.

Question 19.—No.

Question 20.—(*a*) Does not arise.

(*b*) Depth of the seam.

Thickness of the seam.

Inclination of the seam.

Nature of roof above the seam.

Nature of floor below the seam.

Nature of coal.

Structure of coal.

Question 21.—No.

Question 22.—No definite restriction with the number of sections and parting between them as the circumstances are so varying.

Question 23.—No.

Question 24.—No. Section 19 (1) A. B. covers it.

Question 25.—Yes. Lakurka colliery flooded in the year 1913 due to heavy flood in Kartijore, when jore water swelled up and entered in the mine through No. 3 incline.

Question 26.—Yes.

Question 27.—(*a*) Cutting drain around goaf.

Erecting Bands around goaf.

Blanketting goaf if possible.

Diverting course of surface drain.

Maintaining pillar of highest flood level of the adjacent river, and watching over such pillar during monsoon days.

Erecting embankment for preventing river water entering into the mine.

Arrangement of giving danger signal from such riverside to the mine (underground).

Draining adjacent tanks.

(*b*) Yes. Legally wherever necessary.

Question 28.—None.

Question 29.—No.

Question 30.—Yes.

Question 31.—Should be retained. Circumstances often come when it requires.

Question 32.—None.

Question 33.—Jambad seam. Good second class, seam 40 inches, present working section top 10 feet 8 inches, inclination varies from 1 in 14 to 1 in 18.

Question 34.—Sections particulars given in *Question 33.*

Question 35.—No depillaring, but driving galleries.

Question 36.—Up to seams 15 feet thick about 75 per cent.

Up to seams 15 feet to 30 feet thick about 50 per cent.

Question 37.—(*a*) Yes.

(*b*) (1) Messrs. North Burrakur Coal Co., have got compensation from East Indian Railway Rs. 84,000 for coal locked under Jharia yard.

(2) Maharaja of Kasimbazar *versus* Public Works Department for coal locked under Grand Trunk Road and Barakar bridge. Plaintiff Maharaja has received compensation.

(3) Khora Ramji *versus* East Indian Railway for coal locked under Jharia Station. Plaintiff has received compensation of Rs. 96,000.

Question 38.—Life of the colliery as well as productivity will be increased in the long run but output for month will be decreased.

Question 39.—Sand-stowing may be forced simultaneously with the extraction of pillars.

Question 40.—(1) In all workings which are likely to be affected by premature collapses.

(2) In all workings within fire and water logged area.

(3) In all workings under important buildings, sidings, villages, rivers, etc.

Question 41.—No.

Question 42.—Imposition of—

(1) Cess on all coal despatched throughout India.

Cess on royalty figures.

Cess on protective duty.

(2) Rebate on railway freight.

Question 43.—Yes. Such authority should consist of experienced mining engineer nominated by different bodies connected with the industry and from the Government including the Chief Inspector of Mines as an *ex-officio* member.

Question 44.—No.

Question 45.—Certain amount of saving under heads (*a*), (*b*), (*d*), (*e*) and no saving under heads (*c*), (*f*), (*g*), (*h*), it will be increased under heads (*c*), (*h*).

Question 46.—Yes.

Question 47.—Yes.

Question 48.—Any coal saleable at the present market.

Question 49.—Yes.

Question 50.—Yes, provided the mine owners are compensated for the cost.

Question 51.—Yes, as they would be saved to pay compensation

Question 52.—Partial filling in seams comparatively thin and are lying at a great depth.

Question 53.—Additional financial assistance will be necessary for erecting plants, etc.

Question 54.—No.

Question 55.—To both the fields. Yes.

Question 56.—Yes. If possible.

Question 57.—No, it should be under one management.

Question 58.—Managers should have independent charge of both the outlets, in every new case.

Question 59.—(*a*) Yes, (*b*) No.

Question 60.—Yes.

Question 61.—Railway locomotives may be designed to burn low grade coal as Great Indian Peninsula Railway Company are doing. Railway freight should be charged less to encourage its sale. Higher grade coking coal like Giridih coal should be preserved.

Question 62.—Several collieries in Raniganj field are working seams in certain sections bearing certain amount unworked which involves a serious risk of fires. As for instance Kajora seam.

Question 63.—(*a*) Due to a number of recent big accidents and the Department of Mines have become nervous.

(*b*) No. Not in general.

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47. Written Evidence sent in by the Government of the Central Provinces.

Question 2.—There have been no reports of occurrence of fires in coal mines in the Central Provinces.

Question 6.—They are considered to be generally suitable.

Question 12.—The proposal for a rescue station at the Pench Valley coalfields with which alone the Central Provinces Government is concerned, is generally suitable. As for the second part of the question, this is not so essential in the Pench Valley as in other coalfields, where the danger of fires is greater.

Question 14.—Coal in the Central Provinces mines is not liable to spontaneous combustion as it does not ordinarily give off inflammable gas.

Question 15.—Obviously; but as stated above the problem does not arise in Central Provinces coalfields.

Question 16.—Expensive measures such as sand packing should not be prescribed for Central Provinces coalfields, where there is hardly any danger of fires and coal seams are thinner and multiple seams are rare. This makes sand-stowing less necessary in Central Provinces. Any general legislation that may be imposed should be made applicable either to a definite coalfield or to a province but not to all provinces alike irrespective of the conditions obtaining in their respective coalfields. The Local Government is not in favour of any proposal for applying to the Central Provinces collieries restrictions that are not essential and would

place them at a disadvantage in competition with Bengal and Bihar.

Questions 25, 26 & 27.—The Central Provinces coalfields are very liable to flooding, but the ordinary seasonal flooding is not dangerous.

Question 28.—The existing regulations regarding the issue of explosives appear to be generally adequate. Thefts of explosives do occur from time to time but this seems almost unavoidable whatever system is adopted.

Question 30.—*Primâ facie* there would appear to be some advantage in issuing certificates to shot-firers after examination.

Question 31.—Special circumstances may arise in a colliery justifying a relaxation of or exemption from the Regulation. It is therefore desirable that the proviso should be retained.

Questions 38, 39, 40 & 43.—See reply to *Question 16.*

Question 54.—Methods of mining which involve serious avoidable waste should be generally prohibited. The pillar and stall method employed in the Central Provinces is considered to result in a loss of not more than 10 to 15 per cent. of coal at the most and where it is worked with maximum efficiency the proportionate loss does not probably exceed 3 to 5 per cent.

Statutory control of mining methods in the interest of both safety and conservation should be universal, but the regulations should be adapted to the particular field to which they apply and not made of universal application all over India. This Government considers that regular inspection of all coal mines, with a view to ensuring that the method of extraction is economical and that no considerable supplies of coal are wasted, is essential in the interest of Government and is second only to inspection for the purpose of ensuring the health and safety of labour.

The present Department of Mines confines itself almost entirely to questions of health and safety and the Local Government needs the advice of mining experts in respect of conservation. It is believed that the Inspectors of Mines in the Department of Mines are quite competent to advise on questions of conservation also, but they are precluded at present from doing so by the rules of their department. The need for control in the interest of conservation scarcely requires to be justified. The coal deposits in the country are limited and though prices are at present low, they may rise again in future and many deposits which are not now worked as being commercially unremunerative may again come into working. If concessionaires are allowed to adopt wasteful methods of extraction or to permit deposits which are at present unremunerative to become unworkable through fire or flood by want of adequate precautions, considerable future supplies of coal will either be entirely lost to the country or be rendered far more costly to extract than they need be.

Oral Evidence of Mr. C. D. Deshmukh, C.I.E., Financial Secretary to Government, Central Provinces, on behalf of the Central Provinces Government.

Question 2.—My Government's answer to this question is based on the accident reports of the last two years. Reports for the previous years have been eliminated. The annual mines reviews and the Chief Inspector's annual reports for the last ten years have been examined and are found to contain no specific mention of a fire in a Central Provinces coal mine. This does not probably mean that there were no fires; but the inference can legitimately be drawn that no serious case of fire has occurred in Central Provinces coal mines within the last ten years. Since the Local Government's reply to the questionnaire was sent its attention has been drawn to a communication from the Deputy Commissioner, Chhindwara, in which he has made the following statement:—

> "Further there were only two cases of fire, I believe, in recent years. One was reported from Dhau colliery of Rai Sahib Sunderlal in the year 1934. In December 1934 there was also another fire at the Jatachahapa mine of Messrs. Shaw Wallace and Company. The fires were, however, soon brought under control without the Government's assistance and the damage caused was not very appreciable. In neither case was there any loss of human life."

Under Regulation 13 of the Coal Mines Regulations an outbreak of fire is among the occurrences that must be reported to the Chief Inspector through the District Magistrate. An examination of the records in the office of the Chief Inspector of Mines will, therefore, show to what extent fires occur in Central Provinces coal mines.

Question 6.—The Central Provinces Government is agreeable to the Temporary and Supplementary Regulations being made permanent; also the temporary legislation of 1936.

Question 12.—What is meant here is that, of the rescue stations which it is proposed to establish, the one at the Pench Valley field is the only one with which my Government is concerned. So far as I am aware, it is not proposed to establish rescue stations at the other fields in this Province.

Question 14.—I am prepared to accept from the Committee the fact that coal in the Chanda field of the Central Provinces is definitely liable to spontaneous combustion though no case has ever been found in that field.

Question 15.—As the Chanda coal is said to be particularly liable to spontaneous combustion, my Government would be in favour of the extension of the Temporary Regulation No. 14 there in the manner proposed in *Question 14.* The same would apply to any coal that is liable to spontaneous combustion.

Question 16.—The Central Provinces Government has considered carefully all the arguments bearing on the question of the

universal levy of a cess for financing *inter alia* the supply of sand required for compulsory sand-stowing of coal mines and it has come to the conclusion that neither logic nor justice demands that the cess should be collected from collieries which do not stand in need of sand-stowing in the interest of either safety or conservation or both. The Government recognises that in certain classes of mines, particularly in the Chanda coalfield, sand-stowing will probably be necessary in the interest of both safety and conservation, but it can see no justification for their recouping part of the expenditure from collieries in other coalfields, as for instance, the Pench Valley coalfield, where admittedly parallel conditions do not exist. National interests no doubt demand that both safety and conservation should be provided for when a coal mine is worked. But the application of compulsory measures intended to ensure these cannot be regarded by any mine owner as an abnormal restriction that would give him the claim to compensation for part of his expenditure on such measures. Each mine or each coalfield has its own advantages and disadvantages, and there is no more reason why the coal industry in general should finance, even partly sand-stowing in one mine than there is for its paying the extra cost of guarding against floods in another or the extra cost of winning hard coal from thin seams in a third. Any increase in the price of coal from certain collieries that compulsory sand-stowing may lead to must be borne by the colliery concerned as an incident of its business. The Local Government recognises that there is some force in the argument that even in the Pench Valley coal mines sand-stowing may lead to the exploitation of coal resources under railway lines which might otherwise be lost, but in the absence of detailed investigation it is not prepared to accept this as a consideration overriding the main argument against making these collieries liable to the payment of the cess, *viz.*, that the general conditions in these collieries do not demand sand-stowing. As far as the Government is aware no scheme for the imposition of a cess has been worked out in detail and in the event of such a cess being imposed universally, despite the protest of this Government, it reserves to itself the right of criticising the details of the scheme, such as the imposition of similar cess on coal from the Indian States and the proportion of the cess that is to be applied towards research.

Question 51.—As regards coal under the railway lines or sidings, the lessees have no right to work this coal under their leases and must apply for permission in writing in each case. Each of these cases is considered on its merits and the advice of the Chief Inspector of Mines is invariably taken as to the nature and extent of the restrictions that should be imposed. His advice on these points is invariably accepted and the railways are not directly consulted at all by the local Government.

Question 54.—My Government's reply regarding the percentage of recovery by the pillar and stall method followed in the Central Provinces only applies to the Pench Valley field.

The standard form of leases issued by the Local Government requires that the mines should be worked in a skilful and workmanlike manner and upon the most approved principle, but in practice the Local Government is unable to satisfy itself as to whether the mines leased by it are actually being worked by sound methods. Occasionally, when suspicion is aroused or special intimation is received we ask the Mines Department to inspect the mine concerned and submit a report as to the manner in which the mine is being worked. Since 1921, there have only been two cases in which the leases have been cancelled because of bad working, and one case in which a penalty was imposed for the same reason.

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48. Written Evidence of Messrs. Shaw Wallace & Co.

Questions 1-16.—No reply.

Questions 17 & 18.—No reply.

Question 19.—No.

Question 20.—Does not arise.

Question 21.—No.

Question 22.—(*Not answered.*)

Question 23.—No.

Question 24.—We do not favour an authority having general powers. We agree that in certain circumstances the ordering of compulsory packing of galleries prior to pillar extraction is desirable if the loss of large quantities of coal is to be prevented. We suggest that the initiation of such orders should be in the hands of the Mines Department and that the Mines Act might be amended to permit of this under wider circumstances than are possible with the Act as at present framed. It is preferable that such a statutory body should have attached to it a panel of mining engineers from which the Chief Inspector of Mines should nominate three to act independently as assessors prior to the passing of such orders, the majority view to prevail. The gentlemen nominated should invariably have experience of the field and seam under consideration.

Questions 25-27.—No reply.

Question 28.—Supplementary (Temporary) Regulation No. 5 should be modified to permit of the firing of one round of a "non-permitted" explosive in a ventilating district not naturally wet throughout, instead of the one shot only at present permitted subject only to the restrictions imposed by Supplementary (Temporary) Regulation No. 4.

We stress this particularly in relation to mines in the Central Provinces where the whole of the coal is obtained by blasting.

Question 29.—Not in the Central Provinces.

Question 30.—No reply.

Question 31.—We favour the retention of the proviso, but it should be given effect to where circumstances constitute a " special case " as in the Central Provinces where all coal is won by the use of explosives.

We hold this view because hitherto the necessity of allowing a larger quantity than 5 lbs. at our Pench collieries has long been recognised by the Mines Department, but the exemption has now been summarily withdrawn although with the 20 lbs. allowed under the exemption there has never been an accident.

Question 32.—No reply.

Question 33.—In the coalfields covered by the enquiries of your Committee:—

(*a*) No. 15 seam Jharia. Thickness 7 feet 9 inches. Gradient 1 in 6. The coal is selected grade quality, low in moisture content.

(*b*) Bharatchuck or Patmohna seam in Raniganj coalfield. Thickness 9 feet of which the middle 5 feet only of selected grade is worked. Gradient 1 in 6 to 8. It has high percentage of volatile matter with medium moisture content.

(*c*) Kajora seam in Raniganj coalfield. Thickness 21 feet of which 9 feet is worked and is of Grade I quality with high volatile and fairly high moisture content. The gradient is slight say 1 in 20.

(*d*) Jambad seam in Raniganj coalfield which is in two sections of 23 feet and (below) 19 feet respectively separated by a hard stone band 4 feet in thickness. Of the 23 feet section 14 feet 10 inches of Grade I is worked. Of the 19 feet section 7 feet of Grade I is worked. Gradient is slight 1 in 20 or under. Quality similar to (*c*).

(*e*) Pench seam in the Pench Valley coalfield, Central Provinces. Thickness of the working section varies from 3 feet 10 inches to nearly 8 feet with an average of under 6 feet and above it, is a varying thickness of coal bands and shales in which deposits of pyrites exist which with those in the overlying sandstones, disintegrate in the goaves and form with water free sulphuric acid. The quality of the seam is comparatively poor though the calorific value is fair. Gradients vary from 1 in 5 to 1 in 16 and under. The seam is exceptionally hard requiring undercutting and explosives throughout and is expensive to work as compared with seams in the larger coalfields. No application for grading has ever been made.

Question 34.—Please refer to the answer to *Question 33.*

(*a*) The whole thickness is worked.

(*b*) The 2 feet above and 2 feet below the working section is left unworked, it being of very poor quality below Grade II.

(*c*) The 3 feet above and 9 feet section below the working section are very poor in quality and much banded. The upper

3 feet is also required for roof support as owing to shallow depth there is little or no hard strata above.

(*d*) The 8 feet 2 inches section above the 14 feet 10 inches section worked is much banded and very poor in quality. There is a thickness of 9 feet 3 inches above and 2 feet 3 inches below the 7 feet graded section also of very poor quality. A recent analysis of the 2 feet 3 inches section showed 23 per cent. of ash and it is probably better in that respect than any other of the unworked sections under (*d*).

(*e*) The shale and coal bands above the working seam are worked to some extent to make height and are used in the colliery boilers.

Question 35.—In (*a*) to (*d*) (*see previous answers*) no depillaring is being or has been done. In (*e*) about 16 per cent. at present which is a higher percentage than for several years. Practically 100 per cent. of depillaring in (*e*) is being recovered, the greatest seam thickness in depillaring sections being 6 feet.

Question 36.—No reply.

Question 37.—We suggest that in the case of railways a temporary or permanent diversion should be possible to permit of the release of large quantities of coal now locked up. Rivers and bridges present a more difficult problem and we would say that to recover coal locked up under these circumstances stowing would be essential.

Many buildings and villages could be rebuilt at less expense than the cost which stowing below them for support would involve.

Question 38.—It would vary according to the particular circumstances but compulsory stowing would probably prolong the life of the collieries to a greater or lesser extent.

For instance in the Pench field practical experience has shewn our loss of coal in depillaring to be less than 5 per cent. without stowing. In other fields the loss is generally greater.

Question 39.—So far as collieries in the Pench field are concerned we consider this quite unnecessary. In other fields we agree that in selected areas the enforcement of a system of packing would curtail loss of coal and provide for greater safety.

Question 40.—We would limit such enforcement at present to selected areas in the Jharia field to be fixed on the lines suggested in answer to *Question 24.*

Question 41.—No reply.

Question 42.—If compulsory stowing is introduced it should be financed for the most part by a cess on all coal despatched from the Jharia and Bengal fields only, and payable by the consumers.

We include Bengal because in time the extension of compulsory stowing to areas in the Bengal field would appear to be inevitable.

On the other hand most users of Central Provinces coals have special grates fitted for burning this coal and are not likely to burn Bengal coal under these circumstances. They will not receive any

benefit from the conservation of Bengal coal and should not therefore be compelled to contribute towards the cost of conserving material in which they have no interest.

If and when compulsory stowing is introduced into the Central Provinces field, and we hold that this is quite unnecessary since the loss in extraction is now negligible, then despatches of coal from the collieries in that field should also be subject to the imposition of a cess.

It has been suggested that any cess imposed should also be collected on coal from Indian States.

At present no enactment of the British Indian Legislature can apply to Indian States and the levy of a cess on coal from these sources under such legislation would not be possible. A possible method of securing contribution from this coal would be by means of an excise duty. This would be manifestly unfair, because, where collieries in British India, if ordered to stow, could claim for financial assistance out of the cess, those in Indian States if they found stowing necessary could make no such claim on the funds collected since no payment could be made to them under a British Indian enactment.

Royalty receivers in the fields concerned should also be required to contribute a percentage of royalty receipts whether such royalties are payable on coal or on stowing materials.

The danger of acquiring excessive funds should be guarded against to prevent a situation arising such as exists in the Indian Coal Grading Board to-day.

Question 43.—Yes, on the lines set out in our answer to *Question 24* for the defining of areas or seams in which compulsory filling is ordered.

For all other matters such as the assessing of compensation payable and cess collectable an authority consisting of the three mining engineers concerned *plus* two representatives of the mine owners, one from the railways and two from the consumers would represent the statutory board with full powers to enforce the release of sand or other stowing material at rates designed to prevent any attempt at profiteering in such stowing material.

Question 44.—No. This is unnecessary.

Question 45.—No reply.

Question 46.—No. A colliery owner is under his lease generally liable for the payment of a minimum royalty. He has, therefore, to work coal for which there is a market and it may be said that the remainder if unsaleable is of no commercial value.

The prevention or control of a colliery owner's right to make decisions in this matter might lead to the closing down of collieries and the loss of a larger quantity of coal than would otherwise be the case.

Question 47.—If our definition of coal of commercial value is accepted we consider that in this case there is ground for control

but only on the production of indisputable evidence that the coal in the upper seam is capable of being marketed profitably at the time. No question of possible future value should be permitted to enter into the consideration of control or prevention.

Question 48.—We define coal of commercial value as coal which can be mined and marketed profitably at the time the coal in question is under consideration.

Question 49.—No reply.

Question 50.—Yes, where compulsory stowing is ordered only. Elsewhere the option should be left to the mine owner.

Question 51.—Yes, on the ground that at present the railways have a liability under Land Acquisition (Mines) Act which to date has for the most part been successfully avoided. Where the railway company has already paid compensation under the Land Acquisition (Mines) Act, it should not be required to contribute to the cost of stowing.

Question 52.—No reply.

Question 53.—It would appear that the supply of sand free at pitsmouth would be sufficient.

Question 54.—(i) The Indian Mines Act up to date effectively controls mine methods from the point of view of safety and there is no pressing call for drastic innovations.

(ii) There is no case at present for any intervention anywhere in India except in the Jharia coalfield and only in certain sections of that field. If any Government action is taken in this connection, it should be for those areas alone, and only to the extent of providing facilities for stowing and enforcing their use, when advantage of them is not voluntarily taken.

Our reason for recommending that these steps be confined to the Jharia field is in view of its special conditions of mining and holdings, which do not apply elsewhere.

Question 55.—Compulsory stowing should in the first place be restricted to the Jharia field where the conditions would appear to call for this in selected areas only to which the compulsion should be confined.

In the interests of safety it may ultimately be found necessary to prescribe compulsory stowing in certain areas in the Bengal fields.

Question 56.—Where two adjoining properties are leased to one party but from two different royalty owners.

We favour compulsion in the adjustment of boundaries where otherwise the barrier to be left constitutes a serious waste of coal. In such cases an assessment of the *salami* payable to compensate the royalty owners where there is a case for compensation would be necessary. Such *salami* would be assessed by the statutory authority and would have reference only in the case of loss of area by the royalty owners.

Compulsory amalgamation of properties is not favoured by us as presenting too complex a problem.

Questions 57 & 58.—No reply.

Question 59.—Yes, to the first question. No, to the second since the Mines Department already possesses the necessary power.

Question 60.—Yes.

Question 61.—It has been demonstrated on the Great Indian Peninsular, Bengal-Nagpur, and Madras and Southern Mahratta Railways that inferior coal can be utilised as a loco fuel with great advantage where the sources of this fuel are so situated as to make it profitable to use, even with a lower evaporation, on account of the higher freight on coal over the longer distance from Bengal.

Similarly many cotton mills in the west of India are able to work entirely on Central Provinces coals with considerable savings in their bills for fuel.

If it were an urgent necessity to conserve the available reserves of first class coal there is little doubt that the extended use of Central Provinces coal, particularly in western India, both on railways and in factories would bring this about.

It should be understood, however, that this is made possible only by the lower freights on the latter coal which make its delivered price approximately 25 per cent. below that of 1st class Bengal coal in Ahmedabad and its vicinity, thus compensating for the additional consumption.

Question 62.—There is little doubt that the Coal Grading Act of 1925 has led to sections of seams only being extracted where prior to its introduction the full section was worked.

We have in mind particularly the Kajora seam where working sections were reduced in some cases from 20 feet to 9 feet.

Question 63.—(*Not answered.*)

Oral Evidence of Mr. J. B. Ross, on behalf of Messrs. Shaw Wallace & Co.

Question 24.—I agree that, if orders of the Chief Inspector under section 19 requiring sand-stowing in the interests of safety were subject to confirmation by a statutory authority on which there were mining engineers selected from a panel, this would meet the point that I have in view.

Question 42.—I am definitely of opinion that the cess for the purposes of financing sand-stowing should not be imposed on Pench Valley coal. It must be imposed all over the Jharia and Raniganj fields owing to the practical difficulties of differentiating between particular collieries or particular seams in those fields. If it was ever considered necessary to introduce sand-stowing for purposes of safety or conservation into this field, I would then be

in favour of the cess being paid by all coal despatched from that field.

Apart from the political aspects of the matter, I would object to a cess being levied in British India on coal coming from the Indian States unless the conditions in the Indian States were the same as those in British India in all respects, namely, that the Indian States would not be able to impose any duties which do not also exist in British India, and that the collieries in the Indian States would be able to claim the same benefit from the cess funds as the collieries in British India.

Question 43.—I am definitely of opinion that the statutory authority should be a representative one. I would not object to the royalty receivers being represented in addition to the parties whom I have mentioned. I think that the financial implications of the whole scheme are so great that it would be essential to have competent commercial representatives on the statutory authority both from the mine-owners and the consumers. In addition to these representatives I would have a permanent panel of mining engineers from whom three would be selected for each meeting of the statutory authority. I do not think that a statutory authority constituted in this way would be too unwieldy to conduct the necessary business efficiently and promptly.

I favour an independent official as Chairman, preferably a senior I. C. S. official.

Question 54.—I think that sand-stowing is immediately necessary in the Dishergarh seam of the Raniganj field on account of the danger from gas and that it may also be necessary later on in the Jambad and Kajora seams of that field owing to the possible danger of fire in these seams.

My impression is that compulsory sand-stowing for the purposes of conservation of selected and Grade I qualities of coal would not be necessary in the Raniganj field. This does not cover of course coal locked up under railway lines which could be recovered by means of sand-stowing. I should also add that these remarks are subject to those made above in connection with Jambad and Kajora seams where it will not in my opinion be possible to recover pillars without very serious danger of fire without stowing.

I also think that the iron and steel companies should not be allowed to sell any part of the output from their own collieries or their contracted collieries in the open market.

If it is desired to conserve the supplies of coking coal in the national interests, the only way in which this can be done, so far as I can see, is for Government to acquire all the collieries which produce coking coal and so confine the use of coking coal to metallurgical purposes only.

Question 62.—I think that the working of sections of seams under the Coal Grading System has been due as much as anything

to market conditions. With the market as it stands at present, I do not think that anything below Grade I is worth worrying about. What I think might be done is that, where a mine-owner has a seam which contains a section of selected grade while the whole seam taken together would give him a Grade I coal, he should be compelled to work the whole seam rather than only the selected portion leaving the rest.

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49. Written Evidence of Mr. A. H. Parry of Messrs. Shaw Wallace & Co., Chhindwara.

Question 1.—Representative and Sales Agent of the Pench Valley Coal Co., Ltd., and the Amalgamated Coalfields, Ltd., under the Managing Agency of Messrs. Shaw Wallace & Co. Experience of 27 years in the Pench field.

Question 2.—Spontaneous combustion in depillared areas. No increase of fires in the Pench field in recent years. By normal collapses in the Pench collieries.

Question 3.—Only one seam worked at our Pench collieries. Incubation period is uncertain, but such fires as have occurred were certainly not incubated in less than 12 months subsequent to the start of extraction of pillars.

Not if sufficiently good conditions exist.

Question 4.—Not necessarily if the ordinary precaution of panel working is adopted.

Question 5.—Yes. In a thin seam as at Pench a very small percentage would be lost in barrier coal.

Question 6.—Yes.

Question 7.—No, so far at least as Pench collieries are concerned.

Question 8.—Any coal left behind in the goaf would, I think, add to the risk of spontaneous combustion. Not definitely.

Question 9.—If facilities are provided for tapping existing underground delivery mains no additional provision should be necessary, unless it be the laying of a branch from the delivery main to a convenient point in the vicinity of a panel that is in course of being depillared, should this be situated a long distance from the delivery main.

Question 10.—No.

Question 11.—I cannot suggest any practical ones.

Question 12.—It would be an advantage.

Question 13.—No experience but would conclude they have their use within limitations.

Question 14.—No.

Question 15.—Yes, but at Pench collieries, I consider a precaution that fully meets the need against fire before it occurs is to lay out the workings on a panel system, and before depillaring of a panel commences isolation stoppings be built in all roadways through barriers not required to be kept open for haulage, ventilation or travelling, and at these latter building materials be provided *in situ* so that they can be quickly closed in the event of it being necessary to seal off the panel.

Question 16.—(*Not answered.*)

Question 17.—Faulty working by leaving insufficient support.

Question 18.—Air blasts, extensive underground falls, destruction of machinery and plant and mine openings, subsidences on the surface with their attendant damage to buildings endangering the life of occupants, and release of possible large volumes of water from upper seams strata or surface.

Question 19.—No.

Question 20.—(*Not answered.*)

Question 21.—No.

Question 22.—(*Not answered.*)

Questions 23, 24 & 25.—No.

Questions 26 & 27.—(*Not answered.*)

Question 28.—I consider the Permanent and Temporary Regulations prohibiting the firing of more than a single shot in a place should be amended so as to permit of the firing of a round of shots in a single place at Central Provinces' collieries, where the whole of the coal is obtained by blasting.

Question 29.—I have only experience with powder (English and country made) which our collieries have used to the extent of many million lbs, without any untoward results as effecting the safety of the labour or of the mines. For this reason the extended use of "permitted" explosives is not favoured by me at Central Provinces collieries' more particularly so as it introduces the use of detonators, in the handling of which many accidents with loss of life will occur.

Question 30.—I am in favour of it being necessary for Managers to certify that they have examined and satisfied themselves as to the competence of shot-firers employed by them before issuing them an authorisation. The certificate and authorisation issued for use at one mine not to serve at another.

Question 31.—It should be retained and discretion exercised in favour of applicants' request when there is a *primâ facie* case for it. My reason for saying so is based on the fact that for years our collieries were exempted and 20 lbs. allowed. No accident had resulted but the exemption was withdrawn. If the power is not retained the Regulations themselves should be amended so as to

permit mines in the Central Provinces to keep more than 5 lbs. in one place, if not 20 lbs. at least 10 lbs.

Question 32.—None.

Question 33.—(*Not answered.*)

Question 34.—Inferior coal and shale in the roof is only worked to make height when necessary in galleries.

Questions 35, 36 & 37.—(*Not answered.*)

Question 38.—Very little on the life or on the productivity of the Pench collieries in view of the thin seam.

Question 39.—Not at Pench.

Question 40.—In such areas where conservation of coal is considered definitely necessary, as would appear to be the case in the Jharia field.

Question 41.—(*Not answered.*)

Question 42.—I am not in favour of a compulsory system of stowing in the Central Provinces' collieries, and accordingly cannot consider that its coal should contribute towards any scheme for compulsory stowage elsewhere.

The additional cost, if all collieries have to contribute, should be recovered by means of a levy on despatches and collected by the railways.

Question 43.—A statutory authority would appear to be necessary and should, in view of the highly technical nature of the problem have in its composition an advisory committee of selected mining engineers who would define the areas and advise on practical means for carrying out the work with subsequent inspection. The authority would also require to include representatives of mine-owners' associations, a railway expert, a nominee of the Mines Department, and the interests of consumers would probably need consideration.

Question 44.—No, but such statutory authority might be called upon by mine owners to lend the services of their selected mining experts in a consultative capacity.

Question 45.—It is not possible to give any set figure of savings under the heads mentioned, but I cannot visualise in a thin and hard seam such as that mined in the Pench field, where the main expenditure is establishment and the cost of getting coal on which nothing would be saved, that the cost of packing would be otherwise than far in excess of any savings on the other heads.

Question 46.—No, for the reason that it interferes with a coal owner's indisputable right to decide whether or not coal not mined in a seam being worked is of a commercial value from a trading point of view.

Question 47.—There are grounds for assuming that cases might arise where an owner was neglecting the working of one seam that has a definite commercial value in order to obtain a larger immediate gain by working another seam. In such cases interference

would possibly be justified if the operations did cause the destruction of the unworked seam, and which in any case should not arise in the Central Provinces collieries under their leases with Government, even if more than one workable seam exists.

Question 48.—Commercial value in my opinion is difficult to specifically define, but generally interpreted I should define it as coal that can ordinarily find a market in normal times at a price that makes its working worthwhile from a trading point of view.

Question 49.—(*Not answered.*)

Question 50.—Not at least in the Pench field.

Question 51.—By the terms of leases in the Central Provinces no working under railways and siding is permitted without sanction, so no case can be made out for expecting the railway concerned to bear part of the cost.

Questions 52 & 53.—(*Not answered.*)

Question 54.—(i) No, for the reason that a Government department already exists that gives close attention to this matter and the fact that the Indian Mines Act effectively controls it, also in the Central Provinces stringent lease conditions are in force.

(ii) No, it is unnecessary in the Central Provinces, in view of stringent conditions attaching to all leases from Government that operations must be conducted in a workmanlike manner. In view of the loss of large areas of coal in the Jharia field owing to floods and fires, it is presumed that statutory control in the past over mining methods in that field would have prevented much of it, and for this reason there may be grounds for intervention there now.

Question 55.—It should at least not be extended to the Central Provinces.

Question 56.—It seems desirable to devise some form of machinery by which boundaries can be re-adjusted so that such properties can be worked with greater safety and advantage. A Board of Arbitration would probably be necessary to assess differences in gain or loss by such re-adjustment.

Question 57.—Unless the workings of the different seams can be controlled in such a way that each owner observes whatever restrictions or methods would be necessary to ensure the safety of the others rights it does seem a case for disapproval. The dangers otherwise arising from neglect, ignorance, and desire for considering one's own interests only might be the complete destruction of a seam or seams by fire, flood, and collapse with attendant loss of life.

Question 58.—(*Not answered.*)

Question 59.—Yes, but if in all such cases plans are filed with the Mines Department and further procedure in the matter in the event of differences in survey arising left to that department to handle it should meet the case.

Question 60.—Yes.

Question 61.—Large areas of poor quality coal but sufficiently suitable for steam raising purposes are available in the Central Provinces, but cannot be developed to capacity, markets being restricted due to a telescopic scale of rail freight depriving it of the advantage of its geographical position. Locomotives can be constructed to overcome the difficulty in respect to burning poor class coals, and even without such special construction selected and poorer qualities of coal could be suitably mixed to give satisfactory results, and near coal producing areas probably without any loss to the consuming railways, the slightly higher consumption being compensated for by the lower price of the mixture as against the higher price of the selected coal. Railways would require to erect mixing bunkers to ensure that coals were mixed properly when loaded into tenders. It involves a certain amount of trouble and organisation and expenditure.

Questions 62 & 63.—(*Not answered.*)

Oral Evidence.

Question 14.—What I mean is that the precautions to which I have referred to in my answer to *Question 15* are sufficient for all practical purposes in the Pench collieries.

Question 19.—After discussion with the Committee, I agree that, in the interests of mining generally, it is necessary to lay down principles of first working by regulation. These principles will apply in the large majority of cases and the remainder would be safeguarded by a provision that the Chief Inspector of Mines would have the power to vary the principles laid down and also that there would be an appeal from an adverse decision of the Chief Inspector of Mines to the same authority as hears appeals under section 19 of the Act. I agree that the best principles of first working would be those based on a percentage of floor area *plus* a maximum height for galleries. I agree also that the penalty for infringing such principles should be adequate and immediately enforceable. I think that an adequate penalty would be requiring the conditions to be restored securely to those which they should have been under the regulation within a reasonable time and to add that working in that section of the mine may be stopped in the mean time.

Question 21.—I would rather not offer any definite opinion on this highly technical point.

Question 43.—After discussion with the Committee, I would be in favour of a statutory authority for the general purposes of conservation and the administration of any cess being constituted as follows:—

An independent Chairman who should be an experienced Government servant,

the Chief Inspector of Mines, and

three mining engineers with experience of coal mining in India who would be selected by the Chairman for each meeting of the statutory authority from a permanent panel of 10 suitable mining engineers.

If the statutory authority was also the appellate authority in respect of orders under section 19 of the Mines Act, one of the three mining engineers selected by the Chairman would be able to represent the appealing party.

Question 46.—After discussion with the Committee, I think that, as the conditions contemplated in this question do not arise in the collieries with which I am concerned, I would prefer not to express an opinion on it.

Question 47.—Our leases with the Central Provinces Government say that we should work our mines in a workmanlike manner, but as a matter of fact nothing is done to enforce the terms of those leases if they should be violated in any particular case. The Mines Department only inspect from the point of view of safety and the inspections of the District Magistrates, though they may enquire into technical points are not able to disclose whether work is being done properly because these officers have not sufficient technical knowledge to be able to know whether a mine is being worked in a workmanlike manner or not.

Question 51.—Paragraph 4 of Part III of the standard form of lease enforced in the Central Provinces prohibits mining operations or workings in or under a railway line or at any point within a distance of 50 yards from such land. Previous permission in writing has to be obtained before we can take out any coal at all from under a railway line or siding. In practice we are allowed to take out in the first working the maximum quantity commensurate with safety of the railway line or siding. That is why I say that the railways should not be required to bear any part of the cost of stowing in the Central Provinces.

Question 61.—The analysis of the coal produced in the Pench Valley collieries shows that it is Grade III in quality. We sell our coal to the Great Indian Peninsula and Bengal-Nagpur Railways regularly, and to the Bombay, Baroda and Central India Railway occasionally. These railways are able to use our coal after having adapted their locomotives to its use.

50. Written Evidence of Mr. J. K. Martyn, Manager, Barkui Colliery of the Pench Valley Coal Co., Ltd.

Question 1.—Manager of the Barkui colliery of the Pench Valley Coal Co., Ltd. 21 years in the Jharia and Pench Valley coalfields, chiefly in the latter.

Question 2.—Spontaneous combustion of coal.

Yes, to be expected owing to the extensive development of collieries and particularly of goaf areas.

In the Pench collieries in goaf after normal collapse.

Question 3.—Only one seam worked here, and that is liable to spontaneous combustion. Not less than 18 months.

Question 4.—Not necessarily, provided a fire is properly sealed off so that all fresh air is excluded. Conditions differ so greatly as regards the number and thickness of seams to be extracted, and thickness of intervening strata that I cannot generalise.

Question 5.—Yes. Normally not more than 10-15 per cent. need be left in barriers, and these can often be reduced in width with final pillar extraction.

Question 6.—Yes, as far as I can foresee.

Question 7.—No. Where a fan is installed it should usually be exhausting, but if necessity arose for reversing the air current this is in all cases possible as Regulations lay down that such arrangements must exist.

Question 8.—Probably yes. Not definitely.

Question 9.—It should not be compulsory, but if a rising main is available it would be a desirable precaution to have it ready tapped, so that in case of fire pipes could be quickly connected up to wherever needed.

Question 10.—No.

Question 11.—I can suggest none in general terms, such case would have to be dealt with according to conditions, except that materials for building stoppings should of course be always ready.

Question 12.—Decidedly yes.

Question 13.—That under certain conditions breathing apparatus would be of great value.

In one case within my experience this would have been so.

Question 14.—No.

Question 15.—Yes. In any seam liable to spontaneous combustion a panel system of working should be adopted, and materials for quickly erecting stoppings should be available on the colliery.

Question 16.—I have no experience of gas in this country so am unable to reply.

Question 17.—Insufficient support to bear the weight.

Question 18.—From falls where persons are working.

Air blasts.

Blowing out of stoppings of a sealed fire area.

Cutting off exits.

Flooding of the mine due to letting in of a river or accumulation of water from the surface, or even from a dammed off area, underground, collapse of buildings on the surface.

Question 19.—No.

Question 20.—(*Not answered.*)

Question 21.—No.

Question 22.—I have no experience of thick seams.

Question 23.—No.

Question 24.—No. An Inspector of Mines under Section 19 (1) of the Act has power to forbid work which he considers dangerous, and could exercise such powers if necessary. If sand packing could remove the danger then this would appear sufficient.

Question 25.—No.

Question 26.—I should think it quite possible.

Question 27.—By leaving sufficient support under all surface accumulations of water of whatever kind.

In the approach of underground accumulations such as old workings provision is ample.

Question 28.—I am of the opinion that Temporary Regulation No. 5 of Notification No. M.-1055 is unnecessary provided any working place which is dry and dusty and in which shots are to be fired, is, before the firing of shots drenched with water or stone dusted.

Question 29.—Not in the collieries of the Pench coalfield.

I am of the opinion that the dangers of handling great numbers of detonators would outweigh other considerations.

Question 30.—No, for the reason that I consider it essential that shot-firers be periodically orally examined in the carrying out of their duties, as they forget Regulations after a time. If a shot-firer were certificated there would be a tendency for a colliery manager to consider that sufficient.

Question 31.—Yes, and where large quantities of explosives are used should, when possible be exercised for the reason that the issue of explosives, keeping the record of issues and return of explosives to the magazine is made much more difficult and laborious when large number of persons are employed in carrying small quantities into the mine than when a few are employed. This has a tendency to lead to careless work by the man in charge of the magazine and records. I also consider that it is safer to have a few reliable persons in charge of explosives, than a large number, some of whom undoubtedly will be careless or unsuitable for the work, as I have found it difficult to get sufficient reliable men for this responsible duty.

Question 32.—No, this is amply covered.

Question 33.—Barkui seam.

Quality comparatively poor. Very hard and tough necessitating the use of large quantities of explosives. It has bands of shaly coal and in some parts of the mine pyrites. The bottom portion averaging 6 feet is worked. Above this are bands of shale

and coal often containing pyrites. Inclination varies from 1 in 10 to 1 in 20.

Question 34.—The bottom 6 feet only except in places where extra height is needed for grading roads or some such reason.

Question 35.—About 40 per cent. Practically total extraction within the panel. Occasionally near a fault small stoops are left for safety in holding weak roof up.

Question 36.—I am unable to reply to this.

Question 37.—It may be possible in certain cases to divert a railway, temporarily evacuate buildings or rebuild on other sites. This question is too general to admit of a comprehensive reply.

I do not know of compensation having been paid under these circumstances.

Question 38.—In most cases it would increase the life and productivity of the collieries, varying according to the amount which is locked up under railways, roads, etc.

Question 39.—No. I refer only to depillaring in the collieries of which I have experience in the Pench field. In other fields I am unable to reply.

Question 40.—(*Not answered.*)

Question 41.—No.

Question 42.—By a levy on coal despatches and some contribution by Royalty owners.

Question 43.—Yes, this would be necessary. The majority of the members of the statutory authority should be chosen by those who would have to pay for the stowing. Other interests should be represented.

Question 44.—No. A colliery manager would naturally try and lay out his colliery workings in such a manner that sand-stowing would be unnecessary.

Question 45.—I am unable to answer this question in detail because conditions would vary so greatly in different cases. I should judge however that there would be saving under most of the heads; amounting in all, and spread over the life of the colliery to a substantial consideration.

Question 46.—No. The owner is the last judge of what coal is of commercial value, and it is improbable that a seam which might at a future date be valuable would be sacrificed at the present time.

Question 47.—Please refer to my answer to *Question 46.*

Question 48.—Roughly as "coal which can be mined and sold at a profit at the time the question was being considered".

Question 49.—If the fire area above is adequately sealed off it might not be necessary to sand-stow portions of the seam not vertically below the fire.

If the lower seam were worked in panels so that any area could be quickly sealed off, then too sand-stowing might not be necessary, on the other hand I can conceive that in many cases sand-stowing would be essential. It is difficult to generalise on this question—conditions vary so greatly that to state definitely one way or the other is impossible.

Question 50.—Yes, if pillars are to be extracted.

Question 51.—Yes, if extra expense is incurred in extracting coal from under a railway then it seems obvious that the railway should contribute towards the extra cost.

Question 52.—Probably partial filling would in some cases suffice. I can give no cases within my experience.

Question 53.—I think it would be sufficient help if sand were delivered free on the colliery.

Question 54.—(i) The Indian Mines Act fully covers the question of safety.

(ii) I can speak only as far as I know the Pench coalfield and consider there is no necessity for control.

Question 55.—My experience of the Bihar and Bengal fields is insufficient for me to reply to the first part of the question.

Avoidable waste should be reduced as far as possible, but I do not consider there is sufficient waste in the Pench coalfield to call for further legislation as coal mining leases always contain a clause which covers this.

Question 56.—I have no experience of this, so am unable to make suggestions.

Question 57.—I consider this undesirable in many ways. The chief dangers I should anticipate would be flooding or fire of a lower seam if the upper one contained water or was on fire, collapse of the upper seam if pillars were extracted from the lower.

Question 58.—I consider the manager of a mine should have charge of both outlets to that mine, unless the two outlets are under the control of an agent superior to the two managers.

Question 59.—If adjacent mines are working up to a common boundary or barrier I am in favour of the owners being compelled to maintain a joint survey and plan of the workings approaching such barrier. The Mines Department should have the power to enforce the making and keeping up-to-date such surveys.

Question 60.—Yes, but not on the colliery tracing.

Question 61.—Inferior coal could probably be used for many purposes which first grade is now being used for by adopting boiler grates for its consumption. If there is the possibility of a shortage in the future of first grade coal and it is desirable to conserve this class of coal, it is obvious that this could to a certain extent be done by substituting inferior coal for first grade when now used.

As this is a subject with which I have not been brought into contact, I am unable to offer any practical suggestions as to how the use of inferior coals could be stimulated at the expense of the better class ones.

Question 62.—I have had no experience of this.

Question 63.—I have no statistics, but suggest that there may be a higher proportion of accidents in Indian Mines than in those of Great Britain. If this is so it might account for the extra notices and orders issued in India. Excluding the large accidents involving a considerable number of deaths a very noticeable feature of many accidents is that they are caused by the persons involved through their lack of imagination in seeing danger, and their fatalistic outlook on life. It is probable therefore that the Mines Department, in an endeavour to protect the worker intervenes with these notices and orders. I am of the opinion that methods and practice in mining in the Pench coalfield have improved during the past few years.

Oral Evidence.

Question 6.—With the exception of the Temporary Regulation referred to in my answer to *Question 28*, I agree to the Temporary and Supplementary Regulations being made permanent. I also agree to the temporary legislation of 1936 being made permanent.

Question 7.—I agree that it is an advantage as a precaution in case of accident to have mechanical ventilation where there are sealed-off fires, but I do not consider it essential in all cases.

Question 14.—My answer relates primarily to the conditions obtaining in the Pench Valley collieries. We have fired millions of shots here over many years under every possible condition of wetness or dryness, and have never had an ignition of coal dust. We have also experimented and tried to produce such as ignition but have not been able to do so under ordinary shot-firing conditions even where we have used dust which was passed through a 200 per lineal inch mesh. We have only been able to produce an ignition by stemming a cannon with about 5 to 7 lbs. of this fine dust and using 12 oz. of country gun powder or compressed gun powder. Even then the initial ignition was not propagated. My written answer therefore stands.

Question 19.—After discussion with the Committee, I think that general principles of first working are essential in the other coalfields such as Raniganj and Jharia, but I do not consider them so essential in the Pench Valley field so far as my own experience goes. What I am afraid is undue restrictions on the initiative of the management to decide in what way a particular mine will be worked. Provided all local conditions are taken into account in fixing the principles suggested, I have no objection to the idea as a general proposition.

Question 21.—In view of my answer to *Question 19*, I agree that it would follow that on the adoption of general principles of first

working there should be legal prohibitions of the kind contemplated in the question. As regards the distance from the pillar which is being extracted or the point at which pillar extraction is about to begin within which splitting or reduction of pillars or heightening of galleries should be allowed, I would fix that distance at not more than two pillars lengths ahead. I am thinking of our seam in the Pench Valley only.

Question 24.—After discussion with the Committee, I now think that the statutory authority should have the power to require mine-owners to pack where such packing is necessary, especially if the work was financially assisted out of some common statutory funds.

Question 30.—After discussion with the Committee, though I would not consider it necessary in my particular case, it would be a good thing generally to have shot-firers specially certificated by some authority. In our mines, the shot-firers are never allowed to have any financial interest in the getting of the coal. They are paid monthly wages and do nothing but shot-firing.

Question 31.—After discussion with the Committee, I do not think that any particular limit should be prescribed in Regulation 106. I would be in favour of the amount allowed to be used being prescribed by the Chief Inspector in each particular case. In that event there would be no necessity for any proviso as there is at present.

Question 33.—The full thickness of the seam is 11-14 feet including the bands referred to.

Question 42.—So far as my present opinion goes, I recognise that there are great practical difficulties about differentiating between fields as regards the imposition of a cess to finance sand-stowing. There are arguments both ways, but I am still inclined to think that it would not be right for a field such as the Pench Valley where sand-stowing is never likely to be required to have to pay a cess to finance the cost of compulsory sand-stowing in the interests either of safety or conservation.

Question 44.—My answer is only with reference to conditions in the Pench Valley field. I can quite understand that in other fields where the seams are much thicker and close together different considerations would arise.

Questions 46 & 47.—After discussion with the Committee, I now agree that, in the circumstances contemplated in these questions, prevention or control is necessary.

Question 55.—I agree to a definition of "avoidable waste" as all waste which is not incidental to the proper and efficient working of the particular system of mining that is being followed at the time.

Question 60.—After discussion with the Committee, I now have no objection to the proposal in this question provided the surface features are only required to be shown in such a way as will not interfere with the clearness of the underground working.

51. Written Evidence of Mr. G. Llewellin, Manager, Hirdagarh Collieries, Ltd., Chhindwara.

Question 1.—Colliery Manager, Prospecting Engineer, and Mining Engineer, Messrs. Hirdagarh Collieries, Limited, Hirdagarh, Central Provinces. I have held the above posts since January 1932 and the whole of my coal-mining experience in India is as such in this, the Kanhan Valley coalfield of Central Provinces.

Question 2.—I have had no experience of underground fire in India so can give no practical answer from experience to this question.

Question 3.—Only one seam has been worked to any extent in this coalfield and, as far as I am aware, there have been no cases of spontaneous combustion underground. The colliery under my control was the first to start depillaring in this coalfield, some three years ago, and up to date no signs of spontaneous combustion have been detected so the period of incubation cannot be given. This statement however, does not necessarily mean that the period of incubation must be more than three years because owing to the method of working adopted most of the goaf lies under water and only the newer or later goaf lies in a sufficiently dry condition for heating to possibly progress.

I would not be prepared to say that any coal seam, whether of commercial value or not, could be said to be immune from spontaneous combustion and I base this statement on the fact that coals of widely-differing compositions and even anthracites have been known to ignite spontaneously.

Question 4.—I would say that fires increase considerably the difficulties of working from all points of view. The difficulties could be minimised if all the factors are known at the time of layout but generally speaking they cannot be entirely avoided.

The difficulties and dangers would become greater at the final stages of depillaring and also in the case of extraction of seams lying close together.

Question 5.—In my opinion workings in seams liable to spontaneous combustion should be laid out on a panel system; the rare exception being in a case where it would be possible to keep the goaf under water.

The barriers in a panel system which is worked without stowing would have to be left of sufficient width to prevent over-riding. I do not think the amount of coal to be left in the barriers can be very well expressed as a percentage of the seam because each seam would have to be treated on its merits. The size of panel would have to be determined to suit the incubation period whereas the governing factor in choosing the barrier width is prevention of over-riding.

Question 6.—Temporary Coal Mines Regulation—Government of India Notification No. M955 is in my opinion adequate. Notification No. M1055 I consider to be far too wide in its application

in regard to Regulation 4 (2) and Regulation 5. There is absolutely no need for the application of these two regulations to mines in this district. The number of shots fired in this district since the collieries opened must run into millions. The majority of these shots were fired in circumstances against Regulation 4 (2) and Regulation 5, yet I believe I am correct in saying that not one single accident has occurred of the nature against which these regulations are intended to guard. There must have been thousands of shots fired in dry and dusty places under circumstances where the effect would have been that of a blown-out shot, yet there is no record as far as I am aware of a single explosion of any magnitude. I know that it is fallacious to argue that because an accident of this nature has never happened it never can happen but I certainly think that the test of experience in this case has been so vast that it makes the application of the regulations mentioned unwarranted in this district. These regulations guard against a danger which is practically non-existent in this coalfield and are therefore useless as a guard against fire from this danger.

Question 7.—I think that mechanical ventilation should be used in all mines or seams in which there are sealed-off fires. There might possibly be some rare instances where a forcing fan could be used to advantage but in all cases this would have dangers. On the whole I would rather employ a fan which would promote the escape of any gases or fumes in a mine whether from sealed-off fires or otherwise. This would call for an exhausting fan which would also mean that it would be located in the safest place in the event of an explosion in contradiction to the use of a compressing or forcing fan which together with the pit top coverings or seals would have to be located at the downcast.

The use of a forcing fan would also increase the danger in a mine in the event of mechanical breakdown of the fan although this is rather a rare thing.

Question 8.—I would certainly say that broken-up portions of a seam left in a goaf would materially increase the dangers of spontaneous combustion but I cannot speak from experience.

Question 9.—I do not think the provisions mentioned in *Question 9* should be required by law. Each case could be treated on its merits by the Inspectorate and recommendations made accordingly.

Question 10.—I do not think telephonic communication from in-bye parts of a mine to the surface should be required by law.

Question 11.—In mines where there are fires, as a precautionary measure, suitable supplies of materials for building of stoppings and fire seals should obviously be kept in readiness to deal with unexpected outbreaks. If not readily available, suitable apparatus such as smoke helmets should also be kept and any other appliances which would be useful in the event of the quick erection of stoppings being required.

Question 12.—Training in methods of fighting underground fires should be considered essential for the staff of a central rescue

station in addition to the ordinary rescue training. The extent to which these facilities are available is a factor to be taken into consideration in regard to *Question 11.*

Question 13.—I should say that breathing apparatus and gas masks would prove extremely useful in fighting mine fires as also suitable clothing and small portable water pumps of a handy type such as semi-rotary with suitable lengths of armoured hose.

Question 14.—In my opinion an underground fire is always a potential cause of an explosion on account of the possible distillation of gases. This has been definitely proved by the safety in Mines Research Board at Buxton (*vide* Trans. Inst. Min. Eng., Vol. LXXXVII). It therefore is reasonable that all precautions should be taken to prevent a possible gas explosion initiating a dust explosion and so increasing very considerably the dangers. But the liability of the seam or mine to spontaneous combustion and the degree of explosibility of the dust are factors which must be considered. Thus while from what I have learnt of the coalfields of Bengal, Bihar and Orissa, I would say that the regulation requires to be fully extended there I would not say that this would be required in this coalfield.

Question 15.—Precautions against fires occurring at all are most certainly better than after the fires have occurred but this is not a rule which in my opinion should be universally and 'blindly' applied in all coalfields. It is obviously absurd to guard against dangers which to all practical purposes are known to be non-existent. I would however go as far as to say that all coal mining in India should be laid out on a panel system or arranged so that by working from dip to rise the goaf is left in such condition (stowed or left under water permanently) that the possibility of fire is minimised.

Question 16.—Sand-stowing or with other material of a like nature should be enforced in the circumstances mentioned except when it might be possible to keep the goaf fairly full of water. This would necessitate a good dip to the seam.

I do not know of any seam in this coalfield where the above would be necessary as gas is not known and as far as our working seam is known no fire has occurred. I cannot speak for other coalfields in India as I am not familiar with the seams there.

Question 17.—Premature collapses are caused by too much extraction of coal in the first working and/or insufficient pillar sizes. The latter is the main cause.

Question 18.—Underground fires through spontaneous combustion and the needless loss of coal through crushing and over-riding of pillars are the main dangers of premature collapses.

In almost all cases I would say they are due to faulty system of working. It follows that the best preventative is a matter for carrying-out a good system of working.

Question 19.—In my opinion there is no need for minimum dimensions of pillars and maximum sizes of galleries to be laid

down by law. These are matters which cannot be satisfied by a hard and fast rule for all seams in all coalfields and therefore I think each individual case can be mutually settled between the colliery manager or mining engineer concerned in consultation if need be with the Mines Department. If the Mines Department are of the opinion in any case that insufficient dimensions were being adhered to, the remedy already lies in their hands. The lessees could also take action in a similar case on the grounds of improper working.

Question 20.—The main factors governing the sizes of pillars are the crushing strength of the coal and the cover.

Question 21.—Where heightening of galleries and reduction of pillars corresponds to 'robbing' it should be legally prohibited and similarly in the case of splitting except when the latter is done immediately before pillar extraction.

Question 22.—No arbitrary rule or rules can, in my opinion, be laid down to meet these conditions. The method of working thick seams described by Mr. Treharne Rees in his Report to the Government of India is the best that I know of.

Question 23.—I am not in favour of a statutory authority having any more authority in the matter of lay-out, etc., than at present obtains. The Mines Department can always question the adoption of methods and as at present they can be discussed. There is no need in my opinion for statutory powers in this direction.

Question 24.—Threatened collapses or lack of stability in my opinion amount to dangerous occurrences and the authorities (Mines Department) already have the power to deal with such cases. I therefore do not see the necessity for further enlargement of the powers of the Chief Inspector of Mines as detailed in Chapter V, Regulation 19, of the Indian Mines Act.

Question 25.—I have had experience of one irruption of water from the surface which was not absolutely free from danger. A surface diversion of a nullah—which although not directly over a goaf was sufficiently close to the faulted boundary of the depillared area to demand diversion as a precaution during the rains—proved inadequate to take all the water in a storm of exceptional severity. The water forced its way into the nullah and bed of the latter collapsed in two places, the water entering the workings. Although considerable underground flooding was caused nobody was trapped.

Question 26.—Such an irruption as described might in certain cases where underground fire existed have been dangerous due to the generation of gas which could cause an explosive mixture. On the other hand it might have had the good effect of extinguishing the fire before a great deal of generation could have taken place.

Question 27.—The obvious precaution in the above case was to see that the diversion was of amply sufficient size but this case is so rare and unusual that no one would suggest legislation particularly against this. It was a case of the manager being badly

advised against his own better judgment and the responsibility was therefore his.

Question 28.—Temporary Regulation No. 5 in Notification No. M-1055 is a retrograde step as far as safety in shot-firing in this coalfield is concerned and I consider Regulation 4 (2) is redundant in this district.

In my answer to *Question 6* I have dealt with this matter from the point of view of possible explosion causing possible consequent fire.

As far as shot-firing is concerned it has been the practice for many years to fire even as many as four shots at a time. This reduces the work of the shot-firer and reduces the danger to the labour employed underground. By substituting the temporary regulation whereby only one shot at a time can be fired except in special circumstances the work of shot-firers is tremendously increased and, having been used to easier circumstances, it is very difficult to get them to conform to the new regulation. Similarly the other labour brought up to the custom of having all the necessary shots fired in their respective working places at one time have a tendency to leave their places of safety before the work of firing the shots singly has been completed. If the usual dangers associated with blown-out shots, gas, and explosive coal dust, had to be met there would be every reason for forcing the labour at all costs to comply with the regulation but as experience of a very long nature shows that these dangers do not exist then where is the necessity for extending the regulations mentioned to this coalfield and particularly when the enforcement brings in other dangers.

In regard to the Permanent Regulations regarding shot-firing I certainly think that the words " or under the personal direction of " should be deleted from Regulation 108. I have a case in mind where a colliery manager took this to mean that as many as four or even more persons could fire and charge shots providing the shot-firer was somewhere in the vicinity. An interpretation of this sort goes, I believe, beyond what is intended by the regulation and gives all sorts of loopholes to managements who cut costs unscrupulously and unfairly.

Question 29.—The exclusive use of " permitted " explosives in substitution for gunpowder as used at present would be most undesirable in this coalfield and is quite unnecessary. It would definitely add to the dangers of working, increase the cost, and have other objectionable consequences. It would also be a matter of great concern to the civil authorities who take great heed of high explosives and detonators in use at collieries. As previously mentioned the effect of blown-out shots is nullified in this coalfield by the extremely safe conditions, so the very circumstances for which " permitted " explosives are designed do not exist and therefore their use is not called for.

Question 30.—I do not think there is any need for change in the present system of authorisation for shot-firers in this coalfield.

Question 31.—I do not think a single accident of any kind has ever occurred in this coalfield which could be attributed to, or the effects of which would have been reduced in the event of the non-existence of, the proviso to Regulation 106. Permits under the proviso have been enjoyed by many collieries including that of which I hold charge, for many years and I say from experience that the permit to carry increased quantities has resulted in better supervision of the explosive with corresponding less likelihood of danger. I most emphatically say that in the case of gunpowder the proviso should be retained.

Question 32.—I think the present system is quite efficient.

Question 33.—The Ghorawari seam is the only workable seam in this area. The coal is reputed to be (and certainly gets the best price) the best of the Central Provinces coals. I believe it would correspond roughly to the best second grade Bengal coal. A proximate analysis shows 51·70 carbon, 30·33 volatiles, 14·20 ash, and 3·77 moisture. Calorific value is 6,473. The seam is 15 feet thick of which 8 feet in the bottom section is clean coal, the roof portion being banded shale and coal in which there is approximately 3 feet of shale in all. The inclination of the seam is approximately 1 in 10, slightly west of north.

Question 34.—As far as possible all the coal is extracted.

Question 35.—The exact meaning of this question is not quite clear but I take it as referring to the proportion of coal got from pillar cutting in relation to the corresponding whole working. The answer to this would be approximately $\frac{2}{3}$ of the output is obtained by pillar cutting. Actually about 75 per cent. to 80 per cent. of the coal in pillars is extracted but this figure varies a great deal due to the incidence of faults, occasional patches of tender roof with bad slips, and workings near the outcrops where the roof cannot be controlled so well on account of its softness, etc.

Question 36.—I am not familiar with the conditions in the Jharia coalfield so cannot give a proper answer.

Question 37.—*See Question 36.*

Question 38.—I do not think stowing would have much appreciable effect in the collieries under my charge because we do not suffer from the dangers against which stowing helps to safeguard.

It would possibly increase the life and productivity of the collieries but by a very small amount.

Question 39.—In a seam which is not too thick a system of retreating longwall with gobs packed by sand or other incombustible material would be ideal in the recovery of a seam liable to rapid spontaneous combustion. In the case of a thick seam suffering from a similar defect in regard to liability to spontaneous combustion ordinary bord and pillar working with stowing by sand or other incombustible material would be the best method.

Question 40.—The above systems should be enforced where any other system of working would be dangerous to life or likely to lead to unreasonable loss in working. There would also be cases

where the systems referred to might be applied with great advantage in working adjacent seams.

Question 41.—No collieries under my charge in India have been stowed.

Question 42.—If it be found that stowing is essential in any particular area I think a cess on all coal from that area should be levied and should be paid by the consumer.

Question 43.—It would be sufficient in my opinion to have the Chief Inspector of Mines as the statutory authority and such would be desirable but it would be essential to also have an appellate authority.

Question 44.—I do not see any need for increasing the powers already held by the Mines Department in this direction.

Question 45.—Costs under headings (*a*), (*b*) and (*c*), would be practically wiped out. There would be an increase in pumping costs on account of the water required for stowing. There would be a reduction in losses under heading (*d*) and also some reduction under heading (*f*).

There might be some saving under heading (*g*) but this as well as (*h*) would I believe be rather variable factors.

I believe that some saving would be made in regard to underground supervising staff.

Question 46.—I certainly think this is a matter for control in India.

Question 47.—This also is a matter for control.

Question 48.—With stable market conditions over a period of many years it might be possible to give a definition of commercial value as being dependent upon saleability, that is to say, any coal which would be saleable would be said to be of commercial value. But fluctuating markets would give wrong values from time to time so it is very difficult to give a satisfactory definition to meet all cases.

Then again the question has to be considered whether coals which cannot be sold at a certain time for ordinary commercial need as fuel might at some other time be found of value for other processes.

Question 49.—I think in this case simultaneous filling would be required.

Question 50.—Yes, providing the stowing costs are met by a general cess.

Question 51.—I do not think it right that the railway should be called upon to pay for any part of the cost incurred in taking out the coal as they are entitled to the support under common law, I believe. If the railway require the coal to be left they should pay for it; on the other hand if the railway is damaged by the extraction of the coal, the colliery should pay for the damage.

Question 52.—I consider that partial filling could be adopted in the case of working thin seams at reasonable depth when some

subsidence would not have an appreciable effect on the strata. I do not know of instances in this country.

Question 53.—Having read the Report to Government of Mr. Treharne Rees, I do not think I can offer any suggestions in regard to sand or other stowing in any particular which would be an improvement on the report.

Question 54.—In the interests of (i) safety, I think the present system of statutory control on broad lines is quite good but possibly a little more elasticity could be given to the powers of the Mines Department to vary the control as required to suit individual coalfields.

In the interest of (ii) conservation of a national asset, statutory control is essential but it must be competent control. This control should be centred in each coalfield or at any rate decentralised sufficiently to enable the control to be properly carried out. There are coalfields in India to-day under statutory control of local Governments but from my experience I would say that this form of control is most incompetent due to the work being left in the hands of officials who besides being laymen have plenty of other work to do. The result is that the clauses in mining leases calling for areas to be worked in a skilful and workmanlike manner and upon the most approved principles of mining are obligations towards which little or nothing is done to secure their enforcement. The practical result can easily be imagined and, to my misfortune, has been witnessed by me.

It presents a great opportunity to 'get rich quick' colliery proprietors at the expense of a national asset.

Therefore a strict and *competent* statutory control is very necessary.

Question 55.—Where the period of incubation is comparatively short in spontaneous combustion, and such is the condition, I believe, prevailing on the Bengal and Bihar side, I would consider compulsory stowing should be generally adopted. Avoidable waste to an appreciable extent should be prevented everywhere and in the case of coking coals is absolutely essential.

Question 56.—The amalgamation of small areas would help enormously to reduce the loss of coal in working and also in consumption at collieries hence a greater percentage is available for the market with a corresponding effect upon the life of the collieries. Such amalgamations should in the national interest be made compulsory without resort to any *salami* system which, I think is grossly unfair.

Question 57.—I do not approve of independent ownership of seams directly above or below one another neither do I approve of independent working in those conditions. Control of a dual or greater nature in any one working area is objectionable and unified control of working is essential to avoid dangers which may easily arise from incompetent, deliberate, or ignorant, co-operation.

Unified control in these circumstances would also lead to greater conservation of coal.

Amalgamation of the various interests appears to be the only remedy.

Question 58.—I consider the colliery manager should have full and independent charge of all that concerns his particular colliery workings.

Question 59.—I have had personal experience in this direction and consider joint surveys of barriers absolutely essential. It would be better still in my opinion if this work could be done by a statutory authority when called for.

Question 60.—It would tend to eliminate danger to human life if full surface features are properly correlated with the underground plan.

Question 61.—It is clear that large quantities of good coal could be conserved in India by substituting inferior coals for many of the present commercial purposes such as railways, mills, etc. I believe that inferior coals could be more largely used than at present for railway locomotives, industrial power and the manufacture of soft coke, and this saving of good coal could be further augmented by avoiding wasteful and primitive methods of coke making in connection with good coal. I do not consider myself sufficiently acquainted with all the factors to be able to offer any practical ideas beyond the above.

Question 62.—I have no practical experience in this direction.

Question 63.—Interference from time to time under the Mines Act is no doubt more frequent in India than in Great Britain and this is understandable when the fact is taken into account that the mining industry is, generally speaking, far more organised and the general level of intelligence of the labour, in particular, much higher. In many parts of India it is a fact that mining is in a primitive state which has been left behind many years ago in Great Britain.

I also believe there are certain aspects in the control of some collieries in India which do not obtain in Great Britain but which call for tighter supervision on the part of the Mines Department.

For instance, in this country there are instances of managers having to work under so-called agents or general managers who are unqualified in mining. I know of a case of an agent on a monthly pay of Rs. 50 controlling collieries under managers drawing ten times as much salary. In the case of managers with strong personalities and who know their jobs this might not be harmful but otherwise it would be very bad and dangerous. This position should not be possible and if all collieries in India were under properly qualified control there is no doubt the work of the Mines Department under Section 19 would be greatly reduced.

Oral Evidence.

Question 6.—With the exception of the points referred to in my written answer, I am agreeable that the Temporary and Supplementary Regulations should be made permanent. I also agree that the temporary legislation of 1936 should be made permanent.

Question 9.—After discussion with the Committee, I agree that it would be valuable to require the provision of taps on existing water mains and where water is available.

Question 19.—After discussion with the Committee, I agree that general principles of first working should be laid down based on a maximum percentage of floor area with a maximum height for galleries. There should however be a provision for the Chief Inspector of Mines having power to vary the general principles, to suit local conditions or special circumstances. An appeal against an adverse decision of the Chief Inspector of Mines as regards variation of the principles should also lie to the same authority as hears appeals against orders under Section 19. I agree that there should be an adequate and immediately enforceable penalty for any infringement of the general principles laid down. I think that a suitable penalty would be requiring the restoration securely of conditions to what they would have been in accordance with the principles, work in that section of the mine being stopped in the meantime.

Question 21.—I would agree to "immediately before the systematic extraction of pillars" being defined as two pillars lengths ahead of the pillar that is being extracted or the point at which pillar extraction is about to begin.

Question 24.—After discussion with the Committee, I agree that the Chief Inspector of Mines should have the power to require mineowners to pack in the interests of safety, more especially if the work required was to be assisted out of some statutory funds.

Question 30.—After discussion with the Committee, I agree that shot-firers in coal mines should be certificated as proposed. In the collieries with which I am connected, the shot-firers have no financial interest in the winning of coal. They are all paid a monthly wage and shot-firing is their only job.

Question 33.—The whole 15 feet is being worked and the analysis given was arrived at from samples taken by the Assistant Coal Superintendent, State Railway Department, who took samples from all over the seam. We sell our coal mainly to the G. I. P. Railway, and to the cotton mills in Ahmedabad. This year we have tendered for railway contracts at about Rs. 4-8 but we do not know whether we have got any contract.

Question 42.—After discussion with the Committee, I am now inclined to think that a universal cess on all coal and coke carried by rail in or into British India would be the best taking everything into consideration.

Question 43.—I agree that a statutory authority will be necessary for the purpose of conservation provided the Chief Inspector of Mines was a member of that statutory authority. I think there should be an independent Chairman and I would prefer as Chairman a mining engineer from home in no way connected with mining out here. In addition there should be a permanent panel of ten competent mining engineers of whom three would be selected by the Chairman for each meeting. I think that such a statutory authority should also be the appellate authority from the decisions of the Mines Department on points of safety.

Question 54.—I have not given any special thought to the idea that conservation should extend not only to the prevention of waste but also to the uses to which the coal extracted is put. I think that it would be desirable in the national interests to have statutory control for both the above purposes, but I do not think that it would be practicable so far as I can see.

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52. Written Evidence of Mr. J. Thomson, Superintending Engineer, the Ballarpur Collieries Co., Nagpur.

Question 1.—The appointment I hold is Superintending Engineer of the Ballarpur Collieries Co., "Bisesar House", Temple Road, Nagpur, Central Provinces. I have had 22 years' experience in the Indian Mining conditions in the Hyderabad Deccan, Chanda Valley coalfields, the Central Indian coalfields and for a short time in Pench Valley.

Question 2.—Spontaneous combustion arising out of premature collapses is the chief cause of the underground fires. There are, however, no fires in this district. This is, probably, because there has been very little depillaring here and what depillaring has been done, has been done by the aid of sand-packing.

Question 3.—There is only one seam in Chanda Valley which is known as the Thick Seam, and if sand-packing is not resorted to, fire is likely to occur.

The period of incubation might be from six to twelve months.

There is also the danger of flooding in the monsoon if the surface is broken at certain mines.

Question 4.—Fires do increase the difficulties and dangers in extracting the coal and are prejudicial both to the safety of miners and minerals. The danger also increases as the final stage comes on.

Question 5.—I am in favour of working the seams being laid out in the panel system.

The percentage of the seam which would be left in the barriers would depend on the size of the panels and may vary from 15 to

30 per cent. This would also depend on the nature of the seam. All this coal need not, however, be totally lost.

Question 6.—The Temporary Regulations issued by the Government of India Notification No. M. 955 of the 23rd May 1936 and No. M. 1055 of the 27th June 1936 are adequate.

Question 7.—Yes. Fan should be of the exhausting type which might keep the breathing action of the fire to a minimum.

Question 8.—Does increase the risk of spontaneous combustion.

Yes. Warora colliery was on fire probably from this cause and was shut down for this reason.

Question 9.—Water taps on the water mains might be useful in case of fire being in the vicinity of the pipes, but otherwise "No". This should not be enforced by law.

Question 10.—No.

Question 11.—Sufficiently wide barriers between the adjacent collieries should be left in order to allow the mine to be flooded if the fire goes out of control, and to prevent fire or flooding of these mines.

Question 12.—Yes. The training in dealing with the underground fires should be given to rescue brigade.

Question 13.—Breathing apparatus and gas masks would be useful in dealing with the fires, but they should be used by those persons who are trained for their use only.

Question 14.—I do not think that extending Regulation No. 14 would do much good, except in mines giving off inflammable gas.

Question 15.—Yes.

No. The difficulty here is to know where a fire is most likely to occur.

Question 16.—Yes. In all seams giving off inflammable gas and which are liable to spontaneous combustion.

Question 17.—To pillars of being insufficient size and being left standing over long a period of time.

Question 18.—Spontaneous combustion, danger of air blast, danger to life and surface properties, also loss of coal. Premature collapses can be prevented by keeping the pillars of sufficiently large size and not allowing them to be split up until the time of actual extraction, and extracting them as early as possible.

Question 19.—No. The condition between the various districts varies so much that it will be difficult to lay down any definite rule to suit every condition.

Question 20.—The main factors on which the size of the pillars and the width of galleries depend are:—

(1) Depth of the seam from surface;

(2) Thickness of the seam;

(3) The nature of the roof and floor;

(4) The nature of the coal; and

(5) The inclination of the seam.

Question 21.—Yes. The heightening of the galleries need not be restricted unless the seam is very thick, say over 15 feet.

Question 22.—There should be no restriction on the number of sections. The dimensions of the pillars and galleries will depend upon the circumstances. The thickness of the parting will depend upon the nature of the coal and should not be in any case less than 10 feet.

Question 23.—Yes.

Question 24.—Yes.

Question 25.—Rampet colliery belonging to the Singareni Collieries Co., was flooded in 1916 or thereabout by tapping of fissure near the outcrop during the monsoon. The whole of the mine was flooded but was recovered afterwards.

Cause.—Outcrop barrier not large enough.

Question 26.—This is possible, but I have not seen such a case. The situation is, however, covered by Regulation No. 121.

Question 27.—Such irruptions are due to bad surveying or collapse from the surface which allows heavy bodies of water into the workings. This is already covered by Bye-law No. 35 under section 32 of the Indian Mines Act, 1923.

A remedy for this is to see that proper and accurate plans are kept and to use some form of packing to avoid collapses.

Question 28.—No changes necessary.

Question 29.—The mines in this district are free from gas, so that "permitted" explosives need not be used. Over and above, the cost of "permitted" explosives is prohibitive.

Question 30.—Yes.

Question 31.—The proviso to Regulation No. 106, which gives the Chief Inspector of Mines power to allow more than 5 lbs. of explosives to be kept in one place at one time, should be retained. The conditions may arise which may make it necessary to have more than 5 lbs. of explosives to be carried.

Question 32.—No.

Question 33.—In Chanda Valley there is only one seam which varies from 50 feet to 80 feet in thickness. All of it is not of coal, but is divided up by partings. The section is as follows:—

Sandstone Roof.

Ft.	In.		Ft.	In.	
5	1	Coal.	4	0	Coal }
0	10	Shale.	0	8	Shale } (Middle Seam).
3	2	Coal.	1	7	Coal }
0	10	Shale.	5	10	Shale.
2	3	Coal.	0	1	Stone band.
1	10	Shale.	10	5	Coal (Bottom Seam).
14	0	Coal (Top Seam).			
1	0	Shale.	52	6	
0	5	Coal.			
0	6	Shale.			

Sandstone Floor.

What is known as the Top Seam has been extensively worked in Ballarpur and Sasti Collieries and also the Bottom Seam. The quality is good second class, and the inclination of the seam is 1 in 13.

In Ghugus Colliery the seam is the same seam, but the quality changes and there is only one portion of the seam which is workable. The section of this is as follows:—

Sandstone Roof.

Ft.	In.		Ft.	In.	
9	0	Coal and Shale.	12	0	Coal.
3	0	Coal.	6	0	Yellow Laminated Stone.
7	0	Coal and Shale.	10	0	Coal (Working Seam).
2	0	Shale.			
3	0	Coal.	61	0	
9	0	Sandy Shale.			

Coal and Shale Floor.

The quality is slightly lower than Ballarpur Colliery and the inclination of the seam is 1 in 7.

In the Central coalfields (Korea State) Chirimiri colliery, the seam which is at present being worked is also 50 feet in thickness. Only the bottom 19 feet is being worked. The section of the seam is as follows:—

Fine Sandstone Roof.

Ft.	In.		Ft.	In.	
4	0	Coal.	5	0	Shale.
5	0	Sandstone.	22	0	Coal.
4	0	Coal.			
6	0	Shale.	50	0	
4	9	Coal.			

Sandstone Bottom.

The quality is equivalent to selected grade and the inclination of the seam is 1 in 70.

Question 34.—The whole of the seam is not extracted but only sections, that is, the top and the bottom seams in Ballarpur, Sasti and Ghugus and the bottom 19 feet in Chirimiri.

Question 35.—At present no output is being taken from the pillars.

Question 36.—This question is too wide, as I do not know what condition the pillars are in or how they have been worked.

Question 37.—This coal would certainly be lost without stowing, but if stowing is adopted need not be lost. No.

Question 38.—If sand-packing were adopted in these collieries, it will double the life and productivity of them.

Question 39.—I am in favour of a system of packing simultaneously with the extraction of pillars.

Question 40.—In case of our collieries at Ballarpur, sand-packing has been adopted to in the past and in my opinion will have to be continued when further extraction of the pillars is taken in hand.

Question 41.—The last stowing that was done in Ballarpur, was done in between 1918 and 1920. The cost per ton was then said to be annas eight (Rs. 0-8-0) per ton.

Question 42.—The consumers should meet with this charge.

Question 43.—Yes. The authority should be constituted in such a way as to have the Mines Department represented by one Inspector and also three expert Mining Engineers nominated by the Government.

Question 44.—Yes.

Question 45.—Estimated saving that would be secured in—

(*a*) to (*h*) Annas four and pies six only (Rs. 0-4-6).

No.

Question 46.—If it is possible, the lower grade coal should be protected and destruction prevented.

Question 47.—Should be prevented.

Question 48.—Coal of "commercial value" is a coal that could be used for steam raising or can be converted into bye-products by distillation or for which a market can be found. Geographical position has a good deal to do with this.

Question 49.—Yes.

Question 50.—Yes, wherever practicable.

Question 51.—The railways concerned should bear part of the cost, as they will be ensured against risk if there was fire and

they would not require so much supervision of underground workings under railways.

Question 52.—Yes. No.

Question 53.—The price of coal to the consumer should be put up to cover all expenses.

Question 54.—Yes. Since this control is for the general safety and conservation of a national asset, I do not see any reason for limiting the control to any particular field or fields.

Question 55.—I agree that avoidable waste would be stopped.

Question 56.—Yes.

Question 57.—I do not approve of different owners working separate seams in the same area simultaneously or lying within the boundaries of the same leasehold.

If one seam is badly worked or laid out other seams might be affected.

Remedy.—Prohibit.

Questions 58, 59 & 60.—Yes.

Question 61.—There are large reserves of inferior coal which could be used for railway locomotives, industrial power, etc., in the Central Provinces.

Question 62.—By rejecting inferior sections of the seams, it is possible that certain amount of waste had been caused by the Coal Grading Act.

Question 63.—During my experience here, I cannot say that the notices and orders received from the Mines Department are excessive or particularly interfering.

Remarks.—If the Government and general public want safety in Mines and reasonably good working, this cannot be had without paying for it, and unless and until the price of coal goes up, I do not think that very much can be done. To offer the mineowners Rs. 2-8 or Rs. 3 per ton of coal, seems to me to be asking for trouble.

Oral Evidence.

Question 6.—I would be in favour of the Temporary and Supplementary Regulations being made permanent, and also the temporary legislation of 1936.

Question 9.—After discussion with the Committee, I agree that it would be a good plan to legislate for the precautions contemplated on existing water mains and where water is available.

Question 14.—After discussion with the Committee, I would now agree to the extension of Temporary Regulation 14 as suggested.

Question 19.—After discussion with the Committee, I agree that general principles of first working should be laid down by

regulation provided the Chief Inspector of Mines had power to vary those principles under special circumstances and to suit local conditions and provided also that there would be an appeal to the authority hearing appeals under Section 19 against an adverse decision of the Chief Inspector regarding variation. As regards the best such general principles, I am inclined to agree that a percentage of floor area *plus* a maximum height for galleries would be suitable.

I agree also that any penalty for an infringement of such general principles should be adequate and immediately enforceable. An adequate penalty would be the restoration of the conditions to what they should have been in accordance with the principles, all work in that section of the mine being stopped meanwhile.

Question 21.—I agree that " immediately before the systematic extraction of pillars " should be defined as not more than two pillars lengths ahead of the pillar that is being extracted or the point at which pillar extraction is about to begin.

Question 24.—We have been sand-stowing completely in the Ballarpur mine. This was done between 1916 and 1918. This was necessary because the overlying strata is very heavily watered and the surface is below the high flood level of the river, It would therefore be dangerous to allow the surface to break. Again, an additional advantage was also the lessening of the danger of spontaneous combustion in a seam which is known to be liable to such combustion.

Another advantage was that there are two other sections of the seam 4 feet and 5 feet thick respectively and containing very good coal which overlie the two present working sections, and which the stowing operations will leave in a state so that they can be subsequently recovered.

Question 28.—I should like to revise my written answer to the extent of saying that Temporary Regulation No. 5 is unnecessary provided that in dry and dusty places in which the shot is to be fired the precautionary treatment in water or stone dust has been done.

Question 31.—I would prefer the limit of 5 lbs. in Regulation 106 to be done away with, the Chief Inspector of Mines being given the power to fix the limit of the quantity of explosives to be carried in accordance with the conditions in each mine. At Ghugus (Manikpur) colliery the working are at 5,000 feet from the mouth and the gradient is 1 in 7. It is a hardship for shotfirers to have to carry only 5 lbs. of explosives just sufficient only for 15 shots and then to have to run to the surface for a fresh supply of explosives. Formerly we were permitted to carry 10 lbs., but this permission was withdrawn by the Chief Inspector a short time ago. The system at Ghugus colliery is for shotfirers to have two assistants. If the quantity of explosive allowed to be carried at one time is limited to 5 lbs., it would be necessary to authorise a greater number of explosive carriers and in itself

this is extremely objectionable as those explosives carriers are not directly under the supervision of the shot-firer and accidents are more likely to occur than if greater quantity of explosives were permitted to be carried by the shot-firer so that the number of carriers would be diminished.

Question 33.—The analysis of the coal in the two working sections (Chanda Valley) is calorific value 6,265, ash 15 to 18, moisture 10, and volatiles near 30 per cent.

In the Chirimiri colliery where only the bottom 19 feet is being worked, the three sections of 4 feet each on the top of the 22 foot section are all good quality coal of the selected grade. The calorific value is about 7,000, the ash content under 10 per cent., carbons 62-63, and volatiles about 28 per cent., and moisture about 3 per cent.

At Ghugus colliery only the bottom 8 feet is being worked. All the sections of coal above that are of very inferior quality, almost approaching shale.

Question 35.—It is my opinion that, in all the three seams referred to in *Question 33*, the pillars could not safely be recovered without sand-stowing.

Question 43.—I would prefer the statutory authority set up to control sand-stowing in the interests of safety and conservation to be an expert authority. I think that the Chairman of this statutory authority should be an independent person, and I would prefer a Government officer with judicial experience to a mining engineer from home, but not connected with any mining interests in this country. The remaining members should consist of three mining engineers selected for each meeting of the statutory authority from a permanent panel of 10 mining engineers representing all the important coalfields in India. I would be agreeable to the statutory authority constituted as above hearing appeals from the decisions of the Mines Department under Section 19 and as regards safety generally.

Question 45.—It is my considered opinion that, in the collieries of which I have personal experience, the net result of sand-stowing would be a decrease in the cost of extraction.

Question 51.—My answer to this question contemplates conditions all over India and not in the Central Provinces in particular, where the minerals belong to the Government. All our mines in the Central Provinces are worked under leases from the local Government.

Question 53.—We have taken the lease from the Central Provinces Government of the sand rights in a portion of the Wardha river for which we pay at the rate of As. 5-6 an acre per year. It is my experience that the quantity of sand available in this river is unlimited, and that whatever amount of sand may be extracted in any working season would be replaced during the monsoon.

Question 55.—I would agree to a definition of "avoidable waste" as all waste which is not incidental to the proper and efficient working of the system of mining that is being followed.

Question 59.—I am definitely of opinion that the quality of the work done by the existing surveyors is not good. I think that steps should be taken to make the prescribed tests better and to secure a somewhat reliable type of men. If this were done, I agree that mine-owners should pay such better qualified surveyors better wages than they do now.

Question 61.—The coal from the Ghugus colliery has been used very successfully as pulverised fuel in the Hyderabad mint. That Mint was willing to take as much of this coal as we could supply for this purpose.

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53. Written Evidence of Mr. N. C. Kolya, Manager, The Mahakali Coal Mine, Chanda, Central Provinces.

Question 1.—As Colliery Manager. 25 years' experience in Indian Mining conditions—4 years in Bengal and 21 years in Central Provinces' fields.

Question 2.—Heat. Yes. Yes, by premature collapses.

Question 3.—Seams in the Jharia field which are especially dry and ill ventilated. About 2 to 3 months. No.

Question 4.—Yes. Yes.

Question 5.—Yes. About 34 per cent.

Question 6.—Yes.

Question 7.—Yes. Exhausting.

Question 8.—Yes. Yes, at Chandametta Colliery, Chhindwara.

Question 9.—Yes.

Question 10.—Yes. Beyond two furlongs.

Question 11.—To provide safe apparatus for breathing to equip people to guard against all risks and dangers arising out of fires.

Question 12.—Yes.

Question 13.—Its use will certainly ensure safety.

Question 14.—Yes.

Question 15.—Yes. Panel system of workings with a limited number of connections of smaller dimensions so as to be able to build up stoppings with the least possible delay.

Question 16.—Yes. Seams liable to spontaneous combustion.

Question 17.—Irregular workings and pillars being of insufficient sizes.

Question 18.—Spontaneous combustion. By packing of workings.

Question 19.—Yes.

Question 20.—To permit not more than 25 per cent. of coal being extracted in the first workings. Gradient of the seam and thickness of the cover.

Question 21.—Yes.

Question 22.—Each section should not exceed 10 feet in height. Dimensions of the pillars and galleries should be so fixed as to permit not more than 25 per cent. of coal being extracted in the first workings. Partings between the sections will depend on its hardness. Minimum thickness should not be less than 5 feet in coal and 18 inches in stone.

Question 23.—Yes. Yes.

Question 24.—Yes.

Question 25.—I heard years ago of a dangerous irruption of water into the mines during rains in the Jharia Field which were found interconnected.

Question 26.—Yes.

Question 27.—Pit and incline mouths should be above the highest flood level. Extraction of pillars without packings be stopped to prevent subsidence and cracks on the surface. Interconnections be totally stopped. Yes.

Question 28.—Some place other than the main magazine be fixed at a safe distance near the pit mouth to receive the unused explosives at the end of the shifts and unusual hours especially at nights.

Question 29.—Yes.

Question 30.—Yes.

Question 31.—Be retained especially when the Chief Inspector of Mines, has full discretion in the matter.

Question 32.—The canisters in which explosives are kept should have lock and key.

Question 33.—Mahakali seam of the Wardha Valley coalfield, inferior to that of Chhindwara and Bengal, 11½ feet being actually worked, 1 in 5·25.

Question 34.—11½ feet out of 15 feet, 3½ feet being left in the roof.

Question 35.—Taking out 34 per cent. in the first working.

Question 36.—It will be too much to expect more than 30 per cent. as I am informed.

Question 37.—Yes. No.

Question 38.—Life and productivity will be increased.

Question 39.—Yes.

Question 40.—Areas within the heavy water zones, seam liable to spontaneous combustion and low surface areas likely to be inundated by flood.

Question 41.—No.

Question 42.—Reduced railway freights and increased selling prices of coal.

Question 43.—Yes. Of mining experts and Chief Inspector of Mines.

Question 44.—Yes.

Question 45.—There will be an appreciable saving in all the items excepting pumping.

Questions 46 & 47.—Yes.

Question 48.—The difference between the cost of production and the selling price should cover the minimum interest on the investment.

Questions 49 & 50.—Yes.

Question 51.—Yes, because the collieries provide sources of biggest traffic and high income for the railways.

Question 52.—No. Yes. No.

Question 53.—No. Yes.

Question 54.—Yes. Should be universal. Safety is the first consideration and conservation of national asset is the second.

Question 55.—Be extended to all the fields in India. Yes.

Question 56.—Yes.

Question 57.—No. Every likelihood of the pillars not being kept truly over pillars in the seam below. People working in one seam will be unaware of the dangerous accumulation of water and gas in another seam. The owners should be compelled to adjust their interests in such a manner that the working of these seams should be under one management.

Question 58.—Yes.

Question 59.—No. Yes.

Question 60.—Yes.

Question 61.—Railways and many industrial concerns that were formerly using good coal, have in recent years been using inferior grades of coal. There are possibilities that these concerns will have to use in large quantities these inferior grades of coal when restrictions are placed on the selected grades—this will surely save a good deal of best coal in the manufacture of soft coke.

Question 62.—Have no knowledge of same.

Question 63.—The managements have not either learnt to realise their responsibilities as much as those in England do or they are helpless.

Oral Evidence.

Question 6.—I am in favour of the Temporary and Supplementary Regulations, and also the temporary legislation of 1936, being made permanent.

Question 19.—After discussion with the Committee, I agree that general principles of first working, which I approve of, should be based on a percentage of floor area varying with the thickness of the seam and the depth, together with a maximum height of 10 feet for all galleries. In addition there should be provision giving the Chief Inspector of Mines power to vary these first principles in accordance with special circumstances or local conditions.

Question 21.—I agree that "immediately before the systematic extraction of pillars" should be defined as not exceeding two pillars lengths ahead of the pillar that is being extracted or the point at which pillar extraction is about to commence.

Question 24.—I am agreeable to mine-owners being required to pack to ensure stability and to prevent the premature collapses mainly because the pillars in my colliery cannot possibly be recovered without sand-stowing owing to the fact that once the roof was broken the mine would be flooded by the water accumulated above the deposits of clay which are immediately above the coal. Overlying the seam of coal is the Kamptee series which contain water and are extremely pervious. Above the section of seam which is now being worked there is a stratum of shale 3½ feet thick, and above the shale there is a bed of fire-clay from 7 feet to 15 feet in thickness. If these impervious beds are broken by mining operations the water from the heavily watered Kamptee series would enter the mine. This has actually happened in one or two collieries in the Chanda district within my knowledge.

Question 29.—Actually, I am not in favour of the use of "permitted" explosives being required in Indian coal mines other than gassy mines. This is what the regulations now contemplate.

Question 30.—In my opinion, all inspections required to be made under Regulation 70 should be made by a person qualified to test for inflammable gas and such inspection should be made with a locked flame safety lamp. My reason for making this statement is that in any coal mine gas is likely to be found and the inspection should be made in such a manner as to avoid risk of this danger. If this were done, it would be sufficient if shot-firers were required to hold a special certificate for shot-firing only. The practical experience required before being permitted to enter for the examination for special shot-firers' certificates should not be less than one year, and of that period six months should have been spent as an assistant to a shot-firer.

Question 32.—The present Regulation 106 should be amended to require cases or canisters in which explosives are carried to be locked.

Question 33.—I do not know in exactly what grade the working section of 11½ feet would be placed, but the quality is inferior to that of the Pench Valley coal.

Question 34.—The 3½ feet is of the same quality as the remaining 11½ feet and is being left on account of the weak roof. There is no reason why it should not be recovered when the pillars are recovered. There are other sections of coal in the seam, but all these are of very poor quality.

Question 38.—Without sand-stowing it would be necessary for me to leave from 40 per cent. of the coal in the rise workings to 60 per cent. in the deep workings after splitting or reducing pillars, and it would not be possible to extract any pillars entirely. It follows that the life and productivity would be increased at least by 45 per cent.

Question 42.—After discussion with the Committee, I now agree that the only practical way of financing sand-stowing in the interests of safety and conservation is to levy a universal cess on all coal and coke carried by rail in or into British India.

Question 43.—The Chairman of the statutory authority should be an independent person, and I would prefer such independent person to be a mining man from Great Britain not connected directly or indirectly with any mining interests in this country. The Chief Inspector of Mines should also be a member. The remaining members should be selected from a permanent panel of mining engineers chosen from all the important coalfields in India.

Question 45.—I agree that there would be an appreciable saving in the cost of ultimate pumping if present methods of working were continued.

Question 59.—After discussion with the Committee, I am in favour of mine-owners being required by law to make and maintain joint surveys of barriers between their properties.

Question 63.—Both my experience and impressions have shown me that in very many cases the managers are not allowed to exercise a free hand in developing their collieries by unscrupulous owners.

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54. Written Evidence of Mr. D. N. Mukerjee, Manager, Hindusthan Lalpeth Colliery, Chanda.

Question 1.—I am a B. Sc.—Calcutta University. I got the Second Class Colliery Managers' Certificate, 1919, and the First Class Colliery Managers' Certificate, 1921. I have experience as Manager of Collieries—

	Year(s).
In the Raniganj Coalfield	5
In the Jharia Coalfield	7
In the Giridih Coalfield	1
In the Central Provinces Coalfield	5
Total . .	about 18

Question 2.—Crushed dry coal left either on the surface, or in the underground, on oxidation, in contact with air, causes spontaneous combustion.

Coal left in the underground, by badly extracting pillars—to save cost of timbers—or in a thick seam by falls of roof after depillaring, has caused most fires.

Yes, the fires have increased in recent years.

More fires have been caused by normal collapses, *i.e.*, by badly extracting pillars and by allowing the roof coal to fall, in a thick seam.

Question 3.—(1) Most liable to spontaneous combustion is the Chanda seam in the Central Provinces.

(2) Next come some of the Raniganj seams.

(3) Next, in the Jharia field No. 14 to No. 17 seams.

Incubation period of Chanda seam dust coal on the surface about 2 feet thick, in May, is about 14 days.

Under similar circumstances Raniganj seams will last for about 2 months, and the Jharia seams will last for 3 months.

The incubation period differs according to—

(*a*) Powdery condition of stock.

(*b*) Thickness of the stock.

(*c*) Dryness of the stock.

(*d*) Quantity of air available.

No coal seam is absolutely free from the risk of spontaneous combustion. Under certain condition every coal is sure to start fire.

Question 4.—Yes. Fires increase considerably the difficulties and dangers of extracting the remaining coal.

There is not the least doubt that the difficulties and dangers become greater at the final stages of pillar extraction, and as one seam after another lying close together is removed.

Question 5.—A seam liable to spontaneous combustion must be worked in panels. About 10 per cent. of the seam—considering only the section of seam worked—should be left in the barriers without stowing, in the first operation.

Question 6.—No law, however stringent, will be adequate against all the possible dangers from fires. So far, most of the mines were neglected for reducing the cost. The introduction of panel working, stowing and other small measures will surely reduce the danger. No measures will be able to fight with the accumulated evils of ages. More fires and explosions are sure to come by and by. All the Coal Committees of the world will not be able to stop them completely. These measures should have been enforced over 30 years ago.

No more laws than the Temporary Coal Mines Regulations issued with the Government of India Notification No. M1055 of 27th June 1936 are necessary. There should be right of appeal from the decision of the Mines Department.

A good market will do much towards improvement of the mining method, which no law will be able to enforce.

Question 7.—It is not absolutely necessary to ventilate all the mines, with sealed-off fires, mechanically. If natural ventilation is sufficient there is no need for mechanical fans. If gases escape through fire stoppings, no fan will be able to cope with it.

I prefer exhausting fans for these mines.

Question 8.—The coal left in a goaf in crushed condition, either in a thick seam partially worked, or, in a badly worked section,—will, with ventilation, cause fire. Had the unworked section of the thick seams remained unbroken, with stowing, there would have been very little risk of fires. This occurred in—

(1) Khora Ramji's Khas Jharia Colliery.

(2) B. Chanchi's Khas Jharia Colliery.

(3) Sendra Bansjora Colliery, etc.

Question 9.—In dry and dusty mines a provision of taps on water-mains and hose pipes, etc., will be useful. For them these may be enforced.

To prevent a spontaneous combustion in the goaves it is inadequate and useless, specially if depillaring is being done in the rise side.

Before fire:—If water be sprinkled on the goaf coal, less than flooding, it will readily reduce the coal into dust, which is more liable to spontaneous combustion.

After fire started:—At best only a fraction of the goaf can be watered with a hose pipe. Insufficient water poured on fires will cause—

(1) The fire to burn more vigorously by washing away the ashes and leaving the air passages free.

(2) Explosion, either by forming a large volume of steam suddenly, or by causing the steam to split up into an explosive mixture of hydrogen and oxygen.

Question 10.—Telephone arrangement in most of the Indian Mines will be useless. It should not be enforced except in mines where the distance from the mine entrance, to the end of the level galleries, or to the end of main haulage road, is over 5,000 feet.

Question 11.—(1) A competent person, with at least a second class certificate and some scientific training, should be specially appointed to inspect the fire area both on the surface, as well as in the underground.

In the underground, he should carry a safety lamp, some small birds, a thermometer, an instrument for detecting carbon monoxide, etc.

(2) Samples of gases from the fire area are to be analysed periodically through the pipes.

(3) A strong stopping, with a facing of fire-bricks, should be erected round the fire area.

(4) A second panel should be formed around the first stopping.

(5) If the seam is thicker than the height of the working (which is mostly the case) coal should be removed from the roof, and the floor, if necessary, between the first and the second barrier, with a width not less than 10 feet wide.

(6) Depillaring must be done, except in thin seams, after stowing.

(7) If necessary safety lamps should be used.

(8) Bricks, sand, lime, clay, etc., should be kept in close proximity of the fire area for repairs, in emergency.

(9) Alarm signals (ordinary bent rails will do) should be posted in different parts of the mine and there should be a fire drill periodically.

(10) On the surface precaution should be taken not to allow rain water to enter into fire area by cutting drains all round it.

(11) The cracks on the surface are to be filled up with earth.

Question 12.—It is most imperative to establish immediately central mine-rescue stations in the major coalfields in India.

The days are coming when we have to pay the wages of long accumulated sins of neglecting the mines. Worse accidents will occur more frequently in near future. We are to prepare for these as best as we can.

All the mine officials should be trained in dealing with underground fires as well as in rescue works. Every certificate should be endorsed after requisite training.

Question 13.—Every mine official, while being trained in rescue works, should be trained in the use of breathing apparatus and gas masks of the latest make.

Question 14.—The Temporary Regulation No. 14 of Notification No. M955 of 23rd May 1936 should be enforced in all coal mines immediately.

Question 15.—Undoubtedly, prevention is better than cure.

The preventions are:—

(i) Working of panels, (ii) stowing of incombustible materials, (iii) leaving large pillars in the first operation, (iv) working thick seams in sections, (v) careful extraction of pillars, (vi) working from top to lower seams, (vii) keeping thicker barriers (at least 100 feet) between two adjacent properties, (viii) not to split pillars or increase the height and width of galleries except before depillaring.

Question 16.—Universal enforcement of stowing, except in thin seams, to prevent loss of coal and accidents, is necessary. But an immediate drastic method will affect the industry. A board should be appointed to consider enforcement of stowing, every case separately.

Before enforcement of stowing an outlet of coal must be given (refer answer to *Question 42*).

Question 17.—Premature collapses are mainly due from—

(i) insufficient pillars,

(ii) physical nature of roof, floor and coal,

(iii) inclination of the seam,

(iv) slips in coal,

(v) faults and dykes.

Question 18.—Due to premature collapse the following dangers may arise:—

(i) Flooding of the mine.

(ii) Spontaneous combustion.

(iii) Working and ventilation difficulties.

The preventions are:—

(i) Increase the size of the pillars.

(ii) Reduce the size of the galleries.

(iii) Work in panel system to localise the danger.

(iv) If coal or roof or floor is abnormally soft, start de-pillaring early with stowing.

Question 19.—No hard and fast rules can be laid down for the dimensions of the pillars and galleries. They will be different in different cases.

Question 20.—Sizes of pillars and galleries depend upon:—

(i) Overburden, (ii) Physical nature of coal, roof, and floor, (iii) Inclination of the seam, (iv) Presence of faults, dykes and slips.

Question 21.—I am in favour of legal prohibition of splitting and reduction of pillars and heightening of gallery, outside prescribed limit, except immediately before systematic pillar extraction.

Question 22.—In a thick seam each section should be about 16 feet in height. Of course, this will vary according to necessity. But in no case a section should be more than 20 feet in height. In the last case a section of about 5 feet of roof coal should be taken just before pillar extraction.

In a thick seam, the thickness of the partings and the dimensions of pillars and galleries depend upon:—

(i) Physical nature of coal, roof and floor.

(ii) Inclination of the seam.

(iii) Overburden.

(iv) Natural disturbances, *viz.*, faults, dykes and slips.

The partings should not be less than 6 feet in thickness.

Question 23.—I am in favour of a statutory authority having powers to sanction or not a system of layout of workings.

Question 24.—I am in favour of a statutory authority having powers to enforce stowing in a mine prior to pillar extraction.

Question 25.—In the Chanda seam, over the coal, there is a bed of fireclay 10 feet thick. On the top of the fireclay, there is a bed of brown clay about 12 feet thick. Both the clays are naturally impervious to water. The rest of the overburden, on the top of the clays, is pervious, coarse grained, soft sandstone. The rain water, percolating through the sandstones, accumulates on the clays.

In the clay beds there are fissures filled up with sand particles. When all the roof coal is removed, even within a few square feet, although good-sized pillars are standing and the gallery is not wide, the great pressure of water forces the sand particles out of the fissures. Then water rushes out through the fissures like steam from a burst pipe. With the passage of water the clay roof collapses gradually. More water comes in flooding the mine ultimately.

This happened at Lalpeth colliery, an abandoned portion of the Hindusthan Lalpeth colliery. This has happened elsewhere in this field.

Flooding of mines by tapping old goaves is quite common.

Question 26.—Water in a small quantity entering into the fire areas will increase the fire by washing away the ashes, and cause explosions forming into water gases.

But, when the volume of water is great, it may quench the fire.

Question 27.—A drain should be cut round the goaf area on the surface so as to divert the rain water as much as possible.

The cracks of the subsidence on the surface should be filled up with clay.

Diverting away underground water into a sump, to be pumped away, instead of allowing into the fire area in the dip side, requires proper consideration.

Intermittent rain water will not have the quenching effect of a fire, but a constant heavy feeder in the mine may have.

Question 28.—No more fresh measures are necessary, other than the Permanent and Temporary Regulations already in force, to ensure safety in the use of explosives.

Question 29.—Yes, I am in favour of the measure of "permitted" explosives to be enforced in India.

Question 30.—It is not necessary to have certified shot-firers in the mine.

Question 31.—The proviso to Regulation 106, should be retained. In certain cases, it is necessary to keep more than 5 lbs. of explosives. A few pounds of more explosives, if securely kept, will not endanger the mine but will help the work.

Question 32.—No.

Question 33.—In the Hindusthan Lalpeth colliery, the Chanda seam is being worked. There is only one seam in this district.

Quality—

	Per cent.
Fixed Carbon	53·80
Volatiles	34·80
Ash	11·40
	100·00
Moisture	17·00
Calorific Value	6,474

It is a second class coal according to gradation.

Thickness.—The seam is tapering in the outcrop. When fully developed it is said to be 63 feet thick.

Inclination.—1 in 3·75.

Question 34.—Leaving an inferior floor coal 8 feet thick, a section 12 feet thick is worked.

Question 35.—Depillaring has not yet been started here. Pillar extraction cannot be done here without stowing. The reasons are given under answer to *Question 25.* Also on account of thick seam.

Question 36.—The coal in every seam in every colliery has got to be calculated separately. An off-hand answer will be of no value.

Question 37.—Yes, all the coal locked up under the railways will be lost without stowing.

Compensations were paid by the Railways for the locked up coal to the following collieries:—

(i) Khora Ramji's Khas Jharia.

(ii) B. B. Bose's Upper Lodna, etc.

Question 38.—Had the stowing been introduced in the collieries I served, the lives of the collieries would have been increased by about 100 per cent.

The productivity will be the same with stowing.

Question 39.—Complete extraction of a coal seam is not possible in most seams in India on account of their great thicknesses. Complete extraction is only possible in a thin seam with or without stowing.

I am in favour of enforcement of packing, in thick seams, with the extraction of pillars.

Question 40.—In seams up to 16 feet thick, stowing will not be generally necessary, except to protect a top seam or guard against a possible danger of a fire or flood.

In thick seams stowing should be universal.

Valuable metallurgical coals should be specially protected. We should take a patriotic point of view. Unless this is done immediately, the country will be in danger of a serious famine of metallurgical coals in near future. No mineral is simply an individual's property. It is an asset of the country.

A Board should have statutory authority to compel stowing where it is necessary.

Question 41.—I have no practical experience in hydraulic or hand-stowing.

Question 42.—Yes, I am in favour of a compulsory system of stowing in certain areas, seams or conditions.

Some compensation (a part of the additional expenses) will have to be paid to the sufferers.

This amount should be realised from (*a*) a general taxation on coal, and (*b*) the royalty holders.

Proper consideration is to be paid that a colliery owner does not benefit for having his colliery badly worked.

This compensation should be different in each case.

This compensation could be minimised, by creating a good market for coal, which can be done by—

(i) Closing down some of the railway collieries.

(ii) Reducing railway freight. This will enable our coal to fight—crude oil and South African coal.

(iii) Imposing sufficient tax on the South African coal to stop it totally.

(iv) Opening bye-products industries.

(v) Giving general help to other industries for development and opening.

(vi) Opening petrol industries.

(vii) Giving a sufficient bounty on the exported coal to recapture markets in the Pacific Islands, etc.

(viii) Metallurgical and selected grade coals must not be wasted away for ordinary purposes. Some of the safe (from fire, etc.) collieries, with metallurgical coal, should be closed down—as a reserve for the future.

Question 43.—A statutory authority should be set up with legal power to enforce compulsory stowing, to define the area or seams in which pillars should only be got by process of filling, and for paying compensation.

The Statutory Board should consist of:—

(i) Judicial Officer	1
(ii) Inspector of Mines	1
(iii) Representative of royalty holders and colliery owners	2
(iv) Mining engineers	3
Total . .	7

Question 44.—Yes, the statutory authority should be empowered to give or withhold sanction to a proposed system of new working.

Question 45.—Yes, there will be some saving on the items of (i) timbering, (ii) stoppings, etc., when stowing is introduced. The saving will be different, in each colliery, under each item.

Question 46.—In India most of the seams are very thick. In most cases, some section of the seam must be sacrificed for partings.

If by properly working a seam both good and bad coals of it can be secured, bad mining should be controlled.

Question 47.—It is desirable to prevent extraction of a lower seam in such a way as to render unworkable an inferior upper seam.

Question 48.—All coal is of commercial value. The coal which is now considered to be of little value, will be considered valuable later on, when there is a demand.

Question 49.—It is imperative that extraction of a seam, below a fire area, or a goaf connected with a fire area, should only be done by a system of simultaneous filling of the space from which the coal is extracted.

Question 50.—No coal should be lost to the country if practicable.

If removal of coal under the railways, etc., be paying and safe by stowing, it should be done.

Proper consideration must be paid not to endanger the public properties.

Question 51.—In cases where the railway was opened after the opening of the colliery, the colliery might have extracted the pillars cheaply in a thin seam, allowing the surface to subside. For stowing, the colliery will have to bear a higher cost for the benefit of the railway. This additional cost should be borne by the railway.

In a thick seam where the colliery is bound to work in sections by stowing, the Railway should not bear the cost of stowing.

If a railway was opened, first, and the colliery afterwards, the Railway has a right that the surface land should not be disturbed.

While leasing out the surface, of course, the landlord may stipulate about the loss of coal. In that case the agreement between the parties stand.

For protection of colliery sidings the Railway should not pay for stowing.

Question 52.—In thin seams, 5 feet, thick or less with an overburden of at least 200 feet, a partial filling (at least $\frac{2}{3}$) may protect a paddy field, etc. Partial filling, even in thin seams will not protect surface buildings, etc.

Question 53.—Free delivery of sand at the colliery should be considered sufficient in most cases, when compulsory stowing is introduced, if a good market of coal be maintained all the year round.

In certain cases something more than the free delivery of sand will have to be paid.

The subject is more fully dealt in the answer to *Question 42.*

Question 54.—I consider that statutory control over coal mining is necessary both for conservation of a national asset as well as for safety of the employees.

This control should be for all coal mines throughout India. What is happening at Jharia and Raniganj to-day will happen everywhere if bad mining is not controlled even now.

We must take a patriotic point of view. No mineral is simply an individual's property. It is a national asset. As no mineral can be manufactured, we must not waste it. It must be conserved, at all cost, for the future welfare of the country.

Question 55.—Compulsory stowing should be universally introduced, where necessary, in all coal mines throughout India, including the Native States, and all avoidable waste stopped.

The introduction of stowing of necessity should be gradual. It should first be introduced in the Jharia collieries, specially protecting the coking coal, and all the collieries in danger of a fire.

Question 56.—The small mining properties should be amalgamated by law for working them, with safety, economically, and, avoiding waste.

The owners, with reason, cannot demand any additional salami for the amalgamation. By amalgamation, the properties will last longer, and produce more coal, and they will be the gainers.

It is they who should pay the authority for making this sensible arrangement for their benefit.

Question 57.—I do not approve of one owner possessing the rights of one seam above or below another seam possessed by another owner. For the fault of one, the other will have to bear the consequences.

It may cause:—

(i) Flood.

(ii) Premature subsidence.

(iii) Fire to be extended, etc.

In the same boundary two separate owners should not be allowed.

Question 58.—If in a mine there is only one shaft, and the second outlet is in another mine, each of the managers shall have the right to inspect the other shaft, and the passage between them, as often as it is necessary.

Question 59.—It is important that every colliery shall have the right to survey the adjacent properties forming boundary.

This will help to stop robbing of the barrier between adjoining mines.

Question 60.—Surface buildings, etc., should be shown on a plan of underground workings. This will save many accidents from unexpected collapses of buildings due to subsidences.

Question 61.—The selected grade, first grade and metallurgical coals should be conserved by the statutory authority, at all costs, for the future welfare of the country. The best coal should be used where it is really necessary. Second grade or even inferior coals are good enough for all ordinary purposes.

Question 62.—The present gradation of coal has done much evil to the coal industry. On account of the present gradation of coal, based upon calories only, much valuable coal has been wasted away as well as caused much bad mining. The collieries with coal of inferior calories—which may be more suitable for some particular purposes—have to compete with coal of superior calories at the cost of bad mining, for cheapening the cost.

The gradation should have been made according to different uses of coals which is more sensible. The present gradation leaves a wrong impression upon the minds of the general public. They consider that the coal which produces the most calories is the best for all purposes. But, that is not the fact. That a particular coal is more suitable for a particular purpose, should be taught to the public.

For example:—

(1) For fast trains and steamers, etc.

(Necessity,—High calorific and rapid burning coal.)

First Class—

No. A seam, Jharia.

No. B seam, Raniganj.

Second Class—

No. A seam, Jharia.

No. B seam, Raniganj, etc.

(2) For slow moving trains and intermittent works.

(Necessity,—Medium calorific, steady burning coal.)

(3) For domestic purposes.

(Necessity,—Smokeless, odourless, low calorific, steady burning, caking coal.)

(4) For bricks and lime burning purposes.

(Necessity,—Steady, slow burning, low calorific, small coal.)

(5) For metallurgical purposes.

(Necessity,—Producer of a very high temperature and calories, steady burning, caking coal.)

(6) For bye-products and petrol manufacture.

(Necessity,—Presence of necessary constituents in high percentage.)

etc., etc.

This gradation by uses is more valuable than the gradation by mere calorific values.

Question 63.—The reason for introduction of numerous Regulations, etc., of late, is the bad mining.

Causes of bad mining:—

(1) The landlords in Bengal, Bihar and Orissa, in the early days of coal industry, leased out coal lands without any restrictions as how to work without any waste of coal and damage to the mine.

They did so, because they knew nothing about coal mining.

(2) The Central Provinces Government also leased out coal lands, long afterwards, without making restriction to prevent wastage and ruin of the mines.

If there is any delay in applying for the certificate of approval annually, or in paying the royalty, the lease is liable to be cancelled. But one can set fire to a mine or flood it at pleasure, with impunity.

One expects a better care of the public property from the Government. It is obvious that while drafting the Central Provinces Mining Manual the Government did not care to consult any mining engineer.

The effect was most of the mine owners wanted an immediate return of their investments by ruining the mines. There is no one to stop this, even now.

Again.

(3) India lost oversea market of coal when coal was commandeered by the Government during the last war. The Government took no step to recapture the lost market, which they should have done as duty bound.

(4) The abnormal increase in the railway freight for coal during recent year resulted in the introduction of African coal and crude oil at the cost of Indian coal. The railways are not benefited by it. They have lost a large traffic.

(5) The opening of the railway collieries has caused overproduction of coal. Although the coal from the railway

collieries is mostly inferior and costs much higher, the railways persist upon using their own coal even at a loss.

(6) The present senseless gradation of coal has made the competition keener without benefiting any one.

(7) Indian iron and steel industries without whose help the war in the east would have been impossible are not receiving the promised help.

All these conspired to compel bad mining. The mine owners in their struggle for existence, for years together, had no other alternative but to cheapen the production by sacrificing the mines.

The Government should have foreseen this and put a stop to bad mining, years ago.

On account of Permanent Settlement of Bengal, the Government did not like to court unpopularity by interfering with the foolish leasing out of coal lands by the landlords. They pursued the policy of the least resistance.

From time to time, some mining engineer or other, tried to draw attention of the public and the Government, in vain. The bad mining continued without any check.

The Mines Department do the police duty only. They have powers only in small matters. They have no power to stop ruining of the mines. They see it daily to be done but are helpless.

The result is, in the Jharia coalfield alone, there are no less than forty separate fires. In Jharia, the properties are very adjoining, mostly very small, and without sufficient barriers. In all the collieries the pillar extraction is in full swing, without any stowing. The goaves are full of crushed abandoned coal. The whole surrounding of Jharia for miles around are pittied with subsidences.

The few big accidents during the last 18 months are a fraction of what are to come by and by. We have to pay the wages of the long-accumulated sins.

The big accidents during the last few months have, at last, drawn attention of the public and the Government to the actual state of affairs in coal mining, which every mining engineer knew for years.

Now, the Government want to make up for the lost time. They are pressing the helpless Mines Department to check the accidents. The Mines Department, also, with a handful of sand, are trying to stop the incoming tide.

This is the reason why so many Notifications, Recommendations and Regulations have been produced of late.

These small measures will be of no avail. We have to take the bull by its horns. The disease is to be treated at its root, without any further loss of time.

Oral Evidence.

Question 1.—My experience in the Raniganj and Jharia coalfields was under Messrs. H. V. Low & Co., Messrs. Martin & Co., and other private proprietors. My present owners are Messrs. Birla Brothers, Ltd., of Bombay.

Question 6.—I agree that the Temporary and Supplementary Regulations and also the temporary legislation of 1936 should be made permanent.

Question 11 (6).—I would define a thin seam as anything up to 6 feet.

Question 19.—After discussion with the Committee, I am in favour of general principles of first working being laid down by regulation. These principles would vary with the thickness of the seam and depth from the surface, and should be suitably based on a percentage of floor area *plus* a maximum height of galleries of 10 feet. The Chief Inspector of Mines should also have the power to vary these general principles in accordance with local or special conditions, and there should be an appeal from the Chief Inspector's orders declining to vary the principles to the same authority as hears appeals under Section 19. I agree also that a penalty for the infringement of such general principles should be adequate and immediately enforceable. Suitable adequate penalty would be requiring the conditions to be securely restored to what they should have been in accordance with the principles of working, all working in that section of the mine being stopped meanwhile.

Question 21.—I agree to "immediately before the systematic extraction of pillars" being defined as two pillars lengths ahead of the pillar that is being extracted or the point at which pillar extraction is about to begin.

Question 24.—My answer to this question is based on the fact that in my colliery working in the Chanda seam it will be impossible to extract pillars at all without sand-stowing. The reasons for this are given in my written answer to *Question 25.*

Question 29.—Now that the meaning of the term "permitted" explosives has been explained to me by the Committee, I am not in favour of such explosives being enforced by law in the non-gassy mines of India in which they are now required by law.

Question 30.—My answer has primary reference to conditions in the Central Provinces mines where the shot-firers are paid a monthly wage and are not allowed to have any financial interest in the coal getting.

Question 33.—The analysis in this answer is the analysis of three samples taken by the Coal Superintendent from various parts of the seam. The coal would be equivalent to Grade I of the Coal Grading Board. We sell our coal to the cotton mills and ginning factories in the Central Provinces, Berar and the Bombay

Presidency. This year we have contracts for 12,500 tons for the Bengal-Nagpur Railway. The contract price is Rs. 3-10 per ton. It costs us on the average about Rs. 2-8 a ton to raise, including small coal and slack, and provided the outturn is more than 4,000 tons a month.

Question 40.—By saying that valuable metallurgical coals should be specially protected, I mean that such coals should only be allowed to be used for metallurgical purposes. Those collieries which are selling metallurgical coal may be acquired by Government and closed down. If this would cause an undesirable increase in the consumption of good quality steam coal, I would require the consumers of such steam coal to use inferior coals.

Question 42.—By "general taxation" I mean a cess on all coal and coke from any field in India.

Question 43.—I would prefer the statutory authority to consist of experts and not to be representative of the various interests concerned.

Question 56.—I agree that the compulsory powers of amalgamation should be extended to the compulsory acquisition of properties which are deliberately abandoned when the statutory authority is satisfied that they can be worked.

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55. Written Evidence of Mr. I. Warde, Manager, Damua Colliery of the Kanhan Valley Coal Co., Ltd., under the Managing Agency of the Central Provinces Syndicate, Ltd., Nagpur (sent through the Central Provinces and Berar Mining Association).

Question 1.—I. Warde, Manager, Damua Colliery.

Owners—Kanhan Valley Coal Co., Ltd.

I started mining at the Government colliery at Warora, 1901 to 1904. Then I went to the Raniganj and Jharia fields for some years and to Assam and Baluchistan and then back to Himgir Rampur in 1913 (Sambalpur District). I have been in Central Provinces Mining ever since so that my experience has been mainly in the Central Provinces coalfields.

Question 2.—As regards Bengal it was the custom to leave the dust-coal underground. The miners were paid a much higher rate for steam and only two annas a tub for dust. Thus most of the dust was left underground. I believe that in many cases this dust has been the cause of fire. In the Central Provinces it has always been the custom to engage separate loaders and to give the loaders through rate for mined coal and dust. Thus all that was mined has been removed. Very few fires had taken place during the time

I was in Bengal but in recent years I have read of many so I think that the reply to the question as to whether the number of fires have increased should be in the affirmative.

As most premature collapses are of a small area there is not so much chance of spontaneous combustion; but on the other hand as all the coal has not been removed there is more coal per square yard to be the source of danger. In cases where the premature collapse has been due to all the galleries being too wide and all the pillars being too small the collapsed area may of course be of indefinite extent. In normal pillar extraction as much coal as possible has been already removed so that there is less left to catch fire.

A lot also depends upon the superincumbent strata. A sandstone roof is cooler (or rather conducts away the heat quicker) than a clay roof and is therefore less liable to cause fire. But on the other hand in the case of a clay roof, the water percolating from the surface during the next rains is liable to become muddy and deposit a film of clay over each of the pieces of coal. I believe even a thin film of clay sediment has a considerable effect in preventing oxidation and consequently an increase of heat.

Question 3.—They had extensive areas of fire in Warora due to the practice in former years of leaving slack underground. During the time I was there it had become the practice to remove all the coal and there were no fresh fires. In this district there have been some fires round about Parasia and Eklaira stations, due I believe to spontaneous combustion. I believe these fires have been satisfactorily dealt with but I cannot give any details. There is hardly a colliery in the district that has not had a fire at one time or another in their stocks on the surface. This has been due to their getting no orders for slack which has accumulated in heaps. This fact confirms me in my belief that the best way to prevent underground fires due to spontaneous combustion is to remove every bit of coal whether steam or dust from the mine.

At Warora the goaf normally started giving off black damp about a month or so after it had fallen. After another week or so it began to smell when in normal cases it became time to seal off the panel. It would appear that they had found out by experience what was the safe maximum limit for the size of panels in that seam.

At Warora, however, the seam was not entirely removed but owing to there being one seam above another and owing to the intervening strata not being thick enough to stand a heavy fall in the top seam without holing through into the lower seam the two seams were worked together. That is the pillars were left one above another and worked out at one and the same time. These pillars were split and the stooks robbed to the last possible stage. On this account there was coal left in the stooks in the upper and lower seams which might have been removed if there had been only one seam. The amount of sulphur (iron pyrites) has, in my

opinion, a lot to do with the liability to spontaneous combustion. At Warora the percentage of sulphur was high. I think that in the case of seam fairly free from sulphur and with a good thickness of sand-stone immediately above the coal and a seam of soluble clay higher up, the danger of spontaneous combustion is not great, but it would be going too far to say that any seam is entirely free from this danger.

Question 4.—I certainly think that fires increase the difficulties of pillar extraction. Where there is a fire area a line of stopping has to be left all round and pillars would have to be left for the preservation of those stoppings or else the fire might extend into the open goaf.

Whether a fire in an upper seam affected the pillar extraction in the lower would depend upon the distance between the seams. The hot air would tend to go upwards, also if the goaf holed through to the surface the next rains might put it out, partly by the effect of the water and partly by smothering it in silt. In any case the management would have to be very careful till he was satisfied what was going to happen.

Question 5.—Yes, I consider the panel system to be necessary in fiery seams. In Warora each panel contained ten pillars along the strike by seven pillars on the dip with a rib of coal all round. Towards the goaf this rib used to be robbed to about half at the same time that the above-mentioned 70 pillars were being robbed, that is, a barrier 50 feet thick used to be robbed to 25 feet thick.

Question 6.—I entirely agree with the matters embodied in Notification No. M-955 of 23rd May, 1936. But Notification No. M-1055, dated the 27th June is a different matter. The provisions are too general in their application, as they apply to all mines. In my opinion in addition to the usual inspections made by the Inspectors of Mines and the colliery staff an inspection should be made by the Mines Department of all the collieries in India by an expert appointed by the department. He should be qualified to judge exactly to what extent a mine is liable to be dangerous owing to gas or coal dust. The emergency regulations should then be applied to such mines only as are considered dangerous. By applying the regulations to all mines, not only is a lot of unnecessary trouble and worry created but the regulations themselves are the cause of running into other dangers.

Owing to the poor light and the presence of the oil vessel and bonnet of a safety lamp it is difficult to see more than a yard or two in front or to see where to put your foot especially in going downhill in a steep seam. Also it is impossible to examine the roof properly. Added to this is the cost and trouble of manipulating the safety lamps themselves. Therefore where safety lamps are introduced there is an increased danger of accidents such as are liable to result from insufficient illumination. So the introduction of safety lamps should be looked upon as the lesser of two evils and only to be enforced where it is really necessary.

On the whole the Central Provinces mines are free from gas. I have heard that safety lamps were used at Mohpani but I am not sure whether gas was ever found there or not.

Next as regards the use of "permitted" explosives (Temporary Regulation 5). These are meant for use where coal dust and gas are liable to be a source of danger. The regulation requires that unless "permitted" explosives are used, not more than one shot shall be lighted at a time. The coal mining in the Central Provinces has been carried on safely for years with gunpowder. In all my experience, I have never heard of an accident from explosives which might have been avoided had "permitted" explosives been used. On these grounds alone I maintain that the use of "permitted" explosives is not necessary in the Central Provinces coalfields, whatever it may be in other parts of the country.

It is the usual practice for the miner to undercut the coal face and then drill about four shot holes. The shot-firer when he comes round, charges the holes and lights all four fuses. He retires to a safe distance and counts the shots as they go off. If there is a misfire he fences off the place and carries out the rules regarding misfires. If, on the other hand, all is well he waits perhaps 20 minutes or half an hour (according to the ventilation) till the smoke clears away sufficiently for him to inspect the place and point out any loose coal which he thinks the miner should dress down.

The smoke from one shot would take as long, or almost as long, to clear away as it would from four shots so if he were to carry out the regulation strictly it would take him the best part of two hours over each working place. This would lead to his scamping his work and not adhering to the regulation. The next thing would be that he would argue, "If I can ignore one regulation then why not ignore others?" The chief source of danger from coal dust or gas is from a blown-out shot. I cannot see that there is any less chance of a blown-out shot when one shot is lighted at a time as when all four are lighted simultaneously. The gunpowder is locally manufactured and the cost goes back into the pockets of local labour. In the case of "permitted" explosives it would go out of the country. Added to the cost there is the inconvenience of transport and the worry of the railway and police restrictions and regulations to be thought of. The usual magazine license is to possess 100 lbs. at a time. This 100 lbs. of gunpowder can be replenished easily every day or twice a day from the local powder manufacturer's magazine, which would not be the case if the explosive has to be imported.

The use of "permitted" explosives necessitates the employment of a detonator. The detonators will be a greater source of danger than all the rest of it put together. Even with the very limited use of dynamite for stone drifts and wet places there are one or two accidents every year from detonators. This number

is sure to go up by leaps and bounds as soon as the use of detonators becomes general for all the work. Besides this, there is the additional cost of detonators Rs. 6 per 100.

I am therefore of the opinion that as the collieries in the Central Provinces are free from gas and as the coal dust is of a character that is not liable to cause a coal dust explosion, the introduction of "permitted" explosives is unnecessary and undesirable.

As regards conventional signs on colliery plans Notification No. M-955 says:—

"3. (*a*) .r..... So far as practicable the intake airways shall be coloured blue and the return airways red."

It has been an old-established custom that where colours are used at all on colliery plans the intake should be red and the return blue. This is easy to remember because it is in imitation of a chart of the circulation of the blood-red arterial blood going and blue veinous blood returning to the heart.

I fail to see the utility of reversing this old convention.

Question 7.—It would depend upon the extent of the fire area and its situation whether a fan was necessary. In most cases I should say that they could not do without a fan if the stoppings were giving off gas in any quantity.

In normal cases the fan draws the air out of the upcast and it is sucked down the downcast. The winding is done at the downcast, otherwise there would be all the complications of double air-tight doors and the people being always in the return air, etc., etc., according to the regulations it is compulsory to be able (by opening certain doors and closing others in the fan drift) to reverse the current. The upcast would now become a downcast and the fan become a propelsive fan. The old type of fan is slow running and driven by steam and it draws the air in at the centre and delivers it round the periphery. I have had no experience of a "Sirocco" type of fan but I believe they are very efficient and being fast-running are more suitable for use with electric motors. I am not sure if they are not propelsive, *i.e.*, drawing in air from the periphery and delivering it out of the centre but any fan may be converted from exhausting to propelsive according to whether the intake or delivery is connected with the fan drift. If the meaning of the question is whether the air should be forced through or sucked through the mine I should say that unless there was any outlet on the other side of the fire area the pressure would only accumulate the gas and it would be bound to come back sometime when more gas was distilled out of the coal. There might be something in the idea if the fan was made to be forcing during the day shift when men were in the mine and exhausting during the night when all men had been removed from underground. If the fire area were connected with a fall reaching to the surface I should say that a forcing fan, or to be more exact, a forcing system of ventilation would be best.

Question 8.—Usually the carbonaceous matter left behind in the goaf is that coal which it is found impossible or too dangerous to extract or else carbonaceous shale which is of no commercial value. In either case, its presence in the goaf cannot help but increase the danger from spontaneous combustion.

Question 9.—At Warora they had a main pipe line connected to the bottom of the delivery pipe in a shaft 200 feet deep. This pipe line went along the level with branches, each with a hydrant and valve, to within a short distance of each of the fire stoppings. There were several hose pipes each with a connection at one end to suit the hydrant and a nozzle at the other. Each of the stoppings had a removal plug in the middle of the same size as the nozzle. If a wall was thought to be becoming too hot this plug was removed, the nozzle inserted in its place, and the water turned on at the hydrant. Some of the most important stoppings had thermometers and there was also a barometer kept underground. If the barometer was observed to be falling the man-in-charge knew that it was to be expected that black damp would be oozing through the stoppings. Lads were also kept constantly engaged in plastering the stoppings with wet clay as soon as the clay showed signs of becoming dry enough to crack.

The best way to obtain a head of water is to connect up with the delivery. Failing this, of course, a portable water tank and hand pump could be utilised. I do not think that it would be desirable to make all this compulsory for all mines, but where it is necessary or likely to be necessary the Chief Inspector could issue orders requiring whatever he thought fit to be done.

Question 10.—Telephonic communication with the underground workings would be very convenient in all cases but I would not go so far as to say that it should be required by law.

Question 11.—In addition to what I have said in reply to *Question 9*, I should say a good supply of bricks, clay, sand and water to be kept handy in case a new stopping was to be built or an old one reinforced—a supply of brattic cloth and props for constructing a brattice, if required, a number of safety electric torches and gas masks. By gas mask I mean some sort of helmet that can retain sufficient air for a man to walk into black damp for a few minutes to rescue anybody inadvertently overcome by black damp. Of course this would be in addition to any regular rescue station or rescue apparatus with oxygen cylinders that may be kept at a rescue station. These helmets would be meant for immediate temporary use only and kept within a few yards of the actual work being done, a loose fitting coat and trousers of thick felt which can be wetted so as to enable a man to approach a fire and a first aid box with a supply of tannic acid for burns in addition to the box usually kept in the colliery. It is a good idea too to keep a rope tied round the waist of anybody going into a dangerous place. The other end of the rope to be held by his mates in a safe place.

Question 12.—The persons working at mine rescue stations should be trained in how to use their apparatus and in first aid—particularly in artificial respiration, etc. The more they can learn about methods of dealing with underground fires the better. No knowledge is ever wasted.

Question 13.—I have never had experience with gas masks as these have been introduced after the period when I ever worked in mines where there have been underground fires. But I can remember many occasions when a gas mask, or any means of entering into black damp for a few minutes even, would have been very useful indeed.

Question 14.—As will be seen from my reply to *Question 6* I am in favour of all the mines being examined and classified as to their liability to danger from spontaneous combustion, gas and coal dust explosions. The rules can then be suitably relaxed in the case of some and tightened in the case of others. I would also suggest that merely watering a place has only a temporary effect but if the water is made muddy with suitable clay or silt the deposit left after the water dries would form a film on the coal or else mix up with the dust and to some extent render it permanently incombustible. Drenching a place with muddy water would cost very little more than using clean water. The addition of salt or other hydroscopic substance would also tend to keep the place damp but would add to the cost. My opinion is that it is not ordinary dust that usually lies about on the ground that is so dangerous but fine flocculent dust, that is so fine and inpalpable as to float in the air and so becomes explosive.

Such dust would be rather hard to gather up by ordinary methods as a lot of it would be settled on top of timber and other places where it would be hard to get at. A vacuum cleaner would be about the only efficient method of clearing it away. Such dust is seen usually only in old roads and never near a fresh working face.

Question 15.—Yes. In my opinion one of the chief causes of underground fires is the leaving of dust and slack underground. This should be put a stop to. Also hot steam and exhaust pipes should not be allowed to lie on the floor among dust and shale but should be raised a few inches on a couple of bricks so as to be kept clear.

Also as far as possible the pillar cutting should be started at the lowest part of the mine and the goaf allowed to fill up with water as the pillar extraction proceeds towards the rise.

Question 16.—There is no doubt that sand-stowing would vastly increase the safety of mining in every way—not only from the point of inflammable gas but from falls of roof, etc., as well.

From what I can see of it sand-stowing is quite out of the question owing to the present market rate for coal. If it is introduced the cost would I think have to be recovered by a cess on all the collieries irrespective of which collieries are to be sand-stowed

and which not. All the collieries would then automatically have to increase their price by the amount of the cess per ton. It would also be necessary to levy an import duty on foreign coal equal in amount to the cess so as to meet foreign competition.

The sand-stowing may be carried out by a special department created for the purpose or else given out to reliable firms of contractors.

Question 17.—Premature collapses are mainly due to the pillars being left hopelessly small and the galleries too wide. This would probably be due to the coal from pillars being robbed hand over fist. There is a very wide margin between the minimum amount of coal that is required to keep up the roof permanently and what is desirable to carry out pillar cutting efficiently. If therefore the roof begins to collapse before the pillar extraction is started it would show that there is something very wrong somewhere. If there are bad faults and slips in the strata it would also increase the danger of collapse by furnishing a loose end. If the roof is very bad (as it is some in some mines) this would result in local falls but not in a wholesale collapse.

Question 18.—The danger from a collapse happening suddenly is of course that people might be buried in the fall. There is also the danger if the collapse is extensive of the air blast caused thereby. Also as there would naturally be a considerable amount of coal in the fall there would be the danger of spontaneous combustion, which may possibly result in the loss of the mine.

The only way to prevent collapse is to leave sufficient coal in the first working.

Question 19.—I would answer this in the affirmative if it were not that the conditions in different mines vary to such an extent as to make it impossible to lay down any hard and fast rules.

Question 20.—The main factors to be considered are the depth from the surface, the character of the strata immediately above and also below the coal and also the strata between the coal and the surface and the thickness and dip of the seam. Speaking generally about 50 feet from the centre of one gallery to centre of another and galleries about 10 feet wide are about right for a shallow mine.

Question 21.—If pillars are to be indiscriminately split there would be no object in leaving the pillars so large, they might just as well have been made half the size in the first instance. If any manager started splitting pillars that had been left a large size by a previous manager he should be brought to book about it even if there were no specified regulation to that effect. If all the pillars are made too small from the start then there would be nothing to prevent the goaf over running perhaps three or four pillars whenever a heavy fall takes place. I would therefore be in favour of prohibiting the indiscriminate splitting of pillars just to get more coal and regardless of the future safety of the mine but not so as

to prevent a manager from splitting a pillar for some specific purpose such as to put in a tram line or any such purpose.

As for reduction of pillars and heightening of galleries, one of the ways of carrying on good mining is to drive the galleries as low and narrow as possible during the slack period of the year and then to take the roof and sides when there is a demand for coal and a rush of orders. Up to now the width of galleries and the size of pillars has been left to the discretion of the manager as being the man on the spot and so best able to judge as regards the local conditions. The mines are also inspected by the Inspector of Mines from time to time who would soon point it out if any manager were not working in a systematic manner. I am therefore not in favour of any fresh legislation on this point, chiefly because no rule can be made that would suit all conditions.

Question 22.—There is no seam in this field so thick as to require to be worked in two or more sections. There are such seams in Jharia. I therefore think it would be wiser if I left this question to be answered by those who have had more experience of these conditions.

Question 23.—Yes, provided the statutory authority is to be the Chief Inspector of Mines in India.

Question 24.—Yes, provided the statutory authority is to be the Chief Inspector of Mines and the cost of the packing is to be met by the cess on coal mentioned in reply to *Question 16.*

Question 25.—I have had no personal experience of an irruption of water but one that occurred near me in Bengal was due to the mouth of an incline being placed too close to a dry *nala.* During the rains the *nala* rose and flooded the mine.

Question 26.—Theoretically if water is brought in contact with anything at an incandescent heat it ought to split up into its component elements hydrogen and oxygen. As mentioned in my reply to *Question 9* they used to apply water to the fire area by means of a nozzle and I never observed any ill effect resulting from this practice. Very probably more steam than gas was evolved which rendered the gas incombustible.

Question 27.—The management would naturally do their best to prevent an irruption if one was likely to occur and I do not think legislation would make any improvement. I cannot think of any points on which laws could be advantageously passed.

Questions 28 & 29.—This has been dealt with in my reply to *Question 6.*

Question 30.—Yes, provided that if a certificated shot-firer is not available the manager may be allowed to appoint anybody he considers competent enough.

Question 31.—My opinion is that on a busy day 5 lbs. of explosive does not go very far and it is a waste of time for the shot-firer to go backwards and forwards to the magazine. There is no danger in the shot-firer being allowed to have more than one

canister provided that each contains not more than 5 lbs. and is suitably locked before being given over to a carrier. I do not know of any accident having ever happened to a carrier and his canister. All the accidents that take place happen after the cartridge has been taken out of the canister.

Question 32.—I cannot think of anything that is not already provided for in the regulations.

Question 33.—There is only one workable seam at Damua known as the Damua or Ghorawari seam. The thickness is 11½ feet more or less. Damua is at the west end of the field and the coal improves as we go further west, so we claim to have the best coal with a calorific value of 6826. The dip varies from 1 in 3 to 1 in 4.

Question 34.—We are extracting as much of the seam as we can consistent with safety.

Question 35.—At present the proportion of coal from pillar-cutting is about 60 per cent. This proportion varies because when we have a rush of orders we take a larger proportion from galleries roof and side from other inclines which are still in whole coal, but when there is no rush we try and get the greater proportion from pillars and carry on the development work only in the other inclines, driving the galleries low and narrow so as to leave roof and side coal to meet a further sudden demand (see reply to *Question 21*). We try and get as much of the coal as we can consistent with safety but of course we often have to leave stooks as "chowkidars" and we sometimes lose coal by crush coming on. The average proportion of coal lost is about 30 per cent. of the pillars.

Question 36.—The reply to this question would be only approximate even if it were the mature judgment of a mining engineer familiar with the Jharia and Raniganj fields. In Dr. Fox's Memoir on the Coalfields of India I notice that he multiplies the area by the thickness and then takes 50 per cent. of that as the quantity of available coal. If one therefore made allowance for the amount already taken out and substracted that from 50 per cent. it ought to give a fair idea of what may be recovered.

Question 37.—Yes, this coal would be lost. I would also suggest that the stowing should be started at as early a stage as possible because if the barrier is surrounded by goaf it would be uneconomical and perhaps practically impossible to stow it afterwards. The stowed barrier would also serve as an incombustible rib against future fires as between one side of the rib and the other.

Question 38.—With our thickness of coal of 11½ feet I should say that the cost of stowing would be out of all proportion to the additional amount of coal that may be won by stowing, though there is no denying that it would greatly increase the safety of the working in all respects. In such cases, however, where the seam is almost vertical or where it is so thick as to necessitate working

two or more sections leaving section between (*see Question 22*) the conditions would approximate more to metal mining. In these circumstances stowing would vastly increase the quantity of coal that could be extracted.

Question 39.—Each case would have to be decided on its own merits. Where there is a moderately thin seam lying above a thick seam of valuable coal, the working of the upper seam without sand-stowing might increase the difficulty and loss in working the lower seam. In such a case it might be desirable to enforce packing in the upper thin seam.

If on the other hand the thicker seam were above then working it out without stowing might ruin the lower thinner seam, but then the question would arise whether the great cost of packing the thick upper seam would not be more than the value of the coal in the thinner lower seam. The relative value of the coal in the two seams would be an important factor to be taken into consideration.

Question 40.—Each case would have to be decided on its own merits.

Question 41.—I have had no practical experience of stowing.

Question 42.—The cost of stowing should be met by a cess on all coal uniformly distributed over all collieries whether they have to stow or not. Otherwise the collieries which are ordered to introduce stowing would not be able to compete in the market and would have to promptly shut down. I have seen it in print that the cost would be Re. 1 per ton but I am quite sure that it would be very much more. The only two instances that I know of sand-stowing are at Ballarshah and the Damodar river collieries. In both these cases they have a river with unlimited sand. The sand is mixed with water and piped down into the mine and the water pumped out again after the sand has settled out. The cost may be Re. 1 per ton in these favourable circumstances, but 99 per cent. of the collieries in India would have no river handy. In such cases the stowing would have to consist of earth and rock dug up from the surface trammed to the mouth of the mine lowered into the workings, tipped out and then packed by hand labour. In such a case there would not only be the additional cost of acquisition of surface rights (the removal of the soil would ruin the land from an agriculturist's point of view), surface tram line, tubs, hand labour, etc.; but also the interference with the normal working of the mine to be considered. After the tubs filled with earth are tipped out and the contents removed out of the way sufficient for the tubs to be able to be moved, they would have to be shunted to some other place to be loaded, where there is no earth lying in the way. This would naturally interfere with the operation of coal getting.

The amount of the cess to be distributed among all the collieries would depend upon the number and extent of the collieries that

would be required to sand-stow. Perhaps that was meant by the statement that the cost would be Re. 1 per ton.

Question 43.—A statutory authority should be set up, if not the Chief Inspector of Mines then in collaboration with and subordinate to the Chief Inspector.

Perhaps a separate section of the Mines Department with a qualified man in charge would be best. The members of this section would require to be strictly impartial and have no interest, financial or otherwise in any mining company in India. The actual work of stowing could be carried out departmentally or given out on contract, the contractors to work according to instructions and under the supervision of the department.

Question 44.—This would be more the province of the Chief Inspector. Any such powers that were vested in a statutory authority should be subject to the approval and sanction of the Chief Inspector.

Question 45.—(*a*) The cost of timber and wages comes to about 2 annas per ton, all or nearly all of this cost would be saved.

(*b*) Some mines would save more fire-stoppings than others but we may take about 1 anna per ton as the average saving.

(*c*) Sand-stowing would not affect the normal feeders of water in the mine. But in some cases a fall of roof taps a feeder higher up, or water such as ponds or streams on the surface. Sand-stowing would prevent this. In such cases where the sand-stowing is carried out by hydraulic methods, the additional water would be an extra cost to pump out again.

On the whole I do not think that there would be any saving under the head of pumping.

(*d*) The present loss of coal for barriers and under railway sidings would be saved. The revenue cost would not be much affected although the life of the property would be extended.

(*e*) Compensation for building, etc., would be saved to the extent of about 1 anna per ton.

(*f*) In gassy mines there might be a little saving on ventilation, but unless the introduction of sand-stowing obviated the necessity of installing a fan, it would not make much difference.

(*g*) If pillar cutting is started without sand-stowing the work would have to be on without stopping till all the coal was extracted and also the edge of the goaf would have to follow certain lines. But if sand-stowing were introduced there would be no loose end along the edge of the goaf and consequently not the same urgent necessity to carry on. Also the line of the edge of the depillared area could be altered or changed according to requirements if doing so would help to concentrate the output. The saving if any would depend upon the circumstance of each case.

(*h*) In pillar cutting without sand-stowing there is usually some crush on the corners and side of the pillar towards the goaf.

This makes it easier to get off the coal but on the other hand increases the danger, and liability to loss of coal by crush coming on and making the place unsafe.

With sand-stowing the crush would be taken up by the stowing and the coal getting would be more like ordinary side dressing. There is no likelihood of saving under this head.

In addition to the above, because with sand-stowing the strata would not be disturbed the upper seams which are not at present commercially workable would be preserved till such time as the dearth of coal rendered them valuable in the future. Also the preservation of the strata would leave the rock intact for future sinking of shafts down to lower seams. I have been informed that the sand-stowing solidifies like ordinary rock in about three years so there should be no danger in sinking through it.

Question 46.—In view of the limited coal reserves of India I should say yes.

Question 47.—Yes. The reply to this question would be on all fours with the one above.

Question 48.—Any coal that can be sold in the present state of the market or which is likely to be saleable in the near future.

Question 49.—It would be much safer to stow the lower seam or at all events to make all preparations to meet any difficulties which may crop up as to fire, black damp or fire damp which may come in from above. A lot would depend upon the thickness and character of the intervening strata.

Question 50.—This would resolve itself into the question as to who is going to pay for the stowing. The mine-owner would naturally object if the cost of stowing was going to be more than the profit on the coal. Such stowing should be done by the statutory authority before mentioned and the cost met out of the cess on coal.

Question 51.—If the railway insists on 150 yards being kept on each side of the railway boundary I should say they should be made to pay at least part of the cost. In my humble opinion the amount of coal left for the support of railways is much in excess of what is necessary for safety.

Question 52.—This would depend upon the thickness of the seam and the thickness of the overlying strata or depth from surface. If a cubic yard of stone is broken up the pieces will fill more than a cubic yard, so if the seam is thin and the depth great the fall will never hole through to the surface.

Question 53.—I am of opinion that the whole cost should be paid out of the cess which would ultimately be paid by the consumer because the price of the coal would be put up by the amount of the cess. The consumer in India obtains his coal far cheaper than in most countries and it is up to him to pay. The coal-owners are getting rather tired of being told that they should

reduce costs by introducing more systematic and economical methods of working.

Question 54.—Up to now all the big accidents which have led to the temporary emergency regulations have taken place in the Bengal field. This does not say, however, that other fields should not take the warning. In my opinion all the collieries in India should be inspected with a view to ascertain whether there is any liability to similar disasters as have taken place in Bengal. If any of the collieries in other parts of India are found to be in a dangerous state there is no reason why the potential danger should be allowed to continue if it can be removed. One of the recent disasters was due to an explosion where gas had never been found before. The circumstances in this case were unusual because the mine had been drowned out for some time and the accident took place when the water had been pumped out and the mine re-entered. In my opinion the coal had been giving off some gas all along but in such small quantities that it had not been noticed. When the water rose to the shaft bottom the air in the rise workings was locked in and as the gas, which has previously been removed by the ventilation, now bubbled up to the rise and formed a stronger and stronger mixture. If it had been previously known that the coal was giving off some gas, even though only a little, steps might have been taken to avert this accident.

In my opinion safety and conservation of coal resources is a matter that is not confined to any particular field but concerns the whole country. The biggest item of waste that I can see is the dust coal which except in the case of coking, is to all intents and purposes thrown away.

In Baluchistan the bulk of the coal is all dust. I can remember spots where a shovel would be of just as much use as a pick. This is due to the crushed character of the coal and the thinness of seam (2½ feet). The price of imported Bengal coal was Rs. 22 per ton owing to railway freight. The working cost in Baluchistan was Rs. 7 per ton and it used to cost Rs. 7 per ton to convert the coal (dust) into briquettes. Yet the coal-owners used to produce the briquettes and sell them at a profit. They got a sale for all of their output and the imported coal satisfied only that part of the demand which would not be locally supplied. You will note that in this instance the Bengal coal could not compete because of the railway freight which was not in the hands of the Bengal owners so they could not cut it down. If it could be made compulsory that all coal-owners should either briquette or coke all their dust there would be a great saving. In this field about 30 per cent. of the output is slack, *i.e.*, mixed rubble and dust. About ¼ of the slack is rubble but if this rubble is screened out the remaining dust is quite unsaleable. Even as it is the slack is sold at about or very little over cost price. In a dull market it is unsaleable and there are large stocks left to clatter up the loading wharfs and to take fire. It would be costly if each

colliery had its own briquetting plant. In dairy-farming districts there is usually a butter factory to serve the farms for miles around. Each farmer delivers his cream to the buttery and obtains a receipt. In the same manner there may be briquetting plants placed at central points to serve the collieries around. The factory would be in the hands of a separate authority and the cost met by a cess on the whole output of the collieries. The cost of coal (either in the shape of steam or of briquettes) would go up by the amount of the cess but there would be no wastage of dust.

Years ago there was an article written by Mr. R. G. M. Bathgate, General Manager, Jealgora Colliery, Jharia. This article dealt with the reservation of coking coal for metallurgical purposes, conservation of coal resources by stowing and other kindred matters from A to Z. Apart from the mining community not the slightest interest seems to have been taken of this very ably written article although if my memory serves me right, it was published in the *Statesman*. Yet we have arm-chair theorists and politicians frequently getting up on their kind legs and suggesting drastic and futile additions and alterations in the regulations and demanding to know if the Chief Inspector, colliery owners and managers, and in fact everybody but themselves are not asleep. As a matter of fact they themselves have only just woke up and become wise after the event. It is the misfortune, not the fault of the present Chief Inspector that all the big disasters should by pure bad luck happen during his regime. As regards better methods of mining nothing much can be done to make a radical improvement as long as they get the present measly price for coal. For this the colliery owners are as much to blame as anybody for by cut-throat competition they have cut the price down to the bone. I have seen it put forward that owing to the supply exceeding the demand all the second class collieries should be closed down. The boot is really on the other foot. Good authorities state that the amount of iron-ore in the country is much in excess of the amount of coking coal suitable for metallurgical purposes suitable for smelting it. It would therefore much in excess of the amount of coking coal suitable for metallurgical purposes suitable for smelting it. It would therefore be more to the point if the second class collieries were allowed to continue and the first class collieries with coking coal shut down as a reserve for smelting iron.

Question 55.—Compulsory stowing if adopted should be extended to wherever it was urgently needed. If restriction of fire area is the only object aimed at as in the Bengal fields it might be restricted to forming ribs by stowing the whole of a level or a dip from end to end so as to form a fireproof barrier. These stowed ribs would extend across strategic lines so as to confine the fire area in the same manner and in place of the panels mentioned in the reply to *Question 5*.

Question 56.—I do not think that a small owner should be legally compelled to alter his boundaries just because a larger

owner thought it would be better that way. Where it would be better for both parties they would come to a mutual agreement. Only in very flagrant cases of contumacy should the authorities step in. Especially would interference be necessary when a fault or railway line cuts off a corner of a property. If the corner were too small to make it worth while to put down a pair of shafts and if the corner could be easily worked by an adjoining colliery then the latter would have good grounds for asking that corner should be made over to them. I presume that in Bengal where they have permanent settlement and the owner of the surface also owns the mineral rights it may be difficult, but in the Central Provinces the minerals belong to the Government so there ought not to be so much difficulty in the matter.

Question 57.—If the owner in the lower seam worked his coal out first, the strata would probably collapse and ruin the upper seam. If on the other hand the top seam were worked first it might catch fire and endanger the lower seam. In any circumstance a mutual agreement should be arrived at that the upper seam should be depillared first. This question would not arise in the Central Provinces because here a mining lease contains the right to work all the coal in the lease and there cannot be two owners in one and the same area.

Question 58.—I believe they have rules about underground way leave in the English mines. This I presume is necessitated by the great depth and cost of sinking deep shafts. Naturally when a pair of deep shafts is sunk by one company another company in the vicinity would like to use the same shafts and make it worth the while of the first-named company to allow them to do so. If each owner were forced to sink their own shafts it would mean duplication of costs. Owing to the comparatively shallow depth of the seams in India such a condition of things has not as far as I know arisen as each colliery has its own outlets. If owing to the increased depth two or more owners find it paying to use the same pair of shafts I do not see any valid reason why they should be prohibited from doing so.

Question 59.—A joint survey could be mutually agreed upon between neighbouring properties. If any dispute or difference arose then the surveyor of the Mines Department could carry out a check survey. This is, I believe, the usual procedure but if a statutory authority were set up there would be no objection to his carrying out the survey, in the first instance. If either party were dissatisfied they could still appear to the Chief Inspector.

Question 60.—In most collieries where depillaring operations are being carried out they keep an additional map showing the underground workings in black ink and surface features in some other colour. There would be no objection to making this compulsory, or at all events for that part of the mine that is being depillared and say 600 feet all round.

Question 61.—Owing to the removal of the concession rates on coal from the Chhindwara field by the railway the Bengal collieries are very anxious to get into the Bombay and Ahmedabad markets. Bengal is about thrice the distance as Chhindwara is from these markets, so if they are allowed to capture these markets it would mean that Bengal coal would be hauled over twice the distance and therefore there would be twice the amount of coal burnt in the railway locomotives. Added to this is the fact that the railway locomotives burn nothing but the best coal which in this case would mean coking coal from the Bengal field. This would not be the case if the train started from Chhindwara. This point has been more fully dealt with in my reply to *Question 54.*

Question 62.—As I have never worked in Bengal since the Coal Grading Act came into force I cannot say what effect it has had.

Question 63.—In my opinion interference by the Mines Department is rarer in Great Britain than it is in India because coal mining is an old established industry in the former country and the labour is also more experienced and better educated. I have often heard it said that there is many an English miner cutting coal at the face who has a first class certificate in his pocket. In India the conditions are quite different as most of the labourers are raw recruits and even the men who work fairly regularly in the mines are only part-time miners. They are agriculturists first and miners after.

Indian mining being a new industry it naturally follows that the Mines Department would more often require to extend a guiding hand in the shape of notices and orders.

Since its inception the Indian Mines Department has been a model of professional ability and scrupulous fairness. I do not hold the same high opinion of some of the mining offices of Local Governments. I should say that some of the latter are overdue for reformation and overhaul.

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56. Written Evidence of Mr. M. M. Kanotra sent through the Central Provinces and Berar Mining Association.

Question 1.—I am the manager of Junnordeo No. 2 colliery and I have had about 6 years and 6 months experience of Indian coal mining conditions, out of which 2 years in Raniganj (Dishergarh section) and 4 years and 6 months in the Central Provinces coal mines.

Question 2.—Causes of underground fires in India are in my opinion due to extraction of pillars and premature collapse. Seams liable to spontaneous combustions are very likely suitable for underground fires. Clean extraction in thick seams is impossible and coal is left in goaf. There is no packing except stones

from roof falls. Under such circumstances spontaneous heat is generated and causes fires in the goaves and similarly so in the collapsed areas.

Number of fires has increased. No doubt more fires have been caused by pillar extraction, but the extension of fire has been mostly due to premature collapse.

Question 3.—Dishergarh seam of Raniganj coalfield. I have no experience of the period of incubation of the above seam. No seam of commercial value is free from the risk of spontaneous combustion.

Question 4.—Fires increase the difficulties and dangers of extracting the remaining coal. These difficulties increase at the time of depillaring and in a seam below another which is on fire.

Question 5.—I am in favour of new workings of seam known to be liable to spontaneous combustion being laid down in system of panels, 20 per cent. of seam.

Question 6.—In my opinion, under Regulation 10 of Temporary Regulation for coal mines, a method which will maintain the strata between the seams *in situ* and in tact should be discussed with the Mines Department and to give facilities and notice of an excavation under the circumstances must be given to the Mines Department and the local Government beforehand.

Question 7.—Yes, and fans should be exhausting.

Question 8.—Yes, I cannot quote an example.

Question 9.—Yes, it would greatly help dry and dusty main for sprinkling water and would save much negligence on the part of management for such a supply of water.

Question 10.—Yes. Distance should be at least 2,000 feet from the shaft bottom entrance to the mine.

Question 11.—Strict inspection of fire stoppings. Fire area may be separated by an artificial barrier of the uninflammable matter.

Question 12.—Yes.

Question 13.—Recent apparatus so far known have their limited application. But still under obnoxious gases they would help a lot.

Question 14.—Yes. It may be extended to all mines in which coal is known to be liable to spontaneous combustion.

Question 15.—Methods of working should be improved. This requires especially in seams liable to spontaneous combustion and contiguous seams. Panel system is the best known in the former case, while for the latter packing of incombustible matter would prove useful, and this will comply with the Temporary Regulation 10 of Notification No. M. 955 of 23rd May 1936.

Question 16.—Packing would be very useful in seams giving off inflammable gas and also in seams liable to spontaneous combustion and lie one above the other. Dishergarh seam of Raniganj, Nos. 14, 15, 16 and 17 seams of Jharia field should be considered in this connection. But the coal market does not give any chance to the mine-owners to adopt such methods. One likes to have at least his investment back. Position of certain coal mines have become such that they cannot be won out unless the cost price of coal working is immensely increased. And that cannot be done, unless the coal market is also proportionally increased. For this help from all sides is necessary. Only putting in mere regulations would not help the coal cause.

Question 17.—Premature collapses are due to the factors which promote instability from the time the working of mine is started and when pillars are formed the development of lateral stresses in the coal of pillars is begun, thus weakening its capacity to bear the weight of the overlying strata; still widening galleries beyond certain limits will enhance the above stresses. After this water, chemical contents of coal, extension of workings,—hence their individual effects resulting in decreasing stability—, oscillation and additional stresses on floors and roofs and widening and lightening of galleries weaken the pillars.

Question 18.—It promotes spalling, creep, and crushing of pillars. Under the circumstances, if the seam is liable to spontaneous combustion, spontaneous heating may result. At the time of extraction of pillars, collapse follow on unworked pillars thus creating dangers that have been the cause of accidents during pillar extraction.

(i) Necessary to limit percentage of extraction in first working.

(ii) Limitation of the height of galleries.

(iii) Large pillars:—size of pillars depending on nature of coal, depth, thickness of seam, geological disturbance, such as dyke, etc.

Question 19.—No, only because seams of same thickness and apparently of same nature may behave differently under different circumstances. This can only be determined by a mining engineer at the spot. But it can be that the mining engineer may consult the Chief Inspector or Inspector of Mines of the Circle.

Question 20.—As I have mentioned above the size of pillars, maximum dimensions of galleries depend upon the nature, *i.e.*, crushing length of seam, the thickness of seam, depth of the seam from the surface and geological features. However, for general guidance the following can be taken into consideration. It cannot be for all seams. First according to the depth, the size of pillars should be determined. The following table gives the percentage of extraction with depth and size of solid pillar and accordingly

dimensions of gallery should be determined. In my opinion the height of gallery should not be more than 10 feet.

Depth.	Size of solid pillar.	Percentage of extraction in first working.
	Feet.	
100 200	30 36	40
300 400	44 50	30
500 600	60	25
700 800	80 85	20

and below that, percentage of extraction should be 20 per cent.

Question 21.—Yes.

Question 22.—If the seams are thick, the number of sections should be two. The dimensions of the pillars of the upper section should be determined by the above rule, and the dimension of pillars of the lower section should be bigger and galleries consequently small, but the centre of galleries in both the sections should be vertically above the other. Minimum parting should be at least 6 feet.

Question 23.—Yes. They are, no doubt, good suggestions.

Question 24.—Yes. But it depends upon the coal market to allow the mine-owners to adopt such expensive procedure.

Question 25.—(i) A colliery near Signa. (ii) A colliery near Kusunda.

A colliery near Signa was flooded during monsoons due to the proximity of a nullah near an incline of the colliery.

A colliery near Kusunda was flooded due to the collapse of mining lease boundary and rush of water from the neighbouring colliery, which was flooded by the management due to certain reasons.

Question 26.—Yes.

Question 27.—Dangers in the above come under Regulation 72 and that should be strictly followed.

Question 28.—In addition to Temporary Regulation Nos. 2, 3, 4 and 5 in dry and dusty mines, in which, in the opinion of the Chief Inspector of Mines, the dust is dangerous in spite of all the precautions to the above regulation, "permitted" explosives may only be used and the Chief Inspector should be empowered to enforce their use.

Question 29.—This might be suitable but it might be less stringent in view of the facts that mines in India are to a greater extent naturally damp with coal of "poorer" quality.

Question 30.—Yes.

Question 31.—It should be abolished.

(i) It gives the management a chance of employing fewer shot-firers than it is necessary.

(ii) Shot-firers neglect their duties due to heavier work than they can do.

Question 32.—No.

Question 33.—Junnordeo seam.

It is 3rd class coal, compared with Indian Coal Grading Board standard. It is about 10 feet thick with hard coal and shale bands between. Its inclination varies from 1 in 5 to 1 in 3·5.

Question 34.—The whole of the seam is being worked at present.

Question 35.—*Nil.*

Question 36.—Only, 50 to 60 per cent. will be recovered.

Question 37.—Yes.

Nil.

Question 38.—Central Provinces coal is much harder than those of Jharia and Raniganj coalfields. Seams are not generally very thick. Under such conditions I do not think it would make any effect on the life and productivity of the colliery.

But in thick seams of Jharia and Raniganj where seams lie in close proximity, it would have great effect.

Question 39.—Not in all seams. It should be judged by the Mines Department who will give their consent. Again, the same question of cost and coal market arises.

Question 40.—It should be divided into two groups:—(*a*) already worked mines and (*b*) virgin property.

(*a*) (i) The thickness of seams,

(ii) whether it contains inflammable gas or coal dust,

(iii) condition of standing pillars which would account for the danger of premature collapse,

(iv) quality of coal, and

(v) use of coal. This should help in the protection of coking coal. This would automatically suggest one areas like Jharia, Raniganj, Giridih, Bokaro, Karanpur and Assam.

(*b*) Virgin property should be so laid down, as it should be favourable for stowing on a panel system.

Question 41.—No.

Question 42.—Scheme of compensation from Government and private concerns who are lucky as not to suffer such heavy costs.

Question 43.—Yes. Such a statutory authority should be composed of mining experts as the Government should appoint with the help of the Mines Department and should have its headquarter somewhere in the major coalfields, and with permission of an official.

Question 44.—Yes.

Question 45.—(*a*) Re. 0-0-9.
(*b*) ,, 0-0-3.
(*c*) Negligible, rather would be more.
(*d*) ...
(*e*) Re. 0-4-0.
(*f*) ,, 0-0-6.
(*g*) ,, 0-0-9.
(*h*) ,, 0-2-0.
(*i*) ...

Re. 0-8-3.

Questions 46 & 47.—Yes.

Question 48.—Coal of commercial value is one which can find its market; it can be used in locomotives and power industries. Its definition cannot be a limited one.

Questions 49 & 50.—Yes.

Question 51.—Yes. On conservations of national wealth. Every industry should help another if it is inter-connected. Railways should therefore also see that they help an industry which has a close bearing on them.

Question 52.—Filling depends upon the circumstances and local conditions of the seams and whether the filling should be partial can be judged when enforcing such legislation.

Amlabad colliery in Jharia coalfield.

Question 53.—Additional financial assistance.

Question 54.—Limited. There are seams which can be worked out completely without stowing with inflammable matter. It would be an unnecessary burden over collieries which can do without it.

Question 55.—It may be adopted in any field, but the avoidable waste should be stopped whenever and wherever it occurs.

Question 56.—Yes. Small properties must be amalgamated.

Question 57.—Yes, but under the conditions that it should be guarded against waste. It must be worked in such a way that it would not harm the other. Under such circumstances, temporary sand-stowing should be adopted.

Question 58.—It is not necessary.

Question 59.—Yes, Yes.

Question 60.—It may be done.

Question 61.—When railway locomotives and industrial power can use Central Provinces coal which is considered to be inferior to Jharia coal, there is no reason why inferior coal of Jharia and

other places cannot be used by the railway locomotive and such other powers.

Question 62.—I have got no experience of that.

Question 63.—This is only because in certain mines the agent actually (as defined in the Mines Act) is in charge of the mine and not the manager actually speaking, *i.e.*, there is too much interference. The manager has to hear the agent, as he is defined superior to the manager.

I do not know how many so-called agents have experience of mining or understand Mines Act, regulations, rules, bye-laws made under the Mines Act. Under the circumstances, the Mines Department have to look to the things they are kept for.

QUESTIONNAIRE.

(To Landlords' Representatives.)

1. What landlord do you represent and what is the extent of his coal properties?

2. What various kinds of leases are given in your estate, and what power of supervision by the landlord is conferred by such leases over methods of extracting coal? Do the leases specify any particular methods of working, and, if so, what are the methods specified?

3. What percentage of your coal-properties are worked—

(*a*) *Khas*,

(*b*) by lessees, and

(*c*) by sub-lessees?

4. How many proved coal-bearing properties, and of what approximate area, are there in your estate which—

(*a*) have neither been leased out nor worked,

(*b*) have been leased out and not yet worked, and

(*c*) have been leased and worked, but are no longer worked though not exhausted?

5. Are you receiving minimum royalties for the properties under (*b*), and do you have any difficulty in realising such royalties? As regards the properties in (*c*), are there any reasons for work being stopped other than unfavourable market conditions?

6. Do you agree that the size and shape of a mineral leasehold should be so designed as to permit of safe and economical working, and that a statutory authority appointed by Government should have power to give or withhold sanction to the leasing of property which is not so designed?

7. Do you consider that it would be in your interests if the above statutory authority could enforce the amalgamation of small properties and the readjustment of badly-shaped properties without *salami*?

8. Do you agree that mine-owners should be prevented by law—

(*a*) from working a portion of a seam so as to render the remainder of the seam unworkable, and

(*b*) from working a lower seam so as to render an upper seam unworkable?

9. Do you approve of the subletting to others of one or more seams in a mineral leasehold by the lessee of the property? This question refers to a common practice in the major coalfields by which one lessee works a seam or seams above or below those worked by another lessee.

10. Do you know of any instances in your estate in which coal has been won with a view to speedy profit, and with the result that danger has been caused to other unworked coal and to the future interests of the landlord? If so, kindly give particulars of such instances.

11. What are your present arrangements for inspection and control of methods of working by lessees? Would you be prepared to appoint a competent mining engineer to look after your interests and prevent waste of your coal as a capital asset?

12. Would you prefer to appoint such a mining engineer yourself? If you have not appointed, or do not propose to appoint, such a mining engineer, would you object to a statutory authority appointed by Government exercising the necessary control over working by lessees?

13. Would you object to a statutory authority being appointed—

(*a*) to supervise negotiations for leases so far as (i) the shape and size of the areas, and (ii) the methods of working, are concerned,

(*b*) to control actual methods of working so as to prevent undue waste,

(*c*) to insist on a system of packing by incombustible material where this is considered necessary, and

(*d*) generally to regulate and control methods of working so as to secure the maximum percentage of extraction consistent with safety and efficiency?

14. If sand-stowing were made compulsory in the collieries belonging to your estate, what approximate effect would this have on the life and productivity of those collieries?

15. In view of the fact that a system of stowing would result in a larger quantity of coal being won from a given seam or area than is secured by the present methods of working, would you be prepared to concede a reduction in royalty fees in cases in which such improved methods were applied, or alternatively to make a contribution to any cess that might be imposed for the purpose?

16. Does your estate own any part of the sand in the Damodar, Barakar or Adjai Rivers? If so, what are the areas or lengths of sand so owned?

17. In the event of a system of compulsory stowing being introduced, would you be prepared to give the sand free? If not, what royalty per ton or cubic yard of sand would you demand (*a*) from your own leased collieries, and (*b*) from other collieries?

18. Has your estate leased to any coal or other concern any rights in sand in the bed of any part of the Damodar, Barakar or Adjai Rivers? If so, kindly state particulars of such concessions specifying the area leased, the period of the lease, the royalty rate per cubic yard or ton, and any other relevant points.

57. Written Evidence of the Manager, Panchakote Raj Estate, Manbhum.

Question 1.—Zamindar of Chakla Panchakote commonly known as Pachete.

Extent of coal properties 49,730 acres.

Question 2.—(i) Most of the leases are for a term of 999 years.

(ii) Practically there are no terms in the various leases indicating the method to be followed in extracting coal. The only provision provided for is that the lessees are to work the mines in a skilful and workmanlike manner observing all the rules made under the Indian Mines Act. Inspection by lessor's agents of the various books, plans and mines has been provided for.

No, except instroke and outstroke if that can be a method meant here.

Question 3.—(*a*) Nil.

(*b*) 145 *mouzas*, *i.e.*, 44,885 acres approximately.

(*c*) 18 *mouzas*, *i.e.*, 4,169 acres approximately.

Percentage of coal properties are worked 22 per cent. approximately.

Question 4.—No boring has ever been made.

(*a*) 15 *mouzas* with an approximate area of 4,845 acres.

(*b*) 104 *mouzas* with an approximate area of 31,473 acres.

(*c*) 14 *mouzas* with an approximate area of 4,148 acres.

Question 5.—Not for all of the 104 *mouzas*. Minimum royalty is regularly being realised for 10 *mouzas*.

(*c*) No.

No.

Question 6.—Yes. Government interference in the exercise of a private right over property may lead to discriminating leases and unnecessary hindrance.

Question 7.—As I am against any statutory authority I think the question of re-adjustment by exchange of properties should be dealt with if necessary by the Inspector of Mines.

Question 8.—(*a*) Yes.

(*b*) Yes, unless the lower seam is worked by sand-stowing.

Question 9.—No. As in such a case one of the mine owners may so work the mines as to damage the other portions worked by others.

Question 10.—Because of the lack of proper supervision I am not in a position to give any reply to this question. I have, however, heard of such instances but I cannot vouchsafe for the accuracy of such information.

Question 11.—We have in our employ only recently a competent man for the inspection of the workings but most of his time is taken up for underground surveys.

We will appoint a mining engineer on our own choice.

Question 12.—Yes, the latter part of the question does not arise.

Question 13.—Yes. I object to a statutory authority being appointed for the purposes as mentioned in clauses (*a*), (*b*), (*c*) and (*d*).

Question 14.—As in such a case there will not be any unnecessary waste the life of the colliery is sure to be prolonged. I am afraid the mine owners may not in such a case be able to raise as much coal as they are now raising and the result will be a double rise of cost.

Question 15.—Ordinarily the royalty per ton payable to this estate is comparatively low. So further reduction of royalty per ton of coal raised should not be enforced on us, while other landlords would enjoy a higher royalty profit.

This estate is not agreeable to pay any further cess. If any cess is imposed by the Government let it be borne by the lessees.

Question 16.—Yes, in the Damodar and the Barakar rivers and not in the Adjai,

Length:—

Damodar in length 16 miles approximately.

Barakar in length 7 miles approximately.

Question 17.—No. The estate charges 2 annas per 100 cubic feet of sand and sometimes a fixed rent. I shall be prepared to give the sand at the same rate of royalty. But in cases where I find that a real difficulty exists because of the nature and the situation of the mine, I may by private treaty grant concessions.

Question 18.—No. No settlement is made with any coal company in respect of sand in the bed of the rivers Damodar and Barakar within the ambit of this estate.

Details of sand bed settlement to other concerns are mentioned below:—

(A) *Damodar river:*—

1. *Chapraj to Kalajhore.*—Lessees, Indian Iron & Steel Co., Ltd. Settlement for 999 years—annual rent Rs. 137-8-0.

2. *Chapraj to Ghusick Ghat.*—Lessee, Jyotish Chandra Dass. Settlement for 3 years—annual rent Rs. 15.

3. *Gobdhachok Ghat.*—Lessee, Karali Maji. Settlement for 3 years—annual rent Rs. 10.

(B) *Barakar river:*—

1. *Chirkunda to Barmuri Ghat.*—Lessee, Kasimbazar Raj and Ward's Estate. Settlement for 3 years—annual rent Rs. 75.

2. *Dubudi Ramnagor.*—Lessee, Gobardhan Ganguli. Settlement for 3 years—annual rent Rs. 20.

Oral Evidence of Mr. B. Mukherjee, Representative of the Panchkote Raj State.

Question 1.—In addition to the area stated in my written reply there is another pargana named Mohishara in the District of Bankura, containing 50,000 acres of coal bearing properties. The latter is shown in the geological map but has not been proved.

Question 2.—We have a second class certificated manager as our mining engineer. His pay is Rs. 120 a month, and he has been employed for the last eight years. He inspects the books and plans of our lessees and also goes underground regularly. I can cite three instances in which we have discovered our lessees working improperly and in which we have taken steps against them.

The first of these was the Aldih Coal Company of Messrs. Macneill and Company, whom we had to sue for breach of covenant in that they were not submitting the returns required by the leases and were also working instroke and outstroke against the terms of their leases. We were successful in getting the property back in *khas* and then made a fresh settlement with Messrs. Macneill and Company. We raised the royalty from 4 annas to 7 annas. We were also paid three lakhs of *salami*.

The second case was that of the Bengal Coal Company belonging to Messrs. Andrew Yule and Company. This Company had leased our Dumurkunda property and had been working it for 12 years through their Chanch Colliery. The dispute was compromised by the Company paying us Rs. 22,000 as compensation.

The third case was also one in which the Bengal Coal Company had been working our Radanagar property leased to them through their Chotadhemo colliery belonging to the Kasimbazar Estate. This had been going on for six years. The Company paid us Rs. 50,000 amicably as compensation. Since then they have been paying us royalties.

There was also a fourth case in which the Borrea Coal Company managed by Messrs. Balmer Lawrie and Company was sued for bad working on our property. They had to pay Rs. 8,000 as damages. The bad working consisted of loss of coal due to an area being allowed to collapse in the part of the mine which was not being worked at the time.

Question 3.—The percentage of coal properties worked including the Bankura property referred to in my answer to question 1 will only be about 10 per cent.

Question 5 (b).—The other 94 *mouzas* for which we are receiving no minimum royalties were all leased to a Mr. Seddon. He has gone away to England and we are trying to recover these properties in *khas*.

Question 10.—By "lack of proper supervision", I mean that the certificated manager employed by us to look after our properties has been almost entirely employed in surveys, etc., in order to check

up royalties and has actually done very little underground inspection to see whether the mines are being properly worked. We heard that Sodepur Pits Nos. 9 and 10 were being worked with a view to speedy profit. This was 3 or 4 years ago, but we did not make any inspection and I do not know whether what we heard was actually correct. My proprietor used to trust the bigger European firms to work properly, but he has now been disillusioned in so far as the honest payment of royalty is concerned. He has not been in a position to ascertain anything about the methods of working.

Question 11.—There is no immediate prospect of the mining engineer referred to being appointed by us.

Question 13.—I am now agreeable to a statutory authority being appointed for the purposes mentioned in (*b*), (*c*), and (*d*) in the question.

Question 14.—I agree that both the life and productivity of our collieries would be increased by compulsory stowing, but I am not able to give even the approximate estimate of the percentage.

Question 15.—I agree that if the life and productivity of the coal properties of a landlord are going to be increased by compulsory sand-stowing paid for out of a cess to be collected from the workers of the coal, it would be fair that some proportion of this should be assessed on the landlords. In our particular case, however, our rates of royalty are only 2 annas a ton taking into consideration the fact that our leases provide that the lessees will have to pay any future cess of any kind that may be imposed on the property.

Question 17.—We would not agree to give sand free for the purposes of compulsory sand-stowing even if all the other landlords agree to give it free.

Question 18.—In the case of the Equitable Coal Company of Messrs. Macneill and Company, the Estate has given them a right to take sand from our portion of the river for sand-stowing without any charge. The similar rights have not been given to the Bengal Coal Company. We hold that all minerals belong to the zemindar and that even a *patnidar* would not therefore have any right to sand which is a mineral.

Question 18.—The 999 years' lease of sand given to the Indian Iron and Steel Company was given about 18 years ago.

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58. Written Evidence of Mr. G. A. Carver, Consulting Mining Engineer to the Bengal Court of Wards, and Superintendent of Kasimbazar Raj Wards' Estate Khas Collieries.

Question 1.—Consulting Mining Engineer to the Bengal Court of Wards and Superintendent of the Maharaja of Kasimbazar's Khas Collieries.

Coal properties under the Court of Wards—

(i) Kasimbazar—40 square miles.

(ii) Raha & Sons—1,200 *bighas*.

(iii) Burdwan—200 square miles. (Just released from the Wards.)

Question 2.—(A) (*a*) Mining leases—

(1) Virgin properties,

(2) Releasing of partly mined properties.

(3) Abandoned colliery (for stray pillars, etc.).

(*b*) Prospecting mining leases.

(*c*) Wayleave agreements.

(*d*) Pillar-cutting agreements.

(*e*) Fireclay and stone leases.

(B) Practically all leases give us complete control over supervision, systematic methods of working, control of precautions necessary for seams liable to spontaneous combustion, and most matters relative to good mining practice.

Where there have been omissions in original *pottahs* in many cases these have been rectified in subsequent agreements and by mutual arrangements.

Wayleave agreements give us control as stated above over properties which are not appertaining to our own Estate but are being mined contiguously.

(C) Most leases specify the following:—

(*a*) Maximum sizes of pillars, and galleries, or superficial areas at stated depths.

(*b*) Good mining practices—which the Estates have enforced in most cases, as panel system.

(*c*) Adequate barriers.

(*d*) Pillar extraction precautions, *viz.*:—

(1) Permission must first be obtained in writing from the lessor.

(2) Specified time for notices to be given prior to de-pillaring, with a plan.

(3) Area to be de-pillared must not contain more coal than can be reasonably expected to be extracted within a stated period of time.

(4) Stoppings to be built, and shown on plan submitted prior to commencement of de-pillaring operations.

(5) Sizes of stoppings specified.

(6) Mine to be free from dust, gas, and water as far as practicable.

(D) Preservation of shafts for sinking to lower seams, etc.

(E) Damage to upper seams.

Question 3.—The percentages of coal properties worked—

	Per cent.
(*a*) Khas	5·9
(*b*) By lessees	44·3
(*c*) By sub-lessees	1·9
	52·4

Question 4.—Approximate areas of coal bearing properties which—

	Bighas.
(*a*) have neither been leased out nor worked	21,020
(*b*) have been leased out and not yet worked	5,965
(*c*) have been leased out and worked but are no longer worked though not exhausted	2,117

Question 5.—Yes—minimum royalties are received for properties under (*b*) above and also for 1,239 bighas under (*c*) above leases of which are still subsisting. No—except in the case of Nichinta Colliery leased to Messrs. H. V. Low & Co. Payment is being intentionally withheld as applications for reduction of the amount were rejected. Litigation is going on. There seem to be no other reasons for work being stopped than unfavourable market conditions.

Question 6.—Yes—size and shape of a mineral leasehold should be so designed as to permit of safe and economical working.

Safe and economical working of a property should be a lessor's interest, and provided this is not maintained it becomes necessary for a statutory authority to take action.

The Estates of Kasimbazar and Raha consider that no statutory authority is necessary. On the other hand, provided it is considered by your Committee universally necessary, I am convinced that these Estates will co-operate with a statutory authority so appointed for safe, and economical working provided that authority has the landlords well represented.

Question 7.—The amalgamation of small properties, and readjustment of badly shaped properties I consider synonymous, and any legislation to enforce compliance whether by a statutory authority or otherwise most desirable.

I reserve my opinion about abolition of *salami* according to circumstances of each individual case, and the presumption has been concluded that *salami* is not meant as mutation fees.

Question 8.—(*a*) Yes—with certain reservations appertaining to the commercial value of the coal.

(*b*) Yes—with similar reservations to (*a*).

From landlord's point of view provided he obtains the remuneration which would accrue from mining a seam, it is immaterial to him if it is lost. This has reference to a number of cases where the landlord is obtaining, and has obtained the royalty for a seam although it has not been worked.

Question 9.—Yes—the sub-letting or letting to separate lessees of different seams within one property can and is sometimes practised with advantage by landlords, and lessees, with the permission of the former and the necessary safeguards made in the respective leases.

It is always desirable to have one lessee only on a property, but on the other hand it is essential that the seams should be extracted in rotation as far as is practicable.

Such cases are due to the difference in quality of the seams, or leasing out of abandoned properties on short time leases.

Where seams have small intervening strata, this practice is not restored to.

Question 10.—There are the following instances in which coal has been won with a view to speedy profit for which considerable quantities of coal have been lost forever during the period prior to the appointment of the mining engineer:—

(*a*) In *mouza* Baraboni leased to Burrakur Coal Co., Ltd.

(*b*) In *mouza* Aldih leased to Aldih Coal Co., Ltd.

(*c*) In *mouza* Baraboni and Bhanora leased to New Beerbhoom Coal Co., Ltd.

(*d*) In Ekra Khas colliery.

(*e*) In *mouza* Chotodhemo.

(*f*) In *mouza* Vanora near outcrop.

Question 11.—Briefly, Kasimbazar has a staff in the Coalfield who spend practically their entire time on inspection and supervision of the leased collieries appertaining to the Estate.

The staff consists of—

Consulting Engineer—qualified mining engineer.

Royalty Inspector—qualified mining engineer.

Two Surveyors—certified surveyors.

Head Clerk.

One Assistant Clerk.

Inspections are made underground, and on surface regularly, and signed reports of these inspections put on record, in the case of the collieries where de-pillaring is in progress special printed inspection reports are in vogue.

Progress of working places of every leased collieries are brought up-to-date on our plans every six months, and new plans made every 3 years.

Where there are the least signs of collieries, widening galleries intentionally, or otherwise, off-set plans are prepared, and checked periodically.

These inspections extend to other properties than the Kasimbazar Raj Wards' Estate, as in most cases where a lessee of this

Estate has been granted wayleave rights they are granted on condition that the same care and precautions are taken as in the Estate property.

Most leases executed in the last 10 years, or so, lay down methods of working, which are consistent with modern mining, and in the case of old leases there is invariably a clause which can be brought into effect by a mining engineer to ensure that proper methods are employed.

Raha Estate consists of one colliery only, and regular inspections are made by the Consulting Mining Engineer of the Bengal Court of Wards.

The appointment of a competent mining engineer with adequate staff has been and is the practice of Estates under the Bengal Court of Wards.

Question 12.—Appointments are always made by the Bengal Court of Wards.

Question 13.—The appointment of a statutory authority in this respect (*i.e.*, *a*, *b*, *c* & *d*) is tantamount to admitting that lessors and lessees are incapable, and reluctant to manage and conduct their own affairs in a proper and efficient manner.

The delegation of one's private interests to a statutory authority is undesirable, but admittedly essential when those private interests are being mismanaged, therefore if it is considered that this state now exists, then action in the form of a statutory authority required, provided that this authority is so constituted as to have the lessors well represented.

In the particular case of the two Estates Kasimbazar and Raha they have no desire whatsoever to delegate the powers mentioned in this question to a statutory authority as they consider, and I venture to say rightly to, that they have had for a considerable number of years, and still have facilities to deal with all problems on a safe and economical basis. If, however, these facilities were not forthcoming then I feel convinced that they would have no objection whatsoever.

Question 14.—It is extremely difficult to visualise universal stowing, and even if enforced by law under certain conditions would entail in practically every case considerable decrease in output, which means increased life, and greater extraction per seam.

Increased life may affect lessee's interests when they possess leases with restricted period of time.

My very approximate estimate for Kasimbazar's larger leased collieries now working, with modern stowing methods, and sand and water available at pit head would mean a decreased output of approximately 25 per cent. and an increased production of approximately 15 per cent.

Question 15.—Landlords' royalties are the only asset from minerals once leased out; therefore unless they are abnormally high it is unfair to ask for a reduction over and above the benefits

derived, now. As landlords' remuneration is fixed for all times, it is only natural that the sooner his return is forthcoming the greater his assets; therefore immediately off-seating any gain in coal by compulsory sand stowing is the slower rate of extraction, and probable closing down.

There is a tremendous difference throughout coalfields in landlord's royalties which can be attributed to different causes, but leaving aside weak title, mainly due to the inadequate expert supervision, and anxiety to obtain cash payment in the form of *salami*, therefore any cess on royalty would be inequitable, on the other hand a cess on tonnage exhorbitant in specific cases.

My views are that stowing should be universally encouraged and in most cases where resorted to a decrease in royalty would be recommended. My present policy is to grant temporary concession in royalty on a sliding scale, consistent with the selling price of coal.

Question 16.—Kasimbazar.—This Estate has got no ownership in the rivers Adjai and Damodar, but has an area of 801 *bighas* or 265 acres in the Barakar river.

Barakar River—

Mouza Barakar 85 acres.

Mouza Boledih 92 acres.

Mouza Monberia 88 acres.

Question 17.—(*a*) For sand stowing, compulsory or otherwise, Kasimbazar Estate is prepared to give sand free *in situ* to any lessee working Estate property, or adjoining properties from which this Estate collect wayleave royalty.

(*b*) For stowing in collieries where the Estate has no concern whatsoever sand could be obtained at a small royalty. My suggestion is anna 1 per 100 cubic feet.

Question 18.—Barakar River—

(*a*) *Mouza* Monberia—All sand was leased to Messrs. G. C. Roy & Co. for 1340 B.S. at an annual rent of Rs. 760 per annum for 1 year only with option of four renewals.

(*b*) *Mouza* Barakar—Part area settled with Messrs. G. C. Roy & Co. for 1340 B.S. and the option of four renewals at a yearly rent of Rs. 175 per annum.

Part areas also settled with Ram Narayan Shaw at Rs. 115 per annum for 1 year only, *viz.*, 1343 B.S.

Oral Evidence.

Question 2.—The detailed conditions of the leases which I have given only date from about 1922 in the Kasimbazar Raj Wards' Estate. At that time a competent mining engineer was appointed to look after the mining properties of the Estate for the first time. I do not think that these conditions would have been attained

unless such a mining engineer had been appointed. I agree that such conditions in the old leases as not being allowed to drop the surface on any account, or having to apply for permission with further *salami* before pillars could be extracted, were definitely detrimental to the efficient working of the mine, because they encouraged the lessee to extract as much coal as possible in the first working. In a bigger estate with which I am acquainted, namely, the Burdwan Estate, the leases contain general conditions such as I have referred to without any safeguarding conditions which have been obtained in Kasimbazar owing to the competent supervision.

Question 4.—The 21,020 *bighas* of coal properties which have not been leased out nor worked, mainly contain inferior coal, and have not been prospected in detail except in a few cases. The 5,965 bighas leased out and not yet worked have not been developed owing to the market conditions. The quality of the coal is generally good, but it lies comparatively deep and the lessees have not been able to afford to develop it under present conditions. As regards the 2,117 bighas which have been worked but are no longer worked though not exhausted, these properties have been abandoned and left with such small pillars that it is doubtful whether coal will ever be recovered even under favourable market conditions.

Question 7.—If the word '*salami*' is meant to refer to mutation fees, or any consideration for transfer, I am in favour of such fees being done away with. This is my personal opinion, but I do not think my landlord would agree to it except under special circumstances. Kasimbazar Estate is quite agreeable in most cases, but the Burdwan Estate would, I am of opinion, not agree, due chiefly to custom.

Question 10.—The managing agents concerned were:—

(*a*) Messrs. Bird and Company.

(*b*) Messrs. Macneill and Company.

(*c*) Messrs. Balmer Lawrie and Company.

(*d*) At the time Messrs. H. V. Low and Company were the Managing Agents.

(*e*) & (*f*) In both these cases the lessees were Indians and were working under comparatively small scale.

The instances which I have given relate to the period before 1922. There have been two similar cases since 1922, but in both these cases the fault lay primarily with the Estate for giving depillaring rights under unsafe conditions without insisting on proper precautions.

Question 14.—I say that the life of a colliery would be increased by a higher percentage than the productivity because the life would be increased not only on account of the greater total output, but also on account of the decreased annual output, whereas productivity would only be affected by greater total output.

Question 15.—I am agreeable to the landlords contributing towards the cess to finance compulsory sand-stowing, but only if their contribution is put on the same equitable basis for all landlords.

Question 17.—The rate of royalty of 1 anna per 100 cubic feet of sand suggested by me is approximately the same as that suggested by Mr. Treharne Rees in 1920.

Question 18.—The leases referred to in this answer will be cancelled and the Estate will have control of all its sand resources.

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59. Written Evidence of Mr. M. N. Dutt, Superintendent of Mineral Properties, Burdwan Raj Estate.

Question 1.—(*a*) I represent the Burdwan Raj.

(*b*) His coal properties cover the eastern portion of the Raniganj coalfields and will be about 175 square miles roughly.

Question 2.—(*a*) The leases given by this estate can, in general, be classified under three main heads, *viz.*:—

(i) Confirmatory Lease,

(ii) Joint Lease, *i.e.*, Triparty or Four-party Lease, and

(iii) Direct Lease, *i.e.*, where the lease has been given directly to the parties concerned.

(*b*) The power to inspect and check the underground workings of our lessees has been reserved by a clause or clauses in every lease granted by this estate.

(*c*) We do not strictly specify any particular method of working. Our leases demand that mining should be done in a business-like and in the most approved method of mining as per rules laid down by the Department of Mines.

Question 3.—(*a*) None of our mines is worked in *khas*.

(*b*) The total number of mines worked direct by our lessees are very few and will not exceed 16 per cent.

(*c*) The major part of our mines are worked through sub-lessees and will be about 84 per cent. of the total.

Question 4.—(*a*) All our properties which have been proved to contain good and workable coal seams have been leased out.

(*b*) The number and area of the properties which have been leased out but not worked will be about $\frac{1}{4}$ of the total.

(*c*) The number and area of the properties leased out and worked, but are no longer working though not exhausted will be about 16 in number and over 20,000 (twenty thousand *bighas*).

Question 5.—(*a*) Yes.

(*b*) In some cases only.

(c) Unfavourable market condition and low price of coal are the main causes, but in a few cases the non-existence of a railway-siding has been a contributory cause. Existence of mine fire is another reason.

Question 6.—(a) It will be certainly better and advantageous from the mining point of view that the size and shape of the properties should be so designed where possible under the circumstances existing in the particular case or cases.

(b) The statutory authority as suggested and with such powers is not desirable from this point of view as this Estate can always exchange or interchange portion of different leasehold properties or straighten a crooked boundary. This Estate will not, however, object to the appointing of the statutory authority provided their function is restricted to the pointing out of these defects for rectification by this Estate, *i.e.*, so long as it does not interfere with the right and privileges of this Estate as the superior landlord.

The Burdwan Estate, however, will not be much concerned on this particular point as all the properties have already been leased out.

Question 7.—This Estate will agree to give the statutory authority this power and is prepared to forego its right of getting a *salami*. The cases where the right of "instroke and outstroke" and the right to receive and demand wayleave in lieu thereof must however remain in hands of this Estate. Previous reference however must be made to this Estate, so that the initiative may be taken by this Estate first. This Estate must reserve the right of choosing the cases which are to be referred to the statutory authority for action.

Question 8.—We fully agree that the party working the mine should be prevented by law as stated in (a) and (b).

Question 9.—We do not approve of this practice as stated, but this Estate is not interested in the question as in all cases we have leased out all the seams in a property.

Question 10.—Most of our leases are dated from the year 1915 or afterwards, and the cases mentioned in this question are very few. Most of the damages existing at present are done prior to our leases or in the boom period, where our leases are dated 1921 or afterwards.

Question 11.—(a) This Estate maintains a separate department for its coal and mineral properties. A competent Mining Engineer with First Class Mine Manager's Certificate of Competency and Mine experience in India and abroad, is in charge of it. He has the assistance of a mining assistant and surveyor. All of these officers regularly go out on tours and make regular inspections of the underground workings of our mines worked by sub-lessees. Cases of bad workings wherever detected are properly dealt with with a view to prevent wastage and consequent loss of royalty to this Estate.

(*b*) The question of appointing a competent mining engineer therefore does not arise.

Question 12.—This question does not arise so far as this Estate is concerned.

Question 13.—(*a*) As all our properties have already been leased out this point does not affect this Estate.

We will agree to the statutory authority being appointed to advise on the methods of working the mines. Our objections have been dealt with under questions 6 (*b*) and 7.

(*b*) We have no objection.

(*c*) We will agree to this.

(*d*) We will agree to give this power to the statutory authority.

Question 14.—If sand-stowing be made compulsory it is certain that a greater amount of coal will be effected and the life will be prolonged. It is difficult to make any calculation on the extent or percentage of increase as the condition, size and workings of mines vary from mine to mine.

Question 15.—In the majority of our coal properties the rate of royalty received by this Estate is only one anna per ton. This rate is so small as compared with the rate of royalty paid by the actual working party that it is not possible for this Estate to agree to concede to a reduction in royalty or alternatively to agree to any payment of cess imposed for this purpose. My Estate is definitely opposed to reduce the rate of royalty for the purpose of helping and stowing. One of the reasons is that the rate of royalty received by us is in most cases one anna per ton.

Question 16.—This Estate owns the underground mining right of sand in portions of Damodar and Adjai rivers only. The length and areas would be as given below :—

Damodar river, 12 miles (approx.).

Adjai river, 28 miles (approx.).

It may be noted however that the whole Estate including the river beds and banks have been leased out in *Putni* and *Mokrari*, as such the surface rights have already been leased out to the parties by registered leases.

Question 17.—For reasons stated under *Question 15* we cannot agree to give the sand free. My Estate is definitely opposed to grant river sand for sand-stowing purpose free of royalty.

The rate of royalty per ton that would be demanded by this Estate will be—

(*a*) From our own leased collieries 1 anna per ton.

(*b*) From other collieries 2 annas per ton.

Question 18.—Within the coal mining area, no sand mining lease has been granted by this Estate in any part of the Damodar and Adjai rivers.

60. Written Evidence of Mr. P. S. Keelan, C.I.E., Chief Superintendent, Zemindaries, Messrs. Andrew Yule & Co., Ltd., Raniganj.

Question 1.—Bengal Coal Co., Ltd., and Katras Jherria Coal Co., Ltd., about 100 square miles—this is approximately the proved coal bearing area out of approximately 230 square miles.

Question 2.—Leases for 999 years. The very early leases provide for very little supervision by the landlord, but more modern leases provide for control by the landlord. Leases do not specify methods of work but usually contain a provision that mining shall be conducted in the most approved practice prevailing from time to time, inspection by the landlord being provided for.

Question 3.—(*a*) Worked in *khas*—20 square miles.

(*b*) Worked by lessees—7·78 square miles.

(*c*) Worked by sub-lessees—*nil.*

Question 4.—(*a*) Neither leased out nor worked—72·22 square miles.

(*b*) Leased out and not yet worked—*nil.*

(*c*) Leased and worked, but no longer worked though not exhausted—*nil.*

Question 5.—In some cases a percentage of minimum royalties has been foregone owing to bad market. There is no difficulty in realising royalties. No properties have been abandoned by our lessees except for unfavourable market conditions.

Question 6.—I do not agree to statutory control.

Question 7.—*See Question 6.*

Question 8.—(*a*) I do not agree that mine owners should be prevented from working a portion of the seam and rendering the remainder unworkable, as it is not possible to foretell that the remainder left will ever be of commercial value. It is unusual to abandon any portion of a seam if it is marketable.

(*b*) Unless the upper seam is of commercial value, my remarks under *Question 8* (*a*) apply.

Question 9.—There would appear to be no objection to continuance of the present practice provided the parties are controlled by their leases to exercise sufficient precaution and the control of the Mines Department already exists in regard to safety.

Question 10.—I do not know of such instances and these should not occur if the landlord exercises sufficient supervision.

Question 11.—Competent mining engineers are always maintained by this Estate to watch the landlord's interest and prevent waste.

Question 12.—I would personally prefer to appoint mining engineers maintained by the landlords. I cannot admit that a

statutory authority appointed by the Government is going to control our properties any better.

Question 13.—(*a*) I do not agree.

(*b*) I do not agree.

(*c*) Not in all cases.

(*d*) The percentage of first working may be laid down.

Question 14.—An answer to this question is difficult to provide within the time limit. It would necessitate an extensive survey and is therefore impracticable owing to the time limit.

Question 15.—I would not be prepared to concede a deduction in royalty in any case where the royalty per ton was less than the equivalent of 6*d.* per ton.

Question 16.—The Bengal Coal Co., Ltd., own sand in the Damodar river.

Question 17.—Provided all landlords did so. I would be prepared to recommend a royalty $\frac{1}{3}$rd of an anna per cubic yard which is a reasonable demand. I should recommend the same rate from my own collieries as from others.

Question 18.—In certain areas along the Damodar river the sand is leased to contractor at a fixed annual rent and I understand the contractors gather an anna per cart—10 to 12 cubic feet—from the persons taking it. The total areas leased are limited.

Oral Evidence.

Question 2.—The inspections provided for in our leases are carried out periodically by the mining engineer of the landlord. We have had a certain amount of trouble with our lessees, but no litigation so far. Our lessees consist of companies and private individuals, both European and Indian. Our leases from the superior landlords contain terms about not breaking the surface and require fresh *salami* for pillar cutting. The leases we have given to our lessees do not contain such terms, but they are bound by the terms of the head lease. I agree that such terms and leases encourage the party working the coal to extract an excess percentage during the first working.

Question 6.—I would be in favour of a statutory authority to control the first workings and to hear appeals from the decisions of the Mines Department as regards safety. I think that the statutory authority should consist of an independent Chairman, a representative of the Mines Department, and a panel of mining engineers from whom three would be selected by the Chairman for each meeting, one of these mining engineers to represent the other party concerned in the particular case before the statutory authority.

In principle I am against statutory control, for, I am of opinion that the Giridih system of mining would not have been a recognised system to-day, had statutory control existed, for, no

mining engineer would have undertaken the risk attached to the experimental stage, had statutory control existed at that time.

Question 8.—(*a*) I do not think that the quantity of coal left behind determines liability to fire though a greater quantity of coal so left would of course increase the intensity of any fire that might occur.

(*b*) If the upper seam was of commercial value, I would prevent by law its destruction or damage by the working of a lower seam.

Question 10.—I do not know of any instances where coal has been won by our lessees with a view to speedy profit, but I do know of instances where this would have occurred if we had not interfered at an early stage.

Question 12.—I would be in favour of control by the statutory authority referred to above where a landlord does not appoint a competent mining engineer to look after his interests.

Question 13.—It follows from my answer to *Question 12* that I would agree to statutory control in those cases where a landlord does not have a competent mining engineer to look after his interests.

Question 14.—The leased collieries belonging to my Estate are all in the Raniganj field and the seams are comparatively thin. I do not think that in these collieries compulsory stowing would add materially to their life and productivity.

Question 16.—The sand owned by the Bengal Coal Company in the Damodar river extends over a stretch of about 8 miles. 2 miles of this is in Dishergarh, one mile in Jharia and about 4 to 5 miles from Raniganj to Ondal.

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61. Written Evidence of Mr. H. Sen Gupta, Manager, Nawagarh Raj State, Manbhum District.

Question 1.—I represent the Zamindar of Pergana Nawagarh, 1st and 2nd *kismats*.

Approximately 45,000 *bighas* in round number.

Question 2.—*Meadi mokrori* leases, *i.e.*, lease for a fixed term of years with fixed rent or fixed commission and minimum royalty, are ordinarily given.

No power of supervision is conferred by such leases over methods of extracting coal.

There is a general clause in the leases specifying that the coal mines will be made according to *dastur* rules, *i.e.*, without causing any injury to human life and property.

Question 3.—No coal properties are worked *khas*.

(*b* & *c*) Information is not readily obtainable.

Question 4.—(*a*) Approximately 8,000 *bighas* in round number.

(*b*) Approximately 8,500 *bighas*.

(*c*) Approximately 7,500 *bighas*.

Question 5.—No, not for all properties.

Yes, I have. I am not aware of any other reasons than unfavourable market conditions.

Question 6.—So far as I know the size and shape of the coal properties within the jurisdiction of this Estate are not so designed as not to permit of safe and economical working.

Question 7.—No answer arises.

Question 8.—Yes, I agree.

Question 9.—I do not approve on the ground that a lessee working a lower seam may not take so much care for the interest of the lessee working an upper seam and *vice-versâ*.

Question 10.—No.

Question 11.—No present arrangements except the provisions contained in the leases to the effect that mines should be worked without causing any injury to human life and property. No, I am not prepared.

Question 12.—No. It is not possible for this Estate itself to appoint a competent mining engineer in view of the present income derived from the coal properties, but this Estate is prepared to bear the proportionate cost if such mining engineer is appointed by several landlords jointly.

Question 13.—I object to the statutory authority being so empowered, but I recommend a set of rules to be framed for the purpose, which the lessees will follow irrespective of the terms of their leases.

Question 14.—Sand-stowing should not be made compulsory in the collieries belonging to our Estate inasmuch as sufficient sand is not available and sand-stowing would be most costly.

Question 15.—Yes, I am prepared to concede a reasonable reduction in royalty provided that this Estate is benefited thereby.

Question 16.—Yes. This Estate owns some part of the sand in the Damodar river only, about four miles in length.

Question 17.—No. 4 annas per 100 cubic feet of sand from our own leased collieries and 6 annas per 100 cubic feet of sand from other collieries. The rate of royalty will vary according to distance from the river bed.

Question 18.—No.

Oral Evidence of Mr. C. A. Forbes, Representive, Nowagarh Raj Estate.

Question 1.—The 45,000 *bighas* referred to has been proved to be coal-bearing property.

Question 3.—Our lessees are the Burrakur Coal Company and many comparatively small Indian lessees.

Question 5.—I should like to add that besides unfavourable market conditions properties have been abandoned although not exhausted because they have been so badly worked. It is very difficult now to get hold of anybody to work these.

Question 8.—I would have any such law enforced by some Government authority, whether the Mines Department or a separate statutory authority.

Question 10.—There are many cases in my Estate in which coal has been won with a view to speedy profit causing coal to be left which cannot be leased to anybody else. There has also been the general bad working referred to already by me. The Estate does not wish to give particulars of such instances.

Question 12.—I agree that, if the landlords have not looked after their coal mining interests properly, Government should step in and appoint an authority both in the interests of conservation and in the interests of the landlords themselves. I agree that, if my landlord had been properly advised at the time by a competent mining engineer, he would not have given leases of the kind that have been given.

Question 13.—It follows that my Estate would no longer object to the Government authority if empowered by law for the purposes contemplated in this question. As our present leases do not give us any powers of supervision over the mining methods, my Estate would welcome any authority which enables such powers to be efficiently exercised.

Question 14.—If proper methods were enforced, including compulsory sand-stowing where this is necessary in order to recover the maximum percentage of the coal, the result would obviously be in the interests of the Estate as it would eventually get more royalties.

Question 15.—I would have no objection to the landlords being required to contribute directly to a general cess for purposes of conservation provided the incidence was made proportionate to the extent of the interest that will be benefited.

Question 17.—I think that if landlords gave sand or other stowing material free to be used for stowing in any mine by the statutory authority, this would be a sufficient contribution on the part of the landlords. My Estate would be prepared to agree to this, but might want to confine the concession only to its own lessees.

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62. Written Evidence of the Agent, Jharia Raj Estate.

Question 1.—Jharia Raj. The extent of his coal area is about 36,498 acres.

Question 2.—The leases granted are either permanent or for a term of 999 years. In some leases fixed rent has been reserved and in others royalty on each ton of coal raised, manufactured and despatched from demised premises is reserved. The said royalty,

however, is in each case subject to a yearly minimum royalty. No specific power of supervision of the method of extracting coal is reserved in the leases, but in each lease there is a covenant that the lessee would work coal in skilful manner and carefully according to rules and regulations that may be in force from time to time.

Question 3.—(*a*) None.

(*b*) 55 per cent.

(*c*) 45 per cent.

Question 4.—(*a*) About 4,056 acres in about 16 villages.

(*b*) About 1,748 acres in 10 villages.

(*c*) About 2,069 acres in about 38 villages.

Question 5.—Yes. I am getting royalty and there is no difficulty in realising royalty. With reference to properties (*c*) of *Question 4*, in some of them work has been stopped on account of fire whereas others have been closed for bad market.

Question 6.—I do not agree with the suggestion.

Question 7.—No.

Question 8.—(*a*) Yes. (*b*) Yes.

Question 9.—There is no harm.

Question 10.—No such instance has been brought to my knowledge.

Question 11.—As there are no stipulations in the leases regarding control of the method of working, there is no arrangement as stated in this question. The working of the coal of the Jharia Estate is chiefly entrusted with big companies who have their own mining engineers, experts and managers having experiences of English and Indian collieries; I think there is no necessity for me to appoint any inspector.

Question 12.—My answer to this question is as stated above.

Question 13.—(*a*) (i) Yes. (ii) No. (*b*), (*c*) & (*d*) No.

Question 14.—Better result is expected than the present method of working.

Question 15.—Considering that the collieries have been settled at a very low rate of *salami* and commission and rent, it is understood that the lessees would bear all expenses for efficient and economical workings according to up-to-date method and there is no reason why the landlord would bear any share of the expenditure incurred.

Question 16.—The Estate owns 20 miles of sand in the bed of the river Damodar.

Questions 17 & 18.—The sand of the whole bed of the river Damodar in the Jharia Estate has been settled with Bhulanbararee Coal Co., Ltd., on the 25th June 1935, for 999 years on a fixed rent of Rs. 1,000 yearly for the purpose of sand-stowing coal mines

only. In clause 8 of the lease it is stipulated that, " It is hereby expressly agreed that if other mining lessees of the first party (lessor) require sand for sand-stowing their mines then the second party will be bound to allow such lessee to take sand from the river for that purpose on reasonable terms to be arranged between the second party and such lessee."

Oral Evidence of Mr. M. M. Chatterjee, Representative, Jharia Raj Estate.

Question 1.—The whole of the 36,498 acres has been proved to contain coal and it includes all seams from Nos. 1 to 18.

Question 2.—The covenant in our leases about working in a skilful manner and according to the rules and regulations enforced is actually inoperative and does not protect the landlords' interests at all. I agree that if my proprietor had been properly advised at the time, he would not have executed leases of this kind, and would probably have taken steps to better protect his interests.

Question 6.—We do not agree to any control by a statutory authority over the size and shape of a leasehold, or to give or withhold sanction leasing of property which is not so designed as it will interfere with the free discharge of the proprietory rights of the landlord; besides out of 102 coal bearing *mouzas* in this zamindary 88 have been settled by *mouza* boundaries and only 14 have been settled in piece meals which are mostly situated at the outskirts the coalfield containing inferior seams—a field for small capitalists. But we do agree to control by some statutory authority over methods of working generally as has been stated in answer to *Question 13.*

Question 15.—Our royalties vary from 1 anna to 6 annas per ton; the average would be about 3 annas. As regards dead rent, the dead rent is from Re. 1 to Rs. 5 per *bigha* of coal bearing land per annum. The rate of *salami* has varied from Re. 1 to Rs. 15 per *bigha* of area leased. The majority of our leases were given between 1894 and 1905. The total income from rent and royalties is about Rs. 4 lakhs a year. We have to pay out in income-tax and local cesses about 70 per cent. of this income. Out of the total of about 250 leases, about 200 are on dead rent and about 50 on royalty basis.

Question 18.—The lease of sand to the Bhulanbararee Coal Co. (Messrs. Heilgers & Co.) carried a *salami* of Rs. 5,000. The lease to this company is for the whole of the sand in our portion of the Damodar river and does not exclude any sand that may have already been leased to other people. So far as I am aware, no other lease of sand has been given, because we regard sand as a mineral which does not appertain to rights over the surface. Our area of sand in the Damodar river extends from Katrijore to Kargali a distance of about 20 miles.

63. Written Evidence of Mr. S. McLeod Smith, Manager, Ramgarh Estate, Hazaribagh.

Question 1.—Ramgarh Estate under the Court of Wards. Coal-field areas are extensive, extending to nine *thanas* of the district, *viz.*, Nawadih, Gomia, Peterbar, Jaridih, Gola, Ramgarh, Mandu, Barkagaon and Tandwa.

Question 2.—Generally coal, mica and limestone leases. The leases specify certain special methods of working. In order to supervise the working of coal areas, the appointment of a special officer is under contemplation.

Question 3.—(*a*) *Nil.*

(*b*) Bokaro and Ramgarh Limited, and the Karanpura Development Company, Limited.

(*c*) Certain railway companies.

Question 4.—(*a*) There are certain areas which may be available.

(*b*) There are three such blocks (3,750+3,750+4,045=11,545) standard *bighas.*

(*c*) There are two small areas.

Question 5.—(*a*) Yes.

(*b*) Some difficulty in a few cases owing to financial stringency.

(*c*) No.

Question 6.—I agree but do not think statutory measures are required as far as Ramgarh Estate is concerned.

Question 7.—It would not be in the interest of the Estate the amalgamation of small properties without *salami.*

Question 8.—(*a*) Yes.

(*b*) The working of a lower or upper seam depends upon the quality of the mineral selected for the market. If both the adjoining seams are equally good I would certainly like the upper seam to be worked first.

Question 9.—No. Two parties working different seams in the same mine is objectionable.

Question 10.—No.

Question 11.—The Estate has at present no mining engineer to guard its interests. The appointment of an officer of the above qualifications is under contemplation.

Question 12.—In view of the answer given in *Question 11* above, Government control will not be necessary.

Question 13.—(*a*) In view of my opinion given in *Question 6* this question does not arise.

(*b*), (*c*) & (*d*).—In view of the opinion given against *Question 11* this question does not arise.

Question 14.—The result would probably be a greater output of coal.

Question 15.—No.

Question 16.—Yes, the area is extensive.

Question 17.—No.

(*a*) Royalty at 2 annas per 100 cubic feet to our lessees in the Estate.

(*b*) This question can only be decided on applications.

Question 18.—Yes. It has done so in the Damodar and the Kunar rivers. The total area leased out=313·31 acres. Minimum royalty at present charged is at Re. 1 per acre per annum.

Oral Evidence.

Question 1.—The total known coal bearing property of the Estate amounts to 47,289 *bighas*.

Question 2.—I think our standard form of lease provides for supervision by the proprietor over methods of working, but actually no such supervision has been carried out yet. The Estate is to be released from the Court of Wards on the 10th of August 1937, and the proprietor recognises the value to himself of appointing a competent mining engineer to look after his mining interests.

Question 4 (*b*).—I should add that there is another such block amounting to 3,035 *bighas*, making a total of 14,580 *bighas*.

Question 8 (*b*).—After discussion with the Committee, I agree that from the point of view of the estate, such working should be controlled by law.

Question 16.—The area of sand extends to the Bokaro and Karanpura fields.

Question 18.—There are three leases at present of areas of 110 acres, 153 acres, and 50 acres. Of the three leases for sand the area of 110 acres is 3 years old, the area of 153 acres is 2 years old, and the area of 50 acres is recent. All these leases are for 999 years.

General.—Our rates of royalty on coal are steam coal 4 annas per ton, rubble coal 3 annas per ton, dust coal 2 annas per ton, and slack 2½ annas per ton.

Figures of receipts from royalty for the past three years are as noted below:—

1933-34	Rs. 4,28,562
1934-35	Rs. 4,88,693
1935-36	Rs. 5,02,743

QUESTIONNAIRE.

(To Representatives of Iron and Steel Companies.)

1. Will you kindly give the Committee an estimate of the resources of coal suitable for the manufacture of metallurgical coke owned by you or for which you have contracts?

2. In what coalfields do these reserves exist? For how many years will the above reserves last so far as can be seen at present?

3. Apart from supplies of coking coal owned by you or secured by contracts, what other arrangements have you made for supplies of coking coal?

4. Do you purchase coal for the manufacture of metallurgical coke, or metallurgical coke, or both, in the open market? If so, to what extent and from which collieries and coke plants?

5. What is the present annual output of the collieries owned by your company? Is the whole of that output reserved for the manufacture of coke? If not, what proportion of it is sold in the open market?

6. Is high grade coke essential to iron ore smelting? It is said to have been demonstrated that iron ore can be smelted without using any coke at all, but using charcoal, coal or other power? Is there any probability, in the near future, of such processes being applied industrially in India? If not, what are the objections to such processes, and how would they affect blast furnace practice and the economics of smelting?

7. Have you any experience of using for metallurgical purposes coke made from a mixture of coking and non-coking coals? If so, from what seams was the respective coal obtained, what were the proportions of each, and what were the results?

64. Written Evidence of Messrs. The Tata Iron and Steel Co., Ltd.

Question 1.—Our own resources are estimated at 200 million tons and those for which we have existing long term contracts at 8 million tons.

Question 2.—Jharia coalfield.

With proper conservation our reserves may last for 100 years, if the rate of consumption is not very much increased, but a great deal depends on what happens at the collieries surrounding the areas or mouzas in which our reserves are situated. With surrounding collieries subsided, flooded or on fire, it may be impossible to mine 50 per cent. of these reserves.

Question 3.—We purchase coking coal in the open market in small lots whenever required.

Question 4.—We purchase both coking coal as well as metallurgical coke in the open market. The quantities of coal purchased vary in accordance with our requirements and the supplies obtained from our own collieries and under our long term contracts.

We purchase hard coke from Messrs. Turner Morrison, Jardine Skinner, Birds, and Mackinnon Mackenzie to the extent of about 16,000 tons per month.

Question 5.—The output varies between 400,000 and 600,000 tons per year. The small coal is used for coke making, steam coal for boilers, and about 8,000 to 10,000 tons per month of steam coal is sold in the open market, but during the last three years this has been replaced by purchasing a corresponding tonnage of good coking coal in the open market. We have decided not to sell any of our own coal to the railways or any other party during 1937-38.

Question 6.—Yes. High grade coke is essential for iron ore smelting. Yes. Iron ore can be smelted by other means but, in our opinion, there is no probability of this becoming a commercial proposition in the near future.

Question 7.—Our experience is that Indian coking coals will not carry more than 3 per cent. of non-coking coals or coke breeze and still make a satisfactory blast furnace coke.

Oral Evidence of Mr. John Kirk and Dr. F. G. Percival of Messrs. The Tata Iron and Steel Company.

Question 1.—Our reserves of 200 million tons represent the amount available for despatch. This is calculated on a basis of 50 per cent. recovery. With sand-stowing we might get another 25 per cent. We have calculated reserves up to a depth of 1,400 feet. In Jharia, even with sand-stowing, the friability of the coal

leads to crushes, and roof breaks, while the water and strata temperatures make the getting of coal difficult below 1,000 feet and uneconomical below 1,400 feet. The position is different in the Raniganj field; there you can go down, say to 2,000 feet.

The Government have so far only allowed the Tata Iron and Steel Company to take up the lease of areas containing 100 years supply of iron ore. It therefore serves the Steel Company no useful purpose to acquire or conserve tonnages of coal in excess of the quantity required to smelt 100 years supply of iron ore.

In Jharia we find that in XV seam at a depth of 1,000 feet, the coal is very friable, shows signs of crush or squeeze even in the pillars. The galleries have to be closely timbered, as neither the coal roof nor the stone is self-supporting.

These conditions will apply whether sand-stowing is carried out or not and will make the recovery of coal below 1,000 feet more difficult and expensive.

Such conditions limit our calculated reserves to a depth of 1,400 feet. But this should not be read to mean that coal below this depth could not be mined. The real depth limit in mining is whether it is a commercial proposition or not.

In the Raniganj coalfield a depth of close on 2,000 feet has already been attained without serious difficulty, and in our opinion no limit should be put to the depth at which these seams can be mined until further information is available.

Question 2.—With proper conservation our resources may last for a hundred years, but, if the surrounding collieries subside, or get flooded or catch fire, it may be impossible to mine more than 50 per cent. of our reserves, which will be reduced to 50 years. As an organisation, the Tata Iron and Steel Company is in favour of State control or any other method for putting a stop to bad working, fires, floods, etc. We will do whatever this Committee recommends with our own coal.

Question 4.—We purchase 85 to 100 thousand tons of coking coal and 20 thousand tons of gas coal per month in the open market for our own use.

Question 5.—The ten thousand tons of coal put on the market is Jharia coal of coking quality. It is sold in order to secure a balance. The consumption of coking coal went up by 20 to 25 thousand tons up to the end of December, 1936. No coking coal will be put on the market in 1937-38 because our new plant will consume more coal and we will not be able to sell anything. The iron and steel trade is showing signs of improvement. The Tata Iron and Steel Company are interested in the new steel combine which is setting up works at Hirapur, but only in so far as the production of steel is concerned. The new steel plant will not increase the consumption of gas coal appreciably as there will be a corresponding drop in the consumption of coal at Jamshedpur.

Question 7.—We consider the whole Bokaro field a coking coal reserve. Only 25 per cent. of the Kargali seam is suitable for

coking. No. 10 Jharia seam, bottom section, produces good coking coal for blast furnaces. We have tried other coals, but their ash content is too high. We do not think that coals from Nos. 7 and 8 seams would be useful even after mixing. No. 9 seam might be useful with suitable mixing. Coals from these seams give a hard coke, but contain too much of ash. The ash per cent. in coke for Blast Furnace purposes should not exceed 18 to 20 per cent., as any excess ash over 20 per cent. in the coke meant a corresponding reduction in the daily iron production, or in other words, if we put ash in instead of iron the daily output of iron must show a corresponding reduction. A mixture of Nos. 13, 14, 15 and 16 seams is good. Seams Nos. 12, 13, 15 and 16 will take only a small percentage of non-coking coal for production of coke. They produce much coke breeze, and the ash percentage is also high. We are using coal from a special section of No. 10 seam from a certain area only. The whole of No. 10 seam can, however, be cleaned and made suitable for metallurgical purposes after mixing with lower ash coal.

General.—Our mining costs are higher than those of others due to the fact that the wages paid on the Steel Company's collieries are on the average 25 per cent. higher than other collieries. The iron and steel industry, as well as the railways, must have their own coal reserves in order to be protected against squeezing as regards prices. The coal trade has itself to blame for its present position. We can produce all the coal we require, but we are at present working only two out of our five collieries in Jharia. We can meet all our needs from our collieries. We require 2 millions and we have reserves of 200 millions. We are at present meeting only 25 per cent. of our needs from our own coal reserves.

We have decided to protect ourselves at our own expense; we have decided to stow where necessary, *i.e.*, in seams over 13 feet thick. We are leaving 300 feet coal barriers in any new areas we open out. But we are not prepared to pay for the protection of others. We do not want any help. Every mine-owner in Jharia should be made to put his own house in order. For instance, all subsidences should be levelled up as they occur. The railways have not aggravated the position in regard to coal prices. They are merely buying in the cheapest market. Railway collieries have nothing to do with present conditions. *The iron and steel

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* *Copy of letter No. C. 42, dated the 3rd February 1937, from the Director, The Tata Iron and Steel Company, Limited (Agents' Office), to the Secretary, Coal Mining Committee.*

From a copy of the oral evidence given by our representatives, Mr. Kirk and Dr. Percival, before the Coal Mining Committee on 8th January 1937, we notice that in answer to a general question at the end, the following statement has been made which the Tata Iron and Steel Company is unable to endorse:—

"The iron and steel industry is no longer protected now. Tatas can undersell any imported iron and steel. Their duty is now merely a revenue one. I am not prepared to say that protection to iron and steel would necessarily mean protection to coal."

industry is no longer " protected " now. Tatas can undersell any imported iron and steel. The duty is now merely a revenue one. We are not prepared to say that protection to iron and steel would necessarily mean protection to coal. The Tariff Board on its original enquiry eliminated the collieries from the enquiry, so that the capital spent on them was not taken into consideration when fixing the protection given to steel.

The best way of conserving Jharia coal is to acquire the entire field at State expense or by a combination of iron and steel companies; then put out the fires and work the field for coking coal only.

At present prices, it is not possible for colliery owners to undertake precautionary measures. If a cess is imposed, coal companies will most probably reduce their prices further. For securing a fair economic price, a central selling agency should be established and all sales should be conducted through it.

Steps should be taken to prevent profiteering in sand. Messrs. Bird and Company have already taken control of the sand in the Damodar river.

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2. As there appears to have been some misunderstanding in the minds of some of the Members of the Committee on the subject of protection and as our representatives were not entirely qualified to deal with such a question, we forward herewith an extract from our letter of the 27th December 1932, to the Bengal Chamber of Commerce, which clearly explains the position.

Extract from a letter dated the 27th December 1932, addressed to the Secretary, Bengal Chamber of Commerce, Calcutta, by the Tata Iron and Steel Company, Limited.

Some of the steel products manufactured by the Company are protected but the protection does not extend to coal which is definitely excluded from its purview. Over two crores of the capital of the Company has been expended on its collieries and this capital has been definitely excluded by the Tariff Board in estimating the total capital expenditure on the Works on which the scheme of steel protection is based. The position will be made quite clear from the following extract from paragraph 61 of the first Report of the Indian Tariff Board:—

> " We found it necessary to exclude in the first place the capital expenditure on the collieries. During the last six years the Company has sold nearly a million tons of coal produced from its own collieries, or more than a third of the total output. Eventually, when development is completed, the Company expect to produce about two million tons of coal, while their purchases under the 25-year contracts will amount to three-quarters of a million tons more or less. The total requirements at Jamshedpur as estimated by the Company are about 1-¾ million tons. In the face of these figures the only possible conclusion seems to be that the Collieries should be treated as a separate venture and should be expected to pay their own overhead and provide a return on the investment from their own sale proceeds. Unless the collieries are eliminated, we cannot avoid the discussion of what, for our purposes, is really an irrelevant question, *viz.*, to what extent the capital spent on the collieries is a remunerative investment."

It will be apparent from the above that the collieries have been treated as a separate venture which are expected to pay their own overheads and provide a return on the investment from their own sale proceeds. This

55. Written Evidence of Messrs. The Indian Iron and Steel Co., Ltd.

Question 1.—The Company owns coal bearing areas of Ramnagore, Kendwa, Noondih and Jitpur, of which the estimated contents are about 72 millions tons. In view of the thickness of some of the seams, all of this coal is not recoverable.

The Company has also the properties of Parsoondi, Talgoria and Nyaban; the first named is not a coking coal and the others have yet to be proved as suitable for winning coal for manufacture of metallurgical coke.

In addition, we have contracts approximating to 60,000 tons monthly of coal suitable for the manufacture of metallurgical coke.

Question 2.—The coal bearing areas of Ramnagore and Kendwa are in the Barakar Series; Noondih, Jitpur, Talgoria and Nyaban are in the Jharia fields; Parsoondih is in the Raniganj field.

The answer to the second portion of the question is dependent upon the availability of other outside coal to make up the deficit between the actual consumption and present raisings.

Question 3.—Beyond its own coal and the coal secured by outside contracts, the Company has no other arrangements for supplies of coking coal.

Question 4.—The Company purchases coal for the manufacture of metallurgical coke and also metallurgical coke in the open market. The coal for making coke for metallurgical purposes is bought almost entirely from collieries in the Jharia field district, working selected and first grade qualities. Some coal is also bought from Dishergarh for mixing with the Jharia coals.

Question 5.—The present annual output from this Company's collieries is in the neighbourhood of 380,000 tons. In view of the fact that the coal crushing equipment at the Company's coke ovens is limited, a proportion of steal coal is sold in the open market and replaced by bought slack.

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principle has been followed by the Tariff Board and by the Government to the present day in estimating the measure of protection to be granted to the Company.

It might be argued that if the cost to the Company of coal raised or purchased by it is taken into account by the Tariff Board in estimating the cost of production of pig iron and finished steel, the Company still enjoys an indirect protection on coal. Such however is not the case. For the purpose of estimating the cost of production of the pig iron and finished steel the Tariff Board has calculated what would be the fair cost of coal for the period of protection, regardless altogether of the actual cost of coal to the Company. It will thus be seen that the protection enjoyed by the Company on certain of its steel products has no bearing whatsoever on the question of coal and cannot therefore be employed as a legitimate argument for restraining the Company from making the best commercial use of its coal properties which have been treated as an independent venture by the Government.

Question 6.—The blast furnace charge consists of a mixture of—

(*a*) iron bearing materials—ores,

(*b*) a fluxing material—limestone,

(*c*) a fuel.

This para. is concerned solely with (*c*) the fuel.

The fuel in the furnace has to carry out the following functions:—

(i) It must provide economically the heat necessary for smelting.

(ii) Its ash (if any) must form a relatively easily fusible slag with other non-metallic components of the furnace mixture.

(iii) It must be of a texture not too dense to impede the contract of furnace gases.

(iv) It must be mechanically strong and sufficiently so to avoid crushing or breaking during the time of actual combustion.

In a blast furnace as the ore and limestone melt away in the lower part of the furnace to form iron and slag, the weight of the superimposed column of unmolten and semi-molten raw material has to be carried by the incandescent fuel. Also for modern practice it is necessary to have fast driving furnaces carrying as large a proportional weight of ore to coke as possible, as the greater this proportion the less the fuel cost per ton of pig iron produced. This proportion is governed mainly by the strength of the fuel to carry the column of raw material. Considering, therefore, the four points mentioned above as covering the essential qualities for a furnace fuel, it is obvious that a good quality coke is the only fuel that meets these requirements. Charcoal could only be used economically where large supplies of wood are available, and where freight on coking coal or coke would render their use prohibitive. But charcoal could not be used on large furnaces as it would not be sufficiently strong mechanically. It is used in Sweden but the maximum height of these furnaces is about 30 feet to 35 feet against, say, 90 feet to 100 feet for the average modern furnaces.

As regards coal this was used extensively but with the introduction of more modern plants coke is practically always used. The use of coal in a large furnace would result in large quantities of tar being deposited in the gas mains. Further, the coal would not have sufficient strength for use in a large furnace. If it were a coking coal, this effect would be partly offset by the tendency of the coal to coke in its passage down the furnace, but the use of coking coal for this purpose would obviously be absurd as the correct place for coking such coal would be in a coke oven plant.

Summarising, it can be stated that neither charcoal nor coal would be sufficiently strong to enable smelting of Indian ores to

be carried out in large furnaces, *i.e.*, smelting could not be carried out economically.

Electric smelting is carried out in one or two instances when power is very cheap. We are not in a position to comment on this.

Question 7.—We have carried out one or two laboratory tests on semi-coking coals in the district mainly from the Victoria colliery. The cokes obtained from small samples were fair, but not comparable with those obtained from Jharia coals. In any case, the tests were too small to be conclusive. We consider, however, that there is a lot of room for experiment in this direction. A small experimental oven should be built for regular controlled tests to be carried out.

Oral Evidence of Messrs. W. T. V. Harmer, H. V. Peeling and R. D. Duttson, of Messrs. The Indian Iron & Steel Co. and The Bengal Iron Co.

Question 1.—The total reserves given are all coking coal and do not allow for any loss in working. Roughly, about 40 million tons will be recoverable with present methods of working provided no dangers arise from adjacent properties. In the Jitpur Colliery in Jharia where we are depillaring we are extracting 90 per cent., whereas in Ramnagore, which is in the Burrakur series of the Raniganj field, because of the thickness of the seam, only 30 per cent. of the coal is being extracted. With sand-stowing the per centage extraction would be increased. Our consumption of coking coal is about 2,000 tons a day at Hirapur and 1,000 tons at Kulti. We have calculated the reserves to a depth of about 1,800 feet. Our reserves are definitely limited. Nos. 17 and 18 seams in Jitpur are comparatively thin being 9 feet and 12 feet respectively.

Question 4.—We have used varying percentages of Chanch coal mixed with Jharia's without any detrimental effect. No Dishergarh coal has been used for mixing. Apart from Jharias, we have been using Chanch coal, Ramnagore and Victoria coals only. We buy hard coke from Jharia and Giridih. At present we are buying 5,500 tons from Giridih and 5,000 tons from Loyabad. The remainder of the coke comes from our own coking plant. The pig iron market has improved during the last year. Our annual output is about 500,000 tons at Hirapur and 160,000 tons at Kulti. When No. 4 furnace at Kulti is remodelled, it will give an additional 100,000 tons a year probably.

Question 5.—Heretofore, out of the 380,000 tons produced from our collieries, about 120,000 tons has been sold all from Jharia. The policy of the amalgamated companies is to conserve their coking coal. That is, no coking coal will be sold after this year. The reason for selling in the open market at all is that the existing crushing capacity at Kulti is insufficient to deal with the full tonnage of steam coal so that the surplus steam coal is sold and replaced by bought slack. Indian iron ore cannot be smelted

without coke because it is too rich and too heavy. Bokaro and Kargali slack is coking, but the ash content is too high. Bokaro slack bought by us was high in ash, but otherwise of coking quality Kargali coal also has a high ash content; the coke swells slightly but is otherwise good, and would probably give fair coke with suitable blending. We have tried all seams in Jharia from X to XVII. Coke made from purely X seam is not really strong enough. Our furnaces are not designed to use coal.

We think that large furnaces are definitely more economical than small ones. With the present raw materials used, the optimum size of blast furnace may be taken as about 900-1000 tons daily capacity. Bigger furnaces are not sufficiently flexible in times of depression.

General.—The amalgamation of the Iron and Steel Companies will not stabilise the demand for coal because, though the market for iron and steel has improved, outputs must vary with the world demand. Greater steel production will mean greater consumption of pig iron in India instead of being exported, and this in times of depression may help to stabilise the demand for coal.

We do not view a universal cess with disfavour so long as it does not unduly affect our costs. A cess of 4 annas a ton on coal will make a difference of 8 annas a ton in the price of pig iron, and about 11 annas in the price of a ton of steel. Domestic pig iron prices now vary between Rs. 40 to 60 a ton according to grade but the export market on which we so largely depend is under Rs. 30 per ton. Slack was being sold at Rs. 1-4 a ton two years ago; it is now fetching over Rs. 3 a ton. We can just pay this with pig iron at present prices.

We are in favour of the conservation of coking coal if the Geological Survey Department's estimates of reserves are correct. Coking coal should be reserved for metallurgical purposes because the iron and steel industry is a key industry and must be safeguarded. An all-round cess or direct compensation from Government will probably be required. For our part, we are already limiting the working of our collieries to raisings sufficient to pay maintenance charges and are buying the rest from the open market. We would be prepared to close down our collieries and buy in the open market provided prices asked did not exceed our own raising costs.

The resources of non-coking coal are not so low and the need for conserving non-coking coal is therefore not so great.

Conservation of coking coal would ultimately benefit the iron and steel industry, but to a large extent the immediate market conditions must control our policy. If conservation means higher coal prices, we cannot pay those prices unless we can pass the extra amount on to the buyers of our products. If we could not do this, we would have to cut down production and the coal trade would suffer. In practice, matters would adjust themselves.

QUESTIONNAIRE.

(To Representatives of Railways.)

1. Can you give an estimate of the amount of coal locked up beneath your railway and its sidings in the Raniganj and Jharia coalfields?

2. How much of this coal is of selected and first grades, and how much is of second and inferior grades?

3. Can you give an estimate of the quantity of sand that, with your present rolling stock, could be dealt with by your railway in the Raniganj and Jharia coalfields?

4. What rates of freight would be charged on sand for distances up to, say, 10 miles?

5. If the quantity of sand required to be transported by railways from the rivers to the collieries was, say, 1,000,000 tons per month in the Jharia coalfields, and 750,000 tons per month in Raniganj coalfield, can you give an approximate estimate of the expenditure that would be involved on permanent way, rolling stock, etc.?

6. Would you approve of the coal under railway lines and sidings being extracted completely with a system of filling the spaces from which that coal is extracted?

7. If so, since such a system would solve the present problem of the payment of compensation under the Land Acquisition (Mines) Act, what concession in freight per ton of coal could your railway afford to grant to those mine-owners who adopted such a system, or alternatively what contribution to a cess on output for the purpose of financing the compulsory scheme of sand-stowing would your railway be prepared to make?

8. To what extent is your railway now using inferior coal for locomotives? Has such use proved efficient and economical? Could the use of this kind of coal for this purpose be extended with advantage?

9. Is it correct that, at the present moment, practically no compensation is being paid under the Land Acquisition (Mines) Act for coal left unworked under railway lines and sidings? Apart from the assisted sidings agreements entered into before a siding is laid down, and providing that no compensation will be payable by the railway for coal which may have to be left under that siding or under any other parts of the railway line, are agreements also taken at a later stage, after notice has been given by the mine-owner under the Act and a joint enquiry has been made by the Mines Department and the railway, laying down the extent and method of extraction, and providing that no compensation will be payable for the coal left unworked?

10. Will you kindly state how many agreements your railway has with mine-owners—

(*a*) executed before a siding has been put down, and

(*b*) executed after notice has been given by the mine-owner under the Land Acquisition (Mines) Act?

11. If a cess is imposed on all coal and coke despatched by railway in or into British India in order to provide funds for compulsory sand-stowing, would your railway be prepared to collect that cess along with railway freights? Would it make any practical difference if the cess were not at an all-round rate, but at two rates on superior (selected and first grade) and inferior coal respectively?

12. If the main supply of sand is transported to the Collieries by aerial ropeways, could your railway arrange for the transport of sand from ropeway stations in the Jharia and Raniganj coalfields to outlying collieries in these coalfields? It is suggested that such a supply could be carried out by regular rakes of suitable wagons—similar to a ballast train—the whole rake being delivered at one colliery at one time and the same rake being used for different collieries on different days. An estimate of the cost per ton mile of transporting the sand in this manner may be given.

13. The general adoption of sand-stowing may result in some depletion of the sand in the rivers. Will this affect prejudicially the railway bridges over these rivers? If so, can you suggest any means of counteracting this prejudicial effect?

66. Written Evidence sent in by Mr. J. A. Bell, Agent, East Indian Railway.

Question 1.—81,247,816 tons, including 15,130,732 tons which can be taken out without damage to the track based on restrictions imposed by Government declarations or counter notices served under Assisted Siding Agreements.

Question 2.—The Chief Mining Engineer to the Railway Board should answer this question.

Question 3.—It is not possible to answer this question unless it is known what quantity of sand is required to be moved, between which points, and at what rate daily during each month. See answer to *Question 5* also.

Question 4.—The general basis of charge for sand in local booking is the Conference Rules scale less six pies. The rate for all distances up to 10 miles (minimum distance for charge) is 6 pies per maund, or As. 13-7 per ton at owner's risk, subject to charge on the marked carrying capacity of the wagons used; owners to load and unload.

Question 5.—1,750,000 tons of sand roughly represents 80,000 wagon loads and to carry this volume monthly from the nearest sources of supply approximately 8,000 wagons would be required, to be loaded at a daily rate of 2,670 wagons, a figure which exceeds the average daily peak coal loading on this railway. I am of the opinion that it is utterly impossible of execution on the part of sand suppliers. From the answer to *Question 6* it will be observed that coal extractions and sand-stowing can only be performed at a very gradual speed and, therefore, it is improbable that anything like 1,750,000 tons of sand will be required to be moved monthly. Unless complete data as indicated in the answer to *Question 3* is furnished, it is not possible to give any further information on the subject.

Question 6.—There would be no objection to the extraction of coal under the railway lines provided the area from which the coal is extracted and the areas on either side are completely sand-stowed. There will, however, be trouble in arranging how this shall be done in order to keep stability for the railway during the time extraction of coal and sand-stowing are going on. It will certainly mean that only a very small amount of coal can be extracted from under the line at a time and the area will have to be completely sand-stowed and allowed to consolidate before any further extraction can be allowed. The extraction and sand-stowing under the line will have to be done under this Railway's supervision and to its satisfaction which will mean a much larger staff for the inspection of the work.

Question 7.—The question is framed on the assumption that the railway is liable to compensate a colliery owner for coal locked

up under railway lines and the suggestions are made as affording means for discharging this obligation. The Administration does not admit this liability and consequently it can assume no financial obligations with regard to sand-stowing operations or otherwise.

On the assumption, however, that this is a possibility to be examined I have to say that I would not be in favour of any arrangement that would link such compensation or remuneration with the freight rates on coal. There are objections on legal, practical and other grounds. Freights vary with distance whereas the reduction would necessarily have to be at a fixed rate on a given quantity of despatches based to the total amount of money involved. It would be a cumbersome and complicated way of attaining the objective which is presumably to encourage owners to incur the expense of sand-stowing without interfering with railway communications and at the same time remove any coal that might form the subject of dispute. The compensation in such cases would have to be determined with regard to the cost of sand-stowing operations involved but it does not necessarily follow that this cost would entail a lesser financial burden on the Railway than paying for coal locked up, or the alternative of the Railway abandoning a siding altogether. Another objection to linking freight charges with compensation is the possibility of the resultant different freights on coal from the same local areas being held to constitute undue preference, as it is doubtful if the Railway Act would recognise differences in such cases as being justified within the meaning and scope of Sections 42 and 43 of the Railway Act. Further, freights could not in any case, be reduced below the minimum permissible level without special sanction from the Railway Board and the margin between the chargeable scale and minimum permissible rates varies considerably at different leads. From a practical standpoint there appear to be less objections to the second proposal of a contribution to a cess on output but the financial implications of the suggestion would require to be very carefully examined before any view could be expressed on this point. It may be added that the Railway cannot "afford" to incur large financial burdens of the nature stated. Coal freights are already low, and in the event of such burdens being forced on the Railway, it is probable that the raising of coal freights would have to be considered, particularly in view of the fact that as a result of developments in the field of road transport and other factors the ability of merchandise traffic to bear the burdens of the coal traffic to the same extent as formerly is being steadily restricted. In the circumstances stated above no concession in freight per ton of coal can be granted by this railway. The operating ratio is 62 per cent. at the present time and no less than 66·4 per cent. of the total goods ton miles operated is carried at less than the theoretical average working cost per ton mile. In regard to the latter part of the question, it follows that if freight cannot be lowered, this

Railway could not afford to pay any contribution to a cess on output.

Question 8.—(*a*) It is not quite understood what is meant by the term " inferior coal ".

(*b*) Only coal which is suitable and which will effect the greatest economy in working is used on this Railway. This consists entirely of 1st class or selected grade and 2nd class or grade I coal.

The extent to which 1st class selected grade coal has been replaced by 2nd class grade I coal during the past 4 years is shown below:—

Year.	1st class—Selected.	2nd class—Grade I.
	Tons.	Tons.
1933-34	510,000	691,000
1934-35	476,500	746,000
1935-36	309,700	940,000
1936-37	114,000	1,152,000

(*c*) Not at present.

Question 9.—Part I—Yes.

Part II—Assisted Siding Agreements or Loading terms are signed before a siding is laid down. No further agreements are taken if the colliery owners have given notice under the Land Acquisition (Mines) Act of 1885 of their intention to work under the land acquired for the siding or the branch or branch lines with which it is connected.

Question 10.—Assisted Siding Agreements are executed in the following cases:—

(*a*) By the new owner when a property (including the siding) changes hands.

(*b*) When a new siding is constructed.

In the case of the latter the policy is to have the agreement executed before the siding is opened for traffic.

There are 400 Assisted Siding Agreements executed by mine owners of which 5 have been executed after notice has been given by the mine owner under the Land Acquisition (Mines) Act.

Question 11.—If a cess was introduced, arrangements for its collection along with railway freights could be arranged in the same way as the cess on soft coke is now collected, provided the railway is suitably remunerated for the work of collection. This is a point of detail which it is not necessary to go into at the present stage. In regard to the suggestion of different rates of cess on superior and inferior coal, there would be no objection provided no responsibility for determining the quality of coal and the correct rate of cess devolved on the railway staff. Either, therefore, cess in such cases would be levied on the declaration

of quality as made by a despatching colliery (legislation making such correct declaration compulsory and would presumably be necessary), or a system of certification of despatches would have to be evolved by the cess authorities. If the railway interests could be safeguarded in these directions, there is no objection to the proposal. This view must be regarded as provisional because much will depend on the rate of proposed cess. If it is high it might be desirable in order not to increase the risks of non-delivery at destination to the prejudice of railway freight earnings to insist on the condition that the cess must be prepaid by despatchers.

Question 12.—See answer to *Question 3.*

Question 13.—If there is depletion of sand in the rivers in the vicinity of railway bridges, railway bridges are likely to be endangered. The only means that can be thought of counteracting this prejudicial effect is to extract sand supplies from places away from railway bridges.

Oral Evidence.

Question 1.—The counter notices referred to are those that are issued after the Government declarations under Section 5 of the Land Acquisition (Mines) Act of 1885, reminding the mine owner (the person immediately entitled to work or get any mine or minerals lying under any line) of his responsibility for providing support under the Assisted Siding Agreements and of the fact that he has waived all claims to compensation.

The 81,247,816 tons referred to is only the amount of coal in respect of which notice of working has been given and declarations have been issued. It does not include all coal under our railway lines.

Questions 6 & 7.—The real question at issue as regards this question of compensation for coal left to support railway lines of various kinds is whether the legal liability to compensation under the Act of 1885 has been obviated by the Assisted Siding Agreements under which the mine owners have waived any legal right to compensation which might exist.

So far as I am aware, there has been no authoritative judicial decision as to the legal effect of the Assisted Siding Agreements on the general legal position under the Land Acquisition (Mines) Act of 1885.

I agree that, if all coal under the railway lines could be stowed so as to provide proper support, this would be of advantage to the railways, the mine owners and the whole nation generally as it would enable more coal to be recovered than would otherwise be recovered. The railways would not, however, be able to contribute anything towards the expenses of this sand-stowing because the average haulage rate charged to the public and foreign railways for coal is now approximately 2·88 pies per ton mile, while the basic cost of hauling all traffic including coal is approximately

3·77 pies per ton mile. It has also to be remembered that about 66 per cent. of the total traffic consists of coal for private individuals and foreign railways. It follows, therefore, that as coal is already being carried at a rate which is less than the cost of carrying all goods including coal, it would be impossible for the railway to contribute anything towards the cost of sand-stowing without recovering that contribution in the form of increased freight. I should add in this connection that, while coal constitutes 66 per cent. of our traffic, the percentage of our traffic which consists of low rated commodities is approximately 82 per cent. It follows therefore that there is only 18 per cent. of our traffic which can bear higher haulage rates, and it is in respect of this particular traffic that we are suffering most from road competition.

I may add that, even if the Assisted Siding Agreements were found to be legally invalid and unenforceable, I think I could obviate claims for compensation in respect of future sidings and the majority, if not all of such sidings with respect to which no declarations have been made up to the present under the 1885 Act.

So far as my railway is concerned, the question of having to pay compensation was really not contemplated until the first claim was made about 10 years ago. Since then, the necessity to consider this question carefully on the merits of each case has been forced on the railway in its own interests and in the interests of the mine owners concerned. What is done now is that every case comes up to me for my personal orders and I consider carefully, after taking the advice of technical experts, what is the minimum amount of support that may safely be demanded taking into consideration the nature of the seam, the amount of the intervening strata and surface features. It might be possible in particular cases to allow the total extraction of coal where seams being worked are at a depth of more than 500 feet. In all cases we naturally consider the possibility of a diversion or alternative alignment. We do also now try and put down new sidings with reference to the geological features and statutory barriers so as to avoid as far as possible the question of compensation arising at all.

In the past, the acquisitions of surface lands for purposes of sidings used to be made entirely with reference to the amount of land required for constructing the sidings, for example, high embankment. Now-a-days we do also take into consideration the mining requirements and do not acquire more land than is necessary to provide support, or when considerable widths of land have to be acquired for purposes of borrow pits, restrictions are only applied to the extent necessary to ensure support.

Question 8.—Our new locomotives are designed to burn a comparatively inferior coal (low Grade coal below Grade I), and there are certain kinds of running in which a comparatively inferior coal (low grade coal below Grade I) is more efficient than a high grade coal. We are now able to use everything that comes out of the Giridih colliery and we hope soon to be able to use everything that comes out from Bokaro. We are now actually wasting only the dust from Bokaro and we are hoping that we should be able

to make use of this in briquetting. I have suggested to the Government that a special man should be sent to study the subject.

Question 9.—It is also correct that no declarations have been issued by local Government for about three or four years.

Question 11.—I would be prepared to recommend that a general cess on coke and coal to finance sand-stowing operations should be collected by the railway without any remuneration on the understanding that this was regarded as the railway contribution towards the cost of sand-stowing generally.

Question 13.—The question of the effect of the extraction of large quantities of sand near railway bridges would not arise when the foundations of these bridges are on rock. In other cases it will be advisable to consider each bridge individually and to decide the distances beyond which sand could be excavated in large quantities with safety.

General.—My attitude towards rates of railway freight is that the railways should not be used to subsidise any particular industry.

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67. Written Evidence sent in by the Agent, Bengal-Nagpur Railway.

Question 1.—Amount of coal already locked up or likely to be locked up in pillars under the Bengal-Nagpur Railway lines and sidings—

(*a*) In the Raniganj coalfields 5,276,733 tons.

(*b*) In the Jharia coalfields, 50,618,341 tons.

The figures are:—

	Tons.	Per cent.
(*a*) In the Raniganj coalfields—		
Selected and Grade I Coals .	5,191,053	98·38
Grade II and III Coals . .	85,680	1·62
Total .	5,276,733	100·00
(*b*) In the Jharia coalfields—		
Selected and Grade I Coals .	49,126,073	97·06
Grade II and III Coals . .	1,492,268	2·94
Total .	50,618,341	100·00

Question 3.—No. Without some idea of the respective sources and destinations of the sand required, it is impossible to estimate the quantity that can be railed with the varying numbers of the rolling stock available in the coalfields from day to day.

Question 4.—As 10 miles is the minimum chargeable distance the rate for sand for all distances up to 10 miles would be 5 pies

per maund chargeable on the carrying capacity of the wagon used, at owner's risk loading and unloading to be done by sender and consignee.

This charge would be at 'R' Schedule rate approved by the Indian Railway Conference Association as applicable to sand.

A minimum charge of Rs. 20 per four-wheeler wagon is applicable in the case of sand charged at the 'R' Schedule rate.

Questions 5 & 6.—For the information of your Committee I reproduce below in full the remarks given by the Mining Engineer, Bengal-Nagpur Railway, Bhaga:—

"This question is a difficult one to answer because it does not state—

(*a*) which railways have to transport the sand,

(*b*) which rivers have to supply the sand,

(*c*) which points or areas in these rivers have to supply the sand,

(*d*) how much sand is available in the rivers at these points or areas,

(*e*) during how many months of the year the sand has to be taken from the rivers.

In order to arrive at some estimate of costs for new railway lines and sidings I assume that 1,000,000 tons of sand have to be transported every month by the Bengal-Nagpur Railway in the Jharia coalfield.

There is only one great source of sand supply in Jharia coalfield and that is the Damodar river. Other sources are so small that they can be ignored in any big scheme for sand supply.

The sand loading depots or sidings will have to be close by the bank of the Damodar river, but at what points or areas?

It has been suggested that we construct a series of sidings on the bank of the Damodar river opposite to various areas in the river bed that are capable of yielding the requisite quantity of sand.

Where these areas are I do not know, but assuming that they do exist I estimate that about 32 miles of sidings and shunting necks will be required. There must be provided approach lines or lines connecting the sand-loading sidings with the existing Bengal-Nagpur Railway lines. With these added on we might require about 50 miles of new track to be laid.

As very few of the working collieries in Jharia can deal with an inward sand traffic which will in many cases be double the outward traffic in coal, most of the colliery sidings will require alterations and additions. I estimate that 5 miles of new track will be required for the alterations and additions on the Bengal-Nagpur Railway system alone.

The gross total of new track on the Bengal-Nagpur Railway system in Jharia coalfield will therefore be about 55 miles.

Without accurate surveys one cannot very well estimate the cost of this new track, but assuming an average cost of Rs. 75,000 per mile the gross total cost will be 41½ lakhs of rupees.

In place of the foregoing it has been suggested that sand loading be concentrated at two areas at the Damodar river, namely at Bhowrah and at Bhojudih. Whether sufficient sand exists at these places to supply 1,000,000 tons per month remains to be seen, but let us assume that sufficient sand is available and see what we get for an estimate of costs for providing new sidings lines, etc.

Assume each of these places has to supply 500,000 tons of sand per month.

That means 25,000 wagons of sand per month and 1,000 wagons per day in a working month of 25 days. At each place the sand would have to be taken from the river and placed in bunkers from which the wagons could be loaded.

With a working day of 20 hours, 50 wagons of sand will be loaded per hour and with a loco hauling 50 wagons it will be one 'rake' of 50 wagons per hour.

The shortest siding I can think of for this will be one with a total length of 1·6 miles. For the two sidings the total length of track required will be 3·2 miles and when we add on approach lines, the length will be increased to say about 6 miles. With alterations and additions the gross total length of new track to be provided by the Bengal-Nagpur Railway will be 11 miles which at an average cost of Rs. 75,000 per mile works out to a total cost of 8¼ lakhs of rupees.

I make no attempt at estimating the cost of the hoppers and the appliances for getting the sand from the river.

I presume people other than the Bengal-Nagpur Railway will provide these?

Also I make no attempt at estimating the cost of rolling stock, etc.

One thing we must keep in mind is the additional marshalling yards required for dealing with this greatly increased traffic.

We now come to the Raniganj coalfield. I cannot see where the Bengal-Nagpur Railway Company will ever be called upon to transport 750,000 tons of sand per month to collieries situate on the Bengal-Nagpur Railway system in the Raniganj coalfield. All the sand required in these collieries can be conveniently and cheaply transported from the Damodar river either by means of aerial ropeways or by tub haulage arrangements, and even then nothing like 750,000 tons per month will be required.

Perhaps this quantity of 750,000 tons per month is required for *all* the collieries in the Raniganj coalfield? If so, these are available in the Adjai, Barakar and Damodar rivers.

The Bengal-Nagpur Railway is concerned with only the Damudar river.

If the whole of the 750,000 tons of sand has to be got from the Damodar river and loaded on sidings to be provided by the Bengal-Nagpur Railway, I estimated the total length of new track required will be 7 miles at an average cost of Rs. 75,000 per mile. That is the total cost of the new track will be 5¼ lakhs of rupees.

This assumes that there will be two concentrated sand loading depôts at the Damodar river, and that neither alterations nor additions will be required at any of the colliery sidings on the Bengal-Nagpur Railway system in the Raniganj coalfield.

Summarizing we have—

(*a*) Cost of new track required on the Bengal-Nagpur Railway in Jharia coalfield—8¼ lakhs of rupees to 41¼ lakhs of rupees, depending on schemes adopted.

(*b*) Cost of new track required on the Bengal-Nagpur Railway in the Raniganj coalfield—5¼ lakhs of rupees.

Regarding my remarks about alterations and additions to the existing colliery sidings I have further to remark that at present where a loco takes 50 empty wagons to a colliery and draws out 50 loaded coal wagons during the same day, in future with the introduction of sandstowing the loco will have to take in 100 loaded sand wagons and draw out 50 loaded coal wagons along with 50 empty wagons. It might not be able to do that in one day unless greatly extended siding facilities be provided at the colliery.

I would approve of the coal under railway lines and sidings being extracted completely with a system of filling the spaces from which that coal is extracted but the system of filling should have to be an approved system and the colliery company should be made responsible for all delays, damages, accidents and costs caused by the colliery company in the process of filling.

Knowing the way in which some colliery companies perform the ordinary work in, on, or about their collieries, I am not hopeful of them doing the work of filling in proper and safe manner. I am not greatly concerned about bad work and damages caused in other parts of the collieries, but I am concerned about bad work and damages caused used, on and about the Bengal-Nagpur Railway lines and sidings."

Question 7.—The question is a very wide one and it is not possible to send a reply to it without much investigation. Up till now the Bengal-Nagpur Railway has not paid any compensation to any Colliery Company for coal locked up for underground support for the railway lines and sidings. In this respect they are sufficiently protected under the Memorandum of Terms for the construction, working and maintenance of assisted sidings. To enable the Bengal-Nagpur Railway administration to assess the rate of concession in freight per ton of coal to avoid payment of compensation under the Land Acquisition (Mines) Act, we must

know definitely what our liability would amount to under the Land Acquisition (Mines) Act. In the absence of this information it is not possible for the Bengal-Nagpur Railway to give your Committee any approximate idea as to what concession in freight rates they are prepared to offer to the coal trade. For similar reasons, without knowing the amount of freight to be earned and the quantity of coal to be moved by this Railway, I am unable to say at the present moment as to what proportionate contribution the Bengal-Nagpur Raiway will be prepared to give to the cess proposed to be levied on the coal output for the purpose of financing the compulsory scheme of sand-stowing.

Question 8.—According to the grading of coal, as given in the report of the Indian Coal Grading Board, 1936, the Bengal-Nagpur Railway, does not use inferior coal on its locomotives. Use of inferior coal on Railway locomotives is not recommended.

Question 9.—The Bengal-Nagpur Railway Administration has not, up to the present moment, paid any compensation under the Land Acquisition (Mines) Act for coal left unworked under railway lines and sidings.

Agreements have been taken from colliery companies who have originally signed Memorandum of Terms for the construction, working and maintenance of assisted sidings, after notice has been given by the mine owner under the Act and a joint enquiry has been made by the Mines Department and the railway laying down the extent and method of extraction, and providing that no compensation will be payable for the coal left unworked.

These agreements are treated as supplementary to the principal agreements, *viz.*, Memo. of Terms for the construction, working and maintenance of Assisted Sidings. These supplementary agreements limit the previously undefined liability of the colliery companies under the Memorandum of Terms. These agreements do not in any way cancel or supersede the original agreements, *viz.*, Memorandum of Terms.

Question 10—

(a) Memorandum of Terms executed before a siding has been constructed	164
(b) Supplementary Agreements executed after notice has been given by the colliery company under the Land Acquisition (Mines) Act—	
(i) Waiving compensation	13
(ii) Exchange of support or for extra support .	16
Total .	193

The above figures are approximate, and are under check.

Question 11.—At present cess is levied only on soft coke at the rate of 2 annas per ton. This charge is not included in the invoice but the collection thereof is made by us along with the freight either under a separate Money Receipt or through Freight Bill, as the case may be. A commission of 5 per cent. on the total collection

is retained by us and this covers our present cost for the additional work involved.

If the cess is to be introduced on all coal and coke, the same system as is followed at present in the case of soft coke will continue. The question of commission will be considered after the rate of cess has been decided.

The Bengal-Nagpur Railway, however, cannot undertake to collect the cess at two different rates on two different grades of coal, as our staff would not be in a position to distinguish the grades of coal unless some form of certificate by a Grading Board or some other body was furnished for each wagon of coal to be booked.

Question 12.—Please see my remarks against *Question 4.*

A minimum charge of Rs. 20 per four-wheeler wagon is applicable in the case of sand charged at the "R" Schedule rate.

The capacity of an "A" type covered goods wagon is 1,371 cubic feet or 19 tons.

Thus the minimum freight for each ton of sand comes to over Re. 1. Besides the above charge the colliery owner has to bear the cost of loading and unloading. He has also to pay the value of the sand.

The average profit for each ton of coal after meeting all expenses (*viz.*, royalty, cost of extraction, etc., etc.) amounts to annas six only. Thus from a commercial point of view the proposal of obtaining sand for the purpose of filling the spaces from which coal is extracted, is not a paying proposition.

Question 13.—All the Bengal-Nagpur Railway bridges are founded on rock, so the removal of sand will not affect the foundations.

Oral Evidence of Mr. J. Wilson.

General.—I am the Mining Engineer of the Bengal-Nagpur Railway. I am unable to deal with any questions which are concerned with traffic considerations. I expected that the railway representatives would have been here already, but they have probably not been able to attend because of the strike.

Question 1.—The figures given in this question cover all coal under any part of the Bengal-Nagpur Railway line which has been locked up or is likely to be locked up, up to a depth of 1,000 feet.

Out of the total of about 56 million tons of coal in both coalfields locked up under the railways, about 39 millions is under main and branch lines, and the remainder in sidings of various kinds.

Question 6.—I would agree to a system of stowing under railway lines and sidings approved by the statutory authority for the administration of the cess after consultation with the mining engineers of the railway concerned.

Question 8.—The coal which my Railway actually uses is from Jharia selected, Bokaro quarries, Sawang, Aroada, Pench Valley and Rewa State and Hingir-Rampur (coal for shunting purposes).

Question 9.—The words " previously undefined liability of the Colliery Companies under the Memorandum of Terms " means that in the memorandum referred to the amount of support which the colliery company has to arrange for is not stated, whereas this is defined in the supplementary agreements when the work is actually going to be done.

I can give the following instances where the Bengal-Nagpur Railway has allowed the complete extraction of coal under its lines and sidings. These instances all relate to the Dishergarh seam in the Raniganj field, and are not exhaustive over all the coalfields. At the Aldih colliery in three places a 15-foot thick seam was allowed to be extracted at a depth of 565-590 feet. At Poidih, a 15-foot seam was similarly extracted at the depth of 870-900 feet. At Sodepur, a 15-foot seam was extracted at the Aldih branch at a depth of 1,030-1,050 feet. At the Chaurasi colliery a seam 9-foot thick has been allowed to be extracted completely in three places; one at a depth of 465-777 feet, the other at 450-535 feet, and the third at 251-350 feet. The last two were under the Chaurasi branch line. We have not had to suspend traffic at all, but have been able to pack under the line as subsidence took place.

General.—The cost of protective works against fire on the main line Pathardih—Bhojudih was roughly 94,000 rupees.

QUESTIONNAIRE.

(To Representatives of Aerial Ropeway firms.)

1. What firm of aerial ropeway manufacturers do you represent?

2. What type and capacity of ropeway equipment does your firm manufacture?

3. How many separate ropeways would be necessary to deal with a maximum of, say, 1,000,000 tons of sand per month to be conveyed to collieries in the Jharia coalfield, and 750,000 tons of sand per month in the Raniganj coalfield? The average distance over which the sand would have to be carried may be taken to be 5 miles in both coalfields.

4. Can you give an approximate estimate of the expenditure on plant for ropeways to deal with the quantities of sand given in the preceding question?

5. Can you give an approximate estimate of the all-in working cost of conveying the sand per ton-mile?

6. Would it be practicable to design a ropeway or a series of ropeways to drop sand at several collieries *en route*?

7. Kindly give any additional information regarding the practicability and cost of conveying sand from the Damodar river in the Jharia coalfield, and from the Damodar, Barakar and Ádjai rivers in the Raniganj coalfield, over the distance given above.

8. Can you give any information regarding the cost of excavating sand from river beds and loading it by mechanical means?

68. Written Evidence of The British Ropeway Engineering Co., Ltd., Agents, Messrs. Gillanders, Arbuthnot & Co.

Question 1.—Messrs. The British Ropeway Engineering Co., Ltd., 14-18, High Holborn, London, W.C. 1.

Question 2.—Monocables up to 150 tons per hour and bicables up to 350 tons per hour capacity on single lines.

In this question we have pointed out that we manufacture monocables up to 150 tons per hour and bicables up to 350 tons per hour on single lines. When we make this statement, we are dealing with hourly capacities which we have actually handled under test.

In view of the heavy duty which the scheme will entail, we feel quite certain that a ropeway on the monocable system with its limited hourly capacity will hardly be suitable in spite of the lower cost and for this reason, the price which we have given has been based only on bicable ropeways.

We do not recommend higher capacities than 300 tons per hour for the reason that the individual load for 300 tons per hour is about 2 tons nett, 2½ tons gross, which is a very heavy load to be controlled by an Indian when it arrives in the station. We have these loads actually working in this country and with satisfaction.

The size of the load is limited by the number of loads which must be handled per hour so that with 300 tons per hour, handled in loads of 2 tons each, this means 150 loads per hour with time intervals of 24 seconds. We are able to work to smaller time intervals as low as 20 seconds but we do not recommend it if it is possible to avoid same.

We will thus see that the individual capacity of any one ropeway has this limiting factor, *viz.*, the weight of the load and the time intervals between the loads.

Question 3.—Jharia would require 8 bicable ropeways, Raniganj, 6 bicable ropeways, capacity of each line would be 300 tons, hourly working 17 hours daily.

Bearing in mind the limit of duty which we have described in *Question 2* we think that the capacity should be limited to 300 tons per hour and that the ropeway should work 17 hours per day and on this basis 8 bicable ropeways would be required for the Jharia scheme and 6 bicable ropeways for the Raniganj scheme.

If it is possible to increase the number of hours working from 17 to 20, the capacity could be reduced accordingly but we do not recommend working 24 hours a day as all mechanical plant should have a period during which attention could be given to the mechanical parts.

If it is unsuitable to work the ropeway for 17 hours per day, then the number of ropeways required will have to be increased but the cost will rise accordingly.

Question 4.—The cost of material would be £580,000 *plus* freight duty, foundations and erection which we estimate would be a further £150,000.

You will quite realise that the cost of materials which we have given can at the present moment only be regarded as approximate but we assure you that it is a very near estimate.

The remarks apply to the freight, etc., and erection.

Question 5.—The cost would be about six pies including loading and unloading charges.

This has been very carefully worked out from information which we have available with regard to installations in this country.

Question 6.—Yes.

It is quite convenient to arrange the ropeway so that the discharge of the buckets could take place at any point *en route*. This does not affect the cost in any way.

Question 7.—We consider the conditions ideal.

With regard to this question, it is very difficult to give additional information until the full nature of the problem has been disclosed. If we could obtain a plan of the country with the disposition of the collieries and also of the river together with the capacities which it is intended to handle to each one, we would then be able to fix upon economical routes and economical hourly capacities to suit the exact requirements.

Question 8.—The approximate cost by special hydraulic method suitable for all seasons would be two annas per ton.

With regard to this point and the cost of surveying over river beds, we have to bear in mind the conditions of site during the wet and dry seasons. We have a very extensive knowledge of excavating and conveying sand and gravel in this country and we are very well acquainted with all the various methods adopted. We have installations handling up to 250 tons per hour where we combine the excavation and the transport and we consider that we can formulate a combined scheme for you which will keep the cost to the lowest possible figure.

Oral Evidence of Mr. W. F. Tuckett, of Messrs. Gillanders, Arbuthnot & Co.

Question 2.—I agree that the monocable system is cheaper than the bicable system. The cost of a monocable ropeway of 100 tons per hour capacity 5 miles long would be about £15,000 against a bicable ropeway 200 tons per hour 5 miles long £31,000. These prices are f.o.b. England. There is only one bicable ropeway in India at present which was built by the British Ropeway

Engineering Co., Ltd. A monocable contains fewer wearing parts and its load are also more easily handled, it can also be worked very nearly to the declared capacity. The buckets used on a bicable main line cannot be used on monocable subsidiary lines as they are not the same.

Question 3.—17 hours would be a suitable working day with two shifts.

Question 5.—The cost of six pies per ton mile includes loading and unloading, but as far as I am aware does not include depreciation and other overhead charges. I will find out and let the Committee know.

Question 8.—I have no experience of hydraulic excavation and will write to our principals* in London on the following points, and inform you as early as possible:—

(1) whether the cost given in the answer to *Question 5* includes the cost of depreciation, etc.,

(2) the details of the method involving cost of 2 annas a ton for excavating and loading,

(3) the description of the hydraulic method,

(4) the effect on depreciation of buckets and pumping plant.

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* *Extract from a letter from Messrs. The British Ropeway Engineering Co., Ltd.*

"We thank you for your letter of the 10th January. Before replying, we should like to draw your attention to a typographical error in our letter of the 18th December last. In *Question 8* we referred to the cost of 'surveying' over river beds. This should read 'the cost of excavating'.

"We note that the Committee prefer monocable ropeways. We feel that this is a wrong conclusion as the question of the type of ropeway, *i.e.*, monocable or bicable should be settled more by consideration of hourly capacities and technical questions. Monocable ropeways have definite tonnage limitations and whilst it is true that their initial cost is less, it is equally true that the upkeep charges are twice as much as for a corresponding bicable.

"Although it is easier to link up a few collieries only in the first instance, we think that a complete and comprehensive plan should be drawn up embodying the ultimate scheme and that the links to be built in the first place should be designed with a view to suitable conversion at a later date to fit in the complete whole. If this is not done, we are sure that it will ultimately be found that the earlier links are unsuitable for incorporation in the final scheme and so much money will have been unwisely spent.

"We think you should advise the Committee that generally speaking, the economical limit of capacity of a monocable ropeway is in the region of 120 tons per hour. Above this tonnage upkeep costs advance out of all proportion to the tonnage carried. Even up to 120 tons per hour you should emphasize that the upkeep costs are double as great as for corresponding bicable ropeways.

"Regarding *Question 5*, the figure of six pies per ton which we gave includes depreciation. We did not include overhead charges as we cannot assess these without knowing if any of the ordinary colliery staff and engineers would be available to give attention to the installation, neither

69. Written Evidence of Messrs. Bird & Co., Managing Agents of The Kumardhubi Engineering Works, Ltd.

Before we attempt to reply to the questions, we should like to make it quite clear that anything we may say in our replies must definitely be treated as giving information on the broadest lines and all figures given as only approximate, as indeed, it would be impossible to work out detailed schemes in the short time available.

We should also like to add that any comprehensive scheme of the transportation of sand by ropeway would entail an intensive study of the areas concerned and would, to be efficiently done, require the services of one of our expert ropeway engineers from England.

Bearing in mind the above remarks we have pleasure in attempting to reply to your Questionnaire as follows:—

Question 1.—We represent in India Messrs. Ropeways, Ltd., of 152/156, Great Portland Street, London, W. 1. We hope that it is really unnecessary for us to have to introduce our Principals to you as they are, without doubt, the Ropeway Company who have the greatest reputation, probably, in the world, and it was the Founder of Messrs. Ropeways, Ltd., who perfected the system of ropeways now known as the monocable system.

Question 2.—Messrs. Ropeways, Ltd., are the designers and suppliers of the two best known types of ropeway, namely, the monocable system and the bicable system, and their sister appliances, drag lines, cableways, transporters and conveyors.

It may be here convenient to state that ropeways can be economically employed to convey up to 400 tons per hour on a single ropeway although generally speaking their economic limit is about 250 tons per hour on a bicable ropeway, and 150 tons on a monocable railway.

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did we include interest on capital as we did not know how the scheme would be capitalised.

"To make the matter clear, we explain that the figure of six pies per ton includes the following:—

(1) Labour for loading and unloading the ropeways.

(2) Electric power for driving the ropeways.

(3) Depreciation.

(4) Maintenance, repairs and renewals.

"Regarding *Question 8* the information which the Committee requests will require some preparation and we hope to let you have this by an early mail. However, we hardly agree that depreciation with wet sand would be much more than with dry sand as the buckets could be suitably treated to prevent corrosion. We have not found in wet sand any drawback in this country. The size of the buckets would be arranged to suit either wet or dry conditions to obtain the desired capacity."

The monocable system is the simpler in design as the saddle clip has no moving parts and needs no adjustment and no lubrication and the rope being in constant movement works evenly throughout its length and surface.

For the purposes of replying to the Questionnaire we are assuming that the unit capacity of the main lines will be 150 tons an hour on the monocable system, but as the main lines may consist of a twin ropeway running on single compound trestles, the capacity of a main line is thereby increased to 300 tons per hour.

Question 3.—The Jharia coalfield: To deal with one million tons of sand per month is equivalent to 1,800 tons an hour, working 25 days a month and 22 hours a day and on this basis it would mean six main lines each consisting of a twin monocable ropeway capable of dealing with 300 tons an hour.

The distance that can be transported is immaterial from a physical point of view.

Question 4.—To give an approximate estimate of the expenditure of a plant for ropeways to deal with the quantities of sand mentioned in the preceding reply is a problem of considerable magnitude, and we have some hesitation in putting forward figures without a real study of the proposition on the ground.

We have, however, in the past got out schemes for the distribution of sand in the Jharia coalfield, but on not such a comprehensive scale as is now contemplated.

From the experience we have gained in working out these above schemes, we think that we can safely say that a capital cost of Rs. 1,20,000 per mile can be taken for 150 tons per hour monocable ropeway. On the assumption that each of these main lines is six miles long and assuming that each ropeway is a single ropeway and not a twin ropeway, we would then have 12 ropeways each six miles long and the total cost would be approximately Rs. 7,20,000 each or a total of Rs. 86,40,000.

To run the main lines as twin ropeways would, doubtless, reduce the capital cost, but we have purposely left them as single ropeways as it may be more convenient to have 12 separate loading places on the river than only six.

The cost of subsidiary ropeways, say, of from 40 to 50 tons per hour to transport the sand from the main lines to the various collieries may be taken at Rs. 75,000 per mile.

We do not think it would serve any useful purpose at the present time to say how many of these subsidiary ropeways would be required, but it is obvious say at 50 tons per hour to each subsidiary ropeway the maximum number of subsidiary ropeways would be 36, which on an average of $1\frac{1}{2}$ miles long would mean a further capital expenditure of Rs. 40,50,000.

We estimate the above expenditure to include all protection bridges, land acquisition, compensation for dismantled buildings,

haulages or other mechanical means for conveying the sand from the river bed to the ropeway terminal stocks and ready for loading into the ropeways.

We have pleasure in enclosing a blue print showing alternative schemes that were got out a few years ago, but of course, this is only submitted as an illustration and will not suit the comprehensive scheme under discussion.

Question 5.—The same remarks apply to this question as we have made in the reply to *Question 4*, namely, that it is with some anxiety that we give any figures as circumstances may arise in practice which cannot be foreseen and which might tend to vary the cost of transportation. However, to be as helpful as we can, we put forward the figure of 1 anna per ton-mile. This figure would include interest on capital, renewals and repairs, power and labour.

Question 6.—There is no difficulty, whatever, in designing the ropeways to drop sand at several collieries *en route*. It would necessitate tall trestles at each dropping place so as to provide space underneath for a large store of sand. Arrangements could be made to trip every third bucket or any bucket desired.

If the collieries should lie somewhat off the route of the main line, small capacity subsidiary ropeways could be designed to feed off the main ropeways and all operations would be practically automatic.

Question 7.—Although as we have said before it would take some appreciable time to work out a comprehensive scheme, yet we have no hesitation in saying that such a scheme is certainly practicable, provided, of course, there is sufficient sand available to transport and this problem is outside the scope of this Questionnaire.

We may say, however, that owing to the difficulties of sand extraction during the monsoon it would be necessary to create ample stocks at the ropeway terminii to ensure a uniform supply of sand to the ropeway, otherwise the efficiency of this scheme would be very considerably lessened.

You will notice that we have confined our remarks to the Jharia field, but the problem is exactly the same in the Raniganj field.)

Question 8.—From information we have available, we estimate that the cost of excavation of sand by a drag line would be approximately ·75 anna per ton, but we may mention that this figure is included in the all-in cost in the reply we gave to *Question 5*.

In conclusion we have much pleasure in attaching hereto one of Messrs. Ropeways, Ltd.'s catalogues,* which we hope the Committee will find of interest.

* Not printed.

We should also like to add that if more detailed figures are required they can only be obtained by the intensive study of the proposal on the ground by an expert ropeway engineer, and we think it only right to mention that should his services be required, a suitable fee should be arranged so that the schemes he produces will then become the property of Government and would be entirely at their disposal.

From our experience the above procedure is by far the most satisfactory to all concerned, as it would not only relieve all anxiety from Messrs. Ropeways in the event of a large amount of money being expended on surveys, etc., and the scheme eventually not maturing, but also would secure Government's position in obtaining the best possible advice on a problem which requires expert experience to produce an efficient scheme.

Oral Evidence of Mr. E. O. Pearce and Mr. F. W. A. Carpenter of Messrs. Bird & Co.

Question 2.—A monocable ropeway is generally cheaper than a bicable ropeway of the same capacity, but the maximum practicable capacity of a monocable ropeway is less than that of a bicable; that is to say the maximum capacity of a monocable ropeway is say 150 tons per hour while a bicable can transport up to 300 tons per hour. Two monocables of 150 tons per hour capacity will be more expensive than one bicable of 300 tons capacity. It would, however, probably be advantageous to use a larger number of monocable ropeways to meet the total capacity required than bicable ropeways, inasmuch as by so doing a larger number of loading places can be tapped.

Question 3.—In our written evidence we worked on the assumption that the ropeways would be working for 22 hours a day. This is possibly too long and a basis of 20 hours would be better. The life of the rope depends on the tonnage carried, but in several cases within our experience we have known the ropes to last as long as nine years or more. We see no reason why the ropes in question should not last at least three years. The cost we have given include renewals.

With a proper method being employed the time taken to change ropes need not be taken into consideration in estimates of working capacity. In our written evidence we have assumed that a drag line excavator will be used for the extraction of sand from the river at a cost of about £3,500 each delivered in India. The question of loading by manual labour was not taken into consideration but if loading by hand labour would solve the problem of unemployment among female labour it might be advantageous to adopt that process and probably the cost would be no more and possibly less.

Working ropeways at night under proper supervision it would be just as economical as working in the daytime.

Question 5.—The cost of 1 anna per ton-mile is the all-in cost and contemplates excavation by drag lines and not by hand. It would not be practicable to use drag lines for the excavation of sand during the flood period, and this would necessitate the accumulation of stocks of sand at the loading terminii to allow the ropeways to work at full capacity during the monsoon weeks.

The cost of 1 anna per ton-mile given in our written evidence includes the cost of excavation by drag lines which we estimate to be ·75 of an anna per ton; but it must be understood that this figure only applies should the ropeway be from 6 to 10 miles long; that is to say if the total cost of transportation is from 6 annas to 10 annas then the proportion represented by the excavation of sand is ·75 anna per ton.

General.—All our evidence is on very broad lines. We cannot give definite figures until the place has been surveyed and a scheme drawn up.

Messrs. Bird & Co. have acquired the sand rights in the Damodar river from the Jharia Raj. We have merely safeguarded our own future. If any scheme of sandstowing comes into force, we would have no objection to give sand that would be required by the controlling authority on reasonable terms. We have not got the rights to sand for building purposes. Now that we hold the sand rights in the Damodar, it will perhaps be easier for the controlling authority to deal with us rather than with the zemindars.

QUESTIONNAIRE.

(To Port Commissioners, Calcutta,

and

To The Chief Engineer, Irrigation Department,
Government of Bengal.)

1. In the event of several millions of tons of sand being removed annually from a river bed during the dry seasons how would bridges and the régime of the river be affected? Can you give any information about the sand replacement power of rivers such as the Damodar river?

2. Would the removal of large quantities of sand from the Damodar, Barakar and Adjai rivers materially reduce the quantity of sand normally deposited in the Hoogly river? If so, would this materially reduce expenditure on dredging? What other changes to the Hoogly river would be likely to take place if large quantities of sand were taken from the aforementioned rivers?

70. Written Evidence of the Commissioners for the Port of Calcutta.

Question 1.—The effect on the régime of a river of removing large quantities of sand depends upon local conditions. In the case of some rivers, if care be exercised as to the place from which sand is removed, there need be no injurious results. Any scheme for the removal of large quantities of sand should be first approved by the Irrigation Department of the Government of Bengal, and the work should be carried out under the supervision of that Department. The Commissioners have not sufficient information about the river Damodar to express any opinion regarding the extent to which the sand removed from any particular site would be replaced.

Question 2.—It is unlikely that the removal of large quantities of sand from the rivers named would reduce the quantity of sand deposited in the river Hooghly to a sufficient extent to affect the amount of dredging to be done. It is certain that any effect on the Commissioners' expenditure on dredging would be negligible as this expenditure is not affected to any appreciable extent by slight variations in the amount of work to be done. If the régime of a tributary is unaffected in the neighbourhood of its entrance to the Hooghly there is no risk of the removal of sand from the tributary adversely affecting the latter.

Oral Evidence of Commander C. V. L. Norcock and Mr. M. Douglas Kilford.

Question 1.—The conditions in that portion of the river Hooghly with which the Port Commissioners are concerned are entirely different from those obtaining in the rivers up in the coalfields. Our experience in the river Hooghly is that sand excavated by dredging is invariably replaced within a comparatively short period.

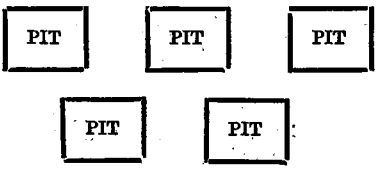
Question 2.—The amount of water that reaches the Hooghly from the Damodar comes mainly through the Rupnarain river. So far as we can see at present, the removal of large quantities of sand from the Damodar river higher up would not appreciably affect the replenishing supply of sand to the James and Mary sands in the river Hooghly.

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71. Written Evidence of Mr. P. C. Roy, Executive Engineer, Irrigation Department, Damodar Division, Bengal.

Question 1.—(*a*) Whether the régime of a river is likely to be affected or not due to removal of a large quantity of sand annually from its bed, depends upon the manner in which sand is removed. If continuous pits are made in the form of a regular channel

without intervening bars any subsequent flood may divert the deep water course of the river along it which may attack river banks at new places and cause serious alteration in the régime of the river. The bridges may also be affected by it. If, on the other hand, thick bars are left between sand pits as shewn in the sketch below, the latter will serve merely as efficient silt traps and will not affect the river except arresting silt in them during floods. Deep isolated sand pits will not affect a bridge unless they are too close to it.



(*b*) No accurate information regarding the sand replacement power of a river like Damodar is available. A very rough idea can, however, be given regarding the Damodar river. As estimated by Mr. D. B. Horn in the latter part of the last century, the proportion of solid matter in the Damodar flood water is 1 in 1,200. The water during an ascending flood is generally thicker with silt and sand. But at a falling flood, when more of seepage than surface washing is drained, the proportion of solid matter becomes less. On average the proportion 1 in 1,200 is probably correct. No experiment upon this point appears to have been recently made by this Department. In the absence of any other reliable finding, Mr. Horn's figure has been assumed by me in my calculation. The solid matter carried down by the floods comprises sand and silt. Heavy sand rolls down creeping the river bed during floods only. Fine sand and silt, generally remain in suspension with the flow of the river. Some gets deposited in the river bed during falling flood and the rest flows out right into the Bay of Bengal. No. information is available showing what percentage of the solid matter actually settles down in the bed of the Damodar or the Hooghly river and what flows out right into the Bay. But it will not probably be seriously out of proportion if about 25 per cent. of the silt and sand is assumed to repose on the river beds. Now, let me take the floods of 1936 into consideration. I chose this year because there was average rainfall in the catchment area which caused several moderate floods. The accompanying estimate shows that the Damodar river discharged about 142 million cubic feet (7·7 million tons) of sand and silt during 1936. It is probable that about 1½ to 2 million tons of the staff lodged on the river beds.

Question 2.—(*a*) The Damodar, Barakar and Adjai are not the only rivers which contribute silt and sand during floods into the Hooghly. Several other rivers, *viz.*, Bhagirathi, More, Dwarka, Bakreswar, Churni, Jalangi, Darkeswar, Selye, Cossye, etc., send down their shares of silt. The total silt and sand

annually contributed by all these tributaries may amount to as much as 320 million cubic feet or 15 million tons and about 3 to 4 million tons may find place on the river beds. No appreciable difference in the bed level of the Hooghly river is likely to be noticed unless at least half the latter quantity is annually removed from the beds of the feeding rivers at a cost of not less than Rs. 10,00,000 per annum. But such annual silt clearance does not appear to be practicably feasible in view of the fact that no room for spoil earth will be available on the banks after a few years' work.

A better policy will perhaps be to throw where possible, the adjoining low areas to the spill of the rivers and then tap from these areas comparatively desilted water into the Hooghly. The initial expenditure may be a bit excessive but the scheme will ultimately work cheaper when the low areas thus elevated by silt deposit will fetch better price.

If the bed of the river Hooghly can be lowered in the above way, cost of dredging will, of course, be proportionately less.

(*b*) No substantial change is likely to be effected in any other way.

DAMODAR RIVER.

Floods of 1936.

Date of floods recorded at Raniganj.	Gauge reading at H. F. L.	Calculated maximum discharge.*	Calculated average discharge (½ of maximum).	Duration days.	Volume of water in million cubic feet.
		Cusecs.	Cusecs.		
26th July 1936 .	13·2	200,000	100,000		
27th July 1936 .	14·6	240,000	120,000	3½	33,969
29th July 1936 .	14·4	234,000	117,000		
7th August 1936 .	15·2	259,000	129,000	2	22,378
10th August 1936 .	16·5	302,000	151,000	2	26,092
16th August 1936 .	14·6	240,000	120,000	1	10,368
12th September 1936	16·2	292,000	146,000	4	50,458
26th September 1936	16·9	318,000	149,000	1	13,737
6th October 1936 .	17·1	326,000	163,000	1	14,083
Total .	..	..	..	..	171,085

* In calculating these discharges, the table prepared by Mr. Addams-Williams in connection with the flood of 1913 [*vide* page 268 of "Selections from the Records of Bengal Government (Damodar floods, etc.)"] has been followed.

Proportion of solid matter in water $= \frac{1}{1,200}$ (as estimated by Mr. D. B. Horn).

$\therefore$ Quantity of solid matter $= \frac{171,085}{1,200} = 142{\cdot}5$, say 142 million cubic feet $= 7{\cdot}1$ millon tons.

Taking 20 public feet = 1 ton of solid matter.

Oral Evidence.

Question 1.—So far as I am aware, Mr. D. B. Horn's estimate of the proportion of solid matter in the Damodar flood water was based on that portion of the river which is between Burdwan and Raniganj. My Department still accepts Mr. Horn's figure for purposes of the calculations to which it applies.

My estimate of 25 per cent. of silt and sand assumed to repose on the river beds is based on readings taken at Raniganj. If large quantities of sand were excavated from the river bed during the hot weather and cold weather, I would expect my estimate of 25 per cent. or $1\frac{1}{2}$ to 2 million tons of sand to be considerably increased.

At Raniganj, we take anything beyond a gauge reading of 13 feet as being flood. There were only 9 days of flood at Raniganj during 1936. It is quite possible that there were more days of floods in the Jharia and Raniganj areas than the 9 days which were found at Raniganj. I would not expect an increase by more than about 10 per cent. in the amount of solid matter.

Assuming that, on the 10th August 1936, the Damodar river at Bhowra colliery in the Jharia field, where the river is 1,000 feet wide and of an average depth of 14 feet, was flowing at a speed of 8 miles per hour, the discharge of water would be 14,200 million cubic feet in 24 hours, and taking 1/1,200 as matter in suspension with the water, the amount of silt carried would be in the vicinity of ·6 million tons, taking 20 cubic feet=1 ton of sand.

Question 2.—It is quite correct that the greater part of the water from the Damodar river reaches the Hooghly through the Rupnarain. This is because the Damodar bifurcates about 55 miles from the river Hooghly and the main stream goes into the Rupnarain at a point about 37 miles from the Hooghly river.

ADDITIONAL SPECIAL QUESTIONNAIRE.

(Dr. C. S. Fox.)

1. In the event of several millions of tons of sand being removed annually from a river bed during the dry seasons how would bridges and the regime of the river be affected? Can you give any information about the sand replacement power of rivers such as the Damodar river?

2. Would the removal of large quantities of sand from the Damodar, Barakar and Adjai rivers materially reduce the quantity of sand normally deposited in the Hoogly river? If so, would this materially reduce expenditure on dredging? What other changes to the Hoogly river would be likely to take place if large quantities of sand were taken from the aforementioned rivers? What effect will the removal of sand as above is likely to have on the course of the abovementioned rivers and on flooding lower down?

3. Can you give estimates of the quantity and depth of sand available in the Damodar, Barakar and Adjai rivers in the vicinity of the Bokaro, Jharia and Raniganj coalfields?

4. Can you furnish estimates of the quantities of coking coal in the Giridih, Karanpura, Bokaro, Jharia, Raniganj and Central Provinces coalfields?

5. Have you or any of your colleagues conducted any experiments with mixtures of coking and non-coking coals for the production of coke for metallurgical purposes? If you have, from what seams was the respective coal obtained, what were the proportions of each, and what were the results?

Written Evidence of Dr. C. S. Fox, Superintending Geologist, Geological Survey of India.

Question 1.—The fundamental considerations in river action are questions of erosion or scour and deposition of silt. Both depend on the same laws which are based on the velocity of flow and depth of water. The velocity depends partly on the gradient of the river bed and volume of water (see "A Theory of Silt and Scour" by W. A. Griffith, *Min. Pro. Inst. Civil Eng.*, Vol. 223, 1923, page 243). The depth of water normally depends on volume of discharge which in turn is influenced by rainfall or thaw of glaciers or both. This flood flow may in some cases be due to the brusting of an ice-dam or landship. The tendency of a river is to work out a smooth channel, but in this the variable velocities due to monsoon—dry periods alternating with wet periods—have a great hindering influence. At low water all suspended matter may be deposited, while in flood time not only is suspended matter easily carried, but scouring takes place and the sandy bed and sides are stirred up and transported by the material being rolled along the bed. In the case of a river like the Damodar, which is still in a rock course throughout the coalfields and only emerges on to the alluvium after it leaves the Raniganj coalfield, scouring is in evidence *above* the Jharia field and deposition is prominent in the Raniganj field. In the Jharia field itself the conditions are almost neutral, *i.e.*, if the bed is left alone scour and deposition so balance that annually no additional amount of silt is added to the banks and bed. If the silt in the bed of the Damodar river in the Jharia coalfield is removed it will be replaced during the rains from that material which is being rolled along the river bed each rains—particularly in floods. These effects of give and take will balance until the river is unable to replace to the full all that is taken, and until this stage is reached the river will remain in a stable state. Presuming the piers of bridges have been carried down to rock in the river bed or to such a depth in the silt that the movement of silt in the river bed does not affect the foundations the safety of the bridge will not be affected. We do not know exactly to what depth the sand movement in the Damodar river bed extends in the Jharia coalfield. I estimated it at about 10 feet during heavy floods, but it may be much more and can hardly be less. Anyhow the bridge piers of the three bridges in this field appear unaffected (except perhaps that of the Dyer road bridge but the slight effects noticeable here may be due to other causes). It is unlikely that 10 feet of sand will be taken from the river bed as there is a very large quantity of sand above this level along the sides and on the banks. All the sand below the years' flood level will generally be filled up annually. If material above average flood level is taken then it can only be replaced when the river reaches the same level, *i.e.*, during high floods.

The question is to what extent can the Damodar river replace silt or sand taken from its bed and banks below flood levels. In

the 24 hours between 9 A.M. on the 8th August to 9 A.M. on the 9th August 1936, when as a result of heavy rain in the Ranchi and Hazaribagh districts the river began to rise high at the earlier date and then began to fall 24 hours later, I estimated that the discharge at Bhowra was at the rate of 756 million cubic feet per 24 hours at the former time and no less than a rate of 13,824 million cubic feet per 24 hours at the latter time (high flood). The average may thus be taken as nearer 8,000 million than 7,000 million cubic feet in the 24 hours under consideration. The water was the colour of pea soup and it was impossible to watch the eddies and churnings of its bed nor to see the movement of the sand, but changes in the bars and shoals were in progress. The suspended matter in the relatively slow moving water near the bank was at least one per cent. and this figure, which gives no idea of the rolling sand in the bed, represents a total of over 4 million tons of solid matter being hurried down in the 24 hours mentioned above. The silt which was being rolled along the river bed may not travel at the same velocity as the river water, but the volume of churned-up silt which was passing a given point in 24 hours can hardly be less than that of suspended matter (taken at one per cent.) in a flood flowing at an average velocity of roughly 6 miles per hour (nearly 9 feet per second)—a velocity which is easily capable of rolling forward pebbles up to six inches in diameter. The velocity of the river at the time it was at high flood was estimated at 8 miles an hour, *i.e.*, nearly 12 feet per second and capable of rolling boulders of 18 inches diameter (see Table of Scouring velocities below).

Material.	Velocity in feet per second.	
Soft loose clay	0·75	It may be stated that these are very conservative values.
Fine sand	0·90	
Coarse sand	1·20	
Coarse sand and gravel	1·50	
Pebbles 1-inch diameter	2·50	
Pebbles 3-inch diameter	5·00	
Boulders 6-inch diameter	8·00	
Boulders 18-inch diameter	12·00	

As already stated the Damodar river above the Jharia field is scouring its bed rather than depositing silt, so that it should be an easy matter to establish the foundations of a bridge on rock and thus put aside any question of danger from scouring in alluvial material. In the Raniganj coalfield on the other hand the river is evidently depositing a little more silt than it receives to carry away into the plains of Burdwan. Here refilling excavations with sand should be done even more efficiently than in the Jharia field. If bridge piers do not go down to rock it is a question as to what depth the sand of the river bed is in movement during floods. We do not know, but it may be more than 10 feet since the material is a little finer than that of the Jharia section of the Damodar river. I do not think any engineer would choose

the vicinity of a bridge to collect sand in quantities of millions of tons, but on the upstream side of the bridge excavations to 10 feet in positions between the piers should help to keep the flood straight. The danger to bridge piers in alluvial river beds is immediately on the downstream side of piers where scouring may be severe during floods and yet fill up as the velocity falls off. In a certain case this down stream scour was undermining a bridge unsuspected by the engineers in charge because the hole was filled up as each flood subsided. (See " The Young Engineer " by J. N. D. LaTouche, 1936, page 85, also pages 101-102; with regard to the movement of the sand in a river bed see details of the " Boulder Dam in the Black Canyon of the Colarado River " by G. B. Barbour, *The Geograph. Journ., Vol.* LXXXVI, No. 6, 1935, page 501.)

Question 2.—Unfortunately I have no recent data on the Damodar river in the Burdwan district, but if the channel section has not greatly altered the following data may prove illuminating:—The catchment of the Damodar river above the Jharia field (Parjori, near the Dyer bridge) is roughly 3,000 square miles; the annual average rainfall on this catchment is about 50 inches; the rainfall between mid-June and September is over 42 inches; the maximum precipitation in 24 hours is 10 inches within the catchment; the greatest rainfall in 24 hours on the whole catchment is about 6 inches; and the resulting flood water from this 6-inch precipitation is computed at 42,000,000,000 cubic feet. The Damodar river is nearly 370 miles long, but only half this length lies above its outfall into the Burdwan plains from the Raniganj coalfield. It was capable of passing nearly 600,000 cubic feet per second along its channel in the Raniganj coalfield; half of this or 300,000 cubic feet per second through its section opposite Burdwan, and only 75,000 to 80,000 cubic feet per second in the tidal portion of its course. These figures are significant and show that the river must spill and deposit immense amounts of silt in the Burdwan district. That the river is a threat to the plains of Burdwan is only too well-known. In the floods of 1913 it spilled silt over 1,200 square miles of good land and rendered about 250,000 people homeless. That it has wandered in its course is also known. At one time it joined the Hughli about Tribeni; at a later period it spilled southward leaving the Hughli to join it lower down at Ulubaria; and now it finds its way to the Hughli opposite Fulta and above the James and Mary sands of shipping fame. All these wanderings and all this fear of the river during times of flood now can be expressed in the one word " silt ". It carries into the alluvial country immense volumes of silt, and owing to its diminished velocity and insufficient channel it drops this silt in its bed and raises it. It may be argued otherwise, but it is almost certain that the replenishment of the silt in and around the James and Mary sands comes from the Damodar. The tails of the James and Mary and other down river sands are washed away during the early months of the year when the flood

tides are stronger than the ebb tides, but the heads of these sands extend up river at the same time. During the rains, when the freshets are running, the greater strength of the ebb tides causes the heads of the sands to wash away and the tails to increase down river. These two actions, probably acting by a steady downward movement of the sands as a whole, keeps the sands where they are. The action at and around the James and Mary sands appears to be partly controlled by floods in the Rupnarayan river, but it seems certain that the replenishing supply of sand comes largely from the Damodar river.

The quantities of sand which pass through the Jharia field course of the Damodar river in a year are, gauged by the 4 million tons of suspended matter in 24 hours after perhaps only 1½ inches of rain, probably not less than 21 million tons each rains. The silt carried into the Burdwan district by the Damodar after its load has been added to by the Barakar, can hardly be less than the same amount (allowing that some is added to the river bed itself each year). The Adjai is a different problem and I have not studied it. It is certain that a large percentage of the sand carried into the plains of Burdwan by the Damodar river must remain there, and only a part thus goes into the Hughli, but at a most critical place. It follows that if the river could be made to drop its silt in its upper reaches the travel into the Hughli must in time be reduced. Now if 20 million tons of silt could be extracted from the Damodar river in the Jharia part of its course the amount taken into the Raniganj field would be trifling. All fine suspended matter probably goes right through to the "sandheads". Then the sand in the Raniganj field would probably come under erosion and pass, but in far smaller amounts than at present into the Burdwan plains and there be trapped. Again the movement of sand into the Hughli would also diminish and in process of time become so small that the quota from the Damodar might be unable to maintain the James and Mary sands. I have no hesitation in saying that it is my considered opinion that the Damodar could replace all the sand up to at least 10 to 12 million tons annually which might be taken from its bed and sides in the Jharia field part of its channel, and that this removal must in time reduce the danger from floods to the district of Burdwan, and also materially improve the navigation of the Hughli river below Fultah point. It is almost impossible to secure reliable data about the silt in the Hughli without ascertaining it oneself. I have had little time to make such investigations, but I have studied the rivers of Bengal with great interest and think the river Damodar carries a great deal of silt and sand into the Hughli.

Question 3.—So far as it has been possible to ascertain the depth of sand and the approximate quantities actually at rest in the bed and banks of the Damodar, Barakar and Adjai rivers in the Bokaro, Jharia and Raniganj coalfields, this has been done and information has been published: for the Upper Damodar river in the Bokaro coalfield by G. V. Hobson (*see* Trans. Mining and

Geological Institute of India, Vol. XXI, Part 4, 1927); for the Damodar river in the Jharia coalfield by C. S. Fox (see Memoirs, Geological Survey of India, Vol. 56, 1930); and for the Damodar, Barakar and Adjai rivers in the Raniganj Coalfield by E. R. Gee (*see* Memoirs, Geological Survey of India, Vol. 61, 1933). In none of these cases has it been possible to ascertain accurately by boring, and only in the case of the Jharia coalfield was a computation made in regard to the sand which is moved along the river bed, *i.e.*, the " current account " as against the " fixed deposit " of the river bed and banks. In the case of the Raniganj coalfield the " fixed deposit " is very large and is probably being added to annually. The Barakar river possibly has a more or less definite " fixed deposit " in the limits of the Raniganj coalfield and could probably replace all the sand likely to be taken from it for collieries around, either in the vicinity of Ramnagar, above, and Dishergarh, below the railway and road bridges, respectively. The amount of sand fixed in the Adjai river in the Raniganj field is probably not very large, but the amount passing through on " current account " is probably quite able to meet the needs for replacing the sand taken for collieries in the north-east of the Raniganj coalfield. The figures for " fixed " and for " current " supplies in the Jharia field, as given in the memoir quoted above, may be accepted as a near approximation for that area.

Question 4.—All these particulars have been given in my memoir on " The Lower Gondwana Coalfields of India " (*see* Memoirs, Geological Survey of India, Vol. 59, 1935). My figures for Giridih, Bokaro and Karanpura were modified in a paper, compiled from my data, by Sir Lewis Fermor, but I showed in my Presidential Address to the Mining and Geological Institute in January, 1936, that these emendations were less likely to be correct than the estimates given in the above memoir (*see* also Records, Geological Survey of India, Vol. LIX, Part 4, pages 371-404, regarding the Low Phosphorus coals of the Giridih field). The Giridih data were supplied by Mr. H. Lancaster; none of the Karanpura coal is known to yield a hard coke in a working scale coke-oven; and the Bokaro coal has never been used without admixture with Jharia coal for making metallurgical coke. If the whole Kargali seam is used the ash content of the coke renders it unattractive. The Jharia and Raniganj figures, by myself and Mr. Gee, respectively, may be taken as close estimates. It is not possible to estimate accurately the coking coal of the Kanhan field in the Central Provinces as the geology is very complicated and the coal has not been proved far north of Damua. The coking coal of the Korea and Chirmiri fields has not yet come under full consideration, but the supplies are not thought to be large.

Question 5.—Yes. I specially arranged for full scale tests of several Lower Gondwana coals and had the good fortune to have the experiments carried out at Giridih under the charge of Mr. G. W. Marshall, the coke-oven expert and chemist to the State

Railways colliery there. The results of the tests were published in the Records of the Geological Survey of India (*see* Records, Geological Survey of India, Vol. LXI, Part 3, pages 294-314). It may, I think, be taken safely that seams Nos. 14, 14A, 17 and 18 Jharia can be blended with any good quality non-caking coal of low moisture content and yield a good metallurgical coke. Seams Nos. 10, 11/12, 13, 15 and 16 Jharia will yield fair quality hard coke, often of metallurgical quality where the coal used is of good, low ash and low moisture, quality. The lower seams of the Jharia field also yield a hard coke, but their ash percentage is too high and thus renders the coke unattractive for metallurgical purposes. The seams of the Raniganj stage in the Jharia and Raniganj fields are also of caking quality when their moisture content is below 5 per cent., but they swell greatly under distillation and are too soft in consequence for heavy furnace charges. Mixed with low moisture lower Barakar or other coals, even if non-caking, they may yield a stronger coke than they do alone. My investigations show that almost any coal with ash less than 20 per cent. and moisture under 4 or 5 per cent. will yield a coke which is fairly strong. If the quality of the coal is good and the volatile matter is about half the fixed carbon, the coke is excellent. When this ratio is nearer $\frac{1}{4}$, a very low volatile coal, the coke is non-swelling, but still hard and good if the quality of the raw coal is good. When the ratio approaches $\frac{3}{4}$, the very high volatile coal yields a swelling coke, but the quality may be good if the coal is high grade. The greatest deterrent to coking is a high moisture content, due to the coal seam having been water-logged, *e.g.*, interbedded in water-bearing strata, for a considerable time. Wetting good slack coal of low moisture material often improves the caking action in an oven, but this temporary damping is different to the dampness of a coal which has long been soaked. In some cases coals of the same seam in workings near the surface are non-caking while that from deeper workings is of caking quality.

Oral Evidence.

Questions 1, 2 & 3.—It is my definite opinion, after a careful study of the whole subject and knowing all the available relevant statistics, that the fixed deposit of sand in the Damodar, Barakar and Adjai rivers is more than sufficient by many times to supply the quantity of sand that may at the present rate of production be required even for wholesale sand-stowing in one year. I am also definitely of opinion that whatever amount of sand may be extracted from the fixed deposit at any place in one year would be replaced during the monsoon floods by the sand which is carried down along the bed of these rivers. If it was found in the course of years that what might be called the current account was not actually proving sufficient to replenish the fixed deposit each year, and that there was any danger of the fixed deposit being depleted to a dangerous extent, it would be quite possible, in the case of

the Jharia section of the Damodar river, to increase the replacement from the current account to more than making up any such difference.

As regards the different estimates of the solid matter carried in suspension in these rivers, one being 1 in 1,200, one being 1 in 1,000 and mine being 1 in 100, these differences are due to the estimates being taken at different points of the river. My actual experiment in this connection was made in the Jharia coalfield near Bhowra and the river there flows with greater velocity than lower down at Raniganj and beyond that point. In any event, these differences regarding the amount of solid matter carried in suspension are not material to the question under consideration, because it is not this solid matter in suspension that would replace the sand excavated from the river bed each year.

APPENDIX.

Note submitted by Professor Forbes W. Sharpley of the Indian School of Mines, Dhanbad.

Referring to my interview with your Committee recently in Dhanbad I raised a number of points in connection with (*a*) Illumination in Coal Mines and (*b*) Indian Research in Safety in Mines about which your Chairman asked me to let the Committee have a memorandum.

Illumination.

I pointed out it was being increasingly recognised in the chief Coal Mining countries—notably Great Britain, Germany and the U. S. A.—that improved lighting was a means of reducing the accident rate. I quoted one or two opinions, and these and others are given in the footnote. They are merely a selection from a large number in a similar strain. Quite a number of references have been made on the matter in evidence given before the Royal Commission on Safety in Coal Mines at present sitting in Great Britain.

By ' good ' lighting I meant not only more lamps of a higher candle power but, also, the correct placing and shading of lamps so as to avoid glare. Where a low intensity of illumination exists glare even from a 1 c.p. lamp can seriously affect the ability to see objects in the same field of vision. Much improvement can be effected by correctly shielding and directing the light from existing lamps even without increasing the number of candle power of lamps and hence at a low cost. These remarks apply to both fixed and portable lamps underground and to lamps on the surface, *e.g.*, over picking belts, etc. I have seen, for example, cases where a haulage engine attendant below ground could only see with great

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" There has been a continuous reduction in the number of accidents as the mains lighting has been extended, and the steady decline in the number of compensation cases is most marked . . . . The number of cases per month has fallen from 6½ to 1½. . . . ."

(Atkinson & Allsop: *" An Experiment in Coal-Face Lighting ". Trans. Inst. Min. Engrs., Vol. 90, 1936, page 282.*)

" The improved lighting is of tremendous value in . . . . helping to avoid ugly accidents."

" The authors are satisfied that the improved lighting is a very important factor in keeping the accident rate as it is."

[Jones and Maynard: *" Coal Face Illumination by means of Compressed Air-Electric (M. L.) Lamps ". Coll., Guard., Vol. 152 (12th June 1936, page 1100).*]

" While definite figures are not available, it seems probable that approximately 35 per cent. of the underground accidents in the mines of the United States are caused by inadequate or improper illumination."

[O. W. Owings (U. S. Bureau of Mines): *" Some Mine Lighting Practices in the United States ". Trans. Illum. Eng. Soc., Vol. 29, 1934, page 60.*]

difficulty and strain down the haulage way on account of bare lamps being hung right in his line of vision over the engine in front of him and because quite inadequate lighting was provided in the haulage road itself. In India where so many mines are free from gas there is little excuse for inadequate lighting while now-a-days safe lighting even at the coal-face of gassy mines is becoming possible of achievement.

I consider that some steps should be taken to lay before mine managers and others concerned the advantages to be obtained from better lighting. I have referred above only to safety since the Committee is concerned principally in this cause but there are other advantages to be obtained and which are even more easily demonstrated, *e.g.*, increased output, cleaner coal, etc., etc. Much research, also, requires to be done on the best lighting methods. I refer to research in general terms below but I might mention here as one instance alone that a sharp divergence of opinion is held by different authorities as to the relative safety from ignition of gas by direct current and high frequency alternating currents. The matter has been shelved for some years, owing to the difficulty of reconciling results. If the advantage of A.C. high frequency currents could be finally and conclusively demonstrated it would go far to increasing the safe use of adequate illumination in gassy mines even at the coal face.

Incidentally I agreed that the use of electric safety hand lamps (or cap lamps) was preferable to flame safety lamps in Indian mines since it was less easy to take down below undetected and incorrectly assembled electric lamp than a flame-lamp in a similar state and that in any case, an incorrectly assembled electric safety lamp was not so likely to prove unsafe in use even if it escaped detection.

Research.

I pointed out that in my opinion the whole question of research in India on matters concerning safety in mines was in an unsatisfactory position. No research at all worth mentioning on this subject was being done in this country whereas in other countries, notably Great Britain and the U. S. A., a vast amount of invaluable work had been and was being done. For instance the Safety in Mines Research Board in Great Britain have published nearly 100 papers embodying the results of research very much of which is taken advantage of directly or indirectly by the coal mining industry in this country. India is thus making use of research done in other countries but is not making any contribution of her own—even for her own benefit. I consider this state of affairs should be remedied.

There is much scope for research in India both on problems of peculiar importance to Indian conditions and on those the successful solution of which would be valuable to the coal mining industry both in India and in other parts of the world. I have in mind a wide range of subjects—a range greater than that covered

by the Safety in Mines Research Board in Great Britain since there are other bodies in that country, *e.g.*, the Medical Research Council, which undertake research in industrial safety problems including mining and to which there is no corresponding work being done here.

It would be impossible here to mention all the subjects on which useful work could be done but I might as an example mention one. (I have already referred above to Illumination on which alone work might be done from many aspects.) It is not at present possible to tell by external examination whether a steel-winding or haulage rope is entirely safe for its work and ropes have either to be taken out of service well before the end of their useful safe life or else a risk of breakage must be run. Magnetic methods of detecting internal flaws offer means of proving the strength of ropes *in situ*. The problem has been tackled by several investigators but so far no entirely successful magnetic test has been evolved. Here is a problem of common interest to India and other mining countries. I am myself at the moment doing some work on it but with inadequate experimental facilities.

I suggest that a Research Board dealing with safety and other problems in coal mining should be set up in India and be financed by a small cess on raisings or from other sources. The value of the work done (as properly-directed industrial research has demonstrated many times) might well be incalculable. Incidentally the prestige of India as an industrial country would, I submit, be considerably enhanced.

It appears anomalous that large sums can be spent on research in India on many other problems—chiefly agricultural but also of an industrial nature—and none on so important an industry as coal mining.

MGIPC—L—VIII-97—16-11-37—150.