

12
Govt. of {1895} Madras
OFFICIAL.

Issued

Recd.

Encl.

G.O., 14th August 1895, No. 1699.

AUGUST.

Reburite.

Communicating to District Magistrates and others endorsement of the Government of India forwarding copy of its letter to the Government of Bombay authorizing it to direct the application of — of the tests contained in the rules which are in force in England, pending the issue of a revised set of rules on the subject, and enclosing copy of certain papers on the question of the suitability of — for use in Mines.

GOVERNMENT OF MADRAS.
JUDICIAL DEPARTMENT.

READ—the following paper :—

From J. P. HEWETT, Esq., C.I.E., Officiating Secretary to the Government of India (Home Department—Public), to the Chief Secretary to the Government of Bombay, dated Simla, the 29th July 1895, No. 1131.

I am directed to acknowledge the receipt of your letter No. 4567, dated the 18th ultimo, forwarding copy of a report of the Chemical Analyser to the Government of Bombay, in which he gives his opinion as to the tests which should be applied to Roburite. The Governor in Council concurs in the view expressed by the Chemical Analyser that the rules adopted in England for the test of such explosives as are included in class 3, division 2, but do not contain gun-cotton, are suitable for the testing of Roburite. Your letter further refers for orders the question raised by Messrs. Anderson and Co. as to their being allowed to mix the ingredients of Roburite in India.

2. As regards the testing of Roburite, I am to say that the Government of India are awaiting further information from Her Majesty's Secretary of State, in view to issuing a revised set of rules on the subject. Pending the issue of such rules, the Governor-General in Council authorizes the Government of Bombay to direct the application to Roburite of the tests contained in the rules * which, it is understood, are in force in England, a copy of which was forwarded with my letter No. 427, dated the 16th March 1895.

* Copy enclosed.

3. With regard to the question as to the manufacture of Roburite in India, referred to in the last paragraph of your letter, I am directed to say that the Government of India will be prepared to grant licenses to mix and manufacture Roburite after the persons wishing to manufacture the explosive have arranged for the place of its manufacture to the satisfaction of the Local Government in whose territories they propose to carry on the work. The Government of India will be glad, in the event of a place of manufacture being sanctioned by the Bombay Government, if the Governor in Council will make proposals as to the conditions which should, in his opinion, be entered in such licenses.

Extract paragraph 2 of letter from the Chemical Examiner to the Government of Bengal, No. 398-A., dated the 17th April 1895.

Extract paragraph 5 of letter from the Chemical Examiner to the Government of Bengal, No. 14-A., dated the 11th January 1892, and enclosures.

Appendix V to the Seventeenth Annual Report of Her Majesty's Inspector of Explosives for the year 1892, containing extracts from the Report by Dr. Dupré and Commander Smith on the risks arising and the precautions to be observed in the manufacture and handling of nitro-benzole and di-nitro-benzole.

4. I am at the same time to enclose, for the information of the Governor in Council, a copy of the papers mentioned in the margin on the question of the suitability of Roburite for use in Mines and to say that the Secretary of State for India has been asked whether the objections made to its use are still maintained and, if not, how they have been removed.

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Copy, with copy of the papers referred to in paragraph 4, forwarded to the Government of Bengal for information and guidance, with reference to the correspondence ending with the letter from this Office No. 913, dated the 14th June 1895.

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Copy, with copy of the papers referred to in paragraph 4, forwarded to other Local Governments and Administrations for information and guidance, in continuation of endorsement Nos. 429-436, dated the 16th March 1895.

(By order.)

(Signed) H. LUSON,
Offg. Depy. Secy. to the Govt. India.

To the Government of Madras.

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I do not know whether the use of roburite in Mines in India is contemplated or whether the objections to its use in Mines in England originally raised are still maintained.

EXTRACT paragraph 5 of letter from the Chemical Examiner to the Government of Bengal, No. 14-A., dated the 11th January 1892.

5. Another point to which I think I ought to refer is that at the "Miners' National Conference," held in Manchester in 1889, the use of roburite was condemned. A question in Parliament was asked the Secretary of State by Mr. J. S. Balfour regarding the use of roburite in Mines. I append Mr. Balfour's question and Mr. Mathews' reply, and also a copy of the proceedings of the Lancashire Miners' Conference. In England, a question of this nature would engage the attention of one of Her Majesty's Inspectors of Explosives, but in India there is no officer, I believe, empowered with similar functions. With the growing use of high explosives in India, I would venture to respectfully suggest that the appointment of one or more officers as Inspectors of Explosives is most highly desirable.

ROBURITE.

Mr. J. S. Balfour asked the Secretary of State for the Home Department whether his attention had been directed to the growing use in Lancashire coal-mines of the explosive called roburite; whether he was aware that the Miners' National Conference, held in Manchester on 14th July 1889, condemned the use of roburite as injurious to the health of the Miners; and whether, if any doubt existed on this point, he would direct an inquiry into the matter, and would give the men an opportunity of producing scientific and other evidence in support of their view.

Mr. Mathews.—Yes, sir, I am informed by the Inspector that there is a growing use of roburite in the Lancashire collieries. It is a useful explosive, and practically safe for use in fiery Mines. I gather from newspaper reports that its use has been condemned by Miners as injurious to health. An inquiry was recently held into this matter by a Committee of Experts on which the Miners' Federation was represented, and their conclusion was that, if proper care is exercised by Managers, short-firers and colliers, the use of roburite will not add to the harmful conditions under which the Miner works. The Inspector informs me that means are now being devised for removing the fumes by ventilation before persons re-enter and for keeping persons out of the return air, and under these circumstances he does not consider any further inquiry, at any rate at present, desirable.

USE OF ROBURITE IN MINES.

A Conference of the Lancashire Miners' Federation was held at Wigan on 4th July, when a special report, which had been prepared by a Committee appointed by the Federation to make investigations into alleged injurious effects upon the health of the Miners caused by the use of roburite for shot-firing purposes in Mines was brought up for consideration. This report, which is the joint production of the whole of the Committee, consisting of S. Woods, the President, Mr. Ashton, Secretary of the Federation, Mr. S. Aspinwall, and four Colliers, takes the form of a criticism upon the conclusions arrived at by Messrs. H. B. Dickson, C. I. Mounsey and N. Hannah, who were appointed jointly by the employers and workmen engaged at the Garswood Coal and Iron Company to investigate and report upon the effect of roburite fumes on the health of workmen. The Committee appointed by the Lancashire Miners' Federation complain that the operations expressed in the report of the specialists, who are two medical practitioners and an analyst, are so shrouded in a multitude of technical scientific statements that it is difficult to discover what their conclusions really are; but the report, it is pointed out, evidently establishes the following points, namely:—

- (1) that the fumes of roburite, when inhaled into the system, are an exceedingly deadly poison, even in the smallest quantity;
- (2) that when these fumes are inhaled into the system in a coal-mine, they carry with them two poisonous gases, differing from each other only by a little in their harmful effect on the human system, viz., nitric oxide and carbonic oxide;
- (3) that roburite may be safe while kept in the sealed cartridges, but the moment they are broken and exposed to the air, the substance is so volatile and poisonous that it at once becomes a great source of danger;
- (4) that incomplete or partial combustion of roburite allows the deadly elements of the composition—nitro-benzene—to escape and freely mix with the air in the Mine, and therefore to be breathed by the men or absorbed by contact with the skin;
- (5) that roburite fired in coal dust gives off a recognised quantity of carbonic oxide;
- (6) that in handling roburite the greatest possible care is necessary, the greatest danger is risked, and the slightest departure from this may be followed by serious results;
- (7) that in the cases examined of men who had worked in places through which the roburite fumes had passed, they suffered from carbonic oxide-poisoning when small quantities of the gases mixed with air had been inhaled;
- (8) that specially trained men only should manipulate or be entrusted with roburite;
- (9) that no Miner would be safe in his place until all the fumes had disappeared;
- (10) that where roburite is used the ventilation must be perfect, with a large quantity of air, and the brattice must be kept close to the coal-face.

These ten facts, it is urged, surely fully establish the whole of the Miners' contention that overhead fumes are injurious to the health of the workmen.

After some discussion, the report was unanimously adopted by the Conference, and as a result, the future use of roburite in Mines for shot-firing purposes will be opposed by the workmen.

EXTRACT from the report on the risks arising and the precautions to be adopted in the manufacture and handling of Nitro-Benzole and Di-Nitro-Benzole, dated 28th November 1892, by Dr. Dupré, F.R.S., and Commander Hamilton P. Smith, R.N.

"Benzole and toluol (coal-tar products) having been treated with nitric and sulphuric acids at moderate temperatures become nitro-benzole or nitro-toluol; further treated with nitric and sulphuric acids at higher temperature, these become di-nitro-benzole or di-nitro-toluol and assume a crystalline form at a temperature of from 158° to 176° F. Meta-di nitro-benzole, when pure, is a yellow crystalline substance, practically inodorous even at a temperature of 80° F. It does not volatilize to any appreciable degree at any temperature below 80° F., but is very sensibly volatile at 120° F. and upwards. It is quite dry to the touch, and does not produce a greasy stain on paper when rubbed upon it. It melts at 194° F.

"Ordinary commercial di-nitro-benzole, however, generally contains a greater or lesser amount of impurities. Some of these impurities are more volatile than the di-nitro-benzole, while some are fluid at ordinary temperature, they thus impart to it a more or less powerful smell, resembling that of oil of bitter almonds (due sometimes, but not always, to the presence of nitro-benzole), and render the substance more or less greasy to the touch.

"The presence of these products considerably increase the danger incurred in working with di-nitro-benzole, since it is at least highly probable that their vapours are poisonous (there are no direct observations bearing on this point), but more particularly because the slightly greasy di-nitro-benzole adhere far more readily to the fingers and is more readily absorbed through the skin than pure dry di-nitro-benzole.

"In most, if not all, the factories in which di-nitro-benzole is used in the explosives the commercial product is submitted to some sort of purification, but the is merely to get rid of or neutralise the free acid present, so as to comply with the requirements of the explosive department of the Home Office, and does not materially affect the in- above mentioned. Meta-di-nitro-benzole acts as a poison, whether ingested, absorbed the skin, or inhaled into the lungs in the form of vapour or dust. With pure di-nitro-b the danger from vapours is present only at a temperature considerably exceeding 100° F. at the danger from dust is of course always present.

"These properties suggest certain precautions, some of which will be stated further on, but here we may mention that manufacturers of explosives should, if possible, use only such di-nitro-benzole as is free, practically, from smell, produces no greasy stain when rubbed on paper, and does not sensibly volatilize at ordinary temperatures.

"Most manufacturers of di-nitro-benzole for purposes entirely unconnected with the more dangerous qualities of the impure di-nitro-benzole, now aim at producing only the pure compound, and have in a great measure succeeded.

"There is, therefore, no difficulty in procuring it; opinions have differed as to whether injury to the workers has been due to the inhalation of fumes, or absorption through the skin of the fluid nitro-benzole, or whether to the inhalation of fumes or dust, or absorption of fine particles of the solid di-nitro-benzole, or whether both were alike dangerous. That nitro-benzole taken internally is a poison will be readily admitted, but our investigations show that with the ordinary caution of sufficient ventilation, necessary in all chemical works, no injury to the health of the workers in the manufacture of nitro-benzole has happened which would call for special legislation."

"Our investigations in regard to di-nitro-benzole lead to very different conclusions, confirming the opinion that this substance is a dangerous poison, which affects injuriously, in a very mild form, those engaged in the manufacture very seriously—sometimes fatally—the workers who handle it or inhale fumes or dust, in places where it forms an ingredient in the manufacture."

"For the benefit of those employed in handling or subject to the fumes of di-nitro-benzole as an ingredient in the manufacture of explosives, we strongly urge that precautionary measures, suggested by us, should be enforced, and in doing so it is but fair to say that we have seen the benefit of such precautions where many of our suggestions have for long, without outside pressure, been carried out.

"At the Roburite Company's works at Gathurst, the beneficial effect of the care taken by the management, and by Dr. Prosser White, their medical adviser, is most marked.

"In the manufacture of explosives, di-nitro-benzole is largely used; the process of manufacture varies slightly in different works, but the following may be taken as a general description.

"The di-nitro-benzole arrives in the purified state, packed in casks in the form of irregular lumps, or sometimes in cases containing numerous slabs.

"In most cases it is further purified to extract all acid; this is done sometimes in large vats in the open air, in which the material is soaked in water, heated by steam pipes, soda being used to neutralise the acid, it is then placed in a hydro-extractor, a jet of water being turned on whilst the containing vessel revolves; the purified di-nitro-benzole is taken to the mixing house, where the oxydising salts and other materials are placed in a roller pan, or in some cases the di-nitro-benzole is put into steam jacket melting pots, and run into the warmed mixing pans in the liquid state.

"The mixture goes to the drying stoves, and in some cases is re-ground; thence it goes to the cartridge-filling rooms, where women and young persons are employed to fill the cartridges, which are taken in trays to the drying house, from there to the waterproofing house, where the cartridges are dipped in liquid paraffin wax.

"The effect upon the health of the miners who use cartridges composed in part of di-nitro-benzole has been carefully considered. We find in the report drawn up by Professor Dixon, Messrs. Mounsey and Hannah (February 1892) on the use of roburite in mines, the following:—

"We are inclined to attribute the cases of undoubted nitro-benzine poisoning which have been brought to our notice to improper manipulation of the cartridges."

"Also,—

"We conclude that roburite, when properly confined, undergoes complete combustion, leaving no trace of nitro-benzine derivations unburnt, but there is a chance of incomplete combustion occurring owing to the explosive not meeting with sufficient resistance."

"Although roburite is a strong poison, and undoubted cases of poisoning have arisen from the use of it in coal mines, yet, if stringent care is exercised, the use will not add to the harmful conditions, &c., the following are the chief precautions suggested by the gentlemen named:—

"Manipulation of cartridges to be entrusted to special shot-firers.

"Effecting tamping.

"Care to remove fumes from working faces.

duct of explosive to be rapidly mixed with large volume of air.

Roburite Company it is stated that in cases of imperfect combustion the unburnt he cartridge is not diffused in fragments or dust, but becomes a solid hard lump; for the cartridges answering this description were shown to us.

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- "1. That the products of explosion of roburite and tonite are not more deleterious than products of the explosion of gunpowder.
- "2. That with regard to the effects of the explosion of roburite, no chemical evidence was obtained of the presence of nitro-benzine, and throughout the inquiry, no case of nitro-benzine poisoning was met with.
- "3. That with regard to the production from roburite, tonite, and gunpowder of carbon monoxide, the quantity found in average samples of air collected in the place is small, and is so quickly dissipated by the air current as to have been detected only in traces at an interval of five minutes after firing of the shot.
- "4. An interval of five minutes is recommended before the hewers return.
- "5. As part of the gas detected in the fumes is produced by the burning of the fuze, firing by electricity is recommended.

"It will be seen that the manipulation of di-nitro-benzole take place chiefly in the manufacture of explosives, and by workers in mines.

"In regard to the miners, after considering the opinions of the high authorities quoted, we do not think special protective legislation necessary, but in regard to explosive works, we beg to recommend the following:—

- "1. No person to be employed without a medical certificate, stating that he or she is physically fit for such employment.
- "2. No woman under the age of 21 to be employed.
- "3. No male young person under the age of 18 to be employed.
- "4. An examination of the workers at their work to be made at least once a fortnight by a certifying surgeon, who shall have power to order temporary suspension or total change of work for any person showing symptoms of suffering from the poison, or if after a fair trial he is of opinion that any person is by constitution unfit, he shall direct that such person shall cease to be employed.
- "5. A supply of fresh milk, and of any drug that the medical officer may consider desirable, shall be kept for all workers liable to suffer.
- "6. No meals to be taken in the workrooms.
- "7. There shall be provided separate lavatories for men and women, with a good supply of hot water, soap, nail brushes, and towels, and whenever the skin has come in contact with di-nitro-benzole, the part shall be immediately washed.
- "8. Overall suits and head-coverings shall be supplied to all workers in shops where di-nitro-benzole is used, these suits to be taken off before meals and before leaving the works, and to be washed at least once a week.
- "9. Suitable respirators (capable of being washed), folds of linen, or woollen material of open texture, or other suitable material, shall be supplied to those workers liable to inhale dust, and the wearing of such respirators shall be urged where the workers derive benefit from their use.
- "10. Where di-nitro-benzole has to be handled, the hands shall always be protected from direct contact with it, either by the use of india-rubber gloves (kept perfectly clean, especially in the inner side), or by means of rags which can be de-troyed after use.
- "11. Where di-nitro-benzole is broken by hand, the instrument used shall be a bar, spade, or tool (if of metal iron or steel should not be used), with a handle long enough to prevent the worker's face from coming into near contact with the material.
- "12. In all rooms or sheds in which the process, either of purifying, grinding, mixing materials of which di-nitro-benzole forms a part, efficient "cowls," ventilating shafts, and mechanical ventilating fans shall be provided to carry off the dust or fumes generated.
- "13. Drying stoves shall be efficiently ventilated, and, when possible, be charged and drawn at fixed times, and a free current of air shall be admitted for some time prior to the workers entering to draw, either a part or the whole of the contents.
- "14. In the process of filling cartridges, the material shall not be touched by hand, but suitable scoops shall be used, and where patent ventilated cartridge-filling machines are not used, there shall be efficient mechanical ventilation arranged in such a manner that the suction shall draw the fumes or dust away from and not across or over the faces of the workers.

"15. A register in a prescribed form shall be kept, and it shall be the duty of a responsible person named by the firm to enter, at least once a week, a statement that he has personally satisfied himself that each and all of the special rules have been observed, or if not, reasons to be stated for such non-observance. The surgeon to enter in this register the dates of his visits, the results of such visits, and any requirement made by him.

"16. The 'dipping' rooms to be efficiently ventilated.

"Di-nitro-benzole is, of course, extensively used in the manufacture of certain dyes, in a small degree for other purposes, but as in such factories (where it is used), the substance is practically never touched by hand, its properties are entirely changed, and the work is carried on in closed vessels which protect the workers from poisonous fumes, we have, therefore, not thought it necessary to carry this inquiry further."

ORDER—dated 14th August 1895, No. 1699, Judicial.

Communicated to all District Magistrates, the Inspector-General of Police, the Commissioner of Police, Madras, and the Chemical Examiner, in continuation of G.O., dated 8th April 1895, No. 750, Judicial.

(True Extract.)

Chief Secretary.

To all District Magistrates.
 " the Inspector-General of Police.
 " " Commissioner of Police, Madras.
 " " Chemical Examiner to Government.
 " Messrs. Parry and Co.
 " " Best and Co.
 " " Arbuthnot and Co.
 " Copy to the Public Works Department, Railway Branch.
 " " Inspector-General of Ordnance.

Exd. C. M. Brisson.

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"Benzole and toluol (coal-tar products) having been treated with nitric and sulphuric acids at moderate temperatures become nitro-benzole or nitro-toluol; further treated with nitric and sulphuric acids at higher temperature, these become di-nitro-benzole or di-nitro-toluol and assume a crystalline form at a temperature of from 158° to 176° F. Meta-di nitro-benzole, when pure, is a yellow crystalline substance, practically inodorous even at a temperature of 80° F. It does not volatilize to any appreciable degree at any temperature below 80° F., but is very sensibly volatile at 120° F. and upwards. It is quite dry to the touch, and does not produce a greasy stain on paper when rubbed upon it. It melts at 194° F.

"Ordinary commercial di-nitro-benzole, however, generally contains a greater or lesser amount of impurities. Some of these impurities are more volatile than the di-nitro-benzole, while some are fluid at ordinary temperature, they thus impart to it a more or less powerful smell, resembling that of oil of bitter almonds (due sometimes, but not always, to the presence of nitro-benzole), and render the substance more or less greasy to the touch.

"The presence of these products considerably increase the danger incurred in working with di-nitro-benzole, since it is at least highly probable that their vapours are poisonous (there are no direct observations bearing on this point), but more particularly because the slightly greasy di-nitro-benzole adhere far more readily to the fingers and is more readily absorbed through the skin than pure dry di-nitro-benzole.

"In most, if not all, the factories in which di-nitro-benzole is used in the manufacture of explosives the commercial product is submitted to some sort of purification, but this purification is merely to get rid of or neutralise the free acid present, so as to comply with the requirements of the explosive department of the Home Office, and does not materially affect the impurities above mentioned. Meta-di-nitro-benzole acts as a poison, whether ingested, absorbed through the skin, or inhaled into the lungs in the form of vapour or dust. With pure di-nitro-benzole the danger from vapours is present only at a temperature considerably exceeding 100° F., but the danger from dust is of course always present.

"These properties suggest certain precautions, some of which will be stated further on, but here we may mention that manufacturers of explosives should, if possible, use only such di-nitro-benzole as is free, practically, from smell, produces no greasy stain when rubbed on paper, and does not sensibly volatilize at ordinary temperatures.

"Most manufacturers of di-nitro-benzole for purposes entirely unconnected with the more dangerous qualities of the impure di-nitro-benzole, now aim at producing only the pure compound, and have in a great measure succeeded.

"There is, therefore, no difficulty in procuring it; opinions have differed as to whether injury to the workers has been due to the inhalation of fumes, or absorption through the skin of the fluid nitro-benzole, or whether to the inhalation of fumes or dust, or absorption of fine particles of the solid di-nitro-benzole, or whether both were alike dangerous. That nitro-benzole taken internally is a poison will be readily admitted, but our investigations show that with the ordinary caution of sufficient ventilation, necessary in all chemical works, no injury to the health of the workers in the manufacture of nitro-benzole has happened which would call for special legislation."

"Our investigations in regard to di-nitro-benzole lead to very different conclusions, confirming the opinion that this substance is a dangerous poison, which affects injuriously, in a very mild form, those engaged in the manufacture very seriously—sometimes fatally—the workers who handle it or inhale fumes or dust, in places where it forms an ingredient in the manufacture."

"For the benefit of those employed in handling or subject to the fumes of di-nitro-benzole as an ingredient in the manufacture of explosives, we strongly urge that precautionary measures, suggested by us, should be enforced, and in doing so it is but fair to say that we have seen the benefit of such precautions where many of our suggestions have for long, without outside pressure, been carried out.

"At the Roburite Company's works at Gathurst, the beneficial effect of the care taken by the management, and by Dr. Prosser White, their medical adviser, is most marked.

"In the manufacture of explosives, di-nitro-benzole is largely used; the process of manufacture varies slightly in different works, but the following may be taken as a general description.

"The di-nitro-benzole arrives in the purified state, packed in casks in the form of irregular lumps, or sometimes in cases containing numerous slabs.

"In most cases it is further purified to extract all acid; this is done sometimes in large vats in the open air, in which the material is soaked in water, heated by steam pipes, soda being used to neutralise the acid, it is then placed in a hydro-extractor, a jet of water being turned on whilst the containing vessel revolves; the purified di-nitro-benzole is taken to the mixing house, where the oxydising salts and other materials are placed in a roller pan, or in some cases the di-nitro-benzole is put into steam jacket melting pots, and run into the warmed mixing pans in the liquid state.

"The mixture goes to the drying stoves, and in some cases is re-ground; thence it goes to the cartridge-filling rooms, where women and young persons are employed to fill the cartridges, which are taken in trays to the drying house, from there to the waterproofing house, where the cartridges are dipped in liquid paraffin wax.

"The effect upon the health of the miners who use cartridges composed in part of di-nitro-benzole has been carefully considered. We find in the report drawn up by Professor Dixon, Messrs. Mounsey and Hannah (February 1892) on the use of roburite in mines, the following:—

"We are inclined to attribute the cases of undoubted nitro-benzene poisoning which have been brought to our notice to improper manipulation of the cartridges."

"Also,—
"We conclude that roburite, when properly confined, undergoes complete combustion, leaving no trace of nitro-benzene derivations unburnt, but there is a chance of incomplete combustion occurring owing to the explosive not meeting with sufficient resistance."

"Although roburite is a strong poison, and undoubted cases of poisoning have arisen from the use of it in coal mines, yet, if stringent care is exercised, the use will not add to the harmful conditions, &c., the following are the chief precautions suggested by the gentlemen named:—

"Manipulation of cartridges to be entrusted to special shot-firers.

"Effecting tamping.

"Care to remove fumes from working faces.

"Products of explosive to be rapidly mixed with large volume of air.

"By the Roburite Company it is stated that in cases of imperfect combustion the unburnt portion of the cartridge is not diffused in fragments or dust, but becomes a solid hard lump; some partially-consumed cartridges answering this description were shown to us.

"On May 29th, 1891, a paper by Professor P. Phillips Bedson, Dr. David Drummond, and Dr. George H. Hume, was read before the Federated Institution of Mining Engineers, in which paper we find the following opinions:—

"1. That the products of explosion of roburite and tonite are not more deleterious than products of the explosion of gunpowder.

"2. That with regard to the effects of the explosion of roburite, no chemical evidence was obtained of the presence of nitro-benzene, and throughout the inquiry, no case of nitro-benzene poisoning was met with.

"3. That with regard to the production from roburite, tonite, and gunpowder of carbon monoxide, the quantity found in average samples of air collected in the place is small, and is so quickly dissipated by the air current as to have been detected only in traces at an interval of five minutes after firing of the shot.

"4. An interval of five minutes is recommended before the hewers return.

"5. As part of the gas detected in the fumes is produced by the burning of the fuze, firing by electricity is recommended.

"It will be seen that the manipulation of di-nitro-benzole take place chiefly in the manufacture of explosives, and by workers in mines.

"In regard to the miners, after considering the opinions of the high authorities quoted, we do not think special protective legislation necessary, but in regard to explosive works, we beg to recommend the following:—

"1. No person to be employed without a medical certificate, stating that he or she is physically fit for such employment.

"2. No woman under the age of 21 to be employed.

"3. No male young person under the age of 18 to be employed.

"4. An examination of the workers at their work to be made at least once a fortnight by a certifying surgeon, who shall have power to order temporary suspension or total change of work for any person showing symptoms of suffering from the poison, or if after a fair trial he is of opinion that any person is by constitution unfit, he shall direct that such person shall cease to be employed.

"5. A supply of fresh milk, and of any drug that the medical officer may consider desirable, shall be kept for all workers liable to suffer.

"6. No meals to be taken in the workrooms.

"7. There shall be provided separate lavatories for men and women, with a good supply of hot water, soap, nail brushes, and towels, and whenever the skin has come in contact with di-nitro-benzole, the part shall be immediately washed.

"8. Overall suits and head-coverings shall be supplied to all workers in shops where di-nitro-benzole is used, these suits to be taken off before meals and before leaving the works, and to be washed at least once a week.

"9. Suitable respirators (capable of being washed), folds of linen, or woollen material of open texture, or other suitable material, shall be supplied to those workers liable to inhale dust, and the wearing of such respirators shall be urged where the workers derive benefit from their use.

"10. Where di-nitro-benzole has to be handled, the hands shall always be protected from direct contact with it, either by the use of india-rubber gloves (kept perfectly clean, especially in the inner side), or by means of rags which can be destroyed after use.

"11. Where di-nitro-benzole is broken by hand, the instrument used shall be a bar, spade, or tool (if of metal iron or steel should not be used), with a handle long enough to prevent the worker's face from coming into near contact with the material.

"12. In all rooms or sheds in which the process, either of purifying, grinding, mixing materials of which di-nitro-benzole forms a part, efficient "cows," ventilating shafts, and mechanical ventilating fans shall be provided to carry off the dust or fumes generated.

"13. Drying stoves shall be efficiently ventilated, and, when possible, be charged and drawn at fixed times, and a free current of air shall be admitted for some time prior to the workers entering to draw, either a part or the whole of the contents.

"14. In the process of filling cartridges, the material shall not be touched by hand, but suitable scoops shall be used, and where patent ventilated cartridge-filling machines are not used, there shall be efficient mechanical ventilation arranged in such a manner that the suction shall draw the fumes or dust away from and not across or over the faces of the workers.

"15. A register in a prescribed form shall be kept, and it shall be the duty of a responsible person named by the firm to enter, at least once a week, a statement that he has personally satisfied himself that each and all of the special rules have been observed, or if not, reasons to be stated for such non-observance. The surgeon to enter in this register the dates of his visits, the results of such visits, and any requirement made by him.

"16. The 'dipping' rooms to be efficiently ventilated.

"Di-nitro-benzole is, of course, extensively used in the manufacture of certain dyes, in a small degree for other purposes, but as in such factories (where it is used), the substance is practically never touched by hand, its properties are entirely changed, and the work is carried on in closed vessels which protect the workers from poisonous fumes, we have, therefore, not thought it necessary to carry this inquiry further."

ORDER—dated 14th August 1895, No. 1699, Judicial.

Communicated to all District Magistrates, the Inspector-General of Police, the Commissioner of Police, Madras, and the Chemical Examiner, in continuation of G.O., dated 8th April 1895, No. 750, Judicial.

(True Extract.)

J. F. PRICE,
Chief Secretary.

To all District Magistrates.

„ the Inspector-General of Police.

„ „ Commissioner of Police, Madras.

„ „ Chemical Examiner to Government.

„ Messrs. Parry and Co.

„ „ Best and Co.

„ „ Arbuthnot and Co.

Copy to the Public Works Department, Railway Branch.

„ „ Inspector-General of Ordnance.

Ed. C. M. Brisson.

Govt. of {1895} Madras.

JUDICIAL.

Issued

Recd.

Encl.

G.O., 14th August 1895, No. 1699.

AUGUST.

Roburite.

Communicating to District Magistrates and others endorsement of the Government of India forwarding copy of its letter to the Government of Bombay authorizing it to direct the application to — of the tests contained in the rules which are in force in England, pending the issue of a revised set of rules on the subject, and enclosing a copy of certain papers on the question of the suitability of — for use in Mines.

GOVERNMENT OF MADRAS.

JUDICIAL DEPARTMENT.

READ—the following paper :—

From J. P. HEWETT, Esq., C.I.E., Officiating Secretary to the Government of India (Home Department—Public), to the Chief Secretary to the Government of Bombay, dated Simla, the 29th July 1895, No. 1131.

I am directed to acknowledge the receipt of your letter No. 4567, dated the 18th ultimo, forwarding copy of a report of the Chemical Analyser to the Government of Bombay, in which he gives his opinion as to the tests which should be applied to Roburite. The Governor in Council concurs in the view expressed by the Chemical Analyser that the rules adopted in England for the test of such explosives as are included in class 3, division 2, but do not contain gun-cotton, are suitable for the testing of Roburite. Your letter further refers for orders the question raised by Messrs. Anderson and Co. as to their being allowed to mix the ingredients of Roburite in India.

2. As regards the testing of Roburite, I am to say that the Government of India are awaiting further information from Her Majesty's Secretary of State, in view to issuing a revised set of rules on the subject. Pending the issue of such rules, the Governor-General in Council authorizes the Government of Bombay to direct the application to Roburite of the tests contained in the rules* which, it is understood, are in force in England, a copy of which was forwarded with my letter No. 427, dated the 16th March 1895.

* Copy enclosed.

3. With regard to the question as to the manufacture of Roburite in India, referred to in the last paragraph of your letter, I am directed to say that the Government of India will be prepared to grant licenses to mix and manufacture Roburite after the persons wishing to manufacture the explosive have arranged for the place of its manufacture to the satisfaction of the Local Government in whose territories they propose to carry on the work. The Government of India will be glad, in the event of a place of manufacture being sanctioned by the Bombay Government, if the Governor in Council will make proposals as to the conditions which should, in his opinion, be entered in such licenses.

Extract paragraph 2 of letter from the Chemical Examiner to the Government of Bengal, No. 398-A., dated the 17th April 1895.

Extract paragraph 5 of letter from the Chemical Examiner to the Government of Bengal, No. 14-A., dated the 11th January 1892, and enclosures.

Appendix V to the Seventeenth Annual Report of Her Majesty's Inspector of Explosives for the year 1892, containing extracts from the Report by Dr. Dupré and Commander Smith on the risks arising and the precautions to be observed in the manufacture and handling of nitro-benzole and di-nitro-benzole.

4. I am at the same time to enclose, for the information of the Governor in Council, a copy of the papers mentioned in the margin on the question of the suitability of Roburite for use in Mines and to say that the Secretary of State for India has been asked whether the objections made to its use are still maintained and, if not, how they have been removed.

No. 1132.

Copy, with copy of the papers referred to in paragraph 4, forwarded to the Government of Bengal for information and guidance, with reference to the correspondence ending with the letter from this Office No. 913, dated the 14th June 1895.

No. 1133.

Copy, with copy of the papers referred to in paragraph 4, forwarded to other Local Governments and Administrations for information and guidance, in continuation of endorsement Nos. 429-436, dated the 16th March 1895.

(By order.)

(Signed) H. LUSON,
Offg. Depy. Secy. to the Govt. India.

To the Government of Madras.

ENCLOSURES.

EXTRACT paragraph 2 of letter from the Chemical Examiner to the Government of Bengal, No. 398-A., dated the 17th April 1895.

2. In this connection I have the honour to draw attention to the circumstance that roburite has been considered unsuitable for use in Mines. This matter was referred to by Surgeon-Lieutenant-Colonel Warden in his letter No. 14-A., dated the 11th January 1892, to the Under Secretary to the Government of Bengal, Judicial Department.

I do not know whether the use of roburite in Mines in India is contemplated or whether the objections to its use in Mines in England originally raised are still maintained.

EXTRACT paragraph 5 of letter from the Chemical Examiner to the Government of Bengal, No. 14-A., dated the 11th January 1892.

5. Another point to which I think I ought to refer is that at the "Miners' National Conference," held in Manchester in 1889, the use of roburite was condemned. A question in Parliament was asked the Secretary of State by Mr. J. S. Balfour regarding the use of roburite in Mines. I append Mr. Balfour's question and Mr. Mathews' reply, and also a copy of the proceedings of the Lancashire Miners' Conference. In England, a question of this nature would engage the attention of one of Her Majesty's Inspectors of Explosives, but in India there is no officer, I believe, empowered with similar functions. With the growing use of high explosives in India, I would venture to respectfully suggest that the appointment of one or more officers as Inspectors of Explosives is most highly desirable.

ROBURITE.

Mr. J. S. Balfour asked the Secretary of State for the Home Department whether his attention had been directed to the growing use in Lancashire coal-mines of the explosive called roburite; whether he was aware that the Miners' National Conference, held in Manchester on 14th July 1889, condemned the use of roburite as injurious to the health of the Miners; and whether, if any doubt existed on this point, he would direct an inquiry into the matter, and would give the men an opportunity of producing scientific and other evidence in support of their view.

Mr. Mathews.—Yes, sir, I am informed by the Inspector that there is a growing use of roburite in the Lancashire collieries. It is a useful explosive, and practically safe for use in fiery to health. An inquiry was recently held into this matter by a Committee of Experts on which the Miners' Federation was represented, and their conclusion was that, if proper care is exercised by Managers, short-firers and colliers, the use of roburite will not add to the harmful conditions under which the Miner works. The Inspector informs me that means are now being devised for removing the fumes by ventilation before persons re-enter and for keeping persons out of the return air, and under these circumstances he does not consider any further inquiry, at any rate at present, desirable.

USE OF ROBURITE IN MINES.

A Conference of the Lancashire Miners' Federation was held at Wigan on 4th July, when a special report, which had been prepared by a Committee appointed by the Federation to make investigations into alleged injurious effects upon the health of the Miners caused by the use of roburite for shot-firing purposes in Mines was brought up for consideration. This report, which is the joint production of the whole of the Committee, consisting of S. Woods, the President, Mr. S. Ashton, Secretary of the Federation, Mr. S. Aspinwall, and four Colliers, takes the form of a criticism upon the conclusions arrived at by Messrs. H. B. Dickson, C. I. Mounsey and N. Hannah, who were appointed jointly by the employers and workmen engaged at the Garswood Coal and Iron Company to investigate and report upon the effect of roburite fumes on the health of workmen. The Committee appointed by the Lancashire Miners' Federation complain that the operations expressed in the report of the specialists, who are two medical practitioners and an analyst, are so shrouded in a multitude of technical scientific statements that it is difficult to discover what their conclusions really are; but the report, it is pointed out, evidently establishes the following points, namely:—

- (1) that the fumes of roburite, when inhaled into the system, are an exceedingly deadly poison, even in the smallest quantity;
- (2) that when these fumes are inhaled into the system in a coal-mine, they carry with them two poisonous gases, differing from each other only by a little in their harmful effect on the human system, viz., nitric oxide and carbonic oxide;
- (3) that roburite may be safe while kept in the sealed cartridges, but the moment they are broken and exposed to the air, the substance is so volatile and poisonous that it at once becomes a great source of danger;
- (4) that incomplete or partial combustion of roburite allows the deadly elements of the composition—nitro-benzene—to escape and freely mix with the air in the Mine, and therefore to be breathed by the men or absorbed by contact with the skin;
- (5) that roburite fired in coal dust gives off a recognised quantity of carbonic oxide;
- (6) that in handling roburite the greatest possible care is necessary, the greatest danger is risked, and the slightest departure from this may be followed by serious results;
- (7) that in the cases examined of men who had worked in places through which the roburite fumes had passed, they suffered from carbonic oxide-poisoning when small quantities of the gases mixed with air had been inhaled;
- (8) that specially trained men only should manipulate or be entrusted with roburite;
- (9) that no Miner would be safe in his place until all the fumes had disappeared;
- (10) that where roburite is used the ventilation must be perfect, with a large quantity of air, and the brattice must be kept close to the coal-face.

These ten facts, it is urged, surely fully establish the whole of the Miners' contention that overhead fumes are injurious to the health of the workmen.

After some discussion, the report was unanimously adopted by the Conference, and as a result, the future use of roburite in Mines for shot-firing purposes will be opposed by the workmen.

EXTRACT from the report on the risks arising and the precautions to be adopted in the manufacture and handling of Nitro-Benzole and Di-Nitro-Benzole, dated 28th November 1892, by Dr. Dupré, F.R.S., and Commander Hamilton P. Smith, R.N.

"Benzole and toluol (coal-tar products) having been treated with nitric and sulphuric acids at moderate temperatures become nitro-benzole or nitro-toluol; further treated with nitric and sulphuric acids at higher temperature, these become di-nitro-benzole or di-nitro-toluol and assume a crystalline form at a temperature of from 158° to 176° F. Meta-di nitro-benzole, when pure, is a crystalline substance, practically inodorous even at a temperature of 80° F. It does not volatilize to any appreciable degree at any temperature below 80° F., but is very sensibly volatile at 120° F. and upwards. It is quite dry to the touch, and does not produce a greasy stain on paper when rubbed upon it. It melts at 194° F.

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- "10. Where di-nitro-benzole has to be handled, the hands shall always be protected from direct contact with it, either by the use of india-rubber gloves (kept perfectly clean, especially in the inner side), or by means of rags which can be destroyed after use.
- "11. Where di-nitro-benzole is broken by hand, the instrument used shall be a bar, spade, or tool (if of metal iron or steel should not be used), with a handle long enough to prevent the worker's face from coming into near contact with the material.
- "12. In all rooms or sheds in which the process, either of purifying, grinding, mixing materials of which di-nitro-benzole forms a part, efficient "cowls," ventilating shafts, and mechanical ventilating fans shall be provided to carry off the dust or fumes generated.
- "13. Drying stoves shall be efficiently ventilated, and, when possible, be charged and drawn at fixed times, and a free current of air shall be admitted for some time prior to the workers entering to draw, either a part or the whole of the contents.
- "14. In the process of filling cartridges, the material shall not be touched by hand, but suitable scoops shall be used, and where patent ventilated cartridge-filling machines are not used, there shall be efficient mechanical ventilation arranged in such a manner that the suction shall draw the fumes or dust away from and not across or over the faces of the workers.

"15. A register in a prescribed form shall be kept, and it shall be the duty of a responsible person named by the firm to enter, at least once a week, a statement that he has personally satisfied himself that each and all of the special rules have been observed, or if not, reasons to be stated for such non-observance. The surgeon to enter in this register the dates of his visits, the results of such visits, and any requirement made by him.

"16. The 'dipping' rooms to be efficiently ventilated.

"Di-nitro-benzole is, of course, extensively used in the manufacture of certain dyes, in a small degree for other purposes, but as in such factories (where it is used), the substance is practically never touched by hand, its properties are entirely changed, and the work is carried on in closed vessels which protect the workers from poisonous fumes, we have, therefore, not thought it necessary to carry this inquiry further."

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(True Extract.)

J. F. PRICE,
Chief Secretary.

To all District Magistrates.

„ the Inspector-General of Police.

„ „ Commissioner of Police, Madras.

„ „ Chemical Examiner to Government.

„ Messrs. Parry and Co.

„ „ Best and Co.

„ „ Arbuthnot and Co.

Copy to the Public Works Department, Railway Branch.

„ „ Inspector-General of Ordnance.

Issued

Recd.

Encl.

G.O., 14th August 1895, No. 1699.

AUGUST.

Roburite.

Communicating to District Magistrates and others endorsement of the Government of India forwarding copy of its letter to the Government of Bombay authorizing it to direct the application to — of the tests contained in the rules which are in force in England, pending the issue of a revised set of rules on the subject, and enclosing a copy of certain papers on the question of the suitability of — for use in Mines.

GOVERNMENT OF MADRAS.

JUDICIAL DEPARTMENT.

READ—the following paper :—

From J. P. HEWETT, Esq., C.I.E., Officiating Secretary to the Government of India (Home Department—Public), to the Chief Secretary to the Government of Bombay, dated Simla, the 29th July 1895, No. 1131.

I am directed to acknowledge the receipt of your letter No. 4567, dated the 18th ultimo, forwarding copy of a report of the Chemical Analyser to the Government of Bombay, in which he gives his opinion as to the tests which should be applied to Roburite. The Governor in Council concurs in the view expressed by the Chemical Analyser that the rules adopted in England for the test of such explosives as are included in class 3, division 2, but do not contain gun-cotton, are suitable for the testing of Roburite. Your letter further refers for orders the question raised by Messrs. Anderson and Co. as to their being allowed to mix the ingredients of Roburite in India.

2. As regards the testing of Roburite, I am to say that the Government of India are awaiting further information from Her Majesty's Secretary of State, in view to issuing a revised set of rules on the subject. Pending the issue of such rules, the Governor-General in Council authorizes the Government of Bombay to direct the application to Roburite of the tests contained in the rules* which, it is understood, are in force in England, a copy of which was forwarded with my letter No. 427, dated the 16th March 1895.

* Copy enclosed.

3. With regard to the question as to the manufacture of Roburite in India, referred to in the last paragraph of your letter, I am directed to say that the Government of India will be prepared to grant licenses to mix and manufacture Roburite after the persons wishing to manufacture the explosive have arranged for the place of its manufacture to the satisfaction of the Local Government in whose territories they propose to carry on the work. The Government of India will be glad, in the event of a place of manufacture being sanctioned by the Bombay Government, if the Governor in Council will make proposals as to the conditions which should, in his opinion, be entered in such licenses.

Extract paragraph 2 of letter from the Chemical Examiner to the Government of Bengal, No. 398-A., dated the 17th April 1895.

Extract paragraph 5 of letter from the Chemical Examiner to the Government of Bengal, No. 14-A., dated the 11th January 1892, and enclosures.

Appendix V to the Seventeenth Annual Report of Her Majesty's Inspector of Explosives for the year 1892, containing extracts from the Report by Dr. Dupré and Commander Smith on the risks arising and the precautions to be observed in the manufacture and handling of nitro-benzole and di-nitro-benzole.

4. I am at the same time to enclose, for the information of the Governor in Council, a copy of the papers mentioned in the margin on the question of the suitability of Roburite for use in Mines and to say that the Secretary of State for India has been asked whether the objections made to its use are still maintained and, if not, how they have been removed.

No. 1132.

Copy, with copy of the papers referred to in paragraph 4, forwarded to the Government of Bengal for information and guidance, with reference to the correspondence ending with the letter from this Office No. 913, dated the 14th June 1895.

No. 1133.

Copy, with copy of the papers referred to in paragraph 4, forwarded to other Local Governments and Administrations for information and guidance, in continuation of endorsement Nos. 429-436, dated the 16th March 1895.

(By order.)

(Signed) H. LUSON,
Offg. Depy. Secy. to the Govt. India.

To the Government of Madras.

ENCLOSURES.

EXTRACT paragraph 2 of letter from the Chemical Examiner to the Government of Bengal, No. 398-A., dated the 17th April 1895.

2. In this connection I have the honour to draw attention to the circumstance that roburite has been considered unsuitable for use in Mines. This matter was referred to by Surgeon-Lieutenant-Colonel Warden in his letter No. 14-A., dated the 11th January 1892, to the Under Secretary to the Government of Bengal, Judicial Department.

I do not know whether the use of roburite in Mines in India is contemplated or whether the objections to its use in Mines in England originally raised are still maintained.

EXTRACT paragraph 5 of letter from the Chemical Examiner to the Government of Bengal, No. 14-A., dated the 11th January 1892.

5. Another point to which I think I ought to refer is that at the "Miners' National Conference," held in Manchester in 1889, the use of roburite was condemned. A question in Parliament was asked the Secretary of State by Mr. J. S. Balfour regarding the use of roburite in Mines. I append Mr. Balfour's question and Mr. Mathews' reply, and also a copy of the proceedings of the Lancashire Miners' Conference. In England, a question of this nature would engage the attention of one of Her Majesty's Inspectors of Explosives, but in India there is no officer, I believe, empowered with similar functions. With the growing use of high explosives in India, I would venture to respectfully suggest that the appointment of one or more officers as Inspectors of Explosives is most highly desirable.

ROBURITE.

Mr. J. S. Balfour asked the Secretary of State for the Home Department whether his attention had been directed to the growing use in Lancashire coal-mines of the explosive called roburite; whether he was aware that the Miners' National Conference, held in Manchester on 14th July 1889, condemned the use of roburite as injurious to the health of the Miners; and whether, if any doubt existed on this point, he would direct an inquiry into the matter, and would give the men an opportunity of producing scientific and other evidence in support of their view.

Mr. Mathews.—Yes, sir, I am informed by the Inspector that there is a growing use of roburite in the Lancashire collieries. It is a useful explosive, and practically safe for use in fiery Mines. I gather from newspaper reports that its use has been condemned by Miners as injurious to health. An inquiry was recently held into this matter by a Committee of Experts on which the Miners' Federation was represented, and their conclusion was that, if proper care is exercised by Managers, short-firers and colliers, the use of roburite will not add to the harmful conditions under which the Miner works. The Inspector informs me that means are now being devised for removing the fumes by ventilation before persons re-enter and for keeping persons out of the return air, and under these circumstances he does not consider any further inquiry, at any rate at present, desirable.

USE OF ROBURITE IN MINES.

A Conference of the Lancashire Miners' Federation was held at Wigan on 4th July, when a special report, which had been prepared by a Committee appointed by the Federation to make investigations into alleged injurious effects upon the health of the Miners caused by the use of roburite for shot-firing purposes in Mines was brought up for consideration. This report, which is the joint production of the whole of the Committee, consisting of S. Woods, the President, Mr. S. Ashton, Secretary of the Federation, Mr. S. Aspinwal, and four Colliers, takes the form of a criticism upon the conclusions arrived at by Messrs. H. B. Dickson, C. I. Mouney and N. Hannah, who were appointed jointly by the employers and workmen engaged at the Garswood Coal and Iron Company to investigate and report upon the effect of roburite fumes on the health of workmen. The Committee appointed by the Lancashire Miners' Federation complain that the operations expressed in the report of the specialists, who are two medical practitioners and an analyst, are so shrouded in a multitude of technical scientific statements that it is difficult to discover what their conclusions really are; but the report, it is pointed out, evidently establishes the following points, namely:—

- (1) that the fumes of roburite, when inhaled into the system, are an exceedingly deadly poison, even in the smallest quantity;
- (2) that when these fumes are inhaled into the system in a coal-mine, they carry with them two poisonous gases, differing from each other only by a little in their harmful effect on the human system, viz., nitric oxide and carbonic oxide;
- (3) that roburite may be safe while kept in the sealed cartridges, but the moment they are broken and exposed to the air, the substance is so volatile and poisonous that it at once becomes a great source of danger;
- (4) that incomplete or partial combustion of roburite allows the deadly elements of the composition—nitro-benzene—to escape and freely mix with the air in the Mine, and therefore to be breathed by the men or absorbed by contact with the skin;
- (5) that roburite fired in coal dust gives off a recognised quantity of carbonic oxide;
- (6) that in handling roburite the greatest possible care is necessary, the greatest danger is risked, and the slightest departure from this may be followed by serious results;
- (7) that in the cases examined of men who had worked in places through which the roburite fumes had passed, they suffered from carbonic oxide-poisoning when small quantities of the gases mixed with air had been inhaled;
- (8) that specially trained men only should manipulate or be entrusted with roburite;
- (9) that no Miner would be safe in his place until all the fumes had disappeared;
- (10) that where roburite is used the ventilation must be perfect, with a large quantity of air, and the brattice must be kept close to the coal-face.

These ten facts, it is urged, surely fully establish the whole of the Miners' contention that overhead fumes are injurious to the health of the workmen.

After some discussion, the report was unanimously adopted by the Conference, and as a result, the future use of roburite in Mines for shot-firing purposes will be opposed by the workmen.

EXTRACT from the report on the risks arising and the precautions to be adopted in the manufacture and handling of Nitro-Benzole and Di-Nitro-Benzole, dated 28th November 1892, by Dr. Dupré, F.R.S., and Commander Hamilton P. Smith, R.N.

"Benzole and toluol (coal-tar products) having been treated with nitric and sulphuric acids at moderate temperatures become nitro-benzole or nitro-toluol; further treated with nitric and sulphuric acids at higher temperature, these become di-nitro-benzole or di-nitro-toluol and assume a crystalline form at a temperature of from 158° to 176° F. Meta-di nitro-benzole, when pure, is a yellow crystalline substance, practically inodorous even at a temperature of 80° F. It does not volatilize to any appreciable degree at any temperature below 80° F., but is very sensibly volatile at 120° F. and upwards. It is quite dry to the touch, and does not produce a greasy stain on paper when rubbed upon it. It melts at 194° F.

"Ordinary commercial di-nitro-benzole, however, generally contains a greater or lesser amount of impurities. Some of these impurities are more volatile than the di-nitro-benzole, while some are fluid at ordinary temperature, they thus impart to it a more or less powerful smell, resembling that of oil of bitter almonds (due sometimes, but not always, to the presence of nitro-benzole), and render the substance more or less greasy to the touch.

"The presence of these products considerably increase the danger incurred in working with di-nitro-benzole, since it is at least highly probable that their vapours are poisonous (there are no direct observations bearing on this point), but more particularly because the slightly greasy di-nitro-benzole adhere far more readily to the fingers and is more readily absorbed through the skin than pure dry di-nitro-benzole.

"In most, if not all, the factories in which di-nitro-benzole is used in the manufacture of explosives the commercial product is submitted to some sort of purification, but this purification is merely to get rid of or neutralise the free acid present, so as to comply with the requirements of the explosive department of the Home Office, and does not materially affect the impurities above mentioned. Meta-di-nitro-benzole acts as a poison, whether ingested, absorbed through the skin, or inhaled into the lungs in the form of vapour or dust. With pure di-nitro-benzole the danger from vapours is present only at a temperature considerably exceeding 100° F., but the danger from dust is of course always present.

"These properties suggest certain precautions, some of which will be stated further on, but here we may mention that manufacturers of explosives should, if possible, use only such di-nitro-benzole as is free, practically, from smell, produces no greasy stain when rubbed on paper, and does not sensibly volatilize at ordinary temperatures.

"Most manufacturers of di-nitro-benzole for purposes entirely unconnected with the more dangerous qualities of the impure di-nitro-benzole, now aim at producing only the pure compound, and have in a great measure succeeded.

"There is, therefore, no difficulty in procuring it; opinions have differed as to whether injury to the workers has been due to the inhalation of fumes, or absorption through the skin of the fluid nitro-benzole, or whether to the inhalation of fumes or dust, or absorption of fine particles of the solid di-nitro-benzole, or whether both were alike dangerous. That nitro-benzole taken internally is a poison will be readily admitted, but our investigations show that with the ordinary caution of sufficient ventilation, necessary in all chemical works, no injury to the health of the workers in the manufacture of nitro-benzole has happened which would call for special legislation."

"Our investigations in regard to di-nitro-benzole lead to very different conclusions, confirming the opinion that this substance is a dangerous poison, which affects injuriously, in a very mild form, those engaged in the manufacture very seriously—sometimes fatally—the workers who handle it or inhale fumes or dust, in places where it forms an ingredient in the manufacture."

"For the benefit of those employed in handling or subject to the fumes of di-nitro-benzole as an ingredient in the manufacture of explosives, we strongly urge that precautionary measures, suggested by us, should be enforced, and in doing so it is but fair to say that we have seen the benefit of such precautions where many of our suggestions have for long, without outside pressure, been carried out.

"At the Roburite Company's works at Gathurst, the beneficial effect of the care taken by the management, and by Dr. Prosser White, their medical adviser, is most marked.

"In the manufacture of explosives, di-nitro-benzole is largely used; the process of manufacture varies slightly in different works, but the following may be taken as a general description.

"The di-nitro-benzole arrives in the purified state, packed in casks in the form of irregular lumps, or sometimes in cases containing numerous slabs.

"In most cases it is further purified to extract all acid; this is done sometimes in large vats in the open air, in which the material is soaked in water, heated by steam pipes, soda being used to neutralise the acid, it is then placed in a hydro-extractor, a jet of water being turned on whilst the containing vessel revolves; the purified di-nitro-benzole is taken to the mixing house, where the oxydising salts and other materials are placed in a roller pan, or in some cases the di-nitro-benzole is put into steam jacket melting pots, and run into the warmed mixing pans in the liquid state.

"The mixture goes to the drying stoves, and in some cases is re-ground; thence it goes to the cartridge-filling rooms, where women and young persons are employed to fill the cartridges, which are taken in trays to the drying house, from there to the waterproofing house, where the cartridges are dipped in liquid paraffin wax.

"The effect upon the health of the miners who use cartridges composed in part of di-nitro-benzole has been carefully considered. We find in the report drawn up by Professor Dixon, Messrs. Mounsey and Hannah (February 1892) on the use of roburite in mines, the following:—

"We are inclined to attribute the cases of undoubted nitro-benzine poisoning which have been brought to our notice to improper manipulation of the cartridges."

"Also,—

"We conclude that roburite, when properly confined, undergoes complete combustion, leaving no trace of nitro-benzine derivations unburnt, but there is a chance of incomplete combustion occurring owing to the explosive not meeting with sufficient resistance."

"Although roburite is a strong poison, and undoubted cases of poisoning have arisen from the use of it in coal mines, yet, if stringent care is exercised, the use will not add to the harmful conditions, &c., the following are the chief precautions suggested by the gentlemen named:—

"Manipulation of cartridges to be entrusted to special shot-firers.

"Effecting tamping.

"Care to remove fumes from working faces.

"Products of explosive to be rapidly mixed with large volume of air.

"By the Roburite Company it is stated that in cases of imperfect combustion the unburnt portion of the cartridge is not diffused in fragments or dust, but becomes a solid hard lump; some partially-consumed cartridges answering this description were shown to us.

"On May 29th, 1891, a paper by Professor P. Phillips Bedson, Dr. David Drummond, and Dr. George H. Hume, was read before the Federated Institution of Mining Engineers, in which paper we find the following opinions:—

- "1. That the products of explosion of roburite and tonite are not more deleterious than products of the explosion of gunpowder.
- "2. That with regard to the effects of the explosion of roburite, no chemical evidence was obtained of the presence of nitro-benzine, and throughout the inquiry, no case of nitro-benzine poisoning was met with.
- "3. That with regard to the production from roburite, tonite, and gunpowder of carbon monoxide, the quantity found in average samples of air collected in the place is small, and is so quickly dissipated by the air current as to have been detected only in traces at an interval of five minutes after firing of the shot.
- "4. An interval of five minutes is recommended before the hewers return.
- "5. As part of the gas detected in the fumes is produced by the burning of the fuze, firing by electricity is recommended.

"It will be seen that the manipulation of di-nitro-benzole take place chiefly in the manufacture of explosives, and by workers in mines.

"In regard to the miners, after considering the opinions of the high authorities quoted, we do not think special protective legislation necessary, but in regard to explosive works, we beg to recommend the following:—

- "1. No person to be employed without a medical certificate, stating that he or she is physically fit for such employment.
- "2. No woman under the age of 21 to be employed.
- "3. No male young person under the age of 18 to be employed.
- "4. An examination of the workers at their work to be made at least once a fortnight by a certifying surgeon, who shall have power to order temporary suspension or total change of work for any person showing symptoms of suffering from the poison, or if after a fair trial he is of opinion that any person is by constitution unfit, he shall direct that such person shall cease to be employed.
- "5. A supply of fresh milk, and of any drug that the medical officer may consider desirable, shall be kept for all workers liable to suffer.
- "6. No meals to be taken in the workrooms.
- "7. There shall be provided separate lavatories for men and women, with a good supply of hot water, soap, nail brushes, and towels, and whenever the skin has come in contact with di-nitro-benzole, the part shall be immediately washed.
- "8. Overall suits and head-coverings shall be supplied to all workers in shops where di-nitro-benzole is used, these suits to be taken off before meals and before leaving the works, and to be washed at least once a week.
- "9. Suitable respirators (capable of being washed), folds of linen, or woollen material of open texture, or other suitable material, shall be supplied to those workers liable to inhale dust, and the wearing of such respirators shall be urged where the workers derive benefit from their use.
- "10. Where di-nitro-benzole has to be handled, the hands shall always be protected from direct contact with it, either by the use of india-rubber gloves (kept perfectly clean, especially in the inner side), or by means of rags which can be destroyed after use.
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