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BUREAU OF LABOR STATISTICS

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REPORT OF BRITISH DEPARTMENTAL COM-
MITTEE ON THE DANGER IN THE USE OF
LEAD IN THE PAINTING OF BUILDINGS



MARCH 1918

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INDUSTRIAL ACCIDENTS AND HYGIENE SECTION

REPORT OF BRITISH DEPARTMENT OF LABOR
COMMITTEE ON THE DANGER IN THE
USE OF LEAD IN THE PAINTING OF BUILDINGS



MARCH, 1916

WASHINGTON
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IN THE USE OF LEAD IN THE PAINTING OF BUILDINGS.

PREFACE.

The extent of lead poisoning among industrial workers has long been the subject of serious concern to the factory inspection authorities in Great Britain. By the Factory Act of 1895, regulations effective January 1, 1896, were introduced in Great Britain, requiring reports of lead poisoning in a list of factory industries and endeavoring to control the use of lead so far as practicable in order to safeguard the health of the workers. As a result of these regulations, the number of cases of lead poisoning has been greatly reduced, so that the average annual number reported in the five-year period, 1910-1914, was less than one-half the number annually reported in the five-year period, 1896-1900.

Owing to the difficulty of securing reports of cases of lead poisoning occurring outside of factories, information at all complete has been lacking as to the extent of lead poisoning among painters employed on buildings. On January 20, 1911, in response to a long-continued and insistent public demand, the Home Secretary appointed two departmental committees to study the danger attendant on the use of paints containing lead to the health of persons engaged in painting, and to consider and report what should be done to obviate or reduce the danger. To one of these committees was assigned the study of the painting of buildings, and to the other the painting of coaches and carriages. The report of the first committee, made after extensive investigations, was issued on May 5, 1915. The report, however, bears the date of November, 1914.

Besides the chairman, the committee consisted of two members of Parliament, the medical inspector of factories, and two representatives each of employing painters and of working painters. The appointment of this committee was prompted by the numerous cases of lead poisoning among painters and the belief that much of it could

be prevented by the same careful regulation or restriction which has proved effective in preventing lead poisoning in factories.

The committee's report is based upon the evidence of 118 witnesses, of whom 93 were selected by the committee as representatives of employers, painters, paint and paint material manufacturers, consultants to paint makers, chemists, architects, physicians, and others with special knowledge of ship and bridge painting and lead poisoning. The remaining 25 witnesses were brought forward by the white lead corrodors' section of the London Chamber of Commerce, and included a certain number from France, Germany, Austria, Belgium, Holland, and Switzerland. The report is printed in a volume of 134 pages, summarizing and analyzing the evidence and presenting the recommendations of the committee. A second volume giving the testimony of the witnesses in full is yet to be issued.

The enactment of a law prohibiting the importation, sale, or use of any paint material containing more than 5 per cent of its dry weight of a soluble lead compound is the principal recommendation of the committee. The committee recognized that in connection with such a restriction as it recommends it would be necessary to exempt specifically certain classes of colors, such as those used by artists, and that it would be desirable to authorize the granting of exemptions applicable only to special branches of the painting industry, where it could be shown to the satisfaction of the Home Secretary that the use of lead paints containing more than 5 per cent of soluble lead can not as yet be dispensed with. In such cases it is considered desirable that the Home Secretary be given power to enforce adequate precautionary measures, namely, abolition of dry rubbing down, provision for overalls, lunch rooms, cloak rooms, elevators, medical examinations, and the like, all of which should be made compulsory and should be enforced by adequate inspection. The supplying of lead materials to any user granted such exemption could be controlled by permitting paint manufacturers to supply the materials in question only on condition that they submit in writing to the proper Government department the name and address of the customer.

To give adequate time for paint makers and others to arrange for supplies of nonpoisonous materials and also to facilitate the introduction of modifications in painting methods, where special work necessitates such changes, the committee recommends that the restriction of the amount of lead in paints to not more than 5 per cent of soluble lead should not be enforced until three years after the publication of its report.

Attention is directed to the possible dangers to health arising from the vapors of linseed oil and turpentine or turpentine substitutes, used in all paints whether compounded with lead or leadless pigments, and to the consequent importance of investigating their possible

effect on health which the evidence before the committee indicated might be serious enough to require action on the part of the Home Office. The committee is of the opinion that any bill proposing to effectuate its recommendations should empower the Home Secretary to make regulations, if he finds it necessary, similar to those which he is now authorized by law to establish in factories and workshops.

The committee found that serious efforts had been made to deal with the evil of lead poisoning among house painters in France, Austria, Germany, Holland, Belgium, and Switzerland, and suggests that Great Britain should not be behind other countries in such a matter. Two methods of dealing with the evil suggested themselves: Either (1) the industry must be governed by a strict code of regulations, or (2) the use of lead must be prohibited altogether, or at any rate restricted within very narrow limits.

The proposal to deal with the situation by regulation the committee regards as impossible, for four principal reasons: (1) The inadequacy of regulations to cope with the evil; (2) the difficulty of prohibiting dry rubbing down, the most frequent cause of lead poisoning; (3) the cost and difficulty of complying with various precautionary measures; and (4) the insuperable difficulty of enforcing regulations by adequate inspection.

The second method for the prevention of lead poisoning, by the prohibition of the use of lead or its restriction within very narrow limits, was favored by a majority of employers who appeared before the committee.

The committee found from the evidence before it that not only are leadless paints suitable for interior work but that they had been used successfully on exterior surfaces. The leadless paints claimed to be of sufficient durability for exterior use were found already obtainable in considerable numbers, with every indication that legislation affecting the amount of lead permissible in paints would give a great impetus to the manufacture of the nonpoisonous substitutes.

The white lead industry in Great Britain in 1910 produced 58,000 tons, 85 per cent of which was for home consumption. It employed approximately 2,500 persons with annual wages of \$750,000. The capital invested amounted to \$6,500,000. In lead mining approximately 2,700 persons were employed, with annual wage payments only slightly less than in the white lead industry. It was estimated that the prohibition of the use of white lead according to the committee's recommendations would limit the demand for this material to 23,000 tons and would also reduce the demand for pig lead by about 25 per cent.

Among the persons employed as house painters in England and Wales, about 30 deaths from lead poisoning are reported each year. As to the number of nonfatal cases there are no complete statistics, since house painters do not come under the factory acts and reports of cases are entirely voluntary. However, the number of nonfatal cases is estimated at about 750 per annum.

In Great Britain the production of zinc oxide, the principal substitute for white lead in outdoor painting, is small, but the committee is of the opinion that a larger call for zinc paints would lead to the establishment of zinc oxide works on a scale sufficient to meet all demands.

The recommendations of the committee are signed by seven of its eight members, one, a representative of the association of master painters, submitting a minority report. This minority report vigorously challenges the conclusions and recommendations of the other members of the committee and urges that regulation should at least be given a thorough trial before prohibiting the use of so valuable a paint material as white lead. This recommendation is based upon the claim that the center of danger in all industries is the dust produced, and that in painting the dust-producing processes harmful to the health of the workers rest on the dry rubbing of lead paint. Therefore, it is suggested that the rational course is to prohibit under heavy penalties the practice of dry rubbing down, and thus remove the great source of danger from poisoning by lead dust.

The full text of the report is reproduced in the following pages.

INTRODUCTORY.

To the Right Honorable Reginald McKenna, M. P., His Majesty's Principal Secretary of State for the Home Department.

SIR: We have the honor to submit the following report dealing with the matters referred to us by His Majesty's principal secretary of state for the Home Department in the warrant of appointment issued on January 20, 1911.

The committee have met on 49 days, of which 37 were occupied in taking evidence and 12 solely in deliberation.

In all 118 witnesses were examined, of whom 93 were selected and called by the committee as adequately covering all the aspects of the problem submitted for solution, viz:

38 employers of house painters;
11 operatives' representatives;
25 representatives of makers of paint or paint materials;
2 consultants to paint makers;
4 chemists;
2 witnesses representing the Royal Institute of British Architects;
4 doctors and others with special knowledge of lead poisoning in the house painting industry;

5 witnesses who dealt mainly with ship painting;
2 witnesses who dealt mainly with bridge painting.

The remaining 25 witnesses were brought forward by the white lead corridorers' section of the London Chamber of Commerce, and included a certain number from France, Germany, Austria, Belgium, Holland, and Switzerland. Their evidence might well have been regarded as irrelevant to the questions involved in the terms of reference, but inasmuch as the interests which they represented were from an indirect point of view such as were most liable to be affected by any drastic interference with the present conditions of the house painting trade, the committee unanimously agreed that they should be heard, and the fullest consideration given to any arguments which they had to adduce. In the event, their evidence proved to be very voluminous and greatly extended the period occupied by the inquiry.

The full list of witnesses who attended at the request of the white lead corridorers' section of the London Chamber of Commerce was as follows:

Dr. I. Kaup, a chief of the central organization for social hygiene in Berlin, and formerly Government medical officer in Vienna, who spoke regarding the conditions in Germany and Austria;

Dr. J. Rambousek, Government medical officer for Bohemia, who gave evidence regarding the working of regulations in Austria;

Mr. de Morsier, reporter of the Swiss commission on the use of white lead;
 Dr. M. Koch, chef de clinique at the cantonal hospital of Geneva;
 Prof. Wefers-Bettink, of the University of Utrecht, who spoke regarding house painting in Holland;
 Mr. K. W. Goudby, consulting pathologist, Harley Street, London;
 Prof. H. E. Armstrong, professor of chemistry at the City and Guilds of London Central Institute;
 Mr. C. A. Klein, chief chemist of the Brimsdown White Lead Co.;
 Mr. O. Meissl, a master painter of Vienna, employing from 300 to 400 workmen;
 Mr. Ch. Ricker-Devroede, a master painter of Brussels;
 Mr. Nooijen, a master painter of The Hague, Holland;
 Mr. E. Niederhauser, a master painter of Cologne, Germany, employing from 80 to 100 workmen;
 Mr. J. Sibthorpe, a master house painter of Dublin, employing about 50 workmen;
 Mr. G. Plumb, foreman for Messrs. G. Trollope & Sons, house painters, Pimlico, employing from 150 to 350 painters;
 Mr. A. Villemot, president of the Color and Varnish Manufacturers' Association of Paris;
 Mr. E. Expert-Bezançon, a white lead manufacturer of Aubervilliers, France;
 Mr. H. Leyendecker, president of the German White Lead Manufacturers' Association;
 Mr. H. Miller, secretary of the London Chamber of Commerce;
 Capt. M. Francis and Mr. E. N. Humphreys, who spoke for the lead-mining interest of Halkyn, North Wales;
 Mr. H. Gardner and Mr. J. Matton, members of firms prominent in the wholesale metal market of London;
 Mr. J. Holt Schoolding, fellow of the Royal Statistical Society;
 Mr. H. G. Lancaster & Mr. E. M. Johnson, members of the firm of Locke, Lancaster & W. R. Johnson (Ltd.), white lead manufacturers, of London.

The whole evidence of the 118 witnesses examined is printed in extenso in a separate volume, and the purport of it is here summarized on the pages immediately following, viz, pages, 11 to 112.

SUMMARY OF EVIDENCE.

DR. T. M. LEGGE.

Dr. Legge, H. M. medical inspector of factories, gave evidence regarding the occurrence of cases of lead poisoning amongst house painters. The provisions of section 73 of the Factory and Workshop Act, 1901, requiring the notification by medical practitioners of cases of lead poisoning coming under their notice, does not apply to house painters, as the occupation of the latter is not one within the scope of the factory acts. A considerable number of cases are, however, reported every year by medical practitioners voluntarily without any legal requirement.

INCIDENCE OF LEAD POISONING.

In this way 1,973 cases were reported among house painters and plumbers in the years 1900-1909, inclusive, and 232 cases in 1910; of these 232 the house painters numbered 197, and the remaining 35 were plumbers; approximately the same relation between cases amongst house painters and those amongst plumbers obtains throughout the recorded figures.

The table handed in by Dr. Legge¹ shows that the largest number of reported cases occurs in London. Birmingham comes next, Manchester third, Bristol fourth, and Leeds fifth. In the whole of Scotland only 20 cases were reported in the five years 1906-1910, 12 of those cases being from Glasgow.

All the above figures, however, can only be regarded as a fraction of the whole, as the notification is purely voluntary.

FATAL CASES.

In regard to fatal cases of lead poisoning among house painters, Dr. Legge was able to give accurate statistics for England and Wales, as an arrangement exists with the registrar general whereby district registrars notify the chief inspector of factories and send copies of death certificates in all cases in which lead is directly or indirectly the cause.² In the 10 years 1900-1909, inclusive, the total number of deaths from lead poisoning among house painters and plumbers amounted to 387.

¹ See Appendix V (in Minutes of Evidence, presented in a separate volume of the original report).

² This arrangement has been in force with the registrar general for England and Wales since 1898, but unfortunately similar statistics are not available for Scotland and Ireland, as corresponding arrangements with the registrar generals of those countries were only made in 1910. The number of deaths reported in the last four years are as follows:

1910.....	35
1911.....	48
1912.....	47
1913.....	37

ESTIMATED TOTAL NUMBER OF CASES.

Complete statistics are available for attacks as well as deaths in respect of 19 classes of workers, namely:

1. Smelting of metals.
2. Brass works.
3. Sheet lead and lead piping.
4. Plumbing and soldering.
5. Printing.
6. File cutting.
7. Tinning and enameling.
8. White lead.
9. Red lead.
10. China and earthenware.
11. Lathotransfers.
12. Glass cutting and polishing.
13. Enameling iron plates.
14. Electric accumulators.
15. Paints and colors.
16. Coach building.
17. Shipbuilding.
18. Paint used in other industries.
19. Other industries.

Assuming that the proportion of deaths to attacks is about the same amongst house painters as amongst these other lead workers, Dr. Legge arrives at an estimated figure for the total attacks in the 10 years 1900-1909 amongst house painters and plumbers as 9,516.

SEVERITY OF ATTACKS.

In reply to Q. 161¹ Dr. Legge states that he was impressed with the prevalence of severe symptoms, such as paralysis and brain symptoms and chronic plumbism, amongst many of the house painters notified as suffering from lead poisoning.

SOURCES OF LEAD POISONING.

Dr. Legge, in reply to Q. 162,¹ classified the chief causes amongst house painters in the order of their importance as follows:

- (1) Dust from mixing dry white lead with oil.
- (2) Dust arising from paint which has dried on overalls.
- (3) Dust from sandpapering one coat of paint before applying another.
- (4) Contamination of food by unwashed hands.
- (5) Possibly the fumes from burning off old paint.

REGULATIONS.

While there are no regulations in force in Great Britain dealing with the work of house painters, because the Home Office has no powers to deal with the painting in places outside the scope of the Factory and Workshop Act, Dr. Legge regarded the dangers of lead poisoning as quite as great and perhaps greater than those in other employments for which regulations have been made.

He stated that exhaust ventilation could not be applied to the removal of dust in house painting, and he also saw such difficulties in regard to periodical medical examination of house painters as would deprive such a measure of its practical value.

FOREIGN REGULATIONS.

Dr. Legge then dealt with the regulations in force in Germany,¹ Belgium,² France,³ and Austria.⁴

MASTER HOUSE PAINTERS AND DECORATORS IN ENGLAND.

A number of employers of house painters stated that they did not at all realize the serious amount of lead poisoning occurring in their trade as they had only known a few slight cases amongst their own workers. They agreed, however, that the amount of sickness and death revealed by the registrar general's reports and other official statistics was very deplorable, and that some action was requisite. Each witness's attention was drawn in detail to the provision of washing accommodation, overalls, and mess rooms, as well as medical examination and other precautionary measures found to be necessary in industries in which lead is used. Each witness was then asked if he would prefer such regulations imposed on the trade or to have the use of lead in paints prohibited or restricted to a very small percentage.

(1) MASTER HOUSE PAINTERS WHO PREFER REGULATIONS TO PROHIBITION OF LEAD.

Mr. Laidler, a master house painter of Newcastle-on-Tyne, one of the witnesses who attended to give evidence on behalf of the National Association of Master House Painters and Decorators, stated that he employs from 80 to 120 painters, and has not known much illness among them. Two-fifths of the work is done with paints containing lead compounds; about 18 to 19 tons of lead are used annually and from 20 to 25 tons of the leadless paints. Mr. Laidler alluded to precautions taken to avoid risk of lead poisoning among his workers; arrangements are made for washing, and the witness considered that hot water was essential. The men provide themselves with clean overalls every week. Ordinary walls and ceilings are rubbed down by his men with dry sandpaper, but all the woodwork is rubbed down with pumice stone and water, thus avoiding dust. Dust arises, however, in scraping off old paint work and no precautions are taken to prevent the inhalation of this. Mr. Laidler was not aware of the extent to which lead poisoning prevailed among house painters, and agreed that it is very deplorable; he thought the existing state of affairs ought to be remedied, and stated emphatically that regulations should be made to insure proper precautions being taken, such as washing accommodation and the avoidance of dry rubbing down, but he could not recommend any method of controlling the dust arising from scraping off old paint. He stated that in his business, distempers, which are zinc water paints, have taken the place of most of the stipling and flattening work in which the principal danger of

¹ See Appendix VI (in Minutes of Evidence, presented in a separate volume of the original report).

² See Appendix VII (in Minutes of Evidence, presented in a separate volume of the original report).

³ See Appendix VIII (in Minutes of Evidence, presented in a separate volume of the original report).

⁴ See Appendix IX (in Minutes of Evidence, presented in a separate volume of the original report).

splashes arises. He did not consider that the trials of substitutes for white lead, such as those carried out by H. M. office of works in the preceding four years, had been extensive enough to convince him that lead could be prohibited.

Mr. J. R. Chappell, also representing the National Association of Master House Painters and Decorators, has been in business as a painter and decorator in Leeds for the last 30 years. His firm employ an average of about 25 painters and he has not known a single case of lead poisoning. Since the Workmen's Compensation Act came into force, however, the rate of insurance has increased and this he attributed partly to the risk of lead poisoning. He referred to experiments carried out by the National Association of Master House Painters in 1910, in which boards were coated with various paints and exposed in different parts of the country to varying atmospheric conditions, with the object of discovering the relative value of different paint materials; but he did not put in any evidence as to the conclusions reached. He agreed that the poisoning indicated by official statistics was very deplorable, but had not himself realized that there was any great danger; he concurred in thinking that this country should be abreast of other nations in its legislation for the worker's welfare.

As regards precautions, he considered hot water to be better than cold and stated that hot water is nearly always available. He would not object to allowing time for washing. He advocated compulsory wearing of overalls, prohibition of keeping outdoor jackets and the like in working rooms, and prohibition of eating near paint. He admitted that there was certainly danger in the operation of dry rubbing down, which was indispensable at certain stages of the painting process.

He was not aware of any possible way of removing the danger of lead poisoning entirely other than by using a substitute for lead. In his experience zinc paints were all right for inside but not for outside work. A test extending over four years, such as that referred to by the office of works, he would not consider a sufficiently long test; he would consider 10 years a more reasonable time.

He would not like any restriction in the working hours of painters; neither would he welcome periodical medical examination, though he would not be opposed to compensation for precautionary suspensions if a system of periodical examinations were introduced. The other precautions he follows out voluntarily at the present time. He would prefer regulations to the abolition of lead, but he admitted that there are certain dangers which would not be removed by regulations. If the committee came to the conclusion that those dangers are so serious that they can only be overcome by the abolition of lead, he would loyally abide by the decision of the committee.

Mr. J. H. McDermid also gave evidence as representing the National Association of Master House Painters and Decorators, and stated that he carried on business in Darlington with an average of 20 or 25 painters—in the season perhaps 40. He confirmed the evidence given by other representatives of the association and agreed that the incidence of lead poisoning was very deplorable. After the various precautionary measures considered necessary for prevention of lead poisoning had been explained to him, Mr. McDermid stated that he would prefer even stringent regulations rather than the abolition of lead; but he

would not like to do away altogether with sandpapering between coats and he could not suggest any means of removing the dust generated in this process or the spray given off when ornamental ceilings are being painted. In conclusion, he repeated that he was surprised at the extent of the mortality and sickness arising from the use of lead by painters, and considered that it was so serious that it was quite proper for the Government to take cognizance of it.

Mr. A. G. White gave evidence as the secretary of the National Federation of Building Trades Employers of Great Britain and Ireland; he had had about 20 years' experience as an employer of house painters, numbering from 100 to 200 on the average. During that period he knew of only three cases of lead poisoning that he could recall, but in addition to this his men were occasionally absent with slight attacks of colic. He had collected some statistics from various branches of the association, which reported, in respect of the experience of plumbism, as follows:

Branch.	Average number of painters employed.	Number of lead poisoning cases.
Southampton.....	60.....	Nil.
Leicester.....	.....	Nil.
Leamington.....	.....	Practically nil.
Chertsey.....	.....	Nil.
Northampton.....	(1 employer).....	Nil.
Liverpool.....	About 1,000.....	No record.
Bulbin.....	.....	3 in 1907-1909, 3 in 1909-10, 2 in 1910-11.

This witness considered that the incidence of lead poisoning in the house painting trade is not serious and that it is a diminishing evil. The members of his association had not collected any statistics concerning the number of days' absence owing to ill-health amongst painters, nor had they held any periodical medical examinations. These, in the witness's opinion, could not be carried out unless they were made compulsory. His association have never taken any collective measures to discover a substitute for white lead; although Mr. White had heard of a number of such paints he had not personally found anything satisfactory. In the witness's opinion the lead poisoning evil had been much exaggerated; when it was pointed out to him that the number of fatal cases was increasing and that the total deaths from lead poisoning among house painters were more numerous than amongst the workers in all factory industries taken together, he admitted that the trade required proper regulation and suggested that the heavy incidence of plumbism was due to the precautions common in other lead industries not being taken in the painting trade. (Q. 9192.) After dealing further with statistics of lead poisoning in detail the witness was questioned with regard to precautionary measures. He agreed that washing accommodation was essential and considered that the supply of hot water was generally practicable and could be made compulsory; he considered that overalls ought to be worn, but would object to the supply thereof by the employers; he would not oppose the responsibility for having them washed being laid on the employers. He thought the danger arising from keeping

them in the workroom was a small one, but a place for storage could be found if required. He said that meal rooms are sometimes provided, but he saw no real need for them. He admitted that there would be difficulty in carrying out regulations such as those fore-shadowed, but considered that the employers would obey such regulations if they were made compulsory.

He considered that in some instances at any rate dry rubbing down would be indispensable, and he could not agree offhand to the prohibition of this process. He thought it would be practicable for the men to be required to wear a mask, and believed he could make one "which would be no more objectionable to wear than a pair of motor goggles."

He could not suggest any way of obviating splashes on the face in painting molded ceilings and the like, but considered it would be sufficient for the men to wash them off afterwards.

With regard to stippling, he admitted that there is a certain amount of spray, and said he used to consider that "stippling a flat wall was one of the things that gives men colic sooner than anything else."

With regard to dust and fumes generally Mr. White could offer no suggestion other than the wearing of a mask, and said, "If the workers will not wear a mask there is no other way out of it but the prohibition of lead." He had tried various forms of zinc oxide paints, but had not found them as efficient as white lead either as regards covering power or durability. He did not think that the four years' trial of leadless paints by the office of works was long enough; he was of opinion that no tests of a substitute could be considered generally satisfactory unless tried on a ship.

Questioned in regard to further precautionary measures, he said he would not object to limitation of workers' hours to 48 a week; he would not object to periodical medical examination, as he thought it might be a good thing.

Summing up his evidence he said he would not object to a strict code of regulations, and was strongly of opinion that such a code was necessary wherever lead is used. With regard to the dust arising from dry rubbing down, however, he could not suggest any precaution other than the wearing of a mask.

Mr. C. E. Wilkinson attended as a representative of the London Association of Master Decorators. He carries on business as a decorator and jobbing builder in London. His firm employs an average of about 20 painters and he has known of no cases of lead poisoning or painter's colic. Some of his painters have been 25 years in his employment without illness. He stated that he was not satisfied as to the reality of the danger of lead poisoning, but thought that cases were wrongly certified. He was not aware of the number of deaths incurred from lead poisoning. He considered that the proportionate incidence was probably very small, but agreed that the fact of there being such a number of deaths was itself deplorable and that something should be done. He considered that regulations were all that was necessary. The provision of overalls and the required washing thereof by employers he considered not practicable and not necessary as the workmen themselves do it. The provision of a mess room would be sometimes difficult; men frequently take food in the rooms where they are working and this Mr. Wilkinson considered not a highly dangerous thing under the circumstances. It would not be

practicable to provide a place for overalls or a cloakroom for outdoor clothing. As regards washing accommodation he said the men always find some means for washing; good soap and cold water is sufficient. A regulation on this subject he considered unnecessary as the men carry towels and soap in their bag. The provision of exhaust draught for dry rubbing down he regarded as impossible, but he considered that the question of dust was exaggerated. Dry rubbing down could largely be dispensed with and the evolution of dust prevented by moistening the glass paper with turpentine. He also considered that lead dust was too heavy to float in the air. He thought medical examination would be a good thing and would not mind if a regulation were made to provide compensation for suspended workers. He stated that he would prefer regulations to prohibition of the use of lead, but considered many of the regulations under consideration impracticable. He thought a simple regulation would suffice. He did not agree with some of the regulations foreshadowed, and they could not all be enforced. If it were felt that unless the whole of the regulations were in force the health of the workpeople would still be in danger, he would not be surprised if prohibition were recommended. Mr. Wilkinson was unwilling to accept either the figures supplied by the painters' trade-unions or the statistics of the registrar general, although he said he could himself only speak for his own employees. He agreed that lead poisoning, if contracted at all, is contracted from the dust, and said his solution was the proper training and education of the painter in cleanliness. He was surprised to hear that good workmen and properly trained painters suffer from lead poisoning as it was contrary to his own experience.

See also the evidence of Messrs. Orr, Carfrac, Dobie, Guest, Bennett, Anderson, and Scott, representing the Association of Master House Painters in Scotland, and Mr. Sibthorpe, who attended at the request of the white-lead corridors' section of the London Chamber of Commerce; the evidence of these gentlemen is summarized on pages 30 to 34 and 104 to 106.

(2) MASTER HOUSE PAINTERS PARTIALLY IN FAVOR OF REGULATIONS.

Mr. J. D. Crace, a retired master decorator, and president of the Institute of British Decorators, gave evidence as a representative decorator of very large experience, stating that he was for 45 years engaged in first-class decoration, employing from 100 to 300 men. The amount of white lead used averaged about 3 tons annually in the latter years of his experience. He had tried zinc oxide a long time ago, but had practically no recent experience of leadless paints. He knew of one definite case of lead poisoning and five or six cases of slight illness in the course of his 45 years' experience.

Precautions were taken for which the foremen were responsible; soap and towels were provided, pails to wash in, and hot water where possible; overalls were provided by the men themselves. Rubbing down was usually done with dry sandpaper on old work, and this process caused dust; but witness was of opinion that the wet process of rubbing down could generally be used throughout. Mr. Crace was surprised at the extent of the lead poisoning evil disclosed by official figures, and agreed that it was very deplorable. He was of opinion

(Q. 1999) that regulations to a certain extent would be a very good thing; later, in reply to Sir Godfrey Faring, he expressed the opinion that prohibition of the use of lead would be disastrous, on the grounds particularly that artistic effects could not be satisfactorily achieved in interior decoration if lead is not used.

Mr. F. Grundy attended as president of the National Association of Master House Painters and Decorators. He had been in the business for 49 years and carries on business at Loughborough. He only employs about an average of 10 painters. He said that he had known of a case of lead poisoning some 10 years ago. He agreed that the amount of sickness and death represented by the official statistics was very deplorable, but he did not admit any danger arising from imperfect washing or from the taking home of dusty overalls. He did not admit the presence of any dust in painting operations, though he considered it a necessity to rub down work with dry sandpaper. He further considered it impossible to breathe spray when painting ornamental ceilings, and he did not recognize the possibility of splashes falling on the worker's face when stippling. In view of the witness's statement that he could not recognize any danger of dust or spray arising in sandpapering and other hazardous processes, the chairman declined to continue his examination of this witness.

In replying to other members of the committee, he stated that he had not given the subject of substitutes for lead much attention; neither did he recognize the necessity for any particular precautions other than the washing off of the looser portions of any paint that might adhere to the workers' hands.

Mr. J. C. Vaughan, of the National Association of Master House Painters and Decorators, stated that he has carried on business as a plumber and decorator at Hereford for over 30 years, employing an average of from 30 to 35 painters. He has only known of one case of lead poisoning, which occurred quite recently. He did not consider that the amount of lead poisoning shown by the official statistics was very large when compared with the number of painters employed, and that he agreed that all this sickness and death is very deplorable and that it was regrettable that this country should be behind others in dealing with the evil. He realized the importance of cleanliness, and considered washing accommodation essential but not always practicable. Some of the men will not trouble to get hot water even when it is practicable to do so. He considered that towels, soap, and nailbrushes should be supplied by the employer, and suggested that such a regulation might be enforced by the local policeman or the sanitary inspector or the inland revenue officer, or alternatively by the appointment of subinspectors for this special purpose. Mr. Vaughan admitted that there would be difficulty in ascertaining where the work was going on and visits to private houses might also be resented. In any case the witness was of opinion that members of the National Association of Master House Painters would loyally carry out regulations.

Mr. Vaughan would not object to supplying and providing for the washing of overalls if it were made compulsory; a storage place for these, as well as for outdoor clothing put off during working hours, could also be provided, though the provision of a separate place for outdoor clothing and a place for keeping food free from contamination would not always be possible. Mr. Vaughan thought dry rubbing down not indispensable; even after the first coat of paint had been

applied rubbing down could be done with pumice stone. As regards hours worked by painters Mr. Vaughan would not object to a 48-hours' limit if it applied to all employers; he would also agree to periodical medical examination at the employer's expense. Compensation in cases of suspension would involve further insurance.

With regard to substitutes he said he had not found a successful nonpoisonous paint; if the office of works could dispense with lead Mr. Vaughan thought other people should be able to do so. A system of regulations would involve increased charges to customers, whereas in the witness's opinion the use of a substitute for lead would involve more frequent painting.

Mr. J. J. Honeychurch attended as a representative of the London Association of Master Decorators and stated that he carries on a building and painting business in various parts of the country, employing an average of 40 painters. He has known cases of lead poisoning among painters, not in connection with his own firm. He did not regard lead poisoning as a real danger for house painters. He stated that there are about 90 firms in his association, but he could not give the number of painters employed by them. He considered that the incidence of lead poisoning did not represent a very large percentage of the number engaged in painting, but agreed that the actual fact of this sickness and death was lamentable and something would have to be done to eradicate the evil. He admitted that lead poisoning would disappear under prohibition, while regulations would only offer a partial remedy. He thought provision of overalls by the employer impossible; the provision of mess rooms and cloakrooms for outdoor clothing impracticable; provision for the storage of overalls could, however, be made. Washing accommodation he considered very necessary, but hot water is not always available. The supply of clean towels, nailbrushes, and soap by employers would not be a great trouble. The use of exhaust draught to remove the dust is impossible. The establishment of periodical medical examination would be possible. He did not see, however, how compensation could be provided for suspended workers. In summarizing the various regulations under consideration he said it would not be possible to carry them all out. Prohibition of lead would be all right provided there was a suitable substitute, but in the present position he would not favor prohibition. Either regulations such as foreshadowed or prohibition would certainly mean much less business. Trials with various substitutes are being made by individual employers at the present time. Zinc keeps its color better than lead, but has not such a good covering power and is more expensive.

(3) MASTER HOUSE PAINTERS WHO PREFER PROHIBITION TO REGULATIONS.

The employers who declared themselves in favor of prohibition or restriction of the use of lead rather than regulations comprised the following:

WITNESSES REPRESENTING THE NATIONAL ASSOCIATION OF MASTER HOUSE PAINTERS AND DECORATORS.

Mr. H. A. Campbell, whose experience extends over 35 years, has his business in the west of London, and employs an average of about 60 painters. He did not think that

and spray as is frequently contended; he agreed that exhaust ventilation was not practicable and recommended the damping of glass paper with turps; he admitted it would not be possible to get rid of all the dust generated in the course of painting work. In view of the almost insuperable difficulties of enforcing a code of regulations, Mr. Campbell thought it would be better to prohibit the use of lead.

Mr. Vigurs Harris has been an employer of painters for the last 40 years at Plymouth; the average number of men employed in his business would be about 50. He considered that dry rubbing down could not be dispensed with between successive coats of paint; he also considered it impracticable to deal with spray by exhaust draught. He had had a long experience with zinc paints and found lead almost a necessity for certain outside work; he considered that it would not matter if all employers were put on the same level by the prohibition of the use of lead applying to them all. He stated emphatically that he would much prefer the abolition of the use of lead to the enforcement of strict regulations; he considered the data available to the trade sufficient to justify the abolition of lead for interior work; while he was not quite clear as regards prohibition of lead for outside painting, he repeated that he would rather risk it than have regulations.

Mr. W. H. Cantrill has had 23 years' experience as a master painter carrying on business in Manchester and employing an average of about 45 painters. He had some knowledge of lead poisoning, having paid compensation in three cases, and he was of opinion there should have been legislation on the subject before now. Rubbing down was indispensable between coats, and there would be a certain amount—in his opinion small—of spray which could not be obviated. Under these circumstances he considered that the only way to meet the danger would be by dispensing with the use of lead. He had used leadless paints both for interior and exterior work, and found that the men handled these paints in quite a satisfactory manner when they were ignorant of their composition. The witness considered that a standard of zinc paints should be fixed, and thought it desirable that time should be allowed for establishing a formula. He was of opinion that such a formula could be established on a basis of five years' use of zinc paints, but he adhered to the position that he would absolutely prefer abolition of lead to regulations.

Mr. J. Pattrell, of Sheffield, stated that he had been in the painting business for 58 years; of these he had been an employer for 49 years. He employs an average of 50 painters and has only known of one case of lead poisoning—an apprentice some 15 years ago. He stated that they pay an increased rate for insurance against workmen's compensation since the inclusion of lead poisoning in the act of 1906. His men are not periodically medically examined and therefore some of them may suffer without his knowledge. He has taken a prominent part in the work of the Master House Painters' Association, having been president in 1899; members were not, however, able to bring up cases of lead poisoning at the discussions and, therefore, they regarded the painting operation as being a healthy one and had taken no steps to collect statistics of illness. The association had

talked over the question of substitutes for white lead, but did not consider they had found anything equal to white lead.

Mr. Pattrell laid stress on the advantage of educating apprentices properly. He agreed that the lead poisoning indicated by the published statistics was very deplorable, and, in view of the measures of prohibition and regulation abroad, he agreed that Great Britain should be abreast of other countries as far as possible. He believed in the importance of personal cleanliness on the part of painters, but did not consider hot water absolutely necessary, though he held it was better than cold and also that it was generally obtainable. He approved of the wearing of overalls and the prohibition of taking food in places where the risk of lead dust arose. He did not consider that there was much dust in connection with painting operations, as the rubbing down is done with pumice stone and water; sandpapering he maintained could be dispensed with. The only remedies he had to suggest were the covering up of the nostrils, plentiful supply of fresh air and periodical sweeping of the floors.

He suggested that lead might be done away with for inside ceilings, and considered that employers would loyally carry out such a prohibition even if no proper means were provided for enforcing it. He would also prohibit the use of white lead in all stippled surfaces. He thought that there was no way of entirely removing the danger without prohibition of lead.

Mr. Pattrell stated that he had used zinc paint occasionally for over 30 years, but had not found it so satisfactory as lead in regard to wearing quality or covering power; if a really efficient substitute could be found he agreed that the use of lead should be prohibited. The alternative of stringent regulations being put to him, he contended that it was not necessary, in his opinion, to make all these regulations, but if the committee were definitely faced with the alternative he thought it would be better for them to recommend the abolition of lead rather than the introduction of such regulations.

Mr. A. Wiltshier is a house painter who has been carrying on business for 22 years at Canterbury, employing on the average about 40 painters. He has only known of one case of lead poisoning—not a serious one—though the insurance premiums have been raised in the painting trade of late years. He stated that he realized the magnitude of the lead poisoning evil, although he was not aware of the reported figures. He considered the sickness to be deplorable and advocated precautions, such as ventilation and cleanliness, provision for washing to include hot water where possible, wearing of overalls, provision of cloakroom and meal-room accommodation, and the like. He did not think there was serious danger from the breathing of dust and spray, although he said "from sandpapering you get a good bit of dust." He advocated the abolition of dry rubbing down before the first coat, but could not suggest a remedy for dust arising from sandpapering between coats; this latter, however, would not constitute more than 5 per cent of the dust. He had no suggestion to offer regarding the spray from painting ceilings, but thought the danger from stippling could be overcome by washing the hands and face immediately after the work.

In reply to the question "Is it possible to remove the dangers entirely in any other way than by using a substitute for lead?" he said, "No."

He said he had used zinc oxide, but his experience with it had not been very favorable. He did not think that the office of works' experience of durability of paints extending over four years was very conclusive. He stated that he would agree to limitation by the hours of employment and periodical medical examination by the certifying surgeon, but he did not agree that the employers should pay for this. He would agree to pay compensation to any worker who was suspended by the doctor on account of doubtful health. He considered that reduced hours of labor and other precautions would mean that the client would have to pay more for painting work; with regard to mess rooms, however, there would be difficulty in connection with small jobs. Mr. Wiltshier stated definitely that he would prefer the abolition of lead to regulations if an efficient substitute for lead is available, and, further, he stated he would agree to prohibition of lead if it would prevent the mortality amongst painters (Q. 6783).

In the latter part of his evidence Mr. Wiltshier gave particulars of the painting of the Canterbury post office with zinc paint; he stated that this was so badly that it had to be repainted after one year.¹ In conclusion, Mr. Wiltshier said that he considered four years was a good trial to give to any paint, but unfortunately some customers make it go to five years.

Mr. J. W. Barker, general house painter and decorator, of Leicester, also attended as a representative of the National Association of Master House Painters and Decorators. He stated that he had been in the painting business all his life and employed an average of 30 hands—more than this in summer. He gave details of three cases of lead poisoning which had occurred amongst his workers in the last two years, but stated that he had known of no other cases during his 40 years' experience; he thought this pointed to so slight a risk that employers might well not have realized the extent of the danger; he was surprised at the official figures as published by the Board of Trade in the Labor Gazette, and agreed that this amount of lead poisoning was very deplorable. He also recognized that it was regrettable that this country should be behind other nations in regard to legislating for the welfare of house painters. He advocated washing accommodation where lead paints are used, and considered hot water much better than cold, but not always possible to obtain; he advocated the use of overalls, but considered that it was not always possible to provide a meal room. The sandpapering of coats of paint he regarded as indispensable in some cases, but he could not suggest any possible way of applying exhaust either to remove that dust or the spray which arises in certain painting operations, but he thought the latter danger could be minimized by the use of respirators.

The witness could not suggest any way of entirely removing the danger except by prohibition of the use of lead; he had not himself found a satisfactory substitute and was surprised to hear of the success of the office of works' experiments; with regard to these he did not consider four years a sufficient test—he would like at least eight years outside. He would object to the limitation of working hours to 48 per week owing to the seasonal nature of the painter's occupa-

¹ See, however, Mr. Patterson's evidence, page 66.

tion, but he would not object to periodical medical examination at the expense of the employer.

Mr. Barker realized that inspection would be difficult in the painting trade, and that it would be almost impossible to carry out regulations such as suggested. He would prefer that the use of lead should be prohibited and the painters should make the best of the substitutes at their disposal, rather than that the trade should be subjected to regulations.

In further examination by Mr. Sutherland, Mr. Barker stated that he did not know of any substitute which was as good as white lead, which he had found in particular the best for priming purposes. In view of the statistics of lead poisoning he considered it absolutely necessary that some restriction should be introduced, and said that if the committee decide in favor of precautions they would doubtless be irksome, but they would try to carry them out; if the regulations were to be numerous Mr. Barker repeated that he would prefer the abolition of the use of lead (Q. 7099). He considered that the cost of precautionary restrictions would be far greater than the cost involved in a change to nonlead paints. In conclusion Mr. Barker said, replying to a question by Mr. Sutherland, that if the use of white lead is prohibited the National Association of Master House Painters and Decorators would not take exception to it.

Mr. T. McHugh said he attended as a representative of the National Association of Master House Painters and Decorators, he being a member of the council of that association.

He has long been of opinion that lead poisoning is a real danger amongst house painters, and should be removed. Rather than issue a code of regulations similar to that introduced in other lead industries, Mr. McHugh would advocate the total prohibition of white lead, or failing that, a restriction to not more than 5 per cent of soluble lead compounds in paint.

The witness said it is generally admitted amongst the trade that lead is not absolutely necessary for interiors, but for outside work there is a feeling that there is nothing better than white lead as a body. He has himself used zinc white well mixed with varnish for exterior work, and stated "If there is good pure zinc oxide with plenty of varnish, in my opinion it is quite as good as white lead paint." (Q. 20688.) The cost of such a paint is not much different from that of a similar lead paint; taking the present price of lead into consideration, zinc is cheaper, but if white lead was totally prohibited the price of zinc would go up. He did not consider, however, that there would be any very great upheaval in the house painting trade if such a prohibition were introduced with a reasonable time allowance.

Mr. McHugh was at that time president of the Liverpool Master Builders' Association, who, at a representative meeting of 400 builders comprising the painting trade of the city of Liverpool, resolved unanimously that they would rather have total prohibition of white lead than any regulations or restrictions. Regulations which can be observed in a factory would be absolutely impossible to carry out on house painting jobs, and the witness regarded it as imperative that the evil of lead poisoning should be dealt with. He regards the record of deaths appearing monthly in the Board of Trade Labor Gazette as simply appalling.

Zinc oxide is being increasingly used in Liverpool, and Mr. McHugh finds that competent painters can apply it equally as well as lead.

WITNESSES REPRESENTING THE NATIONAL FEDERATION OF BUILDING TRADES EMPLOYERS.

Mr. J. S. Holliday, chairman and managing director of Messrs. Holliday & Greenwood (Ltd.), stated that he carried on business at Brixton; he had been concerned with house painting for about 36 years and employs an average of about 60 painters. He has not known of any cases of lead poisoning.

Mr. Holliday is president of the Institute of Builders; he had not previously realized the extent of the lead poisoning evil; he was astonished at the official figures, which he regarded as very deplorable. He considered it regrettable that this country should be behind other nations in legislating for the welfare of house painters.

With regard to precautionary measures he considered washing accommodation essential, but hot water is not generally obtainable. Overalls are worn by the painters but not supplied by the firm; he would have no objection to providing overalls and paying for the washing of them, if that were made a general rule. He would consider it impossible to provide in all cases a place for the painters to hang up their outdoor clothing. He was strongly in favor of provisions which would obviate the taking of meals in any place where there is risk of lead poisoning. With regard to sandpapering he said the trade had always been led to understand that it was indispensable. He could suggest no way of dealing with the dust arising in this process except by the wearing of a respirator. As regards splashes and spray which arise in the painting of ceilings and the like, he suggested the use of Duresco or some other nonpoisonous paint. He had used zinc white a good deal, but found it not quite so dense or possessed of such great preservative powers as white lead; he would not go so far as to say that the experience of the office of works alone would justify the prohibition of lead paints, although he agreed that, if their efficiency could be conclusively proved, the use of lead should be prohibited. If the use of lead is to be continued, he could not agree to the limitation of the painters' hours to 48 per week. He would not like to agree to medical examination at the employer's expense without consulting his partners. Finally, when the various regulations found necessary for the prevention of lead poisoning in other industries had been put to him, Mr. Holliday concluded that he could not agree to them and would prefer to do without lead entirely.

Mr. F. Higgs also gave evidence as representing the National Federation of Building Trades Employers of Great Britain and Ireland. He is a builder and contractor and has carried on business since 1880; partly a contract business in London, employing an average of 35 painters, and partly a jobbing business in Surrey, employing 12 painters. He has had no experience of lead poisoning, and thought that employers of house painters are only now beginning to realize the seriousness of the incidence of lead poisoning, which he considered deplorable. In legislation intended to combat such evils Mr. Higgs considered that Great Britain should act as a pioneer. He considered personal cleanliness as essential for lead workers, and said that hot water was certainly desirable, but it was not always practicable to

provide it. The process of dry rubbing down with sandpaper he regarded as indispensable, and could not suggest any precautionary measure to deal with this other than the wearing of a respirator. The various other precautionary measures necessary where lead compounds are handled were put to the witness, and he stated emphatically that he would rather see white lead abolished than have a number of vexatious regulations applied to the painting industry, although he considered white lead a better paint for pigmentary purposes, covering power, and the like, than any of the substitutes which he had tried. He had made no special investigations, but had used a number of leadless paints from time to time.

Mr. F. L. Walker, who has charge of the decorating department of Messrs. James Shoolbred & Co., Tottenham Court Road, gave evidence as a representative of the London Master Builders' Association. His firm employ an average of about 40 painters, taking the year through, and he has had about 25 years' experience in house painting work. He has only known one case of lead poisoning, and had not realized the extent of this evil among house painters. He agreed that the official figures of sickness and death from plumbism were unquestionably deplorable.

In his opinion sandpapering on new work was indispensable, and on other points also his evidence was entirely in agreement with that of Mr. Higgs. He also agreed with the conclusion of that witness that prohibition of the use of lead would be preferable to regulations on account of the impossibility, in his opinion, of securing compliance with an elaborate code of regulations such as has been found necessary to combat the evil of lead poisoning in other industries.

Mr. T. Hall gave evidence as a representative of the London Master Builders' Association. He has been connected with house painting for 45 years, the last 30 as a master at the Pitfield Wharf, Waterloo Bridge; he employs an average of about 50 painters, taking the whole year round, and has only known of one serious case of lead poisoning. He thought most employers were aware of the extent of the lead poisoning evil, which he agreed was very deplorable. He quoted the measure of prohibition of white lead adopted in France, and stated emphatically that he agreed with entire prohibition of lead in this country also. He stated he knew that the office of works were using a leadless substitute extensively, and said, "I have heard nothing against it; I have heard everything for it" (Q. 9558). In answer to a summing up question as to whether he would prefer abolition of lead for house painting to a complicated code of regulations he said, "I certainly would; I am most decided about that."

Mr. G. H. Merton has been connected with the business of decorating and painting at Liverpool for over 40 years; the average number of painters employed by his firm is between 60 and 80; he has only known of one case of lead poisoning. The federation have given some attention to lead poisoning, but have not made collective endeavors to secure a substitute for lead. He was not aware of the extent of the poisoning among painters, and considered that the official figures indicated an alarming state of affairs. Where lead is used he considered cleanliness important; washing accommodation, including soap, hot water, and nailbrushes, should be provided, but the supply of hot water in some cases is difficult. In witness's opinion it would be nearly impossible to combine hot water and

lations. He would object to supply his men with overalls and prefer to give increased wages rather than do so. To provide a storage place for outdoor clothing is sometimes difficult, but a rule should be made to provide for this. Separate mess-room accommodation is not always practicable. In Mr. Morton's opinion dry rubbing down is not indispensable and could be prohibited at any rate for new work. Where a certain amount of dust is inevitable the only precaution the witness could suggest is the wearing of a respirator. He could not suggest a means of protection against splashes in the case of ceilings when stippling. He could not suggest any way of removing the dangers entirely except by substituting some other material for white lead. So far his experience of substitutes has not been satisfactory either from the point of view of cost or durability, but he is continuing experiments. He would object to a system of medical examinations and would rather pay more wages to the men.

Summing up his evidence Mr. Morton said he would most emphatically object to setting up the necessary machinery to secure complete observance of a code of regulations providing for the supply of overalls, mess rooms, washing accommodation, avoidance of dust, limitation of hours, and the like. He would most decidedly prefer that the use of lead should be prohibited. The witness thought the prohibition of the use of lead might involve repainting twice as often as is now done. He recognized on the other hand that the cost of carrying out regulations would be considerable. The additional cost in either case would be borne by the customers. In further examination the witness stated that he had recently used one zinc white paint for external work which covered rather better than white lead and appeared to be quite as satisfactory.

Mr. F. Griffiths.—The principal regulations were put to this witness as to others, and he said he would prefer total abolition of white lead if the restrictions are at all arduous. The regulations enumerated by the chairman could be carried out in the witness's opinion, but it would be almost impossible to secure enforcement. He thought that regulations would minimize lead poisoning and would not entail any considerable hardship, but it would be difficult to guard the workers from breathing dust generated in certain processes and from splashes, and the witness reiterated that he would definitely prefer prohibition to a code of regulations such as those foreshadowed.

Mr. W. F. Wallis attended as a representative of the National Federation of Building Trades Employers, and said he carried on business as a builder and contractor at Maidstone. They sometimes employ as many as 60 or 70 painters, but the average would not be much more than 25.

In his 23 years' experience he finds on inquiry that there have been four cases of lead poisoning among his workmen; he could not say if there have been slight cases in addition. So far as his observation went, he was not satisfied that lead poisoning was of great importance, and thought that 25 to 30 deaths per annum, taking into consideration the large numbers employed, did not represent an alarming proportion. Nevertheless, he agreed that the recorded sickness and death from lead poisoning among painters is deplorable, and that it

can only be dealt with either by restriction of the use of lead or by regulations.

He considered that the prohibition of white lead was the only alternative which was likely to be efficacious. Regulations might be practicable if they are reasonable. Overalls could be provided and washed at the expense of the employers, who would allow for the additional expense in their estimates. A mess room could generally be provided, but a regulation regarding it would be broken sometimes. It would be very difficult to provide a special storage place for overalls, or a cloakroom for outdoor clothing. He thought it not impossible to provide washing accommodation and even to include hot water always. The employers would willingly allow time to the workers to wash their hands; it is the custom at present to allow three or four minutes before knocking-off time. Nailbrushes, soap, and towels could be provided and distributed by the foreman. It would be difficult, however, to enforce regulations. The use of exhaust draft to remove dust which the men might breathe he considered quite impossible. Periodical medical examination would be onerous, and he would not willingly agree to compensate suspended workers; if it were law, employers would have to conform.

Considering the case in all its aspects, the witness declared himself decidedly in favor of prohibition of the use of white lead rather than regulations.

Mr. W. J. Styles, representing the London Master Builders' Association, has been connected with the building and decorating business for nearly 40 years; his firm employ an average of about 100 painters. He agreed that the amount of sickness and death indicated by the official figures was very deplorable, and that it was regrettable that this country should be behind other nations in dealing with the evil. The various precautions adopted in other lead industries were put to the witness, but he considered it would not always be possible to carry out the requirements as to washing accommodation, storage of overalls, place for outdoor clothing, and provision of mess room. The supply of overalls by the employer would involve a serious expense and the employers could hardly afford to pay for medical examination of the workers. Personally, Mr. Styles was not concerned whether lead be prohibited or regulations for its use enforced. If the former, something else would have to be used and it would not interfere with his business at all. For the trade generally he thought prohibition would be better than an attempt to enforce regulations. Mr. Styles has only had slight experience with leadless paints, and said the men do not like them so well, but the work turned out very good, both on external and on internal surfaces. In answer to Mr. Sutherland the witness said that he thought regulations should be tried before lead is abolished, but in reply to further questions by the chairman he adhered to the view that it would be impossible to carry out regulations.

In conclusion Mr. Styles said that if the use of lead was prohibited for everybody alike he would fall into line; he would have to find some leadless paint. He would certainly raise no objection to such a law if it came into force. Finally, he reiterated that he would choose prohibition rather than the regulations foreshadowed.

which would stand the fumes of chemicals. He does not use zinc white generally because he said he had been trained to understand that white lead is the best basis. In conclusion, he expressed the view that the statistics show good reason for legislation in England, but not in Scotland, and he would prefer the abolition of lead to stringent conditions; he thought it would be a hardship to Scotland to impose any restrictions which are not necessary in that country.

Mr. John Scott has carried on business for a great many years as a house painter in Glasgow, employing on an average from 80 to 90 painters; he said he used to hear a little about lead poisoning cases when he was a boy, but has only known of one case since he has been in business; that was a man who handled lead in the shop and was off half a day about 20 years ago. He agreed that the amount of illness disclosed by official statistics was deplorable and suggested that regulations might mitigate it. He had seen some recent experiments on a small scale with leadless paints and thought they were unsatisfactory, but he had carried out experiments on a large scale with zinc unfortified by lead some 20 years ago. He believed lead paints to be essential and has not made any definite attempts to find a substitute.

With regard to precautionary measures, he would not agree to provide overalls, but he would undertake to provide a place for storing them and also a meal room. There would be a difficulty in providing proper washing accommodation on the basis of one basin to five men, but it would not be impossible to provide hot water. With regard to dry rubbing down, he considered that there was practically no dust unless in exceptional cases. He would not object to the prohibition of dry rubbing down on old work, but he would object to its total prohibition. He considered that on new coats of paint the dust is collected in the sandpaper. He would agree to periodical medical examination if it were made compulsory by law, and he would agree to pay half wages in cases of suspension on account of doubtful health. He preferred regulations to the abolition of lead and thought that regulations could be drawn up to remove all the evils except for the practical difficulty in regard to dry rubbing down.

Mr. J. R. Donald has been in the painting trade 40 years and carries on business as a house painter, employing 20 painters. He has only known of a very few unimportant cases of lead poisoning. He considered that the amount of illness and death disclosed by the official statistics is very deplorable and something should be done. He uses nonpoisonous paints, including Duresco, to the extent of about 25 per cent of the total. He stated that zinc white is slightly dearer than white lead, and stated when giving evidence that, especially in the trying atmosphere of Glasgow, nonlead paint would never fill the place of white lead paints.

With regard to regulations he gave similar evidence to the other Scottish witnesses, and stated that he would prefer regulations to abolition of lead. A few days afterwards, however, he expressed a desire to add the following footnote to his evidence:

Since giving evidence I have made very careful inquiry into the manufacturing of paints and pigments in London, and I am now convinced that white lead can be done without. I desire to add this footnote to my evidence, because my opinion has been changed in consequence of the practical results with leadless paints which have come under my notice in the last few days, and have confirmed the small but successful experiments carried out last year by my sons and myself in Glasgow.

WITNESSES REPRESENTING THE NATIONAL AMALGAMATED SOCIETY OF HOUSE AND SHIP PAINTERS.

Mr. Parsonage, a member of the committee, who has had 35 years' experience as a painter, represented the National Amalgamated Society of Operative House and Ship Painters and Decorators, whose membership varies from 15,000 to 18,000. The witness produced tabulated particulars of a large number of deaths and a still larger number of cases of blindness and total paralysis due to lead poisoning among members of his society.¹ He also spoke of the very numerous cases of a less severe nature, and explained that his society keeps no records of these, as their funds would be altogether insufficient to permit of payments being made except in cases of death or total paralysis. He also spoke of the excessive amount of Bright's disease amongst painters.

Mr. Parsonage considered that dry rubbing down was the most dangerous process in painting. At least 75 per cent of the rubbing down is done dry; of this a large amount is done before the first coat of new paint is applied, but he considered the most dangerous sandpapering work to be that which takes place after the first coat of paint is applied. This rubbing down causes a large amount of dust, which is very difficult to get rid of. He did not consider that dry rubbing down could be replaced by a wet process, except for first-class work, where ground pumice and felt can be used.

Danger also arises in the process of filling or stopping wood or other work which is indented, cracked, or very rough; it is impossible to avoid getting the filling material on the hands and it is generally rubbed down with sandpaper after it has dried hard.

The next most dangerous painting operation the witness considered to be the painting of ceilings which have been covered with relief decoration, molded or raised designs. In doing this work much splashing takes place and some of the small splashes inevitably get into the painter's mouth. The same occurs in the process of stippling. The use of respirators would not be practicable, nor would ventilation by exhaust fans.

Mr. Parsonage alluded to the long hours of work, and then dealt with the dangers attendant on the work of mixing paints; he found that the color men who break up lead paint with a stick frequently suffer from dropped hands, but this symptom would not usually arise until he had been at the work for several years.

Mr. Parsonage also considered there was great danger of the painter inhaling dust arising in the scraping off of old paint.

The witness attached great value to proper washing accommodation, including hot water, although he did not consider the latter to be always practicable. Proper provision is needed for overalls, keeping of food, and a place for meals. He considered, however, that the danger from uncleanness was much smaller than that from dust and spray. In his opinion it would be impossible to remove the principal dangers either by the use of exhaust apparatus or by a prohibition of dry rubbing down; and, therefore, stated emphatically that the substitution of nonpoisonous materials for lead paints was the only way to obviate the danger.

¹ See Appendix XI (Minutes of Evidence), and statistical evidence summarized on pp. 71-73, also Appendix XII (Minutes of Evidence).

respect of rubbing down, this witness considered that there was more danger in doing better-class work, as very little smoothing is done on very cheap work.

Mr. John Bancroft, London organizer of the National Society of Operative House and Ship Painters, stated that he has had 27 years' experience in the house painting trade. The membership of the London branch is about 3,000, and among these there have been 20 cases of lead poisoning since the Workmen's Compensation Act came into force. Of these, seven cases are still on the books of the society. He was unable to give statistics of lead poisoning relating to the earlier years, as they did not tabulate the cases until the passing of the Workmen's Compensation Act of 1906.

Mr. Bancroft supported Mr. Parsonage's evidence throughout; he regarded dust as the principal danger, and was of opinion that it could not be entirely removed or obviated. Dry rubbing down he considered might be reduced but could not be entirely abolished. He also dealt with the danger of splashing in stippling and spraying operations and referred to the importance of means of personal cleanliness; hot water, he said, was generally available. He considered that the periodical medical examination of painters by the certifying surgeon would be practicable if the use of white lead is to be continued. In the witness's opinion the workers in general are not fully alive to the importance of the lead poisoning question; they have not formed any strong opinions definitely opposed to the continued use of lead paints; they often complain, however, that lead is used in a reckless way and that there is great danger from the fact that unpractical foremen are sometimes put in charge of jobs where lead is used, and it is suggested that this entails a considerable increase in the use of dry sandpaper for rubbing down, and this in turn materially increases the risk of lead poisoning.

Mr. George Webb stated that he had had upward of 31 years' experience in the house painting trade, during the last 20 of which he had acted as builder's foreman and foreman decorator. At the time of giving evidence he was just recovering from a second attack of lead poisoning. He claimed to have been always clean in his habits and attributed the greatest danger to the mixing of paints and stoppings; in the mixing of hard stopping white lead dust flies about in the air. He also considered dust from sandpapering to be a serious cause of risk, and was of opinion that this could not be entirely obviated. In other details also he confirmed the evidence given by Mr. Parsonage. The witness stated that he had occasionally used zinc paints and found his work less tiring than when lead was being used; he had noticed the difference in the smell.

Mr. Joseph Devine stated that he has had about 30 years' experience as a painter and is connected with the No. 1 London Branch of the National Society of Operative House and Ship Painters. He has himself suffered from several attacks of lead poisoning and has known others affected. He described his symptoms, but stated that he had always been a very careful and clean worker, washing his hands regularly and using a nailbrush.

He gave details of three cases of lead poisoning occurring during the last three or four years amongst 170 painters in his own branch, which is one of 30 branches of the trade-union in the London district.

Mr. W. Pickles, of Manchester, also gave evidence as a representative of the National Amalgamated Society of Operative House and Ship Painters and Decorators. This witness stated that he had had 32 years' practical experience in the trade, and had known lead poisoning cases both among his own work mates and among the members of his society. He had made a study of the dangers to which painters are exposed, and considered dry rubbing down to be the chief cause of lead poisoning; he also considered the stippling of flaking paints a source of danger. He said that it was impracticable to dispense with dry rubbing down with sandpaper, because wet pumice stone would tear new paint. He gave evidence regarding precautions which should be taken in dealing with lead paints, such as washing, mess rooms, overalls, and the like. He considered that they would be very difficult to carry out fully in house painting. He had practical experience of using nonpoisonous substitutes for white lead and was strongly of opinion that they could be used to the exclusion of white lead; any difficulty experienced by painters in adapting their methods of work to zinc paints could be gradually overcome. He had found zinc paints as good as lead for internal painting, and found the same results with paints used externally at the end of a two years' trial which he had made on the exterior of his own house.

Mr. J. Walsh, of Liverpool, gave similar evidence, and referred to the successful use of nonpoisonous paints in the Muspratt laboratories of the Liverpool University and on the general post-office buildings. He considered that zinc paints can be mixed with the ordinary vehicles and applied in the ordinary way after a little experience; also that zinc paint of standard commercial quality was equally as good as lead.

Mr. Fred Wilson, of Huddersfield, who had 24 years' experience with one firm, gave similar evidence; he had himself had attacks of lead poisoning, which he attributed to dust arising in the rubbing down process and to work in mixing paints. He considered that lead poisoning could only be stamped out by prohibition of lead.

Mr. Frank Lowe, of Manchester, stated that he was a painter of 33 years' experience and connected with the Manchester Branch of the National Amalgamated Society of House and Ship Painters and Decorators. Since July, 1907, when the present compensation act came into force, there had been 5 deaths and 25 serious cases of lead poisoning dealt with in Manchester. He also ascribed the chief danger to rubbing down and next to that stippling. Sandpapering is very dangerous process, but rubbing down can not always be done with pumice stone and water, as newly dried paint would be destroyed by that process. He also spoke of the danger of cleaning paint cans by burning. He recognized the importance of washing conveniences, wearing of overalls, and other precautions, but stated emphatically that he considered prohibition of the use of white lead the only way to overcome the evils attendant on the painting trade. Referring to his recent experiences with pure zinc white paint at Manchester, following on earlier experience in New York with mixed zinc and lead paints, the witness stated that he had formed the opinion that zinc white is just as good a paint as white lead; there is a slight prejudice against zinc because workers do not understand how to use it, but there is no real difficulty in applying such paints. In

In addition to these cases, which received compensation, the witness spoke of many men who have had slight seizures of plumbism and have stayed away for a few days without going on the sick club. In his opinion the principal causes of lead poisoning are the inhalation of spray when doing flattening or similar work, and breathing dust in rubbing down with glass-paper. With regard to ill effects from the fumes of paint, he agreed that they might be due to the turpentine and not the lead. He considered some danger also arose through getting lead on the finger tips and conveying it, even after washing, to the mouth.

In addition to the sandpapering, certain other processes, such as the making up of stoppings and the mixing of paints, give rise to some dust. The paint that gets on the clothing may also break up and form dust afterwards. In stippling he described it as impossible to avoid some spray.

He also referred to an attack of lead poisoning contracted through rubbing down work which had been scorched with the burning-off lamp. The wet method of rubbing down between the application of one coat of paint and the next he considered impossible because of the softness of the paint. Dry sandpapering is also resorted to for cheap work, as it takes less time than rubbing down. He can not suggest any way of safeguarding the worker against spray in stippling and the dust of rubbing down; regulations would not remove the danger.

He regarded washing accommodation as very important and spoke of recent improvements in the provision made by employers. Hot water he considered better for cleansing the hands, and this is not always obtainable. It is frequently impracticable to obtain a meal room, but overalls are generally worn and taken home weekly to be washed; when not in use they are hung up in the room where painting is done.

He was not in favor of periodical medical examination of painters because of the danger arising in the interval between examinations. He said, however, that he had not considered the subject particularly.

Although he has claimed compensation himself, he said he had known one or two men who were reluctant to claim compensation. He considered it impossible to stamp out the evil of lead poisoning unless lead is replaced by some nonpoisonous substance. He has himself used nonpoisonous substitutes for lead, and in his opinion they are practicable even for outside work. He thought that leadless enamels with an extra coat of varnish would be economical for outside use, because they would be more durable. He stated that he had not felt the same bad effects when working with zinc white as when working with lead, and he found no difficulty in applying zinc or other leadless paints. He thought that work painted with a substitute for white lead would require varnishing for external use and admitted that lead paint work is not always varnished.

In further examination he did not think the men regarded it as a hardship to be responsible for providing their own overalls and seeing to their being washed.

Rubbing down with sandpaper moistened with turpentine is no satisfactory.

WITNESSES REPRESENTING THE SCOTTISH SOCIETY OF HOUSE AND SHIP PAINTERS.

Mr. David McKillop said he had 22 years' experience as a working painter, and was connected with the Edinburgh Branch of the Scottish Painters' Society. The number of members in that branch is 549, and the witness gave details of attacks of lead poisoning suffered by Hugh Blyth, William Crawford, James Watson, William Walsh, and Robert Johnson.

He considered that there was very great danger from inhaling lead dust in the process of dry rubbing down. The witness could not suggest any way of guarding against this risk except by compulsory wearing of respirators. He admitted that a man might often be working by himself without anyone over him, and also that he had never seen a comfortable respirator. He considered that the dry method of rubbing down can not be entirely dispensed with. The wet process is suitable for preparation of old paint, but sandpaper is used after the first coat is applied.

He could suggest no way of removing the danger of breathing splashes when doing work on mottled ceilings or stippling; exhaust fans would be impossible.

The witness was questioned regarding the observance of regulations, but said that the only way to stamp out lead poisoning would be to replace lead by some nonpoisonous substance. He admitted that he had himself had no practical experience of substitutes for white lead, but he was not predisposed in their favor; he said he had never used zinc paints, and admitted the ordinary "painter's prejudice" with regard to them. He agreed that house painting was not an occupation which would lend itself to regulations which required enforcement by inspection.

Mr. A. Smith stated that he had had 18 years' experience as a house painter, and is an official of the Aberdeen branch of the Scottish Painters' Society. The membership of this branch averages about 350, and the witness was able to give details regarding 6 cases of lead poisoning. He himself had also had slight symptoms of colic when working in London. Most of the cases of which he spoke appeared to have contracted their illness while out of Scotland. This the witness attributed principally to the large amount of white work done in London, while very little of such work is done in Scotland.

In Mr. Smith's opinion, although the dry method of rubbing down is most prevalent, it could be entirely dispensed with; four or five days would be necessary for fresh oil paint to harden sufficiently for wet rubbing down, so that extra time would be needed. It would be impossible to avoid the danger arising from splashes in certain operations. Both respirators and exhaust fans the witness considered impracticable. He regarded washing accommodation as very important, and suggested that time should be allowed for washing. A proper supply of soap and nailbrushes is not generally provided, but should be. There is often some difficulty in getting water at a painting job. The witness also dealt with the provision and washing of overalls, and the necessity for medical examination, which the witness advocated, although the men might resent it at first. He also referred to the reluctance of some men to claim compensation.

Mr. Smith said he had had some experience with substitutes for white lead, and considered that it was quite possible to use zinc oxide, the color of which is superior, while the durability is, so far as his experience goes, quite equal to that of lead, except under very exceptional circumstances, such as sulphurous atmospheres. The chief objection to zinc oxide is the belief that one would require four or five coats of zinc oxide to equal two coats of white lead in covering power; this the witness considered a fallacy. The masking capacity of zinc oxide is possibly inferior to that of lead in one or two coat work, though only very slightly inferior in the case of two-coat work. With three-coat work he claimed there was ample masking capacity.

He quoted experiments from Cassell's House Decoration, edited by Paul Hasluck, and published in 1911, pointing to the conclusion that "it is possible to produce an oxide of zinc paint whose opacity is equal to that of white lead paint, without prejudice to the saving of more than 25 per cent of material by reason of the superior spreading power of the oxide of zinc paint." (Q. 21260.)

He did not consider that the painting trade was one which would lend itself to regulations which require to be enforced by inspection.

WITNESSES REPRESENTING COLOR, PAINT, OIL, AND VARNISH TRADES ASSOCIATIONS.

Three gentlemen, namely, Mr. A. W. Willis, Mr. K. K. Carson, and Dr. Crow, attended to give evidence on behalf of the London Color, Paint, Oil, and Varnish Trades Association, and stated that at a meeting held at the Cannon Street Hotel a week previously authority had been conferred on them to speak in the name of other paint and color associations as follows:

Hull Paint and District Paint, Color and Varnish Manufacturers' Association. (Q. 11634.)
Liverpool and District Paint, Color and Varnish Manufacturers' Association. (Q. 11635.)
Scottish Oil, Color, Paint, and Varnish Trades Association. (Q. 11635.)

North Eastern Paint and Oil Trades Association. (Q. 11636.)
Mr. A. W. Willis stated that the estimated capital employed in the paint-grinding industry throughout the country is nearly ten millions; it is impossible to say what proportion of that is confined to the manufacture of lead paints. Mr. Willis could not say to what extent paint grinders would be affected by a change from lead to nonpoisonous paints. He stated that paint grinders have been put to considerable expense in complying with the Home Office regulations for paint and color works; these regulations have been beneficial to the workers, as shown by the following table:

	Average, 1900 to 1902.		1910.	
	Cases.	Deaths.	Cases.	Deaths.
White lead.....	125.5	3.1	21	1
Paint grinding.....	42.2	.7	17	1

These figures were quoted to show first the benefit of regulations, and secondly the claim of the paint-grinding industry for consideration in any action which the committee may recommend. In the opinion of the associated paint grinders, white zinc is not as suitable, especially for outdoor work, and is not as reliable as white lead. It will perish sooner, especially in this country, where in London alone it is estimated that sulphur corresponding to 600,000 tons of sulphuric acid is discharged into the air annually. Some boards were produced which it was claimed supported this view. In addition to trials with zinc oxide Mr. Willis stated that experiments had been made with zinc sulphide which was found useless for exterior work as it changes color in the sunlight.

Questioned with regard to the evidence of the office of works, the witness admitted that they are very large users of paints and that their evidence might be regarded as important, but he could not judge without knowing further the way in which the paint was used. He stated that his association are always attempting to find a substitute for lead, and agreed that it would make no great difference to grinders whether white lead or a substitute were ground. As regards the safety of their capital it is a matter of indifference whether lead is prohibited or not. The amount of their capital was only quoted as a justification for giving evidence.

With regard to the heavy incidence of lead poisoning amongst house painters, Mr. Willis considered that there was considerable room for regulations and for the education of young workers. He proposed to prevent ill effects from the dust generated in dry rubbing down by the wearing of respirators, which he thought should be enforced by the infliction of fines on the men who do not wear them. He admitted that there was some expense in the maintenance of appliances for carrying out the Home Office paint and color regulations, and that this would be saved by the prohibition of lead, but he said he did not regard that saving as important.

Mr. K. K. Carson gave evidence primarily regarding precautions which may be taken for mitigating the evils of lead poisoning. The general mixing of paints by the painters themselves is a dangerous operation. He advocated the absolute prohibition of the sale of dry white lead. He considered that the wearing and necessary washing of overalls should be made compulsory; they should not be left overnight in the room where painting is carried on. The employer should provide water and soap for washing the hands, and in the witness's opinion cold water was better than hot. A supply of towels is essential, and the employer should allow time for washing purposes before each meal. The dust generated in the process of dry rubbing down is a serious danger which Mr. Carson considered should be met either by the wearing of a suitable respirator or by the entire prohibition of dry rubbing down. He believed that there was a lot of prejudice in the trade against the latter course, but nevertheless thought it could justifiably be adopted. As regards the respirator Mr. Carson could not say that he liked the one which he produced, but he did not think it a great inconvenience to have to wear such an appliance for a short time; the painter is not dry rubbing down all the time, but the witness could not speak of the actual time that a man would occupy at this work. The witness further advocated the prohibition of the use of tobacco where painting is carried on, and he also con-

sidered the periodical medical examination of painters at the expense of the employer essential; it need not be as often as monthly, and he thought the difficulty arising when men are away on jobs at the time for examination could be overcome by arranging for the men to come up in groups, for example, on a pay day.

In the witness's opinion the regulations suggested would reduce the lead poisoning cases at least 75 per cent if they were properly carried out; with regard to their enforcement he saw no real difficulty provided that there were a few inspectors to go around occasionally. He estimated the number of painters at about 230,000, and thought the work could be very well done by about 50 inspectors. He could not speak as to the cost of such a staff. He thought the medical examination would indicate the men liable to attack; and with regard to dust, which is a great evil, the employer or foreman should be made responsible for seeing that the men wear respirators and observe the regulation generally.

The chipping off of old lead paint on ironwork is such a dangerous occupation in the witness's opinion that it should be prohibited; the work could be done by using a detergent or pickling.

With regard to the view expressed by many master painters that such rules as those put forward would be impossible to carry out the witness said that the paint grinders felt the same when the paint and color regulations were imposed upon them. They thought it would be impossible, but they have found since that they have to carry them out. The witness admitted that the machinery now used for lead grinding could be used to grind zinc.

Dr. Crow spoke primarily in regard to the manufacture of yellow, green, and red paints, as also concerning the lead contents of driers, oils, and varnishes. In some yellow colors used for lining in the coach trade an amount of chromate of lead is employed which may be equivalent to as much as 60 or 80 per cent of lead; the lining work is a very small part of the painting of a coach, infinitesimal really, but necessary for beauty of finish. Zinc yellows have not sufficient opacity. For ordinary yellow chrome paints from 10 to 20 per cent of lead would be used. With regard to the special work of lining, there is no danger to the workman as there is no previous scraping down or special preparation. The paint is generally supplied in a tube. Zinc chromate in addition to being less opaque than lead chromate, is more expensive and gives a much smaller range of tints. In the witness's opinion dry rubbing down between coats is not very dangerous as only the nibs are removed, but he admitted there might be a little dust. In regard to the toxicity of this dust, Dr. Crow quoted the chairman of the health department and other authorities to the effect that lead chromate is not so poisonous as lead carbonate; this is doubtless due to the small percentage of lead chromate which is soluble in dilute hydrochloric acid.

All the above considerations concerning yellows will be equally applicable to greens, which are generally made by adding a percentage of Prussian blue to the yellow chrome. Some of the best greens contain from 20 to 25 per cent of lead chromate, but only a small proportion of this would be soluble in dilute hydrochloric acid, while the usual commercial greens which are used for paints average 3 to 5 per cent of lead.

With regard to reds, Dr. Crow stated that some red colors can not be obtained without something like 90 per cent of orange lead or red lead, which is needed to give opacity. These reds are very important and largely used colors, and are so much favored by certain customers—for example, makers of agricultural implements—that the prohibition might result in increased importation from abroad.

As regards lead in driers, Dr. Crow said he was well acquainted with manganese borate and manganese linoleate, which dry very well in warm weather, but can not be relied upon in the autumn, winter, and spring in the English climate. The limitation of 5 per cent of lead in the dried material of the paint would, however, allow an ample margin for the use of lead for drying purposes.

A change over from lead colors to leadless would involve the reprinting of tint cards and a large number of other difficulties, but an exemption, say, for two years before lead was absolutely prohibited, would assist in this respect; the cost of the colors would, however, be considerably higher.

In the event of the committee agreeing to recommend prohibition in preference to a stringent code of regulations, which would be very expensive to carry out, a restriction to not more than 5 per cent of soluble lead in paints would be a partial solution of the difficulty. The witness added that he appreciated the difficulties, and would not like to say that no perfect solution is possible. Dr. Crow recognized the advantage of limiting the application of tiresome regulations; for example, it would simplify matters if it were laid down that no one was to use paint containing more than 5 per cent of soluble lead, except on certain occasions, for which the permission of the Home Office would have to be obtained; personally he would rather have exemptions of this sort than absolute prohibition.

Further examined with regard to yellows, he said that the range of tints would not be limited if it were permitted to use 20 per cent of chromate of lead, which would represent less than 5 per cent of soluble lead, together with a special exemption for fine colors used for lining and artists' colors.

Zinc sulphide has good covering power, but is decomposed on exposure; it is suitable for internal purposes, but not for external painting. Zinc is obtained from abroad, and the existence of the zinc-oxide corporation would render likely an increase of price if the competition of lead was removed. The witness admitted that zinc could be made by the indirect method from spelter, and that the big zinc mines at Broken Hill are not as yet in the combine. The market remains an open one as long as the entire supply is not cornered, and the witness admitted that the buying of all the zinc in the world by the company was hardly a possible proposition any more than an entire corner of lead.

Mr. Holzappel stated that he attended as a representative of the North East Paint and Oil Trades Association. His own business was concerned chiefly with compositions for ships' bottoms, but in addition they grind zinc paints and have a large trade in various enamels, varnishes, and paints which are all leadless except for the small portion contained in the oil or varnish. They do not grind any lead paints. The enamels are entirely made on a zinc basis and the zinc paints, which are not enamels, are also used on board ship; these are found to stand all right even on the top sides and where they are

exposed to the weather; their cost compares favorably with that of lead paints; by weight zinc paints are dearer than lead, but by bulk they are cheaper. The same paints which are used for ships are also used for houses; they have been gradually introduced for land purposes. To give permanency to the zinc paints a proportion of varnish is added to them; lead paints do not require any varnish added to the medium and so far as that point is concerned lead is a better paint basis than zinc. The witness admitted that he thought lead to be necessary for certain purposes although he had fought against its use all his life. He thought the decorating trade would be seriously affected by the entire prohibition of lead because of the value of the latter in promoting drying. He considered that 10 to 15 per cent of lead might be necessary in the paint to make it act as a drier, though he admitted that manganese driers are for certain purposes as efficient as lead. He could not say that it would be impossible to find a non-lead drier if the use of lead were prohibited, but he thought the system of decorative painting would have to be changed, because he thought that for inside work it would not be possible to obtain an article which would dry sufficiently quickly without lead. It was pointed out to the witness that the majority of the master house painters examined had agreed that lead could be dispensed with for inside painting and he agreed that there might be nonpoisonous paints suitable for internal work. He did not, however, see why the prohibition of lead should be contemplated. He explained the great danger attendant on the removal of red-lead paint from ships' holds; this he considered so serious that it should be restricted. He further considered "that most of the lead poisoning that we have to contend with is in the sand-papery of coats of lead that have been applied, in order to prepare for the next coat. An enormous amount of dust is created through that, and that is partly inhaled and partly swallowed." He considered that the sandpapering of rough surfaces of paint involved the removal of some 25 per cent of the material and he thought dry sand-papery of lead paints should be prohibited and sufficient time given to the paint to dry so that punice stone and water could be used. He agreed that this would increase the cost and the time required for a painting job. He did not think an exhaust draft to remove the dust would be practicable. Mr. Holzappel also emphasized the dangers of mixing dry lead compounds.

He stated that his leadless paints had been applied to public buildings in Newcastle, on tram car bodies, inside railway stations, and in other places where they are exposed to sulphur in the atmosphere. These paints are fairly largely used for outside work and last as well as other paints. The witness's only fear in regard to zinc paints was for inside decoration because of the slowness of drying of the zinc paints. With regard to the cost of paint the witness stated that lead could have no advantage over zinc, but he did not think that the latter could be made to dry as quickly as lead if the same medium is used; if varnish is added, as in the case of the office of works paint, that might facilitate the drying sufficiently.

Questioned further regarding ship painting, the witness said that oxide of iron is used for the inside spaces and zinc paints in the engine room and for deck work. He considered that zinc paint on the bulwarks and deck houses exposed to sea air and the action of sea water and sunshine is exposed to a severe test, and has been found to stand

quite satisfactorily; though, as the witness pointed out, a ship is generally painted once a year if not oftener. He has had no complaints regarding these paints.

WITNESSES REPRESENTING OTHER MANUFACTURERS OF PAINTS OR PAINT MATERIALS.

Mr. W. R. Hardwick, B. Sc., F. I. C., consulting chemist to Purex (Ltd.), attended to give evidence regarding the pigment manufactured by that firm. It is a basic sulphate of lead which the witness stated could be used for all the purposes for which carbonate white lead is used. He claimed that it was cheaper, whiter, and approximately three times as durable as white lead. The witness admitted that cases of lead poisoning have been traced to the use of Purex; but stated that he found the solubility in 4 per cent hydrochloric-acid solution, when calculated in the manner prescribed in the pottery regulations, to be 25 per cent as against 100 per cent, which is the solubility of carbonate white lead; from this he deduced that Purex is only a quarter as poisonous as ordinary white lead.

Mr. Cookson gave evidence as representing the firm of Messrs. Cookson & Co. (Ltd.), desilverizers and manufacturers of white and red lead, lithargo and antimony, at Newcastle-on-Tyne. His firm do not handle any substitutes for lead paint, and the witness pointed out the serious loss of business which his firm would sustain if the use of white lead in paints was prohibited without compensation for white lead manufacturers. He was of opinion that regulations, including periodical medical examination, would mitigate the evil of lead poisoning among painters. He considered that respirators should be worn as precaution against the inhalation of dust in dry rubbing down, or that dry rubbing down should be prohibited. He admitted that the regulations he enumerated would only lessen the evil and not eradicate it, and he recognized the difficulty of enforcing regulations amongst house painters on scattered work all over the country.

Mr. J. W. Garson attended and gave evidence as managing director of Messrs. Lewis Berger & Sons (Ltd.), Hometon. This firm manufacture both zinc and lead paints and consider that they are equally suitable for all practical purposes, but recommend lead in preference to zinc for exterior work on the ground of its being more durable; for interior painting the durability is about the same for zinc as for lead paints. The price of lead paints is somewhat cheaper than that of zinc paints, but the latter cover 10 per cent more and stain their color better. For exterior work zinc prepared in the same way as lead paints would probably only have about two-thirds of the life, but zinc paints can be treated in such manner—for example, by the addition of varnish and of 5 per cent of lead—as to have the same durability as lead paints. The witness added that a coat of lead paint is usually recommended before zinc paints are applied. His firm make enamels as well as other paints, and the enamels are made with zinc, not lead. The witness's firm would not be affected by prohibition of the use of lead, which he considered would give an impetus to manufacturers to find efficient substitutes. The witness is acquainted with the range of paints used by H. M. office of works and considers them more costly to produce than paints com-

to the Menai bridge and the remaining 6 cwt. to the stores of H. M. office of works. In addition to the above quantity which was supplied to the office of works direct, the contractor holding the general office of works contract had been supplied with 5 tons 15 cwt. between April and November, 1911, and that quantity of white lead was delivered to office of works jobs, including the British Museum, Horse Guards, Victoria and Albert Museum, Church Street, Islington, King Edward VII Buildings, Tower of London, Regent's Park, Savings Bank—no address given—Somerset House, Chelsea Hospital, Buckingham Palace, St. James' Palace, the Royal Mews near Buckingham Palace, Natural History Museum, and other places.

Granitic Company's paints.—Evidence was given by a representative of the Granitic Paint Co., of Barking, London, regarding Astrium paints, which are made on a zinc oxide base and are entirely free from white lead. It is claimed that their cost is about the same as that of lead paints, the covering capacity about the same, their retention of color better than that of paints on the white lead base, and their durability equally good. They have been very largely used by contractors for the painting of Government buildings, the paints having been originally compounded to a formula suggested by the principal architect of H. M. office of works.

Ragosino Paint Co.'s paints.—Mr. Heydorn, a director, was heard for the Ragosino Paint Co. (Ltd.), of Bow, London, who manufactures a paint known as Dixon's White. It is claimed that this is an entirely nonpoisonous substitute for the white lead base of paints commonly used; its cost is stated to be about the same, its covering capacity greater, and its retention of color greater. It is made up in paste form and can be thinned down so as to take the place of white lead for all ordinary painting as well as for priming and filling and flattening. The witness, however, did not consider that it was so suitable for sign writing.

Gay & Co.'s paints.—Mr. D. Wait, the works chemist to R. Gay & Co. (Ltd.), attended and gave evidence regarding the paints made by his firm; these include both lead and zinc paints. He considered that the danger of paint mixing was a serious one and should be removed by use of ready-mixed paints supplied by the manufacturer. He also spoke of the danger of spray from the paint brush and the danger of inhaling dust from dry rubbing down. He considered lead sulphate less poisonous than carbonate white lead, but not so safe as lithopone useful for inside work, though not quite so satisfactory as lead paints, and for outside use unsuitable; zinc oxide paint he considered as good as white lead both for exterior and interior painting. He named a number of public buildings on which zinc paints made by his firm had been used and stated that they had no more complaints regarding them than with lead paints previously supplied.

Szerelmey Co.'s paints.—Mr. Cunneen attended to give evidence regarding the paints made by this firm, which are intended for use as substitutes for white lead. There are two distinct compositions, one with a base of zinc oxide and the other oxide of iron, the vehicle in each case being linseed oil. Lead pigments are used for producing certain colors, namely, yellows and greens, which contain

a small percentage of lead, usually 5, 6, or 7 per cent; the red paints contain no lead. An infinitesimal amount of lead may be added in winter to facilitate the drying of the paints. In the opinion of the witness's firm, who have been makers of nonpoisonous paints for over 50 years, it is quite possible to get as good covering power without using lead; the zinc paints deficient in this respect have probably been badly mixed. This firm's paints are a little dearer than lead in the package, but are claimed to be cheaper on the work. They have been proved to be very durable and no complaints have been received on that score. The witness gave a selection of users who have given repeated orders for these paints; these include the Kidderminster Corporation, Exeter Corporation, Grays Thurrock Urban District Council, East Sussex Asylum, a number of breweries, as well as private individuals. The witness quoted the Furness Railway Co., who have been using these paints in the harbor department for more than 15 years, and write: "It is used for painting the inside of all our floating plant and for the channel buoys, and is excellent for any iron or steel in contact with sea water." Amongst other favorable opinions quoted by the witness is a statement of Mr. Langton, sole, official architect of the London Stock Exchange, who writes: "I have used large quantities of Szerelmey paint for the exterior of the Stock Exchange and other buildings in Throgmorton Street, also for my own and other houses at Sutton in Surrey. I am pleased to say that the results have in all cases been satisfactory." (Q. 1233.)

The paint in question is used for exterior as well as interior work, and both on wood and iron. The paint has also been used largely for broad, e. g., by the Crown agents for Bermuda and by the Great Indian Peninsular Railway.

Mr. C. I. Smyth gave evidence regarding the paints manufactured by Messrs. Mander Brothers (Ltd.), Wolverhampton, and stated that paints made on a zinc basis had proved to have sufficient body and covering power and to be durable. They are slightly dearer than lead paints, because of the small demand at present, but if made in large quantities would be cheaper than white lead. In view of possible difficulties with certain colors for which lead compounds have been used, the witness made tests regarding solubility in hydrochloric acid. He found that pure lead chromate has a solubility of only about 1 per cent; commercial chrome yellow, which contains sulphate in addition to lead chromate, is soluble to the extent of 1 per cent; and chrome yellow, which contains white lead in addition to lead chromate, is soluble to the extent of 35 per cent. Orange and red lead are completely soluble. From these experiments Mr. Smyth stated that he was satisfied that there would be no difficulty whatever in making green paints to come within the 5 per cent solubility limit; with regard to reds, of which the basis has hitherto been orange lead, he would wish to experiment further, but he thought success in that direction was quite possible.

The paints of this firm are used almost exclusively for coach painting, and are therefore dealt with somewhat more fully in the report of the coach painting committee.

Mr. A. Vickers attended to represent the firm of Archibald Vickers (Ltd.), paint and varnish manufacturers, who make a zinc base paint

intended as a substitute for white lead. Various vehicles are used, such as wood oil, linseed oil, sunflower seed oil, menhadyn oil, and so on. No lead is introduced into their paints except a very small proportion which may be contained in the zinc. Mr. Vickers prefers to exclude all lead compounds even from the driers, and prefers zinc oxide which has been manufactured by the indirect method. He claims to obtain sufficient covering power without use of either red or white lead. The price at the time of giving evidence is less than the price of lead paints owing to the repeated rise in the price of lead. Twelve months previously, when the price of lead was £9 10s. (\$46.23) a ton cheaper, the price of the lead and zinc paints was about the same. In Mr. Vicker's opinion users of paints who are not accustomed to zinc believe it to be much more costly, but those who have learned to use zinc paint properly find it no more expensive than painting with lead. The leadless paints of this firm have been in use for seven years, and have been found durable even for outside purposes under certain conditions; for example, the zinc paint on the concert hall on Brighton west pier has stood well, whilst the lead paint on the long central shelter on the same pier has perished. Southsea pier had also been painted with zinc paint. The witness admitted that he had had some complaints, but he contended all paint manufacturers have. He was, however, able to give a large number of customers who are so satisfied with the zinc paint that they give repeat orders for it. In the witness's opinion zinc oxide could replace lead in inside work and if mixed with suitable medium also for outside work. Inert base silica is added to the zinc oxide in his paints to give additional covering power and to take the fluffiness out of the paint. For exterior use the witness stated that zinc paint should be used with an increased amount of oil. Even with this addition the paint would not be any more costly than lead paint. The witness did not agree that lead paints were better than zinc paints and considered the latter better than lead in a sea atmosphere. He thought the prejudice against zinc paints was more noticeable among brush hands and certain foremen than among the most skilled practical painters.

Mr. F. Pisart is managing director of the Maastricht Zinc White Co. He does not regard the use of white lead as very dangerous if proper care be used, but precautions are necessary if lead paints are to be retained, and in his opinion zinc can replace lead as a pigment purely on the ground of its superiority. As an instance of the he gave a table showing the increasing use of zinc in Sweden, where in six years the amount of zinc pigments used has risen from 3,000 tons to 4,244 tons, while white lead has decreased from 511 tons to 501 tons. There are no laws against white lead in Sweden, neither are there any duties on white lead, zinc oxide, or lithopone, nor are there any manufacturers of either white lead or zinc paints in Sweden. The witness attributed the preponderance of zinc over lead to the advanced view of painters in Sweden. The experience of Sweden, Mr. Pisart considers, supports his contention that zinc pigments are as durable as and as good as lead in every respect, and that they are no more costly.

In connection with the French prohibition of the use of white lead from January 1, 1915, a commission has been inquiring into the state,

ard of purity to be demanded. The resolution adopted at the meeting of March 25, 1912, reads as follows:

Article 4. The description "zinc white" (*blanc de zinc*) with or without qualification shall be applied exclusively to oxide of zinc used in painting and containing not more than five parts of impurities derived from the ore in 100 parts. Such impurities may consist of lead compounds provided they do not exceed 3 per cent calculated as metallic lead (Pb).

Pure zinc oxide has a tendency to crack with changing temperatures; in its physical properties also a very pure zinc may be obtained which is of no use as a pigment. With 4 per cent of lead the tendency of a zinc oxide paint to crack would be checked, and the witness considered such a grade of zinc oxide would be suitable for making paint for use in this country.

The Belgian Government decided to suppress white lead in the buildings of their railway administration as early as 1903, but after an experiment lasting one year they reverted to white lead, which was used until 1908; in that year they changed the specification to zinc oxide containing 4 per cent of lead compounds, and from that time they have never reverted to white lead. Lead paints were abandoned by the Belgian State railways for their rolling stock at a much earlier date, some 20 years ago. Mr. Pisart claimed that zinc with 4 per cent of lead is as durable as white lead, both for internal and external use, and has greater covering power when used as a white paint applied in three coats over a black surface.

If the use of lead in paints were restricted by law, it would probably cause a temporary rise in the price of zinc, perhaps to the extent of £2 (\$9.73) per ton. This would be due to the necessity for supplying the new material immediately; if the prohibition were only to come into force at the end of five years, he did not think there would be any rise in the market. With a two years' time limit there might be a small rise of £1 or £2 (\$4.87 or \$9.73) per ton. This increase of price would not be permanent, as the supply of zinc adjusts itself to the demand. During the 10 years (1901-1910) the increase in the consumption of metallic zinc has amounted to 6.2 per cent per annum, while the increase in the consumption of lead has been only 2.9 per cent per annum. If a large additional demand for zinc oxide should arise the price would eventually fall, because zinc oxide would be made from very low-grade ores by the direct process, and this would tend to cause the reopening of a great number of mines which are now useless because the ore in them is not good enough for making metallic zinc.

If lead up to 3 per cent were permitted in zinc paints sufficient zinc could certainly be produced by the direct process to supply the full demand in this country within some two years; if the percentage of lead allowed were as great as 4 or 5 per cent it would make it still easier for the direct process makers to obtain suitable ore. Lithopone is a suitable paint for interior work only, but is not so good as a zinc-oxide paint with 4 per cent of lead, which, in the witness's opinion, would be much more durable than any other paint. Lithopone is being very largely used in France and Germany. The import of this material into France has doubled in the course of one year; the present annual consumption of paint materials in France is approximately 25,000 tons of white lead, 8,000 tons of zinc oxide, and 5,000 tons of lithopone.

Mr. Pisart stated that his firm made zinc oxide both by the direct and indirect process; both these processes are more than 50 years old, and there are no patent rights whatever involved. He could see no reason why zinc oxide should not be manufactured in England if the demand increases; his own firm would indeed consider the question of coming over to start manufacturing here.

Mr. Pisart was recalled on October 17, 1912, and questioned further with regard to the material used by the Belgian State railways. He produced an official letter signed by M. de Broqueville, prime minister and minister of railways in Belgium, inclosing a detailed statement regarding materials used, as follows:

The Belgian State railway department no longer use white lead, this material having been prohibited alike for works of maintenance as for those of construction, by a ministerial decree passed in the course of the year 1908.

From the close of that year no further purchases of white lead have been made.

The prohibition of the use of lead applies to all painting work done for the State railways, whether by the railway administration itself or by contractors. It applies to everything—locomotives, wagons, stations, sidings, bridges, signals.

The paint at present used by the Belgian Government as a substitute for white lead consists of zinc white, in which not more than 4 per cent of lead compounds are permitted. This small proportion of lead is advantageous for outside work as it prevents chalking. Where absolutely pure white color is required, Mr. Pisart advocates zinc oxide with 3 per cent of basic sulphate of lead combined in the course of manufacture, not added. Where a pure white color is not so important, and the greatest possible covering power is required for external work, a little more lead should be allowed, say 8 per cent of external sulphate as the maximum. This proportion of lead sulphate would correspond almost exactly to 5 per cent of lead soluble in dilute hydrochloric acid.

Mr. Pisart also made inquiries from the general manager of the Malines works of the Belgian State railway, who found that red oxide of iron is now being used in place of red lead.

Mr. Pisart said his works, employing about 500 men, have been in operation since 1870, and there have been no cases of lead poisoning throughout the 42 years, although no particular precautions are taken to avoid breathing of dust, even in the case of the 20 to 30 men who do the packing and are much exposed to dust. Careful medical examination is carried out in Holland, where the works are situated, and no doctor has reported any case of poisoning from inhaling the zinc dust.

The mechanical effect of breathing lithopone dust has given rise to a case of chest trouble, which the doctor described as "irritation." The official figures quoted in reply to Q. 21823 show that the quantity of zinc white supplied to the Belgian State railways has been diminishing. This the witness ascribed to buying at first on the basis of white lead and finding that the zinc went further than the lead.

Mr. Gaston Depierres is managing director of the Indestructible Paint Co. of London, and a past president of the paint and varnish society. His firm manufactures both lead and zinc paints, so that

he has no interest on either side.

Until the middle of last century white lead was practically the only paint since then white zinc has been gradually more and

more introduced. White lead is peculiarly susceptible to sulphur gases, and has also a tendency to chalk and become powdery, and in the witness's opinion it is undoubtedly possible to dispense with it for painting. He admitted that white lead is a very excellent pigment, but added:

If to-day white lead were suppressed I am sure that our houses would be painted equally as well as they are now painted, and that we should not suffer, and very probably in 20 years time we should almost have forgotten the existence of white lead (Q. 19008).

In his opinion there are only two substitutes for white lead at present known, namely, zinc oxide and lithopone. Zinc oxide has been used for many years, and failures reported with zinc oxide, both in regard to durability and covering properties, were ascribed by the witness to lack of technical knowledge among house painters.

Mr. Depierres described both the direct and indirect processes of making zinc oxide; that made by the direct process is cheaper, and in the witness's opinion a very much better pigment owing to its physical properties. It is more opaque and has a covering power better even than white lead. The peculiar physical properties of zinc oxide made by the direct process are probably connected with the small amount of lead compounds in the zinc as well as to difference in the process of manufacture.

Mr. Depierres considered that the amount of lead present in a zinc paint should not exceed 5 per cent, and should not be artificially added, but should be left in the zinc oxide as prepared from the zinc ore. The Dutch, Swedish, Norwegian, and French Governments permit 4 per cent of lead in zinc oxide; in some specifications for zinc paints in this country 99½ per cent pure zinc oxide has been demanded, and in some cases mixed afterwards with 50 per cent of white lead. This practice the witness considered ridiculous. If zinc oxide paint with 4 per cent of lead naturally present in it had been generally used in this country, he had no doubt a good deal of the prejudice would have been removed.

Lithopone is not so good as zinc oxide for exterior painting, but in the witness's opinion it has survived criticism for interior work and for water paints and undercoatings. It has a very good body and excellent covering power.

The Indestructible Paint Co. have supplied zinc paints for a great many years to the admiralty amongst other users. Large quantities of paint have been supplied for the six superdreadnoughts recently built, and the witness quoted a single order from the admiralty for 4000 gallons of zinc paint manufactured from direct zinc oxide which had obtained in competition the greatest number of points for excellence. Zinc paints can not be applied in exactly the same manner as lead paints, but there is no special difficulty attaching; once the painter is shown how to apply it, he can get in the habit of doing so; at the time of giving evidence, Mr. Depierres said zinc oxide paint was cheaper than lead paint, but under normal market conditions, there would be very little difference in the price. If properly made zinc paint does not deteriorate and can be kept two or three years, its firm guarantee the paint supplied to the admiralty not to set within two years; they could not give any such guarantee for a lead paint. The behavior of zinc paint is very different when applied

over an undercoating of properly made zinc paint and when applied over lead undercoating. So far as the witness's experience goes, he asserted that his firm's zinc paints are efficient substitutes for ordinary lead paints; the prohibition of the use of white lead would not embarrass his firm or their customers.

With regard to colored paints, the witness said it was difficult, but not impossible to obtain good red colors without either red or orange lead. The present range of colors could be obtained provided orange chrome was not excluded, but would be dearer. He referred to recent improvements in leadless reds.

There is no difficulty in regard to blues, and for yellows and greens chromate of lead is an excellent pigment. A complete range of colors would be obtainable even without chromates, but would increase the price of greens certainly 15 or 20 per cent; and the witness did not think prohibition should extend to chromate of lead, which is so insoluble that the amount used in any paint could be kept well within 5 per cent of soluble lead.

In conclusion, Mr. Depierres stated that prohibition of the use of lead is the easiest solution of the poisoning question, and he did not think that the country would suffer from it at all. He repeated that his firm have no interests in the grinding of white zinc in preference to white lead.

Mr. H. G. Chancellor, M. P., and Mr. S. P. Penwarden attended as representatives of Messrs. C. Chancellor & Co., manufacturers of leadless paints. This firm supply zinc paints which it is claimed can be used for any purpose for which white lead is used. The zinc oxide bought for mixing these paints is obtained partly at home and partly abroad. The paints, which are known as Velure, contain no lead whatsoever except in the case of chrome colors. A special medium is used and special thinners. No lead driers are added. Mr. Chancellor claimed that one coat of Velure will cover quite as well as two coats of white lead. The price charged for the paint to ordinary painters is 20s. (\$4.87) a gallon, and the claim that 90 square yards of painting can be done per gallon was fully substantiated by letters from contractors who have used the paint. Some customers have said that they can get the same results with Velure at a cheaper rate than with lead paints, but Mr. Chancellor added that there is a great amount of prejudice against special articles. Velure has been in use since 1899, and a list of buildings in which it has been used was put in. On the question of durability Mr. Chancellor pointed to a number of cases where this paint had been used and had not required renewal for 7 or 8 years. Amongst other instances Mr. Chancellor quoted the Royal Yacht *Victoria and Albert*, the paint work at Southampton and Osborne, Mountjoy, Dublin, external doors at Maidstone and brick walls at Lewes prison, infant hospital in Vincent Square, Plaistow Fever Hospital; at the last-named place it is used exclusively for outside and inside painting on a zinc oxide undercoat. The firm recommend that lead paints should not be used immediately under Velure.

Velure has been used on the Soudan Government and Nigerian railways, the Rio de Janeiro tramcars, Buenos Aires & Pacific Railway and the Royal Indian Marine. The Midland Railway also used Velure on their Heysham boats and the Belfast & Northern Counties Railway of Ireland. Velure has also been used very largely in the garden

suburbs both for external and internal painting. The houses at Letchworth and Hampstead are generally finished in two coats instead of three or four. After priming they put on one coat generally of zinc and finish with one coat of Velure. Velure is supplied in about 150 colors and fresh tints are being added every day. Mr. Chancellor said so far as his experience goes their paints are efficient substitutes for ordinary lead paints, and are far more durable as they are less liable to atmospheric and chemical action. There is no difficulty in obtaining supplies of zinc oxide apart from strikes and temporary dislocations of this kind. The increased demand for zinc would probably lead to a rise in price and the formation of a corner similar to the one which was being attempted in white lead. At the time the evidence was given Mr. Chancellor thought if white lead were prohibited probably other pigments would be discovered which would compete with zinc and keep the price from rising unduly. In any case he thought that the prohibition of white lead would not materially affect the public purse. Velure is slower drying than common paints and this property contributes to its durability, lustre, and beauty. White lead acts as a drier and therefore white lead paints dry more quickly. Mr. Chancellor said that he recommended the slow drying Velure only for the last coat. Zinc oxide is generally used for the undercoats with a special leadless liquid drier. He reiterated that prohibition of the use of white lead would not entail harm to anybody except the white lead manufacturers.

Mr. Penwarden in further examination said that the sale of Velure has a distinct tendency to increase. It is supplied both for glossy and flat finish. It is not difficult to apply, being similar in use to varnish. A very small proportion, indeed a negligible percentage, of customers who have tried Velure have reverted to the use of lead. M. Giraud and M. Petit.—These two gentlemen attended as representatives of the French firm of Carlier Frères, who manufacture hydrated zinc oxide, called "Zinox." This is stiff paste composed of pure zinc oxide and hydrated and ground in pure linseed oil. The painter prepares his paint from this paste by the addition of oil, turpentine, driers, and coloring materials. Zinox is guaranteed to be free from white lead, and is intended to be used as a substitute for white lead paste in making up paints. Such paints have greater covering power than those made from white lead, in the proportion of 12 square meters obliterated to the same extent as 11 square meters with the same quantity of white lead.

Zinox is not cheaper than white lead weight for weight, but the paint made from it is cheaper in use. Between 700 and 800 tons have been sold in the first six months of 1912. The paint has been in use in France for seven years, and the customers say it is cheaper in use than white lead. There have also been no complaints as to its durability for either interior or exterior work. A five-story house was painted as a trial at St. Denis, near Paris; the first and second stories with Zinox, and the third, fourth, and fifth stories with white lead. This paint work has been exposed nearly six years without repainting, and the Zinox was then in a better condition than the white lead. Zinox has also been found to stand better than white lead at Lille. A list of principal customers was given, practically all wholesale paint merchants.

This paint had not yet been tried in England. It was further stated that it had been used on yachts, and testimonials from users were produced. It can be used with equal success on iron and steel or on wood. Zinc oxide firms are only too glad to make contracts with paint manufacturers, and M. Petit said that he had no fear of being short of zinc oxide if the demand increased. Zinox was further stated to be unaffected by moisture, and could be used on glass. It is supplied to the contractors for certain of the French railways, but the witnesses could not give the amounts bought annually by the railways, as all the users are supplied through paint merchants. The demand for Zinox has practically doubled each year.

Mr. A. Connell attended as a representative of Messrs. Meister, Lucius, and Bruning, who manufacture anilin and alizarin dyes, which are leadless coloring materials intended for use as stainers in paints. The colors are sold as "Hansa" yellows, "Hansa" greens, and so on. Practically all colors are manufactured, including reds. They are used as substitutes for coloring materials which have a lead base. They do not fade or change tint when exposed to bright light. "Hansa" yellow, moreover, possesses the advantage over lead chrome that it can be applied on line without change of color. The witness stated that "Hansa" yellow can be used with advantage for all purposes for which chromo yellow is used to-day. He generally recommends the use of "Hansa" colors with lithopone as the base paint, but they are even better with zinc white than with lithopone.

The actual coloring material known as "Hansa" yellow has been estimated at from 10 to 50 per cent more expensive than lead chrome. This, in the case of a paint containing 10 per cent of yellow coloring material, would mean that the paint was from 1 to 5 per cent more expensive.

These new colors have been on the market since May, 1910, and the witness considered two years sufficient to judge of the permanence of coloring material. The demand for "Hansa" colors is considerable and increasing. If the use of lead materials were to be prohibited, the increase in the cost of painting operations would be very slight owing to the relatively small quantities of coloring material used in any painting job.

Rabok Co.'s paints.—Capt. Platau and Mr. Milnes attended and gave evidence as representatives of the Rabok Manufacturing Co. of Sheffield. Their paint is compounded of finely ground graphite in a hydrocarbon medium. This is nonpoisonous and the makers claim that it is extremely durable, and that it is only about half the price of lead paint. It is intended to be used as a primer. Its color is a natural dark steel gray tinted with maroon or olive green, but it is claimed that light colors can be applied over it. It is mostly used for exteriors in America, and it was stated to have been found satisfactory for certain exposed structures in Sheffield.

Mr. W. Cail attended as representative of Cail's Bitmo Co. (Ltd.) of Newcastle-on-Tyne, who are manufacturers of bituminous compounds which can be used either as ordinary paints or as priming coats. One of the compositions is put on in nearly a boiling state. The bitmo preparations are used for bunkers, floors under boilers, tank tops, bilges, deck holds, peaks, funnels, and other parts of ships. In a few cases they are applied on wood, but they are essentially intended to be applied on metal. With a bitmo solution

an undercoating of red lead is not required, and by using these preparations it is possible to dispense with the use of lead entirely for the painting of iron or steel work. The bituminous coating is entirely leadless, and contains no lead driers or turpentine. It is substantially a carbon paint which is rust proof, damp proof, and not affected by sulphur or acid fumes. It takes three or four hours to dry in an ordinary room, but somewhat longer in an inclosed space. The composition is stated to stand well in exposed positions and is being tried on one of the high steel bridges over the Tyne. The covering power of the composition is said to be twice that of lead paint; it costs about 35s. (\$8.52) per hundredweight ready for use. The witness gave a long list of firms who have expressed satisfaction with the bitmo compositions and have given repeat orders (Q. 19267).

CONSULTANTS TO PAINT MANUFACTURERS.

Mr. J. Cruickshank Smith, D. Sc. (Aberdeen), F. C. S., member of the Society of Chemical Industry, member of the International Testing Association, past president of the Paint and Varnish Society, and author of a number of books and papers on the manufacture of paints, dealt with the uses of and constitution of paints. He spoke of the essential difference between lead and zinc pigments, involving different methods of treatment; he did not consider that it would necessarily be more difficult to use zinc paints than lead, but some change in the painter's methods would be requisite, and failures with zinc paints frequently result from employment of unsuitable driers; he thought some of the difficulties might be overcome by sending out zinc paints in a semi-finished state.

So far as protective painting goes—painting on iron and steel—the witness said unhesitatingly that he had found zinc paints to give much better results than white lead; on wood he considered it possible to manipulate zinc pigments in such a way as probably to give as good results as white lead, but it is not an easy problem. White lead holds its own, especially as a most excellent priming for plaster walls he considered lead to be inferior to zinc suitably prepared. Summing up, he considered zinc oxide paint superior to lead for interior painting and also for outside work if due regard be paid to the vehicle; the cost of using zinc paints might be a little more than for lead paints. The witness was of opinion that it should be made compulsory to notify cases of poisoning amongst painters; to label all packages containing lead compounds; to prevent inhalation of dust containing lead. He did not offer any practical suggestions as he was a purely scientific expert witness, but he considered that in the interests of health it was essential either to prohibit the use of lead or to require the observance of regulations.

Mr. Charles A. Linc stated that he had studied the subject of the positions which can be used either as ordinary paints or as priming coats. One of the compositions is put on in nearly a boiling state. The bitmo preparations are used for bunkers, floors under boilers, tank tops, bilges, deck holds, peaks, funnels, and other parts of ships. In a few cases they are applied on wood, but they are essentially intended to be applied on metal. With a bitmo solution

not financially interested in any make of paints. He considered that zinc sulphide could be used with advantage for all undercoats and all interior work, while for exterior work he would apply varnish over it or add varnish to the last coat; zinc oxide with the right thinners gives a very durable paint, and a mixture of zinc oxide and graphite gives an extremely durable protective coating for iron and steel. The vehicle used in making up a paint is of much more importance than the pigment; thus the oils and driers commonly used for lead are not suitable for zinc paints; Mr. Lino advocates pale drying oil, a small proportion of linoleate or borate of manganese being introduced into the oil in the course of manufacture.

Zinc sulphide costs about the same as lead, but the bulk is double and the covering power better. Priming coats of lead paint are not necessary before the application of zinc paints; there are advantages in using a modified water paint to produce a hard foundation on which to apply zinc paints.

Mr. Lino admitted that some lithopone is of very inferior quality; good zinc sulphide paint should contain a far larger proportion of zinc sulphide than that found in cheap lithopone paints. For white finishing coat the witness would use a good zinc oxide, which is readily obtainable and is suitable for finishing either with enamel surface or a flat surface.

The witness gave a number of examples of houses painted with zinc paints showing the very great durability of these when properly prepared and applied. The zinc paints are made by most paint grinders in England from imported lithopone or zinc oxide. The witness's opinion if the demand for zinc oxide was increased capital would be found for its manufacture in England, and the increased demand would not increase the price because of the competition with zinc sulphide. Mr. Lino did not think that the prohibition of the use of lead in paints would entail any serious difficulties.

With regard to priming coats of paint on woodwork, a surface can be obtained without the use of lead by a variety of substances such as the wood fillers in use in America.

Mr. Lino also gave evidence regarding colored paints obtained without the use of lead, and stated that their use would entail an increase in the cost of painting. The witness stated that he did not know of any tints or colors which, for decorative purposes, can not be obtained without the use of lead.

CHEMISTS.

Professor Baly, fellow of the Institute of Chemistry, of the Royal Society, and of the Chemical Society of London, and at present Grant Professor of Inorganic Chemistry in the University of Liverpool, first attended before the committee on March 28, 1911, and gave details of a very important research which led him to the conclusion that volatile lead compounds were given off during drying of paints containing white lead. In the course of further evidence, however, given by Prof. Baly on February 21, 1912, he stated that further experiments had satisfied him that these emanations did not contain volatile compounds of lead. He had him-

suffered from some form of poisoning at the time of making the first experiments, and the doctors had misled him by diagnosing that illness as lead poisoning. Since that time he has pursued his investigation very much further and has condensed the emanations, which are undoubtedly poisonous although they do not contain lead. Professor Baly made comparative experiments with lead sulphate and zinc white and found practically no condensable emanation from either. The poisonous emanation which comes off from white lead paste is probably an oxidized product of linseed oil, and the poisonous effects may be due to the presence of unsaturated aldehydes. These poisonous aldehydic compounds are also given off from linseed oil with manganese dioxide. The use of driers increases the amount of these emanations, which are always found with white lead paint. They come off from white lead much more freely than from zinc white, and the poisoning effect produced by them is similar to that associated with lead poisoning although the illness is not really lead poisoning.

THE ADMIRALTY CHEMIST.

Mr. Arnold Philip, the admiralty chemist, stationed at H. M. dockyard, Portsmouth, attended to give evidence as to the use of paints in the British navy. The admiralty have for some time recognized the dangers attaching to the use of lead paints, and have taken precautions accordingly. Red oxide of iron has replaced red lead on double bottoms for a considerable period, and the iron casings of boilers are now coated with oxide of iron paint instead of red lead; the red oxide paint consists of red oxide of iron in boiled linseed oil with a proportion of driers representing less than 1 per cent of lead oxide.

Zinc white paints also have been introduced, partly as a substitute for white lead in the interior spaces and quite recently as enamels for the inside of cabins in the place of white lead paints. The use of zinc white has greatly increased in the navy during recent years; for over 10 years mixtures of zinc and lead paints have been used extensively. As regards painting work inside cabins, zinc white enamels have been found to wear a great deal better than lead paints. They also on the whole retain their color better. Although the first cost of a zinc white enamel is greater than that of a white lead paint, the former is so much more durable that in the end it is more economical. So far the general use of zinc paints has been confined to interior work, for which they have proved entirely satisfactory. In Mr. Philip's opinion the widespread belief that lead paints are the best is due to their having a much longer history than zinc paints. The exterior painting in the navy is almost entirely done on metal with white lead stained with lamp black to the standard grey tint. The durability of the paint is not an important factor, as the service allowance of paint is about eight coats per annum, and therefore the outside paint does not weather off; repainting is resorted to as soon as any of the paint is damaged mechanically. In view of this fact, Mr. Philip's opinion is that leadless paints would be equally serviceable for the outside painting.

SUPERINTENDING CHEMIST OF THE GOVERNMENT LABORATORY.

Mr. Grant Hooper, F. I. C., F. C. S., is superintending chemist of the Government laboratory. He gave evidence as representing Dr. Dobbie, principal chemist of the Government laboratory, in regard to questions affecting the estimation of the proportion of lead in paints.

He stated that if the committee decided to recommend the restriction of the amount of lead to, say, not more than 5 per cent in paints, there would be no difficulty in determining the proportion by analysis of any given sample of paint.

Further, if the committee were to recommend restriction in terms of soluble lead, estimated in a manner similar to that in which the soluble lead in pottery glazes is determined, there would be no difficulty in devising a plan for the determination of soluble lead; in such a test it would be necessary to prepare first the dry substance of the paint, in other words to free it from oil or vehicle, just as a pottery glaze has to be freed from the water with which it is mixed; thereafter the determination would proceed on the same lines as in the case of the pottery glaze material. The most convenient way to express the solubility is in terms of lead monoxide. The solubility of ordinary white lead estimated in this manner is 100 per cent; a 5 per cent limit for soluble lead would therefore only permit 5 per cent of white lead being used in a paint. Other lead compounds, for example lead sulphate, are not so readily soluble, and therefore the 5 per cent limit of soluble lead would permit of a freer use of such compounds—as much as 20 per cent in the case of lead sulphate. The solubility limit would therefore, encourage the use of less soluble forms of lead, which is a desirable result from the standpoint of health.

Mr. Grant Hooper next dealt with certain colored paints. He stated that he had estimated the lead in a range of dark green paints and found them to contain 6 to 18 per cent of lead, all soluble; the 5 per cent limit would restrict the use of lead in such paints, but would at least of the lead chromate in such paints could be replaced by zinc chromate at a not very serious increase in price.

Mr. Grant Hooper suggested a form of words for setting forth such a solubility limit, namely:

After the . . . day of . . . no paint or wash shall be sold or used for coloring, or protecting any wood, stone, metal, or any building, or construction, or part of a building or construction, unless such paint or wash is free from lead and lead compounds, or unless when tested in the manner described below it shall not yield more than a definite proportion (say, 5 per cent) of soluble lead or lead compounds calculated as a percentage of lead monoxide on the dry substance of the paint or wash. The "dry substance" is meant the paint or wash substance dry and free from turpentine, oil, varnish, and varnish material, gelatine, size, and other fluid or adhesive or water proofing material.

He also suggested the following as the prescribed method of testing: *Method of testing.*—If the paint or wash be mixed with water, turpentine, oil, varnish, size or other adhesive or waterproofing substance, it shall first of all be freed as far as possible from such vehicle or adhesive or waterproofing substance by drying it by treatment with ether, petroleum spirit, alcohol, water, or other neutral solvent solvents. If the residual substance so obtained should contain insoluble varnish matter, size, or other adhesive material which can not be removed except by the action of reagents which affect the other constituents of the paint or wash, then the proportion of such varnish matter, size, or other adhesive material shall be ascertained by suitable means, and a deduction be made for the same from the weight of residual matter taken for the determination of the soluble lead, so that the proportion of soluble lead shall be calculated as a percentage on the dry substance in

on varnish matter, size, etc. For the determination of the soluble lead, a weighed quantity of the dried or dry material, freed as far as possible from oil, or other vehicle, adhesive substance, as described above, is to be continuously shaken for one hour, the common temperature, with 1,000 times its weight of an aqueous solution of hydrochloric acid containing 0.25 per cent of actual or real hydrochloric acid. This solution is thereafter to be allowed to stand for one hour and to be passed through a filter. The lead salt contained in an aliquot portion of the clear filtrate is then to be precipitated as lead sulphide and weighed as lead sulphate.

He pointed out that both of these forms of words might be somewhat modified in the light of further experience. In practice no doubt ready-made paints would be bought under a guarantee that the necessary testing of samples could be done either by local authorities by the Government laboratory.

Further questioned as regards red paints, Mr. Hooper suggested that they could be made either with oxide of iron or with vermilion; the great cost of the latter pigment has led to the introduction of many vermilionettes, which the witness suggested could be probably placed by aluminium lakes.

THE PRINCIPAL CHEMIST OF THE GOVERNMENT LABORATORY.

Dr. J. J. Dobbie, principal chemist of the Government laboratory, as good enough, at the request of the committee, to make a careful investigation into the conflicting statements which had been put forward with regard to the existence of lead vapors in air which has been in contact with surfaces freshly painted with lead paint. The statements regarding emanations containing lead which were published in the report of the French white lead committee of 1907, were based largely on the use of Trillat's reagent. The first part of Dr. Dobbie's investigation dealt with the use of this reagent, which he reports as being unreliable on account of the extreme difficulty to secure the absence of all traces of peroxides and other oxidizing agents which have the power of reacting with it to give a blue color. As a means of estimating small quantities of lead, he found it altogether unsatisfactory. In the next place, Dr. Dobbie endeavored to reproduce the experiments of MM. Heim and Ilébert described in Appendix XV to the French report. Experiments on these lines carried out at the Government laboratory with special precautions entirely failed to confirm MM. Heim and Ilébert's results.

He further investigation into the possibility of vapors containing lead being produced as a result of reactions which go on during the drying of lead paints made up with oil and turpentine were carried out on lines similar to those described by Mr. Klein in his experiment p. 5. A box was constructed with partitions so arranged that air

was drawn in at one end and must pass between the adjacent partitions, having a total area of some 100 square feet, before leaving at the other. Various mixtures of white lead with linseed oil or turpentine or both, in some cases driers in addition, were applied to the partitions and air was passed through until the paint was dry. The air drawn through the partitions was carried first through cotton wool plugs and then through absorption bulbs. As long as the cotton wool plug employed was of the usual length, 3 inches, lead could always be

¹ See evidence of Prof. Italy, p. 58; Mr. Klein, p. 106; and Prof. Armstrong, p. 93.

detected in the absorption bulbs as well as in the cotton wool. introducing a sufficient number of cotton wool plugs the whole of lead could be trapped therein, no trace of the metal being detected in the absorption apparatus. These experiments show that a current of air which has been passed over a surface freshly painted with lead paint contains traces of lead which, however, is not present in vapor, but in the form of minute solid particles.

Dr. Dobbie adds further that "whatever the form in which it enters the air, it is certain that the quantity is so small as to be negligible for all practicable purposes," and points out that according to the statement of the French observers in their report the quantity of lead obtained by them must have been similarly minute.

The conclusions arrived at from the above experiments were confirmed by spectroscopic examination of air exposed to freshly painted surfaces. Lead forms several well-known volatile compounds which vapors, when present in even very minute quantity, exercise a powerful absorptive action on light. A layer of air 4 feet thick in contact with a surface freshly painted with a mixture of white lead and red showed not the least trace of absorption. Dr. Dobbie concludes, therefore, that "if emanations of lead take place from painted surfaces, the amount is so small as not to be detectable" (Q. 22497).

Dr. Dobbie also carried out a series of distillation experiments similar to those described by Mr. Klein, but on a larger scale, the results entirely confirming those obtained by Mr. Klein.

In connection with the poisonous character of vapors given off by turpentine, Dr. Dobbie pointed out that in the experiments not away from present in the absorption apparatus traces of acid and aldehyde as well as considerable quantities of terpin hydrate. The acid and aldehyde might be derived either from the oil or from the turpentine or from both. In view, however, of spectroscopic observations made, Dr. Dobbie states it is doubtful if any considerable amount of decomposition of the oil occurs under 160° F., and he is therefore inclined to the view that the turpentine is the source of nearly all the decomposition products observed. He found, however, that boiled oil alone, a mixture of white lead and linseed oil, and a mixture of white lead and linseed oil gave off aldehyde vapors at the ordinary temperature; the amount in each case is very small, and he could not say whether it is greater in one case than in the other.

In further examination, Dr. Dobbie expressed the view that the processes which cause dust in lead painting could be abolished, but that would do away with direct lead poisoning. He produced a small particle of metallic lead of about one-seventh or one-eighth of the size of an ordinary pin's head, and stated that that was the total quantity of lead which it was found possible to collect from the air drawn over some three-quarters of a hundredweight of paint which had been dried in the apparatus during the 40 days that the experiment lasted. This amount of lead in the air represented very much less than a medicinal dose of lead; it is about a thirtieth of a minimum dose that is given medicinally in cases of severe diarrhea, for instance.

Dr. Dobbie also stated that in Belgium the principal regulations are those prohibiting the sale of dry powder and the prohibition of dry lead in the form of white lead in the painting of surfaces if there is lead in the paint.

In commenting on all these foreign enactments, Sir Henry said he always been of opinion that if sufficient care is taken you can almost any ingredient quite safely by forbidding it where it is unnecessary, and, if it is allowed at all, putting it under strict regulation (Q. 10298). Such an enactment as the prohibition of white lead for any purpose in paint would be easy to enforce. On the whole, Sir Henry advocated a combination of prohibition and regulation.

¹ See Mr. Klein's evidence, p. 100.

SIR HENRY CUNYNGHAME, K. C. B.

Sir Henry H. S. Cunyngame, K. C. B., Legal Assistant Under-Secretary of State for the Home Department, has devoted considerable attention to the question of lead poisoning arising from the use of lead paints. He considered the evil to be a very serious one and a remediable one. Some action is undoubtedly called for either in the way of prohibition or restriction of the use of lead or by a code of regulations.

In France a law was passed on July 20, 1909, to come into force five years later, prohibiting the use of white lead in any painting operations either on the exterior or interior of buildings. This is the most drastic enactment yet made in regard to the lead-poisoning evil.

In Austria the use of lead for interior painting has been prohibited since the 1st of April, 1909, but it is still permitted for exterior work and certain specific purposes under a very strict code of regulations, which include ventilation, washing and dressing rooms, marking of vessels containing lead paint, prohibition of the employment of women and young persons; overalls are prescribed and in certain cases medical examination.

In Germany there is an order, applying to all States of the German Empire equally, which enacts that workers are not directly to handle dry pigments containing lead; the grinding of white lead with oil or varnish is not to be done by hand; the processes of rubbing down or oil-stoning of oil color or stopping not clearly free from lead shall not be done except after damping; the employer must see that overalls are worn and must also provide washing utensils, nailbrushes, soap, and towels; the employer is charged to give information to the workers who handle lead colors as to the danger to health, and he must give them a copy of a warning pamphlet; there are further regulations which apply only to painting operations carried out in connection with another industry. It is also required that the employer issue regulations which shall be binding on the workers. These regulations must include the prohibition of the consumption of spirits in any place where work is carried on; the prohibition of taking food or drink in a place where paints are kept or used; and the prohibition of leaving the place of employment until they have put off working clothes and carefully washed their hands. The wearing of working clothes is to be made compulsory and the smoking of cigars and cigarettes is prohibited during work. With these is coupled the provision that any worker who, after repeated warnings, continues to break the rules may be dismissed without notice, any contract notwithstanding. Provision is also to be made for medical supervision of the worker's health.

In Belgium the principal regulations are those prohibiting the sale of dry powder and the prohibition of dry lead in the form of white lead in the painting of surfaces if there is lead in the paint. In commenting on all these foreign enactments, Sir Henry said he always been of opinion that if sufficient care is taken you can almost any ingredient quite safely by forbidding it where it is unnecessary, and, if it is allowed at all, putting it under strict regulation (Q. 10298). Such an enactment as the prohibition of white lead for any purpose in paint would be easy to enforce. On the whole, Sir Henry advocated a combination of prohibition and regulation.

If the use of certain paints is prohibited, power should be given the proper authority to add to the schedule from time to time any other paints which prove to be equally dangerous. A regulation making it illegal to sell white lead unless it was marked as white lead would be useful. In any code intended to apply to the painting of buildings the term "building" should be defined so that it would include, for example, conservatories, but not necessarily a chicken house or a dog kennel; Sir Henry suggested as a definition of a building "any place in which there is a door which a man can enter." Special exemptions might be necessary in regard to certain articles made in factories, artistic work, portraits, and the like, and possibly also ships and boats, though Sir Henry believed that for these purposes zinc white is better than white lead. The witness stated that he had found zinc white giving excellent results for interior painting for this and many other purposes he thought lead ought to be prohibited. It might be necessary to provide exemptions for exposures paint work not protected by varnish in places where the atmosphere contains an abnormal amount of sulphurous acid, but Sir Henry strongly advocated the rule "no white lead for interiors or exteriors coupled with the provision for the Home Office to grant exemptions in cases where it was shown to be absolutely necessary, e. g., for safety of girders or gutters in railway stations and the like, to white lead; where, however, any such exemption was granted it should be accompanied with a full code of regulations applicable to the use of lead paint.

Sir Henry was not in favor of a 5 per cent limit of soluble lead, he did not believe that it was necessary to put lead in the paint; he would prefer total prohibition with exemptions in certain cases; the exemption up to a 5 per cent limit might be granted if asked for.

Sir Henry recognized the exceptional climatic conditions of such places as Manchester, but said further that he had not made any place of study of substitutes for white lead and thought it very probable that efficient substitutes might be found for use even in bad climates; he thought that in any case exemptions should only be given for a few years. In any case the prohibition of the use of lead should be accompanied with a time limit, to allow painters to learn the use of zinc paints. In connection with prohibition, materials should be considered leadless if they only contain a trace, say 0.01 per cent of lead; Sir Henry admitted, however, that it might be expedient to allow 3 or 4 per cent so as not to exclude zinc oxide made by the process, but this he would prefer to do by schedule, which could be amended from time to time. He would advocate the prohibition of the making of white lead for the purpose of paint as well as the sale and use thereof for that purpose. He thought the admission of 5 to 5 per cent would involve administrative difficulties, but it might have to be allowed where it was shown to be necessary.

WITNESSES REPRESENTING H. M. OFFICE OF WORKS.

Mr. G. D. Patterson first attended to give evidence before the committee on March 28, 1911, he being at that time clerk of works in charge of the West London district. He stated that he had carried out extensive experiments with substitutes for lead paints, under the direction of the principal architect, Sir Henry Tanner, to whom

entrusted the supervision of the palaces, the Houses of Parliament, Government offices, Crown courts, post offices, inland revenue offices in England and Wales, and foreign consulates throughout the world. Three grades of paint are used by the office of works, namely:

- (1) Low grade paints for external painting and "lower class of internals";
- (2) Medium quality enamels for "general internals";
- (3) Best enamels for the better-class rooms only.

In each class he stated that he found the relative characteristics of lead and zinc paints the same, and he found the prices of lead and zinc approximately the same for the same quality of paint. He stated that lead paints have other defects besides involving risk of poisoning, inasmuch as they are discolored by sulphur in the atmosphere, they chalk in chemical and scale on hot pipes and surfaces (see Q. 1059). He experienced considerable difficulty in obtaining nonpoisonous substitutes for lead at first; he obtained zinc oxide paints from the usual paint makers, but found they required different treatment to the white lead paints previously used. It was soon discovered that difficulty of drying could be overcome by using refined boiled linseed oil with manganese borate driers and a trace only of litharge; and sufficient capacity could be obtained by using thick paints containing as much as 70 per cent of zinc oxide; with these he found that bare plaster walls could be painted with two coats of zinc paint in place of three coats of white lead paint. Such paints have been used generally in the painting of Crown buildings since 1907, the use of lead being confined to the small proportion needed for priming on new work. He stated that he had no doubt whatever that zinc paints, with the addition, say, of 5 per cent of lead compounds, could absolutely replace all lead paints for ordinary use; somewhat more than 5 per cent of lead compounds, however, he considered necessary for dark green paints.

Mr. Patterson laid stress on the importance of the medium, and specified that in finishing coats a certain proportion of varnish is always used; notwithstanding this the zinc paints cost the same as the corresponding lead paints. He said there should be much prejudice to meet in prohibiting the use of lead paints, but he did not consider such a step would entail great inconvenience or would it be a dangerous one to the trade. Paints containing more than 5 per cent of lead could certainly be prohibited except for greens, which a limit of 10 per cent should be allowed.

Mr. G. D. Patterson was recalled in November, 1911, when he confirmed his previous evidence and gave certain further details. With regard to the proportion of varnish in the medium used for external paints, namely, 1 of varnish to 3 of oil with zinc oxide and 1 of varnish to 2 of oil with iron oxide and other dark paints, the office of works gave the paint contractor a free hand in this matter and the latter uses whatever proportion of varnish and driers he believes to be best. The addition of varnish is undoubtedly of material use in securing durability. Although good varnish is a somewhat costly ingredient of office of works have found zinc paints, even with the varnish used, no more costly than lead paints. Some of the lead paints previously used had varnish in them and some not; zinc paints which

with the varnish have cost the same price have been found as good as new, withstanding weather conditions, better in appearance, and more permanent in tint than the lead paints.

To confirm the statement that zinc paints are not more costly, Mr. Patterson asked for quotations for lead paints from a number of contractors.

Firm No. 1 replied, "The price of our lead and zinc base paints is the same in their respective brands."

Firm No. 2 stated that "the difference in the cost per gallon would be practically nil on the assumption that the respective coverings and powers are alike."

Firm No. 3 said that "the similar paint with a white lead base would cost slightly more expensive than zinc, the price of lead paint being 7s. 6d. (\$1.82) per gallon against 7s. (\$1.70) for the zinc paint."

With regard to specification, pure zinc can be specified in place of genuine white lead, and a certain percentage of other ingredients such as baryta, gypsum, silica, or whiting, can be allowed if desired. The office of works only use a flattening paint occasionally, but zinc paints are supplied in three grades, namely, flat, eggshell, and full gloss.

The office of works had been asked to make inquiries with regard to the allegations appearing in Mr. Wiltshire's evidence concerning the painting of the Canterbury post office.¹ Mr. Patterson found the statement that the work had to be redone within a year was erroneous; it was not repainted until it was fully due in accordance with the board's rules that new work should be repainted two or three years after completion—a rule which applied equally to lead paint. In the case of the Canterbury post office part of the original paint was only redone after 4 years and the rest of the building after 5 years. At the time of repainting the work was examined by an architect, who reported that the state of the old paint was quite good as could be expected after 3 years' wear, and the repainting was done in pursuance of the board's order that new work should always be repainted after 3 years at latest.

Mr. Patterson reaffirmed his previous statement that zinc paint could replace lead paints without loss of quality or increase of cost except in regard to green paints, for which in the present state of knowledge he would like to be free to use 10 per cent of lead; he said, however, there were indications that the difficulty of getting lead greens may shortly disappear. Where the paint is used under exceptionally trying conditions, as, for example, in the greenhouses at Kew, both lead and zinc paints have been found equally unsatisfactory.

With regard to the length of the office of works' experience with leadless paints Mr. Patterson stated he could speak personally of about 5 or 6 years' experience with leadless paints under definite and careful observation; he had found the results quite as good as with lead paints. He did not think that it was any easier for the office of works than for any ordinary firm to get satisfactory leadless paints.

Questioned in regard to 5 per cent of soluble lead being sufficient to meet the requirements of yellows and greens, Mr. Patterson said the office of works had not gone into the matter of soluble lead as trusted with total lead contents. The office of works' formulae mixed by the paint manufacturer to the office of works' formulae

These paints are bought by the contractors who undertake painting withstanding weather conditions, better in appearance, and more permanent in tint than the lead paints. In Mr. Patterson's opinion the experience of the office of works is sufficient to warrant a measure of prohibition of white lead. The office of works tests were carried out on wood and plaster as well as on iron.

The office of works still use white lead partly on engineering work which is not under the control of the principal architect and partly for fillings, stoppings, and the like. Moreover, owing to the fact that many men have not yet become accustomed to the use of zinc paints, there may have been ordered by some of the clerks of works; the latter are instructed to specify zinc paints, but they have not hitherto been absolutely prohibited from ordering lead. On recent work use of lead for filling has been dispensed with.

Mr. Patterson was again recalled on November 14, 1912, and put in place of showing details of the early experiments made by the office of works with leadless paints. He thought that these experiments were successfully conducted; the actual painting was carried out before he was associated with the experiments, but the condition of the paint at a later date was judged by three clerks of works, namely, Mr. Carpenter, Mr. Jones, and himself.

According to Sir Henry Tanner's instructions, a big experiment was put in hand as soon as they were satisfied that the smaller experiments were satisfactory. The five blocks of the post office savings bank building at West Kensington were used for the large-scale experiment, all being painted externally with ivory white paint, one block with the white lead, and the other four blocks different zinc oxide paints. Mr. Patterson gave details of this important experiment, which was carried out in the year 1906.

Under ordinary circumstances the office of works' painting is expected to stand in good condition externally for four years. The architect, who reported the result of the examination of the paint in 1910 is shown in Appendix XXV. The results obtained with the zinc paints were so satisfactory that the office of works have continued to specify for such paints from 1910 onwards.

The formula now in use differs somewhat from the formula of the paint supplied in 1906, the proportion of zinc oxide required in the present state of paint being raised to 58 per cent, while at the same time a maximum of 5 per cent of lead is now allowed in zinc paints, whereas one of the paints used in 1906 contained more than a trace. Paints are now used exclusively except for Kew painting work.

Mr. Patterson put in a list of buildings showing the kind of paint used on each, and dealt with the instructions issued by Sir Henry Tanner with regard to the disuse of lead paints. Most of the paint work is done for the office of works by triennial contracts, a small part only (for example, Buckingham Palace) is done by special contractors, and the contractors are required to conform to the office of works' rules and to use zinc paints. Contractors' paints are in cases of doubt analyzed.

The use of lead for priming woodwork has been discontinued since May, 1912, but up to the time of giving evidence lead paints were still in use for priming iron and steel. Tests are being made with leadless materials also for this latter purpose. A very little

¹ See p. 22.

¹ In Minutes of Evidence, presented in a separate volume of the original report.

work, and both witnesses agreed that a limitation of the lead content to 5 per cent would not introduce serious difficulties.

The vehicle, in the opinion of these witnesses, is as important as the pigment, and they considered tung oil, which is cheaper than linseed oil, is a most suitable vehicle. The Royal Institute of British Architects are prepared to adopt before long a standard specification which would include zinc paints, and it was stated that architects generally would welcome the prohibition of lead if possible, witnesses considering that it would be perfectly safe for them to assent to a limitation of the lead in paints to not more than 5 per cent. At the same time the knowledge of zinc paints amongst architects is not great and up to the present time white lead has been specified as a matter of habit.

WITNESSES REPRESENTING MESSRS. CADBURY BROS. (LTD.)

Mr. B. J. Morley attended to give evidence regarding the use of leadless paints by Messrs. Cadbury Bros. at their works at Bournville, near Birmingham. The witness is foreman painter for the firm and has had over 34 years' experience. He has at present control of 30 to 50 painters who are employed in all varieties of work. Leadless paints have been used exclusively by Messrs. Cadbury for 3 years and almost exclusively for 7 years; the change from lead paints to leadless was commenced 12 years ago.

The paint materials at present in use at the Bournville works are: For white bases, pure zinc oxide; for general reds, oxide of iron; for greens, leadless green, which is sometimes made from barium and sometimes from zinc, but most commonly from ferrocyanide of potassium and ochre. In addition to these, various better-colored colors, such as carmine, are used, but these are all quite leadless. The use of red lead as well as other lead compounds has been entirely abandoned.

The leadless paints are mostly applied by Messrs. Cadbury's own men, but occasionally by outsiders. All the paints used are bought in the paste form ground in oil or turps as the case may require; the oxide of zinc is bought ground in pure linseed oil.

The specification for zinc oxide is 99 per cent pure oxide of zinc without a trace of lead; as long as the material is free from lead, cadmium, or barium, and it contains 98 per cent of pure oxide of zinc is accepted. The standard of purity for iron oxide is 97 per cent ferric oxide.

Mr. Morley stated that he is entirely satisfied with the results obtained with all their leadless paints; the work includes good oil work, factory work, both exterior and interior, and comprising iron, steel, and wood work, and greenhouse work; there are also motor vans, locomotives, and other incidental items of paint work, which are all done under the supervision of the witness and according to specifications. About 5 cwt. of lead is still bought annually for use of the pipe fitters and engine fitters, but none of it is used in painting. Samples of the various materials are analyzed for lead and the witness stated that he was confident there would never be more than 3 per cent of lead in any of their paints; they endeavor to eliminate even that small percentage.

In Mr. Morley's opinion the use of leadless paints is not more costly than lead. He has not been able to trace any difference in the cost in one way or the other.

The witness next gave examples of large buildings which had been painted with leadless paints; apart from one which was last painted 11 years ago, at which time he could not be certain that the paints were absolutely free from lead, he instanced two buildings some 600 feet by 40 feet which were painted 7 years ago absolutely without lead. These were painted externally, both woodwork and ironwork, partly with zinc oxide and partly with iron oxide paints. They were not new buildings, but were repainted over lead, which the witness considered a disadvantage because it attacks the zinc and has a tendency to powder in the presence of sulphurous fumes. He also instanced two or three blocks of new buildings painted entirely with zinc. One of these was painted about 3 years ago and the other about 5 years ago. The practice of the firm is to paint externally once in 7 years; from the whole of his experience throughout the factory Mr. Morley had arrived at the definite conclusion that the leadless paints stand better than the white lead paints used to do.

In regard to interior painting, of which the witness's experience includes the interior of a greenhouse painted as an experiment, his conclusions are even more strongly in favor of leadless paints. In the witness's opinion priming, as well as other paint work, can be done efficiently without the use of lead.

In further examination the witness stated that at first some difficulties had been found in respect of drying and in obtaining a perfect matting paint, but these difficulties have now been overcome; the firm's own men find no difficulty in applying leadless paints, but outside contractors' men are less accustomed to it.

The thinners used with zinc oxide consist of raw linseed oil, American turps, and boiled oil, together with from 1 pint to 1 quart of turps varnish to every half hundredweight of oxide of zinc. The zinc paints cost more per cwt. than lead paints, but owing to the much greater specific gravity of zinc than lead, Mr. Morley has not found that the painting costs any more per square yard.

WITNESSES DEALING MAINLY WITH STATISTICS OF LEAD POISONING AMONG HOUSE PAINTERS.¹

Mr. Parsonage gave evidence to the effect that the average membership of the National Amalgamated Society of Operative House and Ship Painters and Decorators over the last six years was about 3,000, of whom a very small number, probably not more than 100, could be engaged on ship painting exclusively. He handed in a table² showing amounts paid as compensation for serious cases of lead poisoning among the members of his society, and he also handed to Mr. Collis records of 935 deaths³ from all causes which had occurred among members of his society during the six years 1905-1910, and assured the committee that the records, which were not specially compiled for this inquiry, but comprised the ordinary quarterly returns, could be relied upon as absolutely trustworthy.

¹ See also evidence of Dr. Legge, p. 4.
² See Appendix XI (Minutes of Evidence).

³ Tabulated in Appendix XII (Minutes of Evidence).

Mr. Gardner gave similar evidence as secretary of the Scottish Society of Operative House and Ship Painters, stating that the average membership of his society was 3,240, of whom not more than 10 per cent would be exclusively engaged in ship painting. He handed to Dr. Collis records of 305 deaths from all causes which occurred during the 10 years 1901-1910, inclusive.

Dr. Collis, a member of the committee and II. M. medical inspector of factories at the Home Office, gave evidence regarding the details of the death returns handed in by Messrs. Parsonage and Gardner. He prefaced his evidence by dealing briefly with the important point in the registrar general's mortality returns for the plumbers, painters, and glaziers, among whom the mortality is shown to be 11 per cent higher than amongst the general population.

In the registrar general's supplement attention is called to the excessive incidence of Bright's disease, phthisis, and nervous diseases, as well as plumbism, among workers whose occupation involves exposure to absorption of lead. Following this conclusion, Dr. Collis stated that he had tabulated the figures supplied by Messrs. Parsonage and Gardner with special regard to the incidence among the members of the two trade societies of plumbism, Bright's disease and phthisis, but he did not attempt to deal with nervous diseases in his investigation owing to his uncertainty as to which diseases the registrar general had included under that heading. Dr. Collis put in a table showing details of the two societies taken together as well as a further table showing the deductions which may fairly be drawn from the first table.¹ He summed up the results briefly as showing that of every 100 deaths which have occurred among the members of the two societies, between 13 and 14 have occurred from causes attributable to lead. The elimination of those causes of death which are connected with work in lead resulted in the conclusion that the age of death from the remaining causes would closely approximate the average age at death of all males. In Appendix XII, Table B,² added in Bowley in his book "Elements of Statistics," regards as the most useful form of average. In the case of members of the two trade societies the median age at death is eight years lower than it is for males. These conclusions agree almost exactly with the corresponding deduction from the registrar general's figures, which show the median age of plumbers, painters, and glaziers at death is 48, as compared with 56-57 among the general male population.

Dr. Collis satisfied himself from a study of the statistics that lowering of the median age at death was due solely to the increase of prevalence of plumbism, phthisis, and Bright's disease, the first of which cause a lower median age at death than that caused by the other diseases. Dr. Collis then compared the figures of the National Amalgamated Society with those of the Scottish society, and pointed out that the latter the incidence of plumbism is decidedly lower, that Bright's disease somewhat lower, and that of phthisis decidedly higher; the mortality from accident is also higher in the Scottish society.

¹ See Appendix XII (Minutes of Evidence).

² In Minutes of Evidence, presented in a separate volume of the original report.

The witness next dealt with statistics of invalidity and showed that the amount of sickness among any class of workers could be judged by the contributions required by the friendly societies. As long ago as 1854 it was realized that four classes of workers were exposed to excessive risk of invalidity, namely, marmers, miners and colliers, painters, and railway servants; while the painters are not liable to accident sickness to anything like the same extent as the other three classes just named, the contribution required from the painters stands second and is only exceeded by that required from the miners and colliers. Dr. Collis also quoted figures given in the United States Bulletin of Labor for 1910,¹ showing the insurance rates charged in the various occupations in all the principal civilized countries. Since the act of 1906 made lead poisoning a ground for compensation under the Workmen's Compensation Act the insurance rates for painters have increased, while the rates have somewhat decreased during the same period for most other occupations; further, the increase of rates for painters which has taken place since 1907 has not occurred in countries where lead poisoning is not the subject of compensation.

Dr. Edgington is the certifying surgeon for North Birmingham, and has a considerable number of lead poisoning cases. He produced particulars of 106 cases seen in the course of 24 years. Included in these were 11 cases of house painters, 3 of which only were reported to the Home Office. The other 8 were not reported because the poisoning had not been contracted in a factory or workshop. Seeing that only 3 cases out of 11 were reported to the Home Office, Dr. Edgington concluded that there must be a very large number of unreported cases in the city of Birmingham taken as a whole. Dr. Edgington explained that he did not tabulate a case as lead poisoning if only one symptom, such as colic, is present; he always requires to have it confirmed by some secondary symptom.

In Dr. Edgington's opinion the breathing of lead dust is the common cause of lead poisoning, and the use of nonpoisonous paints is the only reliable way of preventing plumbism. In the case of house painters regulations would be almost impossible, because the work is done in houses where they could not possibly be regulated or inspected.

WITNESSES DEALING MAINLY WITH SHIP PAINTING.

Great Eastern Railway Co.—Commander W. H. Coys, R.N.R., marine superintendent, gave evidence in regard to the paints used on the Great Eastern Co's ships at Parkston Quay, Harwich. Up to the time of giving evidence lead paints had been used for all purposes except the black outside work; the company had decided, however, to use zinc paints exclusively in future because they found the tendency of lead paints to turn yellow—an objectionable feature—and their experiments had shown that the zinc paints were entirely satisfactory. The witness stated that they were making the change from lead to zinc paints without any misgivings, and if the committee were to recommend the prohibition of lead in future it would not affect them in the least. The change is being made entirely from a business point of view and not out of regard for the danger of lead poisoning.

With regard to red lead Commander Coysh said that he had found that red lead the best protective paint for first coats on iron, so far as mechanical abrasion. The ships of the Orient Line are painted with coming very much into use, but he would wish to experiment further about every two months. The zinc white is painted in paste before discarding the use of red lead for iron primings. He stated that he had never used red lead after the first coating; with regard to white lead he repeated that they have decided to replace it with zinc paint, applying zinc paints, even when he has engaged painters who have because the latter is the better paint both for internal and external work.

Mr. G. Schobert, a manufacturer of leadless compositions for painting ship's hulls, stated that he had supplied his composition to the Great Eastern Railway Co. among others. The pigment base of the composition was either zinc or oxide of iron. The witness claimed that with pure chemical oxide of iron he could obtain a paint of greater covering power than either red or white lead, and for white paints could achieve the same results with zinc oxide. He considered that the covering power of red and white lead had been overrated because painters have been able to secure genuine red and white lead in a pure form, whereas if such paints as zinc white or oxide of iron or red paint, or yellow ochers are demanded, adulterated pigments are generally supplied. The witness stated that the cost of his paints per cwt. is greater than the cost of lead paints per cwt., but the bulk of paint obtained is nearly twice as much as lead paints; the lightness of leadless paints is a decided advantage. The paints in question have been in use for some 45 years and have been used by the Lancashire & Yorkshire Railway Co., Great Eastern Railway Co., Sir Frederick Boulton's Steamship Co. All these have given repeat orders, as has also the District Railway Co., the Brentford Gas Co., the Dutch Danish Governments, four or five Dutch gas companies, and a number of other users both at home and abroad. The paint is particularly suitable for use on iron and steel and could replace red lead on the metal without previous priming with lead paint.

Capt. Tuko is the marine superintendent of the Orient Steamship Co. and exercises full control over the painting work on the ships of that line; he employs about 27 to 40 painters and a very small amount of painting is also done by the sailors on the various ships. Up to the time of giving evidence lead paints had been used for painting funnels and ventilators only; for all ordinary internal and external painting the Orient Line have used zinc paints for at least 35 years. Zined, priming paints are used both on wood and metal; a zinc white paint with a little coloring matter, such as yellow ochre, is used for the colored painting; zinc white is used for the holds generally; and the interior of cabins enamel paints, such as Rystolite and Satin are used over the zinc undercoats. Enamel paints are also used on the deck houses and white zinc for the rails; the hulls are painted with a leadless black paint. A small proportion only of lead is used in the buff-colored paint for funnels and ventilators. Even the very small amount of lead used for funnels and ventilators is forming the substance of experiment, and Capt. Tuko was of opinion that entire prohibition of lead paint would not affect the company in the least. The paint may be slightly more expensive than lead, but not sufficiently so to affect them at all. The chief advantage of zinc is that it does not turn yellow as white lead would. Capt. Tuko said that they were entirely satisfied with the zinc paints for exterior as well as interior and in every respect. The durability is satisfactory, the holds beneath

about every four years; with regard to exterior work, no paint could be allowed to go more than a few months owing to mechanical abrasion. The ships of the Orient Line are painted externally about every two months. The zinc white is painted in paste and mixed up with linseed oil and a certain amount of driers, but He has not found any difficulty on the workmen's part applying zinc paints, even when he has engaged painters who have previously been accustomed to lead paints. As regards the painting the hulls below the water line, Capt. Tuko stated they used Wood's composition, which contains copper but not lead so far as the witness He stated that it was a patent composition, and the makers could not disclose its constitution.

Mr. G. B. Mockford, foreman of painters at H. M. dockyard, Portsmouth, attended to give evidence regarding the practical use of paints in the British navy. At the time of giving evidence he had only had months' experience at the Portsmouth dockyard, where 320 painters are employed, but he had had 74 years' experience in a similar capacity at Sheerness. He had known several cases of poisoning by lead, and considered that its use constituted a very decided danger; lead paints are not used by the admiralty in confined spaces; oxide of iron paints have been substituted with very good results 15 years ago for such work as the painting of double bottoms, compartments, fore and hatchways and bunkers. Oxide of iron has been greatly preferred to white lead for finishing coats, but the use of late in preference to white lead for finishing coats, but the witness attributed the greatest danger to the rubbing down of painted surfaces, which is considered in amount though often almost invisible. In his opinion the way to obviate that danger is to extend the use of zinc paints. At the time of giving evidence the royal yacht *Victoria and Albert* had just been painted, and the renovation of all the royal apartments was carried out with zinc paints. Lead had greater covering power than zinc in the witness's experience, and therefore a priming coat of half lead and half zinc is generally given in the seamen's quarters where granulated zinc is used.

The admiralty have laid down a number of regulations to be observed in painting ships. Soap, towels, and nailbrushes are provided for the men, and hot water, which, in the witness's opinion, is most essential, is allowed for washing, namely, five minutes before the noon bell rings and five minutes before the afternoon bell ringing. The washing is enforced by the chargehand, who holds the men's tickets and does not give them out until the men have been to the washhouse and have washed their overalls, which are, moreover, washed fortnightly at the admiralty's expense in a large laundry with steam machinery on board. At Sheerness dockyard the men are examined every Saturday morning; at Portsmouth dockyard they are seen by the medical officer at convenient intervals in batches of about 20. In the witness's opinion a great improvement in the general health has been noticeable during the last 10 years. Notwithstanding all the above-named precautions, lead poisoning cases still occur frequently, and the men have to be put on to work which does not involve contact with lead.

The witness considered that the abolition of lead is the only way to remove the evils entirely, and he thought it would be practicable to prohibit the use of lead except for priming coats on iron and steel surfaces; this answer applied both to inside and outside painting. The witness excepted priming coats on iron and steel surfaces in his answer because the lead paint at present used is very satisfactory, and he made no experiments on a large scale on such surfaces with nonlead paints; he would not go so far as to say that no other paint than a lead paint would be likely to succeed on iron and steel. From the witness's experience of zinc paints on the upper deck work of the *Victory* and *Albat*, he regarded it as probable that the same paints suitable for tinted would stand quite well for the outside painting of battleship hulls but no instruction to this effect has yet been issued by the admiralty. The witness could see no objection to the use of nonlead paints for the upper decks and also for the whole of the hull, in board and out.

Mr. W. Simpson is foreman painter at Messrs. Brown and Caldwell's shipbuilding and engineering works, Clydebank. He has had 18 years' experience and has some 410 men under his charge. He has had to do with very few lead poisoning cases, only about six having been reported to him, but he agreed that there may have been cases which he did not come to his knowledge. Some dust may be breathed when men are doing dry rubbing down, but he did not consider that this was much danger, given due cleanliness on the part of the men. He said that in his opinion no paint stood better than white lead, and in reply to further questions he said he had used leadless paints very largely and had found that such paints as zinc oxide stood very well. On admiralty work oxide of iron is used entirely for confined spaces. In his experience zinc is very satisfactory, though they seldom bring up paint work with zinc from the base, and he said he preferred zinc oxide as a base. He spoke of one vessel which had been done entirely with zinc oxide, the whole of the inside and the hull brought up to the bare metal throughout with zinc paint, and the result looked perfectly well. He has had no report of any complaint. The witness thought zinc was not so durable as white lead, and instanced the painting of some 250-ton cranes which did not stand so well. The cranes were originally painted five years previously over oxide of iron. The witness thought white lead better than zinc white because a machine for rolling plates had been painted 10 years previously with white lead and was still in good condition.

With regard to steel plates with rust on them, the witness for red lead the best covering, as the rust will in time show through zinc paint and even white lead. For a ship's bottom he considers nothing stands better than mixed red and white lead; zinc paint gets under water. In confined spaces on admiralty work oxide of iron is used, and also bituminous paints and red lead have been used in double bottoms.

The witness has found no difference in the effect on the men except that they get partially overpowered by the fumes if they stay in a confined space too long. The fumes are worse in the case of bituminous paint.

The witness expressed the opinion that lead poisoning is due to the carelessness and uncleanness of the men, and complained that he had known them to sit down for meals with their hands covered with paint, although washing accommodation is provided. In further

experiments with two gallons of leadless white paints have also been made; these have been found entirely satisfactory and as efficient and durable as the best lead paints in the atmospheric conditions prevailing in London railway termini. Mr. Ellison, therefore, concluded that the prohibition of the use of lead would cause no difficulty so far as his work was concerned.

Mr. Ellison, resident engineer of the Southeastern & Chatham Railway at Charing Cross and Cannon Street, stated that he was in charge of the painting operations on the river bridges at these two Nonpoisonous painting materials have been used some- extensively by the Southeastern & Chatham Railway Co. the Charing Cross and Cannon Street bridges and other smaller Bridges ordinary coal-tar paint has been used and has proved durable very efficient indeed in every way. Some of this paint, for example, on the under side of Cannon Street bridge was last painted with 18 years ago, and it is almost as good now as when it was put on; to coats of this paint are as good as anything known for protective purposes, provided that the black color is not objected to. It is rather in labor taken for applying it, but is nevertheless economical, because two coats are as good as three coats of lead paint. It is not, however, so durable as other paints when exposed to sulphurous fumes such as are found in the atmosphere inside railway termini. On the roofs of Charing Cross and Cannon Street stations, where atmospheric conditions are very trying, silica graphite paints have been found very efficient; three coats of that paint applied to Cannon Street station roof two years previously had proved completely to them that it was superior to lead paint. Silica graphite is absolutely leadless, but could not be used white. Another known as carbonizing coating paint, has been used on Cannon Street station roof as against lead applied to other parts of the roof at the same time; three years later both paints were in about the same condition, and the same was noted at the end of the sixth year when the work was repainted; two coats of carbonizing coating were used, as against three coats of the best lead paint. The comparative costs of the paints above referred to work out as follows:

	Cost per square yard in pence.		
	Material.	Labor.	Total.
Carbonizing coating: silica			
Graphite.....	0.661	1.68	2.344
Coal tar.....	.435	3.60	4.035
Lead paint.....	.875	1.68	2.558

Mr. P. J. Hunter is an inspector of the Forth Bridge Railway and in charge of the painting operations on the Forth Bridge. No lead materials are principally used, particularly oxide of iron. Some red and white lead are also used, the proportions being as follows:

Red lead.....	1 ton 16 cwt. (dry).
White lead.....	16 cwt. (paste).
Oxide of iron.....	9 tons (paste).

Seventy-five per cent of the paint used, therefore, is leadless, the mixture of red and white lead is still preferred as a priming on naked steel which has had to be chipped and scraped. Oxide of iron has been used over a lead priming ever since the bridge was built. Repainting is done every three years, but the lower part exposed to the sea spray are now being painted every year, the rest of this is probably only absolutely necessary every two years. Hunter considers lead paint not so good as iron oxide for the outside of a bridge, as it absorbs oxygen from the atmosphere and there is a tendency then for corrosion to begin. The lead paint is also more expensive, the contract prices for the year quoted being: Iron oxide 12s. (\$2.92) per cwt.; red lead, 16s. (\$3.89); white lead, 19s. 9d. (\$4.49). Mr. Hunter said they had never tried to find a substitute for lead as a priming coat, but was sure if lead was prohibited a substitute would be found. There has been no lead poisoning among the workmen in recent years, but there were some cases of painter's colic 20 years ago due to dust from cleaning paint off the insides of the tubes. The work is scraped and brushed with a wire brush, thus causing dust, but only very small surfaces are done each year. There is no general painting in the insides of the tubes and the current of air through them is so strong that it carries away any little dust that may be made. At the time of giving evidence Mr. Hunter was experimenting with a bituminous paint for priming coats and it appears to be satisfactory. Some of the outside work was finished entirely with red lead and that deteriorated very soon. All oxide of iron dust on the steel was not satisfactory. In conclusion Mr. Hunter said that he would not mind if the use of white lead were prohibited altogether provided he could find an efficient substitute for priming faces on steel, and this he would expect to do fairly easily if it were necessary.

WITNESSES SUBMITTED BY THE WHITE LEAD CORRODEE SECTION OF THE LONDON CHAMBER OF COMMERCE.

Dr. Ignaz Kaup is a doctor of medicine who has devoted great attention to the subject of lead poisoning in general and among his patients in particular. He has held a number of important official appointments in connection with the Austrian Government, by which he was also specially commissioned to assist in the work of the Austrian Commission on Lead Poisoning. He was also professor of industrial hygiene in the University of Vienna. Since 1907 Dr. Kaup has been a departmental chief of the Central Organization for Social Hygiene in Berlin; also professor of hygiene in the Technical Hochschule of Charlottenburg and editor of a journal and author of numerous publications on the subject of lead poisoning.

AUSTRIA.

Dr. Kaup noted, when government medical officer in Vienna, a great amount of lead poisoning in that city; he wrote a brochure on the subject in 1902, and in 1904 was appointed a member of the Austrian commission to inquire into lead poisoning. The commission found that reliable statistics of lead poisoning could only be obtained for Vienna, in which the number of cases rose from 20 in 1901 to 253 in 1906. The report lays very great stress upon the danger of dry rubbing down, it having been found that the inside of a room in which dry rubbing down was being done contained from 1 to 25 milligrammes of white lead per 1,000 liters of air, i. e., from 10 to 250 milligrammes per 10 cubic meters of air. This dangerous process of dry rubbing down is in Austria practically confined to inside painting; the report of the Austrian commission therefore draws a sharp distinction between inside and outside painting. To the general absence of dry rubbing down on exterior work the Austrian report ascribes the relatively small amount of poisoning due to outside painting, notwithstanding the large amount of white lead used therein. At that time (1905) moreover the commission found that "the question of substitutes for outside painting is still in the stage of experiment and inquiry." As a result of the report of the Austrian commission a set of regulations issued by the minister of commerce in 1908. These, which are set forth in extenso in Appendix IX,¹ include as the chief provisions:

- (1) Prohibition of dry rubbing down and pumice stoning (sec. 7).
- (2) Prohibition of white lead for inside use (sec. 4).
- (3) Notification of lead contents on paint cans, etc. (sec. 3).
- (4) Provision by employer of (a) washing accommodations in all cases; (b) overalls and head coverings where more than 20 workers are employed; and (c) respirators for all workers in processes entailing the generation of much dust (sec. 8).
- (5) Provision by employer of special rooms for washing and for keeping clothes where more than 20 are employed (sec. 2).
- (6) Periodical medical inspection where more than 20 are employed, and medical certificate before reemployment of a workman once lead-sick (sec. 6).
- (7) Provision of instructions as to the danger and nature of lead poisoning and the means of avoiding it (sec. 11).

At the time of Dr. Kaup giving evidence the regulations had been in force some 2½ years and a diminution in the number of cases had already been traced, the number of cases of lead poisoning among members of the Sickness Insurance Fund, Vienna, being the highest in 1904, 1905, and 1906; 197, 198, and 253, respectively, in those three years. In the year in which the commission was sitting the cases were only 108; in 1908, 167; in 1909, 143; and in 1910, 138. These last quoted figures, however, are higher than those for 1901 and 1902, when the cases numbered 130 and 125, respectively; it appears, however, that the number of painters has increased materially during the 10 years 1901-1910, and therefore a figure of 138 for the last year may represent some improvement

¹ In Minutes of Evidence, presented in a separate volume of the original report.

on the figures of 130 for the first year of the decennium, but at the improvement is very slight.

GERMANY.

Regulations for the painting industry were established in Germany on June 27, 1905, and include the following provisions:

- (1) Prohibition of dry rubbing down and dry pumice stone (sec. 3).
- (2) Provision by employer of washing appliances (sec. 5).
- (3) Provision of special rooms for washing and for clothing (sec. 8).
- (4) Rules by employer (*a*) to require special work clothes, prohibiting (*b*) spirit drinking and smoking during work, and (*c*) eating or drinking before washing (secs. 4 and 5).
- (5) Half-yearly medical inspection, and prohibition of work before recovery from lead poisoning (sec. 10).
- (6) A medical register (sec. 11).
- (7) Provision of instructions as to the danger and prevention of lead poisoning (sec. 6).

There is no obligation to notify cases of lead poisoning in Germany and any statistics are therefore necessarily incomplete. In Kaup's opinion the available records of hospitals are "reliable an estimate of the increase or decrease of lead poisoning, but not give an accurate picture of the full extent of it, inasmuch as workmen only go to the hospitals as a last resource." The records show a decrease in the number of the cases from 178 in Berlin and 1,050 in the whole of Prussia in 1904, to 130 in Berlin and 900 in the whole of Prussia in 1908. The full table printed in Appendix XV¹ shows the decrease since 1906, when the regulations came into force, not only in the number of cases, but even in the number of days of illness and the proportion of cases among painters to total cases of lead poisoning. The statistics of the sickness insurance fund for the painters of Berlin show a similar reduction, *c. g.*, the number of cases of lead poisoning falling from 379 in 1907 to 268 in 1910. These last statistics Dr. Kaup considers quite reliable, but unfortunately they are only available for important centers, such as Berlin, and not for the country as a whole.

Dr. Kaup considered that the decrease in the amount of lead poisoning among painters was directly due to the effect of the regulations. He was strongly of opinion, however, that the provisions of the regulations must be supplemented by thorough and well-organized methods for the medical instruction and medical supervision of the workmen, and he considered that neither Austria nor Germany was in so favorable a position as England in regard to such enforcement of the requirements, inasmuch as England already possesses a system of local sanitary inspectors and medical officers of health.

Dr. Kaup considers that the notification of lead poisoning should be made compulsory; that vessels containing lead paints should be labelled "containing lead, and poisonous." He regards dry rubbing down as the most important source of danger, and in his opinion would be possible to dispense entirely with dry rubbing down.

Dr. Kaup was questioned with regard to evidence taken by the Austrian commission. He stated that master painters, work-

men (that is working men), factory owners, and the technical staff of factories were examined. Mr. Meissl, who gave evidence before the present committee, was examined as a practical man who might be regarded as a leading authority amongst painters. He told the Austrian commission that he had made extensive experiments with zinc white and had found it not sufficiently durable for outside use. A number of other master painters corroborated this statement and said that they had also made practical experiments, though not scientific experiments, and had reached similar conclusions. As a whole the master painters of Vienna said that for outside painting they considered white lead to be absolutely necessary, but on the other hand the master painters of Galicia, one of the northern Provinces, stated that quite satisfactory results might be obtained with zinc white. This difference of opinion Dr. Kaup attributes to the inferior quality which would satisfy the people of Galicia. Mr. Meissl and the other house painters who appeared before the Austrian commission gave no evidence based on scientific experiments, but stated that in fulfilling contracts they had frequently been observed that zinc white was very easily rubbed off, while this was not observed with white lead. An inspector of the Austrian State railways had also made experiments with leadless paints and found that surfaces coated therewith showed, after very short time—not stated more definitely—fissures and ruptures, considering the cost of paint previous to moisture; this was not the case with lead paints. Mr. Meissl and one other witness were the only ones who were examined or cross-examined at any length by the Austrian commission; the others simply agreed and stated that they had nothing they wished to add. Three or four cases are quoted of experiments which had proved unfavorable to leadless paints; for example, two houses at Lemberg, one painted with white and found after five or six years to be in a condition capable of being washed, the other painted with lithopone, which had been washed and not in as good a condition after some time, the exact period not being stated. A second illustration was given where a painter in Lemberg had painted his kitchen with lithopone, which after nine months could be wiped off with the dry hand. In addition to the master painters, who gave their opinion in support of Mr. Meissl against leadless paints, there were also present at the inquiry certain experts, such as Mr. Andes, the owner of a paint factory, and Mr. Stebel, the owner of a zinc white factory. They made statements that lithopone or zinc white might yield very satisfactory results, but they only said that in their formal answers to the questions put without producing proof. Dr. Kaup desired to emphasize the fact that he attached particular importance to the evidence given by the master painters, but very little to the evidence given by the factory owners.

The chairman referred Dr. Kaup to the eminently satisfactory experience with leadless paints on a large scale in England, *e. g.*, the buildings bank buildings, many post offices and sorting offices, the top structures of the Orient Steamship Co.'s liners, the royal yacht, and other ships, the railway bridges and station roofs and other structures, the exterior of the London stock exchange, the Highland Railway Co.'s carriages and wagons, the Daimler Motor Co.'s

¹ In Minutes of Evidence, presented in a separate volume of the original report.

Dr. Rambousek pointed out that these figures are not complete as great many cases escape reporting. The figures, even allowing for the more exact inquiries made in 1910 than in previous years, show the beneficial results of the efforts to check lead poisoning; the witness attributed the improvement mainly to the regulations of 1908. The figures of course include cases of industrial poisoning occurring in factories; they are not confined to house painters. Dr. Rambousek, however, quoted them as showing the effect which can be obtained by regulations without prohibition; but at the same time deplored the imperfect observance of regulations in Austria owing to the lack of inspectors and official doctors. He added that he understood the "in England circumstances are far more favorable."

With regard to the prohibition of the use of lead for inside painting Dr. Rambousek referred to the difficulty of distinguishing between inside and outside work, and stated that in his opinion the prohibition of lead for inside work was largely evaded. Dr. Rambousek considered the prohibition of the use of a dangerous article to be a mode of dealing with the danger which is "somewhat childish in its simplicity"; he thought it would lead to an intolerable interference with the machinery of civilization if it were applied to all substances which are of greater danger than white lead.

Among the regulations to be observed by workers who use lead Dr. Rambousek laid great stress upon personal cleanliness and the instruction of the workman. First it would be necessary to prohibit dangerous processes such as dry rubbing down, and to provide for workmen the means of cleanliness. Dr. Rambousek attaches great importance to the duty of declaring when a pigment contains lead, e. g., by labeling the receptacle. He added that in any scheme of regulations there should be provision for periodical medical inspection.

Dr. Rambousek was questioned closely regarding the number of factory inspectors in Bohemia and the extent of their duties. He admitted that the inspection could not be frequent enough to establish with absolute certainty the observance of the regulations in all places to which they relate. Dr. Rambousek dealt further with the ineffectiveness of lead poisoning figures in Bohemia, and made it clear that improvement, namely, a reduction from 25 cases in 1906 to 2 in annum in recent years, was a white lead works. In reply to a question as to whether the inspection of a factory is not a very different thing from the inspection of a large number of private houses, Dr. Rambousek replied, "I still maintain that this shows that in every case regulations are well enforced, the regulations will show beneficial results." He admitted that if the majority of the employers preferred the prohibition of the use of lead to a system of cumbersome and irksome regulations, there is nothing more to be said; he added that the greatest resistance in Austria does not come from the master painters, but from the makers of white lead, because Austria, and particularly Carinthia, has a very big lead industry. The witness expressed grave doubts as to the existence of satisfactory substitutes for lead and referred to a number of experiments carried out in Bohemia by Government works by big private contractors; the latter's replies were to the effect that the lead-free paints were not satisfactory substitutes for white lead; the chief objection was insufficient covering

power and insufficient durability. Both lithopone and zinc paints were used, and the result was always the same.

In Bohemia a workman suffering from lead poisoning is entitled to compensation during the time that he is actually ill.

Dr. Rambousek reiterated (answer to Q. 14598) that the commission on the question between prohibition and cumbersome regulations had to decide in favor of the latter "because they had to place very high value on the white lead industry; Austria is otherwise an industrially poor country and the prohibition would cause a very great industrial loss and general economic disturbance." This, however, Dr. Rambousek did not consider the sole reason for the decision in favor of regulations; in his opinion the impossibility of replacing white lead by any substitute was an equally big factor.

Mr. O. Meissl stated that he was a master painter in Vienna with over 30 years' experience and possessing also chemical knowledge; he employs 300 to 400 hands. He referred to the evidence given by him as representing Viennese master painters before the Austrian commission on Lead Poisoning, and spoke of the beneficial results which had accrued from the regulations issued on 25th of April, 1908. As regards enforcement, he explained that the painters of Vienna all belong to a sickness insurance office; many of the trade-union officials being also officials under the sickness insurance scheme, there is a strong tendency for the sickness insurance office to report every possible breach of the regulations to which its attention is called by a letter applying for sick pay; from the employer's point of view the regulations are quite sufficiently enforced in this way.

Mr. Meissl stated that he had spent a good deal of time and money endeavoring to procure or make an effective substitute for white lead, but in his judgment and experience the latter material is indispensable for outside painting owing to its special properties and its exceptional durability and covering power. For inside painting white lead has not so great an advantage over zinc white, but even here white lead is indispensable for specially damp places.

Mr. Meissl undertakes large contracts in connection with the painting of bridges and other steel structures and considers red lead to be indispensable for this purpose.

In his opinion, one of the most important provisions of the regulations is the requirement of a declaration when a pigment contains lead. In his experience smoking, especially cigarette smoking, greatly increases the predisposition to lead poisoning. He further considers that no one should be reemployed after an attack of lead poisoning without a certificate of recovery. He agreed with the report of the Austrian commission in attaching great importance to the prohibition of rubbing down as the chief cause of lead poisoning amongst house painters. In his own opinion and that of other experts in the trade, there is no process of dry rubbing down which could not be replaced by wet rubbing.

Questioned in regard to the experience of the English office of works with substitutes for lead paints, Mr. Meissl thought that the reason for the difference between their experience and his experience in Vienna may be found in the difference of climate.

With regard to bridge painting, Mr. Meissl acknowledged that very good dark colors can be produced without lead for the protective painting of ironwork. Mr. Meissl stated that it was common for him to give a five years' guaranty for work executed with white lead;

but he declines responsibility for the durability of the paint whenever using other than lead paints.

Since the regulations have come into force Mr. Meissl has had about six or seven cases of lead poisoning per annum amongst his painters who number from 300 to 400 in the season, but fall off to about 12 or 130 in January. He contends that the majority of the cases are slight. The regulation requiring medical inspection of the men is not strictly enforced. With regard to the Austrian regulations in general, he considers that another five or six years will be required before they will be quite understood and carried out; he regards the lead poisoning evil as sufficiently serious to render regulations absolutely necessary.

Mr. Ricker-Devroede stated that he had been in business as a master painter in Brussels for 25 years, and is president of the Brussels Clubbro Syndicale of Painters and Decorators.

He used to mix all his own lead colors prior to July, 1910, when this was forbidden by the Belgian decree.

Zinc white is largely used in Belgium for interiors and is a both white color, but does not incorporate the oil. The witness said he had found no efficient substitute for white lead for outside painting and even for certain inside work which is unduly exposed to moisture. Mr. Ricker-Devroede detailed the steps which had led up to the Belgian legislation dealing with the use of lead in painting.

The first decree, dated May 13, 1905, came into force on August 1, 1906, and included regulations dealing with the grinding and carriage of white lead, the prohibition of dry rubbing down, the provision of working clothes and washing appliances, and quarterly medical examination. These regulations drew forth an emphatic protest on the 19th of May, 1907, from the master painters' federation, who reiterated a resolution passed at their Liège congress in 1905 to the effect that "although white lead was irreplaceable for certain work they preferred a total prohibition of its use, making, or importing to a regulation which they were unanimously of opinion was inadmissible to their work places" (Q. 14841).

This was followed by a further report by the "section centrale" who, on the 19th of February, 1908, reported that "the Belgian Legislature is justified in regulating, limiting, or even prohibiting the use of white lead for painting, provided there is a real necessity to use so relatively to the danger run" (Q. 14844); but they also reported strongly in regard to the injury that would be done to the white lead manufacturer, and concluded by recommending the adoption of additional regulations rather than prohibition. After further consideration, the Belgian Parliament passed the law of August 20, 1908, prohibiting dry rubbing down and providing for regulations to be made controlling the use of white lead; such regulations were made by royal decree of July 25, 1910, and provide further for the use of white lead in paste form only, the avoidance of handling and splashing, keeping clean of material and tools, the provision of washing accommodation, and quarterly medical examination of workmen at the expense of the employer; the employer is also required to see that the workmen wear overalls and head coverings. (See Appendix VII.)

In further examination Mr. Ricker-Devroede said there were about 4,000 master house painters in Belgium, some of whom use only white

lead; none of them use only zinc. If zinc white only were used, the education of the painter would have to be recommenced. This is the only difficulty with regard to interior painting.

The witness described the medium which he had used for zinc paints, and said they never added varnish for interior work. He would prefer to use white lead for durability wherever the paint is exposed to moisture.

He estimated the number of painters in Belgium as 25,000 to 30,000, but said there were no statistics of any kind as to the incidence of lead poisoning. He admitted that certain of the regulations dealing with dry grinding and carriage of dry white lead would not be applicable in England, as the painter obtains practically all his white lead in the form of paste. He also agreed that it would be impossible to enforce regulations by inspection in private houses, but said in practice if dry rubbing down were done the worker would report such breach of the law to his trade-union. Dry rubbing down is a very dangerous process—the witness alleged that it would perhaps be just as dangerous, but probably in a different way, with zinc paints, and maintained that dry rubbing down can be entirely dispensed with.

The men supply themselves with overalls, and various washing appliances are supplied by the employer; the use of these is only enforced by the interference of fellow workmen or as the result of questions put to the workers by the medical examiners at the quarterly examination. He did not consider that the medical examination was sufficiently severe in Belgium at present.

Mr. Ricker-Devroede put in a letter¹ in which the Belgian Association of Master House Painters state: "Of all these regulations the most iniquitous is the medical inspection imposed on the operative painter. This provision, which is vexatious and humiliating, is without any effect" (Q. 14926). The witness stated that he signed this letter in his capacity of president of the association; it does not represent his personal opinion.

The Federation of Master Painters in Belgium only embraces about 800 out of the 4,000 master painters in the country, but these 800 include most of the principal firms and employ more than half the house painters in the country. These 800 passed a resolution at their congress in Liège in 1905 in favor of prohibition of the use of lead rather than regulations; they set forth the same views again in a memorial dated May 19, 1907, and again in a letter dated September 30, 1911. The other 3,200 master painters took no action except to issue a protest before the regulations were passed claiming that there was no danger in using lead in house painting.

Mr. Ricker-Devroede further added that the Belgian State railways had had trouble with zinc white, and had returned to the use of white lead at their works at Malines, where 3,500 workmen, including at least 500 painters, are employed.²

Mr. Ricker-Devroede further emphasized the importance of the white lead industry in Belgium, and the danger which existed in his opinion of a monopoly arising in regard to zinc white.

¹ See Appendix XVIII (Minutes of Evidence).

² This statement was subsequently disproved by documentary evidence to the contrary submitted to the committee (see Q. 21823), and confirmed through the Foreign Office (see p. 146).

³ In Minutes of Evidence, presented in a separate volume of the original report.

Mr. E. Expert-Bezançon stated that he is principal partner in Expert-Bezançon & Co., of Aubervilliers, near Paris, with works near Lille, where both white and red lead are manufactured. He quoted the French law of July 20, 1909, prohibiting the use of white lead in the painting of buildings after January 1, 1915. He stated that this law had had no effect up to then, inasmuch as master painters are using the same quantities of white lead as before.

The witness gave many details regarding the inquiry carried out by the French Parliamentary Commission on White Lead, and dealt with various distinguished men who expressed themselves against prohibition. He strongly criticized the method of collecting statistics of lead poisoning which were quoted in that report.

Mr. Expert-Bezançon next referred to unsuccessful attempts to manufacture zinc white, which he said was largely a monopoly of the Vieille Montagne Co. He stated (Q. 15103) that his conclusion is simple, namely, that a mistake has been made in France.

In further examination the witness said that he knew of only one firm in France which uses zinc white exclusively, and quoted a number of authorities who disagree with the French law. He admitted that he spoke as a white lead manufacturer, but he considered that prohibition was also unfair to French master painters.

The use of white lead on public buildings in France has been abandoned for 10 years, but the witness maintained that the painting with zinc had been more expensive.

Mr. Nooijen stated that he was a member of the Guild of Dutch Master Painters and closely followed the work of the Dutch commission in 1903. He stated that his guild does not object to the accuracy of the final conclusions of the commission having regard to the materials used for its experiments, but it is generally considered that the zinc white paint prescribed by the commission was too thick to work with, and it is alleged that it was frequently diluted with oil. The opinion of master painters in Holland is that lead is much better for exterior painting than zinc white as it resists the action of the atmosphere, although the lead is liable to discoloration where there is sulphuretted hydrogen in the air.

Mr. Nooijen stated that he had tried all the substitutes for white lead known to him; he painted his own house with zinc white mixed with stand oil and found that it lasted three years at the southwest side and four years at the northeast side. White lead mixed with stand oil or boiled oil would last several years longer. White lead is not used in Holland for finishing interior painting; zinc white is nearly always used. The interior of witness's house, painted nine years ago with zinc white mixed with stand oil, is still in excellent condition.

Mr. Nooijen explained that stand oil is linseed oil which has been boiled for a very long time and is of two kinds, thick and thin. The latter is most suitable for inside work and the former for outside work. For inside work zinc white mixed with stand oil forms a very strong glossy paint, but must be thinned with turpentine; zinc white with stand oil forms a very strong paint for outside use, but must be thinned with raw linseed oil. White lead mixed with stand oil and thinned with linseed oil makes, however, the best of all paints for exterior work except for its liability to change color in the presence of sulphuretted hydrogen. It is impervious to atmospheric changes and does not crack with variations of temperature. Zinc white does not

offer the same resistance to humidity, and in ordinary circumstances the witness estimated its life for exterior painting at three years as against five years for white lead. Zinc white, even when mixed with stand oil, is very badly affected by sulphuric acid; this chemical is present in the humid smoky atmosphere of Amsterdam, where zinc white was found to last one year only, whilst in the clear air at Utrecht it lasted four years. Mr. Nooijen stated that the outside of ships are painted below the water line with red lead and linseed oil, above the water line with iron oxide and linseed oil, over which zinc white is used.

For filling or stopping, white lead is still used in Holland, but in witness's opinion it can be replaced by zinc white. In Holland old paint is generally rubbed down wet; there is no dry rubbing process except among ship painters.

There are at present no regulations of any kind affecting house painters in Holland, but it is probable that such will be issued as a consequence of the findings of the white lead commission. Large quantities of white lead are used by the Netherlands Government.

In further examination Mr. Nooijen stated that in his opinion lead poisoning does not exist among house painters in Holland, notwithstanding that the commission was appointed in 1903 to inquire into the use of white lead paints. There are no statistics regarding lead poisoning among Dutch house painters. The witness stated he was in agreement with the conclusions of the Dutch commission regarding the action of sulphuric acid and humidity on zinc paints; for external use he considered that white lead should stand over five years in a humid atmosphere. For inside work in Holland there is never such an excessive amount of moisture.

He was not in agreement with the fifth conclusion of the commission, which was that

Zinc white paints applied on zinc, Portland cement, or iron (the latter having previously been provided with first coats of red oxide of lead or iron) are able to withstand the action of the open air during five years quite as well as white lead paints, and can entirely replace the latter, provided they are not exposed to the action of vapors containing sulphurous acid.

In the witness's opinion zinc white, if used for exterior painting, would only stand for 1½ to 2 years on the south side of a building in a wet atmosphere. On the north side, where it is not exposed to the sun, it would stand 2½ years to 3 years as against 3 to 4 years for white lead. The commission considered zinc white satisfactory except for window sills and cornice work; witness estimated such work as forming one-sixth or one-eighth part of the paint work of a building. Mr. Nooijen disagreed also with some of the other findings of the commission, partly because the tests were not carried out in a practical way, although he admitted there were two representatives of master painters on the commission and these signed the report.

Mr. Nooijen expressed himself in favor of a regulation for the prohibition of dry rubbing down. He considered that pumice stone and water could be used on a fresh coat of paint after drying for 24 hours. He also advocated supply of washing conveniences for the workmen.

As regards the enforcement of regulations, Mr. Nooijen stated that the workmen usually report irregularities and there is also plenty of inspection even in private houses; he believed the special rules

to be applied to house painters would be as complete as those which are in force today in the potteries in Holland.

Mr. Nooijen stated that the Guild of Master Painters in Holland (Goutido Amsterdam) includes 1,300 to 1,400 master painters employing about 10,000 men. In connection with this organization there is a large insurance society, of which the witness is secretary. White lead poisoning is an accident under the Dutch law¹ and if case occurred 70 per cent of the man's wages would have to be paid as compensation. This law has been in force since 1903, but not a single case has come to the witness's knowledge.

Mr. K. W. Goadby is a consulting pathologist, of Harley Street, London, who has devoted special attention to questions of lead poisoning. Included in his publications on the subject may be mentioned Appendices XXIV and XXV of the departmental committee on the use of lead compounds in the manufacture of pottery and a book on "Lead Poisoning and Lead Absorption," written in collaboration with Dr. T. M. Legge, H.M. medical inspector factories.

In connection with lead poisoning amongst painters Mr. Goadby made experiments with white lead, litharge, zinc sulphide, zinc oxide, and basic lead sulphate. He also experimented with turpentine and linseed oil. The apparatus used for the experiments is fully described in his evidence, and the results obtained point conclusively to there being no lead present in the emanations even at more than tropical temperatures. Mr. Goadby had discussed the matter with Professor Baly and agreed with him that emanations are present; these emanations contain all sorts of organic compounds, but no lead compounds. In experiments made with lead and oil Mr. Goadby obtained a definite amount of vapor in which even at ordinary temperatures the curious painty smell was clearly observable. With zinc and oil this peculiar smell was scarcely discernible at all at normal temperatures. This the witness accounted for by reference to the chemical reaction between the lead and the oil; apparently zinc does not interact at normal temperatures in form insoluble. In these conclusions Mr. Goadby differs from the conclusions of M. Breton, Dr. Heim, M. Hébert, and Dr. Marie, which he carried out experiments for the French Government inquiry. The divergence of results Mr. Goadby attributed to an absence of reliable

¹ Inquiry made through the Foreign Office does not confirm this, except as regards an acute case. Official reply is as follows:

MEMORANDUM.

Lead poisoning is not a professional accident according to the Dutch law, but it is regarded as a professional disease. When the law had only been in operation for a short time a case was submitted to a court of law in which compensation was claimed by a painter's workman suffering from pain in the abdomen which his doctor ascribed to white lead poisoning. The central council of appeal considered (Verdict 64, December 30, 1913) "that it is unnecessary to ascertain whether the physical suffering which occurred on 10th April, 1903, was caused by lead poisoning, and whether this poisoning was the consequence of the carrying on of the trade, as, even if this were the case, this suffering could not be regarded as an accident in the sense of the Accident Insurance law of 1900." This was also the standpoint of the directors of the State Insurance Bank, and since that time could have been maintained.

Nevertheless, compensation was in one instance paid for poisoning by white lead, namely, when it was possible to regard the case as acute poisoning, as, in fact, suffering which is the usual consequence of a professional disease is generally regarded as an accident when it occurs in an acute form as a result of sudden severe action (of a poison).

Thus, in September, 1907, two persons had opened a cask of white lead and had worked it, in doing which white lead powder was diffused in the air to a much greater extent than was otherwise the case, and a considerable quantity was probably inhaled through the mouth. When fairly shortly afterwards both workmen became suddenly ill, suffering from severe abdominal cramp, hard swollen abdomen, nausea, vomiting—in short all the phenomena of acute poisoning, it was decided that a professional accident had occurred.

So far as is known this has been the only case of this nature.

ity in the test described by M. Trillat, which was mainly used by the French observers. He agreed that it would be an excellent thing to ask the Government laboratory to investigate and report on the tests in question.

Mr. Goadby next dealt with physiological experiments and described the apparatus used. Animals were exposed to the vapors arising from paints made with white lead, zinc oxide, zinc sulphide, and lead sulphate. Similar effects were produced in all cases, but the distinctive structural changes in the kidneys were those indicative of tubal nephritis, whereas the kidneys of animals suffering from definite lead poisoning show, as reported in connection with the potteries inquiry, interstitial nephritis. Although the ultimate results were very similar, the animals exposed to the lead paint in the whole showed severer symptoms than those exposed to the zinc paint alone. The emanation in particular commenced earlier in the case of the animals exposed to lead; the least damage was produced by the ordinary zinc oxide; the next by the lithopone paint; the next, in order, by the lead sulphate paint; and then came the white lead. So far as these experiments on animals were concerned the effect of the turpentine vapor appeared practically as quickly with the zinc oxide as with the lead paint, but the later changes, those that are produced by the oil and lead, are more pronounced in the case of lead than in the case of zinc.

Mr. Goadby also made experiments to compare the emanations from white lead paste and zinc oxide paste made up in each case with linseed oil only. He found no emanation given off by either of sufficient extent to produce any effect at all on the animals exposed.

He then experimented with the following paint constituents: (1) Linseed oil alone; (2) turpentine alone; (3) turpentine and a lead acetate drier. The animal exposed to the linseed oil vapor exhibited no symptoms whatever; the animals exposed to turpentine showed acute illness of a much more severe type than that shown by the animals exposed to ready-mixed white lead or zinc oxide paints. Mr. Goadby detailed the symptoms produced by turpentine, and stated that he had formed the definite conclusion that the symptoms which he had found in the animals in the case of both lead and zinc paints were due to the turpentine in those paints. The amount of turpentine vapor in the air to which the animals were exposed Mr. Goadby estimated at from 6 to 10 milligrams per litre; this would be equivalent to about half a pint of turpentine vaporized and filling the air of a room say 20 by 15 feet by 10 feet high. Mr. Goadby considered that this experiment indicated that the commonly noted symptoms of headache and nausea and also colic of a certain type complained of by people on the smell of paint were explained on the hypothesis of turpentine. He himself and his laboratory assistant both suffered from nausea and headache during the turpentine experiments.

Mr. Goadby also referred to some inoculation experiments, but agreed as a matter of fact that a painter would not be likely to get inoculated with either lead or zinc.

¹ See evidence of Dr. Dobble, pp. 61 and 62, and Appendix XXVII (Minutes of Evidence).

Mr. Goadby also made experiments on the inhalation of dust such as painters would be liable to breathe in the dry rubbing down process. The animal exposed to white lead dust showed signs of lead poisoning at the end of a fortnight; the one exposed to zinc oxide showed no symptoms whatever except a loss of body weight, notwithstanding that the quantity of dust used was four times as much as in the case of lead.

Mr. Goadby gave details of post mortem examinations of the animals; the one exposed to lead showing the hemorrhages and ulceration and other lesions which he had previously described as typical signs of lead poisoning; this he stated showed that "a small dose of lead over periods of roughly six hours a day is distinctly serious," but he pointed out that the dose was bigger than a mouse would get. In the case of the animals exposed to zinc oxide dust the doses being, as above stated, four times as great, the animals had only lost a small proportion of the body weight, and the lesions were comparatively slight, but sufficient to show that there was some early inflammation from metallic particles. From this Mr. Goadby deduces that it is not a good thing for an animal or a man to absorb even zinc oxide dust. He stated, however, in conclusion that that difference of the white lead animal and the zinc animal was very marked. The blood of the animals experimented upon was also examined; basophilia staining was found with both turpentine and white lead, and even the animals exposed to zinc oxide and zinc sulphide showed presence of a few basophils in the blood.

The general conclusion regarding these experiments was that the effect of turpentine is a matter which calls for serious investigation; it could produce symptoms similar to those complained of by persons who smell fresh paint; the illness from it is definite, and not easily confused with lead poisoning, but has possibly been so confused in the past because it has been associated with paint. Arguing from the analogy of alcohol, which also affects the kidneys, it is a priori probable that the inhalation of turpentine vapor would make men more prone to contract lead poisoning; in any case the effect of turpentine might account in some measure for the high incidence of Bright's disease and other diseases of the kidneys amongst painters. Some of the fatal cases certified as lead poisoning may have been due to kidney disease brought about by turpentine, but Mr. Goadby agreed that the average of 30 deaths a year amongst house painters certified as due to lead poisoning represents a very serious condition of affairs.

Mr. Goadby was recalled on October 17, 1912, and described further experiments which he had made with a view to testing M. Trillat's and M. Marie's observations of the effect of zinc and lead compounds on bacteria. The broad result of these experiments was that a distinct inhibition of growth takes place on exposure to the gases given off from heated white lead and oil, and a slight inhibition from the gases given off by heated zinc oxide and oil. The witness satisfied himself in each case that this was due to the formation of aldehyde and formic acid. The greater effect of white lead and oil he ascribed to the chemical action between the white lead and the oil.

With regard to experiments carried out at ordinary temperatures Mr. Goadby found that all pigments when mixed with oil and dried

give off a vapor which kills bacteria. These emanations seem to be independent of the kind of pigment, and depend mainly on the drier. This vapor which kills bacteria would, in the witness's opinion, have a hygienic effect and disinfectant action, and would possibly reduce to ill effects as the amount would be very small and given off locally. These vapors do not contain lead, and Mr. Goadby therefore concludes that the lead poisoning which occurs amongst painters must be due to the absorption of lead in some other form than a vapor. This confirms the view that the breathing of lead dust is the most serious cause of lead poisoning.

Prof. H. E. Armstrong is professor of chemistry at the City and Guilds of London Central Institute, and the author of several works on chemical subjects. He stated that he made an extensive study on the chemical point of view of noxious vapors of turpentine and similar substances. He found himself entirely in disagreement with the conclusions regarding emanations of lead compounds from drying paints as enunciated by Prof. Baly, of Liverpool University, in a paper read on May 3, 1911, and subsequently published in various trade journals.

At the outset of his own experiments, Prof. Armstrong confirmed P. Klein's experiments, in which lead was found in the distillate resulting from passing steam into a mixture of white lead and only when lead acetate was present as well. This he accounted for by the carrying over of fine particles with the steam; the same applies when white lead is distilled in vacuo.

In the witness's opinion there is no spraying effect or mechanical separation of particles taking place during the ordinary drying of paint, and he considers turpentine to be responsible for the smell which has been generally attributed to lead paints. Turpentine vapors will produce headache and other symptoms which, as well as the smell, may be much more pronounced in the case of white lead than in other paints, because the latter substances do not promote changes in the oil to the same extent.

Prof. Armstrong did not consider Prof. Baly's test a practicable one, and described experiments which he himself had made with turpentine and turpentine leaves.

The conclusions which Prof. Armstrong placed before the committee were that the vapors given off during the drying of lead paints are not objectionable under ordinary circumstances, and do not contain any lead compound; the rate at which the vapors are produced, is not their total amount, is determined by the rate of drying, which is more rapid in the case of lead paints; that vapors of turpentine produce marked effects, but the workers seem to grow accustomed to them, while they are transient and can be easily guarded against.

In further examination, Prof. Armstrong agreed that it would be very desirable to ask the principal chemist of the Government laboratory to report on the various tests for the presence of lead, such as those relied upon by M. Breton, Dr. Hoin, M. Hébert, and Dr. Maro.

The precautions against inhalation of turpentine vapor suggested by the witness consisted simply in the opening of windows. The witness found that all linseed oil paints will give off vapors sooner or later; in the case of lead, sooner; and in the case of zinc white, later.

The danger of turpentine vapor depends entirely on the quantity which is inhaled; just as in the case of chloroform small quantities may produce very little effect.

Later, Prof. Armstrong said that the time during which a man is exposed to turpentine vapor is within practical limits the deciding factor of the extent of risk from turpentine rather than the proportion of turpentine put into the paint; of course, if there be a large amount of turpentine in the paint, it will continue to evaporate from the painted surface over a longer period of time.

Turpentine substitutes, such as petrol and naphtha, have about the same volatility as turpentine. If a zinc paint were made to dry as quickly as a lead paint, the effect as shown by the vapor given off would probably be similar, but the witness could only speak theoretically on that point. He did not think it would be possible to treat commercial turpentine in any way which would materially reduce its harmfulness.

Prof. Armstrong was recalled on the 17th of October, 1912, to submit his criticisms of the French experiments referred to in Breton's report. He also referred to a further paper by Prof. Breton on the toxicity of paints, in which he attributed the ill effects not amongst people inhabiting freshly-painted rooms to unsaturated aldehydes and not lead. He expressed further the opinion that many cases which have been regarded as lead poisoning may have been attributable to other causes; that the interaction of oil and white gives the toughest paint film; and that the vapor given off by paint in drying may have a distinct hygienic value as a disinfectant.

In further examination, Prof. Armstrong said that the vapor given off by drying paint might have a hygienic value in killing germs. It might, however, at the same time produce headache and other effects of that kind. These vapors arise from the interaction of lead and oil, not from the lead itself. In the early stages the vapor given off is mainly turpentine, but the witness considered that the oil vapor given off subsequently was the more poisonous. He agreed that the lead dust breathed in the process of dry rubbing down was the chief source of danger. He considered that turpentine might produce temporary effects, but it should not be regarded as a poisonous substance. Turpentine is not innocuous; if used as a beverage it would be poisonous, but as used in paint he did not think it would be injurious to a workman in his daily occupation; he would soon get accustomed to it, as it produces an effect which may be compared with the effect of smelling salts. Smelling salts, Prof. Armstrong added, would be dangerous if taken in quantity.

Mr. A. Villenot is the president of the Color and Varnish Manufacturers' Association of Paris and has carried on business there for years as a paint grinder and color manufacturer. He stated that far as his business is concerned, it is immaterial whether he grinds lead or zinc paints, but he considered white lead the most efficient paint for exterior surfaces exposed to atmospheric variations, moisture, and strong sunlight.

White lead is a hydrocarbonate which is neither acid nor basic and is ground with about 10 kilograms of oil per 100 kilograms of powder. Zinc white is a protoxide of zinc, is faintly acid, and is ground with 18 to 22 kilograms of oil per 100 kilograms of powder.

Both products are easy to use and give a very good finished surface in competent hands.

Lead possesses more covering power and greater elasticity and can be matched more easily if a portion of the painted surface has been damaged. White and red lead form a good jointing material which is easy to use.

In the witness's opinion the dangers attendant on the use of white lead are not great enough to justify its prohibition. He does not agree with the findings of the French White Lead Commission which alleged were the outcome in a large measure of political agitation and humanitarian considerations for the health of the workmen.

White lead is cheaper than zinc white and easier to apply.

Mr. Villenot referred to the failure of a factory established for the manufacture of lithopone and also alleged that the marine department and other French Government departments had been obliged to revert to the use of white lead and red lead in certain cases. He thought that the Maison Leclair was using only zinc oxide, but they do exceptional work and employ skillful workmen.

He did not consider that sufficient leadless paints would be available on the market if the French prohibition law is put into operation at the end of 1914.

The witness agreed that white lead is a dangerous material and precautions are required to prevent ill effects on the health, but he considered regulations such as prohibition of the transport of dry white lead, prohibition of dry rubbing down, and improvement of washing conveniences and the like would, if properly enforced, remove the danger.

The French Government provided that a period of five years should elapse before the prohibition of white lead became absolute, for two reasons: (1) to give time in which to replace white lead, to transform the factories and so on; (2) to give something in the nature of an indemnity to the manufacturers of white lead. Subsequent inquiries have resulted in the adoption of regulations in Belgium and Germany; while in Austria the use of white lead has been forbidden in interiors only.

Mr. Emil Niederhauser is a master painter of Cologne employing about 100 hands. He has known very little lead poisoning among his workmen and considers that the regulations now in force in Germany simply protect the workmen. The men are given printed instructions, which the witness thought might be made more simple, and the half-yearly medical inspection brings home to them the necessity for extraordinary care. Nailbrushes and towels are supplied to men who are working at private houses.

The witness referred to statistics presented by Dr. Kaup showing a decrease in the incidence of lead poisoning; this in Mr. Niederhauser's opinion is principally due to the prohibition of the dusty process of dry rubbing down and the improved personal cleanliness of the workers.

No additional factory inspectors have been appointed to secure the carrying out of the new regulations in the district of Cologne.

In the witness's opinion white lead is the best paint for exterior work. Lead is also used on account of its great covering power for priming coats on interior work, and a finishing coat of zinc white is used where pure white color is desired.

In 1903 inquiries were addressed to all users of paint in Germany asking them whether white lead could be replaced by any other material; the replies showed a universal opinion that white lead could not be replaced for exterior painting and that it was also necessary for undercoats for interior painting, while at the same time cleanliness was stated to be the chief cause of lead poisoning. The witness regards white lead mixed with oil as practically harmless as a paint, but considers that in the preparation of the old surface the rubbing down should be done wet.

The witness quoted a circular of September, 1907, of the Prussian railway authority prohibiting the use of zinc white, lithopone, etc., for exterior use in consequence of tests which showed that white lead alone was satisfactory for this purpose.

He summarized his conclusions by stating his opinion that there is an efficient substitute for white lead where the durability of the paint is important, and that there is no more danger to workmen handling paint than in many other trades provided that the rubbing down be done wet.

In further examination the witness said he considered the new regulations in Germany sufficient for the protection of the worker because the statistics quoted by Dr. Kaup show a decrease in the incidence of lead poisoning and because the regulations have brought about an improvement in the cleanliness of painters; the witness considered that all lead poisoning is due to lack of cleanliness on the part of workers (Q. 16284); he regards the prohibition of dry rubbing down, however, as very desirable and considers it quite possible to dispense with such a process in all painting. He considers that the regulations in Germany are enforced by the exchange of information regarding irregularities among the men themselves.

His own central workshop has been inspected twice during the five years that the regulations have been in force, once by an industrial inspector and once by a police inspector. No inspections have been made at the places where the painting work is done.

Questioned further in regard to control of irregularities by information given by the men, Mr. Niederhauser admitted that it usually resulted in the man losing his place, the usual course being, that "the man gives information to the trade-union; the trade-union informs the authorities, that is the police or the industrial inspector; the employer is fined and the man is dismissed" (Q. 16300), but the witness added that if the man were a very capable worker he might not be dismissed.

When Mr. Niederhauser affirmed that dry rubbing down could be dispensed with, he did not mean that wet pumice stoning could take the place of sandpapering on a first coat of paint; after 12 or 15 hours the paint can be sponged down and then rubbed with sandpaper. He did not consider that this would be equivalent to dry rubbing down. In connection with the lavatory regulations, every man entering employment as a painter is supplied with a basin, towel, nailbrush and a piece of soap; he carries these with him always. Hot water is not provided and would not be practicable, but cold water is always available and it is the duty of the foreman to see that the men have their basins, towels, etc.

Mr. Niederhauser employs from 80 to 100 men, and during the five years the regulations have been in force he has not had occasion

admit any man for uncleanness. The men are required to wear special blouses and trousers and to provide for their being washed at reasonable intervals.

In conclusion, the witness said that he did not think that the regulations can always be observed, but the welfare of the men is considered as far as possible. It would be impossible to control observance of the regulations by inspection.

Mr. Niederhauser considered the prohibition of the use of lead to be impossible. The success of leadless paints on trams, motor cars, and the like he attributed to the protective value of varnish; the success of such paints where not varnished over he could not explain. Zinc white in his experience is not sufficiently durable.

Mr. Hans Leyendecker is president of the German White Lead Manufacturers' Association, and was consulted at the time of the drawing up of the German regulations for white-lead factories. These regulations have resulted in a decrease in cases of lead poisoning. In 1905, an inquiry was addressed to the guild of painters in Germany, and the replies, which were unfavorable to the substitution of zinc for lead, were summarized by the witness. In June of the same year the German regulations were made.

Mr. Leyendecker considered that regulations can be applied to the painting trade, and instanced the prohibition of dry rubbing down in house painting in Germany. The regulations are controlled by the police or inspectors of factories. The witness stated that hot water is always provided in Germany, and the wearing of overalls insisted on. He advocates the provision of milk to workers, but considers this would be difficult to enforce.

The inquiries addressed to the guild of painters were in the form of questions, to which they replied; there was no cross-examination of witnesses.

He admitted that the regulations in Germany have led to a slow rate of decrease in the case of lead poisoning, and also that regulations would be difficult to enforce, especially at first; he is nevertheless convinced that they are preferable to prohibition. He instanced the experiments of the Prussian State railways with substitutes which extended over some three or four years, and resulted in white lead being again specified for railway work.

Mr. de Morsier is editor of a Geneva paper and formerly deputy. The question of prohibiting white lead in painting was first raised in 1904, and the draft of a measure was referred to a commission of which he was a member and reporter. This Swiss commission took the evidence of 31 witnesses, and also made inquiries by circular. Of the witnesses questioned verbally as to their attitude towards prohibition of lead, 8 trade-union workmen and 2 employers expressed themselves for prohibition by law, while 8 workmen, 9 employers and 1 manufacturer expressed themselves against. Of the employers questioned by letter, 5 replied in favor of prohibition and 46 against. Of the architects written to, 1 was in favor of total prohibition and 1 in favor of prohibition for the interior; 9 were against. Of the 3 doctors who replied, 2 only asked for prohibition, while the re-

The number of cases in white lead factories in Germany were as follows: In 1895, 312; in 1899, 306; in 1901, 282; in 1902, 327; in 1903, 134; in 1905, 137; in 1906, 160; in 1907, 177; in 1908, 172. (Kaufmännische Sozial-Hygiene, Sept., 1910, p. 10.) See Appendix VI (Statistics of Evidence).

mainder considered that regulations would be sufficient to meet the danger. The commission accordingly arrived at the following conclusions:

- (1) That though white lead is poisonous its use in house painting does not constitute a social peril sufficient to necessitate prohibition.
- (2) Zinc oxide can replace white lead in a large number of cases, but the general opinion and experience of the trade is that white lead is still sometimes necessary.
- (3) White lead is not dangerous when simple precautions are taken.
- (4) White lead dust is dangerous when inhaled for a long time or in too large quantities.
- (5) Use of white lead in the form of paste removes the danger of dust.
- (6) The dry scraping off of old lead paint produces much dust which is breathed; burning off is equally bad.
- (7) Dry rubbing down of paint is not dangerous unless the work is prolonged in unventilated rooms or the workman keeps his face too near the work. The amount of rubbing down done in Geneva is regarded as negligible.
- (8) The trade fear an increase in the price of zinc and consequently in the cost of painting work.
- (9) In the absence of regulations, precautionary measures are not carried out with sufficient thoroughness.
- (10) Lead poisoning is uncommon in Geneva, and the sufferers probably have neglected elementary precautions.
- (11) There does not exist in Geneva among the workmen a special demand for the total suppression of white lead.

Mr. de Morsier then criticised the conduct and conclusions of the inquiry carried out by the French commission.

Following on the report of the Swiss commission a law was passed to regulate the use of white lead on 26th October, 1907 (Appendix XIX¹), also regulations were issued on 21st December, 1907 (Appendix XX¹). Mr. de Morsier put in a chronological statement of the steps which led up to these measures (see Qs. 16520-41). As a result of further inquiries in 1908 it was resolved that the use of white lead inside work should be prohibited in all the works executed by or contracted for by the Federal Government departments.

In further examination Mr. de Morsier dealt with the difference between painting in France and Geneva; he stated that he did not know anything of English conditions. Although there is but little lead poisoning in Geneva, regulations were considered desirable prohibiting the use of white lead in powder, and forbidding dry pumstoning, scraping off and burning off of paint, and the direct use of fillings with the hand is also prohibited. Provision of washing accommodation, overalls, and a place for clothing are required. The regulations are enforced in the first instance by informing the workmen regarding the regulations and by charging the police with the enforcement of the regulations for overalls and place for clothing as well as authorizing the police to receive complaints from workers. The police very rarely enter a house unless they receive a complaint. Under the regulations all dusty operations are required to be carried

¹ In Minutes of Evidence, presented in a separate volume of the original report.

out in a wet way; the witness could not say how far the regulations are observed, as there is always a little difficulty in this respect in Geneva. In the witness's opinion dry rubbing down could be dispensed with.

Dr. M. Roch is chef de clinique at the cantonal hospital at Geneva. He spoke of 44 cases of lead poisoning treated during the seven years ending 1906 at the cantonal hospital; of these 24 occurred among the house painters, who number from 300 to 400 in Geneva, and 20 occurred among men following other trades. He stated that he had studied the whole subject impartially. After dealing with various aspects of the lead poisoning question he quoted the alleged experience of the Belgian Government, who prohibited the use of carbonate of lead for the railways, and have recently reversed that decision.¹ In Dr. Roch's opinion lead poisoning can be prevented without prohibition of the use of lead. Salts of lead, white lead in particular, appear to form with the acids of unseed oil metallic soaps which can not be produced either with zinc white or barium, and this in Dr. Roch's opinion accounts for the durability which results from the use of the former for exterior work. Litharge can be replaced by oxide of manganese, but red lead appears in the meantime to be indispensable for the priming of ironwork.

Dr. Roch suggested regulations which should include—

- (a) The prohibition of dry grinding and mixing.
- (b) Prohibition of the importation and supply of lead colors not already mixed with oil and ready for use.
- (c) Prohibition of handling of white lead by the workmen when filling or making fillings.
- (d) Dry rubbing down with glass-paper, which produces dust, should also be prohibited, as should be burning off—with a spirit lamp—of old paint, which is likely to produce toxic emanations.
- (e) The cleaning down of old paint should be done wet and with a liquid solvent.
- (f) Workmen should be prohibited whilst at work from smoking (especially cigarettes). They should be compelled to wear working clothes whilst at work, to take them off immediately after they have finished and before eating their food, and the working clothes should be regularly washed.
- (g) A strict regulation should be made for the washing of the workmen's hands with soap, and the use of nailbrush and clean towel before they partake of food. Perhaps, also, it would be advisable to have a medical examination of all painters once or twice a year.

In the witness's opinion these regulations would be very efficacious, and he considered they should be tried before prohibition. Dr. Roch stated that he found in nearly every case that lead poisoning was due to the carelessness of the worker, and he did not consider that this alone constituted sufficient ground for prohibition of the use of lead.

In further examination Dr. Roch said he considered that the dust from dry rubbing down was one of the most serious dangers. If it is impossible to prevent the formation of dust, then prohibition would

¹ See, however, p. 140.

be better than regulations (Q. 16740). The witness agreed that regulations must be enforced by inspection, and regretted that in Switzerland there is hardly any control to enforce the regulations.

Mr. C. A. Klein is a technical chemist of Victoria University, sometime demonstrator in chemistry at Sheffield University College, and at present chief chemist to the Brimsdown White Lead Co. He detailed experiments which he had carried out at the requests of the chemists' committee of the white lead corrodors' section of the London Chamber of Commerce. His first series of experiments led him to the conclusion that it was impossible to prepare a volatile lead compound even under conditions much more favorable to its formation than those obtaining in painting practice. In view of the animal experiments of Mr. Goadby, Mr. Klein made experiments for determining the rate of volatilization of turpentine from a paint film. He found that the whole of the turpentine is practically removed at the end of one hour, and that there is therefore little difference in the behavior of the turpentine in the paint whatever be the pigment, either lead or zinc. Mr. Klein also made experiments with substitutes for white lead, namely, lead oxysulphate, zinc oxide, and lithopone, as well as with various ready-mixed white paints. He formed the conclusion that there is no efficient substitute for white lead. Apart from the determination of the merits or demerits of any paint, which must depend on a practical trial, Mr. Klein submitted the following points:

- (1) That the effect of sulphuretted hydrogen on zinc is similar to the effect on lead paints, but is not so apparent because the zinc paint does not change color whilst the lead paint goes yellow.
- (2) Sulphur dioxide, which is freely present in the London atmosphere, produces with zinc oxide a compound which is soluble in water; with lead it produces a compound insoluble in water.
- (3) The spreading power of white lead is better than that of zinc white.
- (4) White lead is not a powder of uniform size, and this gives the paint film greater stability than that possessed by substitutes for white lead, which are invariably in a very fine state of subdivision and regular size. On all these grounds Mr. Klein considers white lead the best pigment.

Mr. Klein has known of no case of lead poisoning attributable to the handling of white lead in paste form; he regards the inhalation of dust as the source of practically all the trouble, and suggests that respirators should be worn if dry rubbing down is permitted to be carried on. The handling of dry lead colors is also a source of danger. This could be avoided by regulations prohibiting their use except in the form of paste.

In further examination Mr. Klein reaffirmed his disagreement with the observers who claim to find lead emanations from drying paints and repeated emphatically his opinion that dry rubbing down should be prohibited or that the painter should be obliged to wear a respirator whilst the work is being done. He considered that regulations could be enforced in the painting trade just as they are enforced in other lead industries, such as white lead works. In the first instance

he would educate painters as to the dangers of lead poisoning. The employer should be forced to see that the regulations are carried out; washing accommodation is requisite, including hot water, if possible, but he did not consider hot water necessary if pumice soap is used.

Mr. Hedley Miller is an official of the London Chamber of Commerce, and stated that he had collected certain statistics to present on behalf of members of the chamber directly or indirectly interested. The British white lead industry shows a production of 57,000 tons for 1910, of which he estimates that over 85 per cent is consumed in this country. The white lead manufacturers employed, in 1910, 2,489 men, involving some 8,100 dependents. He estimated the wages paid at £178,300 (\$770,366.95), and the total capital employed at £1,334,000 (\$6,491,911).

Mr. Miller referred to the indirect effect which prohibition would have on other industries, and quoted the amounts spent annually by white lead manufacturers on pots, timber, tan, and acetic acid. In addition to the £864,660 (\$4,207,867.89) spent in 1910 on pig lead, the total consumption of pig lead in this country amounts to 200,000 tons per annum, and this the witness estimated would be reduced by 25 per cent if the demand for white lead ceased. He dealt further with the employment of men in the British lead mining industry, which he gave as 2,678 men with 6,945 dependents, and earning £151,308 (\$736,340.38) annually in wages. The smelting and refining firms employed 780 workmen with 2,439 dependents, wages £72,970 (\$355,108.51). The output of British red lead and litharge is about 11,800 tons, involving an estimated capital of £150,000 (\$729,975).

Mr. Miller next dealt with substitutes for white lead, and stated that he considered zinc oxide the only substitute in any way efficient. This pigment has been known for a great many years and is largely used for interior finishing work. The chamber of commerce addressed a set of questions to the leading painting and decorating firms in the principal cities of the United Kingdom outside London and received 25 replies, which the witness summarized as follows:

111 said that there was no substitute for white lead for outside painting effective for body, covering power, and durability.

78 said that they had had experience of zinc white for exterior work; of whom 52 said that it was unsatisfactory and not equal to white lead. A few said that zinc white is unsatisfactory except when used with enamel or varnish.

110 said that they have had experience of the use of zinc white for inside work.

93 recommended the use of undercoats of white lead for inside work.

91 have no objection to simple regulations, such as quarterly medical inspection; the use of overalls; provision of soap and water, etc., and the use of them before meals.

He also stated that a number of firms volunteered the information that they had little or no experience of lead poisoning. He referred the committee to a statement by Mr. Stas, made in 1885, that "to-day the white disputes with white lead for pride of place," but he added, zinc white can not replace white lead for all purposes; it is not

prejudice or custom, that enemy of progress, and less still ill-will that is responsible, but the very nature of zinc white itself, which it is not in the power of man to change." Mr. Miller quoted the statement of the departmental committee of 1893 to the effect that zinc oxide is good for inside but has not sufficient covering power or durability for exterior work.

Mr. Miller was further questioned regarding the amount of British white lead exported and used in this country for purposes other than painting. On November 14, 1912, he again attended before the committee and offered supplementary evidence, in which he stated that the figures for 1910 were as follows:

	Tons.
Total home manufacture of white lead.....	57, 946
Total import of white lead.....	14, 436
Together.....	72, 382
Total exports of white lead.....	20, 219
Balance, being total home consumption.....	52, 163

As far as the witness could ascertain the white lead corroded in the United Kingdom delivered, during the year 1910, 2,984 tons of white lead dry for purposes other than painting. Of 125 painters and grinders who were asked in regard to the same matter, 117 replied disclosing total deliveries of white lead for purposes other than painting of less than 11 tons. Mr. Miller therefore concluded that approximately 3,000 tons of white lead are used in this country for purposes other than painting. He agreed that this estimate was based only on ex parte figures given by the white lead manufacturers and that he had no means of having them verified. If the use of white lead were prohibited for painting purposes in this country he agreed that the larger quantity of the 14,436 tons now imported would cease to come into this country. The British white lead manufacturers would, however, retain a market for some 23,000 tons made up of 3,000 tons for purposes other than painting and 20,000 tons for export, except in so far as the foreign markets for the latter might be affected by the closure of a market in this country for the 14,000 tons of foreign white lead at present imported.

Capt. Matthew Francis is senior partner in the firm of Matthew Francis & Son, of Halkyn, near Holywell, Wales, and has practiced as a mining engineer for 50 years in the Flintshire district. He manages four North Welsh mines and is consultant for three others.

He pointed out that the prohibition of white lead would have a prejudicial effect on the lead mining industry, especially as a larger proportion of their output goes to white lead corrodors. He dealt with the fluctuations in the price of lead, and stated that he felt sure that the British lead mining industry would be ruined if the use of white lead for painting were prohibited. He maintained that the dangers attendant on the use of lead could be adequately met by regulations, but agreed that if the regulations can not be enforced lead should be prohibited. He thought, however, it was too very easy to carry out regulations.

Mr. E. N. Humphreys is a fellow of the Institute of Chartered Accountants, and is a director of two of the mining companies referred to by Capt. Francis. He quoted the capital of those two com-

panies as just over £71,000 (\$345,521.50), and said the average number of men employed by them was 200, earning from £11,000 (\$53,531.50), to £12,000 (\$58,398) per annum in wages.

He dwelt upon the importance of the lead mining industry in the county of Flint, and said he was informed that about 25 per cent of the output of Welsh lead is used by white lead corrodors; if the use of white lead is prohibited, it would so reduce the demand as to cause a serious reaction upon the price of lead ore. This would in its turn extinguish the present small margin of profit, and result in the closing of the mines and the throwing out of employment of the men now engaged therein.

He considered that regulations should be adopted for the painting industry, and considered that these, together with the education of the workers, would reduce the risk to its lowest point. He admitted there would be difficulty in enforcing regulations for painting, and agreed that work can not be done on dry surfaces without engendering a certain amount of dust which can not be removed.

In further examination, Mr. Humphreys was asked if he thought it worth while trying to save an industry which can not pay a living wage to its workmen and can only pay 1 per cent interest on its capital; he replied that the average rate of wages works out at 22s. (\$5.35) a week, which he did not admit was below the level of a living wage in that district.

Mr. Henry Gardner is a director of the firm of Henry R. Merton & Co. (Ltd.), and the Merton Metallurgical Co. (Ltd.), who carry on business in London and Frankfort. He dealt with the causes of fluctuations in the price of lead ore and said that the prohibition of the use of white lead for painting would lead to a reduction of the price of lead, and would ruin the lead mining industry.

Mr. Julius Matton is a member of the metal exchange, and has been connected with the lead trade in London for 35 years. He estimated the total consumption of lead in England at about 200,000 tons, of which approximately 45,000 tons are used for conversion into white lead and 12,000 tons for conversion into red lead and litharge.

The prohibition of the use of white lead in painting would cause a decrease in the price of lead, and would practically destroy the British lead mining industry. English lead commands a little higher price than most foreign lead because it is better for making white lead, but it is no better than the average foreign lead for any other purpose.

Mr. H. C. Lancaster is the technical director of Messrs. Locke, Lancaster, and W. W. & R. Johnson & Sons (Ltd.), desilverizers and manufacturers of lead in all its branches, and grinders of zinc oxide. He considers that no zinc ores exist in British possessions from which a marketable zinc oxide can be made by the direct process; he referred to several attempts to establish this manufacture in Great Britain, and said all resulted in more or less failure. If made by the indirect method it could not compete with that made abroad by the direct process. Prohibition of lead would make the paint trade dependent on foreign supplies of raw material. He admitted that there is at present a combination for maintaining the prices of white lead.

The proportions of zinc and lead produced in the British Empire, as compared with the world's production, are about the same, as shown by the following table for the year 1909:

	Production in metric tons.		
	Great Britain.	British colonies and dependencies.	Total British Empire.
Lead.....	23,000	204,000	227,000
Zinc.....	4,000	151,000	155,000
			826,000 701,000

Mr. Lancaster thought if lead were prohibited there would be great difficulty in producing the extra amount of zinc oxide needed, and the price would presumably go up.

The witness stated that zinc is not as good as white lead for outside work, but when it was pointed out that some large users who have tried it have found it just as good, Mr. Lancaster said no doubt it is a very vexed question. One man will pin his faith to zinc oxide and another to lead; in the witness's opinion both lead and zinc are useful for pigments and they have their specific uses.

Mr. J. Sibthorpe said he was a master house painter of 45 years' experience and has carried on business for many years in Dublin, where he employs an average of 50 painters. He has only known of one case of lead poisoning amongst his men for the last 10 years. He agreed that the lead poisoning evil in this country was sufficiently great to justify some action being taken; he would prefer the introduction of regulations rather than the prohibition of the use of lead. He advocated the following regulations:

1. The labeling of all receptacles in which lead colors are kept, sold, or sent to a painting job.
2. (a) The licensing of each master painter; the license should be so worded as to bind the latter to observe all regulations in force or to come into force for the use of lead paint. (b) The licensing of each operative painter, who should be required to keep a card upon which should be noted the places and times of his employment for at least 12 months and any attacks of lead sickness; the card to be produced for inspection by any employer, inspector, or examining doctor.
3. Prohibition of the use of white lead otherwise than in the form of paste.
4. Prohibition of dry pumice stoning or glass-paperying of old paint or surfaces that have been burned off. The dry scraping of painted woodwork should be restricted to the very few cases, less than 5 per cent, where it is absolutely necessary, and only permitted after notice to the inspector, so that safeguards should be used. The witness did not consider that there was any danger from the dry scraping of iron because, there being rust underneath, the paint comes off in flakes. He also regarded glass-paperying between coats of paint as nonhazardous.

because fine paper is used to remove the small paint protuberances called "nibs," and almost all that is taken off adheres to the glass paper. Alternatively the use of waterproof glass paper or ground pumice with water should be insisted on. If lead were prohibited dry pumice stoning and the like should nevertheless be forbidden for at least 20 years afterwards.

5. Burning off. This the witness does not consider dangerous.
6. The provision of overalls by the workmen; the foreman to see to the observance of this regulation, clean overalls being insisted on every Monday. The witness considered that it would be unfair to put this burden upon the employer, (a) because they provide all the brushes; (b) because of the difficulties and delay arising from fitting; and (c) because of the liability to loss which the men can much more easily prevent.
7. (a) Facilities for washing, i. e., nailbrushes, soap, towels, and hot water; the employer to be absolutely responsible for the first three and primarily responsible for the last, but with the right to demand it from an occupier in the case of an occupied house. (b) Separate place for mess room and for storing outdoor clothing apart from the place where the paint is stored and mixed; the responsibility for this to be the same as in regard to hot water. (c) Provision of water-closet accommodation; the responsibility for this in occupied houses to rest on the occupier, subject to the liability of the employer to make good any damage.
8. All licensed employers to permit their paint shops to be inspected whenever called upon.
9. All licensed workmen to be medically examined at least three times a year. The individual employer or the local master painters' society should keep a register in which the doctor should make notes of his inspections, and the dates of each inspection should be entered on the workman's card by the inspecting doctor.
10. Men who have suffered from recurring attacks of lead poisoning to be deprived of their license to use lead and to be restricted to nonlead employment; alternatively to receive reasonable compensation, to which the employers during the preceding 12 months should contribute pro rata.

Mr. Sibthorpe believed that such a set of regulations would be most effective in preventing lead poisoning and would not impose an unreasonable burden on the employer. He considered that they could be efficiently enforced without great cost to the community by the employment of special inspectors including possible expunters who have had to leave the trade owing to their susceptibility to lead poisoning. He calculated that for the city of Dublin with a population of 402,000 four inspectors at a salary of £2 (\$9.73) rising to £3 (\$14.60) a week would suffice. The witness regarded the alternative prohibition of lead as impracticable, and said it would greatly increase the cost of painting as the average life of paint would be at least one-quarter less. In the witness's opinion the only substitute

for white lead is zinc white, which is much less durable outside. In certain branches of work, such as painting of ironwork on ships, he claimed that there is no practical substitute for red lead. He thought prohibition would involve inspection equally with regulations and it would be a more difficult kind of inspection, and would be more unpopular both with employers and men. He submitted also a note regarding the instructions of the commissioners of Irish lights and of public works, who specify for lead painting.

In further examination he said that he would agree to the provision of overalls by employers if such a rule were found necessary. He considered inspection could be carried out even in the case of private houses, and maintained that the use of substitutes for white lead would entail 25 per cent more labor as well as more frequent painting. He agreed that if the use of lead were prohibited painters could use zinc paints equally as well without any special training.

With regard to the number of special inspectors required, the proportion of four inspectors for the city of Dublin might, if applied throughout the United Kingdom, mean 450 such inspectors. In his view the registrar's fees would go a long way toward paying for these inspectors.

Mr. G. Plumb is foreman of the painting and decorating department of Messrs. G. Trollope, of Pimlico. He has had 44 years' experience as a house painter and has been nine years in control of a large body of painters averaging from 150 to 350 according to the season. In his opinion white lead is superior to any other kind of pigment as regards (1) efficiency and (2) durability. As regards ironwork he considered that nothing can generally supersede red lead. In his opinion the dangers of dry rubbing down have been exaggerated, but he could see no objection to the prohibition of that process. He advocated medical examination, provision by the employer of washing facilities and the wearing of overalls. Regulations should be made compulsory on workmen, employers and householders alike. He agreed that inspectors would be necessary for their enforcement, but considered that this would be equally necessary with prohibition.

In further examination he stated that during his nine years' connection with his present firm there have only been three cases of lead poisoning with compensation. At the time of giving evidence there was a man away a day or two with colic, but such cases are not serious. He did not consider that they had many cases of colic, certainly not 10 per cent of their men. These cases mostly happen on country jobs where the men have not the conveniences of their own homes. He was surprised to hear of cases where leadless paints had been used successfully and affirmed that whenever he had used zinc paints he had found them unsatisfactory. He agreed that red oxide of iron and graphite paints are very good, but not equal to red lead as an undercoating on iron. He stated that most of his own work had been high class decorating work, including the decorative portions of five or six ships of the Royal Mail Steam Packet Co. and one of the Orient Line. In regard to the latter he used lead and said there was no stipulation to the contrary, but he is employed by the contractors on motor boats only. He considered that wet rubbing down was in certain cases impracticable. The dry rubbing down of filling and stopping for example, could not be abolished. The witness further alleged the

all dust, even zinc dust, would be harmful if breathed, though he admitted that he had no evidence that zinc was poisonous.

Prof. Bettink said he was a doctor of chemistry and a pharmaceutical chemist, and was for upwards of 30 years professor of pharmaceutical chemistry and toxicology at the University of Utrecht. He referred to the work of the Dutch White Lead Commission appointed on September 13, 1903, consisting of 15 members including Government officials, chemists, technical persons, architects, and three master painters. In October, 1906, they issued a provisional report which included the following opinion: "Zinc white paint is in no respect inferior to white lead paint as regards covering power, and may be said to cover even slightly better." This statement was criticized by Mr. Van Hoek, a master painter, and the Netherlands Master Painters' Association, on the ground that the zinc paint experimented with by the commission was too thick for practical use.

Prof. Bettink detailed the final conclusions of the Dutch commission,¹ and went on to say that although zinc oxide retains its color in the presence of hydrogen sulphide it does not resist sulphurous vapors as well as lead does. In the witness's opinion also it has a smaller covering power in the proportion of 118 to 153. He also referred to the better combination of lead with oil, and to the expectation that regulations would be issued in Holland as the result of the commissioners' report.

With regard to health statistics, he alleged that painters in Holland are mostly men not physically strong enough to follow a more exacting vocation, and that their illness is often more due to general weakness than to white lead.

He considered that the fumes from burning off paint are not dangerous, but rubbing down should be done wet. White lead should also not be supplied to painters in a dry state.

He quoted the amount of lead used by the marine department at Amsterdam, and summed up his evidence by saying that zinc oxide is inferior to white lead in durability and is more costly.

In further examination, Prof. Bettink said he investigated cases of lead poisoning on behalf of the Dutch Government, and found that in six years there had been four cases of lead poisoning amongst house painters in the city of Amsterdam, which has 600,000 inhabitants. There were four hospital cases, as there are no official statistics kept with regard to lead poisoning generally in the city. The witness agreed that there would be a much larger number of cases of lead poisoning which did not come to hospitals, but they would be of minor interest as the serious cases all go through the hospitals. Prof. Bettink thought a good many cases of illness attributed to lead poisoning are not really lead poisoning at all. In an inquiry made in September and October, 1911, he spoke to 20 master painters employing altogether 300 hands, and these could only recall one case of lead poisoning in the last 40 years. He also questioned operatives and found that they also were quite convinced of the smallness of the danger of lead poisoning.

After some further criticism of the conclusions of the Dutch commission, which the witness said were contrary to his own views, Prof. Bettink said it had been noted that iron oxide paint on ships wasted

¹ See Appendix XXXIV (Minutes of Evidence).

away within three or four months. Other statements in regard to the inferiority of leadless paints the witness said were not based on any practical experience, but on his theoretical knowledge as a chemist. Zinc paints properly mixed with oil could be used for indoor work, but can not stand exposure to a wet atmosphere. A regulation such as the prohibition of dry rubbing down, which is already in force in Amsterdam, is carried into effect by special inspectors of labor and inspectors of buildings, who have a right to enter any house which is being erected or repaired.

Mr. J. Holt Schooling is a fellow of the Royal Statistical Society, and an associate of the Institute of Actuaries, and holds various statistical and actuarial appointments. He prepared and laid before the committee a lengthy report on occupational mortality, based on the supplement to the sixty-fifth annual report of the registrar general for England and Wales.

In his first table he gives the mean annual death rate in each age group for a number of occupations which have a higher death rate than the occupation of plumber, painter, and glazier, which is referred to throughout as "Occupation 64." He also pointed out that there are only six occupations in England and Wales where the death rate in all age groups is lower than the death rate in occupation 64.

In connection with the third table, Mr. Schooling points out that at all ages the death rate from plumbism in occupation 64 is one fifty-fourth part of the death rate from all causes and actually amounts to 0.23 deaths per annum per thousand living. He adds: "This rate is much smaller than the special death risks that attach to various other occupations, and it is relatively trivial."

In the next table the witness points out that the death rates in occupation 64 have been decreasing since 1880-1882 at a much greater rate than the decrease in the death rates of all occupied males.

In the fifth table this decrease in the death rates is further compared with that for all occupied males in industrial districts of England and Wales. From these and other tables put in by the witness, he deduces that the mortality in occupational group 64 "Plumber, painter, and glazier," is in no way excessive or abnormal.

Mr. Holt Schooling next deals with occupational sickness and refers to the extensive investigation by the Manchester Unity Friendly Society published in 1903. The special data relating to house painters were, however, not available, as the detailed data were destroyed on the completion of the investigation. From such data as are available, the witness deduces that "there does exist some presumptive evidence that the sickness from all causes in the occupation plumber, painter, and glazier, is not in excess of the sickness among the general population" (Q. 18622).

The witness also deduces that, assuming identical age distribution in both cases the mortality from lead poisoning per 100 cases of sickness from lead poisoning is slightly less than the mortality from all causes per 100 cases of sickness from all causes, there being 4.3 deaths per 100 cases of lead poisoning as compared with 4.7 deaths per 100 cases of sickness of all kinds. This relates to all occupations, not house painters only.

In the absence of reliable data of occupational sickness, Mr. Holt Schooling suggests that a large friendly society or a number of small friendly societies should be induced to fill up experience cards, on

for each member engaged in an occupation exposed to the risk of lead poisoning; at present, in the witness's opinion, no valid basis exists by which to form any sound opinion as to the incidence of sickness amongst house painters.

In further examination, the witness admitted that there are a certain number of deaths from lead poisoning and from diseases which are accelerated by exposure to lead; if a painter could be safeguarded against all risk of lead poisoning the mortality might be slightly reduced. The elimination of deaths attributable to lead poisoning would not make much difference, as the witness considers that the mortality from plumbism is relatively trivial. He pointed out that he used the expression "the mortality among painters is by no means unduly high" in a purely statistical sense, meaning that it is not much higher than the average; if it were possible to eliminate the lead poisoning, then it would be correct to say that the present figures are unduly high by such an amount as represents the mortality from lead poisoning. As pointed out in Table C, the death rate from plumbism is only one fifty-fourth part of the death rate from all causes; the witness was disposed to agree that this might be paraphrased by saying that out of every 54 painters, plumbers, and glaziers who died, only 53 would die if there were no exposure to risk of lead poisoning. He agreed that the one of 54 who now dies of lead poisoning ought to be saved if possible, provided that care is taken not to drive him to death from drink or unemployment or other causes.

The witness was not in possession of the statistics of the painters' societies, and agreed that if these are properly collated and properly considered, they must carry great weight.

With regard to the tables of occupational sickness, the witness said the data are entirely defective. He admitted (Q. 18726) that it was not satisfactory to state (Q. 18630) that "Perhaps the occupation, paints, and colors plus coach building plus white lead, is the group most likely to include house painters," inasmuch as house painters are not included under the factory act at all. He minimized the importance of any statistics which did not include age distribution. He admitted that 48 and 35 deaths from lead poisoning among house painters and plumbers, in 1911 and 1910, respectively, constitute a not deplorable in itself.

Mr. E. M. Johnson is a director of Messrs. Locke, Lancaster & Co., and W. W. & R. Johnson (Ltd.), lead desilverizers and white lead corrodors; he has also acted as chairman of the committee of the white lead corrodors section of the London Chamber of Commerce. He submitted three reasons against prohibition:

- (1) There is no statistical or other evidence that prohibition is more necessary in the case of red and white lead than in the case of other articles.
- (2) That prohibition has not been possible elsewhere and is not possible in the United Kingdom.
- (3) That education and regulations have been successful elsewhere and if tried here would be successful.

In connection with the first point Mr. Johnson summarized Mr. Holt Schooling's evidence, as well as that of Mr. Goadby, Prof. Armstrong, and Mr. Klein.

In connection with the second point, that prohibition has not been possible elsewhere, Mr. Johnson referred to the evidence of Dr. Kamm, Dr. Rambousek, M. Ricker-Devroede, Herr Leyendecker, Herr Dullens, Herr Niederhauser, Prof. Wefers Betink, M. de Moras, Dr. Koch, and others. The witness also quoted a passage from the report of the British consul at Lille to the effect that the law prohibiting the use of white lead for outdoor painting purposes, which came into operation on the 1st January, 1915, does not appear to be in favor with the public, and pointing out that there is no sensible decrease in the amount of white lead used.

Under the third head, that education and regulations have been successful elsewhere and if tried here would be successful, Mr. Johnson again referred to points in the evidence of foreign witnesses, and emphasized the opinions expressed by Mr. Plumb and Mr. Sibthorp that there is no practical difficulty in dispensing with dry rubbing down. He advocated the prohibition of this process as in the Austrian and German regulations. He claimed that an effective system of regulation need not be costly, as the workmen themselves might assist through the trade-unions in the enforcement of the regulations as happens in Germany and Austria, and that the supervision of painting operations might be intrusted to the sanitary inspectors and surveyors of the various local authorities; or, alternatively, the inspectorate set up under the national health insurance act might be utilized—he suggested that 40 additional insurance act inspectors would be ample for this extra work. Mr. Johnson said he did not wish to draft a set of regulations, but he tabulated the points which he thought should be included in regulations.

FOR BOTH INSIDE AND OUTSIDE HOUSE PAINTING.

- (a) The affixing of notices calling attention to the regulations and to the dangers attendant on painting work; each employer to be responsible that every workman has a copy of the regulations and instructions before engaging him.
- (b) Prohibition of mixing and use of dry colors except in white lead or grinding works under Home Office regulations.
- (c) Prohibition of dry pumice stoning and dry scraping off of paints.
- (d) Clear labeling of vessels containing lead.
- (e) Provision and weekly washing of aprons or overalls or beards and head coverings; washing facilities to be provided in all cases including hot water if convenient, otherwise special soap to be provided for use with cold water, and nailbrushes; ten minutes to be allowed for washing before meals and on leaving work.
- (f) Quarterly or half-yearly inspection by a doctor; proper registration of self-blood examination.
- (g) Workmen to submit themselves to prescribed medical examinations, and to produce to the employer or inspector their card showing date of last medical inspection.
- (h) Doctor to have power to suspend for prophylactic reasons.
- (i) Master to have power to dismiss and not to reengage for such reasons.
- (j) If medical inspector certifies a man to be alcoholic, he is not to be employed where he would come into contact with lead or other metallic poisons.

(k) No workman to be employed without a certificate of good health from an approved doctor.

(l) Workmen handling white lead to work in such a way as to avoid contact of the substance with the hands and also to avoid splashes.

(m) Workmen so employed to wear clothing and headgear exclusively reserved for this work, and to keep them in a good state of cleanliness and to take them off before leaving the work place.

(n) Before taking food or drink and before leaving the work place, workmen to rinse their mouths and also to wash hands and faces with special soap. Food brought into the work places to be inclosed in boxes or coverings kept well shut until the mealtime.

(o) Workmen to keep the material and tools under their charge in a good state of cleanliness.

(p) Workmen to be forbidden to bring spirits or tobacco or to consume either in the work place.

(q) Breaches of any of these regulations to be punished by a fine.

(r) Increased fines for repeated offenses.

ADDITIONAL FOR INSIDE HOUSE PAINTING ONLY.

(a) Rubbing off and pumice stoning off old paint only after previous and complete moistening. Everything rubbed off to be removed before it becomes dry.

(b) Foremen to be responsible for above, and for seeing that a copy of the regulations and instructions is displayed on every job.

In further examination Mr. Johnson admitted the official figures giving the proportion of metallic lead imported into this country as 92 per cent of the total; approximately one-third of this comes from British possessions. Notwithstanding this, Mr. Johnson stated that pig lead is mainly, if not entirely, a British product because of the large amount of desilverizing which is done on foreign lead. He said that he thought the pig lead as used in this country for white lead making is mainly, if not entirely, a British product, and added "Whether it is foreign or English you are going to interfere with the consumption in this country of some 25 per cent."

He did not dispute the registrar general's figures showing the number of deaths from lead poisoning among house painters and agreed that everything possible and reasonable should be done to prevent this part of the mortality among house painters. He agreed that regulations or prohibition are the only alternatives. It was not his impression that the enforcement of the prohibition of dry rubbing down would be impracticable. He was not in a position to produce statistics that lead poisoning had been stamped out by regulations in any country; he said there had not been time yet to show the full advantage gained. He advocated that regulations should be drafted by an impartial committee, but stated emphatically that he realized the present committee to be an impartial one, and did not wish to suggest anything to the contrary. He withdrew the statements made in his proof regarding the large reduction in the number of cases of lead poisoning in the period 1909-1910, as it was pointed out to him that he had taken factory cases and house painting together; the reduction was entirely in the former class; the increase in the cases in the latter class he attributed partly to recent compensation legislation.

Mr. Johnson's suggestions as to regulations were based on what has been found necessary for factories and also on foreign regulations; he admitted that some master painters might regard them as irksome, and he recognized the difficulty, if not the impossibility, of carrying out some of these regulations in the house painting trade. He had not taken any steps to ascertain whether the regulations suggested by the white lead corrodors would be acceptable to the painting trade. He emphasized the hardships which the Welsh lead miners would suffer under prohibition, and also said that it would not be possible to adapt the machinery now used for making white lead to the producing of zinc white.

Mr. Johnson was recalled and further examined on the following day, when he called the committee's attention to the importance of the system of blood examinations of lead workers and dwelt further on the economic disadvantages of prohibition. He stated that he had no practical experience of the system of self-inspection, but considered that something of the kind was necessary to insure proper observance of regulations. He also advocated the use of national health insurance records for the collection of statistics and reaffirmed the possibility of utilizing sanitary inspectors and other officers of the local authority for the enforcement of regulations applicable to house painters. He alluded to the unfamiliarity of country doctors with lead poisoning. He desired to call attention to special soap intended for the use of lead workers. He also advocated trade guilds for painters on the lines of the existing plumbers' guilds. Mr. Johnson agreed that the cost of medical examinations, and indeed the cost of compliance with regulations of any kind, would be finally borne by the consumer.

ANALYSIS OF EVIDENCE.

EXTENT OF THE LEAD POISONING EVIL AMONG HOUSE PAINTERS.

STATISTICS OF FATAL CASES.

The employment of house painting is for the most part confined to premises which do not come under the jurisdiction of the factory acts, and to this extent, therefore, there is no compulsory obligation to report to any government department the cases of lead poisoning which occur among house painters. There are accordingly no complete statistics available; indeed, as far as nonfatal cases are concerned no reliable information can be obtained, and the committee have been obliged to fall back on approximate estimates.

In respect of fatal cases arrangements were made in 1898 with the registrar general for England and Wales¹ to forward to the Home Office copies of all death certificates on which lead poisoning appears as the cause of death, and in Appendix X² an analysis of them is given extending over a period of 10 years, namely, from 1900 to 1909, inclusive.

From this analysis it will be seen that of the deaths notified as due to lead poisoning, Dr. Legge, H. M. medical inspector of factories, Home Office, has critically examined 627 certificates, which respectively represented 284 house painters, 79 house plumbers, and 264 factory operatives; these figures are not, however, quite exhaustive, and the total notifications of such deaths are so important that, in addition, it is advisable to give the following table, showing the actual statistics (a) for the period 1900-1909, and (b) for the years 1910-1913, inclusive.

DEATHS FROM LEAD POISONING.

Year.	Occupations not under the jurisdiction of the factory acts.			Total.	Occupations under the jurisdiction of the factory acts.
	House painters.	House plumbers.	Total.		
1900.....	31	11	42	38	
1901.....	30	11	41	34	
1902.....	26	6	32	14	
1903.....	32	7	39	19	
1904.....	30	9	39	26	
1905.....	19	9	28	23	
1906.....	30	6	36	33	
1907.....	32	7	39	26	
1908.....	29	15	44	32	
1909.....	34	13	47	30	
Total, 10 years, 1900-1909.....	293	91	387	275	
1910.....	31	6	37	38	
1911.....	35	13	48	37	
1912.....	37	10	47	44	
1913.....	31	6	37	27	
Total, 14 years, 1900-1913.....	427	129	556	421	

¹ Similar arrangements have been made with the registrars general for Scotland and Ireland, but only from the onwards.

² Minutes of Evidence, presented in a separate volume of the original report.

These figures show that the number of deaths from lead poisoning among house painters, viz, 427, alone exceeds the total of all deaths from lead poisoning among factory operatives, notwithstanding that the latter include workers engaged in the manufacture of white lead and other lead compounds, in the manufacture of pottery, in lead smelting, and many other industries in which the risk of lead poisoning has long been recognized, and which have been the subject of special legislation as shown in the following table:

	Industry.	Under general provisions only of factory acts. ¹	Under special rules.	Under regulations.
	(1)	(2)	(3)	(4)
1	Smelting of lead and other metals.....	1879-1891.....	1894-1911.....	From 1912.....
2	Brass works.....	1879-1896.....	1896-1910.....	From 1910.....
3	Sheet lead and lead piping.....	From 1879.....		
4	Plumbing and soldering.....	From 1879.....		
5	Printing.....	From 1879.....		
6	File cutting.....	1879-1902.....		From 1903.....
7	Tinning and enameling.....	1879-1904.....	1891-1909.....	From 1909.....
8	White lead.....	1879-1893.....	From 1893.....	
9	Red lead.....	1879-1893.....	1894-1911.....	From 1912.....
10	China and earthenware.....	1879-1894.....	1891-1912.....	From 1913.....
10A	Lithotransfers.....	1879-1898.....	1899-1913.....	From 1913.....
11	Glass cutting and polishing.....	From 1879.....		
12	Enameling iron plates.....	1879-1893.....	1894-1908.....	From 1909.....
13	Electric accumulators.....	1879-1893.....	1894-1903.....	From 1901.....
14	Paints and colors.....	1879-1893.....	1891-1907.....	From 1907.....
15	Coach building.....	From 1879.....		
16	Shipbuilding.....	From 1879.....		
17	Paint used in other industries.....	From 1879.....		
18	Other industries.....	From 1879.....	(^b).....	(^b).....
	Total.....			

¹ Inspectors have had power since 1879 to require fans where dust is generated to an injurious extent, and since 1895 similar power regarding fumes. Washing conveniences have been required since 1896 where lead is used. Mess rooms and exclusion from workrooms during mealtime have been required since 1901 where lead is so used as to give rise to dust or fumes.

Deaths from lead poisoning												
1900	1901	1902	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912
(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
1	3	.....	2	1	1	1	2	.....	.....	.....	.....	.....
1	1	.....	.....	1	1	.....	1	.....	.....	.....	.....	.....
2	1	1	.....	3	2	4	2	.....	.....	.....	.....	.....
3	7	1	2	4	4	2	3	.....	.....	.....	.....	.....
6	7	1	2	2	1	7	.....	.....	.....	.....	.....	.....
8	5	4	3	4	3	4	0	1	.....	.....	.....	.....
.....	3	2	.....	.....	.....	1	.....	.....	.....	.....	.....	.....
.....	1	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1	.....	.....	1	1	1	.....	1	.....	.....	.....	.....	.....
5	4	1	5	4	3	7	3	.....	.....	.....	.....	.....
2	1	1	1	.....	2	1	1	.....	.....	.....	.....	.....
5	.....	1	1	3	2	3	2	.....	.....	.....	.....	.....
4	1	.....	3	3	1	2	2	.....	.....	.....	.....	.....
38	34	14	19	26	23	33	26	3	.....	.....	.....	.....

² Employment of workers under 18 prohibited from 1882.

³ Taking of meals prohibited in dipping department from 1882.

⁴ Taking of meals prohibited in places where dry powder is used from 1882.

⁵ Heading of yarn only, under special rules, 1895-1907; under regulations, 1909-1912.

INCIDENCE OF LEAD POISONING AMONG PAINTERS IN RELATION TO NUMBERS EMPLOYED.

Census of occupation.—The number of painters and glaziers in England and Wales shown in the census of 1911 was as follows:

Painters.....	181,613
Glaziers.....	2,950
Total.....	184,563

In the 1901 census, glaziers were not counted separately, but the total of painters and glaziers was 160,201.

Assuming that the proportion of glaziers to painters was the same in 1901 as in 1911, we obtain the following figures for 1901:

Painters.....	157,640
Glaziers.....	2,561
Total.....	160,201

The average number of painters in the years 1901-1911 in England and Wales is therefore 169,627. Of this total about 12 per cent, or approximately 20,000, may be taken as being employers, and the balance, in round figures, 150,000.

Deaths from lead poisoning.—Among these workers there occurred in ten years 1900-1909, 293 deaths which were certified as due to lead poisoning, or a mortality rate of 0.195 per 1,000 per annum.

MORTALITY RATES FROM LEAD POISONING IN OTHER INDUSTRIES.

For purposes of comparison, the following average mortality rates for the 14 years 1900 to 1913, have been calculated for various lead industries under the factory act; but the numbers employed in most of these industries are too small to justify attaching very special importance to a death rate per 1,000.

Industry.	Number employed in processes.	Total deaths in 14 years (1900-13).	Mortality per 1,000 per annum.
White lead.....	1,201	36	2.141
Vitreous enamelling.....	933	1	.076
Tinning of metals.....	874	1	.081
Electric accumulators.....	1,475	8	.387
Paints and colors.....	1,400	9	.459
Earthenware and china.....	7,085	99	.908
Smelting of metals.....	2,874	36	.803
Coach building.....	29,308	61	.149
File cutting.....	5,550	22	.283
Printing.....	58,777	24	.029

In addition to the certificates of death due to lead poisoning which were provided by the registrar general, accurate statistics were obtained from the two principal societies of the painting trade, namely, the National Amalgamated Society of House and Ship Painters and Decorators, and the Scottish Society of House and Ship Painters.

Of these two societies the former had, at the time of taking evidence, a membership of 16,000 and the latter 3,240. Each society has preserved accurate and up-to-date records of deaths occurring

among their members, the one from 1905 and the other from 1901, and from these sources their secretaries¹ were able to place at the disposal of Dr. E. L. Collis, II. M. medical inspector of factories, Home Office, detailed particulars of 1,240 deaths.

Of these deaths, Dr. Collis has given an analysis in Tables I and II of Appendix XII,² and in the latter has compared the figures relating to painters with—(a) the total number of deaths of all males which occurred in England and Wales from 1900 to 1902, inclusive; and (b) the class designated "Plumbers, painters, and glaziers" in the returns of the registrar general.

The figures quoted in Table I² further indicate two very important conclusions, namely: (1) that in every 100 deaths which have occurred among members of these societies between 13 and 14 occurred from causes attributable to lead, and among the class "Plumber, painter, and glazier" about 12; (2) that the average age at death due to all causes in the painting industry is no less than eight years younger than that of all males.

ESTIMATE OF NUMBER OF NONFATAL CASES.

In respect of nonfatal cases of lead poisoning among house painters, the committee, as already stated, have no reliable statistics to submit. It is true that, although exempt from the legal obligation which applies in respect of factory operatives, medical practitioners do occasionally report such cases, but the percentage of those reported to the total number it is clearly impossible to define, and in all probability is constantly varying. Such as they are, however, whether notified voluntarily or in the erroneous belief that the legal requirement exists, the committee submit the yearly returns for what they are worth in the following table.

Nonfatal cases of lead poisoning voluntarily reported:

Year.	House painters and plumbers.
1900.....	199
1901.....	169
1902.....	179
1903.....	201
1904.....	227
1905.....	163
1906.....	181
1907.....	174
1908.....	239
1909.....	241
1910.....	232
1911.....	263
1912.....	256
1913.....	291

In default of any complete statistics bearing on the point, Dr. Legge, H. M. medical inspector of factories, Home Office, has suggested that it would probably be reasonable to assume that the proportion of fatal to nonfatal cases is substantially the same in the house painting trade as it is in all the factory industries taken together. On this assumption the total number of lead poisoning attacks among house painters and plumbers would amount to

¹ Members of the committee.

² In Minutes of Evidence, presented in a separate volume of the original report.

nearly 1,000 per annum, but this estimate is a very rough one, and can not be regarded as reliable for accurate calculation.

It is, however, worth while noting the figure at which, if computed on this principle, the number of cases would work out among house painters taken alone, and comparing it with the attack rates which have been calculated for the various industries under the factory acts in which the number of workers in direct contact with lead is definitely known. In this respect, in the years 1900-1909, out of 6,762 cases of illness due to lead poisoning among operatives employed on premises under the factory and workshop acts, the number of deaths amounted to 275, and during the same period the number among house painters due to the same cause to 293. The estimated number accordingly of attacks of lead poisoning among house painters in ten years would work out as follows, viz:

$$\frac{6,762 \times 293}{275} = 7,205 \text{ cases, or an annual average of } 720.5.$$

As, therefore, the average number of operative painters as above estimated is 150,000, their attack rate from lead poisoning is approximately 4.8 per 1,000 per annum; those of the various industries under the Factory and Workshop Act with which, as above-mentioned, this rate should be compared, are as follows:

ATTACK RATES FROM LEAD POISONING—AVERAGE OF 14 YEARS, 1900-1913.

Industry.	Number employed in lead processes.	Total cases in 14 years.	Attack rate per 1,000 per annum.
White lead.....	1,201	1,422	84.6
Wireless enamelling.....	933	192	7.8
Electric accumulators.....	878	422	15.6
Paints and colors.....	1,475	501	20.4
Earthenware and china.....	1,400	1,376	25.6
Smelting of metals.....	7,085	1,576	13.9
Ceac'h building.....	2,878	1,026	11.3
File cutting.....	29,308	1,205	2.0
Printing.....	56,777	523	3.4
			0.6

But while the rates of deaths and attacks due to lead poisoning among house painters are thus comparatively small, they are not so insignificant as at first appears. In the first place the case incidence is materially affected by certain conditions of employment peculiar to the trade. Painting operations, for example, are not carried on with full vigor throughout the year and very few painters therefore are exposed to the risk of lead poisoning during more than nine months out of twelve. Moreover, such is the diversity of their occupation—including, as it does, preparatory work of all kinds, whitewashing, distemper and the like—that the estimated time during which a painter is actually handling lead materials is not more than one-third of his working hours. Inasmuch as a period of absence from lead work assists the system to regain its normal condition, the above considerations alone might be expected to reduce the incidence by more than 75 per cent, and to that extent the rates—whether of death or illness—as indicating the magnitude of the danger to which operatives are exposed when in full work, would be very greatly underestimated.

Further, it must be remembered that a large and increasing proportion of the 150,000 operative painters are partly engaged in applying leadless paints, and that by their elimination the death and case rates of those constantly using lead paints would be still further increased.

But notwithstanding the various circumstances which tend to reduce the death and case rates per 1,000, the evil of lead poisoning among house painters is shown to be productive of an actual average of 29 deaths and an estimated average of 720 cases per annum. In other relations of life it is generally admitted that against such an amount of sickness and death every precaution ought to be taken, and even in such instances as casualties, caused by London traffic, which, if calculated per 1,000 of those daily using the streets would show the smallest mortality rate, every effort is made to prevent them. The committee, however, found that the employers in the painting trade as a whole possessed but little knowledge of lead poisoning among their workmen; little notice appears, as a rule, to be taken of their absence on account of ill health, and no evidence was forthcoming to prove that any master house painter ever instituted even a voluntary system of medical examination. Without such a system it would be impossible to realize how much of a worker's absence was due to lead poisoning, and several employers, when questioned, while admitting the magnitude of the danger, expressed considerable surprise at the extent to which, according to the official records, plumbism among house painters existed.

Imperfect, however, as these official records may be, it is abundantly evident that in the house painting industry plumbism constitutes a very real evil. There can be no doubt that it materially affects the workman's expectation of life, and in this respect the table of deaths on page 113 shows that no improvement has as yet taken place. In the regulated industries, on the other hand, the statistics published monthly in the "Labor Gazette" of the Board of Trade and annually in the report of the chief inspector of factories prove that the attack rates are steadily falling. It is clearly evident therefore, that the tendency to plumbism among painters ought, if possible, to be controlled; practically every witness, whose attention was called to the figures, admitted that the extent of illness and death attributable to its ravages was very deplorable, and agreed that immediate action ought to be taken to reduce it to a minimum.

Increased cost of insurance against liability for workmen's compensation.—By the Workmen's Compensation Act of 1906, which came into force on July 1, 1907, provision was for the first time made for compensation to be paid by the employer to any workman who could obtain the requisite certificates showing that he was suffering from lead poisoning. At first the premiums charged by insurance companies for insurance against risk of claims under the workmen's compensation and employers' liability acts were 20s. (\$4.87) per cent, but after three years' experience the rate was increased to 30s. (\$7.30) per cent.

Unfortunately it is impossible to say how much of the increase is due to the new risk of payment for plumbism introduced by the 1906 act and how much to the general increase in accident risks; but it stands to reason that the first-named risk must have had its share in causing the premiums to be raised.

ACTION TAKEN BY FOREIGN GOVERNMENTS.

Sir Henry Cunyngname, K. C. B., who at the time of giving evidence was legal assistant undersecretary of state for the Home Department, outlined for the committee the various laws and decrees affecting house painters in foreign countries, and translations of the full text of these enactments will be found in the appendices to the report. Further details were moreover furnished to the committee by Dr. Legge and by the various foreign witnesses whose evidence was submitted by the white lead corridors' section of the London Chamber of Commerce.

FRANCE.

After a lengthy inquiry and careful reports both to the Chamber of Deputies and to the Senate, a law was passed on July 20, 1909, prohibiting the use of white lead in all painting operations on buildings whether on the exterior or interior. An interval of five years was prescribed before the coming into force of this law, which will take effect as from the 1st of January, 1915.

AUSTRIA.

By a ministerial order of the 15th of April, 1908, regulations were issued to control the use of white lead paints, which was prohibited in respect of interior painting as from the 1st of April, 1909. For exterior painting, however, it was still permitted, subject to drastic precautionary conditions, as well as for certain specific purposes, for example:

- (i) for the laying on of a first or priming coat over old lead paint when pure white paint is being renewed;
 - (ii) for paint which is frequently exposed to the influence of aqueous or other vapors;
 - (iii) for internal painting in the case of work which would otherwise not be carried out in Austria.
- The conditions in question under which the use of white lead paint is permissible include—
- (i) provisions for the ventilation and cleanliness of work places;
 - (ii) the prohibition of dry rubbing down and pumice stoning;
 - (iii) the equipment of washing and dressing rooms;
 - (iv) the marking of vessels containing lead paint;
 - (v) the prohibition of employment of women and young persons;
 - (vi) the wearing of overalls and head coverings, which must be supplied by the employer wherever more than 20 workers are employed;
 - (vii) quarterly medical examination of painters where more than 20 are employed.

GERMANY.

Regulations applying to all States in the German Empire were issued on the 27th of June, 1905, and provide for the prohibition of dry rubbing down and pumice stoning; the wearing of overalls; the provision of washing facilities. These regulations have been in force since the 1st of January, 1906.

BELGIUM.

The earliest decree concerning the use of white lead in the painting of buildings came into force on the 15th of August, 1906, and provides for the prohibition of dry rubbing down, the provision of working clothes and washing appliances and quarterly medical examination. Against these regulations, however, the master painters' federation offered an emphatic protest, and in place of them memorialized their Government in favor of prohibiting the use of lead altogether. The whole question was therefore again made the subject of inquiry, but by the law of August 20 [1909], fresh regulations were enacted to which effect was given by a royal decree dated July 25, 1910. These have been in force since the 2d of September, 1910; on the one hand they prohibit the sale, transport, and use of white lead otherwise than in the form of paste ground and mixed with oil, as well as the two processes of "dry scraping" and "dry pumice stoning;" on the other they provide for the wearing of overalls, storage of outdoor clothing, the supply of washing conveniences and quarterly medical examination of workers at the expense of the employers.

HOLLAND.

An exhaustive investigation of the white lead question was undertaken by a commission of the Netherlands Government, which reported on the 5th of October, 1909, to the effect that zinc white paints can be substituted for white lead paints with good results where there is exposure to sulphuretted hydrogen vapors, but not where exposed to frequent recurrent action of vapors containing sulphurous acid; that zinc white paints applied on zinc, Portland cement, or iron (the latter having been primed with either red oxide of lead or iron) are able to withstand the action of the open air during five years quite as well as white lead paints and can entirely replace the latter except where exposed to vapors of sulphurous acid; that zinc white paints applied on wood, iron, zinc, Portland cement, and plaster can entirely replace white lead paints in the interior of buildings except where much exposed to sulphurous acid vapors or to great dampness; that zinc white paints remain in good condition during five years, and can replace white lead paints with good results when applied on wood exposed to the open air except in the presence of vapors containing sulphurous acid, but where accumulations of water remain for a long time, zinc white paints require renewal after three or four years for the preservation of the wood, and to this extent are inferior to white lead paints; that zinc white paints such as used by the white lead commission cover at least as well as ordinary white lead paints used in Holland, and the zinc white putty used by the commission is quite as serviceable as ordinary white lead putty; that painting with zinc white paint, such as that used by the commission on new woodwork in the open air, is not dearer than painting with ordinary white lead paints; but that repainting of existing paintwork in the open air with zinc white paints as used by the white lead commission is dearer than repainting with white lead paints; that lithopone paints are unfit for use in the open air; that for ironwork above water priming coats of oxide of iron are quite as good as priming coats of red oxide of lead, but oxide of iron can not be used for coats of paint under water; that while oxide of iron is cheaper than red oxide of lead, more technical

ability is required for applying subsequent coats over oxide of iron priming than over lead priming. No law has so far been passed by the Netherlands Government to give effect to the findings of this commission.

SWITZERLAND.

As a result of successive investigations, a law was passed on October 26, 1907, prohibiting the use of white lead otherwise than in the form of paste, and prohibiting the processes of dry pumice stoning, dry scraping off and burning off of old paint. This law was amplified by regulations issued on December 21, 1907, which provide in addition that the same workmen should not be set to pumice stone freshly painted surfaces for more than half of each working-day, and that apprentices should never be employed on this kind of work. The employers are also required to provide for their workmen without charge, apparatus and utensils necessary for avoiding direct handling of white lead; overalls, which shall be properly kept and frequently washed; places for storage of outdoor clothing and the necessary appliances for personal cleanliness, such as water, soap and towels.

It appears, therefore, that several countries have made very serious efforts to grapple with the evil of lead poisoning among house painters, and the English witnesses questioned by the committee agreed practically without exception that it is undesirable that this country should be behind other nations in such a matter.

METHODS OF DEALING WITH LEAD POISONING.

The committee, accordingly, proceeded to inquire by what methods the effects of lead poisoning in the house painting trade could best be mitigated. The problem, witnesses agreed—and indeed it was self-evident—resolved itself into two following alternatives; either—

- (I.) the industry must be controlled by a strict code of regulations; or else
- (II.) the use of lead must be altogether prohibited, or at any rate restricted within very narrow limits.

Of these two alternative methods the latter is at once simple and effective; the former, therefore, as being essentially complicated and less certain in its results, it will be convenient to discuss in detail.

I. REGULATIONS.

SCIENTIFIC DATA CONCERNING THE CAUSATION OF LEAD POISONING.

In connection with regulations intended to govern the use of a poisonous material, it is important to consider the manner in which the poison gains access to the worker's system.

Much of the modern research work on this subject is to be found in "Lead Poisoning and Lead Absorption," the authors of which are Dr. Legge, II. M. medical inspector of factories, and Mr. K. W. Goadby, both of whom gave evidence before the committee. The latter, moreover, carried out a valuable series of experiments for the departmental committee on the use of lead in potteries; these, taken in conjunction with the further investigations detailed in Mr. Goadby's

evidence before this committee, and in the appendices, have led to the conclusions that lead may gain entrance to the human system—

- (a) by the respiratory system as a consequence of inhaling lead-dust laden air;
- (b) by the alimentary system as a consequence of swallowing lead dust or lead-contaminated food.

The first of these modes of entry is by far the most dangerous to the worker; the risk entailed in the second mode is small but not negligible.

One or two other modes of entry, e. g., through the unbroken skin, present points of theoretical interest, but the amount so entering in practice is so small as to be entirely negligible.

The conclusion to be drawn from this is that lead-laden dust is by far the most serious evil to which a lead worker is exposed; and with this conclusion other scientific witnesses questioned were in complete agreement.

The most recently concluded experiments of Mr. Goadby, moreover, tend to emphasize the danger of long continued inhalation of even very small quantities of lead-laden dust; he has demonstrated that an animal exposed for 16 months to such an atmosphere during eight hours each day, while showing no symptoms of poisoning, has nevertheless undergone such constitutional deterioration as to succumb to an inoculated dose insufficient in amount to produce symptoms in a normal animal.

NECESSARY PRECAUTIONS.

Considering the extent of the evil, it is evident that any code of regulations, to be effective, must include all the precautions which have been found to be necessary in the case of other lead industries in which regulations have been provided under the Factory and Workshop Act. These involve—

- (1) Efficient measures for the avoidance or removal of dust or spray which is formed in the course of work and contains lead in its composition.
- (2) The provision of hot water for the purpose of washing, and adequate washing accommodation.
- (3) The provision of mess rooms.
- (4) The provision of overalls and their washing and maintenance.
- (5) The provision of cupboards for the storage of overalls when not in use, and of separate cupboards or cloak-rooms at a distance from any source of lead-laden dust for the storage of outdoor clothing which is taken off during working hours.
- (6) Limitation of hours of employment.
- (7) Periodical medical examination, with power on the part of the examining doctor to suspend from work.

LEAD-LADEN DUST THE GREAT DANGER.

The principal evil, as stated above, to which the artisan engaged in the house painting and decorative trades is exposed is the poison contained in lead-laden dust formed from the materials which he has to use. This dust he is liable to inhale when at work, both in the course of its creation, and subsequently after it has accumulated,

or he may absorb the poison of it into his system by swallowing it in meal-times with the food he eats. The quantity of poison assimilated in the latter manner is small; slight, however as it is, it might be sufficient to cause the breakdown of a constitution already undermined by lead poison, and as such it must be taken into account. For the purpose, therefore, of greater clearness, it will be best for us to consider the various processes whereby fresh dust is generated and to review those precautions against its ill effects which witnesses suggested might be taken to protect the artisan while actually at work; it would then be a simple matter to appreciate the various ways in which the dust is accumulated, and any additional safeguards which may be necessary.

PRODUCTION OF LEAD-LADEN DUST. THE PROCESS OF DRY RUBBING DOWN.

Of the various processes contributing to the production of lead-laden dust witnesses unanimously agreed that the "dry rubbing down" of painted surfaces was by far the most prolific. Of this operation, however, there are two distinct classes, which consequently require to be considered separately, viz:

(1) The dry rubbing down of old paint work in preparation for the application of fresh coats of paint.

(2) The dry rubbing down of newly painted surfaces, to prepare them for the application of a second coat of paint.

With regard to the first of these two classes it is already the practice of many house painting and decorating firms to have the rubbing down of old paintwork done with pumice stone and water instead of dry sandpaper, and the witnesses practically all agreed that for the operation the use of dry materials could be discontinued.

The conditions, on the other hand, obtaining in the second class of dry rubbing down are entirely different, inasmuch as in most cases the work has to be done before the first coat of paint is sufficiently dry to admit of the use of pumice stone and water. The majority of the witnesses, therefore, insisted that the process must be a dry one; there were, however, a few who held a contrary opinion; Mr. St. Thorpe, for example, a prominent master house painter of Dublin, emphatically stated that all dry rubbing down could be dispensed with, and ought to be prohibited; with this view, moreover, several other employers were in substantial agreement, although two of them modified their admission by adding that they would prefer not to give up the process for fear the quality of the painting might suffer.

Again, it was suggested by a few of the employers that the process of rubbing down could be made sufficiently wet to prevent the escape of dust by moistening the sandpaper with some fluid other than water, for example, with turpentine, but Mr. Parsonage, a member of the committee, who represented the National Amalgamated Society of Operative House and Ship Painters and Decorators, contended, on the other hand, that such a proposal could not be carried out, and no evidence was forthcoming to show that, even if it could have been, its observance could be strictly enforced.

The point was also taken that the risk attendant on dry rubbing down was greatly exaggerated. In this respect five of the witnesses argued the possibility of considerably reducing the extent to which it was employed, while some maintained that the sandpapering is

required between coats was too slight to give rise to an appreciable amount of dust.

The committee, however, are satisfied both as to the importance of the process to the trade and the dangerous degree to which it produces dust. On the first point, 21 employers and 4 out of 6 operative painters freely admitted the impracticability of discontinuing it, and in the second, many of the workmen who were examined, including Mr. Parsonage, assured the committee that the amount of dust created was very considerable; one witness even went so far as to assert that it was sufficient to show the tracks of a man as he moved about.

QUANTITY OF LEAD-LADEN DUST PRODUCED BY DRY SANDPAPERING.

The amount of lead-laden dust floating in the atmosphere of a room in which, in connection with house painting, the process of sandpapering is in operation, can only be measured by means of special testing apparatus, the introduction of which into private premises has so far been prevented by insuperable difficulties. The amount therefore in question has, as yet, never been directly determined; but, in certain coach-painting shops, a series of tests have been carried out by Mr. G. Elmhurst Duckering, one of His Majesty's inspectors of factories, whereby the quantity of dust generated in the air by rubbing down processes of a similar character has been properly ascertained. In these tests the air was collected as near as possible to the breathing level of the workers during the time that the operation was under consideration were in progress, and, as shown in Appendix XIII, Table I,¹ was proved to contain lead in quantities more than sufficient to render it dangerous,² viz, in proportions varying according to the amount of lead contained in the paint and the extent of the work involved, from 3 to as much as 1,025 milligrammes per 10 cubic meters of air.³

Dr. Ignaz Kaup also gave evidence as to the comparative quantities of lead in dust determined in Austria as present in the air of rooms in which painted surfaces were respectively dry rubbed and dry pumice stoned; these quantities he quoted at figures varying from 1 to 25 milligrammes of lead per 1,000 liters of air; the equivalent, that is, of 10 to 250 milligrammes of lead per 10 cubic meters of air.

PRACTICAL SAFEGUARDS RECOMMENDED BY WITNESSES.

In view of this evidence the committee came to the conclusion that the air of rooms in which paint surfaces are dry rubbed is sufficiently impregnated with lead to constitute a definite danger; they therefore required whether the dangerous dust could be removed at the moment of its production, but it was found impossible to suggest any practical method of so doing. Two witnesses, indeed, were of opinion that exhaust fans could be successfully applied, and no doubt in certain operations in other trades they have been found to be a most effective means of disposing of vitiated dust. For example, the operation in

¹ In Minutes of Evidence, presented in a separate volume of the original report.

² Large and Goadby in their work on "Lead Poisoning and Lead Absorption," stated on page 207, "We have found that if the amount of lead present in the air breathed contains less than 5 milligrammes per 10 cubic meters of air, cases of encephalopathy and paralysis would never, and cases of colic very rarely, occur."
³ Somewhere about 2 milligrammes * * * of lead we regard as the lowest safe quantity of lead which, in lead as fume or dust in the air, may, in the course of years, set up chronic plumbism."
⁴ A fuller discussion of these figures will be found in the report of the departmental committee on the use of lead compounds in the painting of coaches, etc.

the pottery trade known as ware cleaning, in which the worker rubs off superfluous particles of dried glaze from an article which has been dipped in a glaze containing lead; there the ware cleaner when at work remains constantly in one place with his materials in front of him, and the exhaust fan can be so adjusted as to suck away safely any dust which the process produces before he can either inhale or swallow any of it. But no such device could be made applicable to the work of a house painter. Its adoption is obviously, in the first place, only feasible where supplies of electricity are available, and in the second it is impossible to conceive any means of adjusting it so as adequately to protect a workman engaged in dry rubbing down a wall.

The only other safeguard proposed was that of respirators, and several employers were of opinion that the workmen might with advantage be compelled to wear them. It was, however, found to be impossible to recommend any form of efficient respirator which could possibly be worn for any length of time.

FINE SPRAY.

Fine spray is produced by the process known as "stippling," that is to say, beating a fresh coat of paint with a hard flat brush in order to spread it out evenly over the required surface. The actual risk entailed by a single operation of this kind is very small, but such as it is, it constitutes an additional danger.

The process of "stippling" is sometimes carried out by the workman who actually lays on the coat of paint, but more often by another workman, and in the latter case both are exposed to the risk of inhaling the spray from the stippling tool. Some spray and splashing of paint is inevitable in painting molded or relief designs, particularly in connection with ceiling and other interior work, but for these lead paints have already been largely displaced by leadless paints or distempers.

FUMES.

From all fresh paint fumes are constantly being given off, and have in the past been held by eminent experts to contain the elements of lead poisoning. The committee have therefore given the matter careful consideration, but, guided by results of experiments carried out by Dr. Dobbie, the principal chemist of the Government laboratory, and the statements of other distinguished scientists, viz, Mr. K. W. Goadby, Prof. H. E. Armstrong, and Mr. C. A. Klein, as well as Prof. E. C. C. Baly in his later evidence, they have formed the opinion that fumes may be justifiably disregarded as in any way a source of lead poisoning. The vapors or gaseous emanations from drying paint surfaces are undoubtedly of a nauseous odor and in certain circumstances the reverse of wholesome, but the researches of the experts named above have established the fact that they contain no lead. It is true that by passing a current of air over freshly painted surfaces for a very long time Dr. Dobbie was able to collect traces of lead arising from the paint in the form of minute solid particles, but the amount so collected was infinitesimal, and consequently, as a poison, a negligible quantity.

ACCUMULATION OF LEAD-LADEN DUST AND THE NECESSARY PRECAUTIONS AGAINST IT.

Such being the origin of the lead-laden dust, and the practical impossibility of devising any effective means of protecting workmen from it in the course of its formation, it now remains to consider the question of its accumulation, and to ascertain what precautions are now being taken against it, and what, in addition, ought to be insisted upon in future.

In this respect it would appear that, since it is impossible to remove the dust which the workmen make while at work, it must accumulate during the whole of that period, and the air in the room continue for some time afterwards to be vitiated. In such an atmosphere, it is naturally dangerous for a workman to eat his dinner, and for this purpose, therefore, it is of the utmost importance that he should be able to go into another room; but this is not sufficient; he must also be prevented from carrying the dust away with him, and, as it is inevitable that his hands become smeared with paint and his clothes become splashed with it, he must be provided both with suitable washing accommodation and with overalls with which while at work his clothes may be covered up.

WASHING ACCOMMODATION.

All the witnesses who were questioned on the subject agreed as to the great importance of providing means for maintaining personal cleanliness, and especially for the removal of any paint containing lead from the hands, so as to prevent the danger of food being infected with the poison when conveyed by the hand to the mouth. For this purpose hot water is most necessary, and while several employers stated that the workmen could, and on occasion did, beat water for their own use, it was generally recognized that it would be very difficult to supply it to all painters wherever they are engaged.

MESS ROOMS.

The importance of providing proper mess rooms requires no comment, inasmuch as without them the workmen have to eat their meals in dangerous surroundings. For those, however, employed on the smaller decorating jobs satisfactory arrangements in this respect are very rarely made, and the evidence shows that in most cases it would be almost impossible to provide suitable accommodation.

OVERALLS.

At the present moment overalls are, as a general rule, worn by house painters when at work, or at all events by the most skillful of them, and it is usually the practice—although not one universally observed—to wash overalls or renew them once a week.

The latter is an eminently necessary precaution. In order to ascertain the amount of dust carried by overalls after use, the committee caused several representative specimens of them to be critically examined; these were collected at a series of surprise visits paid to premises where painting operations were in progress, and for the purpose different classes of buildings were selected, ranging in

quality from a west end private residence of the highest order to the buildings of a suburban railway station. The overalls were in each instance secured on a Saturday morning in order that the dust which they might be found to hold might fairly represent the degree of contamination resulting from a full week's work; and finally each overall was examined at the Government laboratory in such a manner as to determine—

- (1) The amount of lead in the dust removed by beating.
- (2) The amount of lead in the fine dust secreted in pockets.
- (3) Any remaining lead.

The full result of these tests will be found in Appendix XXXII, from which it will be seen that the average amount of lead contained in the dust collected from one man's overalls after one week's use amounted to no less than 92.7 milligrammes. To realize the full extent of the danger which such a quantity entails these figures should be compared with those given above on page 127, showing the amounts of lead-laden dust, varying from 3 to 1,025 milligrammes per 10 cubic feet of air in rooms in which the most dangerous painting processes were being carried on, and the generally smaller amounts—varying from 1 to 124 milligrammes per 10 cubic feet of air—which have been found in the atmosphere in various other industries in which lead poisoning has been prevalent to a serious extent.²

The necessity of overalls is, therefore, beyond question, but according to the custom of the trade, each workman has to buy his overalls for himself; the attention of the employers' representatives was accordingly called to the acceptance by employers in other lead industries—for example, white-lead making and the manufacture of electric accumulators and pottery—of the duty of providing workmen, free of charge, with the working clothes required for use in all processes involving contact with lead compounds. The evidence, however, of the employers of house painters revealed a strong disinclination to adopt any such course; only a few were willing to undertake to supply overalls and to provide for their washing and renewal at the firm's expense; the great majority maintained that any such obligation would impose too severe a burden upon them.

STORAGE OF OVERALLS AND OUTDOOR CLOTHING.

Overalls when not in use, and outdoor clothing when taken off by the men before setting to work, if left about on premises in which the air is vitiated, must inevitably accumulate dust, and their proper storage is proportionately desirable. As, moreover, the overalls, after being once used, contain dust, they ought to be kept apart from the outdoor clothing, and separate cupboards, respectively provided for them. In either case, however, suitable accommodation is seldom available, and its provision would frequently be a matter of the greatest difficulty.

LIMITATION OF WORKING HOURS.

In other industries in which lead is used the necessity of shorter hours has been definitely established, and their adoption agreed to by the employers. The evidence, none the less, showed that in the house painting trade, owing to its peculiar character, no such regula-

tion would be generally acceptable. The business is to a great extent a "seasonal" one, and therefore during that part of the year when most repainting is done comparatively long hours of employment are often demanded.

PERIODICAL MEDICAL EXAMINATION.

The special rules and regulations made under the factory and workshop acts also lay it down as a cardinal principle that workers in lead compounds¹ must periodically be medically examined. Incidentally the examining medical officer has the power on the first appearance of any symptom of lead poisoning to suspend any worker from a particular employment.

On the question of providing periodical medical examination in the house painting and decorating trades, 35 witnesses gave evidence; of these, 14 employers and 6 workmen were prepared to agree to the adoption of the proposal; of the remainder, 5 employers objected to any such examination being undertaken at the expense of the employer; 6 employers and 2 workmen were altogether opposed to it; and 2 employers failed to give a definite opinion.

It should also be noted² that since 1910 a regulation has been in force in Belgium requiring painters to be medically examined every quarter, and Mr. Ricker-Devroede, the president of the Belgian corporation of painters, when giving evidence before the committee, put in a letter,³ signed by himself and the secretary of the corporation, in which reference is made to the regulation in question in the following striking terms:

(TRANSLATION.)

Of all these regulations, the most iniquitous is the medical inspection imposed on the operative painter; this provision, which is vexatious and humiliating, is without any effect. The corporation of painters would prefer the total suppression of white lead in their work.

COMPENSATION FOR WORKMEN SUSPENDED FROM WORK.

With regard to the question of compensation, the workmen's compensation act provides for half wages to be paid to all workers actually certified as suffering from lead poisoning; but the attention of witnesses was further called to the recommendations of the departmental committee on the use of lead, etc., in potteries, in which it is laid down that for a period not exceeding three months any workers suspended from employment on account of symptoms indicating a tendency to incipient lead poisoning should be entitled to a weekly allowance. This recommendation is generally observed in the pottery trade, and in reply to the inquiry whether a regulation on similar lines could with advantage be applied to the house painting and decorating trades, definite opinions were obtained from 20 employers. Of these, although one or two of them foresaw the possibility of difficulties arising, 13 were agreeable to its adoption; one, on the other hand, while admitting the principle of compensation, suggested that it should only be payable in a lump sum, and the remaining six definitely opposed the payment of any compensation.

¹ Except in the process of file cutting by hand, the regulations for which do not require medical examination.

² See evidence of Sir H. Cunyngbame and Mr. Ricker-Devroede.

³ See Appendix XVIII [minutes of Evidence].

¹ In Minutes of Evidence, presented in a separate volume of the original report.

² See also Appendix XIII.

INPRACTICABILITY OF AN ADEQUATE CODE OF REGULATIONS.

It has already been seen that it is impossible to devise any adequate measures for the protection of workmen from lead-laden dust at the moment of its creation, and consequently the particular risk thereby entailed can only be prevented by the prohibition of the use of lead. But the other precautions which have been discussed present a more open question; before, therefore, coming to any conclusion with regard to them, it is desirable to review the evidence of the principal witnesses who were in favor of their adoption.

EVIDENCE OF WITNESSES IN FAVOR OF A CODE OF REGULATIONS.

(a) The representatives of the paint, oil, and varnish trades associations admitted the need of taking action for the protection of house painters and decorators; but, in view of experiments in which zinc, when compared with lead, had been found to be inferior for exterior paintwork, they considered that rather than lead should be prohibited it would be preferable to adopt regulations. Their associations embraced in their membership many of the leading firms of paint grinders, and in support of their recommendation they drew attention to the beneficial results obtained by regulations in the white lead making and paint grinding industries.

They regarded periodical medical examination at the expense of employers as imperative, and for the enforcement of this and all other regulations, were of opinion that 50 inspectors would suffice. They did not, however, deal in any detail with the manifest difficulties which such enforcement, to be successful, would inevitably involve.

(b) Mr. Sibthorpe was also in favor of a code of regulations, and dealt carefully with the question of inspection. Mr. Sibthorpe is, as already mentioned, a master house painter of Dublin, employing some 50 workmen, and was put forward as a witness by the white lead corridorers' section of the London Chamber of Commerce; he advocated a system whereby, on the one hand, each master painter should be obliged to take out a license binding him to observe all regulations in force or to come into force in connection with the use of lead paints, and, on the other, each operative painter should also have to take out a license requiring him to keep a card, to be produced when asked for, recording the places of his employment and particulars of any attacks of lead poisoning from which he may have suffered. Mr. Sibthorpe further recommended the prohibition of dry pumice stoning or sandpapering of old paint or surfaces that have been burnt off; the provision of overalls by the workmen; the provision of facilities for washing, including nailbrushes, towels, and hot water; the latter, in the case of occupied houses, to be demanded as a right from the occupier; the provision, equally to be demanded from the occupier as a right, of a mess room and a storage room for outdoor clothing separate from any place where the paint is mixed or kept; and finally, medical examination of all licensed workmen at least three times a year, with suspension from employment on account of recurring attacks of lead poisoning, and either the restriction of workmen so suspended to non-lead employment, or an allowance to them of reasonable compensation.¹

¹ It should be noted, as previously stated on p. 121, that workers actually suffering from lead poisoning are already entitled by law to compensation.

Mr. Sibthorpe believed that such regulations could be efficiently enforced by the employment of special inspectors, including possibly ex-painters who have had to leave the trade owing to their susceptibility to lead poisoning. He calculated that four such inspectors at a salary of £2 (\$9.73) rising to £3 (\$14.60) a week, would suffice for the whole of the United Kingdom, at the same proportionate rate about 450 special inspectors would be required, a number more than double that of the present staff of the whole factory department, which at a cost of £100,000 (\$486,650) embraces all the workshops and factories in the United Kingdom; so large a department, therefore, appears to be unjustifiable, and in addition, although the class of special inspectors proposed is a very poor one, it is not likely that it could be equipped and maintained for the same sum; but even if this extremely economic estimate were correct, and if, as suggested by the witness, a substantial portion of the cost could be recovered by charging registrars' fees for the licenses which he advocated, the creation of 450 new officials at so great an annual cost to the country as £100,000 (\$486,650) would be an extravagance which the committee could not possibly recommend.

(c) Mr. E. M. Johnson, a leading white lead manufacturer, who also urged the adoption of regulations, suggested that the supervision of painting operations might be entrusted to the sanitary inspectors and surveyors, or to other local authorities; the committee, however, do not think it desirable to rely for such assistance on any of these officials and indeed their time is already so fully occupied that it would eventually result in the necessity of appointing a large additional number. As a third alternative, Mr. Johnson proposed that this work of inspection should be imposed on the insurance act inspectors, and contended that 40 additional inspectors would be ample for the purpose. Such a suggestion the committee do not regard as warrantable, and believe that the vast amount of technical supervision entailed would necessitate a very much greater increase in their staff.

(d) Mr. J. C. Vaughan, one of the representatives of the National Association of Master House Painters and Decorators, suggested that regulations might be enforced by the local policeman or the sanitary inspector or the inland revenue officer, or alternatively by the appointment of subinspectors for this special purpose. Several of the other advocates of regulations, in preference to prohibition, thought that the difficulty of inspection might be overcome, but were unable to satisfy the committee in regard to the means whereby this could be accomplished. Mr. Vaughan and others admitted, moreover, that there would be difficulties in ascertaining where painting operations were in progress, and also that visits paid to private houses for the purpose of inspection, without which the adequate enforcement of regulations falls to the ground, would be likely to cause resentment.

EVIDENCE OF FOREIGN WITNESSES.

The case, therefore, for control by regulations, as shown by the evidence of these four witnesses, is by no means a strong one.

In addition it appears from that of the foreign witnesses introduced by the white lead corridorers' section of the London Chamber of Commerce, that although in Germany, Austria, and Switzerland, where regulations have been adopted for these trades, the number of lead

poisoning cases has to some extent been reduced, the progress made in combating the lead evil has been comparatively slow; even in Germany and Austria, where the dry rubbing down of lead painted surfaces has been definitely prohibited by law, cases of lead poisoning have become by no means rare, and its incidence is still far too high to admit of its acceptance as a degree of industrial risk which may be regarded as negligible for workers in this country.

DIFFICULTY OF ENFORCING REGULATIONS.

Furthermore, all the foreign witnesses admitted that as a means of thoroughly enforcing the observance of regulations in all painting operations, inspection was very unreliable. Such an admission will be recognized as the more important when it is borne in mind that in Germany and Austria householders appear to have little or no objection to the inspection of their private premises. In this country it is far otherwise; the difficulty, therefore, of insuring a proper and effective inspection of painting operations in private dwellings would be greatly increased, and it would be proportionately injudicious to recommend the adoption of any measures which, for their enforcement, would depend on it.

INSUFFICIENCY OF REGULATIONS, EVEN WHEN ENFORCED.

But apart from the difficulty of enforcing regulations a number of witnesses admitted that regulations, even if properly complied with, were in themselves sufficient to provide but a partial solution of the lead poisoning problem. This view is strongly confirmed by the experience of the admiralty, who have laid down a number of regulations to be observed wherever lead paints are used. Thus, at Portsmouth dockyard, where 320 painters are employed, ample laboratory accommodation is provided, including hot water; time is allowed for washing; and, in addition attention to personal cleanliness is superintended by a charge man, who does not allow any painter to leave until he has washed; all painters are supplied, at the expense of the admiralty, with overalls, which are washed fortnightly in a steam laundry on the dockyard premises; and a system of periodical medical examinations is strictly enforced. Despite all these precautions and the care taken to assure their observance, lead poisoning cases still occur, the men attacked being transferred to work not involving contact with lead.

RESOLUTION OF MASTER HOUSE PAINTER'S ASSOCIATION.

As an early stage of the inquiry, viz, on September 27, 1911, the following resolution, proposed by Mr. Butterworth and seconded by Mr. John Brown, was passed by the National Association of Master House Painters and Decorators at a meeting at Derby:

That this meeting of the members of the National Association of Master Painters of England and Wales, assembled at Derby, regrets the severe sickness and mortality incident to the use of white lead, but they are of opinion that great injury would be done to the painting trade and to the larger interests of the public by the prohibition of the use of white lead, and in the opinion of the meeting it is very desirable that a trial be first given to effective regulations.

A copy of the resolution, signed by Mr. T. N. Richards, president of the association, was forwarded to the committee and is accord-

ingly here reproduced verbatim. Obviously, however, the members who voted on the resolution were not in possession of all the evidence that was laid before the committee, and their resolution therefore only amounts to an expression of continued confidence in the white lead pigments which they have been accustomed to use for generations, and no indication is given as to how regulations could be made effective and adequately enforced.

CONCLUSIONS OF THE COMMITTEE.

The committee therefore consider that it is impossible to deal with the evil in question by regulations for four principal reasons:

- (1) The inadequacy of regulations to cope with the evil.
- (2) The difficulty of prohibiting dry rubbing down.
- (3) The cost and difficulty of complying with various precautionary measures.
- (4) The insuperable difficulty of enforcing regulations by adequate inspection.

II. PROHIBITION OR RESTRICTION OF THE USE OF LEAD.

But if it is impossible either to devise or enforce effective precautions against the risks attending the use of lead, there is only one way of obviating them. If the evil can not be controlled by regulations, the cause of it must be removed, and the use of lead be either totally prohibited or at least greatly restricted.

In order, however, to ascertain accurately the view taken by the trade, the choice between these two alternatives, viz—

- (1) The control of the use of lead by regulations;
 - (2) The prohibition or restriction of the use of lead;
- was specifically submitted to 36 representative employers, of whom 10 appeared as members of builders' federations, and the remaining 26 included representatives of the National Association of Master House Painters and Decorators and of the London Association of Master Decorators.

CHOICE OF EMPLOYERS BETWEEN REGULATIONS AND PROHIBITION.

The replies given by the witnesses are summarized in the following table, the principal figures in each column indicating the number of witnesses interrogated, and those in brackets the approximate number of painters employed by them.

CHOICE OF 36 EMPLOYERS SPECIFICALLY QUESTIONED AS TO THEIR PREFERENCE FOR REGULATIONS AS AGAINST PROHIBITION.

	Builders' federations.	Other employers.	Total.
Prefer prohibition	19 [400]	9 [400]	28 [800]
Prefer regulations	1 [100]	13 [1,000]	14 [1,100]
Don't bid.		4 [100]	4 [100]
Total	20 [500]	26 [1,500]	46 [2,000]

One of these (Mr. McHugh) spoke also for the Liverpool Master Builders' Association, whose membership numbering 400, resolved unanimously that they "would rather vote for total prohibition of white lead than be hedged in with any regulations or restrictions."

From this table it will be seen that of the 36 witnesses questioned, 14 employing 1,150 painters declared in favor of control by regulation, and 18 employing 800 painters in favor of the prohibition of the use of lead. It is, however, clear from the preceding pages of this report that but little serious thought has ever been given by employers to the evil of lead poisoning, and the evidence of the 36 master house painters now under review pointed strongly to the conclusion that no concerted action has ever been taken to put an end to it. Even those employers who voted in favor of regulations as opposed to the prohibition of the use of lead have only, in exceptional cases, taken steps to insure the observance by their own workmen of necessary precautions, and they further admit that many of the precautionary measures found necessary and enforced in other lead industries would be either very difficult to carry out or quite impracticable in connection with house painting operations.

Many of the witnesses, moreover, pointed out that any increase in the cost of painting due either to the prohibition of the use of lead or the establishment of regulations would ultimately fall to be borne by the customer. Mr. J. W. Barker, of Leicester, one of the representatives of the National Association of Master House Painters and Decorators, in particular, when stating his preference for prohibition added that the cost of precautionary restrictions would be far greater than the cost involved in a change to nonlead paints; if the latter course should be adopted, Mr. Barker felt sure that the national association would not raise any objection to carrying it into effect; this statement is important in view of the prominent part taken by the witness in the affairs of the association, of which he is a past president.

POSSIBILITY OF PROHIBITING THE USE OF LEAD.

In these circumstances it is evident that theoretically the prohibition of the use of lead would be by far the preferable policy to adopt, but the question arises whether or not its abolition can be carried into effect without causing undue detriment to the trade. At the present moment lead forms the principal ingredient in the composition of oil paints, especially of those intended for exterior use, and, in consequence, before coming to a definite conclusion, particular attention must be paid to the two following important questions:

- (1) Is there a reasonable certainty that leadless paints would be efficient for all purposes?
- (2) Would the supply of such materials be sufficient to meet all the requirements of the trade?

EFFICIENCY OF LEADLESS PAINT.

Taking the first of these two points, it should be noted that no member of the various employers' associations could refer to any systematic attempt, made in the past, to discover a satisfactory substitute for lead in the manufacture of paint. This has in all probability been due to the employers' lack of interest in the question of lead poison, but, whatever the cause may be, there is—as the evidence sufficiently proved, and as Mr. J. Milton, one of the representatives of the London Association of Master Decorators frankly admitted—a real prejudice in the trade against the use of any materials other than those to which painters have been for generations accustomed.

EVIDENCE OF EMPLOYERS.

It is true that a certain number of employers examined claimed to have used various leadless paints from time to time, but such experiments appear to have been made in rather a half-hearted manner. Thus, Mr. J. D. Crace, a witness representing the Institute of British Decorators, stated that he had tried zinc paints a long time ago, but had no recent experience of them; Mr. Honeychurch, of the London Association of Master Decorators, had made some individual trials, from which he found that zinc retained its color better than lead, while, on the other hand, it was not so durable and at that time more expensive; Mr. Puttrell, of the National Association of Master House Painters, as well as Mr. Higgs and Mr. Walker, who represented builders' federations, had used leadless paints from time to time, and found them not so satisfactory for wear or covering power, but the inferiority of the zinc paints was not great enough to prevent them from advocating the abolition of lead rather than regulations; Col. J. R. Bennett, of the Scottish Master House Painters' Association, had tried zinc paints 15 years ago, and found them unsatisfactory for exterior work; Mr. R. L. Anderson, of the same association, said he had had very little experience with leadless paints, as he had always been given to understand that white lead was the best thing to use; Mr. Scott, also of the same association, claimed that he had made experiments on a large scale with substitutes for lead, but these were carried out some 20 years ago.

On the other hand, it was generally admitted that for the painting of interior surfaces it was quite possible to dispense with lead paints, and further the evidence of the employers contains not a few examples, indicating that, with only a moderate persistence, it is possible to discover leadless paints which, even for exterior painting, are quite satisfactory.

LEADLESS PAINTS SUITABLE FOR EXTERIOR USE.

Mr. Morton, of the National Builders' Federation, for example, although he preferred prohibition to the onerous code of regulations, said that he had not on the whole found substitutes for white lead to be satisfactory, but added that for exterior painting he had recently used zinc paint, which covered rather better than white lead and was quite as good in appearance. Mr. Milton, of the London Association of Master Decorators, while admitting a preference for lead rather than the zinc paints, considered that there was no necessity to use lead for exterior painting, provided that a more suitable medium were substituted for the oil and turpentine mixture at present in use; in support of this theory he explained that in the course of recent experiments he had used leadless white paint made up with boiled refined oil and a good proportion of varnish, and found the paint so composed to be more durable than white lead paint.

Mr. McHugh, of the National Association of Master House Painters and the Liverpool Builders' Association, while recognizing the widespread feeling against anything but white lead for outside work, said he had himself used a good quality of zinc white well mixed with varnish for exterior work, and found it to be quite as good as white lead paint. This witness spoke as president of the Liverpool

Master Builders' Association, who passed a unanimous resolution in favor of prohibition rather than regulations, and added that the use of zinc is finding increasing favor in Liverpool and by competent painters is applied as easily as lead. The experience, too, of Mr. Cantrill—also a member of the National Association of Employers—was very significant, as he had used leadless paints for exterior as well as for interior work, and found that the workmen handled these paints in a satisfactory manner when they were ignorant of the composition. Mr. J. R. Donald, who, as a representative of the Association of Master House Painters in Scotland gave verbal evidence unfavorable to the substitution of zinc white for white lead, amended his evidence by a subsequent note in which he stated that recent practical results obtained with leadless paints had convinced him that white lead was no longer essential. Mr. Bonner, a working master house painter, stated that he had used a substitute for white lead for outside work ever since he started business, and was more than satisfied with the results, as were also his customers. He stated that besides keeping a better color it had proved at the end of five years more durable than white lead; he said, "I have got some fronts done five years ago which are better than white lead fronts done two years ago," and in another part of his evidence he expressed his confidence that, if the use of lead were abolished, ways and means could be found of getting a good white pigment from other materials. Mr. Styles, one of the witnesses representing the London Master Builders' Association, while preferring to retain white lead, expressed his confidence, that if necessary, something else would be invented to replace it without interfering with his business at all. Mr. Vigners Harris, of the National Association of Master House Painters and Decorators, strongly advocated the abolition of the use of lead rather than regulations; although he was not so convinced of the efficiency of substitutes for exterior work as for interior, he considered it quite justifiable taking the risk even for outside work. Mr. Harris, moreover, had had along experience of zinc paints, and stated that, as all employers would be placed on the same footing, the prohibition of lead as an ingredient of paint would cause no injury. Mr. John Anderson, the president of the London Association of Master Decorators, also laid stress on this argument; if the use of lead were abolished all employers would be treated alike, and would require no supervision; if, however, the control of it were left to regulations, he feared that some employers might in practice evade them, and so gain an unfair advantage over those who did their best to observe the law.

EVIDENCE OF FIRMS EITHER MANUFACTURING OR USING LEADLESS PAINTS.

It is thus evident that not only are leadless paints suitable for interior work, but it is also possible, although not the general practice in this country, to apply them with success to exterior surfaces. The committee learned, moreover, that leadless paints which are claimed to be of sufficient durability for application to exterior surfaces, are already obtainable in considerable numbers, and there is every indication that legislation affecting the amount of lead permissible in paints would give a great impetus to the manufacture of nonpoisonous substitutes. In addition, therefore, to the evidence of the employers, which has been above considered, the committee

have obtained the testimony of various leading manufacturers and users of leadless paint.

MAKERS OF LEADLESS PAINT MATERIALS.

Mr. Garson, whose firm manufactures both zinc and lead paints, and who would therefore be unaffected by an increased demand for the former as compared with the latter, stated that for interior painting the durability of both is about the same; the price of lead paints was, at the time of his giving evidence, somewhat less than that of zinc paints, but the latter cover 10 per cent more and retain their color better. For exterior work zinc paints mixed in exactly the same way as lead paints would have only about two-thirds as long a life, but if varnish and, say, 5 per cent of lead are added to the zinc paints the latter are as durable as lead paints. This witness believed that the prohibition of the use of lead would give an impetus to manufacturers to find efficient substitutes, and also that the increased demand for zinc paints would reduce their price. Enamel paints would not be affected, as these are to-day made on a base of zinc oxide and not of lead.

Mr. Rivet also represented a firm who grind both lead and zinc paints, and said that beyond some preliminary disorganization the prohibition or restriction of the use of lead would not at all affect them. He agreed that practically all good enamels are built up from zinc oxide, and said that in certain comparative trials carried out on premises at Westminster they had come to the conclusion that after 15 months' exposure the white lead paint had stood best, while the next best was pure zinc, and mixtures of zinc and lead were indifferent. He admitted that there were plenty of leadless paints suitable for work for which white is not required; satisfactory leadless whites could also be obtained, but at somewhat increased cost and less durability.

The Granitic Paint Co. make paints on a zinc oxide base which are entirely free from lead. These were originally compounded to a formula suggested by the principal architect of H. M. office of works, and have been very largely used in the painting of Government buildings, for particulars of which reference may be made to the evidence of officials of H. M. office of works, summarized on pages 64 to 69.

The Ragosine Paint Co. (Ltd.) manufacture a leadless paint called "Dixon's White," which is made up in paste form and can be thinned down so as to take the place of white lead for all ordinary painting as well as for priming, filling, and flattening.¹

Mr. Wait, chemist to R. Gay & Co. (Ltd.), who manufacture both lead and zinc paints, said he considered zinc oxide paint as good as white lead for exterior as well as for interior painting; he referred to a number of public buildings—including Buckingham Palace, home office, admiralty, war office, new Local Government Board offices, savings bank, general post office, also branch post and sorting offices in London and the Provinces, British Museum, Science and Art Museum, National Gallery, Victoria and Albert Museum, and St. Thomas's Hospital—on which Gay's zinc paints had been used, and

¹ For opinions of users of paints referred to by this and subsequent witnesses, see pp. 142 et seq.

stated that these had been found as satisfactory as the lead paints previously supplied.

The Szeclmancy Co. have been makers of nonpoisonous paints for over 50 years, and consider that good covering power can be obtained without the use of lead. The company have received no complaints on the score of the durability of their zinc oxide paint, for which repeated orders have been received from public corporations, breweries, and many others. Favorable opinions were put in from the Furness Railway Co.; the architect of Messrs. Mitchell, Thoms & Co. (Ltd.), of Chard, in Somersetshire; and Mr. Langton Cole, official architect of the London Stock Exchange.

Archibald Vickers (Ltd.) also make a paint which is intended as a substitute for white lead. This is compounded on a zinc base with various special media. It was stated that this paint had proved more durable than lead under certain conditions for outside purposes, as on the Brighton west pier and Southsea pier.

Mr. Pisart, managing director of the Maubricht Zinc White Co. contended that zinc had been proved to be superior to lead as an ingredient in pigment, and in support of this he quoted the extent to which it was used as such in Sweden. The figures quoted showed that in six years the consumption of zinc pigments in Sweden has risen from 3,032 tons to 4,244 tons, while the consumption of white lead has decreased from 511 tons to 501 tons; the committee regard these statistics as instructive as showing the favor with which zinc paints must be regarded by master painters in Sweden, a country whose chief cities are to be found in a latitude not greatly different from our own, and whose climatic conditions embrace substantially all the varieties of weather met with in the United Kingdom. The British Board of Trade have, from records in their possession of imports and exports of foreign nations, verified the statistics quoted, which may therefore be relied upon as absolutely accurate.

Mr. Pisart also referred to the practice of the Belgian Government, which has exclusively used zinc oxide in place of white lead on the State railways since 1909. In corroboration of this statement the committee received through the Foreign Office the following note from the Belgian minister of railways, marine, posts, and telegraphs.

(TRANSLATION.)

It is perfectly correct that since 1909, white lead has been prohibited for the above works,¹ and that it has been replaced by the material named.

The figures given for the years 1909, 1910, 1911, and 1912, so far as concern the consumption for rolling stock and the like, that is for all purposes other than those appertaining to ways and works, are respectively 47,958 K, 51,461 K, 52,057 K, and 50,254 K of unground zinc white.²

As stated in the letter of the British minister of July 1 last, the quantities furnished as public supplies for the ways and works do not include the quantities used by contractors for works carried out by them, but only what is necessary for the works to be carried out under the State department by operative painters forming part of the staff of the State railway department.

These quantities vary from one cause or another, and depend on the importance of the painting operations, the execution of which is found to be necessary in the course of the year.

¹ The works carried out for the Belgian State Railway Administration, including locomotives and rolling stock, tenders, bridges, and signals.

² That is, 4.1 tons, 50.3 tons, 51.2 tons, and 49.4 tons, respectively.

The quantities of zinc white quoted in the above-named letter of the British minister, as purchased by way of supplies during the years 1909 to 1912 for the requirements of the ways and works services, are correct.

The zinc white need not be absolutely pure, but must contain at most 4 per cent of lead compounds and 0.2 per cent of arsenious acid.

The most careful investigation which has been made, and the opinions given by the most competent authorities on the subject, have established the conclusion that this permitted limit could not present any serious objections from the point of view of the health of the staff engaged in painting operations.

From the point of view of durability, there is no difference between white lead and zinc white for interior painting.

The latter possesses indeed an advantage over the former, as it gives a softer and more beautiful tint.

After washing, carried out under proper conditions, zinc white paintwork recovers its pristine freshness. This is not the case with white lead paintwork, which after washing is always more or less lacking in freshness.

Zinc white for interior work is therefore superior to white lead. For exterior work so far as concerns surfaces which are not particularly exposed to severe conditions, the two methods of painting under consideration are still practically of equal value.

But in special cases (for example, at the seaside) white lead painting possesses a certain superiority over the other.

White lead in this case has a greater durability and affords a better protection to the surfaces on which it is applied.

In spite of this advantage, the administration of the State railways do not hesitate to prohibit white lead, even in these special cases; and this has been done from the point of view of the health of the operatives, whom the State was determined to safeguard from plumbism.

Mr. Dapierrès, managing director of the Indestructible Paint Co. also asserted emphatically that white lead can be dispensed with for painting purposes. His firm supply large quantities of zinc paints for the use of the admiralty.

Mr. Chancelor, M. P., and another representative of his firm, claimed that Messrs. Chancelor & Co.'s zinc paints are as well qualified as white lead for any purpose; letters from contractors were produced showing the great covering power of these paints, and a list was given of a large number of buildings, including various public buildings, to which they have been applied. The same paints have also been employed on the royal yacht *Victoria and Albert*, foreign railways and tramcars, and in garden suburbs near London.

M. Giraud and M. Petit gave evidence regarding the hydrated zinc oxide manufactured by the French firm of Carlier Frères. This paint material, which is guaranteed free from lead, is sold in this country under the name of Zinox. Although it has been in use in this country for seven years, it has only recently been introduced into this country, but since the date on which the above-mentioned gentlemen gave their evidence, it has made considerable progress in England.

Mr. Cruikshank Smith, D. Sc., F. C. S., in the course of technical evidence regarding the essential differences between lead and zinc pigments, stated that he considered zinc oxide all round superior to lead for interior painting and also for exterior painting if the zinc paint is properly prepared with a suitable medium.

Mr. Charles Lino gave similar evidence, and, with reference to a number of houses which he quoted as examples of the use of zinc paints for both interior and exterior work, maintained that they showed greater durability than lead paints, when properly prepared and applied.

The Rabok Co. manufacture graphito paints, mainly in the United States of America, but have also a branch at Sheffield. They contend

that, apart from their preservative properties, Rabok paints can be used as undercoats even with light colors on top.

Cail's Bitmo Co. manufacture bituminous compositions intended for application on metal; they are largely employed on ships and are stated to be applicable as a priming on iron and steel to the entire displacement of lead primings.

Schobert's paints are made of zinc and iron specially composed for use on ships; they can be successfully applied direct on iron and steel without lead priming, and have been in use for some 45 years by railway and steamship companies, gas companies and others, such as the Lancashire & Yorkshire Railway Co., the Great Eastern Railway Co., Sir Frederick Bolton's Steamship Co., and the Farrar Grove's Steamship Co.; also by Messrs. Pritchett & Gold, accumulator makers, and by a number of gas companies, including the Brentford Gas Co.

Users of leadless paints.—The most important evidence under this head relates to the use for a number of years of zinc paints by H. M. office of works, the principal architect of which has under his supervision the royal palaces, the Houses of Parliament, Government offices, Crown courts, post offices, inland revenue offices in England and Wales, and foreign consulates throughout the world.

H. M. office of works.—Mr. Patterson, clerk of the office of works in charge of the West London district, attended on three occasions, and gave detailed evidence to the effect that the office of works had replaced lead paints, though considerable difficulty had been at first encountered. They found, he said, that zinc oxide paints required different treatment to the white lead paints previously used, and were not so easy to dry. The latter trouble was overcome by having the paints made with boiled refined linseed oil with manganese borate driers and a trace only of litharge, while sufficient opacity was obtained by thickening them with as much as 60 to 70 per cent of zinc oxide. Such paints have been found to cost, for identical quality, approximately the same as lead paints, and have been generally employed in the painting of Crown buildings since 1907. Prior to May, 1913, a certain amount of lead paint was still in use; it was, however, confined to the small proportion required for priming of iron and steel and new woodwork; since that date it has been discontinued for the latter purpose, but for iron and steel work an orange lead primer is still required; apart from that and the compounding of green colors, the office of works have discarded lead paints in all their operations. Mr. Patterson further said that he had no doubt whatever that zinc paints, with the addition of, say, 5 per cent of lead compound, could absolutely replace all lead paints for ordinary purposes.¹ Importance is attached to the medium and, for finishing coats, a certain proportion of varnish is always specified by the office of works, but even so, zinc paints only cost the same as the corresponding lead paints. For all ordinary painting the leadless paints have given results quite as good as lead paints over a period of five or six years during which they have been under definite and careful observation. The formula originally specified in 1906 has since been somewhat modified, the proportion of zinc oxide being raised to 58 per cent, and a maximum of not more than 5 per cent of lead compounds being permitted.

¹ With regard to colored paints, see p. 144.

Sir Henry Tanner, the principal architect of the office of works for England and Wales, and in charge of the upkeep of diplomatic and consular buildings abroad, also attended and corroborated the evidence of Mr. Patterson; Sir Henry said he had satisfied himself that the office of works' formula for leadless paints would be applicable to all kinds of outside painting, and that lead is not required, except for a first coat on iron and steel, regarding which experiments are still in progress.¹ Sir Henry Tanner considered that if lead were prohibited architects would specify paints with a zinc basis, and he thought the experience of the office of works was sufficient to justify the abolition of the use of white lead.

Messrs. Cadbury Bros. (Ltd.), the well-known cocoa and chocolate firm of Bournville, near Birmingham, have also given careful attention to the possibility of discarding lead paints. The firm employ from 30 to 50 painters, who are engaged in all varieties of work; leadless paints were first adopted 12 years ago; they have been used almost exclusively for the last 7 years, and during the last 3 years no lead whatever has been introduced into the composition of any paint. The firm's representative stated that the results obtained were entirely satisfactory for office and factory painting, both exterior and interior, whether on iron, steel, or wood work; there was also no appreciable difference in cost one way or the other.

Commander Coys, R. N. R., marine superintendent of the Great Eastern Railway, stated that this company had decided to use zinc paints exclusively on their ships; the change from lead to zinc paints was made in consequence of experiments with the latter which had proved to be entirely satisfactory, and it was decided upon, not on account of the danger of lead poisoning, but solely owing to business considerations. Up to the time of giving evidence the company had not discarded red lead for priming on iron, but experiments were in hand with a protective leadless oxide which was largely coming into use.

Capt. Tuke, marine superintendent of the Orient Steamship Co., stated that for all ordinary internal and external painting on their ships, zinc paints had been exclusively used for 35 years; these paints include zinc priming paints for both wood and metal; zinc white paint with a little coloring matter such as yellow ochre for stone color; zinc white for the holds; and enamel paints over zinc undercoats for the interior of cabins, while the hulls are painted with a leadless black paint. At the time of giving evidence a small proportion of lead was still required for the buff-colored paint used only for funnels and ventilators, but Capt. Tuke was of opinion that the entire prohibition of lead paint would not affect his company in the least.

H. M. admiralty.—Mr. Arnold Philip, the admiralty chemist, testified to the progress made with leadless paints on the ships of H. M. navy, red oxide of iron taking the place of red lead on double bottoms and iron casings of boilers. Zinc white paints have also replaced white lead to a considerable extent during recent years, and zinc enamels have proved the most satisfactory for the inside of cabins. Mr. Philip considered that the widespread belief that lead paints are best was to be ascribed to the length of time that painters have been accustomed to them. In his opinion, leadless paints would be equally as serviceable as lead for the outside painting of navy vessels.

¹ Regarding the successful use of leadless priming on iron and steel, see the evidence of Messrs. Cadbury's representative, of Capt. Tuke, and of Mr. Eilson, referred to on pp. 143 and 144; and communications summarized in the table at the end of this volume.

Mr. Mockford, foreman of painters at H. M. dockyard, Portsmouth, gave similar evidence, and said he considered the abolition of the use of lead the only way to remove the danger of lead poisoning; he thought, moreover, it would be practicable to prohibit it at once, except for priming coats on iron and steel surfaces; this exception he made because he had so far carried out no experiments on a large scale with leadless paints for that purpose.

Mr. Ellson, resident engineer of the South Eastern & Chatham Railway, in charge of the bridges and railway stations at Charing Cross and Cannon Street, dealt almost exclusively with paints suitable for engineering structures, for which dark colors are not considered objectionable. Under very trying atmospheric conditions in which sulphurous fumes are prevalent, e. g., inside a railway terminus, silica graphitic paints had been conclusively proved to be superior to lead paint. Two coats of carbonizing coating paint had also been found as good as three coats of the best lead paint for a period of six years during which they were tried side by side on Cannon Street roof. The application of coal-tar paint to bridges has proved very efficient in every way, and durable up to as much as 18 years. Mr. Ellson, although not much concerned with white paints, has made small experiments therewith which have proved them to be entirely satisfactory and as efficient and durable as the best lead paints in the severe atmospheric conditions of London railway termini. This witness's conclusion, therefore, was that the prohibition of the use of lead would cause no difficulty in his department.

Mr. Hunter, inspector in charge of the painting operations on the Forth bridge, said that of the paint there used leadless materials, particularly oxide of iron, constitute 75 per cent, but that a mixture of red and white lead is still employed as a priming coat on naked steelwork; he said he had never tried to find a substitute for lead for the latter purpose, but was confident that if lead were prohibited a substitute would easily be found. At the time of giving evidence he was already experimenting with a bituminous paint which appeared satisfactory for this purpose. As regards subsequent coats, Mr. Hunter considered iron oxide distinctly superior to lead paint.

COLORED PAINTS.

The evidence regarding the efficiency of leadless paints reviewed above deals mainly with (1) paintwork which has to be carried out either with white paints or with paints which are only slightly tinted with leadless pigments such as ochers; (2) paintwork of a dark color for which graphite, bituminous, or coal-tar paints are suitable.

For decorative painting, however, colored paints are necessary, and the question of the coloring materials or "stainer" is of importance. A considerable number of the pigments at present in use with lead base paints are themselves leadless; this category includes:

All shades of blue, made up from—

Prussian blue, a ferrocyanide of potassium and iron compound;
Cobalt blue, i. e., oxide of cobalt;
Ultramarine, a complex sodium-aluminium sulpho-silicate;

the various yellows, drabs, and browns, obtained from—

Ochers;
Umbers;

Siennas and other earths;

the purple reds made with—

Crocus Martis, an iron compound;
and a variety of calcined colors such as—

Dove color, containing manganese, iron, and cobalt; purple, containing several different iron compounds;

Mulberry, containing manganese and cobalt;

Dove—another shade—containing chromium oxide and cobalt;

Greens, made by calcining bichromate of potash with other leadless ingredients;

as well as the lakes and anilin colors, some of which have, however, been avoided on account of their want of permanency.¹

In addition there are a few pigments which must of necessity be mixed with leadless paint bases, and require to be carefully protected from contact with any lead paint, because they would tend to turn black owing to the reaction of the lead with the sulphur contained in the color; these include:

Cadmium yellow (sulphide of cadmium);

Vermilion (sulphide of mercury).

On the other hand, evidence shows that yellows, greens, and reds, compounded on a lead base, are to-day widely in demand; it will, therefore, be convenient to deal with these colors separately.

Yellows.—Dr. Crow, representing the color, paint, oil, and varnish trades associations, contended that lead chromate was preferable to zinc yellows, because the latter were deficient in opacity and gave a smaller range of tints.

The amount of lead contained in ordinary chromate paints is about 10 to 20 per cent, and as such would probably be innocuous. In the pottery regulations materials containing less than 5 per cent of lead compounds soluble in a standard solution of hydrochloric acid are regarded as nonpoisonous; a similar test has been applied to various paint materials by the chemists of the Government laboratory and others, and judging by these the proportion of lead chromate soluble in dilute hydrochloric acid would be too small to be material.

These statements are also confirmed by the evidence of Mr. C. I. Smyth, chief chemist to Messrs. Mander Bros., who examined various grades of lead chromate and found the pure salt to have a solubility of only 1 per cent, while commercial chromate containing also lead sulphate has a solubility of 15 per cent, and the solubility of chrome yellow with an admixture of white lead rises to 35 per cent. From this it appears that lead chromate yellows used for the purpose of tinting leadless white paints would result in a paint mixture of solubility well under 5 per cent.

The Szebelney Co.'s yellow paints contain from 5 to 7 per cent of lead compounds, which would also involve much less than 5 per cent of lead soluble in dilute hydrochloric acid.

Mr. Connell, giving evidence respecting the "Hansa" colors manufactured by Messrs. Meister, Lucius & Bruning, pointed out that

¹ Formulae for all the pigments referred to above may be found in standard reference books of trade recipes.

they are made without lead, and although built up from anilin and alizarin they do not fade in bright light and are even unaffected by lime. It is claimed that they can replace chrome yellow for all purposes, but they are from 10 to 50 per cent more expensive; in a paint containing 10 per cent of the yellow pigment, this would mean an increase of 1 to 5 per cent in the cost of the paint.

It appears, therefore, that leadless yellows are not impossible to obtain; and, moreover, that a restriction to not more than 5 per cent of lead compounds soluble in dilute hydrochloric acid would still admit the use of lead chromate as a color provided that it is mixed with a leadless base paint instead of white lead.

Greens.—The ordinary greens, called Brunswick greens, at present in general use, are for the most part mixtures of Prussian blue and lead chromate. The former being leadless, it follows that the above references to yellows will also substantially apply to greens.

H. M. office of works admit as much as 10 per cent of lead compounds in their green paints; in view of the low solubility of lead chromate, this is equivalent to considerably less than 5 per cent of soluble lead. Dr. Crow stated that some of the best greens contain 20 to 35 per cent of lead chromate, of which only a small proportion is soluble, while the usual commercial greens contain only from 3 to 5 per cent of lead compounds.

The Szerelmey Co.'s greens, like their yellows, contain only from 5 to 7 per cent of lead compounds, corresponding to a very low solubility.

The Hansa greens of Meister, Lucius & Bruning are entirely leadless.

Messrs. Cadbury Bros. (Ltd.), of Bournville, use exclusively leadless greens made from barium or zinc, or from ferrocyanide of potassium and ochre.

Thus the conclusion in regard to greens is the same as for yellows, viz, that a 5 per cent solubility limit for lead in paints would not prevent the use of the greens generally employed to-day.

Reds.—Many of the reds at present in use, such as vermilionettes, are made on an orange or red-lead base, and these are almost wholly soluble in dilute hydrochloric acid.

Mr. Grant Hooper, superintending chemist at the Government Laboratory, suggested that red oxide of iron paints and vermilion could be used; if at any time the high price of the latter is an objection, the lead vermilionettes could probably be replaced by aluminum lakes.

Mr. C. I. Smyth also, while admitting that his experiments for the purpose of discovering a suitable substitute for orange lead were as yet very limited, said he thought success in the direction of a red paint of solubility under 5 per cent was quite possible; since giving evidence he has pursued his experiments further and has reported the successful preparation of red paints entirely free from lead; these have been produced at the same price as lead paints and in shades to match every variety of tint; their permanency of color when exposed to light, has, moreover, been tested by continuous exposure to south aspect for periods of two years and upward.

The Szerelmey Co. claim that their red paints contain no lead, and are prepared to supply any shade of red without any lead in its composition.

Messrs. Cadbury Bros. (Ltd.), moreover, use no lead in red paints, which are compounded with iron oxides for general paints and with carmine and other special leadless colors for better-class "signal" reds; the committee have also found other instances in which bright red paints on a lead base have been successfully replaced by leadless reds.

H. M. office of works have in recent years obtained very satisfactory reds on an aniline, i. e., leadless, base.

Small proportion of coloring matter required in the composition of colored paints.—In the composition of colored paints the proportion of coloring matter which is added to a white base paint is in most cases very small. The committee therefore consider that a restriction of the use of lead to not more than 5 per cent of soluble lead in any paint when mixed ready for use would not unduly hamper the decorator in obtaining the requisite range of colors; for the same reason it was clearly established by the evidence of Messrs. Cadbury's representative and others, that the compulsory use of such colors, although in themselves somewhat more expensive than colors the lead in which is not restricted, would only affect the total cost of painting to an infinitesimal degree.

DRIERS.

While there are several leadless driers in general use, such as the lincolates and borates of manganese, a number of witnesses called attention to the valuable properties of certain lead compounds, such as litharge, in promoting the drying of paints; the proportion of lead added to a paint for this purpose is, however, quite negligible—as is abundantly shown by the evidence of Dr. Crow, Mr. Patterson, and others—and would be amply covered by admitting up to 5 per cent of lead compounds in a paint.

CORROBORATION BY PAINT USERS.

In addition to the firms who were heard as representative makers of leadless paints, there are of course a very large number of other paint makers whose nonpoisonous paints are also on the market. With a view to substantiating further the claims of leadless paint materials to be regarded as efficient substitutes for white lead paints, the committee have collected opinions from a number of users of such paints, both those spoken of by witnesses and others.

As a result of this corroborative inquiry, replies have been received from 102 users, the general trend of which indicates that a large number of leadless paints have been found satisfactory in finish, durability, permanence of color, and cost. These include statements from six architects and others who have had under their observation iron and steel casement and window frames which have been primed with a leadless priming paint which has proved itself to be quite efficient for this purpose.

ADEQUACY OF SUPPLY OF LEADLESS MATERIALS FOR PAINTS.

With regard to the available supplies of leadless materials for the manufacture of paint, the second point which, as stated on page 136, the committee have to determine, they were assured that in the event of the use of lead paints being prohibited the quantity of zinc obtainable would alone be sufficient to meet all demands.

* See table at end of this volume.

The total home consumption of white lead for painting purposes was given by Mr. Miller, of the London Chamber of Commerce, speaking on behalf of the white lead manufacturers, as approximately 50,000 tons; zinc compounds, on the other hand, are very much lighter specifically than lead compounds, and, consequently, every ton of zinc yields nearly 60 per cent more volume of paint than each ton of lead. On this basis, therefore, one witness estimated the amount of zinc required to replace lead for painting in this country as about 34,000 tons, but against this a number of witnesses expressed the opinion that more frequent painting of exposed surfaces would be requisite if lead were prohibited; the committee, therefore, propose to take a very liberal estimate, and with a view to considering what effect the increased demand may be expected to have on the zinc market, have assumed that the additional quantity of zinc likely to be required would amount to 50,000 tons.

THE WORLD'S OUTPUT OF ZINC.

Complete figures of the world's output of zinc, with the yearly fluctuations of its price, will be found in the General Report (with statistics) on Mines and Quarries, Part IV. The average consumption and price in each of the last two quadrennials for which figures have been published are:

	Average yearly quantity.	Average price per ton.
1902-1908.....	Tons. 633,887	£ 2. 4.
1907-1910.....	834,287	23 6 9
Difference between consecutive four-yearly periods.....	+200,410	-1 8 10

From this it appears that an average increased demand of just over 50,000 tons each year has not only resulted in no increase in price, but has actually been accompanied by an average reduction of price by over 7s. (\$1.70) per ton annually.

These figures alone the committee feel are sufficient to dispose of the allegation that the supply of zinc might be insufficient to meet the increased demand without a material increase in price; it is, however, also of interest to note a paragraph which has recently appeared in trade journals¹ concerning the syndicate which largely controls the market price of zinc; the paragraph in question is to the effect that in addition to reducing the current quotations of zinc, the syndicate decided, on April 28, "to make a restriction of between 15 and 18 per cent in the output, to commence on May 1," it being "estimated that stocks in hand at the end of April are likely to be well over 80,000 tons." The restriction of 15 to 18 per cent of the output means an artificial diminution of the production by some 150,000 tons; an increased demand, therefore, of 50,000 tons would only absorb about one-third of the recent overproduction.

¹ See "The Ironmonger," of May 2, 1914, page 78. The statement quoted has, moreover, been confirmed by reference to one of the leading members of the metal exchange.

MANUFACTURE OF ZINC OXIDE.

Chemically pure zinc oxide is obtainable by what is known as the indirect process, which involves the conversion of the ore into metallic zinc and the oxidation of the latter into zinc oxide; several witnesses, however, stated that zinc oxide of the kind most suitable for paint manufacture is obtained by the direct process, i. e., by the conversion of zinc ore into zinc oxide without the intermediate process of conversion into metallic zinc. Zinc oxide made by the direct process contains usually from 2 to 4 per cent of lead compounds; as this impurity is mostly in the form of basic lead sulphate the proportion soluble in dilute hydrochloric acid—and, therefore, as stated above, definitely noxious—is negligible. At the present time the price per ton of zinc oxide differs but little from the price of white lead per ton, although, as previously stated, the former is specifically so much lighter that it makes a larger quantity of paint.

It has, however, been suggested that for the first year or two the increased demand for zinc might somewhat raise the price of it, but on the other hand it was pointed out that such increase, if material, might cause those zinc mines to be reopened which, owing to the ore obtainable being of too low a grade, can not at present be worked at a profit; should this prove to be the case, it might well lead to a reduction in the price of zinc paints below the present quotations either for zinc or lead paints.

EFFECT ON WHITE-LEAD INDUSTRY.

A great deal of evidence was submitted on behalf of the white lead corridors concerning the probable effect on the capital invested in the white lead industry and the labor employed therein. The estimated capital of the white lead manufacturers was put at £1,334,000 (\$6,491,911), the number of men employed by them 2,489, and the estimated wages paid £158,300 (\$770,366.95) per annum.

It was further alleged that the consumption of pig lead in this country, which is at present 200,000 tons per annum, would be reduced by 25 per cent if the demand for white lead ceased. The British lead miners number 2,678, earning £151,308 (\$736,340.38) annually in wages. The smelting and refining firms employ 780 workmen, wages £72,970 (\$355,108.51). All these, it was contended, would be more or less affected, directly or indirectly, by any curtailment in the demand for white lead.

While these matters may well be regarded as outside the terms of reference to the present committee, and while the figures themselves are by no means large, the committee feel that it is only right to call attention to them in this report.

It was further pointed out by the advocates of white lead that although one firm in this country is to-day engaged in making zinc oxide and several in grinding zinc paints, the manufacture of zinc oxide is in the main a foreign industry. The British Empire, however, produces 18 per cent of the world's output of zinc as compared with 21½ per cent of the world's output of lead, so that in its early stages lead can not be regarded as substantially more of a British product than zinc.

¹ These are the percentages calculated on the figures, quoted by Mr. Lancaster, for 1909; in 1910 the proportions were, zinc 21 per cent, lead 23.6 per cent; in 1911, zinc 21.1 per cent, lead 22.2 per cent; in 1912, zinc 21.5 per cent, lead 23.1 per cent.

EFFECT OF AN INCREASED DEMAND FOR ZINC OXIDE.

Again, notwithstanding the white lead corrodors' references to one or two unsuccessful attempts which have been made to manufacture zinc oxide in this country, the committee feel little doubt but that an increased demand for zinc paints would eventually result in the establishment here of zinc oxide works on a large scale. In this respect it was stated in evidence that both the direct and indirect processes for making zinc oxide have been known for over 50 years, and are no longer in the United Kingdom the subject of unexpired patent rights; this statement has been verified by reference to H. M. patent office, whose records show that the principal patents relating to the manufacture of zinc oxide expired many years ago, and that the patent restrictions at present in force affect only very minor details, such as special types of furnaces. In these circumstances it appears to be quite possible that an impetus to development of British enterprise in the direction of zinc products would lead to the employment of British capital and British labor therein, which would take the place of capital and labor displaced from the white lead industry.

ZINC HYDRATE AND ANTIMONY TRIOXIDE.

In addition to zinc oxide paints, several new pigments have come to the notice of the committee, for example, zinc hydrate and antimony trioxide. The evidence regarding the former, sold in this country as zinnox, has already been reviewed; antimony paints have been known to chemists for some time, and have been used on a considerable scale in foreign countries, particularly France, but as yet they have not been introduced into the United Kingdom to any great extent. One witness, however, when attending before the committee now sitting with reference to the painting of carriages and coaches, described a new and improved process of manufacture about to be started on the Thames, and further quite recently two other English firms, viz, the Thames Smelting Co. (Ltd.), of Gravesend, and Antimors (Ltd.), of London, have begun to make a specialty of this product, which is being offered at prices comparing favorably with other paint materials. Thus it appears there are other leadless materials which are likely to become important competitors of zinc oxide as the basis of white paints in the event of the use of lead being restricted by law.

RESTRICTION OF THE USE OF LEAD TO NOT MORE THAN 5 PER CENT OF SOLUBLE LEAD.

In view of the two important considerations discussed above, namely—

- (1) the necessity for permitting the use of a certain amount of coloring material containing lead, as well as a very minute quantity of lead in the composition of driers;
- (2) the desirability of admitting zinc oxide made by the direct process,

the committee have carefully considered the advisability of recommending a restriction of the use of lead, rather than its entire prohibition.

Allusion has already been made to exemptions, based on such a restriction, which have been in force for several years in the pottery

industry. A number of important firms engaged therein adopted glazes which, though containing substantial proportions of lead, yield to dilute hydrochloric acid less than 5 per cent of a soluble lead compound; in 1903 these firms were allowed important relaxations under the special rules drafted by Lord James of Hereford, and under the later pottery regulations, based on the report of the departmental committee of 1908-1910, they were allowed still further latitude. The effect of these successive concessions has been greatly to increase the number of firms confining their operations to the so-called low solubility glazes, and where such glazes are exclusively used, however extensive that use may be, there is no record of lead poisoning directly ascribable thereto. It may, therefore, be safely assumed that materials containing less than 5 per cent of soluble lead are substantially harmless.

In other countries similar conclusions have been accepted:

In France, where the committee appointed to report on standards of purity of paint materials have recommended that materials containing not more than 3 per cent of lead should be regarded as leadless.

In Belgium, where the administration of the State railways specify leadless paints for all purposes, and admit, as leadless, materials containing not more than 4 per cent of lead.

EVIDENCE OF REPRESENTATIVES OF THE ROYAL INSTITUTE OF BRITISH ARCHITECTS.

In addition to evidence to which reference has already been made, the committee attach very considerable importance to that of the two representatives of the Royal Institute of British Architects, Mr. Munby and Mr. Wonnacott, who laid before them the results of an investigation undertaken by the science committee of the institute in the years 1908-1910.

They found, as regards interior work, that—

- (1) zinc and lead are equally suitable;
- (2) the cost of decoration with either is the same;
- (3) the covering power of zinc is less, but the spreading power greater;
- (4) the first cost of zinc is greater, but it works out cheaper in the end because of its permanence and durability.

As regards exterior work, there was some doubt, inasmuch as Mr. Munby had come to the conclusion that lead is more durable on exposed surfaces and that certain dark colors are difficult to obtain without any lead; Mr. Wonnacott, on the other hand, had formed the opinion, as a result of the investigation, that zinc was as good as lead for exterior work.

Both witnesses agreed, however, that a limitation of the amount of lead in a paint to not more than 5 per cent would introduce no serious difficulties. While the knowledge of zinc paints among architects is not at present great, and the use of white lead is specified largely as a matter of habit, Mr. Munby and Mr. Wonnacott both stated that architects generally would welcome the prohibition of lead, and both considered it would be perfectly safe for them to assent to a 5 per cent restriction.

SULPHATE OF LEAD.

Reference was made from time to time in the evidence to the value of basic lead sulphate as a white paint material; while this is far from being a nonpoisonous paint, it is less dangerous in use than the hydrated carbonate of lead, known as white lead, to the extent indicated by its smaller solubility in dilute hydrochloric acid. This solubility has been shown to be not more than one-quarter that of white lead, and it follows therefore that a restriction of the use of lead in paints to not more than 5 per cent of soluble lead would permit of the introduction of as much as 20 per cent of a basic lead sulphate into a leadless paint. Mr. Grant Hooper, of the Government laboratory, in particular emphasized the importance of this, pointing out that a solubility limit would encourage the use of those forms of lead which are least soluble and therefore least objectionable from the standpoint of health.

With respect to the application of such a restriction, the committee consulted Mr. Grant Hooper, the superintending chemist of the Government laboratory, and as stated in his evidence, it has been proved by experiment to be perfectly feasible to apply to paints a test similar to that at present used for pottery glazes.

RECOMMENDATIONS.

The committee accordingly recommend that a law should be introduced prohibiting in this country the importation, sale, or use, of any paint material which contains more than 5 per cent of its dry weight of a soluble lead compound when determined in the following manner:

If the paint or wash be mixed with water, turpentine, oil, varnish, size, or other adhesive or waterproofing substance, it shall first of all be freed as far as possible from such vehicle or adhesive or waterproofing substance by drying or by treatment with ether, petroleum, spirit alcohol, water, or other neutral solvent or solvents. If the residual substance so obtained should contain insoluble varnish matter, size, or other adhesive material which can not be removed except by the action of reagents which affect the other constituents of the paint or wash, then the proportion of such varnish matter, size, or other adhesive material shall be ascertained by suitable means, and a deduction be made for the same from the weight of residual matter taken for the determination of the soluble lead so that the proportion of soluble lead found to be present shall be calculated as a percentage of the dry matter free from varnish matter, size, etc. For the determination of soluble lead, a weighed quantity of the dried or dry material, freed as far as possible from oil, or other vehicle, or adhesive substance above described, is to be continually shaken for one hour, at the common temperature, with 1,000 times its weight of an aqueous solution of hydrochloric acid containing 0.25 per cent of actual or real hydrochloric acid. This solution is thereafter to be allowed to stand for one hour and to be passed through a filter. The lead salt contained in an aliquot portion of the clear filtrate is then to be precipitated as lead sulphide and weighed as lead sulphate.

In conjunction with such a restriction, it would be necessary to exempt specifically certain special classes of colors, such as those used by artists; and in addition it would be desirable to provide powers of

granting exemptions applicable only to very special branches of the general painting industry, where it could be shown to the satisfaction of the secretary of state that the use of lead paints containing more than 5 per cent of soluble lead, calculated as above, can not as yet be dispensed with; in such cases the secretary of state should have power to enforce adequate precautionary measures, viz, abolition of dry rubbing down, provision for overalls, mess rooms, cloakrooms, lavatories, medical examination and the like, all of which should be made compulsory and be enforced by adequate inspection. The supply of lead materials to any user to whom such an exemption is granted could be controlled by only permitting paint manufacturers to supply the materials in question on condition of sending written notice of the customer's name and address to the proper Government department.

The committee have endeavored to indicate, in this report, all the principal considerations on which these recommendations have been based; in formulating their opinion they have devoted much time to the most careful study of every point laid before them in the evidence, and consider that on that evidence they could arrive at no other logical conclusion; they have, moreover, every confidence that the restriction recommended will cause no undue difficulties to employers in the industry, and that it will insure the ultimate stamping out of the lead poisoning evil among their operatives.

To give adequate time for paint grinders and others to arrange for supplies of nonpoisonous materials, and also to facilitate the introduction of modifications in painting methods where special work necessitates such changes, the committee recommend that the restriction of the amount of lead in paints to not more than 5 per cent of soluble lead should not be brought into force until three years have elapsed from the date of publication of this report.

DANGERS OTHER THAN LEAD.

While the terms of reference to the present committee deal only with the use of lead compounds, the committee desire to call attention to possible dangers to health arising from the vapors of the media used equally in all paints—whether compounded with lead or leadless pigments—and to the consequent importance of investigating the possible effect on health of vapors arising from the linseed oil and turpentine, or turpentine substitutes, used in ordinary paints. Mr. K. W. Goadby in his evidence describes experiments on animals subjected to turpentine vapor, which, when a sufficient quantity was inhaled, was shown to be capable of producing severe symptoms and even death. Although Prof. Armstrong in his evidence stated that the quantity of turpentine used in painting operations was insufficient to cause ill effects—and in fact compared it with smelling salts, which would also be dangerous if taken in quantity—it may be found that turpentine and other substances used in paints can produce ill effects sufficient to require action on the part of the Home Office; the committee, therefore, consider that, in any bill to be laid before Parliament to give effect to these recommendations, powers should be provided for the secretary of state to make regulations, if he finds it necessary, similar to those which he can establish in factories and workshops under section 79 of the Factory and Workshop Act, 1901.

The committee desire to express their warmest thanks to Mr. E. A. R. Werner, who has throughout the inquiry acted as their secretary, and to record their high appreciation both of his great ability and his untiring assiduity.

ERNEST HATCH, *Chairman*.
 GODFREY BARING.
 HENRY BENTINCK.
 EDGAR L. COLLIS.
 F. G. RICE.
 ARCHD. GARDNER.
 J. PARSONAGE.

NOVEMBER, 1914.

MEMORANDUM BY MR. W. G. SUTHERLAND.

It is with great regret that I find I am unable to associate myself with the conclusions arrived at by my colleagues on the committee.

I desire to acknowledge here the extreme courtesy with which I have been treated by the chairman all through the inquiry, though it has been my misfortune to have to traverse his questions and findings.

It is a grave step to set my individual opinion against the collective judgment of the whole of the other members, but I feel I have no option left me.

To have signed the report of the majority would have been to turn my back on a life-long experience and knowledge of the materials involved, and I respectfully submit, on much of the weightiest evidence put before the committee.

This course of action must not be taken as showing any lack of appreciation on my part of (a) the problem created by the use of white lead as a paint pigment, or (b) of my desire to mitigate its consequences.

I am very solicitous to meet the grave effects of lead poisoning amongst painters, but before resorting to the extreme course of prohibiting the use of so valuable a material as white lead, I am of opinion that, in view of the evidence, a trial should first be given to regulations.

The data before the committee are not, in my opinion, sufficient to justify the step proposed by the majority, involving, as it would, the crippling of a large industry, the destruction of almost the whole of the plant engaged in its operations, and the turning adrift of a large body of workmen (unfitted for other occupation), who are certainly entitled to consideration.

LEAD POISONING "FATALITIES" AND "CASES" IN HOUSE PAINTING OPERATIONS.

Doubtless the consideration that prompted the appointment of the committee was the deaths and disabilities which ensue from the use of white lead as a paint pigment, and the desire to find a remedy either by way of prohibition, regulation of its use, or an efficient substitute.

NUMBERS ENGAGED IN PAINTING OPERATIONS IN ENGLAND AND WALES.

The painting trade is (numerically) the largest section of the building trades, as shown by the recent "Census of occupation."

The last census of occupation (1911) gives the number of painters in England and Wales as 181,613.

As set out in the majority report, the number of painters in 1901 was approximately 157,640.

This gives an average of 169,627, from which about 20,000 should be subtracted to allow for employers, leaving a round figure of 150,000 operative painters.

It is essential to keep this figure clearly in mind, as its relation to deaths and cases is important.

DEATHS.

The number of deaths in England and Wales differ from the "cases" in this respect, they are definite figures. All certified deaths from lead poisoning have to be returned to the registrar general, so we have here definite data to work upon, whereas the "cases" are estimated numbers.

Over a period of ten years, 1900-1909, 293 deaths were certified as being due to lead poisoning amongst painters in England and Wales (Scotland and Ireland are excluded). This gives 29.3 deaths per annum out of an occupation number of this trade in the same area of 150,000.

The 29.3 deaths per annum amongst 150,000 persons equals 0.195 per 1,000 of the occupied painters.

A LOWER INCIDENCE OF DEATHS THAN IN THE SCHEDULED INDUSTRIES.

This is a much lower incidence of deaths than obtains in the combined lead industries which come under factory supervision.

OCCUPATION MORTALITY.

Mr. Holt Schooling's evidence (pp. 581-607) as to the mean annual death rates per 1,000 occupied males living at seven age groups from 15 to death, given on page 582, is based on the Blue Book [Cd. 2619], published 1908, and contained in pages 3 to 159 of that book.

The tables put in show the age distribution of the years of life exposed to risk and death (p. 82, Blue Book [Cd. 2619]).

The comparison is not unfavorable to occupation (64). Plumber and painter and glazier (p. 106), Blue Book. (See pp. 584-585 of the Evidence, Vol. IV, of this report.)

In the comparative mortality figure (Table F), pages 587 and 588, plumber, painter, and glazier is fourth from the bottom.

The figures for all occupied males in industrial districts are 1,122, London districts 1,099, plumber and painter 1,041.

In Table II the mean annual death rate per 1,000 of living painters and plumbers compare favorably at all ages with rates of occupied males in London and the other industrial districts of the country.

Mr. Schooling, in his evidence, expressed the opinion that the elimination of the lead risk would not affect the death rate, and taking the figures of deaths from lead poisoning, 1900-1909, as 293, or 29.3 per annum, and distributing them over 150,000 occupied painters, we have the low incidence of 1 death for every 5,120 persons. Statistically, it would hardly affect the mortality rates.

THE INCIDENCE OF "CASES" OR ATTACKS.

Dr. Legge's estimate, based on the proportion of deaths to attacks in factory occupations, gives 7,205 "cases" of lead poisoning amongst painters in the 10 years, 1900-1909, i. e., 720.5 cases per annum

¹ Page and table references in this section are to other volumes of the original report.

amongst 150,000, an attack rate of 4.8 per 1,000 per annum, but it must be remembered that the figures of the "cases," as distinct from the deaths, are estimated, and calculated on the ratio of "cases" to "fatals" which obtain in other lead industries, subject to factory supervision in which returns have to be made.

Further, of the "cases" of lead poisoning per annum, many may be headache, stomach pains (colic), slight or serious, and many of these "cases" assumed to be lead poisoning may arise from the effects of the vehicles used—oil and turpentine and the driers; but positive and exact data of sickness figures on which to found sound calculation is wanting.

COMPARISON WITH INDUSTRIES UNDER SUPERVISION.

The table on page 120 of the majority report shows the attack rate for lead poisoning in the scheduled industries under the Factory and Workshop Act. Taking the average over all these, the mean attack rate works out at 4.05 per 1,000; but if we exclude "printing," in which the rate is very low indeed, and in which large numbers do not come into any considerable contact with lead, the average of the other nine scheduled trades is 8.3, as against 4.8 per 1,000 for house painters.

It has to be borne in mind that, though there is plenty of variety in a painter's work, he is in contact with lead at intervals over the whole period of his working time.

It is a general impression that painters lose many months in a year through slackness of work; this may be true of the unskilled workman, but the unemployment returns of the largest society of operative painters in the United Kingdom, embodying skilled workmen, does not average three weeks in a year over the whole membership.

THE SOURCE OF THE EVIL—LEAD DUST AND DRY RUBBING DOWN.

It is established by the evidence of the medical authorities who have been before the committee, that the great source of the danger resides in the lead dust created by sandpapering and dry rubbing down. (See Mr. Goadby's evidence, 22006, 22040, 22041.)

This (the dust) is common ground in all lead industries under regulations.

Dr. Legge, H. M. medical inspector of factories, ascribes to dry rubbing down the great source of the trouble in painting operations.

This testimony is supported by that of Dr. Kaup, Germany; Dr. Rambousek, Austria; Dr. Collis, a member of the committee; Mr. Kenneth Goadby, an authority on lead poisoning; and Dr. Dobbie, of the Government laboratory.

Dr. Legge further says that lead poisoning can not come through the skin by way of absorption, and he questions whether it can come through a cut (Q. 80), and Mr. Goadby doubts whether it could, in the normal way of trade occupation, come through the alimentary canal (22063), all of which conclusions definitely curtail the area of danger.

PERSONAL CLEANLINESS NOT NEGLIGIBLE BUT SUBORDINATE.

Personal cleanliness is very desirable, but Dr. Legge thinks the danger from this source (inattention to cleanliness) slight compared with the danger from the dust produced by dry rubbing down; in this

he is supported by Mr. Goadby and the other medical and scientific witnesses.

"Very little trouble is brought about by not washing hands." Mr. Goadby. (22056.) Replying to Mr. Rice as to the provision for cleanliness, Dr. Legge said, "My feeling about that always is this, that unless you can go to the fountain head of the mischief, the dust, and stop that, you are not going to secure much improvement by all the personal cleanliness in the world." (273.)

The danger from lead dust settling on the clothes and afterwards being distributed in the air and inhaled, slight though it is, is dependent on the same source of origin—the dry rubbing down of lead paint. No danger of lead dust can attach to the workman's jacket hanging in the paint shop, for there is no lead dust there. All the lead there is in paste or paint form,¹ and "lead" emanations are not given off.

The same argument holds to the taking of meals in the paint shop (it is only in occasional instances that this is necessary); if the hands are kept clean, no danger arises, because there is no lead dust present, and "lead emanations are not given off."

I am not recommending these places as mess rooms. In the great majority of cases in house painters' work there are alternative rooms, but only pointing out that in the few cases where it does happen, the danger of lead poisoning, indicated by the questions put to most witnesses on these points, would not arise (if dry rubbing down were abolished) if we are to take the medical and scientific evidence as true.

According to Mr. Kenneth Goadby—

Dry rubbing down is the main source of lead dust. (22006.)

The only danger of lead poisoning arises from the dust. (22040.)

If dry rubbing down is prevented the danger is obviated. (22041.)

No absorption through the skin. (22053.)

Absorption through the alimentary canal very small indeed compared with the dust danger. (22063.)

Hot water for washing not important. (22063.)

Medical information not sufficiently precise to determine the prohibition of white lead. (22008.)

OTHER POSSIBLE SOURCES.

The other possible sources of lead dust in the painting trade outside these are very slight.

In this country white lead is supplied to painters in paste form, ground in oil, and can not, therefore, be a source of dust except by rubbing down after application as a paint.

The practice, until recently common on the Continent, of master painters buying their white lead dry and grinding it in their own shops, is to-day unknown in the United Kingdom. It has been obsolete for more than a generation.

Dry white lead is sometimes used by house painters to make "white lead putty" for stopping purposes, occasionally for mixing a paste for affixing canvas to walls or boards, but these two outlets affect so minute an amount of material that they can readily be dispensed with without any inconvenience.

¹ Red lead: If any is in the paint shop it is there only in small quantities, and in thousands of cases it is not there at all.

THE IMMUNITY OF SCOTLAND.

Painters in Scotland, on the testimony of Dr. Legge, are practically immune from lead poisoning outside the Glasgow area, and even there it is comparatively slight (12 cases in five years) and 20 "cases," including Glasgow, over the whole country for the same period of time.¹ (Q. 153.)

This is sustained by the evidence submitted by Mr. Archibald Gardner in 1907 to the departmental committee on building accidents. (Cd. 3848, p. 59.)

"I commenced to work at the trade in 1878 and during the whole of my experience I have only come across two cases; that is, two cases which have come under my personal observation." (1716.)

"We have had so few cases of lead poisoning that we do not think many precautions are necessary." (1720.)

"Well, we have so few cases of lead poisoning, but it should be recommended," i. e., the provision of soap and towels. (1735.)

These very definite answers of a man of Mr. Gardner's experience are confirmatory of Dr. Legge's opinion.

Mr. McKillop and Mr. Arthur Smith came before the committee to give evidence on the prevalence of lead poisoning in Scotland; the evidence of both witnesses was of the most straightforward character, but in the case of Mr. McKillop, who is secretary of the Edinburgh branch of operative painters, with 550 members, he had amongst his members only one case of lead poisoning in 10 years, for which compensation was paid (for eight weeks); all the other cases cited by him were "only general conversations." (20963.)

Mr. Arthur Smith is an official of the Aberdeen branch of the Operative Painters' Society. Mr. Smith's evidence of lead poisoning related to five cases, none of them occurring in his own branch (one of them in America); all of the men were working to-day and two of them were over 70 years of age. Mr. Smith himself when working in London had suffered for three days from an attack of colic.

From a close knowledge of the painting trade and the painters of Scotland, I know that the work is done in a thorough manner, and the methods of preparation and finishing (using dry rubbing down, as a regular process of their trade in the same manner as in England) are as exacting as in any part of the kingdom, and yet, notwithstanding this, lead poisoning outside Glasgow is almost unknown and negligible. Some of the leading master painters in Scotland came before the committee and testified that in their experience they had not known a case of lead poisoning, which confirms the opinion of Dr. Legge as to the slightness of the rate of attack, yet in all cases the lead is the same, and the thinners employed, linseed oil and turpentine, are the same as in England.

¹ These were cases voluntarily reported.

SOURCES OF LEAD POISONING.

OTHER ALLEGED SOURCES OF LEAD POISONING—LEAD EMANATIONS FROM DRYING PAINT AND FROM FUMES CAUSED BY BURNING OFF OLD PAINT.

The committee investigated the question of the possibility of lead poisoning arising from paint in the course of drying, and from the fumes arising from burning off old paint.

The question of the oil and turpentine used in the mixing of paint is not specifically mentioned in the reference appointing the committee, but the inquiry, if it has accomplished nothing else, has evolved a large body of most valuable evidence on the subject, which in its bearing on the question of the use of paint can not be ignored.

It is only in recent years that the attention of scientists has been directed to this aspect of the paint question, and it is one that is quite independent of the pigment employed.

SICKNESS FROM NEW PAINT.

It is common knowledge that the smell of wet or new paint seriously affects certain people, causing sickness and nausea.

The question to be solved was, is this sickness (as some thought) due to the drying paint giving off volatile emanations containing lead compounds? Or is it due to other emanations not lead?—a vital point to determine.

The French commission which conducted the inquiry that preceded the passing of the law prohibiting the use of white lead in France, relied largely on the conclusions of its medical and scientific witnesses, Dr. Heim, Dr. Hébert, and M. Jules le Breton, who conducted experiments on behalf of the Government. These gentlemen decided that volatile lead was thrown off paint in the process of drying.

These conclusions were dissented from by Prof. Armand Gautier, who stated that rooms painted with white lead paint do not emit either lead emanations or lead dust.

M. Jules le Breton, the rapporteur to the commission, stated that by means of Trillat's reagent he had been able to detect the presence of lead in the vapors given off by white lead paint, but M. Trillat, who at the request of M. le Breton repeated these experiments, was unable to confirm this conclusion.

At an early stage of the Home Office inquiry, Prof. Baly, of Liverpool University, appeared before the committee and submitted evidence corroborative of the conclusions of the French experts.

At the outset of the inquiry it was assumed that the results of the experiment made by Prof. Baly and the conclusions on these points of the French experts, M. Heim, and M. Hébert, contained in the report of the French commission, were correct.

The evidence submitted by Mr. C. A. Klein, Prof. Armstrong, Mr. Goadby, and Dr. Dobbie, of the Government laboratory, as the result of their exhaustive and separate experiments, proved that neither Prof. Baly's nor the French tests could be maintained.

Sickness and nausea and other distressing complaints, but not lead poisoning, may arise from emanations and fumes of paint.

Many of the symptoms of lead poisoning, nausea, headache, dizziness, stomach pains, etc., on the evidence of Mr. Goadby and others, may be produced by paint in which there is no lead, and may be mistaken for lead poisoning.

Many of these symptoms are produced by the vapors which are given off from the oil and turpentine in the mixing and drying of the paint.

EMANATIONS—FORMIC ALDEHYDE.

Paint containing drying oil gives off vapors containing formaldehyde, formic and other organic bodies. This is common to all paint containing such vehicles, leadless or otherwise, and this, on the medical testimony placed before the committee, whilst wholesome in the destruction of bacteria, is hurtful to the operatives using the paint, and may be the source of many of the complaints and "cases" which now are attributed to lead.

PROF. E. C. C. BALLY (SECOND APPEARANCE).

Do these experiments lead inevitably to the conclusion that there is no lead in the emanations?—Yes, I think I can say that, certainly. (17013.)

Your further experiment really disposes of your first evidence?—Yes, as regards volatile lead, but nothing more than that. I was wrong, I confess, but I was misled somewhat by the doctors and somewhat by our own tests. (17027.)

Should we have to revise our vocabulary as to poisoning from paint?—I think so, I think that there is a certain amount of poisoning which arises from these aldehydes without any connection with lead, as lead. (17043.)

DR. DOBBIE.

Dr. Dobbie, the principal chemist to the Government laboratory, undertook on behalf of the committee to test the suggestions contained in Prof. Baly's first evidence, and the reliability of the experiments of the French commissioners' experts re emanations giving off lead.

His conclusions are that:

No volatile emanations containing lead, from drying [drying] paint. (22506.)

Drying paint not a possible source of lead poisoning. (22513.)

Formic acid and formic aldehyde come off zinc as well as lead paints. (22519.)

Trillat's reagent is unreliable. (22503.)

Should not weigh with the committee. (22504.)

The evidence submitted by Mr. Goadby, Prof. Armstrong, Mr. C. A. Klein, is sustained entirely by Dr. Dobbie's conclusions, as is set out in the majority report.

THE TESTIMONY OF THE OFFICE OF WORKS.

THE OFFICE OF WORKS.

A prolific source of questions which, in my opinion, diverted the inquiry into wrong channels and led the majority of the committee to what I regard as a mistaken conclusion, was the assumption that the office of works had solved the problem for the community of dispensing with white lead paint by the use at the post offices, Kensington savings bank, etc., of a well-known varnish paint.

With all due respect to the opinion of an important Government department in a matter of this kind, affecting as it does so largely the

interest of the community, such testimony must be judged by the same standards of evidence as apply to ordinary folk.

It is the more necessary to keep this in mind, because at a very early stage of the inquiry, in the questions put from the chair to the witnesses, it was assumed, and that on the bare statement of Mr. Patterson without any corroboration,¹ that the question of alternatives and substitutes for white lead had been solved by the experience or experiments of H. M. office of works.

This assumption, in my opinion, colored the whole inquiry, and its importance must be my apology for devoting so large a space to considering the value of the evidence submitted.

In my review of the evidence of the office of works I wish to disclaim any intention of attacking Mr. Patterson personally; I have no cause to do so. I have only endeavored to show that his evidence is inadequate to build upon it such conclusions as the committee has come to, and my comments go no further than this.

ANY SUBSTITUTE FOR WHITE LEAD MUST BE IMPERSONAL.

I would respectfully lay down this proposition, that as white lead is an impersonal product, so any suggested substitutes or alternatives must partake of the same impersonal character, and be divorced from particular firms.

THE TWO ALTERNATIVE WHITES.

The only two alternative white pigments to white lead are zinc oxide and lithopone. These, like white lead, are impersonal products, in the sense that both or either can be bought under its generic name and apart from the name of the maker, and the standard of quality can be specified and exacted as a condition of sale or purchase. There are brands of zinc oxide and lithopone which may carry a preferential claim on the open market for their particular merit; but that is only the open claim of excellence of quality; they still remain in the category of impersonal and basic materials.

But in accepting and placing reliance on the testimony of the office of works, this important and fundamental distinction has not, in my opinion, been sufficiently considered, because the whole experience of the office of works rests exclusively on what is known as "ready mixed" proprietary paints, and those of two or three firms only.

PROPRIETARY PAINTS.

Proprietary paints should have had no locus standi in an inquiry such as the committee was charged with, and I submit that no conclusions that should have weight with Parliament can be deduced from the evidence tendered by Mr. Patterson on behalf of the office of works.

As a matter of procedure, all that the office of works did in their so-called experiments (which were put before the master painters who came before the committee as so conclusive that they admitted of no cavil) was to advertise for paints to be sent in.

These were received and tested on iron plates and other surfaces, and on the results obtained certain "brands" were approved and adopted.

¹ Except that of Sir Henry Taunier, given Nov., 1912, towards the close of the inquiry.

This may be, and no doubt is, perfectly satisfactory to the office of works for their own requirements. I am not questioning this for one moment, but it does not go beyond that, and I submit that it has no bearing whatever on the question the committee was instructed to inquire into.

LIMITED EXPERIENCE.

The limited experience of the office of works in paints is revealed in Mr. Patterson's answer to question 12916:

"Do you use flattening paints?"—"Only occasionally. Our specification is for glossy paints."

As every architect and decorator knows, an enormous proportion of interior work is finished with flattening paints, and the office of works glossy paints would not satisfy the requirements of the decorating trade or of their customers, nor meet the standard of any aesthetic requirements. At the South Kensington savings bank buildings, to which Mr. Patterson attached great importance, and where "lead paints" and "zinc paints" were used, there was the same absence of any scientific method or plan, and the same simple adherence to proprietary paints made by two or three particular firms. In Mr. Patterson's words: "The lead paints and the zinc paints were the same brand of paints," i. e., made by the same firm, and sold as their particular brand of paint.

NO SPECIFICATION BY THE OFFICE OF WORKS.

Referring to the 1906 test plates, Mr. Patterson said:

These paints that were put on were from all corners. They were not supplied to any specification of ours, but every caller who chose to come and say: "We should be glad to have our paint tried, will you put it on?" had it put on. (12962.)

Do I understand that you do not specify definite proportions of oil and varnish and driers separately?—We do not, we wanted carefully to guard ourselves from the position that we were dictating to the manufacturers. We wanted to leave manufacturers as far as possible with a free hand; we wanted to gain the benefit of any experience they might have had. Our specification was given as a general one, and not as a definite something to which everybody must toe the line to a fraction. (12963.)

Again, Mr. Patterson:

We have, however, to deal with lead paints as they are presented to us on the market, and we take the various makers as they come to us.

NO RECORDS.

Have you a record showing the conditions of the paint of the post office savings bank buildings, and the condition of the paint of the buildings which have been painted under your superintendence?—No. I have no records. (22798.)

Why has no record been kept?—We have too much to do to allow of making any unnecessary records. (22800.)

Now you say that you mixed some samples (paints) yourself from zinc and lead?—That will do. (22880.)

Now you have the formulas of those mixtures?—No. (22881.) No records whatever?—No. I can tell you roughly what I was after and what they were. (22882.)

Such evidence would not be accepted as satisfactory by any scientific body.

I am not questioning Mr. Patterson's judgment on the paints with which he is satisfied as suitable for his department, but I do respectfully submit that his evidence does not go beyond his personal opinion, that in no way can it be regarded as scientific evidence, or as

proving anything more than that the paints satisfied him and his principals.

The office of works never developed a formula of their own for either lead or zinc paints.

All that they did was to have the paints which suited them analyzed, and then adopt the analysis as their "specification."

They kept no records of the paints except the analysis, because they are too busy for making unnecessary records.

They have no evidence as to the bearing of these paints on the health of the workmen; "the contractor takes the burden of that."

Their paints are mainly—

- (a) Varnish paints.
- (b) Enamels.
- (c) Proprietary paints.

These particular makes of paints have been known for many years, through the advertisement columns of the building papers; hundreds of His Majesty's subjects are familiar with them, but no one ever dreamed for a moment that here was a solution of the white-lead question.

The manufacturers of these proprietary paints are reputable firms, but they do not exhaust the scientific enterprise and skill of the paint industry, nor would they claim to do so. The number of ready-mixed proprietary paints on the market are to be counted by the score, the makers of which would not admit any inferiority to the two or three brands adopted by the office of works, and their contention would be upheld by the trade and others. Yet in fact, if not in form, so far as conclusions are based on the experience of the office of works, the paints of these two or three firms, supplied to the office of works, are singled out as having solved the white lead problem.

A BETTER WAY.

If the office of works had bought their own ingredients, detached from any particular firm or firms, and mixed them themselves, if they had carefully recorded their formulas and their inspection results over a long period of time, and had them adjudicated upon by independent experts, their evidence would have been entitled to serious consideration, but as it was presented to the committee it has, in my opinion, no value whatever for the purpose of this inquiry.

The paints used by the office of works have this feature, which separates them from ordinary paints; they are all varnish paints, or enamels.

The two more expensive grades cited would come under the category of enamels, though only one is so specified, and it is not reasonable to classify them as "paints."

PAINT, NOT ENAMEL.

It is essential for a clear apprehension of the position to discriminate between what is known as enamel and what is generally understood as paint.

Enamels are all made from special materials, special oils and varnishes and the formula of their ingredients and manufacture are the secrets of the proprietors.

Varnish paints are made of inferior and cheaper materials, and are also based on secret formulæ.

Paint in the generally accepted use of the term is a substance mixed from ordinary pigments, to which are added oil and turpentine for thinning purposes, and dryers to make it dry.

The great bulk of the paint used in this country is entirely innocent of varnish.

The paints put forward in the table of comparative tests of lead and leadless paints which were submitted to the committee were simply "proprietary paints"; even the lead paints were of the same character, and one paint supplied to H. M. office of works as lead paint, in the analysis had not a trace of lead in it. (See 12962.)

Analysis of office of works.—Stone-color "Lead paint."

Oxide of iron.....	7.19
Barium sulphate.....	52.06
Vehicle.....	38.00
Lead.....	Nil.

This could never have happened if the office of works had mixed their own paints.

The generous percentage of vehicle 38.0 conveys no information as to the amount of varnish incorporated; this is a feature common to all the analyses of the office of works paints, yet it is the essential point; the analysis is further incomplete by 3 per cent.

It is not unreasonable to say that such "evidence" as a serious contribution to the comparative value of white lead and zinc oxide, on which the committee could found conclusions from a scientific point of view, is worthless.

Further, whatever value there is in this testimony, it rests entirely on the word of Mr. G. D. Patterson, one of the clerks of works under Sir Henry Tanner.

If the recommendation of the committee be adopted and the use of the white lead abolished, it appears to me it will be done on the grounds that an efficient substitute is available. The proof of this rests largely on the mere statement of a Government official who is neither a scientist nor a practical painter, and who has no knowledge whether these paints are hurtful to the workman or not.

In an issue involving such large consequences to the community as would be the case if the use of white lead be prohibited, a more definite proof should have been demanded.

LEAD FREELY USED BY THE OFFICE OF WORKS.

It was proved that at the very time when Mr. Patterson was asserting to the committee that the office of works had abandoned the use of white lead, that in May, 1911, no less than 5 tons of white lead were used on the Menai suspension bridge, under the control of the office of works; and an equal amount on buildings in the London area, including Buckingham Palace, St. James's Palace, etc. (See Qs. 12991, 13081.)

Mr. Patterson later on explained to the committee that a large amount of this lead used in the London area was used for bedding window and door frames. The deliveries of this lead on to different jobs was always accompanied by the necessary oil and turpentine,

to make it into paint, and it was always specified to be genuine white lead, which is quite superfluous for bedding purposes.

PROPRIETARY PAINTS.

Mr. Patterson's experience in "leadless" paints, therefore, rests entirely on ready mixed "proprietary paints" supplied by certain firms, and of which the constituents are not disclosed except by analysis.

For the best decorative work, which amounts annually to a very large volume of trade, these ready-mixed varnish paints are entirely unsuitable, and not comparable to the paint mixed by the trained painter for his particular work.

These ready-mixed paints depend for their durability on the varnish which is mixed with them, and the life of the varnish is the life of the paint.

It should be impossible to recommend the prohibition of white lead to Parliament on the basis of proprietary paints. These may be all that their owners claim for them, but to ask Parliament to abolish a pigment so universal and impersonal as white lead for a particular make or makes of paint, would be to set up a monopoly, which is not conceivable.

If I lay stress on the evidence of the office of works, I do so because in my opinion, the inquiry was prejudiced and deflected on to wrong lines by the committee attaching such importance to the experience put forward, as solving the question. It solves nothing.

Men with life-long experience of the trade and its conditions, and in the habit of conducting painting contracts comparable with the operations of the office of works, were confronted with these experiments as a final solution which could not be gainsaid, and their reluctance to accept such a conclusion, so opposed to all their knowledge and experience, was pressed against them as being wanting in open-mindedness.

Your answers will not look well in the evidence. (1002.)
Not a fair answer. (1004.)

NO BEARING ON THE HEALTH OF THE WORKMEN.

Nor can any conclusion be drawn from the experience of the office of works as to the innocuousness to the workmen of their "leadless" paints.

NO RECORDS OF HEALTH STATISTICS—"WE KNOW NOTHING OF IT."

The office of works have no knowledge of this aspect of the case, for in reply to Dr. Collis (Q. 1132): "Do you keep any statistics of the amount of illness that occurs amongst the workpeople of the department?" Mr. Patterson said, "No; the contractor takes all responsibility for that under the conditions of his contract; when a workman falls out of the ranks, we know nothing of it. They have to take any burden in that way." So that, so far as the aspect of the case that is most pertinent to this inquiry is concerned, we get neither light nor leading from the office of works.

Not only painters, but paint manufacturers and chemists of standing, were pointed to the office of works as exemplars of scientific

enterprise and research, and they were asked "were they not behind the times?"

Valuable and disinterested evidence was tendered by Mr. Holzapfel, a paint manufacturer of Newcastle, who appeared before the committee to give evidence on behalf of the paint manufacturers of the northeast coast (Newcastle and Hull).

Mr. Holzapfel has no interest in white lead, his interests are in zinc enamel paints. Notwithstanding this, Mr. Holzapfel told the committee that zinc paint (not enamel) was not as good as white lead paint, and although his firm employ 25 chemists constantly investigating paints of all kinds, the experiments of the office of works were pointed out to him as having solved the problem in zinc paints.

THE ALTERNATIVES TO WHITE LEAD.

ALTERNATIVES TO WHITE LEAD.

When we come to the other two white pigments, zinc oxide and lithopone, the evidence shows they both need fortifying or strengthening for external work by special oils or varnishes, and even then they do not give the permanence of lead.

Indeed, as to lithopone, it is common ground amongst painters and paint makers that, however useful for inside painting, for outside work it is not suitable.

The community has in white lead a known and reasonably cheap pigment that, when mixed with linseed oil and turpentine (common and accessible articles), gives a sound, stable, and inexpensive paint possessing qualities of permanence and protection for whatever structures it is put upon.

White lead is the most useful, as it is the most permanent, white pigment we possess for external painting.

Its use as a paint does not involve the addition of varnish or special oils to give it stability for outside painting.

Is may discolor or darken more rapidly than zinc oxide, but its stability and protecting qualities remain unimpaired.

Zinc oxide changes in the same way under sulphuretted hydrogen acids, but as it turns white it does not show, though the surface is broken through and the protection impaired.

ACTION OF SULPHURETTED HYDROGEN ON WHITE LEAD AND ZINC OXIDE.

The charge frequently made against white lead is that exposure to sulphuretted hydrogen gas produces discoloration, a statement which is obviously true, yet it is seldom recorded that an exactly similar change takes place when zinc oxide is submitted to like conditions, though, of course, this is not apparent owing to the absence of color change.

In the case of lead sulphide there is produced lead sulphide and sulphate, both practically insoluble in water, whilst with zinc sulphate a water soluble sulphite and sulphate is formed which crystallizes and is fatal to the painted surface. (C. A. Klein, 10632.)

It is generally considered that sulphuretted hydrogen is the destructive agent to which painted surfaces are exposed, yet this is entirely untrue. Sulphuretted hydrogen is a minor evil except under special conditions, such as in the vicinity of chemical works, when it is the product of chemical operations. Sulphur dioxide is by far the most important agent, and it is the action of this gas which must be considered. (C. A. Klein, 10633.)

The effect of sulphur dioxide is apparent on historic buildings in London; Sir Arthur Church, in discussing the "Conservation of historic buildings and frescoes," says that the amount of sulphuric acid poured annually into the London atmosphere is estimated by Rudeal as being between 500,000 and 1,000,000 tons.

This is a factor of great importance, and its effect can shortly be stated to be the production of a soluble compound with zinc oxide, as against the production of an insoluble compound in the case of lead. (C. A. Klein, 16834.)

The Dutch commission in their report give attention to this point (Appendix XXXIV, p. 69¹) in consequence of the failure of paints containing zinc, more particularly on the zinc roof of the Palace of Justice at Amsterdam. The chemical subcommittee reported that the roof had been painted with zinc oxide paint, white lead paint, and lithopone paint, and it was found that these paints, more particularly the zinc white paints, had been especially affected in the corners.

In the first sample of soot, 0.13 per cent of zinc was found, indicating, therefore, that the soot had acted either on the zinc white or on the zinc roof itself, which is not surprising, considering the percentage of free sulphurous and sulphuric acid contained in freshly fallen soot.

The three samples of zinc white, white lead, and lithopone paint collected from the roof also contained sulphates soluble in water.

For the purposes of control the paints originally used by the white lead commission were examined as to the presence of soluble sulphate, and it transpired that Silesian zinc white did contain such soluble sulphates, but old Dutch and German white lead, zinc white containing lead and lithopone, did not contain them.

The conclusion may be drawn from the above facts that the sulphurous and sulphuric acid, respectively, of the soot acted on the zinc white paints and changed these partly into sulphate of zinc; which combination, being easily soluble in water, was probably washed away by rain water.

As the same agents, when acting on white lead paints, do not form soluble sulphate of lead, it is clear that in these circumstances zinc white paints are decidedly inferior to white lead paints.

Attention should further be drawn to the high percentage of sulphur contained in soot, while in the event of all the sulphur not being in the form of sulphate, the possibility is not excluded that the sulphur which is not in the form of sulphate will pass, in the long run, to that condition through oxidation, when it will again have a destructive effect on the paint.

Finally, the action of sulphurous acid, sulphuric acid, and moisture was also shown experimentally by suspending strips of white lead and zinc white paint in a damp atmosphere in which sulphur was burnt.

After these strips had been kept in that atmosphere during 32 days they lost when in cold and warm water:

White lead, 0.03 and 0.05 per cent, respectively, of white lead.

Flattening zinc white, 12.32 and 9.21 per cent, respectively, of zinc white.

The great difference in the solubility of the two kinds of paint clearly confirms the supposition above mentioned.

These are established scientific facts, carefully checked and controlled, which entirely confirm Mr. Klein's conclusions, and which, in face of the estimated amount of sulphuric acid (between half and one million tons) poured annually into London, it is not wise to ignore. This conclusion is of fundamental importance in that it recognizes the immutable or characteristic chemical properties of the two metals, lead and zinc.

THE FINDINGS OF THE (HOME OFFICE) 1893 COMMITTEE.

The departmental committee of 1893 said:

With regard to all these so-called substitutes (to white lead), the committee have invariably found that on close inquiry of persons competent to judge and unprejudiced on either side, the substance in question was in some particulars inferior, and they have come to the conclusion that there is at present no substitute that can take the place of carbonate of lead made by the old Dutch process. (Rivet, 15472.)

¹ In Minutes of Evidence, presented in a separate volume of the original report.

THE POSITION TO-DAY.

The position to-day is exactly the same as it was in 1893, when the last departmental committee investigated the subject.

The three possible bases of white paint then were white lead, zinc oxide, and lithopone.

They are the only three available today, commercially. The only new element in the position is that the value of zinc oxide and lithopone is more understood, and their use for interior painting more widely extended by reason of better manufacture and methods of mixing with vehicles.

It would not be possible to displace white lead for external work with any equally efficient material except at enormously increased cost.

The great and distinctive difference between white lead and zinc oxide is that in the case of the former the lead and the linseed oil form, by interaction, a tenacious compound known as linoleate of lead, which is neither lead nor oil, but a fusion of the two; this has great tensile strength in resisting atmospheric influences.

Zinc oxide when mixed with linseed oil is simply held in suspension by the oil and when once the oil film is penetrated, its powers of resistance to the weather and its protective qualities are weakened.

Except where special conditions prevail, zinc oxide and lithopone may be substituted for white lead for interior work, without any serious loss to the community.

VALUE OF WHITE LEAD TO BUILDINGS AND STRUCTURES.

The total annual production of white lead in this country at its source, i.e., the corrodors, is about 50,000 tons, which, at £25 (\$121.66) per ton, represents a sum of £1,250,000 (\$6,083,125), a relatively small industry.

Its importance, however, to the community as a protector of buildings and structures of all kinds, whether of wood, iron, or plaster, is out of all proportion to its monetary value; and it is from this point of view that the prohibition of its use seriously affects the stability and permanence of buildings, in the aggregate worth very many millions sterling.

White lead can be mixed into paint readily and easily by thousands of painters who know from a life's experience that when they are making use of it they have a material that has a definite fixed stability and will give a specific and known protection.

IMPORTANCE OF WHITE LEAD FOR OUTSIDE WORK.

For outside work there is no other white pigment so useful.

It does not need the addition of varnish to give it permanence, as does oxide of zinc.

Of itself, it forms with the oil used a homogeneous compound, elastic and responsive to variations of temperature, which has the elements of durability in its nature.

ODO MARIA MEISSEL.

The testimony of Mr. Odo Meissl, of Vienna, is very weighty. Mr. Meissl is one of the largest contractors for the painting of structural ironwork in Europe. Before becoming a painting contractor, he was

a chemist, so has a scientific and practical knowledge of his materials. The evidence of a man who for years, amongst his other work, has painted the large bridges crossing the Danube, is of a great importance.

GUARANTY FOR WHITE LEAD, NO GUARANTY FOR ZINC OXIDE.

Mr. Meissl is called upon to give a five years' guaranty for all the Government work done by him with white lead, and he freely gives it, but he will not take any responsibility for external work executed with zinc oxide, although he is using it in large quantities in his daily practice for interior work. In answering a question from the chair, Mr. Meissl stated that he painted from 30,000 to 40,000 square meters per year with zinc oxide, which is a considerable amount:

I paint every year some 30,000 to 40,000 square meters with zinc paint only by express stipulation of the person giving the order, but whenever I use paint other than lead, I decline all responsibility for the durability of the paint. I completed one big contract for the railway offices of Wicla, and after one year the paint had to be renewed.

I painted a large wooden fence at Voslau with zinc paint, and after one year, when the fence had to be washed, all the zinc paint came off by washing as if it had been chalk. (13792.)

Yet Mr. Meissl was confronted with the "experience" of the office of works as refuting his life-long knowledge of paint, and he was repeatedly pressed on the point of—"Had he made any experiments with zinc paints?"

THE EVIDENCE OF MASTER PAINTERS.

The great weight of the evidence given by master painters of the United Kingdom and from the Continent is in the same direction, viz, that white lead is far and away the best white pigment known to them, and is essential for external work. They can rely upon it to do good work and it does not fail them.

The addition of good varnish to a paint may give additional stability to it whether it be made of white lead or zinc oxide, but in the latter case it is a necessity for outside work, whilst in the former it is superfluous.

To either pigment it is a serious addition to the cost. It is true that in view of the irksome and impossible conditions foreshadowed as accompanying regulations, some of the employers ultimately admitted that they would prefer prohibition to regulations, but it is fair to point out that the conditions outlined would strangle the trade, and it was only to escape from this dilemma that an assent to prohibition was ultimately and reluctantly given by them.

It was weak but very human.

THE CONDITIONS PRECEDENT TO ABOLITION.

The conditions precedent to the abolition of white lead should be that consumers and the community should have a material or materials to take its place as accessible, as impersonal, and, for outside work, as permanent as white lead.

THE DUTCH COMMISSION.

Attention is directed to the work of the commission appointed by the Dutch Government to find an alternative to white lead as a base for white paint. (See Appendix XXXIV.¹)

The toxicity of lead does not arise in their investigations, though it may have been behind them. It is entirely ignored, the commission simply devoted itself to find an adequate substitute for lead.

Seven years were expended in experimenting with the three pigments, white lead, zinc oxide, lithopone.

It has to be borne in mind that in Holland large quantities of zinc oxide are used annually. The master painter is as familiar with it as he is with lead; he buys it in the dry state as he buys his white lead, and grinds it in his own mill in his shop. So that the Dutch committee was not experimenting with a pigment unfamiliar to the trade, as would be the case in this country.

The thorough and scientific manner of investigation of the Dutch committee is a matter for admiration; they took nothing for granted. They mixed their own paints on a previously determined formula. They employed their own expert to put on the paints, they tested them on bridges, on a ship, on houses exposed to the sea air at the Hook of Holland, and on State buildings at Amsterdam.

They investigated them at intervals, and finding in some experiments that they had been faulty in their preparation, they started again on a new basis.

The Master Painters' Association of the Netherlands, which covers the whole of Holland outside Amsterdam, took exception to the composition of the zinc oxide paint used, and made representations to the commission that it was not possible to use it so thick (as the commission used it) in the ordinary way of trade, yet with whatever advantage accruing to the paint from being thick, it did not prevent the commission in their "final conclusions" from seriously qualifying the virtues of zinc oxide for outside work.

Their final conclusions are of the most qualitative character, and they had to admit that on the vital places such as lintels, sashes, cornices, and window sills, where protection is very important to the structure, zinc oxide did not give as good results as white lead.

DUTCH COMMISSION, "FINAL CONCLUSIONS."

Zinc white paints are not so well able to withstand frequent action of vapors containing sulphurous acid as white lead paints are. As the vapor occurs in coal smoke of locomotives, steamers, tall chimneys, etc., zinc white paint, which is much exposed to such smoke, for instance, in railway stations, etc., will soon become corroded, and is certainly not able to replace white lead there. (14231.) (See Appendix.¹)

WHAT PROHIBITION WOULD MEAN.

ZINC OXIDE.—THE DIFFERENCE IN TECHNIQUE REQUIRED.

The use of zinc oxide paint necessitates an entirely different training on the part of the painters from that required for white lead paint. This is due to the difference in the structure of the two paint pigments.

Good painting with white lead paint is tested by the thinness of the coat; this is an axiom of all good painting.

¹ In Minutes of Evidence, presented in a separate volume of the original report.

Cheap work is always done with a thick layer of paint.

Good painting work consists in the careful spreading and laying off of the paint so as to insure a thin film which dries through and hard. As each successive coat is laid on and dries, there insures a series of hard homogeneous films which give the maximum of wear service to the paint. This is possible with lead paint, because its density enables it to be brushed out thin and still cover.

But zinc oxide must be laid on with a thick coat or it would not cover; if brushed out thin, it involves more coats to get the necessary opacity. In the one case you have inferior painting, in the alternative you have a more costly process.

All fair-minded writers on the subject agree on this point.

M. Petit, a French engineer and a manufacturer of zinc paint, who appeared before the committee, admits this in a book which he published.

He says:

It is obvious from this (the prohibition in France) that the house painter accustomed as he is to the use of white lead, will, if lead is prohibited, have to recast all his ideas as to his method of painting, a difficult thing to do, especially for men of mature years, and a very great hardship and expense will be inflicted on the trade.

This is well brought out, too, in M. de Morsier's evidence.

15,633. In paragraph 15,511 you state, "The question of the thickness of the coat is equally important, because a painting composed of a number of thin coats is much more lasting than one composed of less coats applied thicker." Is not that a very strong argument in favor of white lead? Will you tell the committee why you can spread white lead into a thin serviceable coat, and why you can not do the same with zinc?—"The chief point is that the durability of paint depends not on the number of layers of paint, but on the thickness. The maximum durability of paint is obtained if you have a great number of extremely thin layers, and it is possible to obtain much thinner layers with white lead, because the white lead itself forms a more solid coat than zinc white; the reason for this being that lead carbonate forms with the linseed oil a soap, whilst zinc white does not do so."

This difficulty of technique does not exist to the same extent with paints made on a lithopone base; they can be used with much greater facility than zinc oxide, but they are entirely unsuitable for exterior work.

EFFECT OF THE PROHIBITION OF WHITE LEAD.

Franco is the only country that has made laws for the total prohibition of white lead, and even there exemptions are to be allowed, on the order of the minister of the interior, an unsatisfactory procedure if leadless paints are the best.

But in France the authorities gave a probationary period of five and a half years between the passing of the law, July, 1909, and the date of its coming into operation, January 1, 1915.

THE GRAVITY OF THE COMMITTEE'S PROPOSALS.

The majority of the committee advise a term of three years from the date of the signing of their report for the prohibition of white lead to become operative.

Even admitting the necessity of prohibition, which I do not, I feel that the members of the committee can hardly have realized the full import of their recommendation.

White lead is made a long way in advance of its sale and its use.

Many large users stock it for a period of two years to mature, in the belief, based on their experience, that the lead so held gains in covering power and durability.

The corrodors and grinders also hold large stocks in order to meet the demand made upon them.

Were the recommendation of the majority of the committee adopted, it would mean that a large quantity of this valuable material would be rendered worthless, a destruction of property which nothing in the case justifies.

In France, notwithstanding the fact that the use of zinc oxide is common and familiar to a large number of painters, both masters and workmen, the term of five years was thought to be necessary in which to effect the change.

The difficulty of transference from one material to another, quite distinct in its nature and in its mode of mixing, and the technique of application, could not possibly be overcome in the course of three years.

SOURCE OF ZINC OXIDE AND LITHOPONE.

Practically the entire English supply of zinc oxide is drawn from Continental sources. Several attempts have been made to manufacture it on a large commercial scale in England, but without much success.

LITHOPONE.

Lithopone is made by two firms only in the United Kingdom, and they use their entire output for their own specialties, so that in case of the prohibition of white lead English grinders would be entirely dependent for their raw material on the Continent and America. From the latter source the amount sent us is small, as it is largely used on the spot.

ZINC OXIDE NOT MADE IN ENGLAND (COMMERCIALY).

Zinc oxide is not made in England except by one firm, and that on a relatively small scale, as their chief industry is the making of lithopone. The consequence in case prohibition were enforced at the end of three years would be that the entire painting trade of this country would be held up, and dependent for its supply on foreign countries. Under such conditions the painting trade would be brought to a standstill for lack of material.

I do not attach importance to a material not being made in the United Kingdom if it can be made better elsewhere, and in any reference to our being dependent for zinc oxide and lithopone on foreign countries, my objection to it is that it is proposed to set aside something of known and definite value which we produce in this country for something which at present, and for a long time to come, we can not produce here, and which when produced is not as good as the material we possess.

WHAT WILL BE REQUIRED TO REPLACE WHITE LEAD.

The production of 50,000 tons of zinc oxide and lithopone is not to be easily achieved. The reply suggested is that the demand will create the supply.

A sufficient answer to that is, the manufacture of both zinc oxide and lithopone, though not secret processes, are matters of very delicate and complex manipulation, and depend for success very largely on accumulated experience, which takes many years to bring to perfection, and involves the training of skilled workmen and overlookers and the expenditure of enormous capital.

A FAILURE TO MAKE ZINC OXIDE IN GREAT BRITAIN.

The manufacture of zinc oxide was attempted on a large commercial scale in this country a few years ago at Ellesmere Port, on the Manchester Ship Canal; it ended in a disastrous failure and a great loss of capital, not from financial causes, but from lack of experience and skill in manufacturing the material. (Mr. Lancaster, 17569-17583.)

Mr. Lancaster's evidence on the possible sources of supply of zinc oxide and the difficulties of making it in this country is of the utmost importance.

We have not the facilities for making zinc oxide in this country. We have not the material for making it in this country. We have not the knowledge of making it even by what you call the indirect process. (17583.)

The fact that we produce so many tens of thousands of tons of zinc ore within the bounds of the Empire would bring no comfort to the painting trade (brought to a standstill for lack of material) if we did not convert it into zinc oxide, and there is no possibility of this being done inside three years. The works and equipment to produce 50,000 tons of zinc oxide per annum could hardly be built in the time, and the men to work them presents an even greater difficulty.

A FAILURE IN FRANCE.

Mr. A. Villemot in his evidence stated:

Three factories, for instance, were established for the manufacture of lithopone, with a capital of 3,000,000 francs (\$579,000), and three factories were also established for the manufacture of oxide of zinc, and all these institutions have gone into liquidation. (15206.)

But it is impossible, according to that, to produce zinc oxide of a good quality?—No. I mean that it is a question of knowing how to manufacture. (15238.)

70,000 TONS OF ZINC PIGMENT REQUIRED—AN IMPOSSIBLE PROPOSITION.

Further, when prohibition is enforced in France, something like 25,000 tons additional to the present world supply of zinc oxide and lithopone will be needed annually in that country alone, making, with what would be required here to replace the white lead withdrawn from use, something like 70,000 tons. An impossible proposition to effect in three years.

ADMITTING 5 PER CENT OF SOLUBLE LEAD.

The majority of the committee propose to admit a 5 per cent solubility of lead in "leadless" paints, such a proportion being necessary for the production of greens and yellows and other colors, but a 5 per cent solubility can not be regarded as leadless paint, except if so defined by statute, and, more important still, it is a question whether it would

obviate the present trouble of diagnosing lead poisoning amongst painters.

Further, if the use of lead is restricted to a 5 per cent solubility, it cuts out entirely the large range of valuable reds which are to-day in use, and which depend for their permanency of color on a red lead base.

The difficulty of proving that the suggested limitation of 5 per cent is being observed would be enormous, and very vexatious to all involved, and its enforcement would necessitate a very large inspection rate.

DIAGNOSING LEAD POISONING.

The diagnosis of lead poisoning by the medical profession in the past has left something to be desired on the grounds of accuracy, and in its effect on the statistics of lead poisoning; this is being recognized to-day by medical referees.

It is a fair comment to say that, in view of recent investigations as to the action of volatile vapors given off from drying paint by turpentine, some of the sickness which has occurred amongst the workmen (credited to lead poisoning) must be credited to that important and essential ingredient of paint, turpentine.

TURPENTINE AND ITS EFFECTS.

I think that my experiments show that the commonly noticed symptoms of headache and nausea, and also colic of a type, that is to say, stomach ache complained of by people from the smell of paint, are explainable on the turpentine hypothesis. (K. W. Goadby, 14740.)

If turpentine acts on the kidney as one has shown that it does (and one knows that lead does) it is highly important. (14751.)

FRESH PAINT AND SICKNESS.

I have also inquired into and seen cases of poisoning or illness produced by smelling fresh paint, and such illnesses are always more nearly allied in their symptoms to those of turpentine poisoning than of lead poisoning. In fact, I think it is quite easy to distinguish. (K. W. Goadby, 14790.)

Then your conclusion is that there is a definite illness from turpentine not easily confused with lead poisoning?—Not easily confused, but I think it has been confused a good deal, because it has been associated with paint. (K. W. Goadby, 14791.) Yes, quite. You say, in fact, that turpentine introduces the danger of a new illness?—I think so. (K. W. Goadby, 14794.)

THE TENDENCY OF MEDICAL DECISIONS.

The tendency of doctors to give the benefit of the doubt in cases where the man has been engaged in lead occupations, and bring in a verdict of lead poisoning, is thus referred to in Mr. Goadby's evidence: There is always a tendency, recently at any rate, to bring in a verdict of lead poisoning if possible. I think that that is the general tendency. (14813.)

What makes you say that, because you know there is a medical referee?—Yes, I know. I know several medical referees, and they each of them take this view, and I am not criticizing their view, that in a case of doubt, where the evidence is almost evenly balanced and there is evidence of the man having been employed in a lead industry in which he might have contracted lead poisoning, it is common just to give the benefit of the doubt on the point of lead. I think that is right, but for the purposes of statistics it is a little disturbing. (Mr. Goadby, 14814.)

But that opinion of yours would not apply to lead industries where turpentine was not used?—I am talking of all lead. I think that that is the general point of view that a referee would take. I should take it myself if I was acting as referee. I think that it is a fair one, but it is disturbing with regard to statistics, however fair it may be. Thirty deaths is rather a small number to go on alone. (Mr. Goadby, 14815.)

LEAD POISONING NOT AN UNPREVENTABLE DISEASE.

Paralysis and all these maiming diseases which follow lead poisoning only come on in the majority of cases after very long continued exposure. I do not consider lead poisoning by any means an unpreventable disease. I believe it might be a preventable disease if it were recognized in the earlier stages that these changes were going on in the blood. (14819.)

I have shown you that basophile staining may occur in turpentine poisoning. It may occur also presumably in zinc poisoning. The point is that that curious staining in the red cells is not a symptom of lead poisoning alone, and it must not be regarded as such. (Mr. Goadby, 14819.)

But it is most important that such an investigation should not be undertaken by anyone unless he be a competent person in doing blood examination. It can not be done, I am afraid, by the man who is in general practice in the ordinary way. He has not the time or the facilities for doing a rather technical operation of that sort. (Mr. Kenneth Goadby, 14810.)

LEAD POISONING AND LEAD ABSORPTION.

Lead poisoning and lead absorption are not synonymous terms. The literature with regard to the potteries makes the statement that certifying surgeons are to observe that. (14786.)

The problem is not necessarily to abolish the use of white lead; it is to combat its ill effects on the system of the workmen.

SUSCEPTIBILITY TO LEAD POISONING.

I think that it might be possible to devise regulation for practically cutting down lead poisoning to "nil," and I think that in examining the men from time to time in the way I have suggested you would put your finger on the big point—on the men who are careless—and you would have to weed them out, and also the susceptible people. That is what we have done in the white lead works. There are certain people who ought not to be employed in a lead trade, because they are susceptible to lead. There are many intercurrent diseases. There are many men with kidney disease not due to alcohol, but to old rheumatism or scarlet fever. If such a man presented himself at lead works he should not be employed, because he would be dealing with a poison when his tissues are already half poisoned with something else. I think that a very great deal might be done with regard to painting in that way. (Mr. Kenneth Goadby, 14906.)

REGULATIONS AND THE ABOLITION OF DRY RUBBING DOWN.

A better solution of the question would be found in the total prohibition of dry rubbing down.

Accepting the dust theory as the prolific source of lead poisoning (and all the medical authorities are agreed on this point) the abandonment of dry rubbing down would remove at once the source of 90 per cent of the trouble.

I am convinced that if dry rubbing down were prohibited, and, if necessary, enforced by penalties, the trade would observe the restriction and find a substitute for it. The abolition of dry rubbing down is an inconvenience rather than an impossibility.

Stress is laid on the difficulty of enforcing regulations; that is not necessarily a valid reason for not imposing them.

There would be two parties to the regulations, the employer and the workman. The latter would be an efficient check on those employers who sought to evade their obligations, since the health of the workman himself is in question.

The crux of regulations centers on two points: (1) The prohibition of dry rubbing down; (2) facilities for washing.

DANGER IN USE OF LEAD IN THE PAINTING OF BUILDINGS. 177

WASHING ACCOMMODATION ALWAYS AVAILABLE—WATER A NECESSITY FOR THE WORK—HOT WATER NOT A NECESSITY FOR WASHING.

The provision of washing accommodation exists now on most jobs. Men must have hot water for purposes of their work. If hot water is not laid on, they make a fire and heat it in buckets. They also boil water for their meals.

If they can do this for the purposes of their work, they can do it for washing purposes; though the necessity for hot water is not stressed in the least by the medical witness:

Hot water for washing not important. (Mr. Goadby, 22063.)

Unless you can go to the fountainhead of the mischief and stop the dust, you are not going to secure much improvement by all the cleanliness in the world. (Dr. Legge, Q. 273.)

REGULATIONS NEVER TRIED IN THE PAINTING TRADE.

Regulations in the painting trade have never been tried, so their value can not be estimated.

It is only fair to the employers (master painters) to remember that in the experience of thousands of them, the evils of lead poisoning do not exist. It is known to them only by hearsay, or through the published tables of the board of trade, or reports of cases in the daily and other papers.

A PERSONAL EXPERIENCE.

I myself was intimately associated with the trade for nearly 40 years, first as an apprentice and for over 32 years as an employer, and during all that time I never to my knowledge came into contact with a case of lead poisoning. My experience must be that of thousands of other employers.

Seven hundred and twenty "cases" a year, many of them slight, distributed amongst some 20,000 employers, must of necessity pass unnoticed by large numbers.

LEAD DUST NEVER SUSPECTED AS A DANGER.

It is also due to the master house painter to point out that until quite recently the great source of the danger, lead dust, caused by dry rubbing down, was unsuspected by them, the evil being attributed to personal negligence and careless habits.

Nor was this opinion confined to employers. Mr. A. Gardner, who signs the majority report, giving evidence in the building accidents inquiry, 1907 [Cd. 3848], said:

If a man cleans his hands before he takes his food and keeps his overalls in decent condition there is not much risk. (1729.)

I suppose the painters understand that lead poisoning is largely a matter of cleanliness on their part?—Oh, yes, if a man has painter's colic it is to a great extent his own fault, generally speaking. (1758.)

That is because he does not take the precautions which are absolutely necessary?—It is generally due to uncleanness on his part. (1759.)

I am not quoting this evidence as showing any inconsistency on the part of Mr. Gardner. At that time, and with the information I then had, I should myself have replied in similar terms; but this

only confirms the plea I make, that in the matter of lead poisoning the trade has been fixing its attention on the minor evil and neglecting the graver source of trouble.

The investigations and report of the pottery committee drew attention to the danger of lead dust, and the improvement in the health of the workers in white lead works, effected by the requirements laid down by the Home Office, enforce the same conclusion, but the information is unknown to the vast majority of painters.

It is reasonable to suppose that if attention were definitely drawn to this point as it would be if dry rubbing down were prohibited, benefit would be derived from it.

THE EXPERIENCE OF HOLLAND.

The experience of Holland is very similar to that of Scotland. The Netherlands Association of Master Painters includes some 1,400 members, employing 10,000 painters. They have an insurance society for their members, which is an arrangement made between them and the Government, the scale of payments and compensations being settled by the Government. Both are on a much more liberal scale than in this country, but the administration remains in the hands of the association.

The association covers all Holland outside Amsterdam. Mr. M. Nooijen is the secretary of the insurance committee, and makes out all orders for payments for compensation on the Government.

In Holland, lead poisoning, if acute, may be regarded as an "accident" (since 1907), as it is in this country, yet Mr. Nooijen stated to the committee that they had not had any cases of lead poisoning. (Q. 14309-23.)

In my opinion, the significance of the case of Scotland, where there are nearly 15,000 painters, employers, and workmen, and where there were 20 cases in five years (voluntarily reported), and on the evidence of Dr. Legge, lead poisoning (outside the Glasgow area) is negligible, has not been sufficiently appreciated.

Scotland gives cause for serious consideration before destroying an industry, and condemning a material so valuable to the community in protecting its structures as is white lead.

I have not dealt with the question of white lead as a medium of decoration. Its value in this respect is very great, and much can be said for it, as the important evidence of Mr. J. D. Craco discloses, but I have confined my comments to its value to structures and buildings of all kinds.

I am not for the use of white lead at any price, but the public, the manufacturers, and the painting trade are entitled to ask that before so decisive a step is taken as the prohibition of an industry, and a material that has fully justified itself to the community as a valuable material for protective and decorative purposes, regulation should first be tried.

ROOT AND BRANCH PROHIBITION.

Expert opinion is divided as to the respective value, as a paint pigment, of a chemically pure zinc oxide and one containing a percentage of lead salts up to 4 per cent or 5 per cent. For the purposes of channels the former is more generally approved, but for purpose

of paints the zinc oxide, made by the direct process, and containing a small percentage of lead, is considered the more useful and stable pigment.

But if the prohibition of white lead is to be adopted, to be legally efficient it should be root and branch prohibition, without qualification. It would thus get rid of "lead" poisoning, whatever else it brought in its train.

It would also relieve the trade of the liability of lead poisoning as a statutory accident, but so long as any percentage of lead is allowed to remain in the zinc, or the colors, any and all sickness arising from paint may be debited to lead poisoning, so that if percentages of lead are allowed to remain the difficulty of exact diagnosis will remain with it.

This difficulty is no imaginary one, as the testimony of Mr. Goudby given above discloses.

The effective prohibition of lead will seriously reduce the colors for painting and decorative work, and will rule out whole ranges of colors which can not be replaced by zinc colors except at enormously increased cost, which for most commercial purposes would be prohibitive, but that is one of the prices the community must pay if lead is to be prohibited.

Speaking on behalf of the painting trade, I may claim that the master painters are as solicitous as any other body of employers to do what is possible for the welfare of their men, and I feel assured that if regulations were passed they would willingly cooperate with the authorities to make them effective.

My suggestion, put forward with all diffidence, is that regulations should be given a trial for a period of five years, 1915-1919; that the results should be carefully tabulated with a view to see their effect, and if any diminution of attacks and deaths ensued, and that at the end of the period the position be reviewed in the light of the ascertained facts.

If no diminution had taken place, the case for the prohibition of the use of lead would be greatly strengthened, and would be difficult to resist.

I would further respectfully suggest that if in the meantime a committee of investigation could be appointed, comprising representatives of, amongst others—

- The Royal Society of Arts,
- The Royal Institute of British Architects,
- The Society of Chemical Industry,
- The National Federation of Paint and Varnish Manufacturers,
- The National Association of Master House Painters,
- The National Amalgamated Society of Operative House Painters,

under an independent chairman, to formulate a plan of operations for making exhaustive tests of white lead and zinc paints, under conditions that would be accepted as authoritative, it would be very helpful in educating public opinion on the point.

I associate myself cordially with the majority in acknowledging the very able service rendered to the committee by Mr. E. A. R. Werner, who has acted as secretary throughout the inquiry.

I much regret that I am compelled to place myself in such direct antagonism to the finding of my colleagues on the committee, but

I have endeavored to give the investigation the benefit of whatever experience I have gained in a lifelong and intimate connection with the painting trade, and have been prompted solely by the desire to have both sides of the question freely ventilated.

This must be my apology for this somewhat lengthy report.

I have the honor to remain, sir, your obedient servant,

W. G. SUTHERLAND.

February, 1915.

I attach a summary, and an outline of regulations; the first, I submitted to the committee.

A SUMMARY.

I submitted to the committee the following summary as a fair deduction from the evidence put before it:

That the inquiry into the use of white lead in building operations by this committee has established—

(1) That the fatalities and injuries to health arising from the use of white lead as a paint are serious.

(2) That the exact incidence of "cases" is uncertain, and in the present state of information conjectural.

(3) That regulations applied to factories where lead is made and used has greatly reduced the "case" and the "fatal" in these industries.

(4) That it is fair to assume that regulations applied to the painting trade would have similar results.

(5) That the center of danger in all lead industries is in the dust produced.

(6) That in the painting trade the dust-producing processes hurtful to the health of the operatives rest on the dry rubbing down of lead paint.

(7) That the danger of lead poisoning from emanations given off by drying paint, or from fumes created by burning off old paint, as proved by the evidence, does not exist.

(8) That the danger arising from painted processes is trivial compared with the danger from dust, but not entirely negligible.

(9) That the incidence of lead poisoning amongst house painters over the number engaged is much lighter than in the other industries into which lead enters, and which come under the operation of the factory acts. Therefore it is desirable before proceeding to so drastic a course as the prohibition of the use of white lead to give a trial to regulations over a sufficient length of time to demonstrate their efficiency or otherwise.

(10) That in Scotland, where the use of white lead in painting operations is as extensive, per painter, as in England, and where the use of abrasives such as sandpaper and dry rubbing down with pumice stone is equally practiced, lead poisoning outside the Glasgow area is almost negligible (vide Dr. Legge's evidence).

(11) That in England the great areas of lead poisoning are London, Lancashire, Birmingham, and Leeds.

(12) That this large location of the evil to congested centers points to indifferent environment as weakening the resistance to

attacks of white lead, and which might be further elucidated by notification of all attacks being made compulsory.

(13) That this is another cogent reason for caution before coming to a decision to prohibit the use of white lead.

(14) That the most rational course is to prohibit (under heavy penalties) dry rubbing down, and thus at one stroke remove the great source of danger from poisoning by lead dust.

(15) That a probationary period of not less than five years be allowed, during which time it shall be made compulsory on the employer to make returns of all cases occurring to his workmen so as to arrive at the true incidence of cases.

That to insure perfect returns the machinery of the new insurance act should be utilized for the stating of all cases, slight or otherwise, of lead poisoning.

(16) That during this period all materials into which lead enters i. e., colors, patent driers, etc., shall be labeled at their source of supply in conspicuous letters as "poisonous," and that it be obligatory on every master to have fixed in a prominent place in his shop a sheet supplied by the Home Office, pointing out the dangers attaching to the use of white and red lead and its compounds, and the necessity of cleanliness in handling them.

(17) That inasmuch as it is the custom long established for operative house painters to provide their own overalls and have them washed at regular intervals, no interference with this practice is necessary beyond making it compulsory on all painters, including workmen employed as painters in foundries and engineering shops and the painting of railway stations and bridges, to wear overalls and have them washed at stated intervals of not less than once in seven days.

(18) That in the present state of supply of zinc paint, whether oxide or sulphide, the prohibition of white lead as a paint base would paralyze the industry of painting and make us entirely dependent on foreign sources of supply, which would not for many years meet the demand.

(19) That this position would be greatly intensified if after 1914 the prohibition of white lead in France becomes operative.

(20) That no Government except France has prohibited the use of white lead, that the State railways of Prussia gave leadless paints an exhaustive trial extending over two years, and abandoned it as unsatisfactory and reverted to the use of lead paints.

(21) That there does not appear to be any white pigment so accessible, so universal, and so reasonably adaptable as a paint to meet all the fluctuations of temperature and climatic conditions of this country as white lead.

(22) That its abolition and the substitution of zinc oxide would impose on the painting trade an entire recasting of its methods and the unlearning of all that it has previously been taught to regard as good painting.

(23) That (with perhaps the exception of the Dutch) the British painter takes first place in Europe amongst painters for the quality of his work, which has a fine tradition attached to it, and it would be a grave mistake to prejudice what Mr. Wonnacott, F. R. I. B. A., in his evidence before the committee, rightly described as a craft.

W. G. S.

OUTLINE OF REGULATIONS.

The peculiar dispersed character of the operations of painting make inspection a difficult matter. Everyone admits this, but in face of the great limitation of the origin of lead poisoning to dry rubbing down (as proved by the medical evidence) its control becomes a much simpler matter.

If the problem of "lead" poisoning were complicated by lead emanations from wet or drying paint, or from paint in cans or kegs, it would be more difficult in solving, but centered as it is largely in this one process, it should not be difficult to control.

Everything else falls into insignificance before this, and the solution of the problem should not be insurmountable.

If it were made a penal offense to rub down white lead paint by the dry process, it would soon resolve itself.

The regulations suggested are merely put forward as a framework for further elaboration if necessary, but it appears to me that elaborate and complicated regulations would defeat their intention, and the simpler they are, so long as they effect their purpose, the more likely are they to be willingly complied with.

A system, such as is outlined, would give the Home Office a mass of exact data which would ultimately determine the problem one way or the other.

SUGGESTED REGULATIONS.

Notification by the Home Office to be posted conspicuously in every painter's shop and in all workshops and engineering and other works where painters are employed as to—

The danger spot in painting operations, i. e., dry rubbing down, and its prohibition.

The necessity for personal cleanliness.

The labeling in bold letters as poisonous at their source of supply of all compounds containing lead.

The imposing on all paint and color manufacturers to send out their colors containing lead to painters, moist, i. e., ground—

- (1) in water for distemper colors.
- (2) in turpentine, or
- (3) in oil.

For fine colors this could be done in tubes, as is the practice at present of a large number of firms, and, for big bulk, in kegs.

Compulsion on all workmen to provide overalls and have them washed once a week. This operates with all decent painters to-day, and is the custom of the trade.

Five minutes to be allowed by the employer before each meal hour for washing of hands.

The employer to provide washing facilities and soap and towels. Medical inspection at intervals of two months and the certification of same on cards to be provided for the purpose.

There is no serious difficulty in this, as even for workmen working on country jobs, the bulk of them "come in" once in every two months; this is a stipulation in most working rules. The possession of such a card to be obligatory on the workman, and to last for a year, the cards to be returned to the Home Office at the end of the year to be tabulated, and the records kept.

All cases of "lead poisoning," their exact nature, development, duration to be recorded and checked by the medical referee in the district concerned.

In cases where there are symptoms of lead poisoning, the employer to transfer the workman to work where he will not come in contact with lead—this in case the attack is slight, and not sufficient to preclude the man from working. (In the latter case he comes under the operation of the Workmen's Compensation Act.) The many processes in the painting trade gives the employer opportunities for this without any serious inconveniences.

W. G. S.

NOTES ON MR. SUTHERLAND'S MEMORANDUM.

In regard to Scotland, Mr. Sutherland is entirely erroneous regarding the comparatively small number of lead-poisoning cases. The returns received by the Scottish Painters' Society during the first 18 months that sick benefit was payable under the National Insurance Act show that 23 members were certified as suffering from "colic," "lead colic," or "plumbism," while in addition to these cases 6 members received workmen's compensation for the same disease; and these figures fully bear out Dr. Legge's estimate as to "attack" cases. The cause of a large proportion of these cases not appearing in the analysis of reported cases is the want of notification by medical practitioners to the factory department.

It is true that the proportion of cases to the membership of the Society shows a lower attack rate than among painters in England. This is accounted for by the fact that in Scotland there is far less dry rubbing down than in England.

The quotations from my evidence of 1907, given before a committee dealing with building accidents, only show that before close inquiry I inclined to the opinion that the dangers were exaggerated. I entered the present inquiry with an open mind and found that the evidence was such as to convince me absolutely.

ARCHD. GARDNER.

In our opinion, Mr. Sutherland's arguments respecting the different technique required for applying zinc paints could not be regarded seriously and would not be accepted by practical men—whether employers or operatives—in view of the admittedly wide use of such paints in France, Holland, Belgium, and Scandinavia, as well as the evidence of witnesses regarding the extensive use of such paints in this country for interior painting, and in many cases for exterior painting also, where zinc and lead paints are habitually applied by the same workman.

ARCHD. GARDNER.
J. PARSONAGE.

Mr. Sutherland has, in his memorandum, reflected on the methods whereby his colleagues have arrived at their conclusions; we feel it to be unnecessary to refute Mr. Sutherland's allegations in detail, but we must protest against the implication that we have based our findings on the testimony of any one individual witness, inasmuch as the evidence sufficiently reveals the wide scope of our investigations.

We wish, further, to dissociate ourselves from the way in which the evidence relating to H. M. office of works is dealt with. Both Sir Henry Tanner and Mr. Patterson came before the committee to state the experience and observations of unbiased officials of a Government department, having neither personal nor pecuniary interest in either lead or zinc.

Those members of the committee whose signatures follow that of the chairman hereunder regret the form of Mr. Sutherland's reference, on page 166, to an unimportant incident. Mr. Sutherland presents his quotations—without their context—in such a manner as to infer a lack of fairness on the part of the chairman, whose conduct of the whole inquiry we need hardly say has been as impartial as it has been conspicuously able.

ERNEST HATCH, *Chairman*.
GODFREY BARING.
HENRY BENTINCK.
EDGAR L. COLLIS.
F. G. RICE.
ARCHD. GARDNER.
J. PARSONAGE.

TABLE OF INFORMATION SUPPLIED

Mar- ginal num- ber.	Name of user of lead- less paint.	Brand of lead- less paint.	Leadless paint used for—		Longest time exposed without repainting.	
			What purpose.	How many years.	Internally.	Externally.
1	Smedley's Hydropathic Co. (Ltd.), Mallock.	A		About 12.	7 years.	5 years.
2	West Ham Corpora- tion.	A		4.	4 years.	4 years.
3	Chertsey Union Guardians.	A	Exterior of in- firmery.	do.		do.
4	Rudd & Son (Ltd.), Grantham.	A		10.	5 years.	
5	Balliol College, Oxford.	A	Special pur- pose in labo- ratory work.	8 or 10.		
6	G. Ramsholtham, 6 St. George's Parade, Finsbury Road, N.	A		9.	8 years.	6 years.
7	Rugby School.	A	Rugby school, school suna- torium, town hospital.	About 10.	About 10 years.	
8	The Infants' Hospital, Vincent Square, S.W.	A		7.	4 years.	4 years.
9	Do.	B		4.	do.	3 years.
10	Do.	C		do.	do.	4 years.
11	E. Watts & Sons, Cotes, I. of W.	A		About 12.		
12	Do.	{D, E}		About 15.		
13	Do.	E	Houses.	do.	8 years.	4 or 5 years, according to position.
14	Partnership Ten- ants (Ltd.), 6 Bloomsbury Square, W.C.	A		10.		
15	Do.	B, F, G.	do.	1 to 2.		
16	J. Clarke, Esq., F.R.I., No. 31, Castle Street, Liverpool.	A	Mills.	About 10.	4 to 5 years.	4 to 5 years.
17	Do.	H.	do.	do.	5 years.	
18	Do.	(Em- mel.)	do.	do.		
19	Leeds Forge Co. (Ltd.), Leeds.	J.		5.	Not used.	3 years.
20	Do.	K.		3 months.		
21	Consett Iron Co. (Ltd.), County Dur- ham.	J.	Outside of corrugated iron roofs.	About 10.		3 or 4 years.

BY USERS OF LEADLESS PAINTS.

Mar- ginal num- ber.	To what extent found satisfactory as regards—				Other remarks.
	Finish.	Durability.	Permanence of color.	Cost of painting operations.	
1	Very good.	Satisfactory; bright and fresh after washing.	"Stands well" (white prin- cipally used).	One-third more than ordinary lead paints.	Well worth additional cost; its finished appearance keeps much better than or- dinary paints.
2	Good glossy surface.	Good.	Good.	Compares favor- ably with other paints.	
3		Lasting very well.			
4	Very satisfac- tory.	Very satisfac- tory.	Very satisfac- tory.	About 6d. (12 cents) per yard superficial.	Best and most economical come across.
5		do.	do.		A paint was wanted which would remain smooth when under slightly warmed wa- ter day and night for months. The paint was very satisfactory for this purpose.
6	Good.	Good.	Good (cream and white best).		For the past 9 years has found nothing better for ex- ternal and internal use.
7	do.	do.	Good.		Preferred to any other on the market. The body is denser; although it may be rather difficult to apply, the extra labor is well ex- pended.
8	Excellent.	Excellent.	It stood well.	Rather heavy.	Paint put on new building.
9	do.	do.	White mostly used; excel- lent in every way.	Quite reasonable.	
10	Fairly good.	No good what- ever when exposed to weather.	Good where sheltered.	Rather cheaper than B.	
11	Very good.	Very good.	Good.	Rather more than ordinary and other lead- less paints.	
12	Good.	Good.	do.	About the same as ordinary paint.	
13	Very good.	Very good.	Very good.	Little more than lead paints at first, but less sens as men got used to it.	Used on about 2,500 houses.
14	Good.	Our best up to now.	do.	do.	
15					Do not propose to use these again as they are not so good as A.
16	Very good.	Very good.		Two coats prop- erly applied and one coat A results for walls; A is the better for steel and wood- work. Large number of mills and works treated with enamel paints on pre- paration, which is more satisfactory than using lead paints for first and second coating under the enamel.	
17	do.	do.		do.	
18	do.	do.	Good.	do.	
19	Solid good.	Medium.	(Black)	Below the aver- age.	
20	Good.		do.	do.	Easily worked and good covering power.
21					

TABLE OF INFORMATION SUPPLIED BY

Mar- ginal num- ber.	Name of user of lead- less paint.	Brand of lead- less paint.	Leadless paint used for—		Longest time exposed without repainting.	
			What purpose.	How many years.	Internally.	Externally.
22	Manchester Corpora- tion (cleansing department).	J.	.....	1.	.....	.....
23	Low Moor Co. (Ltd.), Bradford.	J.	Outside iron- work.	10.	Not used.	3 years.
24	Stewarts & Lloyds (Ltd.), Coatbridge, N. B.	J.	Galvanized corrugated sheets.	About 5.	(Say) 4 years.	(Say) 2 years.
25	Do	L.	do.	.....	.....	.....
26	Easton Glibb & Son (Ltd.), Rosyth, In- verkeithing.	J.	Steel girder work.	3½.	No records.	.....
27	Otto Coke-Oven Co. (Ltd.), Craigstone, Wakfield.	J.	Coke-oven plant.	2 to 3.	2 years.	2 years.
28	R. Hood Haggie & Son (Ltd.), New- castle-on-Tyne.	J.	.....	10 to 12.	Not used.	3 to 5 years.
29	Sharpe & Co., Phoenix Foundry, Lancas- ter.	J.	Corrugated iron roofs.	10.	.....	.....
30	Hendon Paper Works Co. (Ltd.), Sunder- land.	J.	.....	About 12.	About 7 years.	About 3 years.
31	The Koppers Coke- Oven & Bye-Pro- duct Co., Sheffield.	J.	Chemical plant.	4.	.....	.....
32	Sheffield Coal Co., Sheffield.	J.	Ironwork.	3.	3 years.	3 years.
33	Farnley Iron Co. (Ltd.), Farnley.	J.	Outside iron- work.	5.	5 years.	do.
34	Taylor Bros. & Co. (Ltd.), Clarence Iron Works, Leeds.	J.	Iron chimneys, parts of ma- chinery.	5 to 7.	.....	1 year.
35	A. T. Green & Sons (Ltd.), Northfield Engineering Works, Rotherham.	J.	.....	10.	.....	2 to 3 years.
36	South Metropolitan Gas Co., (Old Kent Road, S. E.)	J.	Gas works.	6.	.....	2 years.
37	Armstrong, Whit- worth & Co. (Ltd.), Elswick (ordnance department).	J.	Corrugated sheeting.	9.	.....	8 years.
38	Armstrong, Whit- worth & Co. (Ltd.), Elswick (mercantile ship building de- partment).	J.	Ships.	do.	.....	.....
39	City Steamboat Co. (Ltd.), (Great St., Helen Street, E. C.)	M¹.	Steamships.	4.	3 years.	1 year.
40	Greenshields Cowie & Co., 32 Castle Street, Liverpool.	M¹. M².	do.	About 14.	More than 2 years.	.....
41	Rankin, Gilmour & Co. (Ltd.), 67 South John Street, Liver- pool.	M¹.	do.	20.	Not used.	12 to 14 months.

USERS OF LEADLESS PAINTS—Continued.

Mar- ginal num- ber.	To what extent found satisfactory as regards—				Other remarks.
	Finish.	Durability.	Permanence of color.	Cost of painting operations.	
22	Good.	Can not say.	Can not say.	Slightly cheaper than ordinary paint.	.....
23	do.	Good.	Good.	Painting avail- able.	Very satisfactory.
24	Good; varnish- like.	.....	Soon after ex- posure gloss disappears, leaving dark- brown color.	About 24 (4 cents) per square yard.	.....
25	.....	Double that of J paint.	.....	More expensive than J paint.	.....
26	.....	More durable than rod lead, iron oxide paints, or black var- nish.	.....	.....	Exposed to sea air and water; alternately wetted and dried by running and falling water.
27	Good.	Good.	Good.	Reasonable.	"To maintain a good appear- ance with our plants, we consider it desirable they should be painted every two years."
28	Clean and bright.	do.	Good (black only).	Less than oil paint, flows well, more covering power.	Wellsatisfied; only objection being that it can not be ob- tained in brighter colors.
29	.....	.....	.....	.....	Quite satisfactory.
30	Good at first; becomes dull.	.....	.....	.....	.....
31	All right; black mod- erately shiny surface.	More satisfac- tory when applied to bare iron & foundation.	Black; entirely satisfactory.	Much cheaper than ordinary paint.	Not so satisfactory when ap- plied to apparatus pre- viously coated with boiled oil or other paints.
32	Good.	Good on clean foundation.	Good.	1d. (2 cents) per square yard in structural work.	For corrugated iron it is ex- cellent if put on when sheets are clean, as it does not crack or fly off when the sheets are bent.
33	Fine gloss, similar to varnish.	Good.	All right.	Varies according to class of work.	.....
34	Good.	do.	Good.	.....	.....
35	do.	do.	do.	Reasonable; easily put on and covers well.	The only paint they have found to withstand sulphur fumes.
36	Very good.	Very good.	Very good.	About the same as any ordi- nary paint.	.....
37	Satisfactory in every respect.	Satisfactory in every respect.	Satisfactory in every respect.	Approximate- ly 3 cents per square yard.	.....
38	.....	.....	.....	.....	Vessels leave the yard shortly after the work is done; no complaints from clients as to durability, etc.
39	Very good indeed.	Very good indeed.	Very good indeed.	Various.	.....
40	Satisfactory.	Satisfactory.	Satisfactory.	Cheaper than lead paint; better cover- ing power.	.....
41	Good.	Good.	Good.	Medium.	.....

TABLE OF INFORMATION SUPPLIED BY

Mar- ginal num- ber.	Name of user of lead- less paint.	Brand of lead- less paint.	Leadless paint used for—		Longest time exposed without repainting.	
			What purpose.	How many years.	Internally.	Externally.
42	Cork Steamship Co. (Ltd.), Chapel Street, Liverpool.	M ¹ N ¹	Steamships	15. 13. Over 20 years.	1 to 11 years.	
43	Evan Thomas Rad- cliffe & Co., 4 Dock Chambers, Bute Dock, Cardiff.	M ¹	do.	6.	At least 2 years	6 to 9 months.
44	Charles Radcliffe & Co. (Ltd.), Vienna Chambers, Bute Street, Cardiff.	M ¹	Brewery	2.	18 months.	6 months.
45	Wainey, Condie, Reid & Co. (Ltd.), Brewer Street, Fimlico.	M ¹	Tramcar roofs.	3.	Cars painted annually. ^a	
46	East Ham Corporation	P ¹ M ¹	do.	About 2. 5.	3 years.	3 years.
47	Do.		Pier and thea- ter.	4.	13 months.	6 months.
48	West Pier Co., Driugh- ton.	M ¹	Iron and steel surfaces in ships build- ing.	10.	(b).	
49	Cammell, Laird & Co. (Ltd.), Birkenhead.	M ¹	Steamships	About 14.	3 to 4 years.	1 to 2 years.
50	Galbraith, Pembroke & Co., 31 Leadenhall Street, E. C.	M ¹	do.	About 10. Over 20.	12 months.	6 months.
51	R. Hughes-Jones & Co., 18 Water Street, Liverpool.	M ¹	do.	20 to 23.	6 months.	
52	William Gray & Co. (Ltd.), West Har- lepool.	M ¹	Steamships (decks, holds, and general)	12 to 15.	About 2 years ^c	6 to 9 months.
53	Anglo-Saxon Petro- lium Co. (Ltd.), 21 St. Mary Axe, E. C.	M ¹	Outdoor work; e.g., railings, park seats, shelters, etc.	21.	Not used.	2 years.
54	Jenkins Bros. Mer- chants' Exchange, Cardiff.	M ¹	Iron surfaces.	3.	do.	3 years.
55	Failing Corporation	L.	do.	10.	About 3 months.	18 months ^d .
56	Do.		do.	3.	16 to 18 months	12 months.
57	Do.		do.	2.	1 year.	10 months.
58	Hall Steamship Co. (Ltd.), Cardiff.	M ¹	Steamships	do.	2 years.	2 years.
59	Thames Iron Works, Tower Hill, E. C.	M ¹	House paint- ing (very ex- posed pos- ition).	do.	About 12 months.	
60	Mercantile Steamship Co. (Ltd.), 91-3 Bish- opsgate, E. C.	R ¹	House paint- ing.	do.	3 years.	3 years.
61	Payne & Sanders, 57 Broad Street, Wor- cester.	S.	do.	3.		
62	C. J. Hinde, 117 Han- ley Road, Stroud Green, N.	S.	do.			
63	W. M. Gledhill, 191 J. H. H. Road, Brixton.	S.	do.			

USERS OF LEADLESS PAINTS—Continued.

Mar- ginal num- ber.	To what extent found satisfactory as regards—				Other remarks.
	Finish.	Durability.	Permanence of color.	Cost of painting operations.	
42	Satisfactory	Satisfactory	Satisfactory	Satisfactory	Experience of M. paints, in holds as well as on decks, has been highly satisfactory.
43	Very satisfac- tory.	Very good.	Uniform.	Cheaper than ordinary mixed paints as regards cost of material.	The paint is of uniform qual- ity, and much superior to the lead paints formerly used.
44	Excellent.	Very satisfac- tory.	Good.	Slightly in ex- cess of lead	
45	Good.	Can hardly state yet.	Stands well.	Painting Practically the same as ordi- nary paint.	
46	Satisfactory	Satisfactory	Satisfactory	do.	Cars painted annually "ac- cording to police regula- tions."
47	do.	do.	do.	do.	Suits pier work the best; ex- cellent paint for sea work; withstands action of sea water.
48	Enamel gloss.	Will stand and look well af- ter 3 years.	Very good.	About the same as other paints	As work leaves premises en- tirely, results are not seen after any length of time.
49	Satisfactory	Good.	Satisfactory	Satisfactory	Results generally satisfactory.
50	Good.	Good.	do.	do.	
51	Satisfactory	Satisfactory	do.	Satisfactory	Time varies according to voyages and climates.
52	do.	do.	do.	do.	
53	Good.	Very good.	Good.	do.	
54	Very good.	do.	Very good.	do.	
55	Quite satisfac- tory.	Last particu- larly well.	Shades well maintained.	Cost of material cheaper than ordinary	According to class of cargo carried. Entirely satisfac- tory for all purposes.
56	Good covering power and gloss.	Very satisfac- tory.	Very satisfac- tory.	Somewhat in ex- cess of ordi- nary lead paints.	Very good material for finish- ing coats of all ironwork and woodwork used on out- door work.
57	Very satisfac- tory.	do.	do.	Somewhat in ex- cess of ordi- nary lead paints but not quite so ex- pensive as M. paint.	
58	Very good.	Very good.	Very good.	Expensive.	Ships' bottoms and top- sides.
59	Satisfactory; bright.	More durable than lead paints.	Much longer than lead paints.	Some 5 per cent less than lead paints.	Best paint used; better finish, lasts longer, and has more permanent qualities than any lead or other paints known of.
60	Good.	Good.	Satisfactory.	Economical.	
61	Smooth and beautiful white.	Excels white lead paint.	Keeps excel- lent color.	Little more than white lead paint.	
62	More glossy than white lead paint.	So far quite as durable as white lead paint.	Extor- nal work looks cleaner than white lead paint.	Costs more for material, but no more for labor than lead paint.	Seems to last longer, and stands the weather well.
63	Fine gloss fin- ish.	In good condi- tion after 3 years.	Color still hold- ing.	About 10 per cent cheaper than lead paints.	On one occasion use of lead undercoats turned it yel- low, otherwise it has been most satisfactory.

TABLE OF INFORMATION SUPPLIED BY

Mer- chandise num- ber.	Name of user of lead- less paint.	Brand of lead- less paint.	Leadless paint used for—		Longest time exposed without repainting.	
			What purpose.	How many years.	Internally.	Externally.
64	T. C. Tins, 17 Ches- son Road, West Kensington.	S.	House paint- ing.	Over 2.....	Not yet re- painted.	Not yet re- painted.
65	H. N. Martin, 10 Chir- cus Street, Green- wich.	S.	do.....	1½.....	1½ years.....	1½ years.....
66	The Atlantic Coaling Co. (Ltd.), 36 Lead- enhall Street, E. C.	R ¹	Buildings.....	2.....	2 years.....	5 to 8 months.....
67	Do.....	R ¹	Iron work: wharves and ships' bot- toms, Ironwork.....	do.....	do.....	do.....
68	Brighton and Hove General Gas Co., Portside.	R ¹	Gas works.....	1½.....	do.....	do.....
69	Do.....	T.	do.....	20 to 30.....	6 to 10 years.....	3 to 5 years.....
70	The Bolton Steam Shipping Co. (Ltd.), 57 Bishopsgate, E. C.	R ¹	Steamships (holds).	About 4.....	3 years.....	do.....
71	Do.....	R ¹	Steamships (ships' bot- toms).	do.....	do.....	About 9 months.
72	Kidderminster Cor- poration.	U.	do.....	13.....	Not used.....	5 years.....
73	Grays Thurrock U. D. C., Essex.	U.	do.....	About 20.....	do.....	7 years.....
74	Do.....	H ¹	do.....	4.....	do.....	4 years.....
75	Exeter Corporation.	U.	Hull of a tug- boat.	6.....	Not used.....	do.....
76	The Glen Line, 1 East India Avenue, E. C.	V.	Steamships.....	About 3.....	1 year.....	1½ years ex- posed to weather on fore part of bridge.
77	Do.....	H ¹	do.....	6.....	do.....	6 months.....
78	The Harrison Line, Dock House Bil- later Square, E. C.	V.	do.....	3.....	do.....	do.....
79	Mansion House Cham- bers (Ltd.), 11 Queen Victoria Street, E. C.	W.	do.....	Over 2.....	Over 2 years.....	do.....

USERS OF LEADLESS PAINTS—Continued.

Mer- chandise num- ber.	Other remarks.	To what extent found satisfactory as regards—			
		Finish.	Durability.	Permanence of color.	Cost of painting operations.
64		Quite satisfac- tory.	Quite satisfac- tory.	Holds its color better than other paints used.	Seems to cost less for labor in putting on than other paints.
65	(Can give no opinion as to dur- ability and permanence of color, having used it for only 15 months, but so far it is quite satisfactory in both respects.	Excellent.			Slightly less than white- lead paint.
66		Good and glossy.	Does not de- grade or peel and sets well into iron.	Keeps color well.	Less than lead paint owing to weight.
67	Splendid anticorrosive for iron; can be applied to wood. Splendid preventa- tive, in tropical countries, of dry-rot. Exceeds tar in quality. Somewhat difficult to ex- press any opinion as to the durability of various paints as these works are exposed to very heavy storms from S.W., and all paints are sub- ject to very hard wear. In addition to the weather, a gas works always has an atmosphere of acid and alkali fumes which, of course, are very destructive to paint. On the gen- eral principle, however, it is believed that both the paints noted are very excellent in all respects for general interior and exterior work. Can be highly recommended.	Excellent.	Good.	Good.	Normal.
68		Good.	do.	do.	do.
69		Very good.	Very good.	Very good.	Same as other compositions.
70		Good.	Good.	Good.	Usual.
71	Not superior to other good compositions.	Good hard sur- face equal to varnish.	5 years.	Good lasting color.	3 coats equal to and 1 of var- nish in ordi- nary lead paint.
72		Quite satisfac- tory.	Quite satisfac- tory.	Darkens by exposure to a t m o s- phere.	Easily applied; time occupied in mixing or drying lead paints saved.
73	Attributed to presence of sulphur in atmosphere, the result of cement burning.	Excellent.	do.	Retains color well.	do.
74		Good.	Good.	Good.	Same as lead paint.
75	Better than lead paint.	Excellent.	Excellent.	Excellent.	Moderate.
76	Mostly used externally on boats and deck houses, and found very good on wood or steel.	Very good.	Very good.	Very good.	Moderate.
77		Good.	Good.	Good.	No cheaper than other painting.
78		do.	Not used long enough to prove.	Not used long enough to prove.	
79	Owing to insufficient body, a whitened undercoat is generally used.				

TABLE OF INFORMATION SUPPLIED BY

Mar- ginal num- ber.	Name of user of lead- less paint.	Brand of lead- less paint.	Leadless paint used for—		Longest time exposed without repainting.	
			What purpose.	How many years.	Internally.	Externally.
80	The Haherdashers Co., 9 Deuman Street, S. E.	W	House paint- ing.	Nearly 5.	Not repainted.	
81	Do.	D	do.	About 3.		
82	C. H. Smith & Son, Customhouse Cham- bers, Newcastle-on- Tyne.	X	Ships.	16.	18 months.	12 months.
83	J. Riley, Son & Tully, Exchange Buildings, Newcastle-on-Tyne.	X	do. (Buildings)	18.	2 years.	1 year, 4 years (on ce- ment at sea- side).
84	Do.	M	Peck houses.	5.	2 or 3 years.	12 months.
85	Do.	M	Ships.	10.	2 years.	1 year.
86	Do.	Y	do.	5.	do.	do.
87	Sheffield Corporation.	L	Iron and steel.	5½.	3½ years.	
88	Do.	Z	do.	3½.	do.	do.
89	Cumrad Steamship Co., (Ltd.), Liverpool.	Er	Steamships.	2 or 3.	About 18 months.	About 10 months.
90	Tyne-Fee Steamship Co., Newcastle-on-Tyne, England.	White enamel	do.	About 7.	2 years.	1 year.
91	Huntley & Palmers (Ltd.), Reading.	"Zinc white in oil."		Used as a trial.		Repainting necessary after 2 years.
92	Leeds City Tramways.	AA		5.	No record.	3 years.
93	Metropolitan District Railway.	U	Street ironwork.	About 2.	Not used.	About 5 years.
94	R. Langton Cole, F. R. C. J. B. A. 21, King- sland Street, F. C.	U	do.	More than 30 years.	9 years.	7 years.
95	Milner, Thomas & Co., (Ltd.), Church, Son- ders.	U	do.	10.		4½ years.
96	H. Hayley, resident engineer, East Sus- sex Asylum, Hol- tingly.	U	do.	21.		8 years.
97	The Crittall Manufac- turing Co. (Ltd.), Birmingham.	T	Priming of steel win- dow frames (dipped).	5.		3 years.
98	J. J. Jones 9 Clifford Street, W.	P	do.	7.		

USERS OF LEADLESS PAINTS—Continued.

Mar- ginal num- ber.	Other remarks.	To what extent found satisfactory as regards—			
		Finish.	Durability.	Permanence of color.	Cost of painting operations.
80	a Except where work has been badly used by tenants. These paints are not affected by the cleaning to any great extent, and generally have many advantages over lead paints for general decorations. Vessels clipped and painted every 12 or 18 months holds and decks done with the paint which is always in good condition at time of clipping. No other lead- less paint used being satis- fied with this one.	Very good.	Sound.	Excellent.	Favorable.
81		Glossy.	Good.	Good.	Good.
82			Excellent.	Fades a little after some time.	Much the same as other nonex- pensive paints.
83		Excellent like enamel and washes well.		Holds color.	do.
84					do.
85					do.
86	b This paint is almost iden- tical with X paint. Both are satisfactory for all ironwork. On steel struc- tures for 15 months, in- spected every 3 months, and found as good as when it was applied. Work pre- viously painted with red lead, oil, or white-lead paint did not stand 12 months. All found over a leadless base or skimming.	Slightly rough, gritty face.	Hard face after exposure for 3 years.	Retains color well.	1 coat, 2½d. (5 cents) per yard superficial; 2 coats, 4½d. (9 cents); 3, 6½d. (14 cents); 4, 8½d. (16 cents).
87		do.	do.	do.	Normal for en- amels.
88		Good gloss.	Good.	do.	9d. (18 cents) per yard.
89		Good.	do.	do.	Compared with lead paint, about same; material 12½ per cent cheap- er; less body.
90		Satisfactory.	60 per cent less durable than lead paint.	Retained color	10s. (\$1.87) cwt., cheaper than lead at normal figure.
91		Quite satisfac- tory.	Good.	Good when used alone; not perma- nent mixed as a color.	When used alone is superior to white-lead paint in per- manent color, but not as durable.
92		Satisfactory.	Fairly good.	Generally good	
93		Very good.	Very durable.	Better than lead paint.	About 5 per cent more than lead paint.
94		Good.	Good.	Satisfactory.	Rather more ex- pensive than ordinary paint.
95		do.	Very durable.	Depends upon the shade; green will not stand so well as in a lead paint.	Cost is less than lead paint, ow- ing to durabil- ity.
96		Quite suitable as a finishing coat.	Properly pre- pared, lasts quite as long as lead	More perma- nent than lead paint.	Not so expensive as lead paints.
97	d Initial cost is somewhat greater, but this is set off by its greater covering power.	Completely	Completely	Completely	Economical.
98					

TABLE OF INFORMATION SUPPLIED BY

Mar- ginal num- ber.	Name of user of lead- less paint.	Brand of lead- less paint.	Leadless paint used for—		Longest time exposed without repainting,	
			What purpose.	How many years.	Internally.	Externally.
99	P. Waterhouse, F. R. I. B. A., Staple Inn Buildings, Holborn.	P.	Priming of steel win- dow frames (dipped).	At least 8.		
100	Davis & Emanuel and H. C. Street, 2, Fish- bury Street, F. C.	P.	do.	3 to 4.	6 months at seaside on East coast.	6 months at seaside on East coast.
101	Ruston, Proctor & Co. (Ltd.), Lincoln.	P.	Thrashing ma- chines.	2.		1 year.
102	Henry Hope & Sons (Ltd.), 55 Lionel Street, Birmingham.	P.	Priming of steel window frames (dipped).			
103	W. Clarke, 166 Mel- bourne Road, Leices- ter.	BB.	House paint- ing.	7 or 8.	7 years.	21 years.
104	John Hall, Station Road, Luttworth.	BB.	do.	6.		3 years.
105	Rennett & Plovers, 183 East Road, Cambridge.	BB.	do.	5.		5 years.
106	Frank Wellman, And- ley House, New- market.	BB.	do.	do.	5 years.	
107	J. T. Dodd, 56 Stubb's gate, Newcastle, Staffs.	BB.	do.	6.	6 years.	4 years.
108	J. Brown & Son, King Street, Chertsey.	BB.	do.	5 or 6.	3 years.	do.
109	Thomas Dellow & Sons, 21 Rute Street, Low Fell, Gates- head.	BB.	do.	3.		
110	W. Johnston & Son, 64 Sandgate, Ayr.	BB.	do.	do.		3 years.
111	John R. Gilheespy, 120 John Street, Day- don-on-Tyne.	BB.	do.	do.	3 years.	Not used.
112	J. Besse, 6, Elm Villa, Bally, Doncaster.	BB.	do.	do.	do.	3 years.
113	W. Hindle, 17 Cran- worth Street, Sialy- bridge.	BB.	do.	2.	11 years.	2 years.
114	A. Foden, 21 Ormerod Street, Accrington.	BB.	do.	do.	2 years.	do.
115	J. Newbery, 47 West Street, Bromley, Kent.	BB.	do.	do.	do.	Not used.

USERS OF LEADLESS PAINTS—Continued.

Mar- ginal num- ber.	Other remarks.	To what extent found satisfactory as regards—			
		Finish.	Durability.	Permanence of color.	Cost of painting operations.
99	The frames are sent out well covered with good paint on which the subsequent paint- ing—to suit the exact cover- ing required—stands well and is durable. This ap- plies to internal and exter- nal work.				
100	System of painting by dip- ping more efficient than brush painting.	Quite equal to brushwork.	Satisfactory.	No experience; used only as priming.	Less costly than brushwork.
101	Colors used include: Dark red, bright pink, purple, brown, vermillion, and ultramarine.	Very good; much super- rior to lead.	Very good.	Very good.	Same as lead; first cost slight- ly higher, cov- ering power greater.
102	"The paint compares favor- ably with any other paint which we have used."		As good as lead.		
103	Likes it for inside work; good under enamel.		Stands quite as well as lead.	Keeps color well.	
104	Covers better than lead paint, and is a better color.				
105	Used many tons of this paint on all classes of work inside and outside with good re- sults.		With good weather quite as well as lead paint.	Retains its whiteness well.	
106			Satisfactory.	Does not grow yellow with age like lead paint.	
107			Stands better than white lead.	Keeps its color longer than white lead.	
108					
109	Can turn out better work with this paint than with white-lead paint; covering power greater.				
110	Part of building painted with white lead and part with "BB" paint. After 3 years the paints were equal as regards wear; "BB" paint much whiter in color, and washed much better show- ing the design of powdering.	Equal to white lead.			
111	Excellent white lead for in- terior work.				
112	Considers it to be the best white pigment on the mar- ket. Used on "jobs too numerous to mention."	Stands exceed- ingly well.			
113	In many instances superior to white-lead paint. A perfect substitute for white lead.			Does not turn yellow with age.	
114	Used on many jobs, and for inside work it can not be beaten for body and cover- ing power.			"Retains its whiteness better than the best white leads."	
115	Splendid covering power.				

TABLE OF INFORMATION SUPPLIED BY

Marginal number.	Name of user of leadless paint.	Brand of leadless paint.	Leadless paint used for—		Longest time exposed without repainting.	
			What purpose.	How many years.	Internally.	Externally.
116	M. Pattison & Co., Elvet Bridge, Durham.	BB.	House painting.	2	2 years	1 year.
117	A. R. Clare, 10 Grange Road, Lough-on-Sea.	BB.	do.	1½	1½ years	1½ years
118	S. F. Cox & Co., Hampton-in-Arden, Birmingham.	BB.	do.	2	2 years	Not used.
119	S. Wiltshire, Grand Parade, Leigh-on-Sea.	BB.	do.			1½ years
120	Ducker Bros., 67 King Street, Newtown, N. S. W.	BB.	do.	2	2 years	1 year.
121	G. W. Newman, 13 The Parade, Lewisham High Road, S. E.	S.	do.	do.	do.	2 years.
122	C. J. Turner, 21 Grange Road, Lewisham, S. E.	S.	do.	do.	do.	Not used up till recently.
123	The Sydney, Metropolitan Railway, Surplus Lands Committee.	S.	do.	do.	1½ years	2 years.
124	St. Thomas's Hospital, S. E.	D. L.	do.	Over 15	15 years	6 years.

USERS OF LEADLESS PAINTS—Concluded.

Marginal number.	Other remarks.	To what extent found satisfactory as regards—			
		Finish.	Durability.	Permanence of color.	Cost of painting operations.
116	Mixes freely with varnishes, boiled linseed oil, raw oil, and turps; requires less driers, thus giving greater body; works freely under the brush; a fine undercoat for enamel work; does not powder whilst sandpapering. After 20 years' exposure of painting have found that the coating has not faded or discolored. Has great covering power, and is recommended for houses exposed to sea air. An excellent paint for cleanliness in use, gives a good body and surface, and has a good covering area, and is superior to white lead in many ways.		Work in excellent condition.	Keeps its color well.	
117					
118					
119			Stands the weather quite well.		
120	Very good paint, especially on brickwork.	Excellent.	Seems good after two years.	Excellent.	Just about the same as with white lead.
121	No cracking, blistering, or perishing visible.	Equal to good enamel.			A little cheaper than with white lead.
122		Excellent.	Quite satisfactory.	White keeps color well; when colored by pigments is apt to turn darker.	About 12½ per cent above cost of ordinary lead paint.
123	Generally, results have been very satisfactory; but the paint has not the covering power of lead paint.			Very good, indeed.	13s. 6d. (£3.28) gallon, less 10 per cent, finishing; 11s. 6d. (£2.80) gallon, less 10 per cent undercoating.
124	A very reliable paint in all respects.	Splendid.	Extremely good.		

All food brought into the shops or yards must be inclosed in tight boxes or receptacles until lunch time.

Arr. 8. Employers or heads of establishments must cause their employees engaged in the occupations mentioned in article 1 of this decree to be examined every three months by a physician agreed upon by the minister of the interior and of labor.

The expense of such an examination and fees of the ministerial office must be borne by the employer.

Employers and heads of establishments shall positively prevent any person suffering from chronic lead poisoning or exhibiting symptoms of recurring poisoning from being exposed to such poisoning.

They shall temporarily prevent those not in good health at the time of examination from such exposure.

They shall keep a special register in form as prepared by the administration, and in which the physician agreed upon shall enter such facts as are shown by these examinations. This register shall be forwarded upon requisition to the proper authorities.

Employers and heads of establishments shall not employ persons addicted to intoxication, and must prevent the introduction and drinking of distilled alcoholic beverages within the work yards and shops.

Measures imposed on the employees.

Arr. 9. Employees whose duty it is to prepare the white lead in paste, ground and mixed, shall so work as to prevent contact of the materials and the hands, and splashing of the materials.

Arr. 10. Employees are prohibited from scraping and dry pumicing of surfaces painted or coated with white lead.

Arr. 11. Employees whose duty it is to perform the work mentioned in article 1 must be in possession of clothing and a head dress exclusively devoted to the work; they must keep them in good condition and remove them before leaving the yards or shops.

The clothing which they removed when beginning work must be kept in a place closed to all poisonous dust.

Arr. 12. Before partaking of food or drink, and before quitting the shops and yards, the employees shall rinse the mouth and wash their hands and bodies with soap. Food brought into the shops or yards must be inclosed in boxes or other receptacles tightly closed until meal time.

Arr. 13. The employees must keep the materials and tools in a proper condition.

Arr. 14. Employees are prohibited from bringing into shops and yards any distilled alcoholic beverages, or from drinking them therein.

Arr. 15. Employees are required to take the examinations as provided in article 8 of this decree.

General provisions.

Arr. 16. Infractions of the provisions of this decree are punishable by a fine of 26 fr. (\$5.02) to 100 fr. (\$19.30).

Arr. 17. Subsequent offenses within 12 months after conviction under this decree are punishable by a fine of 100 fr. (\$19.30) as a minimum and 1,000 fr. (\$193) as a maximum.

Arr. 18. Chapter VII and article 85, Volume I of the Penal Code, are applicable to this decree.

Arr. 19. Inspector of labor and labor inspectors delegated by the workmen are charged with the execution of this decree.

FRANCE.

Law concerning the use of white lead in the painting of buildings, either interior or exterior, July 20, 1909, as amended by the labor code.

Code du Travail et de la Prévoyance Social.

LIVRE II, TITRE II, CHAPITRE IV.

ARTICLE 78. In shops, yards, buildings under construction or repair, and in general in every place where the work of painting buildings is being carried on, managers, directors, or agents must, in addition to other provisions of safety, conform to the following conditions:

Arr. 79. After the 1st day of January, 1915, the use of white lead, of lead ground in linseed oil, and all other products in which white lead is a constituent, is prohibited in

APPENDIX.

BELGIUM.

Law concerning the use of white lead in painting, August 20, 1909.

ARTICLE 1. The sale, transportation, and use of white lead in powder, lumps, or cakes for the purpose of painting is forbidden.

The sale, transportation, and use of white lead in powder, lumps, or cakes for other purposes is permitted under such conditions and within such limits as may be fixed by royal decree.

Arr. 2. White lead intended for use in painting may be sold, transported, and used in the form of paste only when ground and mixed with oil.

Arr. 3. Partial or entire prohibition of the sale, transportation, or use of other products, powdered, lumps, or cakes, having a lead base, intended to be used in painting, may be ordered by administrative decree upon advice of the superior council of public hygiene.

Arr. 4. The dry scraping or pumicing of surfaces covered with white lead is prohibited.

Arr. 5. Infractions of this law and of the decrees relative to its execution are punishable by a fine of 26 fr. (\$5.02) to 100 fr. (\$19.30).

Arr. 6. Subsequent infractions within 12 months following a conviction under this law are punishable by a minimum fine of 100 fr. (\$19.30) to a maximum of 1,000 fr. (\$193).

Arr. 7. Chapter VII and article 85 of Book I of the Penal Code is applicable to the infractions mentioned above.

Arr. 8. Infractions of this law may be established by report of the Government labor inspectors, and the burden of proof shall be upon the offender.

A copy of the report shall be served upon the offender within 48 hours, under penalty of becoming void.

Arr. 9. This law shall be in force from and after the date of its publication.

Royal decree of July 25, 1910, relative to the use of white lead in the painting of buildings.

ARTICLE 1. All establishments engaged in house painting by the use of white lead, or in scraping or pumicing of surfaces painted or coated with white lead are subject to the following provisions:

Measures imposed on the employers.

Arr. 2. White lead shall be employed only in the form of paste mixed or ground in oil.

Arr. 3. The working up of the white lead in that form shall be done only in such manner as to prevent contact between the material and the hands, as well as to prevent splashing. It is the duty of employers to furnish the employees with the necessary apparatus for mixing the lead.

Arr. 4. Employers, heads of establishments, or their overseers shall supervise the material and cause tools to be properly cared for.

Arr. 5. Dry scraping or dry pumicing of surfaces painted or coated with white lead is prohibited.

Arr. 6. Employers, heads of establishments, or their overseers shall cause their employees performing the work mentioned in article 1 to wear clothing and head covering exclusively kept for this work.

Clothing which is removed for work shall be kept in a place closed to toxic dust.

Arr. 7. Employers and heads of establishments shall place in yards and shops, at the disposition of their employees, water and articles necessary for cleaning their mouths, for washing their bodies and hands with soap, also for wiping.

Employers, heads of establishments, or their overseers shall cause their employees to perform these acts before eating or drinking and before leaving the yards or shops where they work.

all classes of painting done by employed painters, whether the work is interior or exterior of buildings.

Art. 80. If necessary public regulations may be issued indicating in what special work these provisions may be abrogated.

TITRE III, CHAPITRE II.

Art. 93. The execution of this law is placed under the charge of labor inspectors, who, for this purpose, may enter any establishment mentioned in article 78. Where the work of painting is done in an inhabited dwelling, the inspectors may not enter without the permission of the persons so occupying it.

TITRE IV, CHAPITRE II, SECTION V.

Art. 173. Managers, directors, agents, or overseers contravening any of the provisions of Chapter * * * and IV of Title II of this volume and of the rules and regulations issued in relation to their execution, shall be tried before the police court and punished by a fine of 5 fr. (96.5 cents) to 10 fr. (\$1.93). The fine shall be imposed for each distinct infraction established in the hearing, but shall in no case exceed 200 fr. (\$38.90).

Decree regulating the use of white lead in house painting, July 18, 1902.

ARTICLE 1. White lead may be used in a condition of paste only in house-painting establishments.

Art. 2. In the preparation directly with the hands of material having white lead as a base for house painting is prohibited.

Art. 3. Dry scraping and dry pumicing of white painted surfaces are prohibited.

Art. 4. In the work of wet scraping and pumicing, and in general in all work of painting with white lead, the employer shall place at the disposition of laborers, overcoats exclusively provided for the work, and require their use. They must be kept in good repair and washed often.

All necessary articles must be in a place accessible to the workmen.

Machinery and tools must be kept clean and in a good state of repair, and their cleansing must be effected without dry scraping.

Art. 5. These rules must be posted in the office where the hiring of laborers is done.

Decree of July 15, 1904.

ARTICLE 1. The provisions of article 1 of decree of July 18, 1902, are extended to all painting works.

SWITZERLAND.

Resolution of the National Council concerning the use of white lead in interior painting on public works, June 30, 1903.

The several administrative departments are requested to prevent the use of white lead in the painting of interior surfaces in all work which they have performed under contract or over which they have supervision.

CANTON OF GENEVA.

Law on use of white lead and its compounds in public works and private buildings. (Adopted by the Grand Council, October 26, 1907.)

ARTICLE 1. The use of white lead in painting or in the manufacture of tubes, either in public or private work, in any other form than as a paste, is prohibited.

Art. 2. In public or private work, dry pumicing, dry scraping, or the removal of paint by fire is prohibited.

Art. 3. The State Council shall issue hygienic regulations to which employers and employees must comply in the use of products having a white-lead base.

Art. 4. Any employer or employee not complying with the provisions of this law or the regulations is subject to penalties.

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