LEAD POISONING:

FROM THE INDUSTRIAL, MEDICAL, AND SOCIAL POINTS OF VIEW

LECTURES

DELIVERED AT

THE ROYAL INSTITUTE OF PUBLIC HEALTH

BY

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PREFACE

THE growing interest taken in the subject of lead poisoning is my excuse for the publication in book form of the lectures delivered in the Royal Institute of Public Health, Russell Square. No metal is more widely used in the arts and manufactures, and none lends itself to the increasing requirements of modern life and industrial development more than lead. In the following pages I have tried to place before all who may read these lectures the channels by which lead gains entrance into the body, the effects of the metal upon the organism, and how these effects may be got rid of. Although trades in which lead or its compounds are used will always be more or less dangerous, the extent to which industrial lead poisoning has been reduced is an excellent illustration of what legislation has accomplished, and of the good effected by Home Office inspection and regulations. What has been accomplished in this respect is but earnest of what can be. In

the hope that by throwing additional light upon the subject such an object may be attained, this little book is launched upon the medical profession and the public.

In the Appendix are printed, by permission of the Controller of H.M. Stationery Office, the Factory and Workshop Orders relating to lead poisoning.

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Britain for zinc white and lithopone for internal decoration. In the United States the painting of signboards is a special trade. It is highly skilled labour. Young men are apprenticed to the trade for four years. During the last fifteen years a change has been creeping over this trade. "Signboards" are now prepared in the painters' shops. Lead is one of the commonest pigments used both on iron and wood. Although the occupation is not so healthy as it was when all the work was carried on out of doors, yet, since sand-papering is not required to any extent, the work is much healthier than that of a house-painter.

Ship-painting, so far as the decoration of saloons and cabins is concerned, is highly skilled work. As in coach-painting, several coats of paint have to be applied. The paint frequently contains lead and turpentine, and when the surface is dry it has to be sand-papered. Apart from the use of rapidly-drying spirit paints, there is little danger to men when painting the outside of a ship, for the work is carried on in the open air, so that vapours are readily dispersed. It is the inside work which is trying to the men, for when the final coats are reached the paint frequently contains lead and zinc white in equal parts, with turpentine only and no linseed-oil. This is the part of the work the men object to; but, as stated

earlier, the symptoms are probably due more to turpentine than to lead, judging from the strangury, hæmaturia, and pain in the back, complained of. The remarks apropos of the finer decorative work inside houses and ships apply equally to the painting of railway carriages, coaches, and automobiles. Painters of agricultural implements occasionally suffer from plumbism when the red paint contains lead, but, as much of the work is carried on in the open air, there is less risk to the men than in indoor painting.

Lead Paints and Leadless Paints

We can hardly avoid considering the question of lead *versus* leadless paints. Any reliable opinion upon the relative commercial and decorative values of white lead paint and paint made with zinc oxide can only be furnished by technical chemists, colour manufacturers, master-decorators, and practical house and ship painters. Among these experts there is, unfortunately, a great variety of opinion. Their divergent views render it difficult for other people to express an opinion. The question as to whether, from a purely decorative point of view, the use of white lead paints should be entirely disallowed is a matter in regard to which in this country no satisfactory decision has as yet been arrived at. It is therefore one con-

cerning which, before any legislation is attempted, a body of experts should be invited by the British Government to carry out a series of experiments in different parts of the country, and to report to the Home Office. There is no need for undue haste in the matter. France has passed a law totally prohibiting the use of lead paints after 1915, but doubts have been expressed both in France and in other countries as to the wisdom of the step. I have already alluded to the antiquity of the white lead industry, and to the difficulty of abolishing old trade customs. These remarks apply here equally well. Total prohibition of the use of lead paints was tried in Switzerland in 1904, and abandoned as being impracticable. The White Lead Commission of the Netherlands reported that zinc white paints withstand the action of sulphuretted hydrogen better than white lead paints, but that they do not withstand the action of the sulphurous acid present in the atmosphere so well as paints made with white lead—that is to say, for internal decoration zinc white is as good as, if not better than, white lead, but that for outside work white lead is superior. Since 1909 Belgium has prohibited the sale and use of dry white lead, but she allows the sale of this material mixed and ground in oil. Germany permits the sale of white lead paint already mixed

and ready for use. Austria prohibits the use of white lead for the interior of houses. No uniform international attitude has as yet been assumed in regard to this important question. It is one to which the International Association of Labour Legislation is giving attention.

There is nothing to support the statement which is current in some quarters, that British house-painters are prejudiced in favour of lead paints. Knowing the danger incidental to their use, they have nothing to gain by using them to the exclusion of others. Zinc oxide and lithopone, the latter a compound of zinc sulphide and barium sulphate, have been recommended as substitutes for lead carbonate. As pigments these undoubtedly possess valuable properties. The high degree of opacity owned by white lead, the readiness with which it obliterates uneven surfaces and produces a dense white effect with very little material, render it difficult for it to be replaced by substitutes. For external decoration lead carbonate stands exposure to the weather well. There is less division of opinion in regard to zinc white giving equally as good results as lead carbonate in internal work. Noel Heaton maintains that zinc white has neither the fineness nor the density of white lead, nor is

there that peculiar influence exerted upon oil by it whereby the absorption of oxygen is increased and the paint caused to dry quickly. To the circumstance of white lead being a basic compound containing two molecules of normal carbonate of lead and one of hydroxide is attributed the power it possesses of combining with oil to form a paint capable of producing a smooth working quality in the brush which all painters like. It is, however, one of the advantages claimed for zinc white that the paint made from it is not so readily discoloured by sulphuretted hydrogen gas. Instead of becoming changed, like lead paint, by this gas into a black sulphide, it becomes the white sulphide of zinc which, as already stated, is one of the constituents of lithopone. Judging from the Report of the Netherlands Government and our own experience at home, it is not the sulphuretted hydrogen in the air of our large towns which is the discolouring agent, so much as the sulphurous and sulphuric acids which are being given off in increasing quantities into the atmosphere owing to the larger consumption of coal-gas for illuminating and cooking purposes. Coal-gas attacks zinc white more readily than it does white lead. It is said and this is a point to which we shall return —that greater skill and care are required with zinc

than lead paints, and that they must be applied in thin layers. Zinc white requires from 16 to 20 per cent. of oil to grind it into a stiff paste with a minimum of turpentine.

Oxide of zinc is not a dryer like white lead. Dr. A. P. Laurie,* of the Heriot-Watt College, Edinburgh, raises on this point an important question as to what is meant by "drying." As applied to water the term means loss by evaporation, but as regards spirit varnish it means evaporation of spirit and an undissolved resin left behind. In the drying of linseed-oil the oil absorbs oxygen, and the fatty acid of the oil becomes converted into oxy-linoleic acid, which is the most stable form linseed-oil can assume. Raw linseed-oil when exposed to the air takes days to dry, but the drying process can be hastened by treating the oil with white lead. The white lead is of itself a drier, so that of two surfaces painted respectively with white lead and zinc, each containing its proper proportion of oil and exposed to the air, the surface, painted with white lead dries the more quickly. Laurie maintains, notwithstanding the fact of the painted surface being thinner, that weight for weight zinc white has as good covering power as the carbonate of lead. Cruickshank Smith gives as the spreading capacity

* "The Paint Question," J. Cruickshank Smith, 1909.

in square yards per hundredweight the following: Oxide of zinc, 870; red lead, 424; white lead, 614 to 806; the prices per hundredweight in shillings being 46, 28, and 28 to 32, respectively; and the estimated numbers of tons required for painting the surfaces in twenty years being 4, 4, and 5 to 6.

When the proposed interdiction of lead paints was being discussed in the French Legislative Assembly, opinions of experts upon the relative merits of zinc and lead were quoted. It was stated that the naval engineers of Rouen, after three years' experience of both pigments, preferred zinc to lead, since the white colour of the paint did not blacken under the influence of sulphur. Equally favourable to zinc were the opinions of the naval engineers of Bordeaux. At the request of the French Government, experiments dealing with the covering and enduring power of the two paints were carried out at the Annexe of the Pasteur Institute, Paris. A Commission nominated by the Society of Public Medicine and of Hygiene undertook a series of experiments with the object of comparing surfaces painted with zinc and lead bases. The Commission was composed of Dr. L. Martin, M. Livache (a chemist), and M. Vaillant (an architect), along with Messrs. Mauger, Wernet, and Rigolet, representing the building trades of Paris.

In 1902, under the supervision of this Commission, a working painter applied paints containing zinc and lead bases to similar surfaces, and a few months afterwards the following report was published: (1) The colour and the polish of zinc white are equal to those of white lead; (2) the covering power and drying are practically the same. In order to test the enduring properties of the paints, it was necessary to allow atmospheric agents to exercise their destructive influence over a longer period. It was therefore arranged to examine the painted surfaces a year afterwards.

In October, 1903, the Commission reported that there was no appreciable difference between the paintings so far as concerned their reaction to atmospheric influences, and that both for internal and external painting the results were absolutely comparable.

Since 1903 three additional examinations of the painted surfaces have been made—viz., on September 30, 1904, October 11, 1905, and October 31, 1906, all the reports of which confirm the previous statement.

Zinc sulphide and lithopone are also spoken of as substitutes for lead carbonate. Lithopone is obtained by the double decomposition of barium sulphide and zinc sulphate. The precipitate consists of barium sulphate and zinc sulphide. The

precipitate, which is beautifully white, is washed, dried, ground, and mixed with oil to form a paste which has all the appearance of white lead paint. Lithopone was placed upon the market as a substitute for white lead. Petit says that it has less covering power than lead, owing to the large quantity of barium sulphate it contains—viz., 67 per cent.

Applied to iron surfaces, the zinc sulphide of the lithopone is said to part with its sulphur to the metal and to form iron sulphide, also that, while the zinc sulphide mixes readily enough with oil, yet, owing to a process of vulcanization, it is liable to undergo decomposition.

Dr. Ignace Kaup informs us that the master-decorators of Vienna have recently been substituting zinc white, also lithopone, for lead carbonate in private dwellings, but that for public buildings white lead and varnish are still used. Only recently several of the workmen when painting a large Government building in Vienna became ill. The illness, rightly or wrongly, was attributed to plumbism. Master-painters both at home and abroad are divided in their opinions as to the value of lithopone. Some hold that it does not retain its colour well, and that its covering power is not so good as that of white lead. It is said to be all right on plaster, but not so satisfactory on wood, especially if the wood is new. Lithopone possesses the advantage of being about 4s. per hundredweight cheaper than white lead. In some of the Swiss railway carriage works only zinc white and lithopone are used.

It is hardly necessary to discuss at length the question of the use of sulphate of lead as a substitute for lead carbonate. From a paint point of view both have about equal values. Although it has hitherto been generally believed that lead sulphate is less soluble in the juices of the alimentary canal than the carbonate, and therefore less likely to be absorbed, the data obtained from recent experiments are conflicting. Lead sulphate can therefore not be regarded as a substitute for the carbonate, since it would only be replacing one lead paint by another.

As I wished to know the opinion of British master painters and decorators upon the relative merits of zinc white and lead carbonate, I applied to the Employers' Association, and in April, 1913, received the following information: Of 45 master-painters who replied, 43 expressed themselves in favour of white lead for the exterior of buildings; for inside work 17 preferred zinc white to lead. For internal decoration there is no reason why zinc white should not be more frequently used than it is, but for the external painting of houses

the majority of master-painters seem to be in favour of lead paint.

There is a hygienic aspect of house-painting to which attention ought to be drawn. I refer to the antiseptic properties of paints. Two years ago Professor H. J. Hutchens and I carried out a series of experiments with various paints to test their germicidal powers. The micro-organism used was the *Bacillus coli*. The experiments extended over a period of three and a half months. We found that vapour from drying paint at 37° C. possessed definite bactericidal properties; it retarded and prevented the growth of micro-organisms. Paints which had been dried for forty-eight hours exercised a similar influence, but after five days they no longer possessed such power. Similar results were obtained by H. A. Gardner. Like myself, he attaches considerable importance to the circumstance, for by painting chambers with an oil pigment we have an efficient means of destroying bacteria in rooms which have been occupied by persons who were the subjects of contagious disease. During painting the rooms should be well ventilated, but when finished they should be closed for a day or two, to allow of the vapours exercising their antiseptic influence upon the walls and contents.

Lead Poisoning among Painters

In Great Britain it is difficult to estimate the amount of lead poisoning in painters, owing to notification of plumbism being voluntary, also to the fact that house and ship painting do not come within the Factory Act. The figures received under voluntary notification show lead poisoning to be even more prevalent among painters than was expected, also that it is increasing. These remarks apply equally to painters in Germany, France, Austria, and the United States. Painters have a higher mortality than the general population. In Berlin in 1903 the general death rate per 1,000 inhabitants was 11·61, but for painters it was 14. Fleck* gives as the mortality rates of German painters 1·3 per cent. from lead poisoning; nervous diseases, 7·8 per cent.; heart, kidney and liver disease, 20·8 per cent. Figures taken from the Prudential Insurance Company of America show the deaths from the same causes to be 1·5, 10·7, and 35·9 per cent. respectively. Among German painters diseases of the respiratory organs caused 41·6 per cent. of deaths, and in the United States 26·3 per cent.

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* West, "Handbuch der Arbeiter Krankheiten," p. 513, Jena, 1908.