knowingly kept some for purposes of reference or comparison, will either have to destroy it or acquire a licence or other authority to retain it, and if he retains it he may apparently have to produce it when required for inspection by a constable or other duly accredited representative of the Home Office. As for purchasing, keeping and using these drugs for professional purposes, most chemists will think twice before undertaking to keep in order the licences, forms, books, etc., necessary to secure him immunity from the pains and penalties likely to overtake anyone undertaking such an operation.

These are a few of the possible difficulties which will occur to a chemist who casually peruses the draft regulations. The catalogue would no doubt be of considerable length if they were considered with a solicitor, versed in the possible legal twists and turns of an apparently innocent sentence in any of the 15 articles. Matters are apparently somewhat simpler if the chemist happens to be in addition a ship's captain with a ship at his disposal, a registered pharmacist, medical practitioner, dentist or veterinary surgeon; and the professional chemist who has much to do with these drugs, dangerous in more senses than one, will probably find his best course to be to take a medical degree, although even then he will probably need the help of a solicitor—unless he becomes that also—to steer clear of the difficulties which his professional duties may thrust upon him.

Fortunately the regulations are still only in draft, and it is earnestly to be hoped that the Institute of Chemistry and the Society of Public Analysts, which are the bodies best qualified to speak for chemists on such a matter, will promptly call the attention of the Home Office to a fact which it appears to have forgotten, namely, that professional, as well as legal, chemists, occasionally have to deal with these dangerous drugs in the course of their work. A short addition to the regulations indicating that chemists engaged in research, teaching or professional practice are exempt from the general restrictions would apparently meet the necessities of the case.

DISEASES OF OCCUPATION.*

STEPHEN MIALL.

The human body was designed for use in circumstances widely different from those which exist in modern industrial areas, and though evolution can accomplish much it is slow in its operation, and many thousands of years are required for any appreciable change in the qualities of the human organism. As chemical industry becomes more and more complicated it becomes more and more specialised, and we find now men and women who for the whole of their working life are engaged in the same processes, involving exposure to the same chemical compound hour after hour, day after day, and year after year. Whether this is entirely necessary I am not sure, but I wish to indicate very briefly some of the dangers of this sort of life and how they may be prevented or reduced to a minimum.

Broadly speaking, one may say that constant exposure to any chemical compound is likely to be injurious to health, particularly if the compound is likely to give rise to dust, fumes, or gas, and that an abundant supply of fresh air is, as one might expect, the best method of protecting the health of the workers. No doubt some compounds are worse than others, but one may say that all forms of dust and fumes are bad. Constant exposure to coal dust and tar causes what is known as pitch-makers' cancer, the tar being in this case the main irritant; the manufacture of marmalade causes injury to the skin by reason of the peeling of oranges and lemons; miners exposed to coal dust or to a fine silica dust have their lungs affected in a particular way; and workers exposed to dust of metallic compounds, phosphorus fumes, etc., contract specific kinds of poisoning.

Carbonic-oxide poisoning, carbon-dioxide poisoning, poisoning by chlorine, nitrous fumes, ammonia, aniline, tetrachlorethane, turpentine, ether, and acetone are not uncommon in industrial conditions.

The diagnosis of these diseases is often difficult; the cure is often difficult, the conditions under which they are contracted differ enormously, but they are usually all preventible by good ventilation.

The incidence of phosphorus poisoning is well known. Five-and-twenty years ago there were five or six cases a year in this country of phosphorus poisoning out of about 1700 persons employed in phosphorus processes. This has now been reduced to about three cases every two years, and the cause of the reduction is well known: to a large extent red phosphorus is employed instead of yellow phosphorus. The Swiss Government in 1879 introduced a Bill for the prohibition of the use of yellow phosphorus, which in due course became law, but it had to be radically altered because the disease became more prevalent. It seems that the workers imagined that when yellow phosphorus was prohibited they could dispense with a number of precautions which had usually been adopted, and they engaged to a considerable extent in processes where red phosphorus was used under very unhygienic conditions. Finally, the Act was practically repealed, and regulations were adopted by the various cantons which ensured suitable hygienic conditions of work. In France sesqui-sulphide of phosphorus, which gives off no fumes, has for many years been used instead of yellow phosphorus, and phosphorus poisoning has been stamped out in that country. It is interesting to note that whereas good ventilation and the ordinary rules of hygiene have in the main been responsible for the diminution of phosphorus poisoning in this and other countries, the substitution of some other forms of poisoning has been repeatedly advocated; in America there was a practice in match factories of hanging round the necks of the workers small vessels containing turpentine. In Italy a non-poisonous match was made of which the principal ingredient was persulphocyanic acid. The true remedy is a simple and efficacious one. Sir Thomas Oliver, who was a member of the Phosphorus Commission which reported rather more than 20 years ago, and is a recognised authority on dangerous trades, states in relation to phosphorus poisoning: "Of all hygienic measures full and free ventilation is the best."

Cases of poisoning by carbon monoxide, nitrous fumes, ammonia, and other gases are on the increase in this country; there were 90 reported cases in 1913, and 132 cases in 1919; of these 59 in 1913 and 85 in 1919 were cases of carbonic oxide poisoning. Almost all these cases were due to ignorance on the part of the workers of the dangerous character of the fumes, or carelessness. There is no difficult chemical problem involved in the prevention of this form of poisoning; common sense in preventing and detecting leaks in flues will reduce such cases speedily, and workmen should be warned that products of combustion of all kinds are liable to be dangerous to health. A fair number of the cases of poisoning by such gases occur not in a closed room, but out of doors, in a gas works or lime kiln, or plant of that type. All these are preventible. In mines compressed air is largely used for drilling and for ventilation, and a number of deaths have

* From a paper read before the Liverpool Section on January 24, 1921.

resulted from the overheating of the air compressor and the firing of the oil used for lubricating the cylinders.[2] During the war there were many cases of carbon-monoxide poisoning from the exhaust of small power petrol-engines installed in dug-outs or similar places, and there have been cases of poisoning from the exhaust attached to closed motor cars, motor lorries, and ambulances.

During the last two or three years cases of chronic benzene poisoning have been notified in this country which have resulted from the employment of benzene as a solvent for rubber, and one case is of exceptional interest. In May, 1918, structural alterations were made in a particular factory, wooden uprights being inserted in certain windows so that they could not be widely opened. In July, 1918, a workman employed in the room was reported as suffering from benzene poisoning, and the case proved fatal.[3] Analyses of the air in different parts of the room showed from two to ten parts of benzene in 10,000 parts of air. The ventilation of the room was improved and no further cases occurred.

Poisoning by turpentine vapour is a problem which has been recently investigated in connexion with the paint industry. It has been long known that many persons are particularly susceptible to the smell of a newly-painted room; the white lead, the turpentine, the linseed oil, and the dryers have all been suspected. I suppose no scientific man now believes in a volatile lead compound given off as a gas or emanation from lead paint, and experiments made during the last twenty years clearly point to turpentine as being the delinquent. Lehmann in 1899 described the symptoms produced in cats by turpentine vapour, and Sir Kenneth Goadby has more recently shown that the poisonous effects produced in animals by exposing them to the vapour given off by painted surfaces are caused by the turpentine content of the paint and not by the linseed oil, dryers, or metallic salt of the paint. Turpentine poisoning produces kidney disease, and seems to cause, or predispose to, gout. Sir Kenneth Goadby states in the joint book by Dr. T. M. Legge and himself[4] that, according to Garrod, gout is constantly occurring among painters.

Dr. G. Arbour Stephens, in a recent paper,[5] reports that during the last six years he has had eight cases where the analysis of the liver showed from about 0·1 to about 0·9 grains of cadmium per pound, with merely a trace of lead. It is presumed from the details he gives that these cases occurred in the zinc-smelting industry in South Wales, and that they were all fatal cases. The symptoms of cadmium poisoning include kidney disease, constipation, and loss of appetite. Zinc is known to be a general protoplasmic poison and, according to Harnack, in the higher animals it causes muscular paralysis and kidney disease. Copper, tin, nickel, and manganese have injurious properties, but the cases of poisoning by these are few and far between.

White lead has been manufactured here since at least the time of Queen Elizabeth, and a variety of lead compounds has been made for a century; lead or lead compounds are used in a remarkably large number of industries and processes, and it is not surprising that by the time the disease had been identified and the method of preventing lead poisoning had become known it had become very prevalent; indeed, as we look back, it seems appalling to think that thirty years ago or less there were in Europe hundreds, or even thousands, of cases of lead poisoning every year, and most of them easily preventible. In many towns lead poisoning was in those days contracted through drinking water kept in contact with lead; in the white lead trade there were in this country nearly 400 cases a year; in the china and earthenware trade there were upwards of 200 cases a year; in smelting, in brass works, in printing, file cutting, glass cutting, shipbuilding and other trades there were over 400 cases, making a total of over 1000 cases per annum.

The attention of the public and of the Home Office was directed to the prevalence of lead poisoning at the end of the last century, when many inquiries were held and considerable information collected. The prohibition of the use of lead compounds in the pottery industry was threatened and various substitutes for lead were suggested. Finally regulations were put into force compelling the removal of dust, the wearing of overalls, regular medical examination, and so on. At the same time the manufacturers of china and earthenware were encouraged to use for glazing purposes an insoluble silicate of lead instead of the very soluble and very dusty white lead formerly used. On the whole the insoluble silicate has been a great boon to the manufacturers of pottery. It has been as satisfactory and cheap to use as the soluble white lead, more uniform in its composition and better to handle, and since its introduction the number of cases of lead poisoning in the china and earthenware trade has steadily declined. It came down from 200 a year in 1900 to 76 a year ten years ago, 15 cases in 1917, 11 cases in 1918 and 21 cases in 1919. The amount of lead in use in the industry has, so far as I am aware, not materially altered; the number of persons employed in the industry has slightly increased and the number of cases has declined to something less than one-tenth.

In the white-lead industry the diminution of cases has been somewhat similar, but even more marked: the number of cases was 399 in 1899, 189 in 1901, 40 in 1915, 18 in 1916, 17 in 1917 and none in 1918. The amount of white lead manufactured in England has declined during that period by about 10 per cent. and the number of persons employed is probably about the same as it was. These striking results have been attained by a careful study of lead poisoning during the last 20 or 25 years. Sir Edward Thorpe, Sir Thomas Oliver, and Dr. Legge, the Chief Medical Inspector of the Home Office, have been largely responsible for these results, and they were assisted in their efforts by a number of Home Secretaries, Inspectors of Factories and private individuals of both sexes. What is the vital factor necessary to the prevention of lead poisoning? Dr. Legge tells us in the Home Office Report for 1918,[7] and these are his words: "On the practical side little more is to be learnt as to how lead poisoning is caused, and it can be taken as axiomatic that all risk lies in inhalation of dust and fumes. These removed and prevented, there will be no lead poisoning." And again, in the Home Office Report for the year 1919,[8] Dr. Legge stated, "that locally applied exhaust ventilation is the sheet-anchor in the protection of the workers from leady dust and fumes and that these alone are the causative agents." With this knowledge it should be possible to reduce yet further the cases of lead poisoning in this country, and the next trade in which a serious effort is to be made is the painters' trade—I mean the painting of houses, ships, bridges and so forth, not the manufacture of paints and varnishes.

It is somewhat unexpected that lead poisoning should be caused not by the particles of lead swallowed by the worker, but by even more minute particles of lead compounds floating in the air and getting into his lungs and there acted on by the juices of the body and so getting into the system. But that this is the usual cause is now generally accepted.

The problem is beset with small difficulties which nevertheless are capable of being surmounted. To begin with, lead poisoning is in many cases by no means easy to identify. A doctor who regularly examines men who are employed in a lead factory

can, with a good deal of certainty, state whether a particular man is contracting lead poisoning and should be suspended from work or given employment which does not involve contact with lead compounds. But if a worker goes to the average careful general practitioner and complains of headache, colic, constipation, kidney trouble, and so on, it is pretty nearly impossible for the cause of these symptoms to be identified. There are so many things which will bring about these symptoms. Legge and Goadby—and I quote these as the greatest living authorities on lead poisoning—state in their book[9]: "The headache complained of by painters is probably not due to lead poisoning but, as has been suggested, to turpentine." Turpentine, too, is probably the cause of the gout to which painters are subject. But of one thing we may be certain, if a man goes to a general practitioner and complains of such symptoms as I have mentioned, and states that he is a painter or employed in a lead works, his case will be duly reported as one of lead poisoning. This is not merely an opinion of my own. Legge and Goadby[10] say that there is "an increasing inclination to attribute chronic nephritis and even (without sufficient justification in our opinion) phthisis and pneumonia to lead poisoning on the death certificates of lead workers." I do not deny that lead poisoning exists among painters and others, but I am quite certain that a great many of the so-called cases of lead poisoning in the paint trade and in other trades have no connexion with lead at all. The cases of cadmium poisoning I have already mentioned were some of them certainly, and all of them probably, returned in the statistics as lead poisoning, and no one can say how many cases of turpentine poisoning, indigestion, Bright's disease, etc., among lead workers have been returned as lead poisoning, but the number must be very large.

From time to time proposals have been made to reduce the frequency of lead poisoning by prohibiting the use of white lead in paint, and this question will be considered at the next conference of the International Labour Office at Geneva. I want you as scientific men to consider somewhat carefully what such prohibition means; if the principle is once admitted, we may have to face the prohibition in their own industries of mercury, antimony, copper, arsenic, and a host of other chemicals which are not intended for human consumption. The prohibition of lead in paints only deals with a portion of the problem, and will give a false sense of security to the painters similar to that which operated so dangerously in the phosphorus workers in Switzerland. The proper solution of the problem is that which has been found so efficacious in many other diseases of occupation—fresh air and the removal of dust and fumes. It has been seriously advocated that to avoid lead poisoning houses should be painted with antimony compounds, titanium compounds, and other heavy metal derivatives; the fact is that the dust of nearly all compounds of heavy metals is injurious and that the fumes of nearly all volatile solvents are bad for the health.

It is known to all in the trade that the dust is produced in the dry rubbing-down of old paint by pumice-stone or sandpaper, and, in my opinion, this should be prohibited by law. Rubbing down can be done wet—perhaps not quite so easily, but sufficiently so—and the painters ought to be protected from exposure to dust of old paint.

It is possible to do away with the dust of the rubbing down by keeping the sandpaper moistened with a cheap mineral oil. The sandpaper lasts as well as without the oil and the result upon the paint is fully as good. This is a method with which many German painters are familiar, and if it could be generally introduced into this country a great step forward would have been taken in improving the conditions in house painting and carriage and railway coach painting and ship painting.

Again, there is no reason why painters and those who prepare the paints for them should ever handle or be supplied with dry white lead or any other pigment; these should invariably be supplied ground in oil or some other medium. As to the vapours from the solvents in ready-mixed paints, I saw workmen in America a year or so ago painting the inside of a house by means of a spray, and attached to the painter was a tube communicating with the outside of the house enabling him to breathe fresh air instead of air which, in that particular case, was contaminated by the vapours of benzene, white spirit, and other solvents. If this method of applying paint is not liked in this country, much might be done by the opening of doors and windows of a newly painted room. The question of individual susceptibility has also to be considered, but one may say with a good deal of confidence that the prevention of dust, or its removal by fans or otherwise at the moment of its formation, and the removal of vapours or volatile solvents and the substitution of fresh air will bring cases of painters' colic, whether properly attributed to lead, to turpentine, or any other substance, down to insignificant proportions, and that no other remedy will be equally efficacious.

I am sorry to say that this sort of reasoning does not appeal to such a body as the International Labour Office, and that the very polyglot body which will in due course meet at Geneva will pay but little attention to medical evidence. The Treaty of Peace signed at Versailles provided for the holding of international conferences on questions in which labour is interested, such conferences to be attended by representatives of the governments, the employers, and the workers of every country, and each country is under an obligation to carry out so far as practicable the decisions arrived at by the conferences.

When I was at Washington rather more than a year ago at the first of these conferences we had to consider the health of the workers, and, in particular, the prevention of anthrax, of mercury poisoning, of phosphorus poisoning, and of lead poisoning in so far as it affected women and young persons. We made certain recommendations, one of which has in substance been embodied in the Women and Young Persons (Employment in Lead Processes) Bill, which became an Act of Parliament last session. I am bound to say that though I have in the past had a good deal to do with Acts of Parliament, I did not realise until I was at Washington the extraordinary difficulty of devising rules which would achieve the desired result without unnecessary dislocation of trade, and which were capable of being applied to a variety of countries with different industrial conditions and different methods of domestic legislation. With my recent experience of the Lead Processes Bill, I now realise the difficulties still more acutely, but even at Washington I thought it desirable to suggest to the conference that in view of the complexity of industrial diseases the problems attached to them should be carefully considered beforehand by a committee on which the governments, the employers, and the workers should all be represented. The Conference at Washington unanimously recommended the appointment of such a committee, but no such committee has been so far appointed, and a purely bureaucratic organisation is tackling the problems instead. Governments are particularly susceptible to public opinion, and the public opinion of to-day is largely based on the imperfect recollection of the cases of lead poisoning which occurred five-and-twenty years ago. An instance of this was brought to my notice during the passage of the above-mentioned Bill through

Parliament last session. In supporting the Bill one speaker gave an instance of lead poisoning which had occurred in the paint trade. He gave various details, and I had the incident he mentioned looked into and found it was a case of poisoning by arsenite of copper. This is typical of what happens. The conditions five-and-twenty years ago were so bad, and made such an impression on the social workers of the day, that many people believe that they prevail yet. The fact is that the Home Office, under the guidance of Dr. Legge, has very much reduced lead poisoning, and in the pottery industry has to all intents and purposes abolished it, for there are in that trade no new cases, and the cases which are from time to time reported in the china and earthenware statistics are the deaths of workers as they gradually get old, who contracted lead poisoning many years ago, before the Home Office regulations came into force. But though these facts are known to a few of us, the public as a whole, not only in this country, but in other countries, have not had time to bring their knowledge up to date, and, stimulated by their recollection of bygone days, they have brought pressure to bear on the various governments of the world, and the officials who represent them, to treat the problem as if it still was in the same state as it was a generation ago. The International Labour Office shows no inclination to have such problems scientifically examined by the employers and workers who are most nearly concerned, but they have appointed a permanent official, who seems to be entrusted with the duty of preparing a case for the prohibition of lead, and who has manifested no anxiety to have the assistance of such a committee as was recommended at Washington.

It is not very easy, but it is possible, to frame regulations which would reduce to a minimum the vapours and dust to which painters are exposed, and you may ask me why such regulations have not been, at any rate, given a trial. The answer is that in some foreign countries—for instance, Austria, Germany, and Belgium—they have been tried and have proved beneficial, and I am not without hope that the Home Government may give them a trial. Government Departments at the present time have their hands full of problems, and one cannot blame any department for not desiring to add more to its already heavy load. But I think the Home Office must pay the penalty of success. It has done so much to improve the condition of the workers with so little interference with trade; it has in the past co-operated fairly and reasonably with trades unions and manufacturers, and the tradition which it has created is one not to be lightly destroyed. We chemical manufacturers and chemists, recognising the importance of chemistry to the nation and the fact that we are now only in the beginning of a highly specialised chemical industry, must bring pressure to bear on the Home Office and all other Government Departments concerned to maintain the high standard they have themselves set up and not to be led away by the false gods of the Geneva bureaucracy. The International Labour Office may be productive of much good, but in so far as industrial hygiene is concerned it will accomplish nothing without the co-operation of those primarily affected, and its present methods are tending to promote suspicion rather than confidence.

References.

[1] Oliver, "Dangerous Trades," p. 429.
[2] Journal of State Medicine, Vol. XXVIII., p. 306.
[3] Home Office Report for 1918, p. 79.
[4] Legge and Goadby, p. 109.
[5] Journal of Industrial Hygiene, Vol. II., p. 129.
[6] See Journal of Industrial Hygiene, Vol. II., p. 72.
[7] Home Office Report for 1918, p. 60.
[8] Home Office Report for 1919, p. 61.
[9] Legge and Goadby, p. 120.
[10] Legge and Goadby, p. 56.

BRITISH CHEMICAL PLANT MANUFACTURERS' ASSOCIATION.

Prior to the war British chemical manufacturers procured much of their plant from Germany owing to the difficulty they experienced in obtaining plant in this country which satisfied their requirements. A feeling had long prevailed in the industry that steps should be taken to promote closer co-operation between British chemical and British chemical-plant manufacturers. The need for such action was fully realised by those members of the Association of British Chemical Manufacturers who accompanied the mission sent out by that body under the ægis of the Department of Overseas Trade to inspect chemical factories in the Occupied Area of Germany in May, 1919.

A year later it was decided to invite representatives of the plant manufacturers to meet in conference representatives of the Fine Chemical Group of the Association of British Chemical Manufacturers, to whom the matter was of particular importance. The plant manufacturers agreed that it was desirable that they should be brought more closely into touch with the chemical manufacturers and kept more adequately informed of their requirements, and expressed their willingness to do all in their power to assist the chemical manufacturers. The two conferences then held led to the formation of the British Chemical Plant Manufacturers' Association, which at its inaugural meeting in July last consisted of nineteen firms. Mr. J. H. Rawson (The Widnes Foundry Co., Ltd.), Mr. L. M. G. Fraser (Messrs. W. J. Fraser and Co., Ltd.), and Mr. E. A. Alliott (Messrs. Manlove Alliott and Co., Ltd.) were elected chairman, vice-chairman, and hon. treasurer, respectively, and Mr. W. J. U. Woolcock (General Manager of the Association of British Chemical Manufacturers), secretary. The new Association became affiliated to the Association of British Chemical Manufacturers.

It was agreed that one of the first questions to be considered was the standardisation of chemical plant and apparatus, in which the Germans have reached a very advanced stage. At a joint meeting of representatives of the two Associations it was decided that the question of standardising jacketted-pans with stirrers and covers, boiling-pans and filter-press plant should be the first to receive consideration. The joint sub-committees which were set up to consider these matters are making good progress. Both the British Chemical Plant Manufacturers' Association and the Association of British Chemical Manufacturers are represented on the Sectional Committee on Chemical Engineering of the British Engineering Standards Association, which is also considering the standardisation of chemical plant and apparatus. A joint research committee was also appointed to investigate any new types of plant which may be reported to be in use in other countries and to go into any questions bearing upon the improvement of chemical plant in this country. This committee has invited the co-operation of the Chemical Engineering Group of the Society of Chemical Industry.

Attention having been drawn to the fact that the German plant manufacturers utilise nickel to a much greater extent than the British plant manufacturers, the Committee has now under consideration the uses to which this metal could be put in chemical plant. In this connexion very valuable assistance is being received from the Mond Nickel Co. The question of the use of 12 per cent. chromium steel is also being investigated.

The membership of the British Chemical Plant Manufacturers' Association has increased considerably since its inauguration, and it is hoped that, as the Association becomes more fully representative