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University of Cincinnati.

CINCINNATI, OHIO.

Dr. Greaud,
Societe de Produits Chimiques
Ethyl-Kuhlmann.

Paimboeuf,
(Loire Inferieure),
F R A N C E.

Pursuant to our meeting in Paimboeuf, I discussed the entire problem with which you are presented with my associated in London.

Mr. Bevan decided that he and I should pay a visit to the appropriate representatives of Kuhlmann in Paris, presenting them with our views in person, and also in the form of a general Memorandum. I am sending you for your confidential information a copy of this Memorandum. It is not intended to be complete in all respects, and I have carefully avoided any implications that could be regarded as unduly critical or discourteous. I was also careful not to involve you in an unfavourable situation. However, I have done the best I could to follow through on my promise to support you in every possible way.

I believe that favourable results will follow, and I sincerely trust that this will be the case. It may take a little time, and I hope that you will not have to be patient for an intolerable period. Perhaps you will let me know from time to time what progress is being made. My office address is given above for that purpose.

I should like to take this opportunity of thanking you for the fullness of your information. I should also like to express my great appreciation of your hospitality and my acknowledgment of the splendid luncheon which you provided. I trust we shall be able to resume our conversation in the not too distant future on some equally pleasant occasion, when there are no troubles to discuss.

With kindest personal regards,

Sincerely yours.

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*17-1-1949
Final report*

MEMORANDUM ON VISIT TO ETHYL-KUHLMANN, FAINBOEUF
BY DR. M. DAVISON, DECEMBER 1948.

PURPOSE.

- (1) To ascertain the medical facts associated with an instance of possible tetraethyl lead intoxication in manufacture at the Ethyl-Kuhlmann Plant at Fainboeuf.
- (2) To make suggestions, if necessary, to obviate the possibility of intoxication in future.

ITINERARY.

Arrived at Nantes on the afternoon of Tuesday, 14th December, 1948 accompanied by Monsieur Journeau of Ethyl S.A., Paris. Met Dr. Léquyer, part-time Medical Officer to Ethyl-Kuhlmann, Fainboeuf. Proceeded by road to Fainboeuf and met Monsieur Rossoz, the Works' Manager, (Monsieur Chuffart, General Manager, was absent), Monsieur Roubeix, the Process Manager and Mademoiselle Leguen, Nurse-Health Visitor.

The case of [REDACTED] the individual reputed to have died with symptoms common to delirium tremens and tetraethyl lead poisoning, and American and English current methods of control were discussed in comparison with those at Fainboeuf. A conducted tour of the lead recovery and alloy buildings was made with Messieurs Rossoz and Roubeix, Dr. Léquyer and Monsieur Journeau. These buildings were not in operation. The other process buildings were out of action owing to an electrical failure and were deferred until the following day.

Selected process operators were examined in conjunction with Dr. Léquyer.

In the evening discussions were held with Dr. P. Fraud, Chief of the local Association of Industrial Medical Officers, Dr. Léquyer and Monsieur Journeau.

On Wednesday, 15th December, Fainboeuf was revisited. Met Monsieur Chuffart, the General Manager, and had further discussions on problems. A conducted tour of the main buildings of the "Ethyl" fluid Plant was made with Monsieur Rossoz, Monsieur Roubeix, Dr. Léquyer and Monsieur Journeau. Fourteen samples of urine were collected from a cross section of process employees and laboratory staff.

In the evening had a further discussion with Dr. Giroire, Company's Medical Officer to the Plant, who is the leading neurologist in the area and Physician-in-Charge of the neuro-surgical unit at St. Jacques Hospital, Nantes, together with Dr. Léquyer, Monsieur Rossoz and Monsieur Journeau.

On Thursday, 16th December, St. Jacques Hospital was visited and Dr. Corman, the Physician who treated [REDACTED], Dr. Léquyer and Monsieur Journeau were also present.

Returned to Paris in the afternoon.

On Friday, 17th December findings were discussed with Colonel G. Thenault. Returned to London in the afternoon.

NARRATIVE.

One encountered a most cooperative spirit, courtesy and hospitality throughout this visit.

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Dr. L  quyer, aged about thirty years, married, and residing in Nantes, 47 kilometres from Rainboeuf, is a graduate of Paris University and has taken a post-graduate course of six months in industrial medicine. He attends the Ethyl-Kuhlmann Plant at Rainboeuf on one half-day and one day alternately each week, where he supervises, in a general way, some 550 employees at the plant and, in particular some 90 employees of the "Ethyl" fluid plant. He also looks after a number of factories in Nantes. He is employed full-time on this industrial work, and is a member of an association of five doctors who give a Factory Medical Service in the Nantes area, and of which Dr. Arsud is the Chief.

Dr. Giroire is still interested in the workings of the plant but, owing to pressure of other professional duties, he handed this work over to Dr. L  quyer in 1945.

After discussions with these medical men, they were in full agreement with the suggestions and recommendations made for medical control. One gained the impression that the Industrial Medical Service was in its infancy in the area and that safety practices were not too strictly observed in most factories, although some propaganda had been issued by "L'Association des Industries de France" and Ethyl-Kuhlmann had issued an excellent little booklet entitled "S  curit  ". None of the medical gentlemen had any up-to-date knowledge on the problems of the manufacture and handling of "Ethyl" fluid.

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There is very good accommodation for the medical service which, however, is poorly equipped and inadequately staffed. There is a medical laboratory for the examination of physiological specimens some two miles from the plant, but this has never been used. There are no chemists or technicians available to undertake this work. The blood counts are carried out by a competent trained nurse, Mademoiselle Leguen, who has been at the plant for many years and who also performs duties similar to those of a Health Visitor in this country. The scope for and methods of recording initial and routine medical examinations are admirable but cannot be carried out in entirety by the part-time Medical Officer, nor can all the necessary details be completed as the facilities are not available.

As regards the staff at the plant, the absence of a Safety Organisation is the most outstanding defect. Even though at present the plant is a four-autoclave unit, supervision of hygiene and safety from medical angles is considered as essential as in American and British plants. The payroll employees of the plant are drawn from the peasantry, who for generations have derived a livelihood from the soil and to whom factory life is something new. One was informed that many of the workmen had other occupations in agriculture and horticulture in the area. The majority are stated to be of Celtic origin and are, therefore, more susceptible to pulmonary tuberculosis. Rainboeuf is situated in a wine growing area. Much of the wine produced is of inferior grade which is unfit for export and is consumed in not too moderate quantities by most. A number of the process employees, who were stated to drink to excess, were presented for examination through the courtesy of the Management. All were well nourished but in some one noted pallor, marked tremor of the tongue, lips and hands and obtained a history of restlessness, sleeplessness, bad dreams, anorexia, especially in the morning, and other digestive disturbances. The dental state of most, from our point of view, was simply appalling. The blood pressure, taken with an Aneroid Sphygmomanometer, was normal in all cases. The temperatures of some were depressed, and the pulse rates within normal limits of variation. Frankly, by clinical examination only, it is impossible to distinguish between the effects of alcohol and tetraethyl lead intoxication in instances of this type, although from the history, the signs and symptoms were almost certainly due to alcohol.

It will be a most unenviable task for the Management, Medical Officer and a Safety Organisation to educate these men, and to enforce regulations in safe working practices. Most of these men have their meals at home. Some of their clothing is provided by the employers. Wooden sabots are worn.

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The clothing is washed once a week in a small laundry on the plant. A female is employed in the laundry.

From the medical point of view the plant was structurally sound, had excellent floors and was well lighted. The Lead Recovery Building, which was constructed to deal with eight autoclaves, works for two weeks and is closed for two weeks. It was not in operation at the time of inspection. It was stated that very little trouble was encountered with the wet sludge conveyor, the drier, the vacuum and the condensate tank. The Alloy Building was probably a little dustier than at Northwich, and apparently the same troubles in packing hoppers exist at Laiboeuf as elsewhere. One noted two men dealing with a hopper without using dust masks. In the Tetraethyl Lead Building, which also deals with the washing of tetraethyl lead, there were small leaks from the rear glands of the autoclaves and some signs of contamination of the surfaces of the stills. Drop-leg cleaning is carried out after each charge. The men carrying out this operation were observed to be wearing canister respirators. There were some defects in the exhaust ventilation of the T.E.L. washing room and the exhaust on the drum packing booth, which was being used, was not working. None of these, with the present rate of production, would be sufficient to give rise to fatal tetraethyl lead poisoning, although excessive lead absorption and perhaps signs of mild intoxication may possibly be encountered. One was informed that the men did not like wearing the air line masks, and as a routine the canister type masks are used, the canisters being changed six monthly. Leather gloves are a general issue; the later types have not yet been obtained. Lead-in-air figures in the T.E.L. Building are higher than in Northwich, but generally under 5.0 mgs. per ten cubic metres of air by the lead sulphide method.

The three main defects, when compared with American and British Plants, are inadequate medical control, indifferent maintenance and absence of essential supervision, especially on maintenance jobs.

In the instance of the man [REDACTED] who died on the 1st December, 1948 in St. Jacques Hospital, with a diagnosis of delirium tremens, the possibility of tetraethyl lead intoxication may be considered under the usual four headings:-

- (1) Significant exposure.
- (2) Clinical manifestations.
- (3) Evidence of abnormal amounts of lead in faecal excretions and body tissues.
- (4) Any other cause.

(1) Significant exposure.

As stated above, a general survey of the Plant does not warrant a conclusion that exposure of the workmen is excessive. Owing to lack of supervision, however, and in the absence of any record of the actual work carried out by this man during the three weeks prior to the onset of disease, it is not possible to state that he did not undertake some hazardous job of maintenance without adequate protection and supervision. In the absence, therefore, of any concrete evidence it must be provisionally accepted that, from the nature of his occupation, significant exposure was possible.

(2) Clinical manifestations.

There are some unusual features in this case which have not hitherto been recorded but, on the whole, the symptoms were similar to those which may be expected in cases of tetraethyl lead poisoning. Dr. Gorman, who treated Albert Nickolas, considered him to be a case of delirium tremens, a common disease in the area, but he did not respond to treatment in the usual manner.

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(3) Evidence of abnormal amounts of lead in faecal excretions and body tissues.

There are no records of previous excretions in urine and faeces. Samples of tissues and one sample of urine have been handed to Professor Dodds for analysis, on receipt of the results of which a full case report on this man will be compiled.

(4) Any other cause.

The deceased workman was a known chronic alcoholic, which is a disease of a mental type, and as such the man should never have been employed on the manufacture of tetraethyl lead. Delirium tremens results from persistent drinking, generally under the stimulus of temporary unusual amounts, sudden cessation or shock. According to British medical teaching, a death rate of about one in seven is to be expected in delirium tremens, even with adequate treatment, and of these most are under forty years of age. The entire disease process may be due to one cause, namely, alcohol. On the other hand, it is generally accepted that persons addicted to alcohol are unreliable, careless and defective in judgement, and it is quite possible that this man may have undertaken some maintenance work without sufficient care and regard to the hazard involved, and being an alcoholic would naturally be more prone to the toxic effects of tetraethyl lead.

Whatever is the final conclusion in this case, it can be stated, at this stage, that the fatal termination was in part due to excessive drinking of alcohol, and that exposure to tetraethyl lead may possibly have played a part.

This unsatisfactory state of affairs is due to inadequate measures of control, and it is advisable that the T.E.L. Plant at Paimboeuf should consider extending and improving medical control and hygiene to the standards recommended by Dr. Kahoe, so that it will be possible at all times to know the degree of exposure and absorption of tetraethyl lead of all groups of workmen and individuals engaged on the Plant. This should be contemplated at the earliest possible date. If full facilities are unlikely to be initiated then an interim scheme of control could be considered immediately. This would bring this Plant into line with current practice in American and British Plants.

For safe working and control the essentials are considered under the following four headings:-

- (1) Medical and Hygiene.
- (2) Engineering, design and maintenance.
- (3) Education.
- (4) Enforcement.

(1) Medical and Hygiene.

A Medical Officer employed full-time on a Plant requires about two years to acquire a proper perspective of the general hazards and control. To accomplish the necessary work under existing conditions, the services of a Medical Officer for at least three days per week would be required. As the Plant will eventually have eight autoclaves, it is recommended that a full-time Medical Officer be employed who has had some initial training in another tetraethyl lead Plant, and who should reside within ten miles of Paimboeuf. One full-time technician is necessary, even at present, to carry out the blood examinations required.

The only safe and reliable guide to absorption and excretion of tetraethyl lead is the analysis of physiological samples of blood, urine and faeces of individuals exposed. If it is not possible immediately to put into use the laboratory provided for this purpose, it is suggested that analysis of freshly voided specimens of urine, by a short method, be initiated

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on the plant at the earliest possible date. At least one, and preferably two technicians would be required initially for this purpose.

Men for employment should be very thoroughly examined when first presented, and only men who are organically sound, mentally stable and of at least average intelligence should be selected. If any defect is found which is of doubtful significance, the Company should be given the benefit of the doubt, and the prospective employee rejected as unsuitable and unfit. Persons addicted to alcohol should definitely not be employed. The superman is not sought. A physique which is capable of undergoing moderate but not severe strain is adequate. Previous work in the lead trade is also a cause for rejection. The standards used in the Northwich Plant are attached. All men selected should have full blood counts carried out and, where considered necessary, liver function tests, X-ray of chest, blood test for syphilis, sedimentation rate and minor biochemical analysis, such as blood urea and blood sugar determination. The lead concentration in urine and faeces should be determined and, preferably also, the blood lead concentration before engagement on the process. In no case should a man be permitted to start work on the process unless passed as fit and suitable by the Medical Officer.

Starting with an organically sound industrial community, the object then is to promote and preserve the health of all employees at the highest possible level. Any deviation from normal may be readily detected. Persons developing or suffering from any organic disease of a temporary or permanent nature should be precluded from work on the manufacture of tetraethyl lead. As stated above, the Company should be given the benefit of any doubt at the initial examination, but after employment and engagement on the process the individual should be given the benefit of any doubt and, if necessary, found alternative work not involving exposure. A man returning to work after sickness absence should be re-examined and considered as to fitness for re-employment on tetraethyl lead manufacture.

It is recommended that the standard of medical equipment be improved immediately, that the apparatus for thorough examination of eyes, ears, nose and throat be provided and that a check should be frequently made on sphygmomanometers. The mercury type of sphygmomanometer is preferred.

As regards physiological samples, when the service is first started all process workers should have an analysis made of all faecal matter and urine collected over a twenty-four hour period. This should be carried out at six weekly intervals, and snap samples of urine should be examined at the three weeks intervening between the six weekly samples. In this way the basic data required to establish the degree of exposure and lead absorption in groups of workmen can be readily collected and compared. Afterwards, the system can be modified to suit the needs of the plant, for example, it will probably be found that the persons working in the tetraethyl lead building will not require analysis of faeces, and the people working in the lead smelting and alloy buildings will require to have such samples analysed until such time as the excretion of lead in faeces approaches the mean for the plant. Blood sampling can be introduced as the service permits.

The "Criteria for the Interpretation of Analytical Data" by Dr. R.A. Kenoe is attached.

The blood examinations should be made under terms of absolute values if possible, and certainly a reliable method of determination of haemoglobin, such as the alkali or acid haematin methods, is desirable. In the British Plant a minimum of 90% haemoglobin (100% = 14.75 grams), is accepted as the lowest at which a man should be permitted to continue employment on the plant. Stippled cell counts should be expressed as numbers per million and it is recommended that methods common to the American and British Plants be used.

From the clinical, physiological and blood examinations the Medical Officer will be in a position to know exactly where exposure lies. He should spend a considerable time on the plant to ascertain the sources from which exposure has arisen, and make recommendations to the management

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accordingly, in order that the sources of hazard may be controlled. The Medical Officer should appreciate that he must spend a considerable time on the Plant. His attitude, owing to a different type of training, will be quite unlike that of the Chemist and Engineer, but the three together ought to compromise in such a manner as will lead to greater efficiency, production and safety in manufacture.

The Medical Officer should be responsible for the training of first aid personnel, and exercise supervision over air sampling figures and protective clothing. He should not have any executive authority on the Plant, but the Management should give due care and consideration to his recommendations. Recommendations made in regard to employees should always be followed and accepted. Recommendations in regard to Plant changes in process, repairs, maintenance, etc. should be considered by the Management.

All the medical men contacted were very interested in the matters discussed, and extracts from world literature, together with various recommendations and regulations, which they requested, will be forwarded to them.

A Safety Officer should be appointed whose duties will be the education of the employees in the types and degrees of hazards on the Plant, and the methods by which they can be controlled. He will be responsible for the maintenance and deployment of all safety equipment and should supervise both clothing and the welfare of the men. He should be present, at least for a time, on maintenance jobs to see that the regulations and rules regarding safety are being observed by the workmen employed, and should ensure that a safety sheet is prepared for all workmen carrying out a hazardous job. He should be responsible for the deployment of first aid personnel trained by the Medical Officer. If he should find that the bathing accommodation is inadequate, and feels that all Works' clothing should be provided and washed, say twice weekly, he should make recommendations accordingly.

All persons engaged in the manufacture of tetraethyl lead should be dentally fit.

The above is only a rough outline of what is necessary and details will be forwarded later.

(2) Engineering, design and maintenance.

From the medical viewpoint we can make no constructive criticism on the Plant design, but would like to stress the necessity for unremitting zeal in the search for sources of contamination from the Plant equipment, and efforts to abate them. A summary of the points at which lead, organic and inorganic, has been found to be most prevalent in other Plants will be forwarded later. The ideal is that there should be no exposure to lead, organic or inorganic, on the Plant.

(3) Education.

Education of the men at the Maimboef Plant will certainly be a very difficult task. As in all tetraethyl lead plants it is the Medical Officer's duty to educate the Management and the men, and also to accept the education of the Chemist and Engineer, again, in order that maximum production may be obtained with maximum efficiency, economy and control.

(4) Enforcement.

Enforcement of the regulations is a matter of supervision and falls within the province of the Works' Manager, the Process Manager, the Safety Officer, the Medical Officer and the Foremen.

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Attached for reference and information are copies of:-

- (1) Standards of Fitness for Personnel Selected for Employment in Tetraethyl Lead Manufacture.
- (2) Works Rules.
- (3) Safety Rules.
- (4) Safety Certificate (this is normally prepared in duplicate).
- (5) Notes on the collection of Faeces and Urine.
- (6) A Short Method of Analysis of Urine.
- (7) Staining of Stippled Cells in Blood.
- (8) Criteria for the Interpretation of Analytical Data.



E. Davison.
(Senior Medical Officer).

22nd December, 1948.

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