

VISIT OF PROFESSOR KEHOE TO SWEDEN

Report by Chief Medical Officer

On 11.3.68 at 2.0 p.m. Prof. R.A. Kehoe addressed a meeting composed of Swedish Health Authorities and others in the Board Room of a Swedish Bank in Stockholm. Prof. Kehoe was introduced to the meeting, which was under the chairmanship of Prof. Abramson, by the vice President of Esso in Sweden, Mr. Andersson. Subsequently, Mr. Anderson passed the meeting to the chairman who described Prof. Kehoe as being a physiologist, a pathologist and an occupational health physician - a unique combination. A list of those present at the meeting is appended.

Prof. Kehoe began by describing the background development of the tetraethyl lead industry from 1924. From this time to the present day much investigatory work has been devoted to aspects of public health in the U.S.A. As a result of this work there is no doubt that we know very well of our present day situation in respect to lead as an environmental health factor.

Prof. Kehoe indicated that much of Danielsson's work had been taken from his own, but on an incomplete basis. He went on to discuss his earlier work in which an investigation of Mexican natives had revealed that all normal people take in and excrete lead. This work had been criticised on grounds of poor analytical methods that were used at this time. Although present day analytical methods are more accurate, this criticism is not valid, as the results obtained by the older method showed good reproducibility with a consistent loss factor of 80 µg.lead per sample analysed.

Prof. Kehoe then showed and discussed a series of slides demonstrating blood and urinary lead levels in sectors of the American population and also similar data relating to French and German figures between the wars. He then went on to demonstrate the results of lead input and output studies on some of his experimental subjects from the Kettering Laboratory and estimated from these data that the amount of lead absorbed from air was of the order of 15 - 20 µg.lead per day.

At this point some of those at the meeting raised queries with Prof. Kehoe on the matter of blood lead levels considered to be normal in healthy people, Danielsson and Lundholm in particular being inclined to criticise his methods and results. Prof. Kehoe then described the results of analysis of post-mortem tissue for lead from a child who had died from meningitis. He indicated that the highest concentrations of lead was found in skeletal tissue, especially in long bone. Danielsson interrupted to decry these results on the basis that this was not a representative case, since the child concerned was unhealthy and underweight. Prof. Kehoe responded sharply to these objections, saying that he had no doubt, as a physiologist, of the validity of these results. He seemed at this stage to have gained the confidence and sympathy of the bulk of his audience, in particular the medically qualified among them. Prof. Kehoe continued by indicating, despite interruptions from Danielsson, that the evidence showed that there was no progressive accumulation of lead in the body of non-occupationally exposed people. Lead is present in all soils in varying concentrations which finds its way into vegetation and so into animals. For Centuries past Man's utilisation of lead has caused an increased distribution of this metal in the environment. Any attempt to evaluate this increase by means of guesswork or extrapolation is invalid, as only practical investigatory work can provide a satisfactory answer. The lead content in food in the U.S.A. is somewhat lower now than in the past, largely due to the elimination of the use of lead arsenate insecticides and to food containers being constructed from lead free materials.

Prof. Kehoe pointed out that some Industrial lead plants in the U.S.A. do not operate satisfactorily, but the determination between safe and unsafe practices is clearly established. He then went on to show some of the slides from his Harben lectures of 1961, from which he demonstrated that intake of 1 mg. lead/day resulted in a steady straight line accumulation, and 2 mg. lead intake/day resulted in the same picture to a more marked degree. With respect to air contamination it is necessary to limit lead concentrations in order to prevent any measurable steady increase in body accumulation. Work on this aspect is being undertaken at the present time in the U.S.A.

Danielsson disagreed with Prof. Kehoe's interpretation of one of his slides, indicating that what Prof. Kehoe described as a plateau was, as he saw it statistically, a rising curve. Prof. Kehoe did not agree, but did not pursue the matter with him, and continued with his talk. He discussed the fate of inhaled lead particles the majority of which are not absorbed by the lungs, but are transferred to the alimentary tract, from where about 10% are absorbed into the body system. Particles of size greater than 0.75 μ g. are dealt with in this way.

He went on to describe the work that he is at present conducting in the Kettering Laboratory at Cincinnati where human subjects are being exposed to differing levels of lead in air, with a view to finding that level of lead which will result in a measurable increase of lead output in the urine with no concomitant increase in blood lead level.

In summarising his talk, Prof. Kehoe stated that during the past three decades, despite an increasing use of leaded gasoline, the American population showed no evidence of increased lead absorption. In Cincinnati lead-in-air levels had decreased, despite an increase in automobiles. This was explained by redistribution of traffic flows and a reduction in the utilisation of coal as a fuel.

It is not possible to calculate what may be the lead content of atmosphere by a direct reference to the quantities of gasoline used and the numbers of automobiles on roads. Neither is it possible to calculate how much of the lead in atmosphere may be absorbed via the respiratory tract, because of variables that exist such as an individual's movements, his mode of life and the lead in food which would mask that taken in by the lungs. The lead levels in atmosphere existing at the present time do not constitute a hazard to the population. Absorption of lead via the lungs was probably very much less than thought to be the case at present.

Prof. Kehoe ended his talk by saying he did not consider it to be worthwhile to indulge in calculation in order to arrive at conclusions. Direct investigatory research work is the only way to provide answers to problems. He suggested that the Swedish authorities should consider undertaking research of their own and to make their own observations as was done by the Swiss in the past.

This concluded Prof. Kehoe's talk. Prof. Abramson thanked Prof. Kehoe for the information he had provided and agreed that in Sweden research work should be undertaken to provide the necessary facts.

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In the discussion that followed, Dr. Holmqvist agreed with Prof. Kehoe's remarks with respect to mean lead in blood levels, which, in Sweden over the period 1950 - 67, had shown a downward trend, despite a considerable increase in the number of motor vehicles in use on the roads during this period. Further Dr. Holmqvist agreed with Prof. Kehoe that industrial exposure resulted in a pattern of equilibrium, as represented by plateau levels, which varied according to the exposure picture.

Dr. Lundholm followed this by reading a prepared statement in Swedish, which it is understood consisted of a complaint to the Press of misrepresentation of remarks of his at a previous meeting.

Dr. Cramér commented on lead in blood levels found in sections of the Swedish population. In one area a mean level of 20 µg.lead/100 gm blood had been found, but in some other population groups, such as traffic policemen, a higher figure than this was found. He asked Professor Kehoe whether he had undertaken any metabolic studies on porphyrins and alpha-amino-laevulinic acid (a precursor to porphyrin) excretion in urine; also whether lead sesquioxide (the compound used in Prof. Kehoe's human inhalation experiments) was comparable to the lead halides; and finally do the lead alkyls as such pose a problem in city streets.

In reply Prof. Kehoe indicated that studies on the metabolism of porphyrins and their precursors had been undertaken in industry. The question has been raised of effects of a sub-clinical nature that have not been observed by clinicians. He mentioned the association of porphyrins with the synthesis of haemoglobin and indicated that in his own work at the Kettering Laboratory with human subjects he had not observed any metabolic change involving porphyrins or reticulocytes. In his view an alteration in haemoglobin synthesis would indicate intoxication. In reply to Dr. Cramér's other queries Prof. Kehoe thought that the properties of lead sesquioxide and the lead halides would probably result in the same absorption rate; that lead alkyl compounds do not pose a problem in city streets, the amounts present being almost undetectable.

Dr. Lundholm then began to quote from a copy of the Morse report which was in his possession. Briefly he mentioned that the report stated that prior to the advent of tetraethyl lead in gasoline no base line of lead in humans had been established. Studies on occupational exposure had been undertaken, but sub-clinical effects at normally accepted blood lead levels had been suggested as being feasible and the effects of low lead levels on children, whom Russian workers consider to be more sensitive to lead than adults, could not be disregarded. Prof. Kehoe interjected at this point to say that in his experience this latter statement was not true. Dr. Lundholm then asked Prof. Kehoe whether, as with mercury poisoning, the particular compound of lead involved was of importance in the causation of lead intoxication. Prof. Kehoe replied to Dr. Lundholm by stating that in his 40 years experience he had never seen a case of lead intoxication where the blood lead level was less than 80 µg.lead/100 gm. blood. This observation applied equally to children and adults. He agreed with Dr. Lundholm that the particular lead compound was an important factor in intoxication. Prof. Kehoe then commented on the Morse report, pointing out that the Morse Committee did not include among its members anyone from the Medical Profession and further that there were none among those who comprised the committee who had any real knowledge of the subject.

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Dr. Göthe disagreed with some of Dr. Lundholm's remarks and described the events that followed the change that took place in Sweden in 1967, when traffic was altered to drive on the right of the road as opposed to the left. A large number of students were called in to assist the police in traffic control and when one of these inexperienced youngsters collapsed while on point duty, the newspapers published his collapse as being caused by carbon monoxide poisoning. In point of fact subsequent investigation showed that his carbon monoxide levels in blood were normal and that his collapse had been due to a simple fainting attack. Dr. Göthe described this incident as illustrating how false conclusions can be reached from inadequate and presumptive data. A number of other students involved in the work of traffic control were also investigated and the opportunity was taken to examine their blood for lead concentration; this was found to show a mean value of 16 $\mu\text{g.lead}/100 \text{ gm. blood}$.

Dr. Rylander then spoke of undesirable undertones that he had detected during the course of the meeting. He considered that more work should be done to improve our present knowledge and that no purpose was served in debating the reliability of earlier work.

Mr. Danielsson declared that 200 $\mu\text{g.lead}/\text{m}^3$ of air was not a safe level for exposure. The Japanese take 190 $\mu\text{g.lead}/\text{m}^3$ of air as the maximum allowable concentration figure and a figure of 120 $\mu\text{g.lead}/\text{m}^3$ of air as the Threshold limit value. Supposing Prof. Kehoe to be correct and a figure of 150 $\mu\text{g.lead}/\text{m}^3$ of air was a safe level of exposure for 22% of time in a full week (i.e. estimated time of occupational exposure), since this work involved exposure of normal healthy adults it is therefore not acceptable as valid for all sections of the population. Russian workers have advocated a standard of 0.7 $\mu\text{g.lead}/\text{m}^3$ of air in the ambient atmosphere.

Prof. Kehoe replied that Russian standards are derived from experimental work involving reflex responses, which have no application in practical terms.

At this juncture the chairman, Prof. Abramson, thanked Prof. Kehoe for his address and brought the meeting to an end.

List of Participants

- Chairman: Professor Ernst Abramson, Statens Institut för Folkhälsan, Stockholm.
(State Institution for Occupational Health, Vice Chairman of Poisons Board.)
- Direktör Torsten Andersson, Svenska Esso AB, Stockholm.
- Dr. P.S.I. Barry, London. (Associated Octel Company Limited).
- Docent Kim Cramér, Sahlgrenska Sjukhuset, Göteborg. (Medical Service & Department of Hygiene, University of Gothenburg).
- Tekn.lic. Allan Danielsson, Kungl. Tekniska Högskolan, Stockholm. (Technical Journal).
- Fil. lic. Lennart Danielsson, 1964 års Naturresursutredning. (1964 Natural Resources Investigation Group).
- Redaktör Bo G. Ericsson, Sveriges Radio, Stockholm. (Radio commentator).
- Professor Gideon Gerhardsson, Svenska Arbetsgivareföreningen, Stockholm. (Chairman Government Exhaust Commission Group).
- Bitr.överläkare Carl Johan Göthe, Stockholm. (Asst. Senior M.O. to ? Police).
- Civilingenjör Poul Hansen, Svenska Esso AB, Stockholm.
- Dr. A. Hawkes, Detroit. (Ethyl Corporation).
- Docent Ivar Holmqvist, Bolidens Gruv AB, Rönnskärsverken, Skelleftehamn. (Medical Director Bolidens Mining).
- Mr. D.D. Hornbeck, Brussel. (Ethyl S.A.).
- Herr Hans Håkanson, Svenska Esso AB, Stockholm.
- Civilingenjör Halvar Johansson, Teknisk Tidskrift, Stockholm. (Weekly Engineering Magazine).
- Dr. Robert A. Kehoe, Cincinnati.
- Direktör Rolf af Klinthberg, Svenska Petroleum Institutet, Stockholm.
- Civilingenjör Bertil Lindvall, Analytica AB, Sollentuna.
- Mr. W.K. Lloyd, London. (Associated Octel Company Limited).
- Civilingenjör Hans-Eric Lorentz, Svenska Shell AB, Stockholm.
- Redaktör Lennart Lundegårdh, Svenska Dagbladet, Stockholm. (National newspaper).
- Fil. dr. Bengt Lundholm, Statens Naturvetenskapliga Forskningsråd, Stockholm.
(Natural Scientific Research Council).
- Pol.mag. Lennart Lundqvist, Statens Naturvetenskapliga Forskningsråd, Stockholm.
(Natural Scientific Research Council).
- Redaktör Thomas Michélsen, Dagens Nyheter, Stockholm. (National newspaper).
- Byråchef Goran Persson, Statens Naturvårdsverk, Luftvårdsbyrån, Solna. (Director of Air Conservation, Member of Exhaust Commission Group).
- Mr. dr. Ragnar Rylander, Stockholm. (State Institution for Occupational Health).
- Dr. Carl-Henrik Skoglund, Stockholm. (Esso doctor).
- Farm.lic. Ulla Swarén, Giftnämnden, Stockholm. (Pharmacology, Poisons board).
- Redaktör Siv. Österberg, Läkartidningen, Stockholm. (Medical Journal).