

January 29, 1935

Mr. G. Thenault
25 Avenue Victor-Emmanuel III
Room 527
Paris (8 e)
France

Dear Mr. Thenault:

I am writing to give you the opinion which you sought in your letter of January 15th. I choose to send it to you rather than to Dr. Coste for the reason that you will probably wish to translate certain statements in it for him in any case. By way of preface I should like to call your attention to the fact that I am preparing at the present time an article for publication which will present the most detailed evidence which has been obtained by the most precise methods available as to the extent of the exposure to lead which is associated with the handling of gasoline containing tetraethyl lead, as well as that which is associated with the repair and operation of motors which burn such gasoline. You are familiar with the previous evidence which has been published on the subject. Therefore I need not repeat what I have already said. The present evidence is in conformation with that obtained by other methods, but it has the additional significance that the results are quite above reproach both from the point of view of the character of the observations, and the accuracy of the methods by which lead has been determined. In this work we have made use of two methods in parallel for the measurement of lead; (a) our chemical method which has been shown to give somewhat low analytical results, and (b) a spectrographic method which is so sensitive that no question of negative error can be raised concerning it.

(1). By these studies we have demonstrated that the daily handling of leaded gasoline with repeated and frequent skin contact, and that the frequent exposure as a result of spillage, fail to result in a measureable absorption of lead.

(2). We have shown that garage mechanics exposed as long as twelve years to exhaust gases and to lead deposits in motors, do not show sufficient lead absorption to elevate their lead excretion or the lead content of their blood above that of groups of normal individuals.

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Now to translate these observations into practical terms. This simply means that there is no significant lead exposure associated with the handling of gasoline which contains tetraethyl lead in the commercial quantities employed in the United States. It means, furthermore, that persons who are exposed to exhaust gases do not show significant evidence of lead absorption even though they may at times develop evidence of carbon monoxide absorption. The interpretation of this in terms of the effects on pilots or passengers in airplanes is that there is no danger from the point of view of lead poisoning. It must be pointed out, however, that exposure to exhaust gases while not dangerous from the point of view of lead, is extremely dangerous from the point of view of carbon monoxide. There is also a somewhat lesser danger associated with exposure to exhaust gases on account of the fact that they contain appreciable amounts of incompletely burned hydro-carbons, some of which are vile smelling, nauseating, and even definitely irritating to the eyes and mucous membranes. The dangers associated with carbon monoxide are acute in that intoxication can result in a very short time. Under the very worst conditions that can be imagined, danger from the point of view of lead absorption has never been even postulated as acute or rapidly developing intoxication. It is absurd to think of lead absorption from exhaust gases as an acute condition. This is impossible from the very nature of the exposure. It is thus obvious that any symptoms which arise as the result of a single short or long exposure, have no possible relationship to lead absorption, but must arise from some other material, the toxic qualities of which are exerted promptly.

In this connection it may be well to briefly review the toxic characteristics of the materials which result from the complete or partial combustion of gasoline.

Gasoline itself is a toxic material with anaesthetic properties of approximately the same order of effectiveness as chloroform. Persons exposed to concentrations of the order of two and a half percent in air by volume, are readily overcome by drowsiness and stupor, and if the exposure is continued, the individual ceases to breathe and except under favorable conditions, can not be restored. In lower concentrations, inhalation produces varying degrees of drowsiness, drunkenness, vertigo and dizziness which are followed later by weakness, and sometimes by collapse. Irritation of the nervous system with insomnia, tremor, and hyperactive reflexes, continues for varying periods of time after exposure to toxic amounts. Even mild exposure may be associated with dizziness, headache, nausea, and vomiting. In the main, persons so exposed continued to recover without delayed injury after

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cessation of exposure. Occasionally, however, individuals who have been partially or completely overcome by the inhalation of gasoline remain ill and partially disabled for some weeks.

Carbon monoxide absorbed in high concentration produces disturbance of vision, confusion, and unconsciousness without any warning to the individual. In low concentrations, however, (anything in excess of .04 percent) the symptoms depend upon the length of exposure. Common symptoms are headache which increases in severity, nausea, varying degrees of mental disturbance, and sensory disturbance particularly visual. Of these the most frequent and the most significant for moderate exposures is headache which has a tendency to persist often for several hours after the cessation of exposure. The diagnosis in these cases is usually quite simple if the patient is observed within a short time after the cessation of his exposure. The blood will show varying degrees of saturation with carbon monoxide, the symptoms in general correlate very satisfactorily with the degree of saturation of the haemoglobin with carbon monoxide.

I trust that the above rather lengthy recital will give you the information of which you are most in need. If any further specific questions develop, I would be glad if you would communicate them to me promptly.

It may be of some additional interest to you and to the people in France who are investigating this problem, to know that similar questions arose in a corresponding intensity in the United States in the early stages of the use of leaded gasoline. A greater familiarity over a longer period of time has resulted in the complete disappearance of anxiety on the part of the handlers of leaded gasoline, as well as on the part of garage mechanics and pilots. When symptoms develop now in pilots or passengers, it is recognized that the greatest danger to be feared is that of exposure to exhaust gases, and with changes in the design of exhaust pipes and cock pits, the difficulties have been obviated. If leaded gasoline has been responsible for calling attention to the dangerous properties of exhaust gases, it has done well for this is by all odds the greatest danger which is to be faced in connection with the normal operation of the equipment.

With kindest personal regards,

Cordially yours,

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Robert A. Kehoe, M.D.