

October 24, 1942.

Col. G. F. Doriot,
Development and Research Branch,
Office of the Quartermaster General,
Washington, D. C.

Dear Col. Doriot:

At the request of Mr. C. H. Rasmussen with whom I talked over certain problems connected with the use of the Army Field Stove, I am writing to you to define in practical terms the lead hazards associated with the use of leaded gasoline in cook-stoves.

It has been suggested that the operation of such stoves without any filter for the removal of the lead might be attended with little danger over short periods of time, and that field conditions might well justify the risks associated with a lead exposure of this type and degree. On the opposite side it has been feared that even in the presence of a filter of average efficiency, enough lead would pass into the air to cause prompt lead intoxication on the part of exposed persons. Indeed, a recent article in War Medicine for May 1942 (Vol 2, page 450) by Abraham and Baird at Dale Mabry Field Tallahassee, describes two cases of alleged lead poisoning in persons so exposed. (The clinical background of these cases was not suggestive of lead poisoning and the analytical data on which the diagnosis was based were fantastic.)

Actually both ideas as expressed above are extreme viewpoints. No doubt a reasonable middle ground can be found, based on the facts and upon a sensible consideration of such risks in wartime.

A concentration of 1.5 mg. Pb per 10 cu. m. of respired air, is the accepted upper limit of safety in human exposure. This concentration relates to exposures that occur daily in relation to one's occupation, and is based upon the daily inhalation of 10 cu. m. of air (this being the approximate volume of air breathed by a man during an 8-hour working day). Obviously, exposures involving a shorter period of time could be endured with safety at higher levels of concentration, and intermittent or irregular exposures could be considerably higher. Roughly, a safe concentration can be calculated on the basis of the time of exposure per week, taking 48 hours as the standard for which the 1.5 mg. per 10 cu. m. was expressed. Thus, for example, a concentration of 6 mg. per 10 cu. m. might be regarded as safe for practical purposes for 12 hours of exposure per week.

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The "safe" concentration also refers to prolonged exposure in the sense of months but probably not for many years uninterruptedly. Any exposure that is to last but for a short time - i.e. a few weeks or months, may well be considerably higher. For this reason, in emergencies and for short periods, much more severe exposures up to 10, 15, or even 20 mg. per 10 cu. m. can be tolerated with but little danger.

On this background we can consider the facts with reference to the field army stove without a filter.

Assuming that the gasoline contains 4 ml. of lead tetraethyl per gallon (4.24 gm. of Pb) and that the stove operates with a normal stream of air, the effluent stream from the burner (unfiltered) will contain about 101 mg. Pb per 10 cu. m., disregarding the deposition of 1/10 to 1/8 of this amount in the burners and other parts of the stove. It may be seen to what extent this should be diluted by additional ventilation to provide safety for prolonged exposure.

The matter can be stated otherwise. We have calculated that gasoline containing 0.06 gm. Pb per gallon could be used with complete safety without filtration. Allowing something for natural ventilation and something for the intermittency of the exposure in a field army kitchen, one would not expect five times this concentration to cause difficulty in a short time, (a few weeks). If in addition the fumes from the burners were carried away by a flue, and if full and free ventilation were available, little difficulty could be anticipated with ten times the minimal concentration e.g. 10×0.06 or 0.6 gm. Pb per gallon, equivalent to 0.58 c.c. lead tetraethyl per gallon of gasoline.

Of course, food of any kind coming in contact with the flame or the direct heat of the burner would be contaminated, and such contamination would have to be avoided by suitable methods of cooking. That is, boiling and roasting meats a covered container would have to supplant broiling. Moreover containers would have to be cleaned carefully on the outside and by methods that would prevent contamination of other foods. This could be done with little difficulty if the kitchen personnel were properly instructed. In this matter of contamination of food, one must recognize that the danger of being poisoned is not so great as that involved in the inhalation of vapors and fumes of lead. Lead compounds, even in solution are poorly absorbed from the alimentary tract. Careful observations have shown that not more than one tenth of that which is swallowed (as a solution) is absorbed, and therefore, quantities of several milligrams per day can be taken by mouth regularly for months without danger. Continuous accumulation of lead occurs in

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the body, however, if the quantities ingested daily are in excess of half a milligram of lead, or thereabouts, and therefore, the ingestion of larger quantities may not continue indefinitely.

It appears from discussion of the present problem of the field army stove, that its operation could be greatly simplified to dispense with some of the more serious difficulties, by means that would remove a considerable proportion of the lead but not all of it. If this step could be accomplished at once, it appears that considerable relief would be given to field forces who are laboring under serious difficulties, without incurring any serious danger. Subsequent work, no doubt, will result in improvements that will eliminate all the difficulties. It is my impression from the available information that there is need for immediate action and it is the purpose of this letter to show that the lead hazards arising out of the use of leaded fuel are not as great as they might be regarded at first glance.

I hope these necessarily voluminous comments will be of use to you in connection with recommendations that are to be made as a basis for present action. If I can be of further assistance in dealing with this problem, I shall expect you to call upon me.

Very truly yours,

Robert A. Kehoe, M. D.

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