

December 11, 1944

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Dr. A. Link Koven,
Industrial Hygiene Physician,
The State Board of Health,
Jefferson City, Missouri.

Dear Dr. Koven:

I am glad indeed to reply to your letter of December 4, and to give you such advice and assistance as I can. I do wish to say at the outset, however, that in my opinion you are making somewhat of a mistake in doing only blood lead determinations as a means of measuring occupational lead exposure. Inasmuch as the variations in the lead concentration in the blood cover a narrow range as contrasted with the urinary concentration, you are certain to have a rather large number of results that are difficult to interpret. That is to say, there will be a sizable number that will show some evidence of lead exposure without indicating to you with any degree of certainty whether the exposure is of real significance or of borderline significance only. This, I think, is a great disadvantage, since industrial management is not too willing to move quickly or definitely on the basis of dubious recommendations. However, blood analyses will be helpful in many instances.

As to the instructions, we use ordinary pyrex test tubes with fairly heavy walls, for the collection of our blood samples. These tubes have certain disadvantages, but if they are prepared and handled carefully, they are, in our experience, quite satisfactory. The tubes are cleaned with great care in the Laboratory, being washed out with chromic acid cleaning solution in the usual fashion, then rinsed profusely with tap water, and finally with triple distilled water. The last rinse is with water which comes from a silica still, and which, therefore, is almost entirely free of trace metals. These tubes are stoppered with new cork stoppers that have not been used for any other purpose. (We obtain a lot of new stoppers, inspect them carefully, and put them in a dust-proof container, whence they are taken for use as required. We use no preservative of any kind, and we would be afraid to use any anti-coagulant, unless we ourselves had analysed it and subsequently purified it so as to be free of traces of lead. The utmost precautions are necessary here, for the slightest traces of lead

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will make gross errors in dealing with the small samples of blood that are required.)

We purchase or make special needles, composed entirely of stainless steel, thereby eliminating the brass hub, which is otherwise a source of contamination. These needles are sharpened if need be, after each use, then are chemically cleaned, introduced into a chemically cleaned pyrex test tub with cotton at either end to prevent movement, and then are sterilized in an autoclave so as to be ready for immediate use. We should prefer to use some type of Keidel tube, but we have not been able to get a specially made chemically clean tube that would serve our purposes during the war period. We expect to have a quantity of these made when we are able to do so, but we are unwilling to use any of the presently available tubes because of the certainty of frequent contamination of samples.

As to urine containers, we make use of three types.

1. When we can obtain blood samples simultaneously and when samples are to be sent to us in a hurry, as by mail, we provide a pyrex bottle of the type used for milk samples, which is stoppered or rather covered with a gum rubber cap. These can be obtained from Corning Glass Works, Corning, New York, catalogue Number 610, (milk dilution bottle - 180 c.c.). These bottles are chemically cleaned, wrapped carefully, and put in stout mailing tubes. We request samples of approximately 100 ml, collected with the utmost care in accordance with instructions that I am enclosing. Unless the examiner can be impressed with the necessity for the complete avoidance of the slightest possibility of contamination, such samples will frequently be contaminated and give rise to misleading results. Moreover, the sample so collected may be either a highly concentrated urine (as in hot weather), or a highly dilute urine (as in the case of an individual who has just consumed a large quantity of liquid with the idea of making a sample available). In either case the blood sample will give a good clue to the status of the individual and will permit interpretation of the result obtained on the urine sample. (I neglected to say above that we always obtain duplicate samples of blood as a check on each other against the factor of contamination. Contamination of samples is the bugbear of this work. It occurs with considerable frequency and, therefore, must be checked against in every way possible.)

The gum rubber cap we use is Slask cap Number 268, and can be obtained from Davol Rubber Company, Providence, Rhode Island.

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2. The above described containers are suitable for male subjects but not for females, since the samples must in every instance be voided directly into the container. On this account we employ a chemically clean mason jar with a glass top, using either the pint or quart size for spot samples. No preservative is used.

3. For large samples we send out gallon jugs of the type used for fruit juices and the like. These are stoppered with new cork stoppers that have previously been unused. The container is chemically clean, and after stoppering, is introduced into a paper bag of the groceries type, into which it is sealed so as to avoid all opportunity for contamination with dust. These containers are usually delivered to the workman's home or are distributed at the plant in such a way that they cannot come in contact with lead compounds in the working environment. We make no attempt to collect 24-hour samples, since this is neither feasible or necessary. Rather we instruct the subject to collect urine in the container in his hours at home, when he is presumably clean, until not less than two liters have been obtained. At this time the sample is returned by a procedure similar to that employed in distributing containers. In our experience it is necessary to analyse the entire sample. In doing so we deal with quantities of lead that are of fair magnitude, so that the errors of contamination unless very great, are not likely to be very significant. We also find that men properly instructed so as to understand what they are doing will usually cooperate very well.

I think this covers the most important points, but as I have indicated above, I am sending you the instructions which we send out or give out with every set of containers. We find generally that we cannot trust people to convey this information with sufficient care to accomplish satisfactory results and, therefore, must supplement verbal instructions with printed instructions. Despite this precaution we sometimes get bad results where the doctor or the person concerned has not himself been convinced of the necessity of giving careful detailed verbal instructions to workmen. Moreover plant doctors will try to collect samples of blood and urine in rooms contaminated with plant dusts. The results are often distressing.

In accordance with your request I am sending you under separate cover certain reprints. I would suggest also if you do not have them, that two publications of the American Public Health Association on this subject, are very well worth having. I refer to the reports of the Committee on Lead Poisoning, entitled, "Occupational Lead Exposure and Lead Poisoning" and a recently issued report, entitled, "Methods for Determining Lead in Air in Biological Materials." These cost 75 cents each. I recom-

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mend the first, because in it I went to a great deal of trouble in describing methods of obtaining samples and in discussing the interpretation from various analytical results. I know of no other place where details of this kind have been covered adequately.

I trust that all of this will be helpful to you, but if and when I can be of any assistance to you, please do not hesitate to let me know.

Cordially yours,

Robert A. Kehoe, M. D.

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