

NOTES ON THE DETERMINATION OF LEAD IN URINE.

The following comments apply generally to some extent to methods of analysing samples of biological materials for their content, and specifically to the procedures described in the Laboratory Note of the Principal Chemist in the Chemical and Development Department at Abadan, dated 30th January 1943.

COLLECTION OF SAMPLES.

One of the greatest practical difficulties is that of obtaining samples that are wholly free from contamination. Workmen in general and persons without chemical or technical training always fail to appreciate the significance of the manifold opportunities for introducing lead compounds into such samples, and even technically trained persons commonly fail to realise that lead compounds in one's general surroundings readily find their way into samples through contact of the latter with the air and with any material which is not wholly clean in the chemical sense. The quantities of lead found in urine are quite small, being only rarely in excess of 0.50 mg. Pb per litre, and usually (in unexposed persons) of an order of magnitude well under 0.10 Pb per litre. The introduction of a few micrograms of lead into a small sample of urine or blood represents a serious contamination. Contact of the urine with clothing, fingers, rubber or metal catheters and intermediate containers such as urinals, may result in gross contamination, since lead compounds are substantially ubiquitous. Since nothing has been said in the report of the Principal Chemist concerning the care taken in collecting the samples, one hopes for the best while realising that persons who lack experience in this regard usually set up insufficient precautions for the collection of samples of urine. It is possible, even probable, that some of the samples collected from workmen were contaminated, and that some of the excessively high results came about in this manner.

A second point of importance in relation to the collection of samples of urine had to do with the volume of these samples, and the rate of water elimination represented by them. The urinary lead concentration varies strikingly with the quantity of water available for renal secretion when other factors remain constant. A highly concentrated sample obtained on a hot day during which little water was consumed may contain lead in ten or more times the concentration that is found in a sample voided by the same individual on a cool day when a considerable volume of water was taken. For this reason it is advisable to make sure that the urinary secretion is within reasonably normal limits during the period of collection. This is usually assured by collecting a sample over a 24-hour period or more, so as to equalise the hour-to-hour variability of samples. Nevertheless there is likely to be a significant seasonal variation in the lead concentration of the urine where there are large seasonal variations in temperature. Extreme elevation of temperature is certain to be an important factor in this matter. Therefore samples of urine obtained from normal persons without unusual exposure to lead may show lead concentrations well above the limits commonly regarded as normal for such persons. These facts must be taken into account not only in the issuance of instructions for the collection of samples of urine, but also in the interpretation of analytical results.

ANALYTICAL METHOD.

The method of analysis described by the Principal Chemist represents a combination of procedures, the over-all error of which cannot be guessed by the writer. It is not likely any of the standard methods of high precision which are described in the comparatively recent literature on the subject. It would seem that it would give fairly satisfactory results in the hands of a competent

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The practice of splitting the samples of urine, taking only portions for analysis, is fraught with grave danger of error, unless the samples are fresh and entirely free from sediment or suspended material.

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The method assumes that bismuth will not be present as an interfering element. One would require information on the extent of the therapeutic use of bismuth compounds among the workmen to be assured that this may not be an important factor in some of the results.

The interpretation of the analytical data obtained on the men must depend somewhat on factors which have been mentioned in the foregoing paragraphs, and even more upon data obtained on samples on normal (unexposed) persons under comparable conditions with respect to season, consumption of fluids, and general mode of life.

It may well be found feasible and desirable to employ an analytical method that has been found highly sensitive and accurate in a number of laboratories for examining further samples of urine obtained from exposed workmen. The method given in detail by Professor Dodds of the Courtauld Laboratory of Biochemistry of Middlesex Hospital Medical School, and forwarded to Mr. C.J. Wright by Mr. Bevan in his letter of 14th July 1943, may be regarded as entirely satisfactory for such a purpose.

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