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**Lead Industries Association**

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May 4, 1944

Dr. Robert A. Kehoe  
University of Cincinnati  
College of Medicine  
Cincinnati 19, Ohio

Dear Dr. Kehoe:

Ever since receiving your interesting letter of February 7 on lead poisoning in children, I have endeavored to procure and study some of the references you were kind enough to give me on the use of the x-ray so as to familiarize myself with the scientific proof of its usefulness.

For example, I obtained a copy of the paper by Dr. Park and others entitled, "X-Ray Shadows in Growing Bones Produced by Lead; Their Characteristics, Cause, Anatomical Counterpart in the Bone and Differentiation" appearing in the August, 1933 issue of the Journal of Pediatrics. I have also read the paper Drs. McKhann and Vogt wrote entitled, "Lead Poisoning in Children" (A.M.A., October 7, 1933.) These two, I believe, are the most widely quoted studies on the subject. Both articles give meager analytical data to substantiate their findings. In trying to confirm the analytical work described I discovered, to my surprise, what is apparently an unintentional but serious slip in the Park paper.

On page 285, Park says:

"In Vogt's case Aub found that in the dense areas at the ends of the bones the lead per gram of bone was 0.527 and the calcium 0.124 grams. The ratio of lead to calcium was greater than 4 to 1."

In checking this analysis I find that Dr. Park has evidently confused grams with milligrams because this analytical work under Aub showed 0.527 milligrams per gram of bone. In other words, Dr. Park has increased the lead content 1,000 times. In the McKhann paper the lead in



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milligrams per gram of bone for the lead line at the end of the bone is given as 0.602 milligrams - a good check with what Park probably intended to use.

Now, if we consider that the amount of lead in the lead lines of the bones of children who are poisoned with lead amounted to not more than 0.0006 grams per gram of bone, the question arises in my mind as to whether that relatively small amount of lead can be detected by the x-ray. In other words, as I see it, the problem resolves itself simply to this:

1 gm.



Uncontaminated

1 gm.



0.0006 gm. of lead

If we have two samples of bone, each one gram in weight, one uncontaminated and one carrying 0.0006 grams of lead diffused throughout it, will a photographic x-ray plate detect the difference in density between the two!

For an authoritative answer I called on the General Electric X-Ray Corporation recently and asked them whether X-ray technique had been developed sufficiently to distinguish between the two specimens as stated above. I was given an emphatic "No!" as an answer. Certainly one wouldn't expect such an extremely minute amount of lead to show up as a dense sharply distinguishable band by the x-ray!

It has always seemed to me peculiar that the x-ray would show up the lead in children and not in adults if the x-ray is so sensitive that it can detect 0.0006 grams diffused in a gram of bone.

Incidentally, I was also interested to note that in Dr. Park's article on page 293, he listed the five cardinal signs in lead poisoning in children as, (1) anemia, (2) stippling of the red blood cells, (3) the lead line on the gums, (4) the characteristic shadows in the x-ray films of the bones and (5) the presence of lead in the circulating blood, as determined by spectroscopic examination. This listing of the cardinal signs does not appear to me to square with the data contained in your excellent booklet, "Occupational Lead Exposure and Lead Poisoning" for I feel he leaves out one of the most important criteria of all, namely the presence of abnormal amounts of lead in the urine.

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Even though it is with much trepidation that I discuss the subject with medical experts, I do feel that the value of the x-ray as a diagnostic tool resolves itself essentially into a question of chemistry and physics, and should be readily divorceable from medical matters, at least that is my excuse for injecting myself into the controversy.

In your letter of February 7 you were also kind enough to refer me to the investigations of lead poisoning in children in Queensland. Dr. Byers in Boston also referred to this investigation, as one of the reasons for his study of latent effects of lead poisoning in children and he was good enough to loan me his copy of the book, "Chronic Nephritis and Lead Poisoning" by Nye, published in Australia in 1933. If this is the study to which you also refer, it impresses me as being subject to a great amount of criticism:

(1) No paint analyses are given of the paint alleged to have caused the trouble. I think this is important because in Queensland a law was passed in 1922, at least ten years prior to the publication of this book,

"whereby it became illegal to use lead paints on certain parts of the veranda walls and railings..."

In ten years any paint will disappear.

(2) The only paint analyses given appear on page 119, "Results of Analysis of Samples of Lead-Containing Paint." Out of ten analyses given seven had a lead content of "trace" or "nil" and one less than 0.6%. From this evidence I can only conclude that the paints used in Queensland at the time the investigation was being made were apparently lead-free or contained so little lead that I don't believe there was sufficient lead to injure anybody even under free chalking conditions.

(3) I am frankly skeptical of the extremely free chalking of the paint described. It looks to me as if there must have been high amounts of titanium rather than lead in the paint because titanium is notable for its high chalking rate.

(4) Why should the chronic nephritis occur in young people in Queensland and not in other Australian States? The answer given by the author seems to me far

Dr. Kehoe:

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from convincing. (climate)

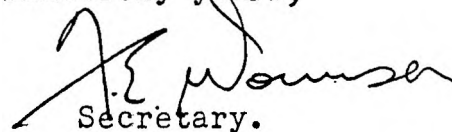
(5) Do you really feel the diagnoses made of the cases described as lead poisoning were accurately determined as lead? It seems to me flimsy medical evidence with no laboratory determination of the presence of lead in the urine except in case 1, with no quantities mentioned.

(6) Incidentally, I notice the author was aware of the work of Park and his associates in using the x-ray as a diagnostic tool for determining lead among children and that the author dismisses the value of this tool, indicating that the x-ray markings are not due to the deposition of lead as they occur in other toxic states.

I am certainly indebted to you for causing me to delve deeply into this whole picture. I wouldn't have missed the scientific interest involved in this problem for anything. It has made me wish to follow it through and I would certainly welcome any further comment you may find time to give me.

With kindest regards,

Sincerely yours,

  
Secretary.

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