

General Review 1849-45

40

KOMMISSION DER
EUROPÄISCHEN GEMEINSCHAFTEN

COMMISSION DES
COMMUNAUTÉS EUROPÉENNES

UNITED STATES ENVIRONMENTAL
PROTECTION AGENCY

INTERNATIONAL SYMPOSIUM

Environmental health aspects of lead

Die gesundheitlichen Aspekte
der Umweltverschmutzung durch Blei

Les problèmes sanitaires posés par le plomb
présent dans l'environnement

SCARCELY REGARDED EUROPEAN
PAPERS ON LEAD

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MONTABAUER, BUNDESREPUBLIK DEUTSCHLAND

Amsterdam, October 2 - 6, 1972

N40720

Scarcely Regarded European Papers on Lead

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- Archiv für Hygiene und Bakteriologie
- Städtische Hygiene
- Zeitschrift für Präventivmedizin
- Zentralblatt für Arbeitsmedizin und Arbeitsschutz
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Scarcely Regarded European Papers

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These papers partly suggest ways taken to resolve important problems

Scarcely Regarded European Papers on Lead

In spite of some contacts between Western and Soviet medical scientists and although medical papers from the USSR are partly reviewed in Western abstracts, important Soviet research, esp. toxicological research, partly reaches us relatively late (and perhaps in some cases not at all). The chief branch of Soviet toxicology, Reflex Toxicology, was born in 1920. It is true however that in 1952 the Soviet MIF for Pb was calculated on the basis of the Pb balance in the body with 0.7 $\mu\text{g}/\text{m}^2$. In 1960 Gusev confirmed it by means of Reflex Toxicology. With an average Pb dust concentration of 2.75 $\mu\text{g}/\text{m}^3$ rats showed changes in the responses to optic and acoustic stimuli, whereas the blood picture remained unchanged. Under practically the same conditions, Gusev found an increased coproporphyrin excretion in the urine of rabbits along with discolorations etc. in the brain of the animals after autopsy. Increases in urinary coproporphyrin were found in children in kindergarten too, who were exposed to industrial Pb dust with a Pb concentration of 1 $\mu\text{g}/\text{m}^3$. Beginning in 1959 the Soviet Union prohibited the delivery of leaded gasoline in large towns, e.g. in Moscow, Riga, Chelyabinsk, Tiflis etc., but not e.g. in Almaty (800,000 inhabitants; no narrow streets). Not until 1960, 3 decades after its origin, news on Reflex Toxicology reached the West. For some years it has been made use of in the USA too, in Cincinnati (Minkars et al, 1966). Its principal value has been acknowledged in this way. A certain aversion to the reception of Soviet results is shown too by the fact that the basic abstracts of the Moscow Academy of Sciences on Toxicology have not been subscribed to by any public library in the RU.

As far as the "conditioned reflexes" are concerned - and they prevail in Soviet toxicology, the nervous system is involved. So we may start with this organ. It is treated by Reflex Toxicology in a rather undifferentiated way as a whole. Akhbarov has studied the neurologic effects of Pb in detail, checking in which order the single nerves are affected and in what kind of phases (irritation, paralyzing etc.). The electrophysiological multiplicity of the effects of the poison is thus better understood. A further important contribution by Akhbarov are his figures on the frequency of a lot of functional disturbances and pathologic phenomena in saturnism. Many of these disturbances and phenomena seem to be unknown in Western countries, e.g. the Pb induced increase of sensitivity for pain. It is a pity that the book of Akhbarov has not been published in English translation.

Though American scientists have recently studied the influence of Pb on adrenocortical functions, it may be mentioned that older related papers exist in the USSR, e.g. by Makochenko. In 106 humans who suffered from Pb poisoning the adrenocortical functions and the adrenocortical reserves were weakened. The effects of Pb on histamine and serotonin metabolism have been treated in Soviet papers. Akhmedova traced a considerable fall of the MAO activity - this enzyme controls the serotonin metabolism - in the various investigated organs of dogs in the first month after the start of the Pb poisoning and a certain increase in the serotonin content of the brain and some parts of the intestines. Slavov and Mandadzhiev found an increase in the blood histamine content of 70 lead workers 30 - 40 years of age. The authors relate this rise to the decrease of the histaminolytic potential - the histaminase activity and the potential had reduced themselves. Among the workers diseases of the respiratory organs, the nervous system, the skin and the subcutaneous

connective tissue and from infectious diseases were more frequent than in the general population. The intensity of the Pb intoxications, as determined by the usual tests had an inverse correlation with histaminase activity and histaminolytic potential. When rats were charged with 2n and 4n, the same biochemical phenomena were observed. After subcutaneous injections of ergonine into the animals, the urinary excretion of 5-oxy-indolacetic acid rose. The authors consider this a sign that the metals had induced a rise of the serotonin content. They conclude that the metals inhibit the degrading functions of the organism and cause in this way an increased frequency of allergies. They consider this a key to a better understanding of allergies. Their thesis seems to open new prophylactic and therapeutic possibilities in skin diseases by elimination of Pb from the body with chelating agents. Therapeutic success with chelating agents in skin diseases have been reported. In addition the thesis would explain the continuous increase of allergies etc.

The thesis faces us of course with the problem of the pathologic threshold to lead. Heilmeyer has declared a urinary ALA-excretion of 3 mg/day to be definitely pathologic, a threshold which has been confirmed by Lehner. Resin writes that excretions of 2-3 mg/day are a sign of functional disturbances. In all these findings the Hanserall method was used. The upper limit of the ALA-excretion is 6 mg/l (Leng et al) or 6 - 9 mg/day, 2 - 3 times the pathologic threshold of Hallmayer. It agrees with these findings that the Swiss practitioner Elmer could cure hundreds of people who lived on a street having densely motorized traffic and suffered from headaches, gastric disturbances etc. He used edetate and proved lead effects in some cases by the lead mobilization test. The headaches had led to the use of analgesics and in this way in some cases to death by renal damage.

Another confirmation for the thesis of subclinical Pb poisoning as a mass phenomenon is offered by the paper by Zykova. In the environment of plants with Pb emissions people 18 - 50 years of age had a higher frequency of functional-degenerative diseases. The lead dust concentration averaged 2.2 $\mu\text{g}/\text{m}^3$. The Soviet MIF has been exceeded in our large towns to a considerable scale.

Finally it must be mentioned that according to Lehner the decisive parameter in lead poisoning is not the blood-lead-level, but the intensity of endogenous or exogenous lead affluences into the blood which disturb biological systems. Of course such affluences are possible with low blood-lead-levels.

Many civilisation-related diseases have been traced to Pb with reasons of varying soundness. Unfortunately there is not time to discuss all these diseases. I shall restrict myself to a phenomenon which has become rather disquieting in our day: heart-infarct.

In Germany there has been a vivid discussion on the problem, whether the heart infarct is caused more by processes in the heart muscle (change of the internal respiration to lactic acid fermentation) or more by vascular damages. Now there is an immense literature on the influence of Pb on the vessels. A less known matter is lead induced myocardium damage.

Nevertheless this problem has already been dealt with in 1952 by Khorov and by Rishvetsky and Levina. In 1957 Zykova - she was mentioned already - noted an increase of heart muscle damage in men 18-50 years of age who lived in an atmosphere with an average Pb dust concentration of 2.2 $\mu\text{g}/\text{m}^3$. An experimental confirmation was given by Zerk et al in 1963. In 5 acutely poisoned rabbits ATPase, NPM and alkaline phosphatase were more inactivated in the myocardium than in other mus-

cles, the acid phosphatase less.

In the USA the idea of Pb induced cardiovascular damages has only very few followers. Therefore the related paper of Sauer et al. of Mississippi may be discussed. On a national scale the authors sought for correlations between different trace elements in drinking water and mortality from a.s. cardiovascular damages. The correlations with Pb were very weak only. But a detailed study of the paper reveals that they determined the Pb content in samples taken in the water works, not from the taps in households. It is known that soft water has a high plumbosolvency and that many houses are provided with lead pipes. In regions with soft drinking water cardiovascular mortality is known to be high. It is very probable that the authors would have obtained better correlations, if they had taken the samples from the taps. A survey on the health risks by lead in drinking water was given by Steffen.

As to the heart infarct it is doubtless that CO induces hypoxia in the cells and in this way enhances the change to fermentative processes. von Ardenne states this clearly. So we are faced with the possibility of synergistic effects of Pb and CO. Indeed Rausa found such effects on the enzyme G-6-PD in human erythrocytes. To Malori we owe a paper on synergistic effects of Pb and a detergent (sodium lauryl sulfate). Rats accumulated twice the lead quantities after intravenous injections of the detergent in their spleens, livers, kidneys and brains. Backer has reported synergistic effects of Pb and polyphosphates without however showing the sources of his statements. Several papers deal with the combined effect of Pb and other metals. Pb and Hg have additive effects according to Fridland. Synergism was not excluded. Additive effects of Pb and Zn were proved by Goova. Zharkova traced synergism Pb/As to high doses and additive effects to lower ones.

Climatic factors too influence lead poisoning. The influence of temperature omitted here. It is well known. Fein initially provokes a high ionization of the air. Induces changes of the serotonin and histamine metabolism and in this way parallels the influence of Pb as mentioned already. In the experiments of Lutmer et al. - they may be treated here, though of non-European origin - Pb dust caused a lower Pb accumulation in the bones of mice, when it was irradiated before. The authors explain this hypothetically with the possibility of agglomeration by the experimental conditions. But a sea-climate with its high irradiation has therapeutic effects in lead poisoning according to Buckup and Hesse. The fact that Pb aggravates rickets (Kollath) seems to confirm the thesis of synergetic effects of Pb and lack of sunshine.

All the mentioned substances, CO, detergents, polyphosphates, mercury penetrate on a steadily increasing scale into our environment and aggravate probably the effects of the poison, of lead.

According to Soviet papers lead components in silicogenous dust accelerate silicosis and aggravate its development (Stefen). It is known that asbestos is already a general environmental problem for children. So lead dust in the atmosphere may accelerate and aggravate asbestosis or other pulmonary diseases in children in combination.

Halogens seem to have antagonistic effects when cooperating with Pb. Goiter is known to be caused chiefly by lack of iodine. But when I is present in drinking water in sufficient quantities, there are still cases of goiter and then its frequency correlates with the Pb concentrations in the water (Liskovoy). The related concentrations are very low.

Unfortunately Soviet toxicology has not drawn behavioural consequences from its neurological results. In Anglo-Saxon countries there is a

vast literature on the pathologic effects of Pb in children which is focussed on behavioural aspects. Now a Roumanian team (Antal et al.) has devoted a comprehensive study to the physiological effects of lead dust along with the prepathological behavioural effects. In the town N the Pb concentrations (of industrial origin) ranged from 5.2 to 46.2, in the town C from 1.1 to 6.3 $\mu\text{g}/\text{m}^3$. In N the educational damages were much greater than in C. They covered decrease of attention, concentration, memory, conduct, apprehension, abstraction, thinking etc. The average AIA excretion of the children in N was 6 $\mu\text{g}/\text{L}$. Physiological parameters (growth etc.) had changed themselves in the children in C too, when compared with the average of the country. The phenomena found by Antal et al. have reached a very disquieting level e.g. in the towns of the Ruhr basin and continue to increase. Lead influence would be a good explanation for this phenomenon.

Almost unknown is a paper of Mashkov on sexual disturbances under the influence of leaded gasoline. The author could study these disturbances in 66 patients who handled this gasoline. They complained chiefly on weakened potency or even impotency. The quality and the quantity of the sperm had decreased. Vapours of leaded gasoline are inhaled on a large scale e.g. by the inhabitants of large towns and by drivers and passengers of cars. According to Bryce-Smith the alkyl concentrations in cars have already been determined. But the results were so disquieting that they were not published. I have suggested several times to perform such determinations, but in vain.

Sperm damage by inorganic lead has been studied experimentally by Egorova et al. The animals were given various quantities of Pb acetate into the stomach 6 times in 10 days. Already 0.002 mg Pb/kg body weight caused sperm damages, e.g. slower motility. The oral lead intake of humans doubles this quantity and that without interruption. The paper of Egorova et al. illustrates the statement of Sanotskii that among the effects of a parental poison burden in children, functional disturbances prevail by far ahead 66 mutations and malformations.

Ladies and gentlemen, In 1968 I published for the first time the thesis that environmental lead may contribute to the general criminality which presents a challenge to our society. 4 scholars have joined this thesis meanwhile and partly contributed new arguments. One of the arguments is the blood lead level of Swiss delinquents. It doubled that of inhabitants of large American towns.

Those who might be in agreement or disagreement are invited to point out the weaknesses and strengths of the ideas presented in this lecture. In view of the serious environmental and health situation we must unite our efforts to reveal the truth. No stone should remain unturned.

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