A CONSIDERATION OF LEAD AS A RACE POISON.

A thesis submitted to the faculty of the Graduate School of the University of Minnesota, in partial fulfillment of the requirements for the degree of Master of Arts.

by

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June 1910.
INTRODUCTION

Lead is one of the racial poisons which injure or destroy the germ plasm. It is usually fatal to the embryo. The fully developed individual may be infected and recover. The germ plasm or race material has strong powers of resistance to racial poisons including that of lead; after serious and protracted injury it may recover completely when the conditions which induced the poisoning are removed.

The importance of acquiring and disseminating knowledge concerning racial poisons can hardly be sufficiently impressed upon our minds.

A department of eugenics which treats of a matter which so profoundly affects the health of the race should receive the earnest attention alike of the medical profession and the laity.

Lead poisoning, plumbea or saturnism, as it is variously called, is the particular race poison chosen as the subject of this paper.

The etiology or racial susceptibility to lead is
little understood. From two different writers I have found authority for the statement that negroes have an undoubted tendency to lead convulsions. From what is definitely known concerning the general neurotic history of the negro this susceptibility to lead is easily understood. In the Philadelphia Hospitals in 1906 there were 6 cases of lead poisoning among negro patients. 3 of these cases were encephalapathies.

There are large numbers of cases among foreigners. This is due chiefly to the fact that they expose themselves unduly owing largely to their imperfect use of English, and consequent inability to understand warnings concerning the handling of lead. It is due also of course to their lack of personal cleanliness.

Aside from this study of lead as it affects humans there is a little interesting information regarding lower animals and their susceptibility to this poison. Cats and dogs cannot live near lead mines. Cows, however, can drink water with 3% lead sulphide in it and remain perfectly healthy. The explanation of this, is that herbivora have a relatively small amount of hydro-
chloric acid in their stomach contents, while carnivoria have a relatively large amount of it.

There were imperial ordinances issued in Europe forbidding the use of lead in wine in the first half of the 15th century. This is the first authentic record we have which shows that the evil effects of lead were beginning to be understood.

Layet, in his Poisons Industrielles, made a list of 111 occupations in which lead formed a necessary factor. There are many more at present.

**PHYSIOLOGICAL EFFECTS.**

Lead infection may be contracted thru inhalation or by absorption thru the skin; but the poison generally enters the system thru the alimentary canal, i. e. - it is taken in with the food as a result of uncleanliness. Lead combines readily with albumen and some of the lesions found in the alimentary canal. (Lesion is defined medically as any derangement or morbid change in function or structure of an organ or tissue.) Under its influence the peptic glands undergo fatty degeneration and may be obliterated altogether in certain areas.

a-(2-86)
Solitary and agminated glands of the intestines and the glands of the muscular walls of the stomach also undergo fatty degeneration. The spasmotic contractions of the intestines produce the constipation so characteristic of the disease. During these contractions the blood is forced out of the intestine causing an increased fulness and tension of the arteries.

Arteriosclerosis is common among lead workers even at an early age. (This is sometimes disputed.) Paralysis of the hand of the metacarpil bones is commonly known; wrist drop is well understood to be a result of lead poisoning while saturnine gout is somewhat a matter of dispute.

The effects of lead upon the nervous system are manifold. The poison causes changes in the nerves, chiefly in the peripheral terminations, but such changes may extend backward to the nerve trunks. Hysteria is a common result in children and leads to cranial nerve troubles. Lead encephalopathy (a term used to designate a form of chronic lead poisoning accompanied by symptoms referable to brain disturbances etc.) is held by most...
physicians to be a direct result of the action of lead. Some dispute has arisen as to whether encephalopathy is directly caused by lead action on the brain cortex or results from general arteriosclerosis and changes in the kidneys caused by lead. In either case paralysis of the cranial nerves results.

Anatomically the most important changes are found in the peripheral nerves. The motor endings in the muscles "show parenchymatous neurites, evinced by segmentation of the anelin and breaking up of the axis cylinders." On chemical analysis, lead is found in the liver, the kidneys, brain and bone marrow. The muscles, blood vessels and nerves are most affected by plumbism.

Anemia is one of the first noticeable effects of plumbism. Anemic persons have not the vitality to produce offspring and thus we have found the point from which this special study of the lead problem evolves.

It may be remarked here that alcoholics are much more susceptible to lead poison than any other class of persons. The offspring of lead infected alcoholics have small chance of surviving.
In many paint shops that I visited, the painters made the statement that the drinkers among them more often had lead colic than the abstainers. All the medical books that I consulted confirm this opinion. Without doubt alcoholic excess predisposes to plumbism. It not only predisposes to plumbism but often actually causes the onset of an attack, generally taking the form of encephalopathy. As with other poisons, alcohol has more effect in the case of women. In all treatments of plumbism alcohol is absolutely excluded. It is to the point here to note that sexual impotency is brought about by the abuse of alcohol, camphor, arcinic, and lead.

METHODS OF LEAD INFECTION.

Of the methods by which persons become infected by lead perhaps the foremost are by inhalation, and by absorption with food. Car shops furnish the very best material for study of infection by inhalation. The car shops that have come under my observation have within the last few years been much improved and in consequence there is not so much danger as formerly. The rooms in these shops where the men work are long and open into one
another. Here there is plenty of light and now arrangements are such that the ventilation is fairly good. The work done on the inside of the cars called "floor work", consequently is less dangerous than the outside work. The real danger lies with the workmen who do the rubbing and sand-papering of the cars. The cars are first a thick flat coat of paint. After this has dried the men sand-paper it off, "level it". Here, there is great danger as the fine white lead dust flies off and fills the air and as the workman breaths over the work, he becomes hot and fatigued, his lungs, throat and nose are filled with this fine powder and he inevitably swallows much of it. Then it is likely that he eats his lunch in the midst of his work with white powdered fingers and in this way he absorbs a great deal more of the poisonous dust. Workmen at this place tell me that often there are 20 men sand-papering in a single room and that the air is at times insufferably thick and white with the flying dust. Carpenters working in the same rooms where the sand-papering is going on or in adjoining rooms often have lead poisoning. Of the workmen
themselves, the painters, rubbers and sand-paperers, there are few among them who do not sooner or later become victims to the disease. By far the greatest number of the workmen are young, unmarried men. These men seldom work long in a place. They come and go, working 2 weeks or so at a time. Painters as a class move about a great deal from house to house, and from town to town, and for that reason a true estimate of the amount of lead poisoning among them is most difficult to obtain.

Another business among painters in which many cases of lead poisoning are contracted is that of carriage making. The poisoning in carriage shops is here acquired in much the same way as in the car shops, namely thru the sand-papering. A certain Jewish doctor of this city tells me that he gets on an average of 5 lead infected patients a week, and that these came largely from carriage shops. This physician states that most of these cases are chronic; that they come to him once or twice and then go away. He says they come, get some medicine that helps them for two or three months and
then perhaps they come back or never return to him again. Physicians do not as a rule keep records of such individuals unless they come more than once. One must take into consideration the facts that some of these lead infected persons may return after some time has elapsed and so may not be recognized by the physician, or that they may go to other physicians thus making the number of cases seem greater than it is. As a rule the physicians whose patients are among the better classes do not come in contact with many cases of saturnism. The reason for this very evidently shows itself in the fact that it is the working classes that handle the lead. But in spite of this transitory nature of the practice among painters, and the consequent impossibility of keeping accurate records of the patients it is clear that there must be very many cases of chronic lead poisoning in this city.

Lead poisoning then is most common among typesetters and painters. The disease, however, also occurs among plumbers, glass grinders, pottery glazers, silver smelters and of course among miners. In the U. S. it is only in the Mexican mines that lead has particularly affected
the workmen. There among the many thousands of men employed in these mines hundreds of cases of plumbism annually develop.

The new industry which has caused this recent increase of the disease among these miners is the smelting and refining of the silver-bearing lead carbonate ores. These mines are scattered over the southern part of the U. S. and Mexico. The considerable number of deaths and the much larger number of permanently disabled men for which this industry is responsible, and which under better conditions might be avoided, is a matter that ought to be noted and carefully looked into by state and local health boards.

It is of interest to note that conditions responsible for plumbism are much more prevalent in England than in the U. S. The truth of this is shown in the work of Saleeby in England among lead infected parents, also by an examination of any of the industrial magazines of that country which show at once the importance of lead in all their manufactures.

a-(4-463)
b-(6-300)
A certain English immigrant woman who has been in this country but one year gave me some information regarding the lead mines of her country. Several of her children worked in the mines. She unconsciously divined a scientific fact regarding lead. She said that there (near Yorkshire) all the families in the community work in the mines. Everybody is pale and nearly every one has lead poisoning. Only men work in the mines where there is danger of the poisoning; the women die if they attempt the work. She said, "When the father gets sick with lead, all the other children (i.e. all the children born after his infection) that he has are sick, and they can't work. Most of 'em die when they're little babes." This shows how truly the laboring classes know the dangers of lead. These people have learned from personal experience and have known for generations that disease and feeble offspring follow where lead poisoning has attacked the parents. These English miners all have large families 10-17 and 20 children. As a rule, this woman tells me, the last 8 or 10 die very young because the parents are poisoned.

In the dales of Durham, where the occupation of lead
mining is mostly hereditary, a lead miner becomes an old man between 40 or 50. The average age of death is about 50. 50% of them all die from chest diseases contracted while breathing lead dust and lead fumes. Lead smelterers die before 30 from inhaling the fumes of lead (oxide and sulphite of lead).

It seems hardly necessary in this paper to mention more than a few accidental ways in which saturnism is contracted. Certain hair-dyes, snuffs and cosmetics are dangerous because of the lead compound in their mixture. Persons have been afflicted with plumbism thru drinking beer out of bottles washed with shot, and washing nursing bottles with shot is not uncommon among ignorant people. Certain dress goods are infected thru the lead compounds used in dye. Drinking water which runs thru lead pipes is very dangerous; also eating food cooked in vessels made and glazed with lead compounds.

An individual of my acquaintance tells me that in New Hampshire a kind of lead acetate compound is used for spraying fruit trees. This has been known to give lead poisoning to persons engaged in the fruit growing business.
but I do not know how common such occurrences are.

Having given an account of several institutions where conditions are such as to make plumbism among workmen possible and probable, it seems only fair to cite an institution in which the exposure to lead poisoning is great, and yet where the surrounding conditions are of a counteracting nature. The institution I have in mind is a paint manufacturing company of Minneapolis. Here the mixer of the white lead, who is the workman most exposed to the poison, has worked for 20 years and he has never experienced any evil effects from his occupation. He is very neat in his personal habits and neither drinks nor smokes. He wears a cap while at work. Some of the workmen wear rubber nose and throat protectors while at this work of mixing. The mixer of whom I speak does not always do this. The whole place is very clean, light and well ventilated. The walls are high and there is plenty of room in which to move and breath. This mixer attributed his good health to his neat habits and hygienic ways of living. "Many painters" he said "Let paint remain on their hands and arms days at a time without
careful washing." They are careless also about getting the paint out of the finger nails.

Such an institution as that above described gives ground for hope that others may be patterned after it when knowledge concerning lead and its evils is more widely disseminated and more thoroughly impressed upon the public mind.

TYPE ROOMS.

Type rooms, or more properly speaking, "casting holes" are much alike in their build and general construction. The one described here is the largest one in this city, and as the foreman of the room informed me, it is typical of all the newspaper type rooms in the northwest.

In a room approximately 40 ft. long by 20 ft. wide, there are 10 casting machines. These fill almost the entire middle space of the room. All other available room is occupied by tables and desks. There are 6 windows on each side of the room. Both ends of the room are dark. At the outside end are 2 circular fan windows 2 ft. in circumference. These are the only
openings supplied for carrying off the fumes from the casting machines. The windows are always open in summer but very little ventilation is possible at any time of the year. The room is at a temperature of $120^\circ$ F. most of the summer, owing to the natural heat and to that of gas-jets which are always kept burning under the casting pots to keep the lead boiling. The temperature is never less than $95^\circ$ F. as the men cannot work fast in any lower temperature.

There are 111 men employed for work in this room. No man is allowed to work more than 6 days a week, and 3 months in each year he works 4 days a week. Fully three fourths of the persons are young single men and boys.

The floors are wood and absolutely saturated with lead dust and lead shavings from the casting machines. The hot air is filled with this dust and with the fumes from open lead pots where lead is boiled. The men hang over these and breath the fumes and dust from 6 to 8 hours each day. They are advised to smoke to counteract the injurious effects of this inhalation. At the back end of the room where the fans that carry off the fumes are
located, the atmosphere is humid and heavy with this metallic odor. The foreman tells me that men often work but 3 months in this place before falling victims to lead poisoning. They have a regularly listed number of men who constitute what is known as the "relief corps". This "relief corps" is a necessity even tho the workmen have comparatively short hours much of the time.

Susceptibility to tuberculosis, so common among printers, is due in large part to lead infection. This statement was made to me by several different printers who positively believed it to be true. This certainly seems most probable amid such conditions. At 4 o'clock in the afternoon the janitor goes thru the room and sweeps, and in so doing stirs up all the dust that might possibly have missed the lungs of the workmen. The sweeping is done at this time of day so that all the casting scraps and lead droppings may be sifted and used again. This work is extremely dirty - the dust flying everywhere, and the hands of the workman are not improved by handling, instead of new lead casting, the old dusty casting which must be remelted.
It is in this place that the men eat their lunches with lead dusty fingers, sitting on lead covered window sills or near the machines. As but half an hour is given for lunch, most of the men have not time to take their lunches at restaurants and many could not afford to do so if there were time. This method of lead infection is clearly understood as we have learned from facts before stated.

The packing of the cast type is also dangerous work to the hands altho this is done in another room far from the fumes of the lead. Some young unmarried women do piece work at this packing. In view of what we know concerning the greater liability of women to lead poisoning the fact that women are employed at it is of note, and certainly sounds a trumpet of alarm to those who need enlightening upon this subject for the effects of maternal lead poisoning have long been recognized. Likewise some children are allowed to work in this place. One notable case is that of a child of 12 whose father died and left a helpless wife with small children. On this account the boy was obliged to learn the printers trade.
He was strong and athletic when he commenced work. In 3 months he was taken to the "Printers Consumptive Hospital" where he died of consumption and lead infection.

The most startling fact learned regarding this place was that over half the 111 men employed are infected to a greater or less degree with lead. Many of them admit this and neglect themselves until the disease reaches a state in which a doctor is required. Others blind themselves to what they know to be true and refuse to admit to themselves that they are infected.

The generally bad conditions about this place are to be remedied in the near future, as a new building in which better sanitary conditions will be possible is to be built. It is true that in no other establishments where lead is employed are the conditions so unfavorable to the health of the workmen. The greatest objection is to be found in the open lead pots of the casting machines. There seems no excuse for this particular feature of the danger involved in such a business.

MATERNAL LEAD POISONING.

For my knowledge of the effects of lead poisoning
on women I am chiefly indebted to an abstract of a book, written by M. Balland, published in the "Gazette Hebdomadaire de Médecine et de Chirurgie." His experiments upon hens' eggs and pregnant guinea pigs are most satisfactory to a clear understanding of lead and its evil effects.

It has been only recently that anything concerning the production of monstrosities and anomalies from eggs inoculated with poisons has been considered in any other light than as coincidental. From the time of Pére actual demonstrations have taken place. Balland in this work has attempted to answer two questions.

1. Is lead poisoning transmissible thru the mother to the foetus?

2. Can a healthy infant be poisoned by an infected nurse?

From a knowledge that sterilization produced anomalies in the egg, it was found that certain poisons did likewise, alcohol, morphine and nitrate of lead. The pathology of the foetus is far more satisfactorily understood than the experimentation upon eggs, however. And
by experimental means as well as from study of women workers in lead, it was indisputably settled that lead poisoning has a strong influence on pregnancy and on its product.

Balland has not treated the subject of paternal lead poisoning in his work, as he says that alcoholism too often figures as a principal factor, and that he prefers to consider only cases in which he has carefully assured himself that alcohol plays no part, and in which lead is the sole poisonous agent.

All experiments upon guinea pigs were conducted with the aim of proving the passage of poisons and medicamental substances thru the placenta; and this accomplished, he next proved that lead was one of these poisons. Porak who preceded Balland in experiments of this nature injected carbonate of lead, ( nitrate of lead proving too strong ) about 6 grammes in 30 days and 6.50 gr. 53 days, into guinea pigs. "He stated that the lead passed steadily thru the placenta and diffused itself more in the foetus than in the mother. He found it in equally perceptible quantities in the liver and central nervous
system of the young, and particularly in the skin; in the mother the liver was the organ especially charged with the accumulated poison. Then as to the question, is lead poisoning transmissible thru the mother to the foetus, this information has been derived." "Of the entire 10 guinea pigs used we note 5 miscarriages.

1 death of pregnant female,  
2 deaths by infection,  
2 normal litters.

The lead solutions used were "acetate neutre de plomb rigorously weighed representing 20 milligrams of acetate by centim, cube. In general the infections given did not exceed one fourth of centim cube or 5 milligrams. acetate neutre de plomb. Concurrent with the infections a quantity of carbonate of lead precisely determined and weighed was mixed with the nourishment of the animals. Each guinea pig absorbed a dose of 0 gr. 50 of white lead in two takings. Of these two modes of administration only the infections were suspended at certain times, the ingestion has been continued and the doses have not varied.

The only symptoms noticeable in the poisoned
mothers were emanciation and anemia. As to the question regarding infection thru the milk of an infected nurse Ballard satisfied himself with experiments upon dogs. Immediately after the birth of the pups the mother dog was infected with lead. The pups were perfectly healthy when born. A number of the pups died, but in several of those who lived marked symptoms of lead poisoning were noticed. Some even had unmistakable symptoms of paraplegia, which is a paralysis of the lower part of the body, usually including the pelvic organs, due to injury or disease of the spinal cord. A toxic examination of 2 that died revealed lead in the muscles and visera. For a long time those who lived were very feeble, and afflicted with an obstinate anemia. From the milk of an infected woman lead amounting to about one-half a millegrame was found in 115 gr. of milk.

N. Constantine Paul has accorded many cases of women who have become infected with lead while pregnant or previous to pregnancy. "He notes the case of one woman who had 3 successful confinements and 3 fine infants before being exposed to the emanations of lead; a- ( 5 - 1141 )
since she has been exposed to such emanations, she has had 10 other pregnancies of which there have been 8 miscarriages, 1 still-born infant and but 1 infant carried to term. The last named child was not strong enough to live and died at 5 months of age. Among others of the fellow workmen in the type-foundries out of 15 pregnancies of 4 women, 10 ended in abortion, 2, in premature labor, 1, in still birth and 1 while living at birth died a few hours afterwards.

Two cases worthy of note are those of women who worked in white lead factories, in England. One woman age 35, had before entering the factory 4 children carried to term. Since working 6 years in the factory she has had 9 miscarriages in succession and no living child. Another woman in this factory 34 years of age, had previous to working there 4 children. After this time she had 2 living children, and 6 miscarriages in succession. She became a victim of plumbism and did not return to the factory. The next pregnancy went to term and she had a child which survived.

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\begin{align*}
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The very fact that lead forms the chief ingredient of most of the abortion-producing medicines on the market furnishes added proof that lead is an abortifacient. It exercises a most injurious influence upon the reproductive functions of both men and women, in the latter causing irregularities of menstruation and excessive losses at the monthly periods which in turn induce anemia.

"Certain women have a pronounced predisposition to saturnism while some can resist doses to which others would succumb. Every individual has special idiosyncrasies and particular reactions according to the toxic agent employed.

I give two cases of Balland's own experiences to further establish the truth of the foregoing statements.

1. Among 13 lead infected women we find

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<td>Miscarriages</td>
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<td>Still births</td>
<td>1</td>
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<tr>
<td>Died shortly after birth</td>
<td>17</td>
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<tr>
<td>Living infants</td>
<td>12</td>
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Among 30 lead infected women.

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<tr>
<td>Died shortly after birth</td>
<td>20</td>
</tr>
<tr>
<td>Living infants</td>
<td>44 a</td>
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PATERNAL LEAD POISONING.

Only cases of paternal saturnism have come under my personal observation. With the exception of women who pack type I believe that there are no other occupations, where lead forms a factor, in which women are employed. This is apparently true of Minneapolis at least. In the cities of Chicago, St. Louis and Omaha, the three cities in the U. S. where the carbonated lead is corroded, that is, where white lead is made, women do some of the work, altho they are prohibited by law from having any hand in the direct process itself. In England woman's great susceptibility to lead poisoning was early recognized and by the 17th century laws were passed forbidding women to work in the lead mines and likewise prohibiting their working in the "white beds" in lead factories. In a- (5 - 1144)
America women workers in lead are comparatively few.

Knowledge of the effects of lead upon the reproductive functions is comparatively recent and is not yet fully understood by physicians and the general public is entirely ignorant upon the subject. French scientists have been more active in this as in other lines of investigative work than those of any other nationality.

In what concerns paternal lead poisoning, its influence has been well demonstrated by Constantine Paul (Th. Paris 186) and in the works of Ganyaire (Th. Paris 1898) and of Denebourg (Th. Paris 1905). Dr. Verhaeghe has shown (Echo medical du Nord Sept. 9, 1906) in what appalling proportion the offspring of artisan painters, are affected, the per cent being 22.91% of still births.

It may be interesting to add that Constantine Paul was the first to institute scientific experimentation upon the results of maternal lead poisoning also.

An examination of American medical journals even of the most recent date shows that the subject of paternal lead poisoning is either ignored entirely or considered
of small importance and accorded but a few lines of discussion.

None of the physicians I interviewed had given the subject any special thought nor had it occurred to them to note the connection between the paternal lead poisoning and the feebleness or absence of offspring. In each case, however, the physician was immediately interested in the subject and generously contributed all the assistance in his power to further the work of the investigation.

There is no special district in Minneapolis which is settled by lead workers so that the cases which I have found have necessarily been isolated ones. That fact that they were located so far apart necessitated the consumption of much time in conducting the investigation, and for this reason I have not been able to collect a sufficient number of cases to do more than contribute substantiary evidence to facts already established. Every case presented points to the same conclusions which have been scientifically demonstrated by Constantine Paul, Ballard, A Emode and Dr. M. Oui and other workers along this line.
QUESTIONS ASKED OF EACH PERSON INTERVIEWED.

1. Name and address
2. Age of man
3. Age of woman
4. Number of years married
5. Length of time employed in business which involved the risk of lead poisoning before contracting the disease.
7. Relative strength or weakness of the children and degree of abnormality if any.
8. Number of still births.
9. Number of miscarriages
10. Length of time between births
11. Woman's explanation of the cause of weakness and abnormality of children.
12. General observations regarding the health conditions of the home — its sanitation and care.
Case 1.

Mrs. K. P.

The man in this case is 48 years of age; the woman 43 years old. They have been married 20 years. The man has been a painter from boyhood, and has worked more at this trade than at any other up to the time of his marriage. The mother is strong and very healthy in appearance. The father has always looked sallow and delicate.

They have 6 living children—4 girls and 2 boys. The father had lead poisoning in a light chronic form shortly previous to his marriage. Later he became so subject to acute attacks of lead colic that when he had been married 5 years he devoted most of his time to paper-hanging and this has been his chief business for the past fifteen years.

One year after marriage—they had a child, a girl who lived but 4 months after its birth. All the following children are strong and healthy in every respect save the youngest, a boy of 7, who is somewhat
delicate. He is pale and enemic in appearance. There have been no miscarriages or still births.

The point of interest in this case lies in the fact that the father had his first attack of lead poisoning just previous to his marriage and for two years felt its effect. As was noted the first child born was weak and died in early infancy. The father then found that he could not keep at the painting business without suffering a return of the malady and from that time on until 2 years before the birth of the youngest child he had none of it and considered himself cured.

He then had another attack of the poisoning contracted while working in a closed room where painting was being done, altho he had no hand in it himself. The youngest child it will be remembered was somewhat weaker physically than the others. Since that time there have been no other children.

One child, a girl, born four years after the oldest girl is somewhat abnormal. She is of a peculiarly nervous temperament. At an early age she drew upside down upon her slate and wrote a form of script called
"looking glass writing." She had to be taught to write normally and then contented herself by writing and drawing both ways. She is capable however in her school work, and aside from this tendency to do everything in queer, freaky ways, she appears normal.

I am not sure that the abnormality of mind of this second child indicates that she was affected by lead but mention the fact because it existed in a family in which the father had had lead poisoning. Abnormalities and disorders of the nervous system are very common among the offspring of lead infected parents.

The mother, as before stated is healthy. The home was not clean, neither were the children that I saw. The mother herself was most unattractive because of her uncleanly appearance. She thought that all her children were strong and gave nothing in explanation to show the cause of the death of the first born. She stated that the doctor had called it spinal meningitis but that he did not feel certain of this.
Case 2.
Mrs. B. N.

The man is about 54 yrs. of age. The woman is 48. They have been married 25 years. At about the age of 20 he commenced to work in car shops, being employed much of the time in the "Twin City Car Shops" of Minneapolis and St. Paul. He did some painting there but after a few years he devoted himself entirely to the rubbing. This work involves the necessity of the workman's sitting on top of the cars. He rubs these with pieces of sand paper. The cars are all in one large room and the dust arising from this sand-papering process is fearful. He remained in this business 20 years and had during that time three acute attacks of lead poisoning. He then gave up the work entirely and has since devoted himself to outside house painting. He has had no acute attacks since giving up the inside work and rubbing. While he had but three acute attacks he never fully recovered from any of them, being always pale, sickly and likely at any time to show the symptoms of lead poisoning.

These people have no children. The woman claims
that this is her husband's fault. She stated that she knew it to be thru no disability on her part, but that rather that he was too sickly and anemic a person to possess the power necessary to reproduction. She said that the lead had always affected him and that she felt that this might have had something to do with their childlessness, not because lead is a race poison but because of its strength-sapping qualities. "It does away with his strength. How can such a man have children?"

The people are both very uncleanly and the house well deserves the appellation filthy. The man has repeatedly been told by his physicians to keep himself clean but the warning has evidently not been heeded. This man also was married 3 yrs. to another woman previous to the marriage above written of. There were likewise no children from this marriage. This is an added proof of the man's sterility.
Case 3.

Mrs. L. G.

The man is 40 years old, his wife 36. They have been married 15 years. The man has always painted at times, and worked steadily at the business about 10 yrs. before his marriage. After working 4 or 5 yrs. at the painting business he had his first attack of lead poisoning. At this time he was taken to the hospital and in 3 weeks was pronounced well.

He did not recover his former strength however and was obliged to give up painting at times, as he feared a reoccurrence of the symptoms of lead poisoning previously experienced. He felt the effects of the poison very quickly, for it chiefly attacked his stomach. For the past 10 years most of his work has been paper-hanging as any contact with paint brought about the former evil results. His wife tells me however that the effects of the lead still remain with him and that he is likely at any time to have another slight attack. These people have no children. The wife is an uneducated woman, but she has read a little along medical lines, in a blind and
laymanlike fashion, and has in consequence many really excellent ideas on "breeding men." She says, that she does not wish any children by a lead poisoned man. She further expressed the fact that she and her husband did not seek children anyway, and neither did they wish them under the circumstances. "There have been times when we should have had them," she said, "but he probably can't have them anyway." This woman did not appreciate the value and extent of her own explanation of the fact that they had no children. By the expression "should have had" she meant to imply that the intercourse had occurred at a time when children might reasonably be expected. She felt that there was something fundamentally wrong in their relations yet was not confident of its cause.

This home was all that could be desired in the way of neatness and the lead infection could hardly have been perpetuated thru any carelessness of the family.

Case 4.

Mrs. S. M.

The woman in this case is about 40 yrs. old. Her husband is 45 yrs. old. They have been married 20 yrs.
The man has been in the paint business for 25 yrs. After being married 15 yrs. - he began work in the Street Railway Car Shops of this city. He had worked there but 4 months when he had his first attack of lead poisoning. His chief work was rubbing and sand-papering the cars and he contracted the poisoning largely thru inhaling the lead dust. It was two years before he recovered from the worst effects of the poisoning. Mrs. M. believes that he has fully recovered now except that his stomach is easily affected whenever he does inside work. The latter statement I believe proves the weakness in her argument as to his recovery. The weakness is evidently chronic.

These people had one child, a girl, 3 yrs. after their marriage. This girl is living at present and is healthy. She said there had been no children since and no miscarriages or still births, tho later the mother implied that there might have been one miscarriage about 7 yrs. ago. (She would not speak definitely upon this matter however).

This home is neat and there seems to be nothing in
the habits of the man to induce a continuance of the disease, save the fact that he is still employed where he is exposed to the effects of lead. Most of his recent work has been done in parts of the car shops where he does not come in direct contact with the flying lead dust as formerly.

Case 5.

Mrs. P. D.

The woman is 31 yrs. of age; her husband about 4 yrs. older. They have been married 7 yrs. This man, suffering from an acute attack of lead poisoning, which lasted 4 months, went to the city hospital. For some time previous to this attack he had felt the nausea, loss of appetite, etc. characteristic of the disease. Physicians were unable to diagnose the case in any of its initial stages. The man was a carpenter, and because of this fact it did not at first occur to the physicians that he had been exposed to lead poison. When he went to the hospital the doctor sent for the shingle nails that he handled and found them to be galvanized with lead. These nails he had been in the
habit of holding in his mouth while he worked and he had become infected in much the same manner as do painters who eat with paint-soiled hands. This case of lead poisoning occurred last year and consequently as yet there has not been sufficient time for recovery. It will be remembered however that the symptoms were felt for some time preceding the acute attack.

These people have 3 children, all of them girls. The youngest child is 14 months old and the mother tells me that she was somewhat more delicate than the other two when she was born. She thinks that she is stronger now however. From my own observation I should judge, that such had been the case as she appears to require more care than the others, and is pale and anemic, and the blue veins are prominent.

This home is of average neatness—The children were not very clean; the food in the kitchen was evidently carelessly prepared, probably thru ignorance of culinary knowledge.
Case 6.
Mrs. J. R.

The woman in this case is 35 yrs. of age and her husband about 40. They have been married 6 yrs. The man has never had an acute attack of lead poisoning. He has been a painter for 20 yrs. and most of his early work was outdoor work; of late years his work has been more confined to inside painting in shops etc. The woman in this case was unwilling to say that he had even directly felt any ill effects from handling lead. She said however that he was very much afraid of it and never liked to speak of it to her. A fellow workman reported the case to me as one of recognized chronic lead poisoning. He is an anemic looking person, very sallow, and has been sick ever since he took up painting as his trade.

They have no children. The woman stated further that she did not want any. The mother of this woman said also that he was not strong enough to have any anyway.
The man in this case evidently keeps the truth concerning his condition from his wife and further she is willing to shut her eyes to what is evident to other members of her family.

It is difficult to make any definite assertion concerning the lack of offspring in this case. The precautions which she was in the habit of taking to prevent the appearance of offspring seem to be unnecessary judging from the anemic and sickly appearance of her husband.

Case 7.
Mrs. C. B.

The woman is 54 - her husband is a few years her senior. This man has been a painter all his life and had worked but three years in the car shops when he had the first acute attack of lead poisoning. His wife said that previous to their marriage 38 yrs. ago he had had some slight attacks of illness accompanied by symptoms similar to those of chronic lead poisoning, but that previous to this first acute attack mentioned above, no special indication of a reoccurrence of the affection
had been observed. They had 3 boys—All of them grown. They are equally healthy, though each is at times subject to headaches such as the father has had all his life. She went on to explain that her husband’s father also had these headaches and that he was also a painter. Whether there is anything of particular scientific interest in this fact or not I am not able to judge—at any rate a delicacy of health that allows of this physical condition has its cause somewhere and it seems possible that a conjecture as to lead being the cause does not seem altogether unreasonable judging from what we know of the disease and its workings. The mother in this case is strong and says she has always been so. The children were all born many years previous to the acute attack cited. The woman had at that time passed the childbearing period.

The only significance of this case lies in the fact that the grandfather, a painter, and the father, also a painter, and the three sons, were all subject to the headaches which accompany chronic lead poisoning.
Case 8.

Mrs. A. O.

The mother is 38 yrs. old. The father is 44. They have been married 17 years.

The man has been in the typographical business for 31 years. He began to learn this trade at 13 and he has never left the business. He is a man of very neat habits. He observed the liability of type workers to lead poisoning and has considered cleanliness a preventive of the disease. For 17 yrs. he carried his lunches and much of the time was obliged to eat them in a far corner of the work room, but in summer in an open window or out of doors. He no longer carries lunches as he believes that there is risk of infection from flying lead particles even at the noon hour, when work is suspended. Two years ago he had the first attack of lead poisoning. Physicians claimed that he contracted it thru inhaling the fumes from the vats of boiling lead which in this establishment are open, and have no fan or pipe outlet connected with the casting machines. (A description of this work room is given elsewhere in this article)
Mr -- has not as yet recovered from this attack. He was always delicate, but considered himself immune from plumbism, as he had never been affected by it tho exposed to it for many years.

These people have one child, a boy of 14. He has always been delicate. His mother stated that they had wondered if the father's delicacy may not have had something to do with this fact. That the print-shop life was largely responsible for her husbands frail health she had no doubt. The boy is hollow chested and sallow like his father. There have been no miscarriages or still births. While some precautions have been taken to prevent conception on account of this acute attack of plumbism, the mother said she wondered why none had occurred and she felt that it might be because of his general lack of vitality.

Case 9.

Mrs. R. A.

The woman in this case is 29 years old. Her husband is 33 years of age. They have been married 9 years. The man has been a painter all his life from boyhood up. He did a great deal of house painting and
about a year previous to his marriage he did indoor work exclusively. About four months after their marriage he had his first attack of acute lead poisoning. In 2 yrs. time he was free from all acute attacks, but until the past year he has not been free from all the symptoms and weaknesses characteristic which follow such attacks.

They had been married 11 months when the first child was born— a girl. This baby lived 9 months and during this whole time she was very delicate and anemic, and showed in every way evidence of a very weak constitution. The doctor that the cause of her death was spinal meningitis but stated that he was not positive that this was the case. He said the child was too weak to live many months anyway.

Since that time the parents, tho desiring children, have had none. The woman herself has up to the last 2 years been pronounced in perfect physical condition. During the last 2 yrs. she has felt that there was something amiss with her, merely a general weakness that she intends to have a physician diagnose and treat. There have been 3 miscarriages.
Both the man and his wife have wondered at their inability to produce offspring. She had not considered that the lead had anything directly to do with this condition, but she felt that there must be something wrong with her husband since his illness.

**Case 10.**

Mrs. E. O. D.

The woman is 38 years of age; her husband 45. They have been married about 20 years.

This man had been a painter 5 yrs. previous to the first attack of lead poisoning. At that time he was a well built, well nourished man, having never been sick before. He was 30 when the attack came upon him. It was due to indoor work. For a few months preceding this trouble he felt, at times, abdominal pains, disliked food and was obliged to be very irregular about his work in consequence. Later wrist drop was noticeable and a very pronounced blue line along the gums. He went to a hospital and was pronounced cured in 3 months time. After a 2 months interval the same symptoms were again in appearance. He thereupon gave up the work of paint-
ing altogether and in a week's time recovered temporarily. With change of occupation no return of the disease was ever noted.

One child, a girl, was born 14 months after marriage. This child was delicate and lived but 4 months. The physician in charge of the case tells me he considered the death to be the result of spinal meningitis. They had no other children until 3 yrs. later. At present they have 5. All of them strong and healthy in every respect.

The man in this case worked at the painters trade six years and then gave it up entirely. It is significant that the only child born when the poisoning could have had any affect was the first girl, who, it will be remembered, died in early infancy. Upon change of occupation and entire freedom from any chance of again encountering the poison the man recovered. And three years from that time another child, perfectly healthy, was born.

It is to be observed in four of the cases above written up a child has died of a disease pronounced by
the attending physician to be spinal meningitis. This is of interest in view of the fact that French investigators state that many children of lead infected parents die of spinal meningitis and other diseases characterized by convulsions.

Following is a translation from the French of the substance of a case presented in an article by Dr. M. Oui, assistant Prof. at the university of Lille. He vouches for its truth as it came under his own personal observation.

"On the 23rd of Aug. 1906, Mme-- aged 38 yrs. a finisher presented herself for advice at the Charity Hospital. This woman was said to be six months and a half advanced in pregnancy, and for 3 weeks had not felt any movement of the child. She was scarcely disturbed she said, by the death of the foetus, having had several still born infants before; her anxiety regarded solely the length of time of retention, which in the preceding accidents of the same nature, had not exceeded one week. Following is the history of this woman.

Manstruating at 16 yrs. regularly, her first
accouchement occurred on the 23rd of Mar. 1890 and she was delivered of a living child, which she nursed up to the age of 6 months. She was then stricken by typhoid fever and then ceased to nurse it.

2nd- accouchement Oct. 1891- child living, which she nursed until the age of 8 months, when it died of meningitis.

3rd - accouchement, Late in 1892- child living, nursed by her, died at the fourth month of an affection not precisely known to the mother.

4th- accouchement - 1894- child died three days before birth.

5th- accouchement premature -- 1898 -- child dead and mortified (Retention of oval remains, symptoms, scraping).


8th -accouchement- miscarriage in Nov. 1902. Foetus dead and mortified.
9th - accouchement - at six and a half months. Oct. 1903 - Foetus dead and mortified.

10th - accouchement - full term Oct. 27, 1904, foetus dead and mortified.

11th (actual number) Last menstruation from 27th to 30th of Jan. 1906.

The first movements of the foetus manifested the 2nd of May. They completely ceased the 2nd of Aug. Since that time the abdomen has very noticeably diminished in size. From the 6th to the 8th of Aug. there has been produced a distinct flow of the mammarys etc. etc.

The union of these symptoms permit no doubt of the death of the foetus.

The antecedents of woman furnish no explanation of this lamentable series of infant deaths. A very close inquiry enables us to discover only an attack of typhoid fever after her first accouchement and since of lead colic of which the two latest attacks occurred in Feb. and Aug. 1906. The first occurring therefore, at the beginning of the pregnancy and the second following very soon after the death of the foetus. Nothing, in
the history or examination of this woman permitted of a belief in the existence of syphilis. It is necessary thus to inquire concerning the father, to ascertain the truth concerning this woman and these infants.

The man is 41 yrs. old. He has been since his military service, a resident of Cochin China for 32 months. Since, he has been employed somewhat irregularly in a large printing establishment of Lille, sometimes at a hand press, sometimes at stereotyping. Since 1890 he has been stereotyper for the newspapers exclusively, and since 1896, he has repeatedly had attacks of painter's colic. Most important, this man has had, by a first wife, a child which is still living. It may be added that according to his wife he is a sober artisan of quiet manners, and that he has never had any other illness than that of lead colic.

We have not, unfortunately been able to examine this man and this flaw may enable the objector to say that perhaps syphilis may have played a part in the great death - natality which is characteristic of the case. There is, besides, an objection which one can
always make even after a clinical examination, if the direct examination be permitted, in certain cases, i.e. – the existence of syphilis can be affirmed. The absence of lesions do not authorize us, on the contrary, to discard absolutely this diagnosis. Moreover, the action of syphilis on the product of conception is weakened in general, in the degree of the age of the disease. Here, on the contrary, the first children are born living, the first has resisted (death) the second is dead at eight months, the third at four months, the fourth at three days, and since, this woman has not given birth to a living child. She has only miscarried with dead and mortified foetuses.

But if we take up again the history of the father, we can establish undeniably that in 1890, that is to say, after the birth of the 2 living infants, which have survived infants which he has had by two different women he has begun to be employed as a sterotyper for newspapers, a kind of work which is considered by all printers to particularly expose the artisan to lead-poisoning. Three infants in succession were there who
succumbed in the course of their first year. Then in 1896 the father began to have painter's colic. Beginning from the moment, seven pregnancies were produced in his wife which all ended in the expulsion of the foetus dead and mortified. Therefore the action of lead poisoning seems to me to be present without doubt.

Dr. Oui quotes in this article a case which he considers an incontrovertible proof of the effects of paternal saturnism. This deposition was presented by Prof. Brouardil before the senatorial commission, charged to examine the project of the law of employing compounds of lead in the work of painting on buildings (house painting).

"M. Periard avait, dans son service, une femme qui s'était mariée avec un individu intoxiqué par le plomb. Elle fait l'une après l'autre cinq fausses couches. Puis, elle accouche une sixième fois d'un enfant superbe, admirable. Après quelques interlocutions diplomatiques. Pinard lui demande: "Mais enfin, est-ce que c'est le Mene?" Elle lui répond: "Ah! j'avais renoncé à avoir des enfants et alors -- J'eus ai a-(1 - 49)
(M. Pinard had in his service a woman who was married to an individual poisoned by lead. She had, one after the other, five miscarriages. Then, she was confined for a sixth time and delivered a superb infant. After some diplomatic inquiries Pinard demanded. "But, really, has this one the same father?" She answered him, "Ah! I had given up having a child, and there --- I wanted one which would be healthy, and this is it." This is therefore an experimental demonstration.)

CONCLUSION.

It is hoped that the collocation and presentation of the foregoing records of the pernicious effects of lead-poisoning upon the mature individual, the child, the embryo and the germ plasm may serve to further substantiate facts already known.
1. Qui (M) Influence du saturnisme paternel sur la grossesse et le produit de conception.
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