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The Manufacture of White Lead, Recent Improvements, Clinical History of a few cases of Plumbism. Suggestions for improving health of white lead worker.

I have after nearly three years careful watching the employed at one of our white lead works in the North of England come to the conclusion that a great deal of sickness amongst the same could with a little care be very easily eliminated and death from white lead poisoning be almost abolished.

I intend in this thesis to give a very brief history of process of manufacture of white lead and suggestions to improve it. Starting with so called dig lead, (the crude lead) this is melted at a moderately low temperature giving of in process little or no fumes and no danger can be said to be attached to process. It is now moulded into so called strap, with holes through it so bent on themselves as to allow gases to pass freely around and through them whilst in stack. These straps are now placed in the stacks formed
formed still in the same and well-known way and here they are kept for about three months. The lead being acted upon by the acetic acid becomes acetic acid of lead only to be turned into the carbonate through time from the fermentation. Mind the employment (chiefly girls) are sent into these stacks to collect into baskets & carry the white lead to the crushing machine. After it has been thoroughly washed and it is sure that the first danger in the whole process is met. For the least neglect or carelessness in melting the white lead may allow a cloud of dust to be generated, formed, which is for many the inhaled by the workers, in parts of their respiration, which when no one is looking they often breathe to wear under their chins. The lead having been crushed in the crushing machine, that united upon in the stack is prepared and sent back to be remelted; this process of remelting is in my opinion to a certain extent dangerous. As fumes are given off in process therefore this should be done protected by a hood, that the fumes, may be carried out of the shops or factories. From the grinder it should be carried in a stream of water.
after having been crushed into a very fine dust at the works, where the water is to a great extent squeezed out by machinery, the lead carbonate is left in cakes. These cakes are now carried on rakes to the drying chamber or still in most factories to the ovens, where it is packed all round on shelves by girls who stand in the ovens, often for hours at a time, the air of which must of necessity often be full of white lead dust, more especially when the lead is very dry & requires to be removed. It is here where the great danger of the whole process lies. For the dust not only affects those actually working in the ovens but is carried in the air across most of the factory, polluting the whole place. Hence the workers observe certain precautions but that cannot eliminate the danger. The lead after being removed from the ovens is stored in earthen tubs for a certain period before being mixed with oil (machinery) to form the ordinary white lead of commerce.

Now I have shown that the process as described is all carried out and till the oven process is reached, I believe to be the source of the whole or major portion of the dangers of the factory. And therefore I am of opinion that some improvement

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ought to be enforced by law. In one factory at least in the North of England I find that drying chambers have been invented for the sake of packed on shelves with wooden slats, sealing the bakery's loaves, and is dried partly by hot water, and partly by vacuum. The process of drying takes about two days, a great saving of time over the open process. The lead is not put free in air to come away with. After the lead is put in, it is dried in this process, a man can very quickly empty a dryer into cartons, but clink here is given off, so a strong current of air is so directed as to carry it up a horse leading out of the factory. I am of opinion that the new ashes will before long take the place of the old ones; but until some such process is enforced by law, we cannot expect even with the greatest care to improve the health of the workers, to any great extent. And as account of the larger number of employed than of those at sea, the question is becoming in my mind a rather serious one, i.e. what, amongst those employed in the ovens, is not at all an uncommon event, and pictures to a greater or less extent in the rule.
I will now mention the precautions which I believe should be carried out before this form of poisoning will be reduced to a minimum.

Each factory should be compelled to employ a medical Inspector, his chief duty being to inspect all the employed, whether male or female, at least once a week so as to become familiar with their appearance and to detect the earliest symptoms of failing health. Inspector should not be content merely looking at the piles. The blue line in my opinion indicates nothing more than that the patient has been amongst lead, and as we shall see when I give some clinical cases, does not give a definite answer as to what extent patient may be affected. The Inspector should examine the patient's hand, as muscular failure is frequently the first symptom observed. Also he should be very careful to examine the face any of the employed, whom he may consider are not keeping up to standard of health. Of course these are best detected by being familiar with the patient's general appearance. I find that in the female it is very valuable to, if it be suspected that
Her health is failing and about her menstrual courses, as I have found, that suppression of the menstural generally but not always precedes any other symptom, even in females who cannot be said to be very anemic. I put a great deal of stress on the medical examination of the employed. But we cannot unfortunately, always believe our patients as very often they intentionally lead us astray in order that they may continue at their work, often believing the dangers to themselves to be much exaggerated.

At the inspection the medical man should not only keep for the future state of health of each individual for future reference, but should have the power to suspend any one for a limited time to be medically treated, or forbid that one from returning to work in the factory. The employed before being allowed to start to work in a white lead factory should pass a medical examination by inspector. At such examination care should be taken to see that patients urine does not contain anything which points to deficient action of the kidneys. Also special care should be given to the examination of the heart. As if so the heart...
the desired advantage will rapidly show itself.

The female workers, starting in factories, should have printed rules and precautions to be observed given to them and be instructed to carry them out fully.

All females employed on entering the factory in the morning should be supplied with complete sets of clothing consisting of night working clothes and overalls. These to be returned when her own clothing is worn out again when her days work is done. As a rule only overalls are supplied but as lead dust is sure to get under that onto her underclothes, I do not consider this to be sufficient as the lead dust can easily be carried about on the ordinary female clothing material, and besides that which she is sure to convey from her clothing by her hands to mouth. She is sure to contaminate food etc whilst doing her ordinary household duties, so that she is more or less exposed to lead dust when in factory and when at home.

Males should be advised to change their clothing when at home, but I think it would even in their case be better to have their working clothes kept in the factory as I cannot help but recognise the danger they are exposed to, carrying white lead dust in their
clothing, I do not believe a great amount could be absorbed through the skin although some little may be. But certainly their hands can become contaminated if the lead can thereby be mixed with their food in small quantities.

Each factory should have large bath rooms and compel each female and admit each male to take a bath before leaving the works at night.

It is absolutely necessary that each one of the employed should keep their nails, fingers, hands, mouth and clothes clean and that their hands be thoroughly washed before any food is taken. It is also wise to encourage tobacco mouth. Teeth of course should be kept thoroughly clean. Decayed teeth should be removed or otherwise treated, as employed seems to be particularly liable to ulceration of gums with swelling and inflammation around any such teeth. It is unusual I believe and very disquieting to give employed a weak solution of sulphuric acid in form of lemonade to drink. I also have found a certain amount of benefit derived by giving them Sodium Chloride in water in order to render the lead
more easily eliminated by the Sidneys, etc.

On leaving the Newcastle-on-Tyne has
in his Gazetteer lectures that a great
deal of stress on the feeding of the employed
men, and I cannot help but admit that I have
frequently found that the earlier, heavier,
and closely fed are the more promptly affected
by the lead. Employed should therefore
be warned not to go without food for long
whilst exposed to lead, and those working
in the more dangerous positions should be
allowed food of some sort every two
or three hours.

The old clinging covers on I have before
mentioned should be abolished as the
same clinging process might be adopted and
yet improved upon. Thereby rendering it
quite unnecessary to handle the lead
in a dry state in any part of whole
process, except perhaps when putting it
into tanks to be stored away.

If these suggestions should be carried out I
am certain in my own mind that 50
per cent of cases of lead poisoning which
were now met with could be done away
with and death from this cause be reduced
Lead Poisoning

Rheumatic Fever. - It seems to me that some people are particularly liable to attacks of lead poisoning, and I believe that people of a nervous temperament are more easily attacked than any others. Females, especially young girls between ages of 10 and 20 years, are very liable to attacks of lead poisoning from whatever cause suffer frequently. Alcoholism seems to predispose, and it seems to me to especially predispose to a form of convulsions. Attacks in my opinion have been more common in winter than in summer, probably explained by the workers living more out of doors in winter than they are wont to do in winter. Attacks of convulsions known have been more common in summer. Some of the workers in white lead factories seem to enjoy immunity from lead effect of the lead. I have known persons working in factories exposed to all the dangers for from ten to fourteen years during the whole of which time they have never had an attack of lead colic or other form of poisoning.
Symptoms of Lead Poisoning

Often we will find, say, a young adult or male starting on a factory job. Perhaps for short a time as those works the skin line on the fume will make its appearance in the patient gradually loses colour, and becomes a peculiar bluish white hue. If we examine his urine we will find that blood is in a greater or less extent wanting.

Constipation soon makes its appearance and appetite fails, patient becoming languid and weary. If now such patient be allowed to continue his employment and expose himself to the cause—how many get any one of the many many forms of the most prominent symptoms of Lead Poisoning. The usual one is cola, but some time we first get weakness of extensor muscles of forearm, or in other restaurants joint attract our attention of an epileptie character, and in at least one case I have been general strain of a muscular character complaining of chiefly attacking legs and arms.

A young person starting to work in a lead factory may show one or more of these symptoms within six weeks.
Clinical Cases.

Convulsion in Male

M. D. aged 210 years. Strong muscular man with a good family history and with no history of convulsions or other nervous disease. He had previously worked in a copper foundry. He was not a teetotaller but was fond not to drink, to excess. He was shown as having refused to be too careful as to cleanliness. He had not complained of being ill but was noticed to be looking ill for some little time back. The blue line on his gums was very well marked.

On the 17th June he had been to a neighbouring village where his wife performed and she had had some pain of her ankles. He was not remembered how she got back to his home. He showed said return about 11 pm and was then noticed to be sweating and acting very strangely. He was seized with the first convulsion of the epileptic character at about 10.30 pm, which lasted according to account given, about four or five minutes. When the movements ceased and he remained in a comatose condition for about twenty minutes, when another convulsion came on which lasted about the same time. Followed by coma as before.
Pulse was hard small and quick. Pupils were rather dilated. At intervals of about twenty minutes he had convulsions until 3.30 a.m. Pulse by this time was quick and fickle, and the pupils more dilated and the convulsions were beginning to follow one another more quickly but were of less duration. At about 4 a.m. I called in a brother Medical Practitioner and Chloroform was very gradually administered until patient was properly under its effect, the process taking slightly over one half-hour. After which a small quantity at intervals for about another hour. No convulsion occurred after patient got fairly under Chloroform. I saw patient again at about 9 a.m. He had had no convulsion and was very restless and cheerful, continually endeavouring to get out of bed and threatening his nurse and others with violence. I now administered four minims of the Inj. Morph. Hyd. HCL. At 11 a.m. after which patient rested a little. However next day at about six a.m. I was called to see patient who was quite conscious. I minim of Inj. Morph. Hyd. HCL.
fear administered and hands were moved with an enema of soap and water. Patient after this slept for a few hours after which he seemed a little more collected but yet had intervals of delirium. Patient was now given a mixture containing 15 grains of Pot. Persim. and 15 grs. Chlorid. hydrate to be given every four hours of the morning, ordered a pure milk diet. On morning of fourth day patient was for the most part perfectly collected but showed signs of delirium at intervals. Pot. Persim. in very small doses was now added to his mixture. Patient about this time began to complain of very severe frontal headache, which did not leave him until end of first week. and about the same time the Pot. Persim. was increased and the Chloral mixture was discontinued. By end of 14 days patient was allowed to get out of bed but on even got he acted strangely at intervals, he had to be constantly watched and was not allowed to leave his room for another week. During which time however he gradually improved and was sent to a convalescent home at end of six weeks, seeming to all appearance completely recovered. But being left in a very weak state which she has never recovered from. During his whole illness his temperature
remained normal, the urine was plentiful and contained a mere trace of albumen at first, which very quickly disappeared. In this case as in several others which I have seen I could find no direct cause for the convulsions except the introduction of lead into the system which I believe acted directly through the nervous system. And in the face of such facts I do not see why the muscles, when we get paralysis, should be supposed to be directly affected, as some told them to be.

Convulsions in Female.

K. S., aged 18 years. Strong muscular girl looking however rather anaemic. Had worked in whale crew quitting off and on for eighteen months. Had not previously complained of being ill. Blew bone on some very paint. On cross-questioning found she had not menstruated for six months previous, but had hidden this fact her fear of being suspected. She was however not pregnant. She did not complain of usual symptoms of anaemia. She complained of her hand which on examination was smaller and stiff—evidently the result of inflammation probably aggravated by the lead. She complained to having been subjected to lead work.
for a month previous. She was seized with convulsions on her way to work on the morning of 16th July. I saw her about mid-day. She looked pale, heart and spoke at random. Her speech was slurred and she complained of loss of sight and hearing. Complained of pain in eyes when exposed to light. She also complained of great frontal headache, also of numbness and tingling of the little and ring finger of left hand. While on examination I found her to be paralyzed. She was at once ordered large doses of chloride of iron repeated every four hours. SheConnor had a second convulsion about 7 pm. followed by another at about 9. PM. Next day on which day I visited her about 12 noon, she was then in a very collapsed condition. She had other convulsions during next two days, but these were not nearly so severe, after which she gradually improved. Her bowels from the first were freely acted upon with colocynth 1 30 grains. She was put on a fluid diet; chiefly beef tea and milk. One month afterwards she was to all appearance enjoying sound health. The headache which had lasted about a fortnight had gradually disappeared together with all other head symptoms. The paralysis of the fingers before mentioned however was still complete and her mental state had not returned. In spite of
all treatment, at time of writing she is in good health and suffers only from the Paralysis which
woman is gradually improving. The case of Paralysis
like two others which I have seen shows what a long
time it needs treatment in the ordinary way, e.g.
massage and electricity, like this case, a case of very limited Paralysis I believe a not
common event. The parts temperature had been
been a little above normal, while to my mind rather
exclude the diagnosis that there had been some
menigitis.

Case of general muscular pains
Called to see Mr. P. on 15 Dec. Young man
who looked weak and anaemic, had a very
bad family history on that father side. Had
previously suffered from bad colic. He complained
of great pain in muscles of legs and forearms.
and to a lesser extent in those of his body
generally, together with headache and constipation.
On inspection nothing could be made out, the
muscles however were tender to the touch. He
also complained of great weakness of his muscles, he
intests were the pains that he had to be given large
doses of morphia repeated at intervals. He gradually
improved so that on 6th May he had little pain
and his muscles rapidly regained their strength, so that
on 10th May he was able to leave his room. He was,
was given a mixture containing 10 per cent. of Per. Sodis. to be taken three times a day. Followed on about the 26th day by a large dose of Syrup. Perri Jodid. He was allowed to return to his work on the 26th day. He was instructed to continue taking the tonics for a long time. True. After he left the factory altogether, his urine on examination contained no albumen, but there was a large deposit of urates and albumen. His temperature remained normal. I believe that if the man had continued at his work, after he felt the pain, paralysis would have gradually come on, as the pain in my opinion was only exaggerated symptoms of threatening paralysis, and were serious in character.

Constipation with Colic

These cases are met with every frequently amongst the blind workers, as this seems to be in most cases, the first sign of actual poisoning or at least of the most serious forms of poisoning. Colic is generally if not always preceded by constipation of obstinate character with hard lach and gaured temper, with loss of appetite. Most attacks. I believe could be avoided if patients would only seek medical advice when these preliminary symptoms appear. Patients are generally suddenly seized with pain on one or other side just below the umbilicus. The pain is constant is almost
stationary, the belly is not touched to touch at first. But later on becomes so. The pain comes in at intervals, and lasts for varying periods and then disappears. Simulating labour pains. In early stage, an ordinary attack of lancinating pain will last from a few hours to four or five days. The sooner of pain is due according to Dr.术语 of Newcastle-on-Tyne to nervous contraction of part of gut with contraction of that immediately above, the point of obstruction. This seems to me to be confirmed by clinical observations. Such symptoms as the extreme pain of an intermittent character, the stationary position of such pain, the pain being often accompanied by vomiting, the vomit being sometimes of a bilious nature, and it being unreleamed by ordinary treatment (for colic suggests the above hypothesis). It is on this understanding that I treated my last case, and it may say with excellent results.

When I had my first case, I tried the ordinary means—using purgative mixture, together with carminatives, and hot fomentations. But this treatment was far from satisfactory; in fact, it seemed often to aggravate the complaint. I could only in the middle case get the bowels to operate freely. In most cases, the purgative medicine simply acted as an irritant, often producing
catach of the stomach, with vomiting, and other
uncommon symptoms. In one patient I gave two
ounces of creton oil, but without the least effect.
Except of anything the pain was increased, and
stomach was set into a catarrhal state. Having
had many similar experiences with many of
my cases, I gave up the purgative method
entirely, and afterwards treated my patients
by first giving a large enema of soap and
water to be given as hot as patient could
comfortably bear it, and then gave him or
her a mixture containing: partly heavy
clay of Dr. Morse; Hydrous (generally 30M)
together with salicylate of bismuth to be
given every two hours, whilst pain was
bearing the dose to be gradually diminished
as pain diminished. The patient meantime
drank, on a purely liquid diet, for awhile
the pain under this treatment did not last for
more than a few hours or a day or so at
most. After the pain ceased the mixture was
abandoned and one containing Pot. Sodicid.
until tincture substituted. The bowels being set
the same time needled on with small doses
of colocynth, assisted by small enemas
of castor oil, or sometimes only soap and
water.
Case of Paralysis

Mr. W. called to see Mr. W. on March 20, 1893. The patient was a man about forty
years of age. He had been in good health, except for a slight sore throat.

On examination, the patient complained of weakness and aching in the muscles of his forearm, so that he could not straighten his wrists, which were very painful. He also suffered from loss of appetite, together with constipation. I found him to be suffering from slight bronchitis. The patient had suffered a few weeks previously from an attack of colic, but had concealed the fact.

Flexion, pronation, and supination of the forearm could be performed, but retention of hand on forearm was performed with great difficulty. The hand and wrist appeared to be swollen, and a suture containing part of the thumb. However, in a week, paralyses of the extensor muscles of the forearm was complete, and the hand in wrist seemed to have increased. At end of another week, the affected muscles had rapidly increased. The interrupted current was tried on the muscles, more effective than without effect. No massage was continued. About this time, patient still
a sharp attack of bronchial asthma which brought his general health near a low. After the gas was removed from the lung, he was treated with syrup of licorice, under which his general health improved, but the paralyzed muscles did not. At the end of three months the interrupta current was applied and had a slight action on the muscles. On August 16th, the patient could not move the full strength of current which he had previously done. So slowly has the improvement been that still he has not full power of his muscles. But I believe that he will ultimately do so.

Case of Ostitis Mentis

S. J., girl aged 19 years. Had worked in lead works one year and three months. Her home was very happy, and her people were very poor. In this case the first symptom was total suppression of the menstrual periods. She also complained of headache and general malaise. She had slight blue line on gums over the molars, teeth not over the incisors. The headache and malaise lasted about three weeks, when symptoms subsided. On mentioning the case, she stated that she felt phlegm in the throat, also she fancied herself an object of a supernatural character walking about the room. Her temperature was occasionally slightly
about normal, and her pupils were much dilated. She first complained of failure of her sight on the tenth day of her illness and the suddenness of the failure that in five days she was completely blind. One evening she requested the eye to be removed. There was complete optic atrophy, with contracted blood vessels, etc.

Her general health after this illness has completely recovered, and she has since married and become a mother.

I believe that in this case we had at least some acute meningitis which rapidly spread along the course of the optic nerve and ultimately affected the retina. At any rate all the symptoms pointed to this.

**Genito Urinary System**

The action of lead on the genito urinary system seems yet to be clearly discussed. Dr. Clever in his Gastroenteric Lectures refers lead poisoning to its effect on the system as to be a lesson to a man becoming father of a healthy child. To this I cannot agree altogether; although lead may be virulent to generation to some extent.
yet I have personally attended the wife of a lead worker during her confinement. The mother was forty years old and was not a lead worker. She had previously been confined twice years ago. The child was small but apparently healthy and is still alive.

I must admit that I have never known personally a female lead worker (in a white lead factory) to give birth to a living child. On the other hand, however, I have only known one abortion and this I believe was due partly to exposure to lead poisoning. However, my personal experience of this subject does not extend very far as most of the female workers in this factory which I had the fortune to be connected with were single women, very poor, and seldom of the better class. All their accomplishments were due to the employment they were able to secure. Amongst the lead workers I did not know of a single patient suffering from granular kidney, and although I have examined the urine of many of them, I only found albumen in some of those who had one or other form of more serious symptoms. Such a fact...
 grew to my mind that granular contracted. Malignancy may be due rather to alcohol than to cold, in many cases where the load is blamed for the disease. I have never seen a single case of joint, in any form, amongst the whole lead workers.

Judging from the clinical observations which I have made it would seem to me that the first action of white lead when taken into the system in small quantities is in some way to interfere with the blood forming process but in what way it acts I cannot say but I believe it is a nervous action. It seems to be at any rate the nervous system which is chiefly affected. All my clinical cases which I have mentioned have I believe had a nervous origin. Colic, Convulsions, Paralysis, Neuraltic pains, etc. All made good recoveries except the case of Paralysis which is still improving and the case of Motor Nervous which is hopeless.

J. J. Foster