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The manufacture of White Lead, Recent Hygienic improvements, Clinical History of a few cases of Plumbism. Suggestions for improving health of white lead workers.

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 short history of process of manufacture of white lead, a preliminary to suggestions

Starting with so called pig-lead, (The metal lead) this is melted at a moderately low temperature giving off in process little or no fumes, and no danger can be said to be attached to process. It is now moulded into so called straps, with holes through & so bent on themselves, as to allow gases to pass freely around & through them whilst in stacks. These straps are now placed in the stacks formed

formed still in the same and well known way, and here they are left for about three months, the lead being acted upon by the acetic acid becomes acetate of lead, only to be turned into the carbonate through gases from the fermentation. Now the employed (chiefly girls) are sent into these stacks to collect into baskets & carry the white lead to the crushing machine, after it has been thoroughly watered, and it is here that the first danger in the whole process is met. For the least neglect or carelessness in watering the white lead may allow a cloud of dust to be ~~generated~~ formed, which is or may be inhaled by the workers, in spite of their respirators, which when no one is looking they often prefer to wear under their chins. The lead having been crushed in the crushing machine, that unacted upon in the stack is separated and sent back to be remelted; the 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 shop or factory. From the grinder it should be carried in a stream of water

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after having been crushed into a very fine dust to the press. 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 racks to the drying chambers 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 clay & 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 over most of the factory, polluting the whole place. True the workers observe certain precautions but these cannot eliminate the danger. The lead after being removed from the ovens is stored in casks for a certain period before being mixed with oil by (machinery) to form the ordinary white lead of commerce.

Now I have shown that the process as described is all carried out. not till the oven process is reached: this 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. In these the lead is packed on shelves with wooden ladders simulating the baker's ladder and is dried partly by hot water and partly by vacuum. The process of drying taking about two days; a great saving of time over the oven process. & the lead dust set free in air is there among with. After the lead (finished) is dry in this process a man can very quietly empty a dryer into casks. but dust here is given off. so a strong current of air is so directed as to carry it up a lane leading out of factory. I am of opinion that the new drier will before long take the place of the old oven; 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 on account of the larger number of employed than of ^{late years} ~~formerly~~, the question is becoming in my mind a rather serious one. As death amongst those employed in the ovens is not at all an uncommon event and sickness to a greater or less extent is 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 appearances and be able to detect the earliest symptoms of failing health. Inspector should not be content with merely looking at the gums. 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-grip as muscular failure is frequently the first symptom observed. Also he should be very careful to examine & question 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 appearances. I find that in the female it is very valuable to, if it be suspected that

her health is failing ask about her menstrual courses as I have found that suppression of the menses generally but not always precedes any other symptoms even in females who cannot be said to be very anaemic 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 note in books kept for the purpose state of health of each individual for future reference & he 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 patient's 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

be diseased anaemia will rapidly show itself
The ~~fact~~ workers starting in factory 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 set
of clothing consisting of light underclothing and
overalls. These to be returned when her own
clothing is donned again when her days work is
done. As a rule only overalls are supplied but
as lead dust is sure to get under these 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 both 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 recognize the danger they run as
long as they carry 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 & the lead can thereby be mixed with their food in small quantities.

wash

Each factory should have large bath rooms. and compel each female and advise 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 of fingers cut very short and clean. and that their hands be thoroughly washed before any food is taken. It is also wise to urinate out mouth. Teeth of course should be kept thoroughly clean. Decayed teeth should be removed or otherwise treated, as employed seem to be peculiarly liable to ulceration of gums with swelling and inflammation around any such teeth. It is usual I believe, and very beneficial 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 kidneys etc.

Dr Oliver of Newcastle-on-Tyne has in his Galstonian Lectures put a great deal of stress on the feeding of the employed and I cannot help but admit that I have frequently found that the weaker & leady feet are the more frequently 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.

in the factory?

The old drying ovens as I have before mentioned should be abolished & the new drying 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 casks 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 are now met with could be done away with and death from this cause be reduced

reduced to a minimum

Lead poisoning

Predisposing Causes. - It seems to me that some people are peculiarly 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 16 and 21 years are very liable to attacks. The badly fed or nourished 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 door in summer than they are wont to do in winter. Attacks of convulsions however have been more common in summer. Some of the workers in white lead factories seem to enjoy immunity from lead effects of the kind I have known persons working in factory & 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 in a factory; in perhaps so short a time as three weeks the blue line on the gums will make its appearance. The patient gradually loses colour, and becomes a peculiar slaty white hue. If we examine his lips we will find that blood is to 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 we may get any one of the very many forms of the more prominent symptoms of lead poisoning. The usual one is colic, but sometimes we first get weakness of extensor muscles of forearm, or in others convulsions first attract our attention of an epileptic character, and in at least one case I have seen several fits of a neuritic character complained of; chiefly attacking legs and arms.

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

Clinical Cases.

Convulsions in male

Mr. Z 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 factory. He was not a teetotaler but was said not to drink to excess. He was however believed not 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 informed me he had had one glass of beer only. He can not remember how he got back to his home. He however did return about 10 pm. and was then noticed to be looking and acting very strangely. He was seized with the first convulsion of an epileptic character at about 10.30 pm. which lasted according to account given me about four or five minutes. when the movements ceased but he remained in a comatose condition for about twenty minutes when another convulsion came on which lasted about the same time. followed by come 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 feeble 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 convulsions
 occurred after patient got fairly under
 Chloroform. I saw patient again
 at about 9 a.m. He had had no convulsions
 but was very restless and delirious
 continually endeavouring to get out of bed
 and threatening his nurses and others with
 violence. I now administered four
 minimums of the Inj. Morph. Hydrat.
 of B.P. after which patient rested a little
 However next day at about six p.m.
 I was called to see patient who was quite
 unmanageable. 5 minimums of Inj. Morph. Hydrat.

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were administered, and bowels 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. Perm. and 15 grs
Chloral-Hydrate to be given every four hours
& he was ordered a pure milk diet. In morning
of Fourth ^{day} patient was for the most part perfectly
collected but showed signs of delirium at intervals
Pot. Iod. in very small doses was now added to
his mixture. Patient about this time began to
complain of very severe frontal head-ache, which
did not leave him until end of first week.
and about the same time the Pot. Iodid was
increased. & the Chloral mixture was discontinued.
Near end of 14 days patient was allowed to
get out of bed. but as even yet 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
having to all appearance completely recovered.
but being left in a very weak state
which he has since recovered from.
During his whole illness his temperature

remained normal, His 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~~ 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 hold them to be.

Convulsions in Female.

H. S. aged 19 years. Strong muscular girl looking however rather anaemic. had worked in white lead factory off and on for eighteen months. Had not previously complained of being ill. Blue line on gums very faint. On cross-questioning found she had not menstruated for six months previous. but had hidden this fact for fear of being suspended. She was however not pregnant. She did not complain of usual symptoms of anaemia. She complained of her knee which on examination was swollen and stiff. evidently the result of rheumatism possibly aggravated by the lead. She confessed to having been subject to head aches.

For a month previous. She was seized with
 convulsions on her way to work on the morning of
 16 Oct 93. I saw her about mid-day. She looked
 stupified and spoke at random. Was decidedly
 deficient both of sight and hearing. Complained of
 pain in eyes when exposed to light. She
 also complained of great frontal head ache, Abs.
 of numbness & tingling of the little and ring fingers
 of left hand. which on examination I found
 to be paralyzed. She was at once ordered large
 doses of Chloral Hydrate repeated every four hours.
 She however had a second convulsion about 7 pm.
 followed by another at about 9 AM. next day
 on which day I visited her about 12 noon. She
 was then in a very staged 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 & Hyocyamus
 pills. She was put on a fluid diet. Chiefly
 leaf tea and milk. One month afterwards she
 was to all appearances enjoying good health
 the head ache 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 menstrual courses had not resumed. in spite of

all treatment. At date of writing she is in good health and suffers only from the paralysis which however is gradually improving. This case of paralysis like two others which I have seen shows what a long time it resists treatment in the ordinary way. e.g. massage and electricity. Also this was a case of very limited paralysis I believe a not common event. The girl's temperature had never been higher than normal, which to my mind rather excludes the diagnosis that there had been some meningitis.

Case of general neuritic pains

Called to see H. P. on 15 Dec 92. Young man who looked white and anaemic, had a very bad family history on his father's side. Had previously suffered from bad colic. He complained of great pain in muscles of legs and forearms, and to a less 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. So intense were the pains that he had to be given large doses of morphia repeated at intervals. He gradually improved so that on 5th May he had little pain and the muscles rapidly regained their strength, so that on 10th May he was able to leave his room. He was

now given a mixture containing 10 grs of Pot. Iod. to be taken three times a day. Followed in about a week's time by large dose of Syrup Ferri Iodid. He was allowed to return to his work on the 20th day. but was instructed to continue taking iron tonics soon after he left the factory altogether.

His urine on examination contained no albumen but there was a large deposit of urates and phosphates. His temperature remained normal. I believe that if this man had continued at his work, after he felt the pain paralysis would have rapidly come on, as the pains in my opinion were only exaggerated symptoms of threatening paralysis and were neuritic in character—

Constipation with Colic

These cases are met with very frequently amongst white lead workers. as this seems to be in most cases the first sign of actual poisoning or at least of the more serious forms of poisoning Colic is generally if not always preceded by constipation of obstinate character with head-ache and furred tongue; 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 in position is almost

stationary, The belly is not tender to touch at first. but later on becomes so. The pain comes on at intervals, and lasts a varying period and then disappears. Simulating labour pains in early stage, An ordinary attack of bad colic will last from a few hours to four or five days. The spasm of pain is due according to Dr. Oliver of Newcastle-on-Tyne to nervous constriction of part of gut with contraction of that immediately above, in fact to 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 unreleaved by ordinary treatment for colic suggests the above hypothesis. It is on this understanding that I treated my later cases, and I may say with excellent results. When I had my first cases I tried the ordinary means, using purgative mixture together with carminatives, and hot fomenting, but this treatment was far from satisfactory: in fact it seemed often to aggravate the complaint. I could only in the milder cases get the bowels to operate freely. In most cases the purgative medicine simply acted as an irritant, often producing

catarrh of the stomach with vomiting and other unmounted symptoms. In one patient I gave three minims of castor-oil - but without the least effect except if anything the pain was increased, and stomach was set into a catarrhal state. Having had very similar experiences with many of my cases, I gave up the purgative method entirely, and afterwards treated my patients by first ordering 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 pretty heavy doses of *Lij. Morph. Hydroch.* (generally 30m) together with subnitrate of Bismuth to be given every two hours, whilst pain was heavy: the dose to be gradually diminished as pain decreased. The patient meantime lived on a purely liquid diet, for as a rule 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 discontinued and one containing *Pot: Iodid.* with tonic substituted. The bowels being at the same time acted on with small doses of colocy with assisted by small enemas of castor oil, or sometimes, only soap and water.

Case of paralysis

was called to see R. W. on March 22nd 1893
 found patient to be a man about forty
 by ears old, very cachectic looking. Family
 History was good. Patient drank pretty
 heavily. Complained of weakness and trembling
 of 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. And
 on examination I found him to be suffering
 from slight bronchitis. He had suffered a
 few weeks previously from an attack of
 Colic but had concealed this fact.

Flexion pronation and supination of forearm
 could be performed but extension of ~~forearm~~
 on forearm was performed with great
 difficulty. He was ordered massage; his bowels
 were operated upon; and he was given a
 mixture containing pot. Iodid. However in
 a week paralysis of the extensor muscles of
 forearm was complete, and the pain in
 wrist seemed to have increased. At end
 of another week the affected muscles had rapidly
 wasted. The interrupted current was tried on the
 muscles now but without effect. no massage
 was continued. About this time patient had

a sharp attack of Chronic Asthma which brought his general health very low. After he got convalescent from this he was treated with Symp. Ferr. Iodid. under which his general health improved but the paralyzed muscles did not. At the end of three months the interrupted current was applied and had a slight action on the muscles. On August 16th Patient could not bear the full strength of current which he had previously borne. 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 Optic neuritis

S. W. Girl aged 19 years. Had worked in lead works one year and three months. Her home was unhappy and her people were very poor. Again in this case the first symptom was total suppression of the menstrual courses. She also complained of headaches and general malaise. She had slight blue line on gums over the molar teeth not over the incisors. The headache and malaise lasted about three weeks, when symptoms suggesting meningitis showed themselves. In fact she kept picking at the clothes. Also she fancied she saw object of a supernatural character walking about the room. Her temperature was occasionally slightly

above normal, and her pupils were much dilated. She first complained of failure of her sight on the tenth day of her illness and so rapid was the failure that in five days she was completely blind, her screaming the eyes a few months back 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 first some basilar meningitis which rapidly spread along the course of the optic nerves, and ultimately effecting the blindness. 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 under discussion. Dr. Oliver in his Galstonian Lectures, believes lead poisoning to so effect the system as to be a bar to a man becoming father of a healthy child. To this I cannot agree altogether; although lead may be derogatory to generation to some extent

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 five 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 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 rather to Syphilis than to lead poisoning.
 However my personal experience of this subject
 does not extend very far as most of the
 female workers in the factory which I
 had the fortune to be connected with, were
 single women, very poor, and desirous of
 hiding all their ailments for fear they
 should not be allowed to continue their employment.
 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

suggests to my mind that granular contracted
 tubercles may be due rather to alcohol than to
 lead, in many cases where the lead is
 blamed for the disease.

I have never seen a single case of gout,
 in any form, amongst the white 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 here I believe had a nervous
 origin. Colic, Convulsions, Paralysis,
 Neuritic Pains, &c. All made good
 recoveries except the case of paralysis
 which is still improving and the case of
 Optic Neuritis which is hopeless.

J. J. Foster