Chronic Lead Poisoning.

special reference to symptoms & pathology.

A Thesis
for the
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Prefatory Remarks.—

Ever since my first lessons in chemistry I have had a fascination for investigating the action of metallic poisons upon the human frame.

During my hospital career, having only seen one case of plumbism in the wards, & another in the dispensary, I considered it rare. But for eighteen months immediately succeeding my graduation I acted as assistant to the medical officer of a large lead work employing two hundred & twelve hands, sixty of whom,—twenty one males and thirty nine females, came under weekly inspection. They are constantly employed in the manufacture and

packing

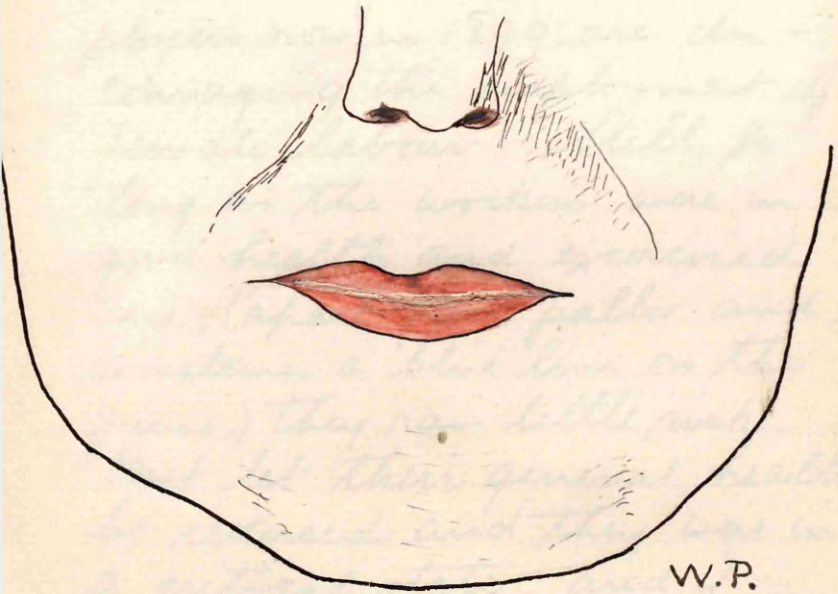
packing of white lead.

During that short period I had twenty six cases of true plumbism, - twenty females and six males, - as well as two cases occurring amongst painters. I thus found plumbism by no means uncommon, and also that the susceptibility of different individuals was very different and due to some inherent individual peculiarity quite independent of complexion. Of the two sexes the female stands it the worst, possibly on account of carelessness on their part. The accompanying diagram Fig. I. shows a not-uncommon condition in which we find the female worker.

The actual percentage per annum of those who worked in the dangerous part of the manufacture & suffered from plumbism was ten per cent males and thirty three per cent females.

So

Fig. I.



Deposit of white lead on the lips of a female lead worker, Who has used her respirator carelessly.

So much has this greater susceptibility of the female been manifest that the employers now in 1899 are discouraging the employment of female labour. Still, so long as the workers were in good health and exercised care, (apart from pallor and sometimes a blue line on the gums,) they ran little risk. But let their general health be reduced and they were in a critical state, and if albumen appeared in the urine they could not stand the work at all. The following is a case in point.

On Dec 12th 91. A.W. went home suffering from colic, vomiting and constipation; the urine was scanty and on examination contained albumen. In five days she recovered, colic disappearing, bowels moving easily

easily. Urine plentiful and no albumen could be detected. She returned to work remained well for fourteen days when she again suffered more severely than formerly with marked albuminuria. She was advised to give up the work.

Here I believe the kidneys, failing to eliminate the poison, were at fault.

As the employers appoint a medical officer to look after their staff they naturally expect that all cases of plumbism shall be treated at home. Hence their comparative rarity in our infirmaries, but now that the act necessitating the notification of all such cases is so justly passed the prevalence of this malady will become better known. But it would be well that all should know that Carelessness on the

part

part of the employees has a great deal to do with their sufferings. Plumbism would be much rarer if they would strictly comply with the instructions of the employers and use the means they have provided for their security, namely – Respirators, overalls, tooth & nail brushes, a plentiful supply of hot & cold water and plunge baths, under the supervision of a matron who is expected to see this carried out. And, in addition to all this, provision is made that they do not start work fasting. In point of fact their health is largely in their own hands, for I have seen cases where they had been employed for twenty years with impunity in the factory I refer to, and had never been off a day on that account.

There

There is a belief entertained by many that female lead workers become sterile on account of the action of lead on the system. This has not been my experience, for many of the employees were subsequently married & had large families. — I can quite understand that such a condition might result where proper precautions were not taken; but might it not be the result of the prophylactic line of treatment adopted by some medical men, who use for a lengthened period and in considerable ~~quantities~~ doses Potassium Iodide, ~~and~~ thus causing atrophy of the ovaries?

That sterility is not necessarily a concomitant of the action of lead, I have had numerous examples, in the case of married women so

employed

employed continuing to have children, and also of un-married ones. for it is no uncommon thing for the medical Officer having to recommend that such a one should be suspended on account of advanced pregnancy; and many of these have been long employed in the manufacture of white lead in the work which I refer to.

This experience has caused me to choose lead poisoning as a subject for my thesis; and for the succeeding seven years I have embraced every opportunity of acquiring farther knowledge connected with this subject. Not only as seen in practice but also by experimenting upon animals.

In this thesis I would like to try and trace lead

on

on its course through the body. Beginning with.

1. Its Introduction
2 " Absorption
3 " Clinical Symptoms and Pathological changes. & its resemblance to Gout & Granular Kidney.
4 " Elimination
5 Some Concluding Remarks.

Chapter I

Introduction to the system

Lead may be introduced into the system in many different ways —. The general public may be affected en masse, through drinking water being contaminated, as occurred at Sheffield in 1890 and Leeds in 1892. Here the water was derived from a peaty surface and as all vegetable acids have a solvent action upon lead hence the poisoning. Had the water contained Sulphates and an absence of vegetable acids most likely there would have been no poisoning, as sulphate of lead would have been formed on the inside of the pipe and this being insoluble forms a coating,

or

or almost enamel, as seen any day on examining lead pipes through which good drinking water has passed, such as that of Loch Katrine. This is the reason leaden pipes are often used with what appears to be immunity. Although two cases occurred here in my practice last year, where an old leaden gas pipe had been used to conduct spring water about twenty yards to a house. ~~[illegible]~~ The only occupants, the husband and his wife, suffered from severe colic blue line & constipation, all disappearing on ceasing to use the water. Here the pipe was in places quite eroded through, the gas having first impregnated the metal & rendered it more soluble.

Infants have suffered from plumbism through the use of a

a lead nipple lotion (B. Med Journal March 1899).

The adulteration of wine by litharge has occurred at Pictou, - hence the name Colica Pictonum.

The white lead worker suffers severely; here the stack, the drying, and packing rooms are the chief sources of danger - The metal in sheets is laid upon jars full of acetic acid packed round with tan, a subacetate due to evaporation of acetic acid, then a carbonate due to the continued fermentation of tan, is formed on the sheets of lead. This is carried by girls to a room where it is washed & rolled thus separating the white lead from the metal. It is then dried and here is a great source of danger. The temperature is intended to be 190°F. and as a consequence there

there is much fine dust in the air. Again in the packing room the fine white powder is emptied into barrels & beaten down & nailed; all this entails much dust. Of the twenty six cases I had I could not say they all occurred in these departments because the same hands are not always working in the same place or room. Still, experience has taught the foremen to strictly enforce the rules for prevention of plumbism while working in these departments.

Painters suffer in the same way. One severe case occurred here four years ago. A gentleman had several painters glazing & painting his greenhouses. One - A.H. aged 29 - suddenly fell down from severe cramp in his stomach, as he thought. On examination I found the characteristic blue line.

Severe

severe twisting colicky pains around the umbilicus, slightly relieved by pressure. vomiting and constipation. The stomach would retain nothing, but morphia hypodermically relieved the pain; the left side of the abdomen remained tender. The urine was scanty & contained albumen. The pulse was hard & slow during the colic.

Glaziers often suffer from plumbism. So well is this known that it is proposed to introduce a bill into Parliament making the use of lead glaze in pottery manufacture a thing of the past.

Plumbers also suffer;- the fumes derived during soldering, & likely composed of lead oxide, would produce symptoms if long inhaled—

Chapter II

Absorption

Lead may be absorbed into the system either through

1. The Skin,
2. Respiratory Tract.
3. Alimentary Canal.

But much depends upon the form in which it is introduced. If in such a condition that it is already dissolved and ready for absorption it may enter the system at once. As in lotions, fumes, or drinking water. If in an insoluble form then we have to consider the circumstances by which it might undergo a chemical change, and its chances of then being absorbed.

That some is taken up is proved by the fact that all lead

lead workers are pale, no matter how careful they are as regards cleanliness, etc. or if they have only worked for a few weeks. Still it must be quickly eliminated, else there would be far more cases of actual acute poisoning.

Absorption by the Skin is seen in cases arising from the use of hair lotions containing lead. Mr. Morgan of Sunderland reported such a case in April 1887 which I give in extenso in another chapter.

By rubbing oleate of lead into the back of a rabbit I have detected lead in the urine six days afterwards. Besides if it is eliminated by the skin (as Dr. Pereira has proved it is for he found it in the sweat), surely it may be absorbed in that way also.

By

By the Respiratory Tract

poisoning may readily take place; and for this reason respirators are used in all lead factories. Bristowe says that when the powder was ground in a dry state (as was formerly the case) not only have workers suffered but horses dogs and even rats have died from its effects.

The Colique seche from which the French sailors suffered was caused by their sleeping in newly painted berths. Here it was combined with the volatile turpentine and in such cases would be directly absorbed.

With the white lead worker it would be the carbonate. This will be deposited (if the respirator is not properly worn) along the whole respiratory tract. Some might even get into

into the very air cells. In any case, in any part of the respiratory tract, it is exposed to heat moisture and the free passage of carbonic acid gas, and in this way may be partly converted into a bicarbonate, in which case it is fairly soluble and thus absorbed.

This may account for the prevalence of the disease amongst those employed in the drying and packing rooms, and explain Alderson's statement that this is the chief mode of absorption in lead workers.

By the Alimentary Canal

This is the usual entrance (seen in general practice. We have only to think of the regular epidemics of plumbism in some of our larger cities on account of contaminated drinking

drinking water. or it may arise from the assimilation of lead with food or drink of any kind.

If it be presented in an insoluble form as in the case of the lead worker it comes in contact with 1. The Saliva, 2 Pepsine. 3. Hydrochloric Acid 4. Bile. 5 Pancreatic Juice, and if digestion be going on albumen will be present along with all these, excepting Saliva. Now if Cartonate of lead be mixed with each of these separately, & left in contact for fifteen minutes, then filtered water added & Sulphuretted Hydrogen passed through the fluid, we get the following results.

1. With Saliva, a lead reaction.
2. " Pepsine no reaction.
3. " Hydrochloric Acid, Slight reaction
4 " Bile lead reaction.

5 With pancreatic juice, No reaction.

If in any case digestion is going on, the albumen will form an insoluble albumenate of lead and thus it will pass off in the faeces.

With this intention a meal is provided for all female lead workers in the factory where I first had my experience of plumbism.

Three years ago I tried an interesting experiment with the vomited matter of a patient suffering from dilated stomach. This, when left in contact with lead carbonate, had a marked solvent effect; here the butyric and lactic acids present no doubt acted as solvents. This may explain the susceptibility of dyspeptics to lead poisoning.

If lead enter the stomach in an insoluble state, then any

If

of these acids will form a salt which is fairly soluble and thus enter the system in considerable quantities.

Albumenate of lead being readily formed & insoluble would counteract this, but it will depend upon which is in excess, the albumen or lead solution.

From all this we see the chances of absorption of lead into the system of those coming in contact with it.

Lead in this soluble form is taken up by the capillary circulation, but I dont think by the lymphatics, certainly not to the same extent, because in lead poisoning the white corpuscles do not appear decreased in numbers, nor, as far as can be detected, altered in

in character. Now if lead entered by the lymphatics might we not expect that such a poisonous substance would on reaching the lymphatic glands interfere with their elaboration of white corpuscles? But clinical and pathological examination fails to detect anything here.

The anatomical position of the lacteal lying as it does in the centre of the intestinal villi, only absorbing fluid after it has passed through nucleated cells, while the capillary absorption is by endosmosis may explain this.

Lead having thus gained entrance into the blood gives rise to certain symptoms and gradually produces pathological changes.

Chapter III.

Clinical Symptoms & Pathological Changes.

1. Premonitory Symptoms - Usually previous to an attack the lead worker has warnings in the shape of.
(a) Sweetish taste in the mouth due to the irritating effect of lead on the taste glands during absorption. (b.) Thirst.
(c) Constipation. This favours absorption by keeping lead longer in the alimentary canal.
When these symptoms appear we know that absorption is taking place, and if speedy measures are taken an attack may even yet be averted. For this reason a mixture of Sulphuric Acid, Magnesium Sulphate, with

liquorice & water as a vehicle is kept handy at the lead work, the intention being to render what is soluble in the alimentary canal insoluble and at the same time get rid of it.

2. Real Symptoms A Anaemia

A The first is anaemia.

All lead workers are more or less pale, some excessively so. Such shows that the system is becoming impregnated with lead.

Microscopically the blood shows the white cells unaltered but the red ones reduced in number, although not altered in shape. The haemoglobin may be reduced as much as 45 per cent below normal. According to Ralf the alkalinity of the blood is reduced possibly because lead was absorbed in acid solution.

Potts.

Popp found the fibrin increased. Hubel's investigations proved a decrease in the solid constituents red cells and albumen while the extractives were increased.

Possibly lead by combining with proteids of tissues forms a compound like albuminate of lead, and in bone marrow replaces ~~lead~~ Iron, the red cells having thus a diminished amount of iron which may be replaced by lead. The fact that bone marrow gives a lead reaction and possibly also red cells (the reaction was not decisive) goes a certain length in proving my theory.

If in greater quantity than might be held by the red cells possibly it is as a compound like albuminate of lead. This, tending to increase the viscidity, renders its circulation slower along

along the walls of the vascular system & sets up an irritating action as seen in the Kidneys liver & retinal vessels. thus we would get an arterio - Capillary fibrosis.

Certainly the pulse is slowed during & after colic and the blood readily Co - agulates in lead poisoning.

(I merely beg to suggest these theories)

That there can be at any time during life only a small quantity of lead in the blood is certain. A one per cent- solution of Acetate stops all amoeboid movements and if kept four minutes together the amoeba are killed. now if much were in the blood we would expect a similar change here and consequent sudden death. Such really takes place in practice.

As

the following case shows.
(from the Transactions of the Northumberland and Durham Medical Society April 87.)

A maiden lady aged 72 came to Mr. Morgan Sunderland complaining of paresis of her left eyelid and for some weeks her arms had ached continuously and were gradually becoming weaker, her appetite was poor, the bowels constipated, the mind clear. A week after, Mr. Morgan found no improvement, so ordered seven grains of potassium Iodide and next morning she was found dead in bed. Here the woman had for a long period been using a hair dye containing lead; this had been absorbed through the skin and gradually produced poisoning. the lead being deposited in the tissues.

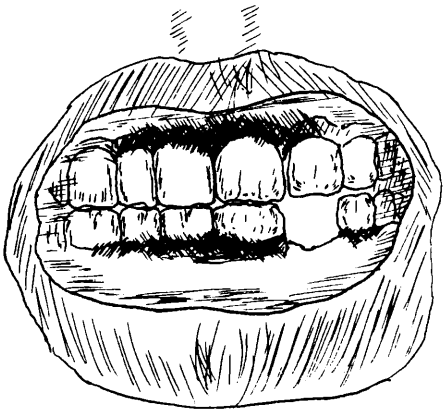
When

When the potassium Iodide was given, the lead in the system became soluble and would be taken up by the blood plasma thus causing death.

In acute lead poisoning (quite apart from its effect as an irritant) we have the same result When taken in small quantities such accidents are avoided, as the blood soon gets rid of the lead by the skin. liver & kidneys, and depositing it in the different parts of the body. According to Bristowe it has been found in the, liver lungs. kidneys. heart. intestinal walls, brain, and muscles. Like anaemia there is another symptom which may cause no inconvenience to the patient Yet have been present for some time; that is -

B

Fig. II.



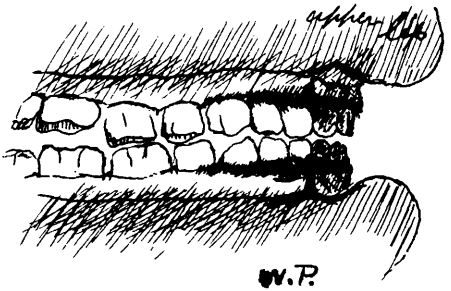
W.P.

Front view of the gums of a male lead worker. Showing characteristic blue line. The second lower incisor is out here the line was absent. He has no complaints & is at his work regularly.

B. a blue line on the gums due to staining or a deposit of sulphide of lead. The food decomposing between the teeth gives the gas, and the fine lead dust- or solution is deposited on the gums & teeth or any uneven surface or crevice. Thus the sulphide is formed and insinuating itself between the teeth & gums produces the blue line which if present for any length of time cannot be washed off.

For the following reasons I regard this as a local action:- 1. it has never so far as I can learn been seen in infants suffering from plumbism. 2. nor in animals, these breathing through their nostrils have not the same deposit on the gums as in man. 3. It is not seen on the whole surface of the gum as where a tooth has been extracted Fig. II and—

Fig. III.



Three Quarters profile of the gums of a female lead worker Showing blue line on the front. it was absent behind in the molar region.
The cheek is as it were removed.

and the gum perfectly healed
4 It is most marked on the lower jaw and more so towards the front gradually decreasing until it is absent at the back (Fig III) nor is it seen on the inside of the teeth.

C. But severe Colicky pains are usually what first calls the unfortunate victim's attention to the fact that he has lead poisoning. He complains of severe twisting colicky pains round the umbilicus, at first relieved by pressure; but if it continues long an inflammatory action is set up, pressure then doing harm. Constipation I have always found present (although some writers have noticed diarrhoea), vomiting is very common. Retraction of the abdominal wall is constant and sometimes

sometimes peristaltic action of the bowels may be noticed. This colic is generally supposed to be caused by spasm of part of the bowel, the portion above contracting & mooving trying to send its contents into the constricted part below.

This intestinal colic is merely part of a general effect of lead upon unstriped muscular fibre for concurrent with the colic there is a rise in blood pressure, the pulse becomes hard & incompressible, and will drop from normal to forty or even lower per minute. The colic first passes off then the pulse gradually becomes softer & quicker & returns to its normal.

Dr Oliver explains this as an affection of the nervous system, he believes lead first irritates the sympathetic and intestinal

intestinal ganglia, causing spasm of portions of intestine and arteries and the slowed heart's action by reflex inhibition through the mesenteric and coeliac plexuses of the abdominal sympathetic. But surely the direct action of lead has some effect upon the muscular fibre, for as Oliver admits, and I have always noticed in all my cases, there is little urine secreted during an attack and as soon as there is a free flow the attack gradually passes off, the colic first. Here the lead is leaving the muscular fibre of the intestines, and then, as the blood is cleared by the kidneys, the circulatory system gradually returns to its normal state.

Again these are symptoms which

which are seen before the nervous ones, in fact they are the first; and if lead has first to be deposited in the nervous system we would surely expect these symptoms equally as soon as, if not before, colic.

Unfortunately I could never manage to inject a solution of lead directly into the blood; still, if done, it would be interesting to know if the blood pressure at once rose & colic appeared.

I think we have here in unstriped muscular fibre a part of the organism specially susceptible to lead, first that in the intestines, then that in the circulatory system. Is it not to this that all the symptoms and pathological changes are due? First an arteric capillary fibrosis with ultimate enlarged -

enlarged heart, and a cirrhotic condition of the liver and kidneys; and then all the serious and often fatal nervous symptoms seen in chronic plumbism. This I think the usual course of events.

D Nervous Symptoms as a rule follow after one or two or more attacks of colic, and are preceded by numbness, general depression vertigo, and aching in the joints.

The most common marked symptom is Wrist-drop; here the muscles supplied by the musculo spiral nerve are affected, - first the extensors of the fingers, then those of the hand, and if the cause is not removed other muscles become affected, as the deltoid when the arm cannot be raised from the side.

That the flexors also suffer, is shown by the general weakness of the arms.
The muscles become atrophied from want of use and may become distorted by the unequal distribution of power.
On account of the weak circulation they soon become painful and tender, in one case I saw there was an inflamed swelling.
Sensibility is always retained but the reflexes are always wanting. Usually this affection is symmetrical.

At one time this was thought to be a local affection due to the deposit of lead in the muscles, but it is now supposed to be a symptom of the effect of lead (possibly secondary) on the nervous system. For the following reasons I believe this to be the correct view:-

1.

1. The rapid shrinking of the muscles without degeneration, & the loss of faradic contractility.
2. The treatment of wrist-drop by sulphur baths I have seen tried & ignominiously fail.
3. Lead like other poisons may have a special affinity for certain parts in the nervous system.

Still I have kept and examined the spinal cords of rabbits poisoned by Acetate of lead and could never detect anything by the microscope.

Occasionally the legs are affected and here again the extensors are the first to suffer. According to Lancquerel 13. per cent of all cases of lead paralysis occur here.

Sometimes generalized paralysis is met with. The following case occurring under the care of Prof Philipson (Brit-

(British Med Journal Mch 21. 1896)
explains this. J. F. A. aged 29,
single, a white lead worker,
was admitted to hospital
complaining of symptoms of
lead poisoning of seven
weeks' duration. Patient had
followed his occupation for the
last three and a half years;
had been engaged principally
in the drying department. At
the end of two and a half years
he experienced his first attack
of colic and constipation.
After fourteen days he re-
turned to work well, when
after working for three months
he had a second attack of
colic, from which he recovered
in five weeks. After this
second attack the patient
drank large quantities of
beer, acidulated with sulphuric
acid, & was exceedingly care-
ful as to cleanliness. Seven
weeks

weeks before admission the patient went to work in his usual health, & while in the factory was suddenly seized with colic. He was conveyed home. Three days subsequently the patient had epileptiform convulsions; he became unconcious and remained thus for twelve days. On regaining sensibility the bowels were opened for the first time since the illness, and the paroxysmal pains decreased in severity ceasing on the following day. Paralysis then suddenly appeared. It attacked first the right leg. At 6 a.m the patient was out of bed and could walk unsupported, but on rising five hours later he was surprised to find his legs give way under him; they helplessly crossed and he

fell

fell to the ground. The right leg was the worst- affected, but before morning they were equally paralysed. Other muscles of the body quickly followed, but the patient was unable to state the order in which they were affected. He never suffered pains in the limbs or back. On admission the temperature, pulse and respirations were normal, Face pale, well marked blue line; patient lay in bed quite powerless, the only movement he could perform freely was elevation of the head and movement of it from side to side. The pupils were widely dilated but reacted slightly to light Both discs was swollen red irregular round the margins with small haemorrhages at places the veins were large & full, and the retina

surrounding

surrounding the disc looked cloudy in places obscuring the vessels; a few haemorrhages were seen in it. On examining the muscles the deltoid, triceps, extensors of the fingers and wrists in both arms, were found to be completely paralysed. The other muscles, with the exception of the long supinator, were much weakened, almost amounting to paralysis. In the legs & thighs all the muscles, both flexors and extensors, were powerless; the muscles of the back except the trapezius were all paralysed, but those of the abdomen, chest, head, neck, face, eyes, appeared to be unaffected. The patient steadily recovered in three months, with the exception of the extensors of the wrists & fingers. Unfortunately

no

no mention of the urine was made in this case; if it had, most likely it would have pointed to some kidney lesion.

Lead seems to affect the motor nerves; at times the paralysis resembles subacute anterior poliomyelitis. In fact Erb thinks (Ziemssen Cyclopedia of Medicine Vol XIII p. 721) that lead poisoning may account for some of these cases, and as proof of this quotes the fact that paralytic symptoms are sometimes the same in both.

Encephalopathy. - Of this the writer has only seen one case - that was on 18th June 1891. A.H. an old lead worker, aged 44, fell down in a convulsion, at 10. AM when I saw him he was in a dazed condition but was gradually recovering; the skin was slightly moist, the pupils dilated and slightly

responded

responded to light, the gums showed a faint blue line, the pulse was slow and hard, respiration appeared normal. The previous history showed that the patient had been a lead worker for eighteen years, during which time he had four attacks of colic and twice wrist-drop; he ceased work three months ago because of a feeling of weakness. Since then he had no complaints apart from irritability and being worried for the last two or three days. That very same night the patient took another convulsion and died. Unfortunately I had no opportunity of examining the urine but was told it was scanty. Nor had I an ophthalmoscope with me. Here lead was the cause of death, but most probably after setting up secondary changes

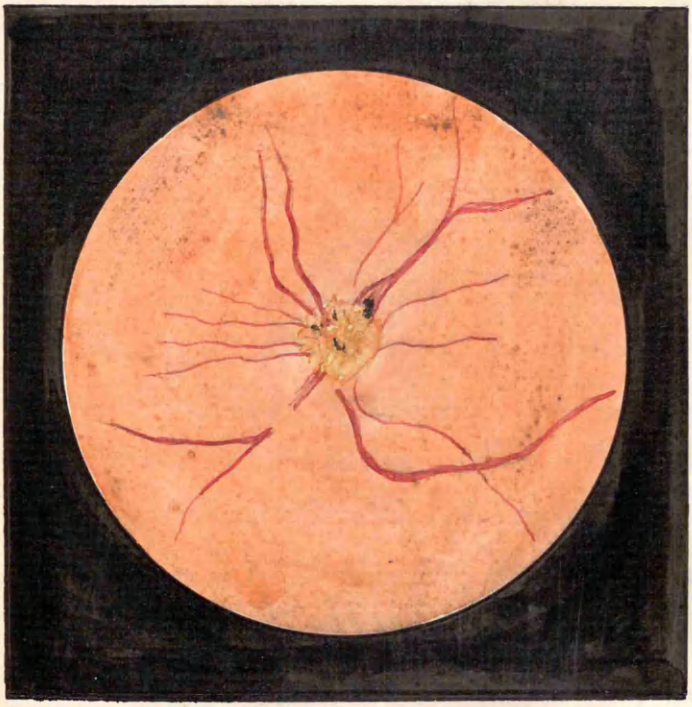
in

the kidneys.

It might be convenient to divide encephalopathy as seen in plumbism into two classes:- 1. Acute, as seen in acute cases of poisoning where we have convulsions and death. This is probably due to the direct action of the poison upon the brain. In the other 2. lead only plays a secondary part and may be similar to the brain symptoms seen in granular kidney and gout, and due to the retention of other poisonous elements in the blood besides lead.

E Sometimes there are marked changes in the optic disc and retina, and if present they are a valuable guide to diagnosis, as by them we may be able to foretell an explosive outbreak such as encephalopathy. Gowers (Medical Opthelmoscopy p 238) says

Fig. IV.



Acute neuritis as seen in lead poisoning

after Dr. Oliver.

says these ocular changes commonly occur in chronic cases of lead poisoning which have presented toxic symptoms for some time, and that they coincide with an increase of the other symptoms. This I believe is usually the case, although Dr Oliver in his Goulstonian lectures describes an acute form where he says the borders of the disc are swollen, ill defined & irregular the disc itself hyperaemic & mottled, the arteries obscured, or if observable they are narrowed and have delicate white lines running along their borders, the veins are distended, occasionally haemorrhages are seen. Such cases he says occur in people who have worked only a few weeks or months in a lead factory and after suffering from acute headache & vomiting suddenly

Fig. V.

W.P.

Right Eye.

F.G. female button maker —

to lead poisoning and al —

Fig V One haemorrhage covers

fovea macula. greater degree

of blindness in this eye.

Fig. VI.

W.P.

Left Eye.

- Neuro Retinitis attributed
- luemenuria . Fig VI artery
crosses a vein and obscures it

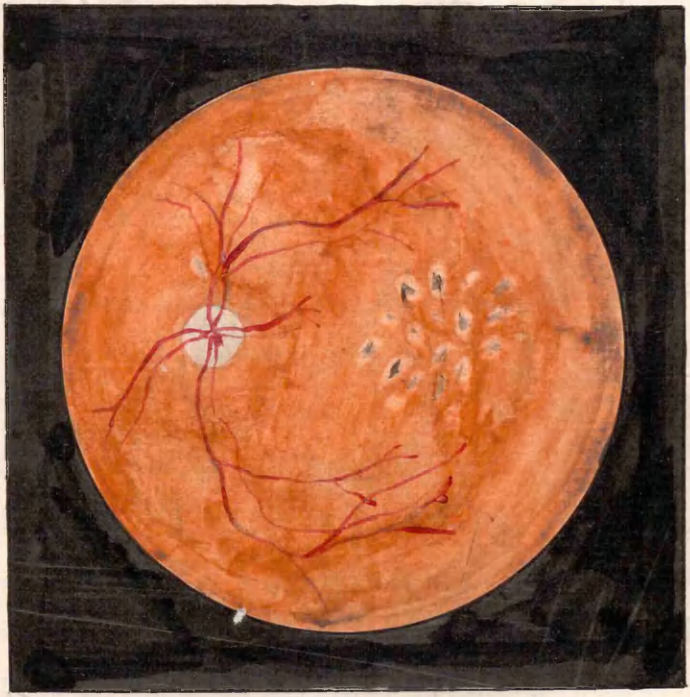
Case seen at Vienna during
Summer 1892.

lose their eyesight. I have tried to copy one of his plates showing such a condition (Fig IV) In this case there was no albumen in the urine.

Of the other class I have seen two examples whilst studying in Vienna in 1892 they were under the care of Dr. Königstein. The first:- 1. a female button maker. During her occupation she used discs of lead which she covered with cloth in the making of buttons. Here the optic discs were indistinct and swollen (but not hyperaemic as in the former case), the margins obliterated, the arteries narrowed and opaque as seen on crossing a vein which they obliterate. Haemorrhages were present in (Fig VI VII) both eyes, especially round the fovea macula; sight was nearly lost in the right eye evidently due to haemorrhage; in the other it was much impaired.

In.

Fig VII



W.P.

The same patient as Fig V. and VI. three months later showing atrophy of the disc Some of the haemorrhages are darkened. menstruation has been disordered for two years.

In July the same year the optic disc (that is three months after first seen) was atrophied as seen in Fig VII, here the vessels are attenuated, & the disc small and pale.

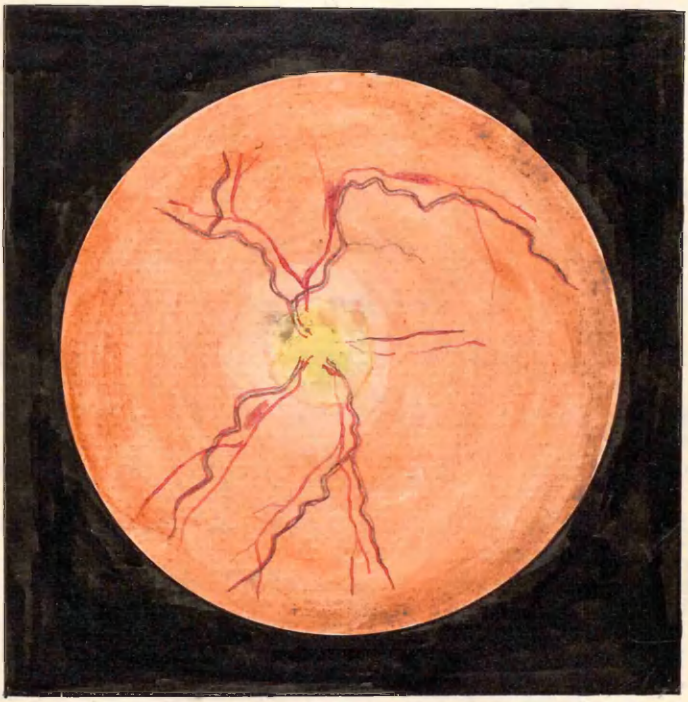
The cause here was attributed to albuminuria influenced by lead poisoning.

2. The other case H K. – a male paint-mixer, with a previous history of three attacks of colic, and at the time of examination he had partial wrist drop. Here the disc was swollen, the margins indistinct, arteries narrowed and opaque, haemorrhages are seen along their course, the veins are distended & tortuous. The sight was not lost but impaired. Lead here had a more marked effect. Fig VIII represents the condition.

Optic neuritis in lead poisoning may thus be divided into

two

Fig. VIII.



W.P.

H.K. male paint mixer, distinct history of plumbism when taken wrist drop was present.

Neuro retinitis. haemorrhages and full tortuous veins are marked.

two classes 1. those cases due to the direct action of lead & 2. those due to its secondary effects; - the first caused by the effusion of the irritating lead-charged blood plasma into the sinuses & along the sheath of the optic nerve causing acute inflammation of the disc & retina. Blindness coming on so suddenly seems to point to this. The second class, - due to the secondary effects of lead, the primary lesion being an arteric capillary fibrosis, then the ophthalmic changes. Such might be produced by direct pressure extending along the sheath of the optic nerve or possibly due to a descending neurosis; the gradual onset & chronicity of the complaint seems to point to the latter as the true explanation, remembering that a haemorrhage may account for a sudden loss of sight-

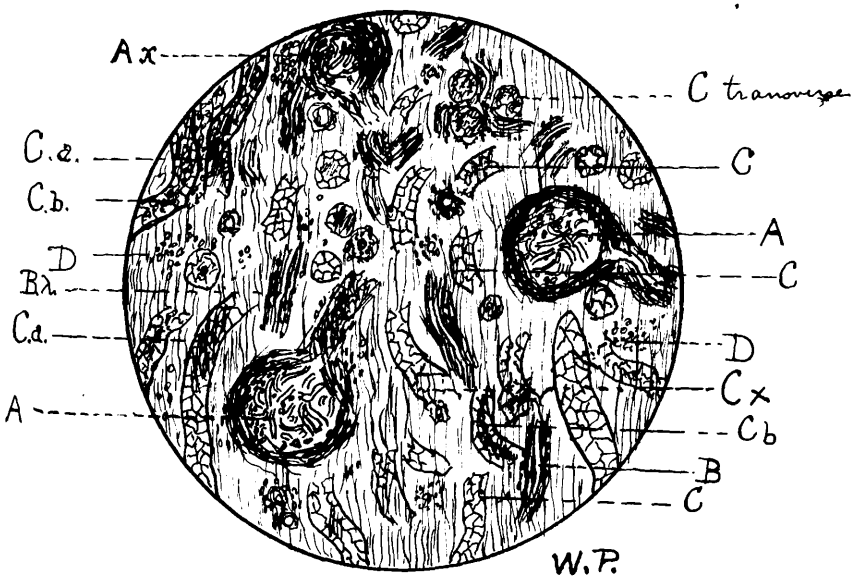
might explain such an occurrence in these cases.

F In the urine albumen is of frequent occurrence and is a very important symptom, for if the kidneys are not fully active and able to speedily eliminate the poison the individual soon suffer; in fact they require to cease any employment bringing them in contact with lead.

Here the extra work devolving upon the kidneys and the devitalising effect of lead (rabbits poisoned by lead have a smell as if of decomposition & they very soon decompose) produce pathological changes.

In rabbits receiving one grain of Acetate of lead per day in meal & water, lead appeared in the urine in five days, and albumen in three weeks. The kidneys then showed no alteration to the naked eye,

Fig. IX.



X about 650.

Section of the kidney of a rabbit which received 1. gr. of Acetate of Lead per day for eight weeks. (Marked albumenuria)

A. Glomeruli, increased connective tissue round the capsule at parts (X) encroaching on the interior. Round cells are noticed

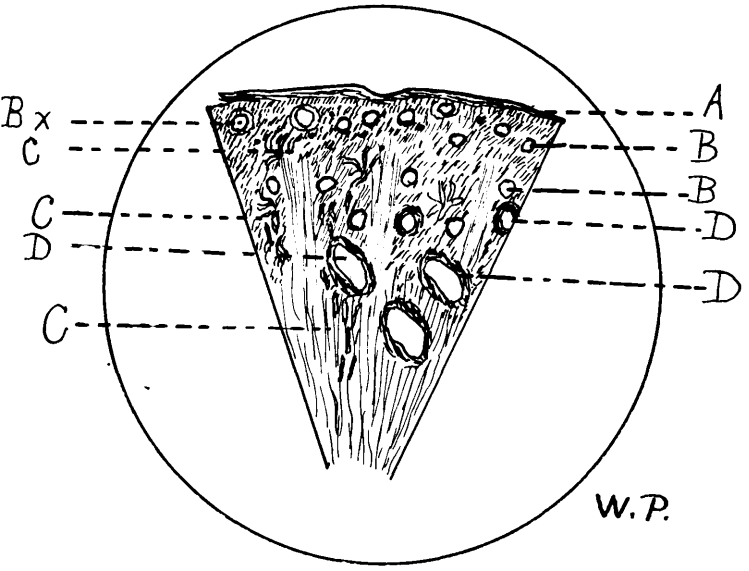
B. Capillaries surrounded by connective tissue and (λ) round cells

C. Convoluted tubules. in many places (a) indistinct and (b) granular x and dilated

D. Round cells in connective tissue

eye, but microscopically the epithelium of the convoluted tubules appeared indistinct & swollen, also some leucocytes appeared round & in the glomeruli. When a rabbit died from lead poisoning, after administration for three months or more, the changes were more marked. To the naked eye the kidneys sometimes appeared slightly smaller, some having an uneven surface; the capsule was at places fixed to the substance of the organ. Microscopically the most striking change was the number of round cells present & quantity of connective tissue. This on reaching the capsule caused a depression & fixation of the kidney substance. The round cells were specially numerous round the capillary vessels & glomeruli. the walls of the arteries was thickened and surrounded

Fig X.



X about 80

Section of the kidney of a rabbit which died from lead poisoning q. 12 weeks

A. Capsule, only at one end detatched. a depression near the centre
B. Glomeruli. x. surrounded by a clear space
C. Convoluted tubules. granular & distorted
D. Blood vessels & spaces. thickened walls

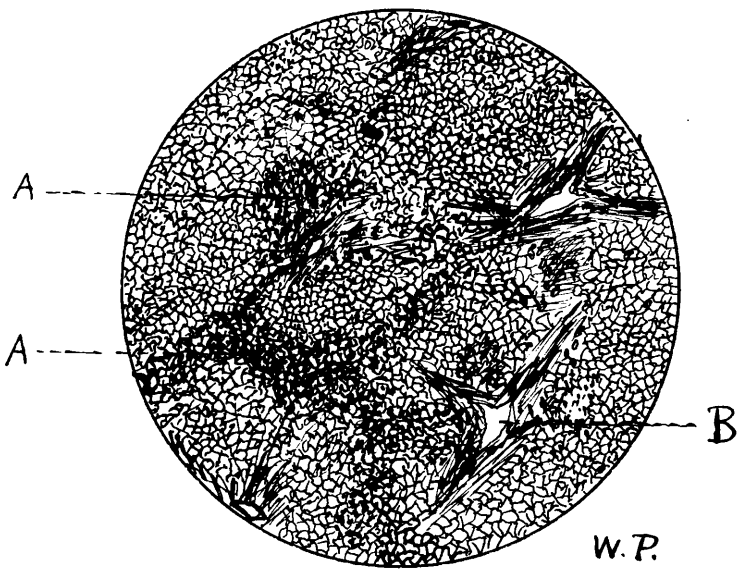
surrounded by connective tissue. The capsules of the glomeruli were also thickened appearing clear in Fig X, and many leucocytes appeared beneath it and between the enclosed tufts of vessels and also as they left the glomeruli. Figs IX and X show the changes.

Such structural changes in the lining of the glomeruli & tubules would fully account for the albumen, and as the organ gradually becomes wholly affected so will other serious symptoms be developed due to the failure of these organs to eliminate animal poisons. (Henkel found extractives in the blood increased.)

Herein I believe lies the explanation of convulsions and some other nervous symptoms seen in chronic plumbism

Like the

Fig. XI.



X about 90

Section of the liver of a rabbit which died from lead poisoning

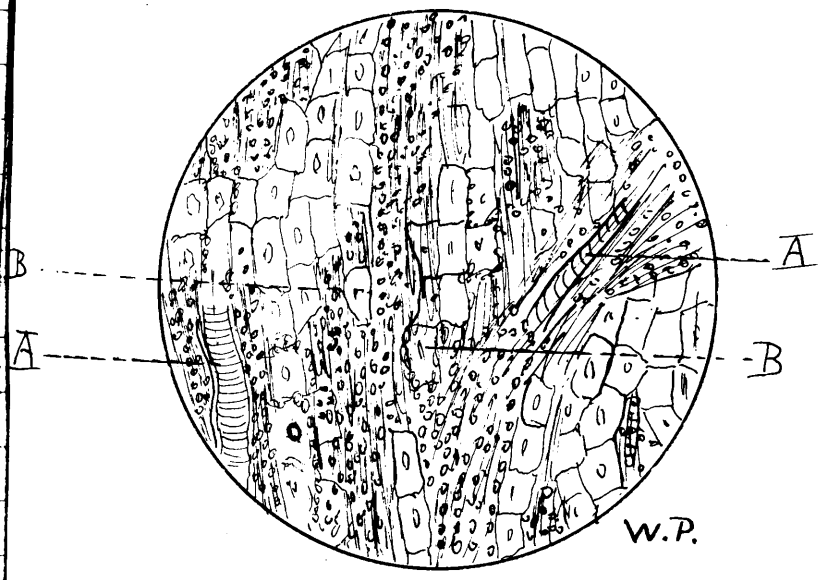
A. Round cells and connective tissue formation

B Central vein round cells seen in the connective tissue

Liver
G. the kidneys the liver also shows pathological changes although I have never noticed any direct symptoms of this during life. In rabbits poisoned by lead the organ is not altered to naked eye appearances, but microscopically the most striking appearance is the presence of round cells; these are most numerous round the vessels where there is an increase of connective tissue, which seems to increase the longer the animal lives. The round cells also appear between the rows of liver cells, even between individual cells, and as these go on to the formation of connective tissue the hepatic cells gradually shrink. The accompanying figures - Fig XI and XII - show the changes I have described.

These ~~pathological~~ changes in the kidneys and liver suggest

Fig XII.



× about 750

Section of the liver of a rabbit which died from lead poisoning (12 weeks)

A. Artery with connective tissue & round cells seen around it

B. Hepatic cell seen shrunken in the connective tissue. This is seen running between the cells & rows of cells.

suggest the connection between Plumbism Gout and Granular kidney.

In plumbism I am told that the kidney lesion is partly due to plugging of the efferent tubules of glomeruli by with carbonate of lead. this I have never been able to detect, lead ~~if~~ eliminated by the kidneys will not be as a carbonate, more likely it will be as a urate.

In the following table I have tried to show the similarity between these three diseases. In all there are grave nervous symptoms and dangers succeeding scanty secretion or suppression of urine. During an attack of Gout Dr Garrod has proved the presence of urate of Soda in the blood. In chronic granular kidney uric acid

uric acid in the blood causes convulsions. In plumbism encephalopathy may be caused by lead but far more commonly it is seen after kidney lesions & then is due possibly to uraties or other animal poisons, as in Gout & Granular Kidney.

In all, there is a somewhat marked resemblance to the kidney lesions.

In both plumbism and gout there is a special tendency to the formation of uric acid.

In London hospitals, where gout is not uncommon, if a few grains of Acetate of lead are given to a patient who has suffered from lead poisoning pains of a gouty nature follow.

Again the nervous symptoms in all three point to a toxic condition of the blood. Viz. thirst, headache, palpitation, restlessness, irritability, paralysis, and convulsions.

Table of Comparison.

Changes in the.	Contracted Granular Kidney	Plumbism	Gout
Vascular System	Enlarged or dilated heart heightened blood pressure Palpitation and syncope	Enlarged or dilated heart high blood pressure at first during colic gradually increasing in duration Palpitation & Syncope	Enlarged or dilated heart or both. Sometimes high blood pressure. Not- if the heart is dilated & failing Palpitation. Syncope & Angina Pectoris
Kidneys and Urine	Cirrhosis Arterial walls thickened connective tissue & round cells round them Urine abundant low S.G. little urea or sediment. Albumen intermittently present often scanty	Cirrhosis in most cases Arterial walls thickened connective tissue & round cells round them Urine often about normal in quantity .. Albumen often present absence of urates often	Cirrhosis Arterial walls thickened connective tissue & round cells round them Urine normal quantity or abundant low S.G.
during active seizure	Urine scanty or suppressed	Urine scanty or suppressed	Urine scanty or suppressed
liver	cirrhosis jaundice not marked	cirrhosis not seen	cirrhosis jaundice sometimes seen
lungs	Asthma. bronchitis pleurisy	not often seen	Asthma & bronchitis
Nervous Symptoms	vertigo headache paralysis & convulsions	headache paralysis convulsions & irritability	vertigo headache great irritability. paralysis & convulsions
Gastro Intestinal	dyspepsia gastralgia diarrhoea (but irregular) haemorrhoids	dyspepsia intestinal colic constipation	marked dyspepsia gastralgia irregularity of the bowels often constipation & haemorrhoids

Chapter IV

Elimination

This is carried on by the skin, the kidneys, and also I think the liver.

1. By the skin. Dr Pereira has found it in the sweat.
2. By the kidneys. After five days' administration of lead to rabbits I have found it in the urine. By its constant irritating action here the pathological conditions already described are here set up.
3. It has been found on post-mortem examination in the liver & the pathological changes in this organ in plumbism point to its presence there. Now as bile has a solvent effect (as previously shown) upon lead and is here secreted

secreted might we not expect that a certain amount would thus pass out of the system.

Chapter V

Concluding remarks -

We are fully aware that lead gradually undermines the strongest constitutions, and as such a useful metal must be required throughout all ages it behoves us to try and guard those who work with it from its dangerous influences, I have tried to show that by cleanliness & the use of ~~inhalators~~ respirators it has already been greatly ameliorated. Scientists are busy devising means by which manual labour will be greatly reduced and thus further diminish the risk of contamination.

Meanwhile

Meanwhile we must try and stop absorption, and if this does take place, then try and get rid of the poison as quickly as possible.