even in cases in which one suspects lead as the cause of the clinical picture a definite conclusion may only be arrived at after a careful consideration of all the facts if the source of poisoning is not detected.

Coincidences are sometimes remarkable. Two days ago, within an hour of writing the above lines, I saw at the hospital a man, aged 50, who had been under my care in June of last year with an anterior crural neuritis of undetermined etiology. The patient has now practically recovered, but the symptoms, as the notes showed, were anomalous. I recalled a remark of that great clinical master Sir William Gowers,¹⁴ who in writing of the diagnosis of lead poisoning says, "It is not possible to avoid error in such cases except by the habit of remembering lead as a possible cause in obscure cases." Was it possible that this man's symptoms had been caused by lead? Upon inquiry as to his occupation he informed me that he was a house painter, and, further, I found that while he was in hospital the house-physician had noted the presence of "a slight blue line round the gums." The teeth had since been extracted, and the line had consequently disappeared. Further, the patient stated that, although he had worked as a house painter for thirty-five years, he had never been troubled with abdominal pains, weakness in the hands, or, so far as he knew, any symptom of lead poisoning. The probabilities would, however, appear to be that this was the cause of his symptoms in view of their anomalous character and the absence of any other apparent etiological factor.

There is a natural tendency to associate symptom-complexes with individual diseases. Now while this is of undoubted value in furthering the general recognition of the disorders in question, it has its disadvantages. There can, for instance, be no question that the symptomatic triad—intention tremor, nystagmus, and scanning speech—emphasized by Charcot in disseminated sclerosis, was too restricted and retarded diagnosis in so far as it failed to include many cases which we now know to be due to the same pathological process. Similarly the three symptoms of lethargic encephalitis to which so much importance was originally attached—lethargy, febrile disturbance, and ocular palsies—concentrated attention upon one particular type of the disease. The same applies to the diagnosis of plumbism, for when we think of lead poisoning most of us, no doubt, at once recall the characteristic wrist-drop, whereas we are apt to forget that a variety of nervous symptoms may be so produced. There is an aphorism so familiar that it savours of a platitude—"More mistakes are made by not looking than by not knowing." Mistakes in the diagnosis of lead poisoning are often due to not expecting. My purpose will have been achieved if I have succeeded in impressing you with the importance of thinking of lead poisoning as a possibility in every case with which you meet which presents anomalous nervous symptoms.

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CUMULATIVE EFFECTS OF INFINITESIMAL DOSES OF LEAD*

BY

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There are two types of plumbism: one, the classical lead poisoning of the textbooks, caused by massive doses; the other, little known, a slow, subtle, insidious saturation of the system by infinitesimal doses of lead extending over a long period of time, and producing a group of symptoms altogether different from the recognized forms of plumbism.

In the type of plumbism to which I refer there is rarely colic, seldom a blue line on the gums, and wrist-drop will occur only if the significance of the early symptoms is not recognized. There is rarely noticeable anaemia. I cannot say if an examination of the blood would reveal any approach to the blood destruction characteristic of the grosser forms of lead poisoning.

SIGNS AND SYMPTOMS

A strange lethargy creeps over the sufferer; he feels as if a cloud had settled over him; he loses interest in life; everything is a trouble—a weariness of flesh and brain. He prefers to sit over the fire to tackling his work, though when he forces himself through his tasks he finds no diminution of brain or bodily power. As the condition continues he becomes gloomy and taciturn. Instead of joining in conversation with relatives and friends he sits silent and apathetic, as if overcome by thoughts too melancholy to utter. All his faculties and bodily powers are sluggish. His bowels are constipated and stubborn, he derives no satisfaction from his food, and has perhaps abdominal discomfort, which he puts down to indigestion. The strange lethargy of body and mind increases. Sleep brings welcome respite, but he gets up tired and weary, as if he had not been to bed, though he has slept heavily all night; so tired, indeed, that to bathe, wash, and dress are ordeals he wishes he could shirk. Breakfast bucks him up, but during the day, oppressed with a weariness of body and misery of mind, and unaccountably tired, he succumbs to his desire to sleep. In neurotic females emotional outbursts, with flatulency and abdominal pain, may punctuate the melancholy.

Apparently lead puts a brake on metabolic processes. The listlessness may be due to deficient renal excretion or to a check to thyroid secretion. The hebetude is not unlike that of myxoedema, and I am sanguine enough to think that lead will lessen thyroid activity. The old doctors were not afraid to administer lead to their patients. The still officinal pil. plumbi cum opio was their favourite prescription. It has passed into the limbo of forgotten remedies, but it is possible that it might prove an efficient weapon in the hyperthyroidism of Graves's disease.

The patient gets no sympathy from those about him. If his expression is saturnine, his complexion is fresh and healthy, he sleeps well, forces himself to do justice to his meals, and his relatives set him down as a gloomy person who will not take the trouble to be chatty and lively. He is usually the only person in the house to behave so strangely, for lead has a selective action, and the freedom of others from symptoms increases contempt for the sufferer. Perhaps he sees a doctor, who suggests change of air. He goes away, and in a few weeks returns home a different man, full of life and energy, with all the

* Read before the North Wales Branch of the British Medical Association.

cobwebs cleared from his brain. But he soon loses the benefit of the change of air. The old lethargy and weariness overcome him again.

This is no fancy picture. I have myself twice suffered from this group of symptoms. Thinking that my bodily and mental hebetude were due to lack of it, I dosed myself with thyroid. That did not make me any brighter. Then, remembering my experiences in Huddersfield, where a soft moorland water caused lead poisoning, I had my urine and the domestic water supply tested for lead. The analyst reported that my urine contained 8/19 of a grain of lead per gallon, and the domestic water supply 1/14 of a grain. With the stoppage of the lead I soon regained my usual energy and good spirits. On going, however, to live elsewhere, the same bodily weariness and mental lethargy crept over me. I had the urine again examined, and it was found to contain 4/25 of a grain of lead per gallon.

ILLUSTRATIVE CASES

During my first attack I had under my care a young lady who, when well, was remarkable for her brightness and activity. A mysterious change had come over her. She was gloomy, taciturn, and miserable, and took no interest in the things which had formerly given her pleasure. She had attacks of a hysterical character, refused food from the discomfort it gave her, and suffered much from flatulence. After some ineffective treatment I had her urine examined. It contained 4/7 or about half a grain of lead in each gallon, and the domestic water supply 1/14 of a grain per gallon. She went away from home, returned her bright, active, healthy self, and with the stoppage of the lead has had no return of her symptoms.

Another case was that of a young doctor who went to live in the South-West of England. When he had been there some time he began to lose energy, and was always weary. He attributed the symptoms to the enervating climate of the South Country. When I heard that the water supply was a soft water I suggested that he should have his urine tested for lead. He scoffed at my suggestion. I have never seen granular kidney as a result of this type of plumbism, but in men who drank to excess I have twice seen lead encephalopathy with unconsciousness and convulsions, and when lead poisoning was prevalent in Huddersfield there was an unusual number of cases of puerperal albuminuria and convulsions. Lead, by slowing bodily processes and hindering metabolism, accentuates the liability of the pregnant woman, with her overcharged system, to develop albuminuria and convulsions. When I heard that this doctor's wife had been laid aside by puerperal albuminuria I told him my Huddersfield experiences, and urged him to have his urine tested for lead. This he did, and the analyst reported that it contained 1/10 of a grain of lead per gallon. Three weeks after the stoppage of the lead he wrote: "I am glad to say that since installing the filter I am much better, not so lazy, but there is still room for improvement." Six months later he reported himself as free from any symptom of plumbism.

Alive now to the possibility that lead might be the cause of his patients' symptoms, this young doctor had the urine of eighteen of his patients tested. In seven no lead was found, in one there was copper, and in the other ten quantities of lead varying from 1/125 to 1/5 of a grain of lead per gallon. Those in whom the larger quantities of lead were found improved after the installation of a filter.

Another case is that of an elderly maiden lady. Her chief complaint was that she was always tired. I begged her to have the urine tested. It was found to contain 8/9 of a grain of lead per gallon. This patient has high blood pressure, reaching at times to 252 mm. Hg systolic and 124 mm. Hg diastolic, a condition which I believe to be exceptional in this form of plumbism. Every year she has gone away, and has had treatment at Harrogate or Ruthin, always returning feeling better. Recently she went to Cheltenham for a month, and though she had no medical treatment, she returned from there feeling better than she had done for years. But with the return to the plumbosolvent water, the old tired feelings set in again.

DIAGNOSIS

This type of plumbism is so little known that it may be overlooked. One patient, whom I sent from home in order to get her away from the lead, was told by a doctor she consulted that she had never had lead poisoning, although lead in quantity was found in both her urine and the domestic water supply, and another doctor told a patient with wrist-drop that the cause could not be lead poisoning, as there was no lead poisoning in the place, although I myself had seen several cases of the type I have described. The symptoms are so different from the plumbism of textbooks that the cause may not be suspected.

The diagnosis of this insidious form of plumbism must never be made from symptoms. If the medical attendant suspects that lead is the cause of his patient's malaise he must not reveal his suspicions until he has verified them. He should ask for a specimen of the patient's urine, saying he wishes to see if the kidneys are sound. If on examination the urine is found free from lead and is otherwise healthy, the doctor has not compromised himself by a premature and mistaken opinion. Not until he has found lead in the urine should he question the purity of the water supply.

The problem is not easier because the symptoms can arise from other causes. When I lived at Criccieth I had an overpowering desire to sleep during the day, although I slept all night. An examination of my urine showed that it contained no lead, and the drinking water a fraction of lead too small to be harmful. My somnolence was due to septic teeth and tonsils. Suspicion should be aroused if a patient, whose water supply is soft, improves on being sent away, only to revert to his misery on returning home.

Nor must one forget that a patient who passes lead in the urine can be attacked by other disorders. A good many years ago I saw a man with symptoms pointing to overpowering of the nervous system, but not sufficiently distinctive to implicate brain or spinal cord. The late Sir Clifford Allbutt saw the patient with me, and, hearing that lead had been found in the man's urine and domestic water supply, agreed that lead was the probable cause of the man's condition. Signs of intracranial pressure came on later, with a slowly progressive right hemiplegia, and the man lapsed into the unconsciousness characteristic of cerebral tumour. I began intensive mercurial medication in the form of hypodermic injections of perchloride of mercury, and the man made a good recovery, with some loss of power in the arm and leg. It transpired that he had had syphilis.

It is impossible for one who is not a skilled analyst to test urine for lead. A few ounces should be sent to a competent analyst. Lead in the urine is a proof that it is in the patient's system. The quantity expelled by the kidneys is no indication of the amount of lead floating round the patient's system. It represents only the surplus percolating through the kidneys. It is the soft waters, especially those from peaty moorlands, which dissolve the lead of the service pipes, and so small is the quantity taken up that it may be years before symptoms arise. Before my attacks I had consumed the lead-laden water for at least six years. The young lady I mentioned had taken the same water for years. The young doctor did not complain for some years, and the elderly lady had been consuming lead-contaminated water for some years before her symptoms made me suspect the presence of the poison. Long-continued ingestion of the poison, in persons susceptible to its action, becomes in time the equivalent of a toxic dose. The presence of only one sufferer in a house is but an exemplification of lead's selective action, or of the inability of the sufferer's eliminatory organs to get rid of the poison.

MATERNAL MORTALITY AND LEAD

Important as are the effects of small doses of lead on health, they acquire added gravity as a possible factor in the causation of maternal mortality. The Registrar-General divides deaths in childbed into two groups: those from puerperal fever, and those due to "eclampsia and other accidents and diseases." Taking the country as a whole, puerperal fever is the most frequent cause of maternal deaths. In places supplied with soft moorland water the position is reversed. There, eclampsia and other accidents and diseases outnumber the deaths from puerperal fever, in some places by more than three times. In an appendix to her report on maternal mortality, Dame Janet Campbell gives the death rates of the Registrar-General's two groups for the four years 1919-22. During those four years the fewest maternal deaths from eclampsia and other accidents and diseases occurred in London, where they were 1.62 per 1,000 births. The London water, drawn largely from chalk-bearing strata, does not dissolve lead. In Dewsbury, Halifax, Huddersfield, Rochdale, and the county of Breconshire, supplied with plumbo-solvent water, the maternal mortality from the same causes was over 5 per 1,000 births, or more than three times that of London, while in Westmorland, Anglesey, Carmarthenshire, Caernarvonshire, Merionethshire, and Radnorshire, it was over 4 per 1,000 births, or about three times that of London. In the county of Westmorland, while there were three maternal deaths from puerperal fever, there were ten from eclampsia. The high maternal death rate from eclampsia and other accidents and diseases occurs where there is soft plumbo-solvent water. The main responsibility for this high death rate rests on eclampsia.

There must be some reason for the disparity between the figures for London and the places I have quoted. Other accidents and diseases of childbed cannot be more frequent in the places I have named than in London. The disparity is greater than the figures indicate, for the London figures are swelled by the cases of eclampsia which occur there. We know that lead is eliminated by the kidneys, and though I can produce no analyses of either blood or urinary urea, the sluggishness and somnolence I have described are not unlike the defective kidney action of Bright's disease. In its grosser forms of poisoning lead damages the kidneys, and more than one of my patients suffering from the subtle form of plumbism have had the nephralgia characteristic of the passage of gravel through the urinary organs.

Next to septicaemia eclampsia is the highest factor in maternal mortality. Knowing the symptoms which I have felt in my own person and observed in my patients, and remembering the frequency of eclampsia when subtle lead poisoning was prevalent in Huddersfield, the high mortality from eclampsia and other accidents and diseases of pregnancy in places supplied with plumbo-solvent water suggests that the continuous ingestion of minute quantities of lead may be the explanation of an otherwise unaccountable mortality. Though the quantity of lead imbibed may be small, it may be enough to turn the scale and precipitate the occurrence of eclampsia in a pregnant woman on the verge of toxæmia. If the conclusions I draw from the figures I have quoted are well founded—and they are confirmed by an examination of the death rates in other places too numerous for mention here—we have, ready to our hands, one means of reducing a great cause of the baffling problem of maternal mortality.

The remedy is simple—to stop the ingestion of lead. This can be done by sending the patient away from the lead, by substituting pipes lined with block tin for the lead pipes, or by passing every drop of water used in the preparation of food or for drinking purposes through a

filter with a charcoal filtering bed. The so-called tin-washed pipes are not a protection, and only a filter with a charcoal filtering medium can be trusted to remove lead from a plumbo-solvent water.

Water supplies contain organic matter derived from the soil of the gathering ground, sometimes sufficient to discolour the water. In moorland waters there is an acid derived from the peat. The lead dissolved is not a simple inorganic salt, but a complex organic compound. It is by its affinity for organic substances that lead injures the body and destroys the embryo in utero. Charcoal, as we know from its effects in fermentative disorders of the digestive tract, attacks organic matter. In a carbon filter the fraction of organic lead in the water is acted upon by a mass of carbon compared with which a dose of charcoal by the mouth is insignificant. After from six to twelve months, according to the use it has had, the charcoal is not a reliable remover of the lead, and a fresh charge should be put into the filter.

No medicinal treatment is necessary to expel lead from the body. If the ingestion of lead is stopped and the eliminatory organs are active, the body will get rid of it. If iodides liberate lead from the tissues, the extra lead set free will aggravate the patient's symptoms.

SOME NEGLECTED SYMPTOMS IN ACUTE ABDOMINAL DISEASE*

BY

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Abdominal disease, whether acute or chronic, is diagnosed by considering three groups of observations. In the first place, local anatomical changes are detected by inspecting with the eyes or *x* rays, feeling with the fingers, or even by listening with the stethoscope; secondly, perversions of physiological function are deduced from certain symptoms indicative of visceral derangement or by carrying out certain tests which betray pathological changes in the abdominal organs; thirdly, when the disease is serious and is influencing the whole organism, note is taken of the great bodily systems, especially the circulatory, respiratory, metabolic, and excretory systems.

In chronic abdominal disease the slowness of the process allows time for compensation to occur; the slight physiological changes are masked or neglected until gross anatomical alterations may attract the attention of the observer, or the general bodily depreciation may be obvious to the patient and his friends. In acute abdominal disease physiological derangement plays a much greater part; rapid changes due to violent stimuli delivered without warning are the rule, and the need for immediate compensation of the vital systems is all too frequently unsatisfied; while gross anatomical changes either are absent or appear only at a comparatively late stage in the course of the illness. Unless these facts are appreciated diagnosis becomes haphazard and unscientific.

SIGNS AND SYMPTOMS OF SHOCK

It is well, therefore, to consider in the first place that symptom which is fairly common but still misinterpreted and ill-understood—that is, shock. When a sudden internal haemorrhage occurs, or when a very violent visceral stimulus is applied, the direct or reflex disturbance of the circulation leads to that clinical picture which is generally known as shock—cold extremities, subnormal temperature, pallor, sweating, a rapid and small pulse, and a lowered blood pressure. With a person who has been in

* An address to the Norwich Division of the British Medical Association.