Inaugural Dissertation
on
Plumbism
by
Joseph Law, Anglus.
On Plumbism.

This thesis, thoroughly practical in its character, is designed to be an unambitious epitome of a few facts on an important subject, which have fallen under the writer's own observation in Sheffield, his native town. It boasts of no ingenious theory, of no brilliant discovery; and the hope that it may be indulgently received, is founded on the carefulness with which its facts have been observed, and on the fidelity with which they are now, though with much diffidence, presented to the medical faculty of this University.

In criminal jurisprudence lead holds a very humble position. Seldom is the physician subpoenaed to display, from the dreaded witness-box, his knowledge or his ignorance of the properties of this metal; and rarely is the eloquent and ingenious barrister indebted to it for a fee. It is immeasurably inferior, so far, to arsenic; but in medical practice, lead takes the precedence of all other metals, and has received the highest honours both from systematic and monographical writers. Among these writers, it is impossible not to acknowledge Prof. Christie's right to the highest place, for his conclusive demonstration of the precise protection given, under different circumstances, to leaden vessels holding water, by minute quantities of calcium, especially by sulphates and phosphates.
On the advice of Mr. Haywood, an experienced professional
chemist, the Sheffield Water Company, taking advantage of
Prof. Christie's discovery, have thrown gypsum into the
open culverts along which the water flows before it reaches
the leaden pipes. Mr. Haywood informed me some time
ago, that the gypsum had not had sufficient time to give a
protective coating of insoluble sulphate to the lead; and
he regretted that, although he had the fullest confidence in
the plan, yet as the water company had half-way neglected
his instructions, he could hardly expect it to be successful.

About fourteen orders of artisans are obnoxious to
the pathogenic effects of lead; but two are omitted from
every list which I have seen: secretors of razors and file-
cutters, in any work on toxicology or medical jurisprudence.
The former employs lead to keep the scales of a cheap description
of razor sufficiently apart to give space for the blade; and in
days, two or three pounds of lead pass through the hands
of one workman. The latter make a very different use of the
metal to be explained presently.

I have not been long acquainted with the fact that
secretors of razors employ lead; and I am not yet quite sure
that they suffer at all from its injurious effects. If they do
not so suffer, it might be very instructive to know the
circumstances to which they may be indebted for their
protection. A supposed case of lead-palsy in one of their
artizans
artigans, came recently under my notice. The patient, eighteen years of age, tall and emaciated, presented no symptoms referable either to the thoracic or abdominal organs. His gums were in a perfectly normal condition, his complexion clear, he had never had a symptom of colic, and the paralysis steadily progressed long after the patient's removal from its supposed cause. The idea of plumbism was irreconcilable with these facts, and a local cause of the paralysis soon became manifest. The paralysis, limited at first to the superior extremities, became general, the patient fell into a hectic fever, the head inclined every day more and more to the left shoulder and could not be elicited from this position; a prominence appeared in the posterior cervical region, and after several days of comatose insensibility, the symptoms terminated in death. On a dissected cadaveric, I found in the spinal canal, corresponding with the third and fourth cervical vertebrae, and also in front of the dislocated bodies of these vertebrae, a mafic of tubercular trudation; the spinal dura mater elevated and some pus within the spinal arachnoïd. The most careful examination failed to detect this trudation in any other part of the body, except two or three minute tubercles in the left kidney. The first opinion, which described the paralysis to lead, was erroneous; but the case it not by its circumstances on that account. It will have the effect of directing my attention to setters-in of razors, who, although they are constantly handling...
handling lead, are not certainly known to suffer any of its injurious consequences. It is difficult to believe in the immunity of these people. Inquiry may show that they are unwilling to tell the truth, or to relinquish a faith held by them from time immemorial, and which reconciles them to the means by which their daily bread is earned.

As the lead-mills of Sheffield resemble those of other localities, I shall make only a few immethodical remarks, arising out of more than a hundred cases, on the way in which the workpeople of these mills suffer, and on the treatment from which they derive the greatest benefit. A large dog confined in the courtyard of these mills, never lived for a longer period than twelve months. Precautions are taken to prevent the dog from taking lead into his mouth, and although no one can say that these precautions are successful, yet the atmosphere is clearly the principal vehicle by which the lead is carried into the system of the animal. This fact is mentioned in order to give some idea of the condition of the atmosphere. Men and women are employed in these mills, and there is a constant change of hands. The more fortunate continue at the employment, often purely free from the severe effects of lead, for ten or even twenty years; but, on the other hand, those who have repeated attacks of Colica Pictorum within a few months, are generally discharged. Removed altogether from the leaden atmosphere, their

health
health rapidly improves, especially if they live well and soberly. All the workpeople have a languid circulation, and a dull complexion more or less characteristic of slow lead-poisoning. A grey-blue line exists on the free margins of the gums of all their people, male and female, and it becomes visible as early as the second or third week. This line appears to be due to the action of the metal upon the sulphur of the decomposing albuminous tissues. I do not know why this deposit, like nitrate of silver, prefers the gums to other equally vascular tissues. This exposed situation does not explain this preference. But lead is, to some extent at least, deposited in various organs. Prof. Christian and also the German physiologist, Würner, have detected lead in the muscles, the latter also in the spinal marrow, of animals poisoned with the metal. These affirmative experiments are quite conclusive, and cannot be shaken by the negative results obtained by Schloffer, Baruel, and Michat. If convincing testimony were necessary, we have it in the interesting paper of Dr. George Wilson, published in the Monthly Journal of Medical Science for May, 1852, and also in Dr. Smith's report on epidemic colic in Ceylon, published in the Monthly Journal of Medical Science for March 1853. Dr. Wilson most unequivocally detected lead in almost every viscera of the horse, while Dr. Smith saw in the human stomach...
Stomach, appearances exactly similar to the line, which existed on the gums. Dr. Smith thinks the colour of this line is a greyish black; to my eye, it resembles the neutral grey-blue of dirty suds. In Sheffield, it is always more strongly marked on the lower than on the upper gums; it is most conspicuous, and makes its appearance first, opposite the lower incisors, not, as in Dr. Smith's case, opposite the first upper molars. The gums present irregular, almost ragged, margins, as if their substance were being absorbed, and they show a tendency to separate from the teeth.

In the Sheffield lead-works, Colica Pictorum is much more frequent than paralysis, or any other cerebro-spinal affliction. Paralysis, indeed, seldom occurs in those who come early under medical treatment: there has been only one case during the last three years. Head-symptoms are very apt to supervene in the last illness of the old workpeople. The women are affected sooner, but they suffer less than the men. The early accession of intestinal irritation in the women, is partly owing, perhaps, to their diet being less wholesome, and containing more trash, than that of the men; and from a similar cause, may arise the fact that young persons suffer more from colic than their elders. The uterine function is invariably deranged,
The catarrh was being suffered generally, indeed always, in those who continued long at the employment. Attacks of colic are sure to take place, whenever any operation causing more dust than usual, is going on at the mills; and damp weather also increase the number of cases. The symptoms, similar in all, are, principally depression of spirits, constipation, loss of appetite, irritability of the stomach, sometimes vomiting, partial repletion of urine, and finally irritation of the abdomen and umbilicus.

The workpeople show no special liability to disorders unconnected with lead. For several years, there has been only one death from disease of the lungs, and this was an ordinary case of pulmonary tuberculosiis with hemoptysis. Now and then there is a case of violent elevation of all the voluntary muscles, which may or may not arise from lead. Medical attendance is provided by the proprietors of the works, who require their servants to seek it early, and to observe the strictest cleanliness. As a prophylactic, but without any good result, a minute quantity of sulphuric acid has been added to the water which the workpeople ordinarily drink.

With respect to the treatment of the colic—peroxide in the workpeople of the Sheffield lead works, the
most useful drug is opium. Opium is, indeed, the best purgative. The patient is relieved as soon as he is brought fairly under its influence; and divine evacuations usually follow. I believe that opium purges by removing the immediate cause of the paroxysm—irregular and spasmodic action of the muscular apparatus of the intestines. Copious streams of warm gruel assist the opium. To complete the cure, it is necessary to attend to the bowels, diet and exercise. I have witnessed the worst consequences from a dogged perseverance in the administration of purgatives and tasters emetic, as practised at L'Hôpital de la Charité. Vomiscition has been found injurious, and no good has been derived from bleed. A strong woman, for example, who had worked only a few months in the mill, had a violent attack of colic. She was bled to thirteen ounces, and instantly became half comatose, and continued so for six hours. For several weeks afterwards there was considerable mental excitement, in fact temporary insanity, from which she slowly recovered. Again, a robust man, being attacked in a similar way, received similar treatment. Excitement so outrageous occurred as to render handcuffs necessary. He recovered at the end of several months. These symptoms never occur under the opium treatment. I am aware
that Prof. Christian has seen good effects from vaccination. Probably the Sheffield cases may be in some respects different from those which came under the observation of Prof. Christian.

File-cutters. The file cutters of Sheffield are 3100 in number. They are self-organized into what is called a "union"; and the general and pecuniary affairs of the union, are managed by two secretaries, a committee and general meetings of the members of the union. The weekly contributions of the members have accumulated into a considerable fund, from which the permanently disabled, the sick, those who cannot get work, and those whom the union will not allow to work on the terms offered by the masters, derive the means of living. This union serves also the purposes of a burial club. The raising of a fund for these purposes, by an order of artizans whose means are not too ample, shows that they profess a fair amount of self-denying prudence. If the union did not occasionally act arbitrarily towards the masters and also towards its own members, it might be considered an unusual and exceptional arrangement of the trade to meet the difficulties inseparable from their humble position, and to counteract the many causes which concur to reduce wages. From what is said
it follows that these people can seldom be without food; and from all I have seen and heard, I infer that they are tolerably sober and moral.

The workshops of the file-cutter is low, well lighted, and without any special contrivance for the purpose, fairly well ventilated by means of the door, chimney, and broken panes. They sit very near each other, and to the windows, a good light being indispensable. A heavy wooden block standing on the floor, supports an anvil on which a piece of lead is placed, and finally the file is closely connected with the piece of lead. The size of the lead is adapted to that of the file. The workman holds a chisel in his left hand and a hammer in his right, and the file is cut every time he strikes the chisel with the hammer. The lead is used to steady the file, and to absorb the "jaz", which would be painful, especially to the chisel hand, if some yielding inelastic substance were not interposed between the anvil and file. Now, at every stroke of the hammer, a dark-grey dust rises from between the lead and anvil. This dust I have found to contain a mixture of protoxide of lead with the metal. Insolled the metal out of the dust and then subjected the residue to the action of acetic acid, and filtered the solution, in which characteristic precipitates were given 1. by chromate of potash, 2. by sulphured hydrogen, 3. by sulphuric acid.
acid and 4. by Sodica of Potashum. The metal, which was melted out of the dust, was dissolved in Nitric acid; and from this solution, Sulphate of Lead was thrown down by Sulfuric acids. To ascertain whether there was any lead in the general atmosphere of the workshops, I placed a glass dish containing distilled vinegar in a corner near the floor. At the end of a week, I filtered the vinegar, which had become dirty, and obtained a solution, which manifested the usual reactions of a salt of lead, on the addition of the asphyxiate tests. We know that lead brought by a particular process into a state of inconceivably minute subdivision, burns when thrown into the atmosphere, producing intense heat and bright light. How the dust, which visibly follows every stroke of the file-cutter's hammer, may contain clean and very fine particles of lead, which are oxidized the instant they touch the atmosphere. The file-cutter sits on a stool nearly as high as his anvil, in order that he may bend over, and his head overhang his work - a position precisely adapted for rendering him obnoxious to the poisonous dust, which is constantly being detangled.

From a body of statistical facts, which I derived from one of their secretaries, it appears that file-
cutters are old at 45, and that, when I made my inquiry, there were only two in the union about 60 years of age, and only one about 70. The secretary, a very intelligent member of the trade, who for years has been solely occupied with the duties of his secretarialship, was unable to believe that this melancholy state of things was at all due to lead. Time out of mind, in Sheffield and other places, has the process of file-cutting above described, been carried on. Our instinctive confidence in the unchangeableness of the creator's laws, compels us to believe that lead has, all this time, probably without our exciting suspicion in our human breast, been viciously undermining its health and abbreviating the lives of thousands of human beings. The cadaverous face and grey-blue gum were all this time disregarded or unnoticed, while the "dropping" wrist, and the occasional colic were supposed results from general and undefined causes. Even now the incredulous file-cutter smiles when lead is spoken of as the cause of his premature decay; and many medical men, who have not looked into the matter, join in the file-cutter's laugh. The grey-blue line on the margin of the gum, which three years ago recited my wonder, is seen in nearly all file-cutters, of forty
for thirty workmen, whom I inspected in one manufactory, it was absent only in two. Its distinctness bore some, but certainly no very definite, relation either to age, to the length of the time the individual had been employed at the trade, or to the presence or absence of other indications of plumblism. This line existed in a boy, who had worked only six weeks, and who had not had any other symptom; and was absent in a man, who had been five years at work, and whose left thumb had "dropped." But the cutters of large files and rasps, who raise most dust, have usually the intensest blue line; so that by merely looking at the gums, one can, with more or less confidence, not only tell a man that he cuts files, but whether he cuts large or small files. It may be useful to conjure the fact now stated, with the following observation from Dr Smith's report already referred to. "It may be interesting to mention," says Dr Smith, "as perhaps tending to throw some light on the origin of the dark line in the gums, that, in the only three cases under any notice, in which the toothbrush was regularly used, there was no trace of a dark mark in the gums, although the symptoms of colic could not be omitted: and that I fancied I could trace a distinct relation between the quantity of "tartar" on the teeth and the intensity of
the marking in the gums. These observations point to the possibility that the lens may be produced by the direct local application of lead to the gums. While I cannot deny this possibility, I am reminded that the acetate of lead, given in the form of pill, when there can hardly be a direct application of the salt of lead to the gums, is capable of producing the grey-blue lens, in two or three weeks. Colic is much less common in file-cutter's than partial paralysis; while at the lead works, colic is common and paralysis rare. Lead is introduced slowly into the system of the file-cutter: at the lead works, although the presence of the poison is acknowledged and precautions are taken, the workmen are brought rapidly under its influence. The difference in the action of the lead upon the two orders of artisans, may be partly due to the different chemical forms of it, to which they are respectively subjected. I have shown that the file-cutter encounters the protoxide—the compound, which, after cupellation, receives the name of litharge. At the smelt it is encountered in various forms, chiefly as white lead, or white carbonate of lead—the most poisonous, according to Dr. Thompson, of all the salts of lead, though I believe Prof. Christian agrees with Wibman, in regarding the diacetate as perhaps the most energetic poison among the salts of lead.
and in attributing its corrosive action to some affinity existing between the animal principles and the result of oxides in the diestals. The observations, however, of our best authors on the comparative poisonous energy of the salts of lead, are founded chiefly on cases of acute lead-poisoning, and might be inapplicable to chronic cases, in which the lead finds its way into the system by the common integuments and chiefly by the lungs. On this point I am unable to make any confident statement, never having a case of acute lead-poisoning; but it is remarkable that in painters, who use chiefly the carbonate of lead, I have several times witnessed colic, but never paralysis.

The colic paroxysms in the file-cutter is, in general, easily relieved with opium, fomentations and warm quail stimulants. The "dropping" of the thumb or wrist yields much relief; but is frequently cured by blisters, Linimentum Simplicis, electro-conversion and passive exercise of the affected muscles. I have never seen any good result from splints, though they have been fairly tried; and I cannot commend the use of Sulphates with the view of converting the lead, present in the tissues of the patient, into an insoluble Sulphate. Some of the foregoing means, or all of them in the progress of a long case, timely and properly employed, are generally successful. But the file-cutter is not always willing to follow for any length of time advice founded on the belief that he is suffering
lead, and he returns, in many instances, too soon to the workshop. The knowledge that when disabled, he can betake himself to the union fund, may tend to foster this indifference, though there can be no doubt that very file-cutter would prefer health and work to disease idleness and dependence. The "dropping" or "falling" takes place indifferently in the wrist of the chief and in the wrist of the hammer hand. The file-cutter's belief in the paralyzing consequences of the inexpressant "jar", it by no means absurd. The "jar" which follows a false stroke of the hammer, is very painful. I have seen incomplete paralysis of the wrist of a "striker", this man who apart the "maker" in forging any kind of cutlery. The "striker" swings a large two-handled hammer over his shoulder when he strikes; the "maker", who models the heated steel into the necessary form, uses a much smaller one hand hammer. Still paralysis is very rare in the "striker".

Perhaps the "jar" and lead together produce the paralysis. No opinion on this point can affect the conclusion which I aim to establish, viz. that the process of file cutting as at present practised, exposes the workers to the slow poisonous action of lead, producing premature decay and death.

If then this serious evil be traced to a bit of lead interposed between the anvil and file, may not
innocent substances be substituted for the noxious metal? May not water or oil prevent the disengaged metallic particles from getting into the atmosphere? I do not know. The prejudice of the man must first be diminished. I persuaded one, whom I had converted to my belief, to make a fair trial of gutta percha: he found it too changeable with temperature and too plastic. The discovery of a suitable substance will probably take place in the workshop. The intelligent file-cutter can easily try every method which presents itself to his mind. The use of lead can hardly survive the strange prejudice which at present exist in the minds of file cutters, and a few years may happily remove those prejudices. In the meantime the poison must do its work.

I have been intentionally silent on the morbid anatomical conditions produced by lead, because I have never seen any which I could confidently attribute to that metal. In Smith's case, already referred to, were acute, he found the ilium contracted in all and intermuscles in some; some dark discoloration and raw ulceration of the stomach; and on the brain the appearance "of a remarkable development of the glandulae Pacchioni". I believe it is much more usual to find the colon contracted than the ilium and still more usual to find no appearances at all.
It would afford me the sincerest satisfaction to witness the expulsion of a slow but sure progress from the workshop of the useful file-cutter, where, disregarded and untold, it has been lurking too long. This happy event would save hundreds from the sorrows of early widowhood and orphanage. My desire to be the humble instrument of this desirable achievement has induced me to give some attention to the subject. I submit the result of my imperfect inquiries to the Medical Faculty of this University in the form of a thesis, which I trust may be judged indulgently for the sake of the motion by which I have been stimulated.