very closely allied to, if not identical with, the purposive experimental hypnosis."

The diagnosis in these cases may be difficult. To quote again from Osler: "A condition of fright and excitement following an accident may persist for days or even weeks, and then gradually pass away. The symptoms of neurasthenia or hysteria which subsequently develop present nothing peculiar, and are identical with those which occur under other circumstances. It may require a careful study of the case to determine whether the individual is honestly suffering from the symptoms of which he complains." A still more important question is, Has the patient organic disease? The symptoms given under the first two groups of cases (those with simple neurasthenia and those with marked hysterical symptoms), may exist in a marked degree, and may persist for several years without the slightest evidence of organic disease.

"In regard to prognosis, it may be said that a majority of patients with traumatic hysteria recover. Patients have recovered after the persistence of the most aggravated symptoms, with complete disability of several years' duration. In extremely rare cases organic diseases may develop."

While we call these cases hysterical or functional for want of better terms, they are often very serious in the impairment which they cause, and very intractable when there is no suspicion whatever of malingering or intentional exaggeration.

ON THE OCCURRENCE OF LEAD IN CITY DRINKING-WATERS.¹

BY WILLIAM B. HILLS, M.D.,
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In October, 1889, Dr. E. M. Greene read a paper before the Boston Society for Medical Observation, in which he presented the results of an investigation which had recently been made by him relative to the occurrence of lead in Boston drinking-water. Sixteen examinations were made of water taken from different parts of the city and coming from Lake Cochituate. The service pipes were in all cases of lead. Fourteen of the specimens examined contained lead. In three of the fourteen cases the water had stood in the pipes for various intervals, namely, fifteen minutes, thirty minutes, and two days; in the latter case, practically for several weeks. The remaining eleven specimens were taken after the water had been allowed to run from two to thirty minutes.²

Dr. Greene was not, however, the first to investigate this subject. The presence of lead in the water supplied to Boston through lead pipes had already been pointed out, several years before, by the late Prof. Wm. Ripley Nichols, who states that such water always contains traces of lead in solution. The amount of lead taken up by the water of Lake Cochituate in passing through some 150 feet of pipe, which had been in use for some years, was found to be only 0.03 part in 100,000, or less than 0.02 grain in the U. S. gallon. Water which is allowed to remain in the pipe for some time, or is drawn from the hot water faucets, may, however, contain as much as 0.1 or even 0.2 part in 100,000, or 0.06 to 0.12 grain in the gallon.

As a result of his investigations, Professor Nichols

came to the conclusion that the use of lead pipes for house distribution in connection with a public supply, is, as a rule, unattended with danger. The pipes soon become covered with a coating of lead compounds which is practically insoluble. After the formation of this coating, the action on the lead practically ceases, provided the pipes are kept constantly filled so as to prevent exposure to the alternate action of air and water. He expressed the opinion, however, that it probably never ceases absolutely.³

While, therefore, Dr. Greene's results were not new from a qualitative point of view, quantitatively they were important, in that they directed attention to dangers the existence of which had hitherto appeared improbable. One of the specimens examined by him, taken after running two minutes, contained nearly one grain of lead to the gallon; a second specimen, drawn after running five minutes, contained nearly one-half a grain to the gallon. These figures are far above those obtained by Nichols, and exceed any which have been suggested as an outside limit of safety. In point of fact, Dr. Greene's investigations were suggested by the occurrence of several cases of lead poisoning in the families occupying the houses from which these samples came.

It is not stated whether the specimens examined were filtered or unfiltered. It is hardly conceivable, however, that water taken under the conditions given by Dr. Greene could have contained such an amount of lead in solution. Presumably the lead was present, in large part, in the form of insoluble compounds held in suspension. One obvious source of such compounds is the insoluble coating which may be presumed to exist on the interior of the lead pipe. There is, however, one other possible source which was brought to my notice in the course of an investigation of this subject which was undertaken in 1890, and carried on in a desultory manner till about a year ago. During this period I examined nine specimens of city waters for lead—three taken from a house in Boston, six from my own house in Cambridge. Two of the Cambridge samples had stood in the pipe over night; the remaining four samples were taken after the water had been allowed to run from two to five minutes. The Boston samples came from a house on Commonwealth Avenue. The occupant, a physician, died soon after the analyses were made, and before I had an opportunity to inquire concerning the conditions under which the samples were taken. Lead was present in all the samples examined. The water examined was in all cases unfiltered; the analyses were qualitative. While the number of analyses is small, the results, so far as they go, confirm those previously obtained by others, and in connection with the latter justify the statement that lead in minute quantity is a common constituent of the drinking-water as supplied in cities.

It has been my intention to make quantitative estimations in filtered and unfiltered specimens of water; but this work has been prevented thus far by other duties. In the meanwhile my attention has been directed to the occurrence, at times, in water drawn through a galvanized-iron pipe in my laboratory at the Medical School, of solid particles which were found upon analysis to be red lead. A single analysis of filtered water drawn through the same pipe showed the presence of a trace of lead in solution. Upon inquiry I have

¹ Read before the Cambridge Society for Medical Improvement.

² Boston Med. and Surg. Jour., cxxi, page 533.

³ Report of the Massachusetts State Board of Health, 1871, page 32, and Water-Supply, pages 212-214.

learned the following facts, the presentation of which is the main object of this paper:

Red lead is used very generally by plumbers, steam-fitters, and gas-fitters in coupling iron and brass pipes. In the process of coupling, the lead is usually applied to the thread upon the inside of the couple. When the pipe is fitted to the couple, the surplus lead, comprising in fact the greater part of that applied to the thread, is forced forward and into the pipe through which the water, steam or gas flows. Wherever there is a couple, therefore, the water is usually in direct contact with the red lead, as the exhibits show. I have seen pipes which were almost closed by an overhanging curtain of red lead; and I know of one instance in which the flow of gas was prevented by a similar curtain.

The number of couples in a house that is fitted with galvanized iron or brass pipes for the conduction of water depends upon the length of the pipe, the number of faucets, and the number of bends in the pipe. Galvanized iron and brass pipes cannot be bent as lead pipes are; changes in direction are therefore effected by the use of couples technically called "L's" and "T's." It is not customary to employ iron or brass pipes throughout the house. Brass pipes are used, however, for the conduction of hot water; and there is a practice in vogue in some cities of using galvanized-iron pipes in part in the place of lead pipe for the conduction of cold water. In such cases the water is conducted from the street into the cellar of the house through galvanized-iron pipes and the lead pipe is connected in the cellar. The water drawn on the first floor of the house flows, therefore, through but a few feet of lead pipe. This practice has been followed to some extent certainly in this city.

Probably the facts I have presented afford a partial explanation of the presence in city waters of such large quantities of lead as were detected by Dr. Greene. For red lead, although a so-called insoluble compound, is probably not absolutely insoluble. Moreover, it frequently contains more or less lead monoxide, which is more soluble than the red lead. The friability of red lead furnishes an additional opportunity for contamination with minute particles worn off by the water as it passes through the pipe. It is in fact preferred to white lead by plumbers on account of its friability; for white lead sets to a comparatively firm mass which offers considerable opposition to the separation of the pipes when repairs are necessary. For this reason white lead, if properly applied, is perhaps preferable to red lead from a sanitary point of view. Asphalt is preferable to either.

The possibility of lead-poisoning as a result of coupling pipes with red lead and white lead was long ago pointed out. I am not aware that the method of applying the lead compounds has received any attention. I have therefore ventured to call attention to it, since the particular method of application which is in vogue must certainly increase the opportunities for the contamination of our water-supplies, and for the absorption of lead into the system. It is possible that our city waters are more frequent sources of chronic lead-poisoning than we have suspected.

Much of the danger attendant upon the use of lead compounds for coupling pipes may be avoided by applying the lead compound to the thread on the outside of the pipe instead of to the thread of the couple. Then, when the coupling is effected, the sur-

plus lead compound is forced backward on to the outside of the pipe instead of forward into the interior. The process may with a little care be so conducted that little or no lead is exposed to the action of the water. I am informed, however, by an engineer to whom I am indebted for the facts herein presented relative to the coupling of pipes, that, so far as his observations extend, probably ninety per cent. of all plumbers, steam-fitters and gas-fitters apply the lead compound in the manner first described, that is, to the thread of the couple.

DISCUSSION.

Dr. DRIVER had occasion to examine a lead pipe, used to conduct drinking-water from a well, which opened into the well over a large stone. Near the opening the pipe was bent at a sharp angle, and inspection showed the pipe at this point was worn as thin as paper by the continued friction and impact of the water and substances held in suspension. He thought it would be well to inspect all curves in lead water-pipe for the purpose of determining what is the general effect of the water current in wearing down the pipe, and how far this may be a source of lead in the water-supply.

Dr. A. P. CLARKE asked if galvanized-iron pipe was objectionable for conducting water-supplies.

Dr. HILLS said the only objection was that of its rusting. As long as the zinc coating remains intact this will not occur; but as soon as the water gains access to the iron then rusting goes on rapidly.

Dr. H. MARION asked if it would not be advisable to notify the plumbers' association of the facts brought out by the paper of the evening.

Dr. HILLS said that when the engineer of the Harvard Medical School informed some plumbers who were busy doing a job of iron piping of the dangers involved in the method they were employing for fitting the joints, he was cursed and told to mind his own business.

Dr. MARCY asked about the process of japanning and its application to water-pipe, and the value of block-tin pipe.

Dr. HILLS thought the base material used in japanning was asphalt. Block tin is used somewhat for water-pipes, and it is the best material; but there is danger of getting a lead pipe lined with tin, in which case, if the coating is imperfect, the lead is easily acted on by the water. A similar combination was found in Dr. Bowditch's house where the pipe, supposed to be tin, was found on analysis, to be an alloy of tin and lead. Lead and tin may be united in all proportions.

A FEW CASES ILLUSTRATIVE OF THE DIAGNOSTIC VALUE OF AN EXAMINATION OF THE BLOOD.¹

BY HENRY JACKSON, M.D.,
Physician to Out-Patients, Boston City Hospital.

I WISH to report here to-night a few cases which demonstrate typically several important points which may be brought out by a careful examination of the blood.

Careful work of investigators throughout the world has shown the association of the ameboid plasmodia

¹ Read before the Boston Society for Medical Observation, November 5, 1894.