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.

discovered by Larnan with malarial fever. That these organisms are the cause of the disease is rendered extremely probable as:

(1) Careful and competent observers declare they are always present in malaria.

(2) They are found in the blood just before a chill and increase in number up to the acme of the chill.

(3) They disappear with the subsidence of the chill.

(4) They disappear from the blood in the course of a few days after the administration of quinine in doses sufficient to stop the chills.

(5) They are not found in the blood of cases not malarial.

The first cases to which I wish to draw your attention are malaria, two perfectly typical cases of the tertian type in which the examination of the blood served only to make the physical examination complete in every detail, though the diagnosis was perfectly clear without this method of examination. The other two malarial cases which I have to present are atypical, of a form rarely seen here, cases in which the examination of the blood rendered certain the diagnosis of malaria which otherwise would at best have been only problematical.

CASE I. A man seen at the Boston Dispensary in November, 1892. His family history and previous history negative. Two months before he was seen he went to work at Saugus. He had been well until the last week or ten days, during which time he had had chills followed by fever and sweating coming every second day. He came to the dispensary two hours after a chill. His skin was hot and moist; face flushed; temperature 103°; area of splenic dulness increased. An examination of the blood showed a large number of the plasmodia malariae. They were all in the red blood-corpuscles, contained numerous pigment granules and some were so large that they almost filled the corpuscles.

CASE II. A boy seventeen years of age. He entered the Boston City Hospital September 7, 1894. Family history negative. Five years ago he had typhoid fever. His health was good until six days before entrance to the hospital. During the last week he had complained of lassitude, headache, loss of appetite, malaise. He had vomited twice at the beginning of the attack. His bowels had been constipated, there having been no movement for four days; no abdominal tenderness, but a little colic. On the day of entrance, and about a week after the beginning of his sickness, he had a chill followed by sweating, and was brought to the hospital.

On entrance he had a temperature of 103° and a pulse of 100; tongue dry, with a brownish coat. Thoracic examination was negative, except for a few râles heard in both backs. The area of splenic dulness was increased. The abdomen was tense, tympanitic, without tenderness or rose spots.

Examination of the blood during the second chill on September 11th showed the presence of several full-grown intra-cellular malarial organisms; two small extra-cellular organisms were found. The chills did not recur after quinine was given, and he was discharged well on September 20th.

Interest attached to this case in that careful personal inquiry failed to show that he had lived or worked in any of the regions about Boston in which malaria is prevalent. He came from Prince Edwards Island

seven years ago, and since that time has lived continuously in Boston; during the last eighteen months he has lived on Northampton Street, near Washington Street. The diagnosis was perfectly clear after the observation of the recurrent chills in the hospital; but the history of general malaise for a week previous to the first chill, and the appearance of the lad strongly suggested typhoid fever, and he was referred to the hospital as a probable case of typhoid fever. The case is interesting to us in Boston as demonstrating the gradual march of malarial fever into the heart of the city; this lad lived not far from Muddy Brook, a water-course along whose banks Townsend found a good many cases in a collective examination of out-patient cases made two years ago.

CASE III. A Swede, twenty-two years of age, entered the Boston City Hospital September 10, 1894. His family history was negative. Eight years ago he had yellow fever in South America. He did not use alcohol or tobacco in excess. He was a sailor on a vessel which had been moored for several weeks in the Potomac and had arrived in Boston, September 6th, five days before he was admitted to the hospital. He was taken sick the day after his arrival in Boston, with a feeling of pain all over the body, backache, headache, and complete loss of appetite; there was no history of chill. Examination showed a man of powerful physique; his mental condition was extremely apathetic, and in response to questions his replies were slow and dull. His face was flushed, and the skin and conjunctivæ were somewhat yellow. His tongue was covered with a dirty, gray coat, thick and very dry. The areas of the liver and splenic dulness were somewhat increased. The abdomen was lax, without tenderness, and no rose spots were seen.

On September 11th the jaundice was more marked. His lips were dry, cracked and bleeding. There was marked stupor. Bile was found in the urine, but the stools were not clay colored.

On September 13th he responded a little more readily to questions. The tongue was dry, cracked and bleeding. Sordes on the teeth. Pulse dicrotic. He had to-day, all over the body, an eruption of urticaria which presented rather an anomalous appearance, the central portion being yellow, surrounded by a red edge. His blood was examined twice by Dr. Stokes; and on the second examination a few small, non-pigmented organisms were found in the red blood-corpuscles. Dr. Stokes was not willing to make an absolute diagnosis of malaria, as he did not find ameboid movements in the intra-cellular forms.

Quinine was given on the 17th; and from that time there was rapid improvement until he was discharged well a week later. The jaundice had practically disappeared before his discharge.

The appearance of this patient was that of a very sick man, the extreme apathy and the condition of the tongue and lips being strongly suggestive of a serious condition. There was no chill during the whole of his sickness; the temperature fell to normal every other day with the exception of his second day in the hospital, and on the alternate days rose rapidly to about 103°. During the first few days of his stay in the hospital there was nothing to suggest the diagnosis of malaria, and his general condition certainly was strongly suggestive of typhoid fever.

CASE IV. A Swede, twenty-four years of age, entered the hospital September 10, 1894, the same day

as the preceding case. His family and previous history were negative. Habits temperate. He was a shipmate of the preceding case. The day after he arrived in Boston he had a severe headache, and was faint so that he was obliged to lie down.

On entrance, examination showed a man of powerful physique; face somewhat flushed; skin very hot and dry; tongue dry, with a thin white coat. His mental condition was somewhat apathetic, and he made no complaint of pain or other uncomfortable sensations. The area of the splenic dulness was increased, but the edge was not felt. Abdomen lax, and showed no rose spots. On the 13th his mental condition was better. His tongue was dry, with a thin, white coat. He had a large patch of herpes on the lips—a symptom rare in typhoid, and spoken of by Dr. Osler as very common in malaria.

The blood was examined by Dr. Stokes on September 13th; and he reported several rather small intracellular, hyaline, malarial plasmodia. These bodies, when carefully watched, were seen to assume various shapes, to push out pseudopodia. No pigment found. Diagnosis malaria.

Quinine was given on the 15th, and a gradual improvement followed, the man being discharged well September 24th.

In this case, again, there were no chills. The rise of temperature was less rapid than in Case III, and the time of fever very irregular. The rise of temperature was so slow and the duration so long that the ordinary night and morning chart does not mark as strongly the tertian characteristics of the case as the four hourly chart does. Though this man was at no time sick enough to cause any alarm, yet his constitutional condition on the days of comparative apyrexia was much less good than we see here in the North in common cases of tertian fever.

In both these cases the prodromata prolonged and rather severe, the marked mental disturbance, and in the first case the severe constitutional disturbance with jaundice are suggestive of the remittent type of malarial fever. Also the absence of chills and the failure of the temperature to fall absolutely to normal on the days intervening between the days of the height of the fever are characteristic of remittent, rather than intermittent fever. In remittent fever the temperature is usually higher and the remission less marked than in these two cases cited. These two cases are to me most interesting, as I have not seen malarial fever of the tertian type, severe in character, without the occurrence of rigors. The blood examination showed organisms of the type usually found in the ordinary forms of intermittent fever. In remittent fever the parasites have not been as carefully studied as in intermittent; but several observers simply make the statement that crescentic forms are found in this type of fever, the same organisms found in severe forms of malarial cachexia. Crescentic organisms were found in a fatal case of remittent fever, which Dr. Cutler reported to the Section for Clinical Medicine, Pathology and Hygiene last spring.

In the two last cases reported no pigment was found in the parasites; in such cases it is of much importance to examine the blood fresh, as the observation of amoeboid motion in the parasites excludes all possibility of mistaking the organism for vacuoles or changes in the refraction of the corpuscles dependent upon drying or other artificial conditions. The value of the micro-

scopic examination of the blood in malaria is demonstrated by the following quotation from Dr. Councilman's article on the malarial parasites:² "In an examination of one hundred and fifty cases we have not a single negative case to report. We have, however, excluded all cases that had received quinine. We have not hesitated to exclude malaria in all cases where no quinine had been given, in which two examinations failed to find the parasites, and further observation of the patient has in each instance confirmed the justice of this diagnosis."

Continued observation has not as yet determined whether the various forms of parasites observed represent distinct species, or simply different stages of development of one and the same species. In tertian fever careful research has traced the development of the small hyaline inter-corpuscular form seen before the chill through its mature form with pigment to its final breaking up with the formation of so-called "spores."

Mannalely, in a recent monograph on the malaria parasites, considers that the different forms seen represent not different shapes of one and the same organism, but real species which do not tend to pass one into the other. As he claims this theoretical consideration is borne out by the clinical observation that one type of fever does not, as a rule, pass into another.

On the other hand, Babes, writing contemporaneously and with equal facilities for observation, considers that no proof has been established of the existence of different species.

Apparently at the present time we can only say, that in the intermittent forms we find intra-corpuscular, hyaline and more or less pigmented forms, while the half-moon forms are found in malarial cachexia and other atypical forms.

CASE V. An Italian, thirty-six years of age, single, hodcarrier. The father died of consumption, the mother of dropsy. Patient had malaria six years ago in Springfield while working on a sewer, and was sick for four months. Twelve years ago he had gonorrhea, and at the same time an ulcer on the penis on account of which he received internal treatment in Bellevue Hospital. He denied all knowledge of secondary symptoms, and took no medicine after leaving the hospital.

He entered the Boston City Hospital August 21st. He was well up to July 1st, since which time he had complained of pain in the head, most marked in the left temporal and frontal region. The pain came on in the evening, was worse at midnight, and gradually disappeared towards morning. He had worked as a hodcarrier until just before entering the hospital, though latterly suffering somewhat from shortness of breath.

Physical examination showed a man of good development. No emaciation; marked pallor; tongue clean, pale. Thoracic examination negative. Liver, spleen and abdomen negative. Glands in the neck, axillæ and groins slightly enlarged. Breath offensive.

August 25th he complained of sore throat. On the left anterior pillar of the fauces a gray patch about half an inch long was seen; there was a red areola surrounding it, and the posterior cervical glands on the same side were swollen. A bacteriological examination made from a swab showed no Klebs-Löffler bacilli.

² Fortschritte d. Medicin, Nos. 12 and 13, Juli, 1888.

On August 29th his throat was better, and he was up and dressed.

I first saw him September 2d. He was then confined to the bed. His color was extremely pale, with a slight yellowish tinge. Mental condition rather apathetic. All movements slow; and even turning in bed was apparently a great exertion. Breath foul.

September 5th. Several small submucoid hemorrhages along the gums.

September 7th. Gradual loss of strength. Report of blood examination by Dr. Stokes:

Red	2,209,375
White	75,000
Hemoglobin	25%
Proportion white to red	1 to 28
<i>Differential Count.</i>	
Small mononuclear	60%
Large mononuclear	37.2%
Neutrophiles	3.2%
Myelocytes	0.2%
Eosinophiles	0

In counting over leucocytes, two nucleated red blood-corpuscles of normal size were seen. No poikilocytosis present. The red cells are of fairly average size. The gross blood-count is typical of leukemia; the increased percentage of small mononuclear leucocytes, as shown by the differential count, enables us to make in connection with the symptoms a fairly positive diagnosis of lymphatic leukemia. The presence of nucleated red blood-corpuscles, of myelocytes and the increased percentage of large mononuclear leucocytes make it probable that there is some involvement of the bones and spleen, although the process is mainly one of a lymphatic disease. Pathological diagnosis, lymphatic leukemia.

September 11th. Gradual loss of strength. Slight bleeding from the gums. Breath foul. No enlargement of spleen.

September 13th. Pulse small but regular. Small blood-clots on the lips and gums, which the patient appeared too weak to care to remove. On the breast and forehead a few small petechial spots seen. Blood examination by Dr. Stokes:

<i>Differential Count.</i>	
Small mononuclear	94%
Large mononuclear	3.8%
Neutrophiles	2.2%
Eosinophiles	0

In counting five hundred leucocytes, five nucleated red blood-globules were seen, but no myelocytes. No poikilocytosis. During the day he appeared very weak, and in the afternoon he sank rapidly and died.

I report this case as a type of the value of the differential blood-count of the leucocytes. The absence of splenic tumor and the small size of the lymphatic glands, as none of them were larger than a good-sized almond, suggested the diagnosis of anemia as the essential factor. The man's general condition on entrance did not even warrant the diagnosis of pernicious anemia. The differential count showed that the increase in the white cells was dependent upon a part increase in the small mononuclear elements, there showing in the first count 60 per cent. and in the second 94 per cent. of the total number of leucocytes, instead of the normal proportion of 20 per cent. On the other hand, the eosinophiles were absent in both counts, showing that their presence is of no importance in leukemia, as was considered when diseases of the blood were first studied by color reagents a few years ago.

Pernicious anemia was ruled out by the relatively small percentage of hemoglobin and the absence of blood-corpuscles of abnormal shape and size, the so-called poikilocytosis.

Recently attention has been called to the association of ulcerations in the mouth and along the intestinal tract with leukemia of acute course. Askanazy has published in the 137th volume of *Virchow's Archiv* a careful microscopical examination of these ulcerations in a case of acute lymphatic leukemia. According to Askanazy the ulcerations are dependent upon a growth of lymphoid elements which mechanically interfere with the circulation, and thereby causes a necrosis of the mucous membrane. In our case the only symptom suggestive of ulceration in the intestines was the presence of loose dejections; the abdomen was not tender. But the ulceration in the throat was not diphtheria, and it was not accompanied by the fever and constitutional symptoms usually found in ulcerative tonsillitis. I think, on the whole, it is fair to assume that the ulceration in the throat was dependent upon the leukemia. The symptom is certainly of sufficient importance to draw one's attention to its prognostic value when observed.

I am indebted to Dr. Buckingham for permission to report these cases, which entered his service while I was acting as a substitute for him.

SOME OBSERVATIONS ON TUBERCULAR MENINGITIS.

BY A. E. AUSTIN, M.D., DORCHESTER, MASS.

IN these days of medical discoveries, when cancer, phthisis, and other diseases formerly considered necessarily fatal, are so carefully studied and so successfully assailed, it seems strange, that another of the so-called fatal diseases, tubercular meningitis, has received so little attention; and, while the unfortunate outcome of all the following cases shows that I am far from reaching a solution of the difficulty, I hope that their report may increase, if in ever so slight a degree, our knowledge of its peculiarities.

CASE I. A boy, two years of age, with no tubercular family history, father and mother both living and in excellent health, had been well from birth, was breast fed, and had the usual number of teeth. When first seen he had been vomiting for four days, and was cross and peevish; the vomiting had no connection with taking of food. The child flushed and turned pale alternately, had a retracted abdomen, constipation and thirst. On the fifth day he was vomiting at intervals; the pupils were dilated, but reacted to light; pulse was 120; temperature 101°. There was no cry, no twitching of muscles, no convulsions; but the child was inclined to sleep, though readily aroused and intelligent looking. There was evidently no headache, as the hands were not carried to the head. There were sordes on the lips. On the ninth day, the respirations were irregular in rhythm, the child was more somnolent and refused food utterly; the temperature was 100° and pulse 100. On the tenth day the temperature was 99° and pulse 92; the child was comatose and could not be aroused; the pupils were unequal, and there was excessive oscillation of the eyes. The eyes were partially closed; there was extreme conjunctivitis; and the respirations consisted of three barely noticeable ones, followed by