quantity of thick pus was found on removing the dressings. The temperature was 99.4° , and the pulse 58. After a restless night, and at 8 o'clock on the morning of the fifth day after trephining, the patient became unconscious. His face was flushed, and his breathing stertorous. The right pupil was dilated, but there was no sign of paralysis on either side of the body. On removing the dressings there was not so much pus present as usual. Having carefully cleansed the wound, I cut the sutures and exposed the trephine opening. The latter was quite filled with dura mater, whose appearance was still dark and unhealthy. Some blood clot was removed after incising the dura mater, but no pus was found; and although the brain cortex looked healthy, no pulsations were visible. From underneath the edges of the trephine opening a few drops of pus subsequently escaped. When these were washed away I punctured in several directions the frontal lobe of the brain, but with a negative result. There being no signs or symptoms present to warrant trephining in any other situation, I did not feel justified in doing so, and having thoroughly cleansed the parts with strong carbolic lotion, I brought the edges of the wound loosely together, and applied the dressings. Two drops of croton oil were placed on the patient's tongue without however producing the desired effect. The patient continued unconscious, and died at 6 P.M. on the same day, ten hours after the coma had set in.

Necropsy.—At the necropsy no pus was found in the wound or on the dressings, although the latter were on for over six hours before death, neither was there any sign of suppuration underneath the scalp. On removing the calvaria the meningeal vessels were found much distended, but except in the neighbourhood of the trephine opening, where it seemed bruised and congested, the dura mater presented a normal appearance. On removing this membrane from the left hemisphere nothing abnormal was seen; but on turning down the membrane on the right side quite a large quantity of thick, creamy pus escaped. This seemed to have collected in the neighbourhood of the horizontal limb of the Sylvian fissure, and involved the lower part of the parietal and upper part of the temporo-sphenoidal lobes; the cortex in these localities presenting an eroded appearance. The interior of the brain was healthy, and no other fracture of the skull was discovered.

There could be no doubt, therefore, that pressure caused by the collection of pus in the region indicated was the primary cause of death; and in the light of the *post-mortem* examination it was easy to see what might have been done by a further endeavour to save the patient's life. But why during life the pus in the subdural space did not travel freely to the trephine opening where it could find an exit would be difficult to say. After the trephining operation a larger quantity of pus saturated the dressings each day than could have been formed in the neighbourhood of the scalp wound. Some of this must therefore have come from inside the dura mater when the patient reposed on either side of his body; but when lying on his back, in which position he continued during the last twelve hours of life, gravity apparently prevented the pus finding an outlet by that channel. If this be correct, it follows that had I placed the patient in the prone position after reopening the wound and incising the dura mater, pus would have flowed through the trephine hole at least in sufficient quantity to indicate the direction in which another opening might have been made for its more speedy and complete evacuation. It seems therefore advisable to vary the position of the patient while searching for pus inside the skull.

A REPORT ON TEN CASES OF POISONING BY ARSENETTED HYDROGEN.

By J. S. CLAYTON, M.D.,

Certifying Surgeon for Factories and Workshops, Accrington District.

This investigation into the circumstances attending ten cases of acute poisoning by arsenetted hydrogen, which occurred at a chemical works in this neighbourhood in August last, was made at the request of the Factory Department of the Home Office for further detailed information than was contained in the usual notification of such cases.

History of the Accident.

The process in which the men were engaged was the manufacture of zinc chloride from crude zinc oxide and hydrochloric acid. The zinc oxide was a waste material obtained from galvanising iron, and was, in fact, a galvaniser's refuse. The HCl was made on the premises, and admittedly contained arsenic. Unfortunately the firm made no quantitative analysis of these crude materials, but their chemist informed me that a sort of examination was made of both, as is their usual custom, sufficient to show them that less than 0.1 per cent. of As was found in the HCl, and much less than that in the Zn, so little, in fact, as to make the quantity impossible to determine. They also stated that so far as they them-

selves knew no other case of AsH_3 poisoning had occurred during the twenty years that this $ZnCl$ process had been going on. That other cases have from time to time occurred is however quite certain, very decided information on this point being obtainable from the medical practitioners in the district, though of a less intense character and only in isolated cases.

There is a vat about 5 feet square at one end of the platform, 6 yards by 4 yards, raised about 4 feet from the ground; from this platform and at the opposite end, and 5 yards from the vat, is a gangway running to the ground. The platform and vat are in the open air, as is also the ground to which the gangway runs, with this exception, that over the ground part, and about 15 feet above, is a sloping roof about 3 feet wide from the wall of the building outside which this process is conducted, for the purpose of affording some shelter from rain to the men beneath. This part, which is a sort of well, is therefore open to the air, with the exception of having the platform in front and the ledge over part of it above. The idea is that any noxious fumes which may be generated may thereby be readily carried away. There is a doorway leading from this well into the building through which material is brought to the vat, and near by, about 10 to 15 yards distant and inside the building, is a furnace. The hydrochloric acid runs direct from a cistern in the adjacent building into the vat by means of a trough. The zinc oxide is emptied from bags into the cistern by men on the spot. These bags are brought from the ground of the well below and up the gangway to the vat by other men.

On this occasion it appears that the men, for some reason, were eager to get through a certain amount of work by noon, and two or three extra hands were taken on. The vat was kept well going, and more fumes than usual may have been evolved. The day was warm and unusually sultry. The fumes could not get away, and as the crude zinc oxide probably had mixed with it a small quantity of zinc carbonate, from which Co_2 would be evolved, the tendency of the gas would be downward, AsH_3 itself being heavier than air. In addition to this tendency, there would undoubtedly be the powerful indraught exerted by the furnace through the open door. Instead of this free access to the air being a security on this occasion, it constituted a danger. As a matter of fact, the men working nearest to the vat on the platform, and furthest from the well, suffered least, those down below in the well the most. Of those on the platform there were three. One was severely poisoned, one slightly, and the third escaped entirely.

With respect to the remainder, four men were engaged shovelling zinc oxide from a cart on to the ground area, and were at no time within 10 yards of the vat. All of these suffered more or less severely, and three others were occupied in loading barrows from this and conveying it up the gangway to the vicinity of the vat. These also were poisoned severely, one with a fatal termination on the seventh day. The obvious deduction from this incident is that of Dr. Dixon Mann:

It ought to be a standing rule at all works where any operations are performed in which hydrogen is largely used from crude materials, that the processes should be carried out in a closed vat, furnished with a sufficiently wide earthenware tube, so as to conduct the gases evolved directly into the tall chimney of the works.

Hitherto the recorded cases of arsenetted hydrogen poisoning have been comparatively few in number. In a very complete monograph on the subject by Drs. Dixon Mann and Gray Clegg a list of 49 cases is recorded which the authors believe includes all cases published up to that time. I am informed by Dr. Legge that the only cases reported to the Home Office since then, and the only cases of which I have obtained information as occurring in this country have been two fatal cases and one non-fatal case which occurred at a Weldon chlorine still at Irvine, Ayrshire, and one at a zinc chloride works in Blackburn, these together with the 10 cases here recorded would bring the total to 63.

SYMPTOMS.

The symptoms in the 10 cases here referred to were characteristic throughout, with the exception of one man who appeared to have absorbed a very small quantity of the gas, and who was correspondingly slightly affected. It is only necessary to quote one case as typical of the series, that of the foreman, who was engaged in emptying bags into the vat,

and who was the most seriously affected of those at the vat. He was a robust, powerful man, and had been engaged at this particular work for sixteen years. If there can be such a thing as immunity to AsH_3 , he should have afforded an example. He had been at work there all the morning, and left his work at 2 P.M. At 2.30 he felt sick, nauseated, and depressed, with a hot, burning pain from his throat to his stomach, and with an intense thirst. This was soon followed by violent vomiting, at first of food, then of everything as soon as swallowed, even iced water. This again was followed by an equally severe diarrhoea; the discharges were at first loose faecal matter, then rice-watery, and finally contained blood. Added to this there was hæmoglobinuria and a rapidly developing jaundice, which within twenty-four hours assumed an intense coppery hue. As is usual in these cases, and without any knowledge of the surrounding circumstances and the obvious cause, a diagnosis of cholera would have been pardonable within the first twelve hours. The whole effect was that of an irritant poison taken by the mouth, being evidence that the arsenic in the gaseous state was absorbed by the blood direct from the lungs, and in its passage through the walls of the stomach, was separated there and acting directly. Doubtless also some may have been swallowed in the saliva. The feeling of depression deepened into extreme prostration, the features were sunk and cyanosed, the pulse thready, and the voice lost. These severe symptoms lasted with gradually diminishing severity for several days. The feeling of prostration, the anæmia, the almost pale green colour of the skin which supervened on the disappearance of the jaundice, lasted for several weeks longer, and it was only after the lapse of five weeks that he was able to return to work.

In the one fatal case the symptoms showed no variation from the above, excepting that there was no tendency to recovery. Towards the close there was suppression of urine, and after thirty-six hours of complete unconsciousness, he died on the seventh day.

In all of these cases there was jaundice. In 8 of them it was intense. In 2 only could it be described as slight. In 9 also there was hæmaturia. Intense thirst and a burning pain in the chest characterised the onset and earlier stages of all the cases. Diarrhoea was troublesome in 5, and all the cases, with the single exception referred to, suffered from profound anæmia in the later stages of the disease. The effect on the nervous system was more or less severe in 9. In 6 of these the prostration and collapse of the earlier stage was very severe.

One man who was engaged with these 10, and who was on the platform nearly the whole time, escaped without any symptoms whatever, and the varying degrees in which they were affected would seem to indicate that individual susceptibility played an important part. The man who died could not have been described before this as a good life. He had been a heavy drinker, and the effects of chronic alcoholism no doubt militated against any tendency to recovery.

Notification.

The medical profession generally, except in districts where industrial lead poisoning is frequent, does not appear to be aware that by Section 29 of the Factory and Workshop Act, 1895, every medical practitioner attending on or called in to visit a patient whom he believes to be suffering from lead poisoning, phosphorous poisoning, arsenic poisoning, anthrax, contracted in any factory or workshop, is required, under penalty, to notify the case forthwith to the Chief Inspector of Factories, Home Office, unless it has been so notified, and that he is entitled to a fee of 2s. 6d. for so doing, and that this requirement was extended by order of the Secretary of State in May, 1899, to mercurial poisoning similarly contracted.

REFERENCE

¹Medical Chronicle, Manchester, 1895.

A SANATORIUM FOR LILLE.—La Ligue du Nord contre la Tuberculose is collecting funds for the erection of a sanatorium for Lille, where it is estimated there are every year 6,000 working people affected with tuberculosis, and 1,200 persons die annually of the disease. The sanatorium will have 100 beds, and should receive from 300 to 400 patients in the year.

THE ELECTROLYTIC DEPOSIT OF SULPHUR FROM THE HARROGATE SULPHUR WATERS AS A THERAPEUTIC AGENT.

By FRANCIS WILLIAM SMITH, M.D. ABERD.,
Harrogate.

DURING "the season" of 1900, at Harrogate, I treated many patients with electricity (mostly the constant current) who were sent to me by physicians in London and other places. The electricity was passed through the Beckwith Harrogate water, at a temperature of 99° F., at the Royal Baths. The analysis of this water, by Mr. Hayton Davis, F.C.S., is as follows:

	Grains per Gallon.
Calcium sulphate	0.580
Calcium carbonate	5.947
Magnesium carbonate	4.222
Sodium carbonate	16.147
Sodium chloride	3.374
Potassium chloride	0.610
Lithium chloride	Trace.
Sodium sulphide	1.700
Silica	0.530

33.339

It will be noted that the water contains a large amount of alkaline carbonates and a considerable amount of sodium sulphide, while the chlorides are small in quantity. This water is largely used for bathing in skin affections at the Royal Baths.

On the skin of many of the patients treated by electricity in this sulphur water I observed a yellow deposit, which looked and smelt like sulphur. This was especially so in the case of Mr. D. (Leamington) and Mr. G. (Manchester). In Mr. D.'s case the skin was quite covered with a yellow powder after the first few baths. He had suffered from acute gouty eczema from September, 1899, till March, 1900, more or less; and when he consulted me in August he was low and weak, with large patches of eczema in different parts of his body, especially on the feet, legs, and arms. I ordered him electricity in the Beckwith sulphur water, and the improvement was rapid. It was towards the close of his "cure" that I was struck with the quantity of what looked like sulphur on his skin, and I thought that electricity had brought this about, because I had never seen any yellow deposits upon the skin after an ordinary hot sulphur bath. Mr. D., in reply to questions, wrote to me on December 12th, 1900, the following answers.

1. The sulphur deposit appeared on my skin very soon after my first (electric) bath, and was always there afterwards.
2. The sulphur was by no means specially deposited on the parts where the ointment had been previously applied.
3. There was a smell of sulphur on my body at all the times when in Harrogate.

In the case of Mr. G., the sulphur was deposited on his skin in the same way, and he got rapidly well, and remains so.

These facts led me to make the following experiment: I attached wires leading to the positive and negative terminals of the main town electrical trunk, and allowed a constant current of 30 milliampères to pass through the Beckwith sulphur water for half an hour, with the result that sulphur was deposited on the positive platinum foil.

Not trusting to my own judgment, I called in the assistance of Professor Smithells, Professor of Chemistry at the Yorkshire College, Leeds; and he, with his assistant, Mr. H. M. Dawson, B.Sc., Ph.D., examined the behaviour of the Beckwith water, and also of the water of the Old Sulphur Well at Harrogate, in the presence of electricity.

Professor Smithells's report, received on December 31st, 1900, is as follows:

Electrolytic theory would lead one to expect that when an electric current is passed through the Harrogate sulphur waters, sulphur would be liberated at the positive pole by direct electrolysis of the sulphides and of the dissolved sulphuretted hydrogen. The electrolysis of the chlorides which exist in the waters, leading primarily to the liberation of chlorine at the positive pole, would liberate sulphur by secondary action from any sulphides and sulphuretted hydrogen present in the water. There is thus every reason to anticipate that if the human body were immersed in the waters, and connected to the positive pole, the negative plate being simply suspended in the water, the whole immersed surface of the body would become the seat of the production and deposition of sulphur. Experiments with platinum electrodes fully bear out this anticipation. Both in the Beckwith water and the water from the Old