CASE OF
FATAL POISONING

BY
SIR WILLIAM BURNETT'S FLUID.

BY
H. LETHEBY, M.B.

LECTURER ON CHEMISTRY IN THE MEDICAL SCHOOL OF THE LONDON HOSPITAL.

COMMUNICATED BY
T. B. CURLING, Esq.

Received April 9th.—Read June 11th, 1850.

THERE is not, I believe, an account of any fatal case of poisoning by chloride of zinc on record. This fact will appear somewhat remarkable, when we consider that one of our commonest and most accessible deodorizing compounds is a strong solution of this poisonous salt. Moreover a reference to the writings of our leading toxicologists, Orfila, Christison, Devergie, and Taylor, will show that this substance is not even regarded as a possible source of danger to the community. It is true, that the last-named author has incidently mentioned the chloride in his work 'On Poisons;' but the properties of the compound are so briefly disposed of, that few persons would consider it to be a virulent poison; for Mr. Taylor merely says, "this is a very soluble deliquescent salt; the chlorine is detected by nitrate of silver." And Dr. Christison, in alluding to the preparations of zinc, states that, "the only important compound of this metal is the sulphate, or *white vitriol*." In point of fact, we may seek in vain, except in the writings of my most erudite friend Dr. Pereira, for any account of the physiological actions of this mineral: all of which circumstances may, perhaps, give an interest to the following report.

On the morning of Thursday, August 16th, 1849, Mr. Miller, of Eye in Suffolk, was sent for in haste, to visit the child of a poor unmarried woman, named Mary Robinson, who lived at Reddingfield, a neighbouring village. Mr. Miller arrived there between ten and eleven o'clock on the forenoon of the day just named; he found the patient, a little girl aged 15 months, in a semi-comatose state,—the vital powers being much prostrated, the countenance pale and anxious, the breathing thoracic and rapid, the pulse quick and fluttering, and the general surface of the body cold, and bedewed with perspiration. On noticing that the lips were swollen, and that the mouth was covered with a thick transparent mucus, Mr. Miller made further search, and perceived that the inner surface of the lips, and lining membrane of the mouth, presented an opaque white appearance, as if they had been acted on by some caustic or corrosive substance. He learned, moreover, that the child was well and hearty early in the morning, but that it had been suddenly seized, about an hour and a half before his visit, with most violent sickness. These facts led him at once to conclude that the child was suffering from the effects of an irritant poison; and his conclusion was in a great degree verified by the circumstance of one of the attendants producing a bottle of Sir William Burnett's disinfecting fluid. This bottle had, it appears, been supplied by Mr. Miller to the mother of the child about a week or ten days before, when there were some patients affected with fever in the house in which she lived.

When roused from its lethargy, the child craved for cold water, and retained it in its mouth with apparent satisfaction; but, on attempting to swallow the water, the greater portion of it returned by the nostrils. On making a careful examination of the throat, Mr. Miller thought that it was somewhat swollen; and he was led to think, that the child was suffering pain in the part, from the circumstance that it frequently raised both hands to its neck.

Mr. Miller tried in vain to give relief to the poor sufferer. He endeavoured to administer a solution of albumen, but the fauces were so swollen and constricted, that little or none of

the antidote passed into the stomach. He noticed, however, that the white of egg employed was coagulated by the fluid matters which still adhered to the mouth. Occasionally the child vomited a frothy liquid, like curds and whey, and at such times it was aroused from its heavy drowsy state; but gradually the coma became deeper, the respiration slower, the pulse more feeble, the surface of the body colder, and at seven o'clock in the evening the child died; its sufferings having continued during a period of ten hours.

A post-mortem examination was made twenty-two hours after death; the body was plump and well developed; the face was pale and somewhat swollen; the lower lip had a dark brown scab upon it, the effect of the corrosive action of the poison; the lining membrane of the lips, mouth, fauces, and œsophagus were of an opaque white colour; the lungs were slightly congested; the auricles of the heart were full of dark semi-fluid coagula, and the ventricles were empty; the outer surface of the stomach presented a peculiar mottled appearance from ramifications of dark purple vessels; the intestines looked paler than natural. The stomach, which felt hard and leathery, contained one ounce and a half of a fluid that resembled curds and whey; the inner surface of the organ was corrugated, opaque, and tinged of a dull leaden hue: this appearance stopped abruptly at the valve of the pylorus, from which point the rest of the alimentary canal had a natural appearance; the kidneys, however, were greatly congested.

As this case was likely to become the subject of criminal investigation, Mr. Miller, at the request of the magistrate and coroner, brought to me the stomach, together with its contents, and a portion of the vomited matters for analysis.

On examination, I found that the interior of the stomach was only slightly acid to litmus paper; and, on digesting the organ in one ounce of distilled water, I obtained a liquid which gave white precipitates with the following reagents; prussiate of potash, monocarbonate of soda, sulphuretted

hydrogen, and acid nitrate of silver ; while it did not furnish a precipitate with a soluble salt of baryta : all of which circumstances clearly indicate that chloride of zinc was present.

The fluid matters taken from the stomach, as well as those ejected by vomiting, exhibited, on being filtered and tested, the same chemical reactions.

Lastly, the tissue of the stomach was broken up with nitro-muriatic acid, the solution evaporated to dryness, redissolved in distilled water, filtered, and precipitated with sulphuretted hydrogen ; by which means I obtained 3·8 grs. of sulphuret of zinc, a quantity equal to 3·2 grs. of the oxide, and 5·4 of the chloride of this metal.

On making an analysis of the disinfecting fluid supplied to the mother, I found that it had a density of 1600, that it was slightly acid to litmus paper, and that it contained 52 per cent. of the solid chloride.

Furthermore, I considered it necessary to make a few experiments with the liquid in question, in order to determine its leading chemical and physiological characters ; and the following are the results obtained.

I.—WITH REGARD TO THE CHEMICAL PROPERTIES OF
SIR WILLIAM BURNETT'S FLUID.

This compound manifests a strong coagulating action on albumen, and on the tissues of the animal body. With a solution of the former, it gives a precipitate or white coagulum, when the saline liquid does not contain more than one part of the solid chloride in 5000 of water ; that is, when Sir William Burnett's fluid is diluted with about 2500 parts of water. And if we make use of the undiluted disinfecting fluid, the coagulum, which is at first formed, rapidly dissolves, and produces a solution from which the albumen is again precipitated on adding a large quantity of distilled water. When poured on the dead mucous membrane, this fluid quickly whitens and coagulates the tissue, even when the liquid contains only one per cent. of its saline constituents ; that is, when it is diluted with about 50 parts of water ; and

a similar coagulation results in the course of five or six minutes, when a liquid of half this strength is used. I have found, moreover, that the compound thus formed with albumen is, to a certain extent, insoluble and indecomposable; for, on digesting the corrugated tissue, or the white coagulum in water for many days, the residue still contains a notable proportion of the metallic chloride. This was proved by taking the stomach of a dog, which had been poisoned with chloride of zinc, and exposing it to the action of a running stream of water for seventy-two hours, after which it was broken up with nitro-sulphuric acid, evaporated to dryness, drenched with a solution of ammonia, filtered, and then precipitated with sulphuretted hydrogen; by which means I obtained 1·3 grs. of sulphuret of zinc. This fact is of some importance in a medico-legal point of view, because it indicates, that the poison may be detected in the tissues of the alimentary canal long after the death and burial of the body.

The quick and, as I may term it, firm coagulating action of the chloride of this metal on liquid albumen, and on the delicate tissues of the body, especially serves to distinguish it from other soluble salts of zinc; for notwithstanding that a small quantity of a strong solution of the sulphate or acetate will slowly act on white of egg or on the dead mucous membrane, yet the reaction is not well marked; and if we employ a weak solution of albumen, the coagulum is instantly dissolved by a very slight excess of the precipitant, a solution being obtained which differs from that of the chloride by its not becoming turbid, when it is diluted with distilled water.

II.—WITH REGARD TO THE PHYSIOLOGICAL PROPERTIES OF THIS COMPOUND.

I may, perhaps, by way of preface, state that I have performed many experiments on living animals with the muriatic solution of different strengths; and although the results have not always terminated in a like fatal manner, yet, the general physiological effects have, in all cases, been so nearly alike

that the record of two or three experiments will be sufficient to illustrate this part of my subject.

In one experiment I took a young terrier puppy, whose respirations were 16 in the minute, and pulse 72. I administered to it, by means of a syringe and œsophagus tube, one fluid ounce of the liquid in question (its sp. gr. being 1600). In one minute the dog vomited, and in so doing brought up the greater part of the chloride, mixed with a little food, which it had taken one hour previously. In the course of four minutes the animal had vomited seven times; and it continued to retch every three or four minutes for the space of half an hour, the matters ejected being at the first watery like mucus, then frothy, and at the last they had the appearance of curds and whey. At the end of the last-named period, the animal appeared to be much exhausted, for it staggered in its walk, and then fell to the ground. At this time its pulse was 110, weak and fluttering; its breathing was laborious, and amounted to twenty respirations in the minute. Soon afterwards the efforts at vomiting were renewed; the animal again rose from the ground, and showed, by its feeble and tottering gait, that the posterior extremities were becoming paralysed; the pupils were now so widely dilated, that the irides were scarcely perceptible. From this time it was again tormented with the most violent retching, and at the termination of the first hour it had vomited nineteen times. Immediately after this, it lay upon the ground perfectly exhausted; its pulse was scarcely perceptible, the breathing had become slower, and more laborious; and, although the animal was quite sensible, yet it was evidently passing into a state of coma. After the lapse of one hour and a half from the first, it was unable to stand, although it frequently tried to do so when the distress of vomiting roused it. At these periods it was sensible, and would look towards me when I called it; in the intervals it appeared to be heavily asleep: gradually, however, the coma became more marked, the surface of the body lost its temperature, the pulse became more and more feeble, the breathing heavy,

slow, and laborious, and in six hours and a half it died, without showing the least sign of convulsions.

The body was examined twenty hours after death. The mucous membrane of the mouth and œsophagus was white and opaque: the stomach was hard, contracted, and empty; its external surface was marked with numerous purple vessels which ran in a longitudinal direction. On opening this organ, its tissues were found to be corrugated and tinged of a dull leaden hue; and on digesting it in water it furnished a solution which contained 6·5 grs. of the chloride. The lungs were not congested; the cavities of the heart were full of black uncoagulated blood, which by treatment with boiling alcohol and water, yielded distinct traces of the poison. The intestines were natural in appearance; the kidneys were much congested; and the urinary bladder was empty.

To a second puppy, a small mongrel terrier, which had been kept without food for twelve hours, I gave half an ounce of the undiluted solution (sp. gr. 1600). Before the experiment was made, its pulse was 70, and its respiration 14, in the minute. In forty-five seconds, the animal vomited, and by so doing threw up the greater portion of the poison. In another minute it was again sick; and in the course of six minutes it had vomited five times, the matters ejected being, as in the last case, frothy and curdled. During the next ten minutes, the dog walked about in a restless, unsteady manner, whining as if it were in pain. At the expiration of that time it lay down and began to appear sleepy; its respirations were then 18 in the minute, and its pulse 114. Two minutes afterwards it rose from the ground, and made slight efforts to vomit. At this time it drew its hind legs heavily along, as if they were becoming paralysed. Soon afterwards the animal was unable to stand, although it made many attempts to do so, and I perceived that it had quite lost the use of the posterior extremities. In twenty minutes from the first it was violently purged; the pupils were largely dilated; the heart was beating feebly, and the respirations were heavy and deep. In thirty-five minutes it appeared to be in great pain, for it rolled itself about and

made a low whining noise. During the next ten minutes it lay as if it were in a deep sleep, and, without being disturbed, it was purged six times. From this period the coma became more and more complete; the respirations heavier and slower; the surface of the body got cold; and at the expiration of the third hour it died without a struggle.

The post-mortem appearances were precisely like those observed in the former case, and the poison was readily detected in the stomach, heart, blood, and muscular tissues of the body. The peritoneum also contained five drachms of a sero-albuminous fluid which yielded 2·3 grs. of chloride of zinc, the poison having transuded the parietes of the stomach and intestines.

In a third experiment, I gave four drachms of the fluid, diluted with half an ounce of water, to a young terrier dog. The contents of the stomach were ejected in one minute; and in the course of the next seven minutes vomiting had occurred eight times, the animal throwing up a frothy mucus mixed with a considerable quantity of food. In fifteen minutes, it began to show signs of approaching coma, for it lay on the ground in a sleepy, heavy condition. At this time its pupils were largely dilated, and its pulse and breathing were slightly accelerated. In the course of the next hour it was roused by its repeated efforts at vomiting: gradually, however, the retching became less and less distressing, and the animal lay in a heavy, comatose state for a period of thirteen hours, when it woke, but looked ill and uncomfortable. It lay dosing during the next day and a half, and then it began to take food. At this time it passed twenty-two drachms of urine, which had a density of 1042, and which yielded 1·2 grs. of sulphuret of zinc. From this period the animal gradually recovered.

The experiments here detailed show that a solution of chloride of zinc exerts a two-fold action on the living animal economy; the first effect being that of an irritant and caustic, for the liquid coagulates the tissues, occasions pain in the part to which it is applied, and almost instantaneous vomiting.

It appears, moreover, from the investigations of Orfila, that the salts of zinc act upon the stomach not only when they are introduced into this organ, but also when they are injected into the blood-vessels of the body, or applied to a wounded surface. The second effects of the poison are of a constitutional nature; and, although I am not prepared to say what amount of these effects are due to the violent injury inflicted on the mucous and other tissues of the stomach, yet I am of opinion, that the poison exerts a distinct and specific action on the motor and organic systems of nerves; for, as in the case with the sulphate of this metal, soon after the poison gains access to the circulation, the breathing and pulse become accelerated, the hind limbs begin to grow feeble and paralytic, and the pupil of the eye undergoes a remarkable amount of dilatation. From this time the paralysis becomes more and more complete, the surface of the body grows cold, the respirations become deep and laborious, and the pulse gets to be fluttering and then almost imperceptible. As yet, however, the mental functions do not appear to be impaired, for the animal exhibits, when it is roused, all the usual signs of intelligence; but, gradually, as the effects of the poison become more and more developed, coma supervenes, a total prostration of all the vital powers is effected, and death takes place without a struggle. All these results are so similar to the effects observed by Orfila and others in cases of fatal poisoning by the sulphate of this metal, that they must, I think, be regarded as the manifestations of its own peculiar mode of action. Moreover, the experiments of Orfila and Blake have demonstrated, that the very same effects are produced when a salt of zinc is injected into the veins, arteries, or cellular tissue of a living animal; and hence, as Professor Christison remarks, "these experiments, when taken together, show that sulphate of zinc, though a moderately active irritant, is more indebted for its activity to a remote operation on some vital organ," or as Orfila states, that "independently of the local irritating action, which this salt exercises, it appears to act by stupefying the brain."

It is also, perhaps, worthy of remark, that the experiments

which I have made with chloride of zinc, prove that the poison is absorbed from the alimentary canal, and carried into the general circulation; for I have detected the metal in the blood removed from the heart, in the tissues of the body, and in the urine excreted during life. These results are but confirmatory of the observations made by Orfila.

Moreover, the appearances presented by the blood indicate, that the poison exerts some peculiar action on this fluid, for in all the cases hitherto examined, the blood has been found black and uncoagulated, and the cavities of the heart have been filled with the fluid, as if the organ had lost its power of contracting on its contents.

Finally, I ought to mention, that Dr. Strettan has recorded two cases of poisoning by chloride of zinc; in one of which the patient took twelve grs. of the salt, and in the other 200 grs. of it, dissolved in a wine-glassful of water. The symptoms produced were very similar to those herein detailed, though in both instances the patients recovered.