TWO CASES OF POISONING WITH ARSENIOUS ACID IN WHICH THE YELLOW SULPHIDE OF ARSENIC WAS FOUND IN THE ALIMENTARY CANAL.

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The restriction which the law places upon the sale of arsenic has undoubtedly tended to greatly diminish the use of this substance by the criminal for homicidal purposes, and it is a striking fact that during the ten years 1893–1902 no deaths were recorded by the Registrar-General from its employment in this manner throughout Great Britain. Accidental and suicidal deaths are also not very frequent, more especially in Scotland, as the following table indicates:

Deaths due to Arsenic in England, Wales, and Scotland during ten years, 1893–1902.

| Year | England and Wales | Scotland |
|------|-------------------|----------|
|      | Accident | Suicide | Accident | Suicide |
| 1893 | 4        | 5       | ...      | ...     |
| 1894 | 5        | 8       | ...      | 2       |
| 1895 | 3        | 4       | 1        | 1       |
| 1896 | 4        | 5       | 1        | ...     |
| 1897 | 3        | 6       | ...      | ...     |
| 1898 | 3        | 4       | 1        | ...     |
| 1899 | 3        | 2       | 2        | 1       |
| 1900 | 11       | 5       | 1        | 1       |
| 1901 | 76¹     | 2       | ...      | 1       |
| 1902 | 8        | 6       | ...      | ...     |
| Total| 120      | 47      | 6        | 5       |

Possibly the ease with which other equally active and more quickly fatal poisons, such as carbolic and oxalic acids, may be readily obtained without exciting the same amount of notice, has tended to make poisoning by arsenic a much less frequent cause of death than in former years.

On this account, as well as because they present many points of interest, the two following cases which have recently come under our notice are recorded. They serve to indicate, moreover, that, even at the present time, arsenic is possibly a more frequent

¹ Thirty of these are returned as due to arsenical beer, but in all probability many more of the cases arose from this cause.
cause of death than the Registrar-General's statistics lead us to believe, and that, unless a post-mortem examination is held in all cases of unexpected death, or of persons dying without medical treatment, the fact of poisoning may elude discovery.

It is a popular and not uncommon idea that the symptoms of poisoning are, as a rule, clear and decisive, and that a medical man called in to view the body after death should be able to express a definite opinion on the subject.

This is, however, not so, because, in the first place, there are very few poisons which leave any external traces of their administration, or which, from their odour, can enable a medical man even to hazard the opinion that a poison has been taken. In the second place, it has to be remembered that even in acute and rapidly fatal cases of poisoning, the symptoms may not be characteristic. In the class of poisons in which, as a rule, symptoms are well marked, namely, the metallic irritants, they may be wholly absent, or present only in such a modified form as not to arouse the slightest suspicion. Indeed, such typical symptoms of irritant poisoning as vomiting, purging, and pain in the abdomen, anomalous as the statement may appear, are more frequently presented by patients who are not suffering from poisoning at all, but from a rupture of a gastric or intestinal ulcer, intussusception, rupture of an extra-uterine pregnancy, or some other acute abdominal condition.

With the Klosowsky or Chapman case in our recollections, it is not necessary to emphasise the fact that in the chronic administration of irritant poisons, the symptoms produced may deceive even the most careful and observant medical man.

The following is an account of the two cases which we desire to record. In one of these we only received certain organs for analysis; but in the other, one of us had the opportunity of making the post-mortem examination, and also of personally inquiring into the circumstances attending the death.

Case 1.—J. M., æt. 24, on the afternoon of 10th October went to a neighbouring town, ostensibly to withdraw money from the bank, and to purchase furniture, etc., in view of his marriage, which was fixed to take place in three weeks. At 4 p.m. he called upon a relation in the town, and had a drink of whisky with him. Nothing unusual was noticed in his manner at this time, and he seemed cheerful and quite well. Shortly afterwards he left his friend's house, saying he must go to the bank before it closed. Instead, however, of going there (where it was afterwards found he had no money), he called at the house of another friend, and partook of tea and some cake. He left here at 6.15 p.m., and, as subsequent investigations proved, visited a chemist's shop, where he purchased a packet of "rat poison," consisting of arsenic mixed with soot. He asked the chemist particularly how it should be administered to rats. At 7 p.m. he met some friends by appointment at the station. He went shopping with them, chose furniture, arranged
for the marriage breakfast, etc., but it is stated that he did not appear to take much interest in the matter. He also bought some sugar-candy, which he and his friends ate in the train on the way home. He got out of the train at the station before his own, and went with his friends to their house. It was noticed that he was looking very pale, and that his eyes appeared red and bloodshot; but on someone remarking that he seemed to have a headache, he said he had not a sore head, but felt "awful queer." He had supper with his friends (9 p.m.), consisting of tea, cake, scones, and cheese, and made a hearty meal. It was noticed that he drank off his first cup of tea with avidity, stating that he was very thirsty. After supper he seemed better, although somewhat dull, and left to walk home at 10 p.m. Nobody heard him arrive home, but next morning, at 5.30 a.m., when his landlady called him as usual, in order that he should get up and go to his work, he said he had been sick since 2 a.m., and would therefore remain in bed for a little longer. He asked for a cup of tea, but he vomited it immediately after taking it. Frequently during the day (11th October) he was sick, and brought up small quantities of fluid. There was constant retching. The vomited matter had the appearance of bile, and it was thought that he was merely suffering from a bilious attack. About 7 p.m. a doctor was sent for, as he was very restless and tossing about in bed. The doctor was unable to come, but at 11 p.m. sent some antipyrin tabloids, with directions that two were to be taken at once, and two more three hours later. The landlady sat up with him until 2 a.m., and put hot bottles to his feet, as he said he was cold. He did not complain of pain anywhere. At 4 a.m. his condition was the same, but at 5.20 a.m. (12th October), twenty-seven hours after the onset of his symptoms, he was found lying dead in bed. He had not been sick since 2 a.m. on the morning of his death, and during the whole course of his illness there was no diarrhoea.

In the above account we have gone somewhat fully into the movements of the deceased prior to the onset of his illness, because, although the case was subsequently considered to be one of suicide, yet in the first instance this was by no means clear.

He gave no indication of an intention to do away with himself,—on the contrary, his letters to his relations when asking them to the marriage, his cheerfulness, his anxiety to make preparations for the wedding, all tended to disarm any such suspicion even if it had existed. The fact that he had purchased poison was also not discovered until some time after his death. It may, however, be remarked in this connection, that while to the layman the fact of a person dying suddenly who is about to be married is considered to be a circumstance against the probability of suicide, yet those who have experience of such cases know that the fact is rather in favour of it. We have had many opportunities of verifying this observation as regards men, but in our experience the same probability does not exist in the case of women under the same circumstances.

The history and symptoms of the case have also been detailed
so far as they could be ascertained, because an interesting question is the determination of the time when the poison was taken.

A post-mortem examination was made two days after death, and the following account is taken from the report of the doctor:

"The mucous membrane of the cheeks, gums, and tongue was found considerably whitened, as was also the mucous membrane of the esophagus, although in a less degree. The stomach, which contained a considerable quantity of light yellow liquid material, was much congested and inflamed at the pyloric end, showing at parts some extravasation of blood into the mucous membrane. Patches of the small intestine also were considerably congested. There was no characteristic odour about the mouth or contents of the stomach. The body otherwise presented no unusual appearances."

The medical examiner concluded from the condition of the intestinal tract that death was due to some irritant poison.

In consequence of this opinion, a chemical analysis was ordered by the Crown, and the following articles, which had been removed at the post-mortem examination, were received on 16th October:—The stomach, with 6 in. of esophagus attached to it; a piece of small intestine about 8 in. in length; a piece of liver about the size of a small apple. All these parts were contained in one bottle, and were immersed in 4 oz. of fluid, presumably the contents of the stomach.

The manner in which these articles were sent for the purpose of analysis forms an admirable example of how this should not be done. Not only were the parts sent wholly insufficient for a proper quantitative analysis to be made, but, from their having been mixed together in the same bottle, it was impossible to determine whether a poison had existed in all of them, or was present only in the stomach, at the time of death. Had the case proved to be one in which another person was suspected of having administered poison, it might have been quite impossible to prove the crime in the face of such neglect of one of the most elementary rules of procedure on the part of a medical man in such circumstances.

On opening the bottle, there was a strong putrefactive odour, and the parts presented the following appearances:—

_Stomach._—This had been cut open along the lesser curvature. The peritoneal surface was smooth, and glistening with slight diffused redness (p.-m.?) at the pyloric end, but nowhere any marked injection of vessels. At the cardiac end, slight greenish discoloration and some putrefactive emphysema. On its posterior external surface there were several diffused patches of a light yellow colour, more especially towards the pyloric end. These patches were irregular in shape, and the colouring matter was situated beneath the peritoneum, and had the appearance of a thin layer of yellow paint.
Internally, the cardiac half of the stomach presented a normal appearance. Towards the pyloric end the mucous membrane had a uniform deep red colour, to some extent, no doubt, the result of putrefactive changes, but due also to intense congestion. It was swollen, and like velvet in appearance. It was contracted into rugae, which were suffused with extravasations of blood. There was no erosion or ulceration of the mucous membrane. The crests of the rugæ presented a most striking appearance. They were of a light yellow colour, and thus formed a yellow network over a considerable area of this part of the stomach. This yellow colour was found to be due to a granular substance deeply embedded in the mucous membrane, which could not be washed or scraped off without injuring the membrane. The deposits were limited solely to the crests of the rugæ, no other portions of the mucous membrane showing a similar coloration, neither did a careful search disclose the presence in the stomach of particles of soot or crystals of arsenious acid.

Esophagus.—In the portion of this organ which was received, little could be made out. The external surface appeared to be normal, while internally the epithelial lining was absent; but whether this was due to accidental causes or to the action of an irritant, could not be determined.

Intestine.—This consisted of a portion of the jejunum, and showed, in addition to congestion of the peritoneum and mucous membrane, some yellow patches under the peritoneal coat similar to those seen on the external surface of the stomach, although not quite so distinct.

Liver.—The portion of liver received was becoming green and soft from putrefaction. It showed nothing of special significance.

The reddish-coloured fluid contained in the bottle amounted to 4 oz. On submitting a small quantity of this fluid to a test by Reinsch's process, the presence of arsenic in it was at once established. Owing to the various organs having been placed together in one bottle, it was considered useless to examine each separately. We accordingly contented ourselves with estimating the quantity of arsenic present in the fluid, which was presumably that contained originally in the stomach. This fluid, on being allowed to stand for a time, deposited a white sediment, which, on being examined microscopically, was seen to be crystalline, many of the crystals having a typical octahedral form. On washing the sediment and purifying it, it was found to consist of 0.214 grm. of arsenious acid. The fluid was then treated in the ordinary way, by means of hydrochloric acid and chlorate of potash, to get rid of organic matter, and the arsenic precipitated by H₂S gas, etc. It was found to contain 0.080 grm. of arsenious acid, so that the total quantity contained in the liquid was 0.294 grm. The examination and analysis gave no indication of the presence of soot.

Portions of the yellow deposit from the rugae, and also from underneath the peritoneum of the stomach and intestine, were examined in order to determine the nature of the pigment. Microscopically it showed no crystals. The colour disappeared on the addition of ammonia. On filtering this solution and evaporating off the ammonia, a yellow deposit was left. This deposit was dissolved in ammonia, and on testing gave the various reactions of arsenic.
The second case was as follows:—

Case 2.—A man, R. J., aged 27, left his lodgings one morning after eating a hearty breakfast, being apparently in good health. He spent the day, so far as can be made out, drinking with friends, and between 4 and 5 p.m. came to his married sister's house. She states that he was not then the worse of drink, but complained of being tired. He appeared to be in his usual state of good health, and sat reading the newspapers until 8 p.m., when his brother-in-law came home. They had supper together, consisting of lentil soup and sausages. As it was a very wet night, his sister asked him to remain with them, which he agreed to. Between 9 and 10 o'clock, after going to bed, he complained of pain in his back, and began to retch. His sister states that he continued retching throughout the night, but she does not think he vomited. He was very thirsty, and drank a large quantity of water. He went twice to the water-closet during the night. At 4 a.m. he got up to go again to the closet, but fell down on his knees at the side of the bed, apparently from weakness. His sister, who helped him into bed, says that he then passed, involuntarily, a watery motion which showed no traces of blood in it. About an hour afterwards he died. There were no convulsions, and he appeared to be unconscious for some time before death. He had complained of pain in the back, but nowhere else.

In accordance with the usual practice in Edinburgh in cases in which death has occurred without a medical man having been in attendance, intimation of the occurrence was made by the sister to the police, and the body was removed to the mortuary.

The investigations of the police disclosed no suspicious circumstances, and the death was attributed to natural causes, connected with the intemperate life which the deceased had been leading for some time. No post-mortem examination was therefore ordered by the authorities, but we obtained permission from the friends to examine the body.

This took place on 6th April, fifty-two hours after death, and the following is an account of the conditions found:—

Body spare, but muscular and well developed. Limbs rigid, moderate amount of lividity in skin of dependent parts of body. Eyes prominent, life-like, and conjunctivae injected. Slight greenish discoloration of the skin at the lower part of the abdomen. When the abdominal viscera were exposed to view by the usual preliminary incision, attention was at once attracted by a bright yellow colour on the surface of a coil of small intestine lying just below the duodenum. This yellow patch was fully the size of a two-shilling piece, its edges were sharply defined, and it conveyed the impression of an area of bright yellow paint underneath the peritoneum. The possibility of arsenical poisoning at once suggested itself, since in the first case, which occurred a few months before, a similar condition had been observed, although in that instance the colour was not so bright, nor were the yellow areas so well defined. The appearance was quite sui generis, and could not be confused with bile staining by anyone in the habit of making autopsies. Acting on the
suspicion thus aroused, the examination of the abdominal viscera was first proceeded with.

The stomach was distended with gas. Its peritoneal coat was hyperæmic, and the large surface blood vessels were filled with dark fluid blood. It contained 12 oz. of a thin greyish-red-coloured fluid, with small masses of white flocculent material floating in it. The mucous membrane of the left half of the stomach was pale, and had a normal appearance. Towards the pylorus, and especially along the greater curvature, the internal surface was contracted into thick rugæ. The mucous membrane was swollen, and like rich crimson velvet. It was suffused with extravasated blood, while an area about the size of the palm of the hand was covered with a white pasty mass or exudate, in which white crystalline particles could be detected with a lens. In the spaces between the rugæ, and also for some distance around the pylorus, the mucous membrane, although hyperæmic, was not so highly inflamed, and showed no extravagations of blood, or exudate. There was no erosion or ulceration of the mucous membrane. In the duodenum just beyond the pyloric orifice, there was a small quantity of a yellow powder adhering to the mucous membrane. The mucous membrane of the duodenum, jejunum, and upper part of the ileum was uniformly red and inflamed, more especially the valvulae conniventes, which were suffused with extravasations of blood. In the mucous membrane of the small intestine there were several areas of a light yellow colour, varying in size from a halfpenny to that of a five-shilling piece. These patches were not sharply defined, and were in some instances faint and liable to be overlooked. The signs of irritation diminished in the lower part of the ileum.

Under the peritoneal surface of the small intestines, in addition to the yellow patch already referred to, there were several other areas of yellow coloration, not quite so bright nor so well defined, but almost equally striking and suggestive of yellow paint, diffused in a thin layer in the tissues. On examining these patches with a lens, no visible granular structure was apparent; they did not correspond in position with the yellow patches seen on the mucous surface.

The small intestines contained about 20 oz. of a greyish-red fluid similar to that found in the stomach.

The cæcum presented several bright yellow patches on the mucous membrane, and one on the peritoneal surface, similar to those above described.

The large intestine was collapsed and empty, except for a small quantity of thin watery fluid. Its mucous membrane was red and inflamed in one or two places, and in the descending colon there were two areas of yellow coloration similar to the others. The mucous membrane of the upper part of the rectum showed patches of inflammatory redness.

The large mesenteric vessels were engorged with dark fluid blood. The mesenteric glands were soft and swollen.

The bladder contained about a teaspoonful of milky opaque urine. Its mucous membrane was not reddened. The capsules of both kidneys were loosely adherent to the cortex, which was swollen and pale.
The liver was very fatty, and engorged with fluid blood. The gall bladder was distended with dark green bile. The spleen and pancreas presented a normal appearance.

The heart contained dark fluid blood. The heart muscle was firm, and appeared healthy. The right ventricle was dilated. Beneath the endocardium of the left ventricle there were numerous extravasations of blood. These varied from the size of a pea to that of a bean, and were situated on the septum and on the musculi papillares towards the apex of the heart.

The lungs were engorged with blood. There were no subpleural hemorrhages.

The tongue was coated with a thick grey deposit. The mucous membrane of the lips and mouth was pale and moist. That of the fauces, larynx, and trachea was red and injected. The mucous membrane of the oesophagus was pale in its upper half. Towards the lower end it was loose and easily detached, and in parts had disappeared.

The vessels of the scalp, membranes of the brain, as well as of the brain itself, were engorged with dark blood.

As a result of the post-mortem examination, there could be no doubt that death had resulted from an irritant poison, in all probability arsenic. The application of Reinsch’s process to a small portion of the contents of the stomach quickly decided this question, the copper becoming at once thickly coated, and on heating, it gave a copious sublimate of octahedral crystals of arsenious acid. The police were made acquainted with the facts now disclosed, and as a result of their further investigation of the case the following interesting circumstances were discovered:

From a statement made by a friend of the deceased, it appears that the latter had told him that arsenic was a good “pick-me-up” for overcoming the effects of drink, and that he sometimes took it. He showed his friend a small box containing arsenic, which he said he had obtained at the electrical engineering works where he was employed as storekeeper, and which he carried about with him in his waistcoat pocket.

When expostulated with for taking such a dangerous substance, the deceased said he knew something about chemistry, and that a little arsenic after he had been drinking did him good. He was never seen to take any by his friend, nor yet by his sister when he came to her house, but on searching the house, the small tin box which he carried about with him was found in the room, empty, except for a few granules of white substance which analysis proved to be arsenious acid. Inquiries made at the works where the deceased had been employed confirmed the fact that arsenic was kept in the store which had been under the deceased’s charge. There can be little doubt, therefore, that the case was one of suicide or of accidental death, and that the deceased had taken a quantity of the arsenic he was in the habit of carrying about with him. His landlady stated that about three weeks before his death he suffered from a
severe attack of diarrhoea, which, in the light of the facts ascertained, may have been due to his having taken a dose of arsenic.

Chemical analysis.—Various organs of the body were first of all submitted to a qualitative test for the presence of arsenic, namely, that of Reinsch. The purity of all reagents was confirmed, and only the production of octahedral crystals by subliming the deposit on the copper was regarded as evidence of the presence of arsenic. Arsenic was thus proved to be present in the urine; blood from the inferior vena cava; bile; kidneys; spleen; liver; contents of the stomach, of the small intestine, and of the large intestine.

Only small quantities of these various organs and fluids were operated on, and in all instances an abundant crystalline sublimate was obtained. The cerebro-spinal fluid, as also the brain itself, gave negative results.

A quantitative analysis was made of the contents of the stomach, and of the small and large intestines. The method employed was: destruction of the organic matter with HCl and KClO₃, precipitation with H₂S gas, and weighing the arsenic as ammonio-magnesium arseniate.

The following amounts of arsenious acid were found to be present:—

| Fluid contents          | Documents   |
|------------------------|-------------|
| Fluid contents of stomach | 0.220 grm. |
| ,, small intestine     | 0.163      |
| ,, large              | 0.040      |

When the case resolved itself into one of suicide, the authorities decided that a complete quantitative analysis was unnecessary. The stomach was therefore preserved as a museum specimen, and no attempt was made to estimate the amount of arsenic which was proved, both microscopically and chemically, to be present in the pasty mass before described.

Through an accident at the autopsy, a considerable quantity of the fluid contents of the small intestine was lost, so that, for these reasons, the total quantity of arsenic present in digestive canal must have been considerably greater than the amount indicated in the above results.

The whole of the liver having been removed from the body, it was decided to make a series of analyses of portions taken from different situations, with a view to determine whether the arsenic was equally distributed throughout the organ. Accordingly, five portions were taken from situations as widely apart as possible.

The whole liver weighed 2010 grms., and the weights of the respective portions taken for analysis, together with the quantities of arsenious acid found in each, were—

1. Middle of posterior surface . 118 grms. = 5.5 mgrms. As₄O₆.
2. Centre of organ . . . . 269 " = 17.1 " "
3. Middle of anterior border . . . 112 " = 5.1 " "
4. Left lobe, lateral margin . . . 100 " = 3.0 " "
5. Right lobe, lateral margin . . . 148 " = 6.6 " "

Results which show a fairly close approximation to each other when the unavoidable errors of an analysis, dealing with such comparatively small quantities, is allowed for.

The five estimations show an average of 5.0 mgrms. As₄O₆ per 100
grms. of liver substance, or in the whole liver an estimated total quantity of 0.100 grm.

The method of analysis employed.—Little difficulty is, as a rule, experienced in getting rid of organic matter when one has to deal with the contents of the stomach or intestines, which are chiefly fluid, or with such organs as the kidney, spleen, etc.

In such circumstances either the method of destroying organic matter with HCl and KClO₃, or the distillation process may be employed, with equally good results and with comparatively little trouble. Probably the simplest method is to use the distillation process, since by this means an almost clear liquid is directly produced ready for treatment with H₂S.

In dealing with the liver, however, which in this case was extremely fatty, considerable difficulties were met with, in connection with the employment of both of these processes.

In the first, that in which HCl and KClO₃ were employed, we found that not only was the process a most lengthy and tedious one, and that owing to the large quantity of fat present a considerable amount of indestructible residue remained, but also it was found difficult to secure for some reason complete and thorough saturation of the resultant fluid with H₂S. So unsatisfactory did this method appear to us, that we decided to employ the distillation method.

A portion of liver was accordingly divided into small pieces, and these were then dried over a water bath. Thereafter they were introduced into a retort with HCl, and, after being allowed to stand for a time, heat was applied. After several trials, however, distillation of the liver in this form had to be given up on account of "bumping," which no amount of care appeared able to overcome. The bumping was apparently due to the fat which formed a thick layer on the surface of the liquid. It seemed to us, therefore, that if the fat could be removed prior to distillation, the process might still be used and prove in many ways preferable to the HCl and KClO₃ method.

With this idea in view, we accordingly resolved to extract the fat from the pieces of liver after they had been dried as before and prior to placing them in the retort. The fat was therefore thoroughly extracted in a Soxhlet tube with ether, and after the ether had been evaporated, the pieces of liver thus deprived of fat were placed in a retort along with HCl, and distilled.

The distillation now proceeded without any trouble from bumping or frothing, and a clear distillate, practically colourless and free from organic matter, was obtained. It seems to us that such a method as that now indicated possesses distinct advantages, inasmuch as it renders the distillation process more feasible of application in the case of such an organ as the liver, which may contain a very considerable proportion of fat.

The abstraction of the fat prior to distillation is not open to objection so far as we can see, since arsenic is insoluble in ether.

We are aware that it is open to objection on account of a possible loss of arsenic during the process; but if the distillation is properly carried out, with due care and precautions, we do not think that the possible error is greater than in the case of other processes.
The method of procedure employed subsequent to destruction of the organic matter, in all instances, was the usual one, namely, precipitation with H₂S, dissolving the H₂S precipitate with NH₄OH, and then evaporating to dryness over a water bath. The residue was then oxidised with HNO₃, evaporated to dryness, and this residue dissolved in water and filtered. After the addition of magnesium mixture, the liquid was allowed to stand for twenty-four hours, when the precipitate was filtered off, ignited, and weighed. An allowance of arsenious acid was made for every 16 c.c. of filtrate from the magnesium arseniate precipitate.

The above cases are interesting in many respects. They tend to indicate how easily, under our present system of procedure, cases of poisoning may remain unrevealed where no doctor has been in attendance. In both of the cases we have recorded, neither in England or Scotland, in the present state of the law, would an autopsy have necessarily taken place prior to burial, with the result that these deaths would in all probability have been certified as due to natural causes. We could give several instances from our own experience, in which, as a result of the police inquiries into the circumstances attending deaths of a more or less sudden nature, and even in the opinion of doctors called in to attend such patients, no unnatural cause was suspected, and yet, on making a post-mortem examination, we have found poisoning by oxalic, hydrocyanic, or carbolic acid. In these cases it was impossible to tell the cause of death from an inspection of the body or of its surroundings, and only an autopsy could disclose this.

If such unsuspected cases can occur in a large town with a superabundance of well-educated doctors, and in connection with poisons such as arsenic, carbolic acid, oxalic acid, and prussic acid, it is not difficult to imagine that there must be annually a considerable number of others throughout the country.

In the first case, that of J. M., neither the amount of arsenic taken nor the time of its administration can be determined. As a rule, however, a threepenny packet of rat poison contains about 7.77 grms. of arsenious acid, and it is probable that this was the quantity taken. It is not likely that he took the poison before supper at 9 p.m., owing to the absence of any marked symptoms, but it is quite possible that he may have swallowed it at any time thereafter, since with a full stomach the effects of the poison would naturally be retarded.

This patient lived for twenty-seven hours after the onset of symptoms, during almost the whole of which time he is stated to have been frequently vomiting and retching. It is quite in accordance with the well-known inefficacy of vomiting to get rid of all the arsenic taken in a solid form, that the contents of the stomach were found to contain a considerable quantity of the poison, although the vomiting had effectually got rid of every
trace of soot. A somewhat unusual circumstance was the entire absence of diarrhoea during the whole period of illness.

The second case, that of R. J., was remarkable for the absence of well-marked symptoms of gastro-intestinal irritation. There was retching, it is true, but he never vomited, while the bowels only moved three times. This appears to have been one of those cases in which the symptoms were partly those of the gastro-intestinal and partly of the paralytic type. This fact, together with the rapidly fatal course of the illness, about seven to eight hours, if we assume, as I think we may, that the poison was taken after supper, would point to a large amount of arsenic having been swallowed. But, on the other hand, we think it is very unlikely that any large quantity was taken, because, notwithstanding that there was no vomiting, the amount of arsenic present in the stomach and intestines was not very great, or in such quantity as is usually associated with the paralytic type of symptoms.

The widespread distribution of the arsenic throughout the various organs in such a short time would be a point of some importance were we not dealing here with the probability of the deceased having frequently taken arsenic previously. How often and how much he was thus in the habit of taking is a matter of conjecture, and it is an interesting problem how he escaped poisoning himself, if, as he is recorded to have said, he took a "pinch" at a time. Taylor states 1 that the question of how much a pinch of arsenic amounted to arose at the trial of Thomas Jennings for the murder of his infant son, Eleazar Jennings, by the administration of arsenic. Actual experiment, Taylor says, shows that a "good pinch" of the powder was equal to 17 grs. It is, of course, beyond belief that a pinch in the present case could have approached this amount on any occasion prior to the fatal one, since 2 or 3 grains would certainly have produced severe symptoms of poisoning, from which, except on possibly one occasion, he does not appear ever to have suffered. It may reasonably be surmised, therefore, that his "pinches" were minute, except upon the last and fatal occasion, and if we assume that the case was one of accident, and that Taylor's computation is correct, then the amount taken did not exceed, in all probability, 17 grains.

The possibility, in this case, that we have to deal with chronic administration of arsenic, detracts from the value which might have been attached to the finding of arsenic so generally diffused throughout the organs after such a short illness, and also from the conclusions which might otherwise have been drawn from the distribution of the arsenic in various parts of the liver.

A feature of interest was the presence of the sulphide of arsenic in both cases in the stomach and intestines. The presence of yellow sulphide of arsenic in the bodies of persons who have

1 Guy's Hosp. Rep., London, 1845, vol. iii. p. 187.
been poisoned with arsenious acid, and which have been buried for some time, is not by any means an uncommon occurrence.

Orfila records a case\(^1\) of a body exhumed one month after burial, in which there was a yellow spot on the cardiac end of the stomach externally, corresponding to a similar spot on its inner surface. The stomach, duodenum, and jejunum were lined with a yellowish mucus, and a great abundance of particles of white arsenic was found where this yellowish mucus was most abundant.

Christison in 1827,\(^2\) in the body of Margaret Warden, poisoned by arsenious acid, and exhumed twenty-two days after death, states: "The stomach contained 10 or 12 oz. of a thick fluid with yellow particles floating in it." Similar particles were adherent to the villous coat, and at some points were deeply embedded in its substance. Besides the yellow particles, a white powder was scattered over the whole stomach and small intestines.

In this case Christison was closely questioned in his cross-examination as to how the presence of the sulphide of arsenic in the stomach might be accounted for. It was suggested for the defence that the case was one of suicide, and that the deceased might have taken sulphide of arsenic, whereas the prisoner was proved only to have purchased the oxide of arsenic. Christison imputed the yellow particles to conversion of part of the oxide of arsenic into the sulphide by H\(_2\)S disengaged in the stomach. Dr. Fyfe, for the defence, stated that he did not conceive this to be a probable explanation, and Christison had to admit that H\(_2\)S had never been found, or rather sought for, in the stomach after death, although it had often been found in the stomachs of animals.

The case of Margaret Mackisser\(^3\) set this question at rest in the following year, for Christison again found shiny yellow particles on the surface of the stomach. Instructed by experience, he did not leave the existence of H\(_2\)S to be presumed from analogy, but actually detected it in the bottle in which the stomach was sent for analysis. The writer of the article makes the further statement, which is of considerable interest, that the presence of the sulphide "appears in fact to be by no means an uncommon appearance in the stomach." It was remarked in another of Christison's cases.\(^4\)

Christison, in his book on "Poisons," 1829, p. 257, remarks that "the appearance does not seem to have attracted much attention: yet I should think it must occur frequently." Numerous cases have been recorded by many observers in later years, and we can therefore agree with Christison that the appearance is by no means an uncommon one in the exhumed bodies of persons who have been poisoned with oxide of arsenic.

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1 Arch. gén. de méd., Paris, 1823, vol. ii. p. 58 (Edin. Med. Journ., vol. xxi. p. 238).
2 Edin. Med. Journ., vol. xxvii. p. 453.
3 Ibid., vol. xxix. p. 415.
4 Edin. Med. Chir. Trans., vol. ii. p. 284.
Not only may the yellow sulphide thus be formed on the surface of particles of the oxide clinging to the mucous membrane of the stomach and intestines and suspended in their contents, but it may also be found deposited in the tissues, which it has reached by inhibition, as for example under the peritoneum of the stomach and intestines, and in neighbouring organs, giving rise to an appearance as if they had been smeared with yellow paint.

In the case of Alice Hewitt, recorded by Taylor, when the body was exhumed eleven weeks after burial, the arsenic had been partially converted into sulphide, "and it was observed that the liver, omentum, and right side of the heart were thickly coated with yellow arsenious sulphide."

Taylor also records a case in which, in addition to the stomach and intestines, the muscles and ligaments in front of the spine and the mesentery were tinged with a bright yellow colour, due to sulphide of arsenic.

Murray records the case of an Indian woman whose dead body was discovered in a box. "Decomposition was fairly advanced, but there was very little odour." Internally it was fresh and well preserved. "The heart was soft from post-mortem changes, and empty. The endocardium of the left ventricle presented a peculiar bright yellow stain or deposit over one-third of its area, as if iodoform had been powdered upon it." In this case it is stated that a packet of "yellow" arsenic was found in the guilty party's house, but it seems by no means proved that this was the form of arsenic administered, and not white arsenic.

Bose, who received the organs after some days for chemical analysis, states that when he examined the heart he found that the endocardium of the right ventricle also showed a similar yellow colour, and suggests that the formation of the sulphide here may have occurred during the interval which elapsed between Murray's examination and his own. He made experiments by poisoning animals with arsenic, and then treating the endocardium of the ventricles with $\text{H}_2\text{S}$, but without positive results.

It is interesting to note that the conversion of antimony into its sulphide has also been observed in exhumed bodies.

In the case of R. v. Klosowski or Chapman (C.C.C., March 1903), Sir Thomas Stevenson informs me that in the body of Bessie Chapman, exhumed twenty-two months after death, he found shiny orange-yellow mucus in the lower part of the ileum, in another of the victims, Mary Chapman or Spink, exhumed five years after death, there was orange-yellow discoloration in the

1 Guy, "Principles of Forensic Medicine," 3rd ed., p. 448; Guy's Hosp. Rep., London, 1845, vol. iii. p. 187; Taylor, "Poisons," 2nd ed., pp. 193, 375; Lancet, London, 1884, vol. i. p. 563.
2 "Principles and Practice of Medical Jurisprudence," 4th ed., vol. i. p. 285.
3 Pharm. Journ., 1862, p. 377.
4 Lancet, London, 1892, vol. ii. p. 936.
5 Ind. Med. Gaz., Calcutta, 1892, p. 142.
lower part of the ileum and first part of the ascending colon. The appearances did not resemble those due to yellow arsenious sulphide, but were like dirty or orange-yellow paint. The presence of the sulphide was proved, and in both cases considerable quantities of antimony were found distributed throughout the various organs of the bodies.

In the case of the third victim (Maud Marsh), whose body was examined before burial, no sulphide was observed, but all the organs contained antimony.

The conversion of white arsenic into the sulphide was regarded as a change which only took place during the advanced stages of putrefaction; and although there are numerous cases recorded in which the appearance was observed in bodies exhumed after burial, yet it is a curious fact that there are very few in which the presence of the sulphide has been noticed within a day or two of death.

This circumstance is all the more remarkable when we consider the very large number of recorded cases of arsenical poisoning in which autopsies have been made, and also recall the opinion expressed by Orrila\(^1\) in 1831, that if arsenic were to be taken \textit{en poudre impalpable}, and if H\(_2\)S gas were present in the alimentary canal, arsenious acid might be transformed into the yellow sulphide in the course of a few hours.

Hofmann\(^2\) refers to the presence of the sulphide in poisoning by white arsenic within a few days after death as a circumstance which, so far as he is aware, had not previously been observed; and he relates a case in which it was found in the caecum two days after the person died.

In addition to the two instances which we record, we have only been able to discover in English literature three others in which the presence of the sulphide was observed under similar circumstances, so that the condition must be regarded as one of some rarity.

The following are the three instances to which we refer:—

Letheby\(^3\) relates an interesting case of a girl, æt. 19, who took only 2\(\frac{1}{2}\) grs. of arsenious oxide. She died in thirty-six hours. The post-mortem examination was made twenty-one hours after death. Along the pylorus the mucous membrane had acquired a gamboge tint, and Letheby remarks on the circumstance that the sulphide should have been found so soon after death.

Taylor\(^4\) records a case in which a man took a large amount of oxide of arsenic. He died eighty-one hours afterwards. There was very little vomiting and no purging. An autopsy was made twenty-one hours after death. "The stomach was distended with

\(^{1}\) "Traité de médecine légale," 1836, tome iii. p. 174.
\(^{2}\) \textit{Wien. med. Wchnschr.}, 1886, Nos. 10–12.
\(^{3}\) \textit{Lancet}, London, 1847, vol. i. p. 44.
\(^{4}\) \textit{Guy's Hosp. Rep.}, London, 1851, vol. vii. p. 187.
gas. The mucous membrane of the left half of the stomach was of a canary-yellow colour, and there was a patch of a similar colour near the pylorus."

Paterson\(^1\) mentions a case in which he made an autopsy on the day following death. The patient took arsenious acid suicidally, and lived for sixty hours, with symptoms of violent vomiting and purging. "The stomach contained several ounces of a brownish-tinted fluid, with dark-coloured stringy mucus and yellowish particles floating in it. On the surface of the lining membrane was a considerable quantity of this yellowish powdery substance. The yellowish powder, when collected and tested, turned out to be arsenious acid tinged with the sulphuret of arsenic."

Hofmann, in his case, found in the caecum light yellow particles with citron-yellow coloration of the mucous membrane, and he suggests the possibility of the formation of the sulphide having taken place during life. He does not regard this as likely to occur during life in the stomach or small intestine, except in special circumstances, such as the administration shortly before death of an alkaline sulphide as an antidote, as Christison\(^2\) had in the year 1827 pointed out. In the large intestine, however, Hofmann thinks it is quite possible for the change to take place, because $\text{H}_2\text{S}$ occurs in the gases of the large intestine, and, as a rule, the contents of this part of the bowel have an acid reaction. Whether this change can, under certain circumstances, occur during life or not, there is no doubt that the conditions present in a body within a few hours after death may be highly favourable to the process of converting arsenic into the sulphide. In the cases cited above, as well as in the two we record, the stomach is described as distended with gas, or the organs otherwise showed evidence of putrefaction, so that there is little difficulty in ascribing the condition to a post-mortem change.

This early conversion of arsenious oxide into the sulphide in the stomach and small intestines is a matter which is of considerable medico-legal importance. If the fact had not been thus placed beyond doubt, it is not improbable that such exceedingly quick and extensive conversion of arsenic in the body into the sulphide might be regarded as impossible, and a guilty person be wrongly accused of administering orpiment, whereas white arsenic had been the poison employed. In the majority of cases, however, it will be found that, in addition to the sulphide, white arsenic is also present, a fact which proves that the poison must have been administered in this latter form. This circumstance was noted in all of the above cases, and it will be further found, as a rule, that the particles which appear yellow are only so on the surface, and contain a core of arsenious oxide.

\(^1\) _Edin. Med. Journ._, 1858, vol. iii. p. 394.
\(^2\) _Ibid._, vol. xxvii. p. 453.
The conversion of arsenic into the sulphide has further medico-legal importance, inasmuch as, owing to its insolubility in water and acid fluids, it cannot become disseminated from organs in which it has once been formed, by processes of imbibition and transudation after death, like the more soluble arsenuous acid.

It must be borne in mind that a yellow coloured particle or a yellow staining of the mucous membrane may be due in cases of arsenical poisoning to other causes.

Taylor\(^1\) found a white crystalline powder mixed with yellow particles in the stomach eight days after death in a case of poisoning by arsenic. At first he thought they were particles of arsenuous acid mixed with the sulphide, but on further investigation the white powder was found to be compound phosphate of ammonium and magnesium, while the yellow particles consisted of organic matter.

Whitford\(^2\) found a bright yellow staining of the bowel and of the mesenteric blood vessels in a child, \(\text{a}t.\) 10, whose body was exhumed twenty-one months after death. The bowel contained small hard granules, which proved to be phosphatic crystals. One grain of arsenic was obtained from the abdominal viscera.

In a second case, that of a man, \(\text{a}t.\) 24, whose body was exhumed after three years’ burial, he also observed yellowish stains on the grave clothes; the intestines presented throughout most of their length a golden yellow staining, and the mesenteric vessels were similarly stained. Small phosphatic crystals were present as in the previous case. On analysis, 3½ grs. of arsenic were extracted from the abdominal viscera.

Brown and Davies\(^3\), who analysed the yellow pigment in these cases, found that it was not sulphide of arsenic, but in all probability was due to bile pigment.

These observations show that in cases of arsenical poisoning, in which yellow stains or particles are observed, the presence of sulphide of arsenic must not be assumed, but must be proved by chemical tests. This was done in our own cases, although the distribution and appearance of the yellow stains were such that they could not be confounded with the effects of bile by anyone who was experienced in the examination of bodies after death.

\(^1\) Guy’s Hosp. Rep., London, 1851, vol. vii. p. 222.
\(^2\) Lancet, London, 1884, vol. i. p. 419.
\(^3\) Ibid., p. 421.