Medico-legal contributions on arsenic : containing reports of a number of cases of arsenical poisoning, together with an account of the methods employed in their chemical examination / by Charles H. Porter.

Porter (C. H.)

MEDICO-LEGAL CONTRIBUTIONS

ON

ARSENIC:

CONTAINING REPORTS OF A NUMBER OF CASES OF ARSENICAL POISONING, TOGETHER WITH AN ACCOUNT OF THE METHODS EMPLOYED IN THEIR

CHEMICAL EXAMINATION.

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MEDICO-LEGAL CONTRIBUTIONS.

I. The Detection of Arsenic.

II. Cases of Arsenical Poisoning.

Intending in this paper to report a number of cases of arsenical poisoning, it has been deemed advisable to preface them by an account of the methods pursued for the detection of the poison. This is done for the reason, that when the details are given, each one may judge for himself as to the degree of reliance to be placed upon the results, and also, because medical men generally are not acquainted with the minutiæ of such examinations.

It may also be said that while the special works on poisons contain detailed information regarding the various tests, they are deficient in any systematic method of procedure applicable to those cases where the particular poison is unknown.

Aside from text books on chemical analysis, and a single one on the detection of poisons, there is nothing easily accessible to medical men in this country that furnishes detailed information upon this subject. The design of the first part of this paper (which bears no claim to originality, but is a compilation from various sources), then, is to give the method pursued in the investigation of the cases hereafter reported—a general mode of procedure in all cases of metallic poisoning (ensuring the detection of the various toxical agents), with special reference however to arsenic; and again to give a systematic plan, whereby the material can be most properly prepared for obtaining the various tests, together with a brief description of the more characteristic chemical reactions for arsenic.

Part I. The Detection of Arsenic.

I. *General Considerations.*

1. *Chemical evidence.*—The chemical evidence in cases of supposed poisoning is generally regarded as the least fallacious of all branches of proof. Owing to the labors of Orfila, Fresenius, Otto, Stas, Flandin and others in the detection of poisons, the subject has become so far developed, that in the majority of cases a charge of poisoning may be satisfactorily decided by the results of a chemical examination. This opinion is entertained not only by professional chemists, as well as by intelligent medical men, but also by courts of justice, so that commonly the chemical detection of a poison is deemed necessary before a conviction can be obtained in a charge of poisoning.

But it must be said, that not unfrequently too much reliance is placed upon chemical evidence, many deeming it unsafe to convict where this evidence is wanting. This is however a narrow view, and indicates an ignorance of toxical science. Simply because poison is found in certain remains, it does not necessarily follow that it was the cause of death; the symptoms and post mortem appearances may prove the contrary; nor does the absence of poison in the dead prove that death was not occasioned by poison.

In this country, few if any individuals have been convicted of the crime of poisoning, where the poison was not supposed to have been found in the body. In England, the celebrated Palmer case offers an instance to the contrary, and others might be mentioned. There seems to be no good reason (where other evidence is positive,) why a conviction should not be obtained, even in the absence of chemical evidence; all that is necessary in such a case, is to satisfy a jury that the deceased died from poison, and this occasionally may be done without, as well as with the class of evidence we are speaking of.

The detection of poisons in the tissues generally, as well as in the intestinal tract, and in the food and medicine given, furnishes the most complete chemical evidence of poisoning; if only found in the stomach or in the food or medicine, the testimony is weakened because there is a possibility that it might have been placed there subsequently.

There are certain fallacies which must be guarded against in receiving evidence derived from chemical examinations in medico

legal investigations. It is not to be supposed that in all cases such examinations will be made by those most competent, and hence, besides the inherent difficulties of such researches, it is necessary to insure ourselves against the ignorance and unskillfulness of the operator. Thus we may allude to the meagreness or absence of characteristic tests for many organic poisons, and the difficulty of separating them from organic mixtures; again, and this is more pertinent to the subject of this paper, it has been ascertained that many of the reagents, supposed to be pure, are often contaminated with poisons.

Thus, arsenic is often found in zinc, sulphuric acid and chlorohydric acid, and in other materials used in toxical investigations. The knowledge of this fact causes us to doubt whether the arsenic discovered in minute quantities in many reported cases, was contained in the remains examined or in the chemicals used. The above remarks illustrate the great danger there is in relying upon the supposed detection of minute quantities of poison, in the absence of physiological and pathological evidence, and without a careful examination by competent authority of the methods followed in operating upon the materials examined.

Before treating of the methods of analysis, a few remarks may be made concerning the

2. *Physical examination of materials for analysis.*

Food, contents of the stomach, &c.

By a careful physical examination of these substances poison may often be discovered. The best mode of procedure is to place a part of the suspected mass into a glass vessel such as a beaker, and after adding water, stir the whole with a glass rod. After allowing it to settle, pour off the water, without disturbing the sediment. To this water should again be added and the operation repeated. In the bottom of the vessel may often be seen arsenious acid in the form of small white particles, which feel gritty and grate under the glass rod. These are to be taken out and dried. As simple tests, one or more may be gently heated in a glass tube sealed at one end, and another in a similar tube with carbonate of soda. If in the first tube is produced a white crytalline deposit, and in the second a black metallic mirror, it is pretty decisive evidence of the existence of arsenic.

Stomach, intestines, &c.—If the intestinal tract is to be examined, it should be completely opened, and its appearance carefully observed.

Very often particles of arsenious acid may be seen adhering to the mucous membrane, which may be tested in the manner just mentioned.

3. *Division of materials for analysis.*—Mechanical division facilitates chemical action; it is therefore proper to minutely divide organic substances before commencing their analysis. This may be done by a pair of scissors or small shears, but where a considerable quantity of animal matter is to be operated upon, a small new "meat-chopper" (consisting of an iron cylinder containing a set of revolving knives) may most conveniently be employed. By such an apparatus, in five or ten minutes the various parts, as the stomach, intestines, liver, kidney, &c., may be converted into an almost homogeneous pulpy mass, and thus be in the best condition for being acted upon by chemical agents.

4. *Necessity of a preliminary examination.*—From what has already been said of the fallacies of chemical evidence, and the nature of the errors that may arise, it is evident that in cases of suspected poisoning, the chemical examination ought only to be entrusted to experienced and reliable men. No amount of labor ought to be spared in such an examination, in obtaining reliable results, for an error may cost a human life, and from the fact of impurities of a poisonous character occurring in our chemicals, &c. there exists in my opinion, a real necessity for a thorough preliminary examination. Portions of animal or vegetable matter as the case may be, equal in weight to the articles afterwards to be examined ought to be taken, and subjected in the same vessels and apparatus to the same processes, by the use of portions of the same reagents in as large a quantity as will afterwards be used in the actual examination.

If this examination shows the vessels and chemicals to be pure or free from poison, the analyst may at once proceed to the examination of the suspected material; and if otherwise, he will detect the impure materials and can replace them. Only after this procedure can the real examination be properly undertaken, the results will then be entitled to confidence, and all doubt will be removed from the mind of the examiner regarding the source of the poison, in case any is found; it will besides free him from many embarrassing questions when in the witness box, which otherwise might seriously affect him.

It may be stated here that it was probably in consequence of arsenic occurring in the reagents employed in the investigations,

and the omission of their preliminary examination, that led to Orfila's erroneous assertion that arsenic is a normal constituent of the human body. Because of this omission in the case of Mrs. Wooler,(Durham, Eng., Winter Assizes, 1855,) doubt was thrown on the scientific evidence by reason of the use of chlorohydric acid containing arsenic; the discovery of this impurity was not made until after the analysis was completed.

In every case investigated by me, a preliminary examination has been made in the way just mentioned. It is true that but a few poisons, of which the chief is arsenic, are likely to occur in the materials employed in analysis; occasionally, however, others are present, and as a general rule, therefore, it is advisable to make a preliminary examination.

5. *Separate examination of each part.*—It is always desirable that each part be separately examined, as for instance, the stomach, the contents of the stomach, the small intestines, the large intestines, the liver, &c., for often by proceeding thus, important information may be obtained. It is best also to consume in the first examination but a part of the material (after the whole has been finely divided and intimately mixed)—two-thirds for example—so that in case of accident an examination may still be made; and to this there is usually no objection, since in almost all cases, if the poison can be detected in the whole it can be in the part mentioned, and in sufficient quantity not only to identify it but to make the greater number of the confirmatory tests.

6. *Remarks on the method to be pursued.*—It is not difficult to identify the various metallic poisons when they are free from other substances, by the application of a few simple tests. Where, however, the poisons are in admixture with organic matter, the problem presented is of far more difficult solution, for the organic substances may prevent, modify or conceal the characteristic chemical reactions which otherwise would take place upon the application of the different reagents. As most often the substances presented for toxical examination are articles of food or portions of the human system, toxicologists have devised many methods for the destruction or separation of the organic matter without any loss of the poison. The method we prefer is that proposed by Duflos? and elaborated by Fresenius and Babo. I speak from a somewhat large experience, and can say that, taking everything into consideration, it is far more reliable and

satisfactory than any other that I have met with. In many cases forwarded to me for examination, I have not been informed of the circumstances attending the death, and have therefore sought for a method by which (after determining as far as possible the absence of organic poisons,) none of the metallic poisons could escape detection, and have adopted that alluded to.

If the problem was always the simple one, "is arsenic or is mercury contained in these remains," other processes might possibly be more advantageously employed. Taylor, in his work on poisons, speaks depreciatingly of Fresenius' and Babo's method as being elaborate and exhaustive, and says that (according to Orfila) its complications surpass all credibility. To this it may be replied that the process which the most distinguished chemists of the world approve, as Otto, Bocher, Wohler, Silliman, &c., and which stands the test of years, must have great merit in it or it would not be thus supported; in their opinion it is evidently the best that has been devised.

It is true that the process demands a considerable amount of chemical knowledge and skill in manipulation; it *is* elaborate and exhaustive, it is also accurate and reliable, and can be satisfactorily applied in any case.

It may be said that in many cases a physician or other person, who has not applied himself especially to the detection of poisons, may satisfactorily determine their presence; undoubtedly this is true, but it seems to us most prudent, in cases involving a human life, to have the examination conducted by those who are experts and have made toxicology a specialty, for thus the fallacies attending all chemical processes in the hands of the inexperienced are removed.

We will now briefly give a

II. *General method for the destruction of organic matter in the presence of the metallic poisons.*

1. *Decolorization and solution.*—If much water is present in the matter to be examined, it is desirable to concentrate it in a water bath, or at a temperature not exceeding 212 deg. F.; it is then to be treated as indicated below.

Solid matter, such as the liver, stomach, &c., after being finely divided, is to be placed in a porcelain evaporating dish, and mixed with chlorohydric acid and water, until it forms a thin paste. It is neither desirable nor necessary to use a very strong

acid; an acid having the density of 1.11 is sufficient. The dish is then to be placed upon a water bath, or over a lamp, and gently heated at a temperature not exceeding 180 deg. F. Chlorate of potash is then to be added, in portions of from 10 to 20 grains, every five minutes or thereabouts, occasionally stirring the mixture until the whole is converted into a light yellow homogeneous liquid, when it is allowed to cool. (The fatty matters are with difficulty destroyed, nor is their decomposition generally absolutely necessary: they solidify upon cooling, and are easily removed.) The liquid is now to be placed upon the sand bath and heated until the smell of chlorine has disappeared. By the action of the chlorohydric acid upon the chlorate of potash, chlorine compounds are evolved, which decompose the organic matter, and convert any arsenic that may be present into arsenic acid. After cooling, the liquid is to be filtered, and the filtrate carefully preserved; the residue remaining upon the filter is to be thoroughly washed and the washings collected in a separate vessel, if in large quantity they may be evaporated to the bulk of 3 or 4 ounces, and are then to be added to the original liquid. (The residue may contain sulphate of lead.)

2. *Treatment by sulphydric acid*, (H S.)—The mixed fluid is poured into a beaker glass, and a slow stream of washed sulphydric acid passed through it for twelve hours, it is then to be allowed to remain at rest for the same length of time. This treatment precipitates any arsenic, mercury, antimony, copper, &c., that may be present in the form of the corresponding sulphid, together with a portion of organic matter. The liquid is afterwards filtered and the precipitate washed until a small portion of the washings gives no precipitate with nitrate of silver, thus indicating the absence of chlorine—(the filtrate and washings may contain zinc, &c.)

The production of a precipitate by sulphydric acid does not of itself indicate that any metals were in solution, since organic matter, even if alone, is precipitated under these circumstances.

3. *Purification of the precipitate.*—It is to be particularly noted that in order to obtain satisfactory results, all the materials used in the following operations must be free from chlorine, otherwise a portion or the whole of the arsenic, according to the quantity present, will be converted into the chlorid and may be volatilized. If the precipitate by sulphydric acid is of a yellow color, it may contain arsenic, antimony or tin, if of a dark color

approaching to blackness it may contain copper, lead, bismuth or mercury together with the metals first named. It is now to be treated with ammonia and sulphid of ammonium, which will dissolve the sulphids of arsenic, antimony and tin. The ammoniacal solution may be poured upon the filter (stirring the precipitate meanwhile with a feather or with a glass rod covered with caoutchouc) until all soluble matter is removed. The precipitate is then to be washed and the first filtrate, mixed with the washings is to be evaporated to dryness at a moderate temperature. The dry residue is to be treated with fuming nitric acid and gently evaporated. This operation is to be repeated until the residue while moist is of a clear yellow color. A few drops of water are to be added and gradually a solution of carbonate of soda to neutralize the acid. A mixture of two parts of nitrate of soda and one part of carbonate of soda is then added, the whole is carefully mixed together and dried, then placed in a porcelain crucible and gradually heated to fusion. By this operation all organic matter has been destroyed and the metals present oxydized; the antimony is converted into antimoniate of soda, the tin into binoxyde of tin and the arsenic into arsenate of soda; the latter only is soluble in cold water. The fused mass when cold is therefore treated with cold water, and the solution placed in a porcelain dish, sulphuric acid is then added until the liquid is strongly acid. This expels any nitric and nitrous acids that may be present, it is then evaporated and when quite concentrated, more sulphuric acid is added. If no red fumes appear upon the last addition it has been added in sufficient quantity; if they are produced the operation must be repeated. The solution finally must be evaporated until the white fumes of sulphuric acid are given off. Any arsenic present is now in solution as arsenic acid. It is desirable in order to determine the weight of arsenic present to convert it into arsenious acid; this is readily done by adding concentrated sulphurous acid solution, until its odor is distinctly perceptible, then evaporating the liquid until its odor disappears.

III. *Method for determining the weight of arsenic and making the characteristic tests.*

1. *Determination of the weight of arsenic.*

The solution obtained as just directed is to be diluted with water, placed in a beaker, together with the washings of the porcelain dish, and a stream of washed sulphydric acid passed

into it. If any arsenic is present, it will be precipitated in the form of tersulphid of arsenic.

This is to be collected on a small filter (previously dried at 212 deg. F. and weighed,) then thoroughly washed, and dried at the same temperature as before and again weighed. The increase in the weight of the filter represents the amount of tersulphid of arsenic present.

Or the precipitate may be collected on a small filter thoroughly washed, then dilute ammonia added drop by drop, until it is all dissolved; the filtrate and the washings are to be collected in a weighed dish and evaporated to dryness and weighed as above.

Each part of tersulphid of arsenic is equal to 0.8049 of arsenious acid, or to 0.6098 of metallic arsenic.

Thus supposing the weight of the sulphid of arsenic was 0.345 grains, this is equal to (0.345×0.8049=) 0.277 grains arsenious acid or to (0.305×6098) 0.210 grains metallic arsenic.

2. *Conversion of the sulphid of arsenic into compounds suitable for testing.*

It is now desirable to make the most characteristic tests for arsenic, some of them are popularly known, and it is expected by courts of justice that they shall be made when arsenic is found in the examination of a case of suspected poisoning, there are others less known, but at least equally distinctive. Now, although it is not necessary to make them all to satisfy a chemist of the presence of arsenic, yet, as in the majority of cases, there is a sufficient quantity present to make all those tests, which are deemed satisfactory by medical jurists, and as it consumes but little time, is it not as well to make all, or at least the greater part of them? Any common test omitted is often seized by the defendant's counsel, and is made to appear as the most characteristic, if not the only reliable test; why not avoid even this slight perplexity, besides otherwise the jury may be misled; again an accumulation of tests perfectly corresponding with, and corroborating each other, is more satisfactory to them.

In fact, the production of a metallic mirror, easily volatilized and readily oxydizable, and which furnishes by oxydation octahedral crystals soluble in water, is sufficient evidence of arsenic.

Various plans may be adopted to bring the sulphid of arsenic, obtained in the manner just mentioned, into a state fit for making the various tests.

The following method is convenient and simple. A part, or the

whole of the sulphid of arsenic, according to the quantity obtained, is to be placed in a small porcelain dish, and concentrated nitric acid added, and evaporated. This operation is to be repeated a number of times. The residue is to be repeatedly moistened with water, and as often evaporated, by this means every trace of nitric acid is finally removed (a condition essential to the success of the succeeding operations) the sulphid of arsenic is by this treatment converted into arsenic acid. The mass remaining in the dish is dissolved in a small quantity of water, and if particles of sulphur are present, it is to be filtered, the filter thoroughly washed, and the washings mixed with the original solution. The mixed fluid may be divided into two parts, *A* and *B*.

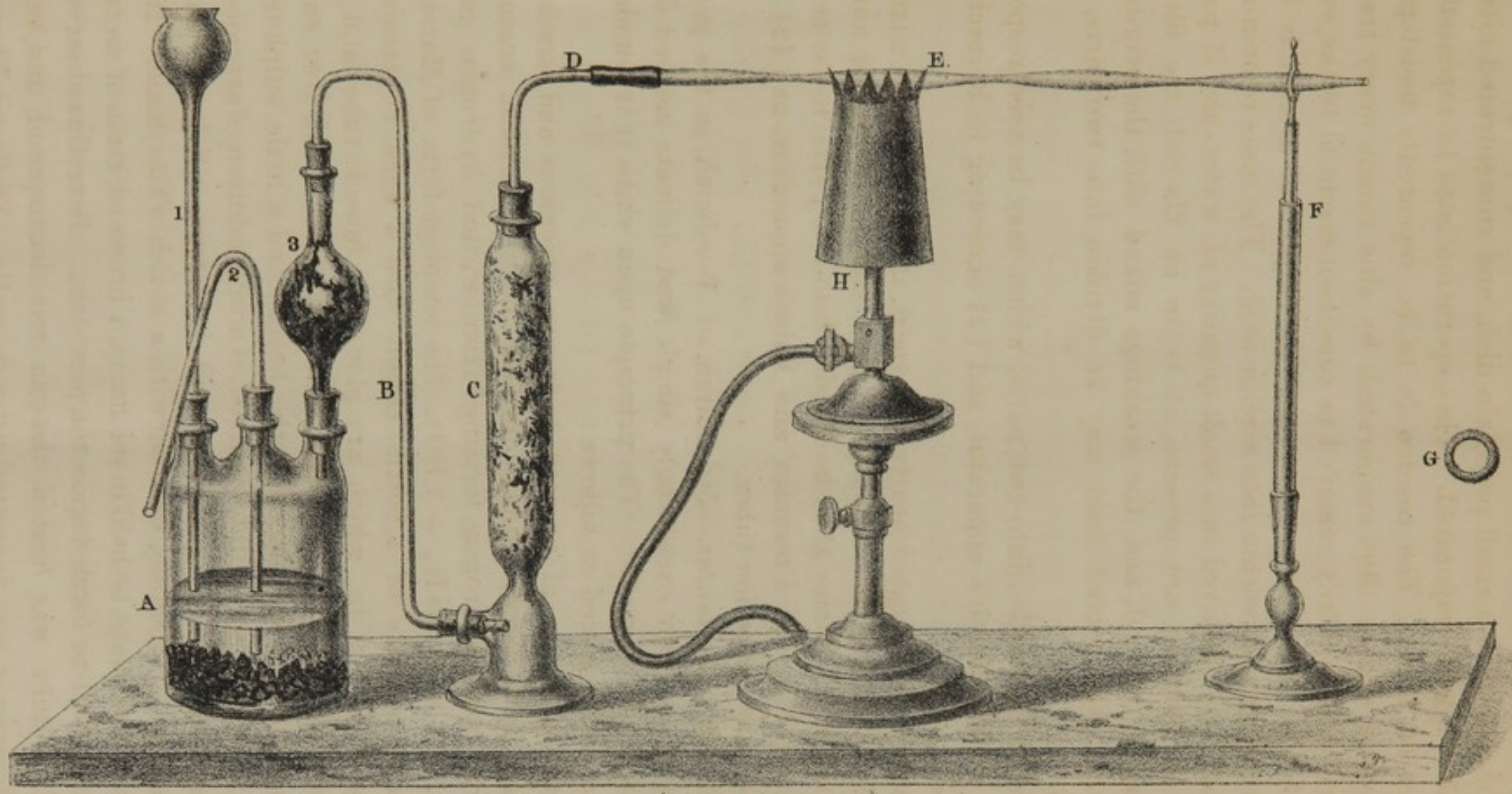
A is to be divided into two parts, which may be used respectively in (1) Marsh's apparatus, and (2) according to Reinsch's method.

B is to be evaporated nearly to dryness, then thoroughly mixed with twice its bulk of carbonate of soda, and gently heated until perfectly dry. It may then be divided into two parts, to be used respectively in (1) Fresenius' and Babo's apparatus, and (2) in the ordinary reduction tubes.

3. *Marsh's Apparatus.*—Mr. Marsh, of Woolwich, in the year 1836, proposed an exceedingly simple and delicate method for the detection of arsenic. The principle upon which it is founded may be briefly stated as follows:

In the presence of nascent hydrogen, arsenious and arsenic acids are deoxydized, water is formed, and the metallic arsenic combines with hydrogen forming arseniuretted hydrogen gas. ($As\,O_3 + 6\,H, = As\,H_3 + 3\,HO$). The simplest form of Marsh's apparatus consists of a bottle closed with a cork containing two perforations, in which are placed a funnel tube and a tube bent at right angles, drawn out to a point at the free end, zinc and water being placed in the bottle, and a little sulphuric acid added, hydrogen will be evolved, if now a solution of arsenious or arsenic acid be added, arsenetted hydrogen will be formed. This gas is inflammable, burning with a bluish white flame. If a cold porcelain plate be held in the flame, a brownish stain of metallic arsenic will be formed upon the porcelain. Berzelius observed that if the tube was heated, the gas was decomposed, and that metallic arsenic was deposited upon its walls. Pfaff and Thompson made, independently of each other, the discovery that

PLATE I.



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antimony formed a similar compound with hydrogen, and that it exhibited phenomena similar to those already noticed in the case of arsenetted hydrogen. This last discovery destroyed confidence in Marsh's test, until it was found that the two compounds could readily be distinguished.

Marsh's apparatus as originally proposed was open to numerous objections; improvements have been made, however, by which these have been very completely removed. The apparatus here described, I have used with much advantage, although somewhat more complicated than the form usually employed, it fulfills its objects so perfectly, that the trouble of making it is amply compensated for by its efficiency.

The generating vessel *A*, (plate 1) is a Wolfe's bottle; its three necks are closed by corks, in which are accurately fitted (1) a funnel-tube, (2) a syphon-tube, for drawing off the liquid when in large quantity, without admitting air and long suspending the operation; and (3) a bulbed tube filled with fragments of pumice stone or charcoal moistened with sulphuric acid. A tube *B* bent thrice at right angles, connects the drying bulb with the drying tube *C*; this has in its lower part, immediately above the constriction, a little asbestus or cotton to prevent the mass above from falling down. The lower half of the tube is to be filled with caustic potash in fragments the size of a pea; the upper half is nearly filled with fragments of chlorid of calcium; finally, a little asbestus or cotton is placed above.

The caustic potash serves two purposes—that of drying the gas and removing any acid that may be present, which otherwise might prevent the formation of arsenical spots. Thus, if sulphuric acid was carried over it would liberate chlorohydric acid from the chlorid of calcium; and again, if a chlorohydric solution was to be used in the apparatus (which is not to be recommended), the effect above mentioned might occur; the potash removes all danger of this happening. The chlorid of calcium serves simply to dry the gas. The mouth of the drying-tube is closed with a cork, through which passes a short tube *D*, bent at right angles. The reduction tube *E* ought to be of Bohemian glass—this will not readily fuse, and being free from lead, will not blacken when heated; it is connected with *D* by a small bit of rubber tubing. A convenient sized tube is one of about three-sixteenths of an inch external diameter, and about two-thirds of this diameter within; a section of such a tube is shown in *G*.

It is advisable to draw out the tube at points from two to two and a half inches asunder, and also at the end for a jet as shown in the figure; for a small deposit produced in a constriction may be more distinctly seen than if in another part of the tube. A number of these tubes, throughly cleansed and from 12 to 18 inches in length, ought to be previously prepared. The tube may be heated by an ordinary alcohol lamp, more conveniently by a Bunsen's gas-burner, represented as in the figure, enclosed by a sheet-iron case (supported by a perforated cork moving on the stem of the burner), thus preventing the flame flickering by currents of air. *F* is a simple support for the tube *E*.

It is not necessary to give in detail the proper mode of using the apparatus; suffice it to say that zinc and water being placed within the generator, diluted sulphuric acid (one of acid to three of water) previously cooled, is to be added. When the air is driven out the tube may be heated; if after the lapse of an hour or two no stain is produced in the tube the supposed arsenical liquid may be introduced and tested. It is advisable to obtain mirrors at different parts of a number of tubes, and spots upon a number of pieces of porcelain, such as crucible covers; if the arsenic is present in but minute quantity no spots can be obtained on the porcelain. (See Flandin's method of procedure, Traité de Poisons, t. i., p. 621.) The delicacy of Marsh's test is very great, thus Storer shows that the 1-3000th of a grain of arsenious acid in more than ten million times its weight of water will give a distinct stain in the reduction tube. (Am. Acad. Arts and Sciences, Proc. vol. viii., p. 79.)

We may notice briefly some of the more simple modes of distinguishing between the mirrors and spots produced by arsenic and antimony.

1. *Treatment of the mirrors in the reduction tube.—a.* The arsenical mirrors are always produced beyond the heated part, while antimonetted hydrogen being more easily decomposed by heat than is arsenetted hydrogen, produces a mirror before as well as beyond the heated part.

b. Arsenic mirrors are of a lustrous, blackish-brown color, and when thin, are semi-transparent. Antimony mirrors are fused into small silver-white globules, near the heated part of the tube; beyond they are dull and almost black.

c. If a very slow stream of dry sulphydric acid is passed into the tube and the mirror is gently heated, it will, if arsenic, be

converted into the yellow sulphid of arsenic, and if antimony, into the orange or black sulphid of antimony.

d. If dry chlorohydric acid gas be passed into the tube, (treated as above,) when cold, the deposit, if of sulphid of arsenic remains unchanged, if of sulphid of antimony it is converted into chlorid of antimony, and is volatilized. (The spot if unchanged may be dissolved in ammonia and further experimented with.)

2. *Treatment of the spots on porcelain.*—*a.* Arsenic spots, when moistened with a solution of hypochlorite of soda, immediately disappear; antimony spots are not affected, at least, not until after a long time.

b. An arsenic spot, treated with a drop of yellow sulphid of ammonium, dissolves slowly and imperfectly; an antimony spot rapidly disappears. If, after this treatment, they are allowed to dry, the antimony spot assumes a rich orange tint, the arsenic spot a light lemon color on the borders, with a larger or smaller mass of undissolved metal in the center.

It may be remarked that, not unfrequently, solutions containing organic matter are introduced into Marsh's apparatus; this is extremely improper, for organic matter alone occasionally produces mirrors similar to those obtained by arsenic and antimony, and if these metals are present, the indications are neither so clear nor so satisfactory as when pure solutions are used.

4. *Reinsch's test.* — Hugo Reinsch published in 1843, (Ann. d'Hygeine, 1843, vol. i. p. 439), a simple method of detecting arsenic, it may be stated as follows: The suspected mass, if not liquid, is to be finely divided, placed in a porcelain dish with water, and chlorohydric acid added until distinctly acid. The mixture is then to be boiled until it becomes, as far as possible, homogeneous. It is then to be strained or filtered and boiled again with strips of bright copper foil or gauze. Arsenic, if present, is deposited upon the copper, which becomes blackened. The metallic slips are then carefully washed, dried and heated in a glass tube closed at one end, when arsenious acid sublimes, which may be recognized by its solubility in water and by the liquid tests noted hereafter. (The liquid prepared from the suspected organic matter, in the manner previously mentioned, is admirably fitted for this purpose.) Lippart has shown (Jour. für prak. chem., lxxxi, p. 16,) that the deposit is not pure arsenic as was generally supposed, but a combination of arsenic and

copper, (Cu. 68, As. 32 p. c.), and that by continued heating of this deposit in hydrogen gas it loses only 7 p. c. of arsenic and that then if ignited in air, the greater part of the arsenic remains.

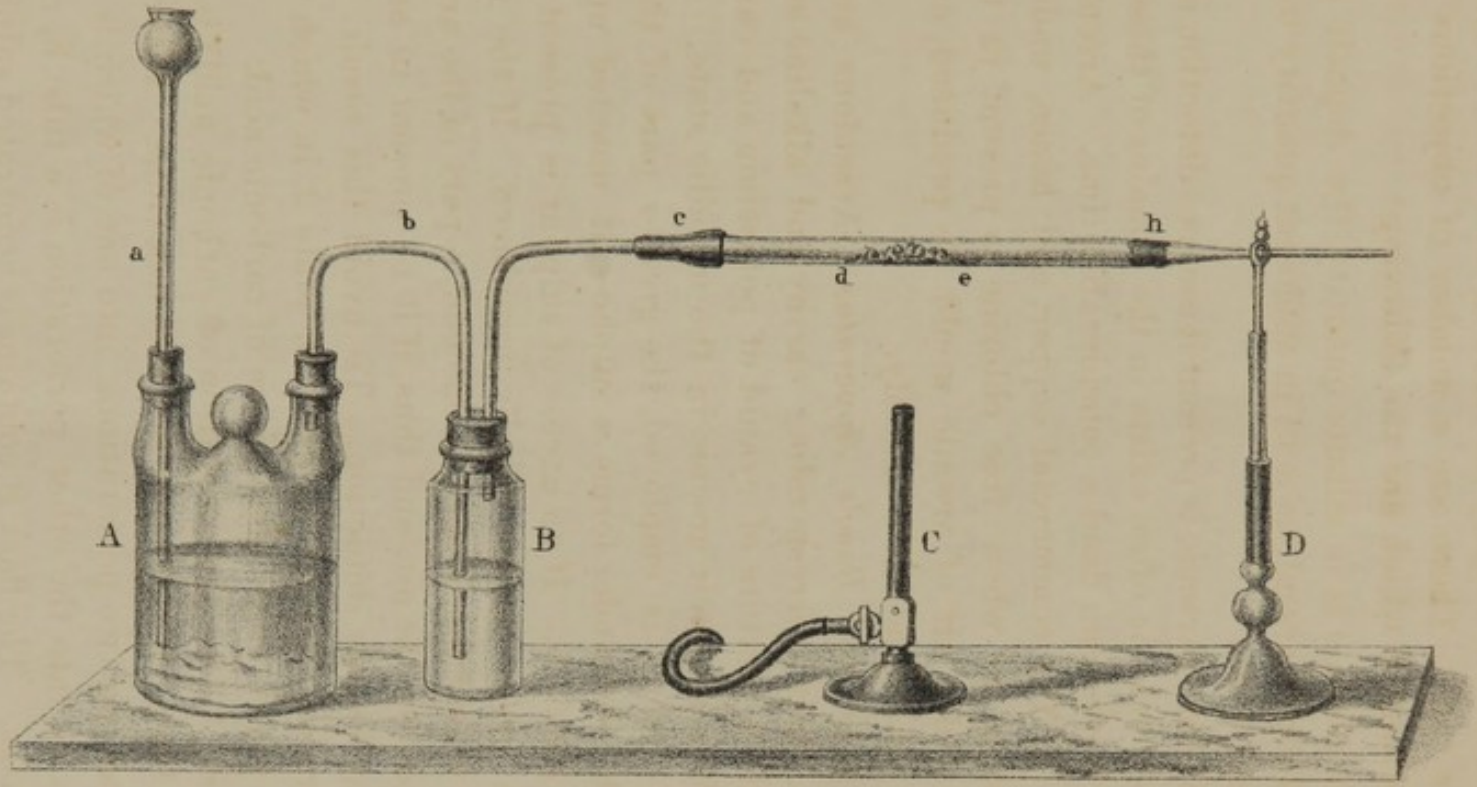
Reinsch's test is readily made, it is not, however, so delicate as Marsh's test. There are a number of objections to it, the most important of which are the following:

1. If the arsenic is in minute quantity, the deposit on copper will not produce arsenious acid in sufficient quantity to make the confirmatory tests.

2. If sulphid of arsenic is present it escapes detection altogether. In this state arsenic often exists in the remains of those poisoned by it who have been dead a considerable time. Arsenic is often contained in the commercial copper, and hence, under certain circumstances, as when free chlorine is present in the liquid examined, a deposit of arsenic would be produced, even if the liquid did not contain it originally.

5. *Fresenius' and Babo's Apparatus.*—Arsenious and arsenic acids, and their corresponding earthy and alkaline salts, when ignited with a mixture of cyanid of potassium and carbonate of soda, yield up all their arsenic in the metallic state. If the ter-sulphid of arsenic is employed, the greater part of the metal is reduced, the remainder forms a sulpho-salt unacted upon by cyanid of potassium. If an excess of sulphur is present the metal remains in great part or wholly unreduced. If the ignition is made in a glass tube, sealed at one end, a part of the arsenic may be oxydized by the air, and thus, if it be present in small quantity, it may escape detection. To avoid this result, Fresenius and Babo recommend the apparatus. plate 2, in which the reduction takes place, in an atmosphere of carbonic acid.

The flask A (for the evolution of carbonic acid) is partially filled with lumps of marble or compact limestone. It is closed by a cork, containing two perforations, into one of which is fitted the funnel tube a, into the other perforation is a tube b, connecting the two flasks. The flask B contains concentrated sulphuric acid, which dries the gas as it passes through it. The mode of using the apparatus is as follows: The sulphid of arsenic, or preferrably the arsenate of soda, prepared from the suspected matter as already mentioned, is pulverized in a warm mortar, with ten parts of a well dried mixture, consisting of three parts of carbonate of soda and one part of cyanid of potassium. The



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Lith. of Van Benthuysen Albany

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powdered mass is then placed on a slip of glazed card paper, bent into the shape of a gutter and pushed into the reduction tube down to e. By turning the card, the mixture is deposited between d and e, without soiling other parts of the tube. The card is then withdrawn, and the tube connected with the apparatus (as shown in the figure), supporting its free end if necessary. The tube ought to be of Bohemian glass, and about one-fourth of an inch external diameter. Chlorohydric acid is now added to the flask A, the carbonic acid evolved is dried in B. The reduction tube must now be gently heated throughout its whole length until all moisture is expelled, both from its walls and from the mixture. When this is accomplished, and when (the air having been completely driven out) the bubbles of carbonic acid gas pass through B at the rate of one a second, a lighted lamp may be placed at E, and the mixture heated by another lamp flame. The greater part of the arsenic will condense at the point H, a small portion will escape from the tube, producing a garlic odor in the atmosphere. By carefully heating the tube before and beyond the deposit, it may be collected in a small spot and will have a highly lustrous metallic appearance. If it is to be preserved, the point may be sealed by the blow pipe flame, the other extremity drawn out and sealed in a similar manner. The deposit may, of course, be converted into arsenious acid by oxydation, dissolved in water, and the liquid tests applied.

The advantages of Fresenius' and Babo's test are these:

1. It is simple and easy of execution.

2. It is impossible to confound arsenic with antimony; antimony compounds do not furnish any deposit under these circumstances.

3. It is a delicate test, the $\frac{1}{300}$ part of a grain may be detected by careful manipulation. It is not, however, nearly so delicate nor so readily applied as Marsh's test.

6. *Reduction Test—Liquid Tests.—a. The reduction test* now to be considered is the same as the last, except that the arsenic is volatilized in air instead of in carbonic acid. A number of tubes are to be prepared, with a bulb on one extremity. The mixture of the arsenical compound, carbonate of soda and cyanid of potassium, is to be introduced into the bulb of the tube by means of a paper gutter, as already mentioned, not more than half filling it. The bulb is first to be gently warmed, (and if moisture escapes it should be removed with a twisted slip of

paper,) afterwards it is to be heated till the mass fuses, and finally more intensely, by this means an arsenic mirror is obtained of great purity and beauty.

b. Odor test.—If the tube be cut off just below the mirror, and if then it is held inclining upwards in the flame of an alcohol lamp, the flame will be tinged bluish white, and the characteristic garlic odor may be perceived.

c. Guy's method of reduction.—As it is often difficult to distinguish the octahedral form of the arsenious acid crystals, or critically to examine the deposits, when the quantity is small and contained in a tube, Guy proposes the following method:

A tube is employed three-fourths of an inch in length, and of rather larger diameter than is commonly employed. This tube is supported in a vertical position, by being dropped into a hole punched in a slip of copper foil. The arsenical mixture is then dropped into the tube, and heat carefully applied to the closed end, at the same time a clean microscopic glass cover or a glass slide is placed over the open end of the tube; crystals of arsenious acid are thus produced which may readily be examined by the microscope. When metallic arsenic is sublimed, the crust is found to consist of a multitude of globular particles, or if partially oxidized, of octahedral crystals mixed with the globules. The delicacy of this test is such, that with the 1-1000th of a grain of arsenic, thousands of distinct octrhedral crystals of arsenious acid may be obtained. (Archives of Medicine, No. 3, p. 25.)

d. Oxydation test.—If the closed end of the tube be cut off and the mirror is carefully and gradually heated, the arsenic will volatilize, and oxydizing becomes converted into arsenious acid, which will condense in the cooler part of the tube in a mass of minute octahedral crystals.

e. Solution.—If that part of the tube containing the crystalline deposit be heated in a test tube with water, the deposit will dissolve; with this solution, the liquid tests may be made as follows:

Liquid tests.—a. If to the solution a few drops of nitrate of silver are added, and then very dilute ammonia, drop by drop, the characteristic yellow precipitate of arsenite of silver will be produced.

b. Treated with solution of sulphate of copper and ammonia added as above, a grass green precipitate of arsenite of copper will be produced.

c. Treated with chlorohydric acid, and then strong sulphydric

TOXICAL EXAMINATION OF ALLEN BAKER.

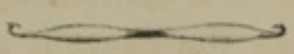
DIED JULY 5th 1850. AGED 59 YEARS.

Examination commenced Jan 1st 1851
concluded March 1851.

A
BRAIN

A

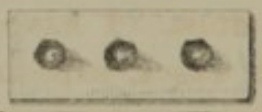
Arsenic by Marsh's Apparatus



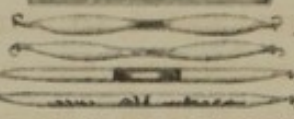
Arsenic by Marsh's Apparatus

B

B
THORAX



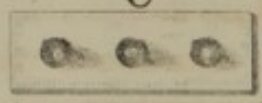
Arsenic by Marsh's Apparatus



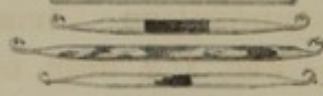
Arsenic by Marsh's Apparatus
Sulphuret of Arsenic
Arsenious Acid
Arsenate of Silver

C
ABDOMEN

C



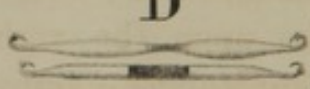
Arsenic by Marsh's Apparatus



Arsenic by Reusch's Method
Arsenate of Copper
Arsenic by Fresenius' and Babo's Apparatus

D
MUSCULAR TISSUE

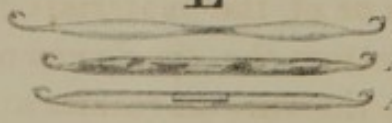
D



Arsenic by Marsh's Apparatus
Arsenic by Reusch's Method

E
BONES

E



Arsenic by Marsh's Apparatus
Arsenate of Copper
Arsenious Acid

CHARLES H. PORTER, M.D.

Albany Medical College

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acid water be added, a precipitate of the yellow sulphid of arsenic is produced, soluble in ammonia.

d. If a small mass of the crystals (see *d*) be boiled with nitric acid, arsenic acid is produced, which gives, with nitrate of silver and ammonia added as above, a reddish brown precipitate of arsenate of silver.

It is evident that the various tests given in this section may be made from the deposits produced in Marsh's and Fresenius' and Babo's apparatus.

Which and how many of the tests enumerated are to be made, must depend upon the quantity of arsenic found. In most cases, as has been said if discovered, there is sufficient present, with careful manipulation to make them all.

7. *Preservation of the tests.*—It is considered of importance by medical jurists that specimens of the poison obtained in the course of the examination of a medico-legal case be preserved, that they may be shown to the court if a trial occurs. In certain cases, as in those where metallic poisons have been discovered, this may readily be done. I have been in the habit for a considerable time, in such cases, especially where arsenic has been found to be the toxical agent, to attach the slips of porcelain and the glass tubes containing the various tests, to a sheet of card-board, and inserting this in a frame (protected by a plate of glass) as is shown in Plate 3.

In the upper part is mentioned the name of the party submitted to toxical examination; immediately below the age and date of death, and the date of the commencement and completion of the examination; below these, in the centre, are placed the specimens; upon the right, opposite each, are stated the nature of the substances exhibited; upon the left are the names of the parts or of the materials found to contain the poison, indicating by letters the specimens obtained from each.

By this arrangement the various results are placed in a secure and permanent form which may readily be inspected. The collection itself gives at a glance an epitome of the chemical examination.

As regards the mode of preserving the specimens, it may simply be said that the tubes containing the mirrors from Marsh's and Fresenius & Babo's apparatus are drawn out to a point at either end and sealed by a blow-pipe, the deposits being in the centre, the same with the other solid tests. The liquid tests

may be formed in tubes of the proper form by the successive introduction of the proper reagents, or they may be placed there after being formed in another vessel by simply heating such a tube and immediately immersing its open end into the liquid containing the precipitate, leaving it there till it cools; a portion of the precipitate and liquid will rise in it, when the open end is to be sealed. The tubes are then to be attached by wires or cord to the card-board, and the proper names attached as already mentioned.

Part II. Cases of Arsenical Poisoning.

Case No. 1.

Albert Anderson was tried at Norwich, Chenango county, September, 1859, for administering poison to William Brooks, with intent to kill.

1. *Symptoms and circumstances.*

It would appear, from the evidence, that Brooks, a farmer, had had some slight difficulty with Anderson, his hired man, some few days previous to the alleged poisoning. When taking their supper one evening, Mrs. Brooks observed on pouring out the tea that it appeared as if a little flour was strewn over it; attention was called to it, but the family finally concluded that there was nothing wrong about it.

Brooks, after eating a small quantity of food, took a swallow of tea, and remarked that "it bit his throat badly;" he then took a mouthful of food, and still suspecting nothing, again drank a portion of tea; he immediately became sick and said, that he was poisoned. The symptoms subsequently observed were those commonly produced in cases of arsenical poisoning; thus he experienced almost continual retching and vomiting, there was profuse diarrhea and a terrible burning pain in his throat and stomach. In a short time there was great prostration, his pulse was small and feeble, respiration difficult, the extremities cold and his face expressive of great anxiety. After the vomiting, which continued an hour or more, the above symptoms diminished in intensity, but it was not until after months had elapsed that he fully recovered his health.

2. *Chemical examination.*

The tea leaves handed me for analysis, upon being examined with a lens, were found to be covered with innumerable crystals, many of which were observed to be of an octahedral form, these,

submitted to analysis, were found to consist of arsenious acid. Thirty grains of the tea leaves yielded 0.59 grains of arsenic. A number of the leaves covered with the white crystalline deposit, together with specimens of the metallic arsenic and its various compounds, produced in the examination were carefully preserved for exhibition in court.

3. *Resumè.*

This case is interesting from the short period which elapsed between the imbibition of the poison and its first effects. It would appear from the testimony that it could not have been more than two or three minutes from the time B. drank the tea till vomiting and pain occurred. The tea probably contained a very considerable quanty of arsenic in solution, at least as large a quantity as the hot water (which had been boiling) containing such organic matter could dissolve, and hence, its effects would be more likely to be produced quickly than if taken only in the solid state. Mr. Brooks on first drinking the tea remarked that "it bit his throat badly;" this circumstance seems to me worthy of note, as another illustration of the fact that in certain cases, especially when the arsenic is in solution, an unusual or peculiar taste is perceived, thus it has been variously described by different persons as having a hot, a rough or an acrid taste, while, ordinarily, those poisoned by it perceive no peculiarity in the food or other article in which it is given.

It may be mentioned here that the attending physician (Dr. S. C. Gibson), on first reaching the house, appreciating the nature of the case, at once secured and retained in his possession, till given to me for analysis, the tea leaves, the supposed cause of the sickness, thus preventing any difficulty from arising in the investigation of the affair, so far as the poisonous material was concerned. Allusion is made to the above fact, because in the great majority of cases so little attention is paid to this point, that the poisoned article is carelessly or designedly removed or destroyed, or is so treated that its identity cannot afterwards be established, thus preventing or embarrassing the judicial investigation of the case.

When on the stand as a witness, I produced the various specimens of arsenic and its compounds, obtained in my analysis, but in this as in certain other cases in which I have been engaged, the defendant's counsel objected to their being shown to the jury

on the ground that they were incompetent to judge of their value; the court sustained the objection, and the specimens were not exhibited.

Case No. 2.

The People of the State of New York vs. Charles D. Swan.—Charles D. Swan was indicted by the Grand Jury of Erie county in December, 1858, for administering poison, with intent to kill Nancy Swan. The above case was tried at the Erie Oyer and Terminer, July, 1859, Judge Clinton presiding.

Although I had no personal connection with this case until a late period, and then only remotely, yet as it presents some points of peculiar interest, and has not so far as I can learn, been published, I am induced to present a brief synopsis of it here.

1. *Symptoms and circumstances.*

It would appear from the testimony, that the accused was not happy in his family relations: thus, he was not on good terms with his mother-in-law, Jane Harrington (the principal witness for the prosecution), and his wife (the Nancy Swan mentioned in the indictment), made preparations for an application for divorce some few months after their marriage. She, it may be stated, was affected with phthisis, and had been in a hopeless condition for some months previous to her death. Mrs. Harrington testifies that on the 22d of September, Swan came home earlier than usual, and pulled out four apples, saying, "here are some sweet apples; she (his wife) has been teazing me for them; to be sure that they are sweet, I have run a knife in and tasted them." They were hard green skinned apples, the incisions extended from the stem to the blow, apparently half way to the core. Swan left that same evening and was not seen by the witness until after his wife's death, (which occurred from pulmonary consumption, December 31st, 1858, about a year after their marriage.) The apples were laid away in a drawer until the 11th of October. On Monday, October 11th, Mrs. Swan being in better health than usual, enquired for the apples; they were then mealy; her mother gave her one; she admired it, and ate a part of it; the remainder, about one-third, being eaten by the witness, who says there was nothing peculiar in its taste. The other apples, three in number, were placed in a dish and baked in the oven. Soon after eating the apple, Mrs. Harrington says she experienced nausea and a painful burning in her throat; her daughter com-

plained of these symptoms and of thirst. Both drank of mustard and water and vomited freely. At night their lips, mouths and faces were much swollen. The witness says her head swelled up to the size of a half bushel, her eyes were completely closed, and her tongue and throat in such a condition that she could not speak intelligibly; for three or four days she said she was helpless, and it was about a fortnight before she could attend to her business.

Dr. W. Bartlett testified that he saw Mrs. Harrington the day after the apples were said to have been eaten, and Mrs. Swan the next day after; the latter complained of a burning pain in her stomach and an excruciating pain in her throat (her throat was ulcerated before), she could not articulate well, and complained that she could not swallow. The former complained of pain in the stomach, she also complained of her lips and tongue; they were swollen and continued to swell; on the seventh day she could not see for a day and a night.

2. *Physical and Chemical Examination.*

Mrs. Harrington testified that after the apples were baked, her son and herself examined them; two were found to have incisions in them, in which was something that looked like white flour. In one of the apples there was about as much white powder as would cover, not heaping, a three cent piece; in the other not so much. Suspecting the presence of poison, Mrs. Harrington caused them to be analyzed. Prof. James Hadley testified that in each of the two baked apples received by him there was a slit extending from the stem to the apex, and from the surface pretty near to the core. Both apples were opened; there seemed to be a white powder on the cut surface of both. The apples were placed in Prof. Geo. Hadley's hands, who testified that there was at least one grain of white arsenic on the cut surface of one apple.

Dr. J. F. Miner, sworn for the defence, testified that he inserted arsenic into two apples, in one before, in the other after baking; in the first about fifteen grains, in the second about ten grains. The arsenic put into the apple before baking was much more absorbed than that in the other apple, and again, the juice during the baking had saturated and discolored the arsenic, while that put into the apple after baking was but little absorbed and retained its white, fresh appearance.

Evidence tending to impeach the character of Mrs. Harrington was then presented, and afterwards rebutting testimony introduced.

The prisoner was convicted, and sentenced to be imprisoned, at hard labor, in the State Prison, at Auburn, for the term of twenty years.

3. *Application for Pardon, &c.*

Governor Morgan, in accordance with his usual custom, visited the State Prison, at Auburn, in Sept., 1860, and there granted an interview to those who wished for a pardon, and among others to Swan. The statement made by Swan consisted in a general denial of the truth of that testimony upon which his conviction was obtained, and an assertion of his entire innocence of the crime for which he was suffering punishment. He claimed his release, not as an act of mercy, but simply as an act of justice. Statements were subsequently received by the Governor from the presiding judge at the trial, the prosecuting attorney and other responsible parties, all of whom were satisfied of the innocence of Swan, from certain experiments made by Prof. George Hadley on

4. *The Effect of Arsenic on Apples,*

A brief abstract of which is given below. Notice must be taken here of an affidavit made by Mr. B. S. Brown, in which he states that on the third of March, 1860, he made incisions in two apples, one sweet and the other sour, and placed in each gash a little arsenic. Twenty-one days after, March twenty-fourth, the apples were examined, and their cut surface were found to have decayed, parted, and shrunk away from each other, at least one-eighth of an inch; the skin on each side of the incisions was found withered, wrinkled and drawn in towards the core.

Prof. Hadley's affidavit stated that, from the 27th of July till the 18th of August, 1860, he conducted a series of experiments to ascertain the effects of arsenic upon apples, so far as these effects might have an important bearing on the testimony of witnessess in the above mentioned trial. After alluding to the slight changes which take place in apples in which deep gashes have been made, even after the lapse of a week or two, he says:

"When, however, a grain or two of arsenic (arsenious acid or common white arsenic,) is inserted in the cut, the cut begins to open and, in the course of a few (two to five) days, the edges are

separated from one-eighth to one-fourth of an inch, or even more, showing very plainly the white arsenic within. At the same time the skin adjacent to the cut, begins to be discolored, and, together with the pulp beneath, turns dark brown, both in appearance and consistency, resembling the ordinary decay of the apple. This change begins to show itself on the second or third day, and then makes steady and regular progress, extending on each side of the cut so rapidly, that by the eighth day it attained the width of from five-eighths to seven-eighths of an inch; by the sixteenth, of one and a half to two inches, and by the twentieth or twenty-first day from one-third to one-half or more of the apple (according to its size,) will be affected with decay."

The experiments which gave the above results were conducted with great care upon a great variety of apples, and the results were singularly uniform.

Upon the application for the pardon of Swan being made, Governor Morgan placed the various papers in my possession, and requested me to make such experiments as would tend to elucidate the matter, and report to him my results, and my opinion of the case.

I took apples of various kinds and qualities, and made three similar incisions in each; in one arsenic was placed, in another a little sand, the third was left free. This proceeding was adopted that the effect of an inert foreign body (sand) in the incision might be compared with that containing arsenic, and the empty one. The changes observed during three weeks corroborated in great part those mentioned above. Experiments of a like character were also made upon other fruits, the results were generally similar and need not here be detailed.

From a perusal of the testimony and the results of my experiments, I was convinced that it was impossible that Swan was guilty of the crime of which he was convicted, and so reported.

Gov. Morgan subsequently pardoned the prisoner as an act of simple justice, being entirely satisfied of his innocence.

5. *Résumé.*

In this case it will be remembered that the apples were said to have been given to Mrs. Harrington on the 22d of September, and were then placed in a bureau drawer till the 11th of October—a period of 19 days; and as Swan was absent during that time, the charge could only be sustained upon the theory that he

had inserted arsenic in the apples on the 22d of September. It is to be noticed that when Mrs. Harrington gave her daughter one of the apples (it containing an incision), the latter it is stated admired it as if it was particularly perfect; whereas experiment proves that if arsenic had been inserted at the time supposed (19 days previously), such a change would have taken place in the apple that it could hardly have been handled, much less eaten, without its peculiar condition attracting particular notice and observation.

Again, it was stated that the arsenic contained in the baked apple was *white;* the experiment of Dr. Miner shows that if it had been inserted *before* baking, the juices would have discolored it. These considerations, it seems to us, abundantly prove that Swan could not have been guilty of the crime of which he was convicted.

The peculiar effect of arsenic on pulpy fruits, as shown in the above experiments, has not, so far as I can learn, been hitherto noticed; and it seems to me an interesting, and in this case at least, a highly important fact.

Case No. 3.

Mary Hartung was tried at Albany, Albany county, January, 1859, for the murder of her husband, Emil Hartung, by poisoning him with arsenic.

1. *Symptoms.*

Emil Hartung, the deceased, was the keeper of a drinking saloon in Albany. In the early part of April, 1858, he was attacked with acute inflammation of the larynx. His attending physician was Dr. Joseph Levi, from whose testimony we gather the following description of his illness and death.

April 11. He complained of pain in the throat, coughed much, and exhibited febrile symptoms. Dr. Levi diagnosed the case as acute laryngitis, and prescribed tartar emetic, $\frac{1}{8}$ grain, every second hour, sinapism to the throat, and demulcent draughts, recommending him to lie in bed.

April 12. Patient rather more comfortable. Pain in the throat, and cough continued. The tartar emetic was ordered to be taken in smaller doses, and a blister applied to the throat.

April 13. In addition to former symptoms patient labored under great oppression of the chest and dyspnoea. Then the tartar

emetic was discontinued, and he was bled and put on a prescription of nitrate of potash and muriate of ammonia dissolved in mucilage. In the evening he was much relieved, and from this time continued gradually improving for a week.

April 20. In the morning he complained of constipation, and accordingly two "light cathartic pills" were administered. At ten o'clock in the evening Dr. Levi called and found that Hartung had undergone a remarkable change. His face wore "the hipocratic expression," he was tossing restlessly about the bed, laboring for breath; his pulse was quick, small, and irregular, his extremities cold and skin of a livid hue. He had purged and vomited violently since morning and complained of an intolerable burning sensation and pain in his chest. At 3 o'clock in the morning of April 21st, he was speechless and at 8 o'clock expired.

It should here be mentioned that during his entire illness he manifested great aversion to the food furnished him by his wife, every article being rejected after he had tasted it, on account, as he said, of its peculiar taste.

It should also be mentioned that all matters evacuated by vomiting and purging were thrown away, so that Dr. Levi had no opportunity of seeing them although he enquired for them. During the course of the illness Dr. Levi had no suspicion that the symptoms were other than natural, until the day before death, when he was struck so forcibly with the mortal change which had occurred that he made earnest inquiries as to what his patient had taken to produce such results.

2. *Post-mortem Examination.*

The body was exhumed and an autopsy made by Dr. Jacob Rheinhart, on the twenty-first of May, one month after death. He stated that the stomach and œsophagus showed traces of inflammation sufficient to account for death.

The trachea, lungs, liver, spleen, stomach and intestines were reserved for chemical examination.

3. *Chemical Examination.*

On the twenty-first of May the above mentioned organs were delivered to me for analysis. They had not previously been laid open or cut into.

On a physical examination the mucous coat of the œsophagus was found to be thickened, easily detached and readily torn. The

stomach showed marks of violent inflammation. Its mucous membrane was of a dull red color, which became brighter by exposure to the air. It was much thickened, especially along its greater curvature, and was soft and easily separated from the muscular coat. Beneath the mucous layer were patches of a dark color, apparently arising from extravasated blood. The duodenum also showed marks of inflammation and its mucous coat was ulcerated and detached in different places.

Upon the external and internal surfaces of the stomach, and upon the exterior of the liver and spleen there were patches of a gamboge-yellow color, of various sizes, ranging from one-sixteenth of an inch, to more than one inch in diameter. These spots were particularly abundant upon the mucous surface of the stomach, and upon the liver. On treating this yellow matter with solution of ammonia, the color disappeared, showing it to be sulphid of arsenic, produced by the action of the sulphydric acid, generated during decomposition of the body, upon the arsenious acid present.

By pursuing the general method of analysis already described, arsenic was found both in the stomach and liver. Two-thirds of the stomach yielded *six* grains of arsenic, the remaining third having been reserved for examination in case any accident might happen to the larger portion operated upon. All the usual tests were made, and the various combinations of arsenic thus obtained preserved for exhibition at the trial of the accused.

4. *Resumè.*

In regard to the inflammation of the stomach and œsophagus observed at the post mortem examination, Dr. Rheinhart, who conducted the examination, made the following statement at the coroner's inquest.

"The irritating matters of which the deceased died, must have been taken into the stomach *two months* before death." At the trial of Mrs. Hartung he persisted in this opinion, observing further:

"It might be that the death was accelerated by something else; the appearances which I observed could not be produced by arsenic administered within three days of the time of death; the appearances were sufficient in themselves to produce death."

In answer to this broad assertion, we may observe that while the inflammation of the throat in this case may have been pro-

duced by some other agency than arsenic, yet, inflammation of that organ has been observed in the case of a person who died in twenty hours after arsenic had been taken, and moreover that inflammation of the stomach has been found in cases of arsenical poisoning where the patients survived only two, three and a half and five hours.

In this case Mr. Hartung probably did not survive more than eighteen or twenty hours after the arsenic was administered to him, for the description of his illness given by Dr. Levi points out very strikingly the time when the character of the disease changed from relief and comparative comfort to the horrible agony and well marked symptoms of arsenical poisoning, viz: between the morning and evening of the day preceding his death.

In relation to the earlier part of Hartung's illness, the following facts are worthy of attention:

At the trial, Louis Sautter, an apothecary, testified that six weeks before Hartung died, Mrs. Hartung purchased at his store a small jar of phosphorus paste, stating that she wished to use it to destroy vermin.

Mary Foell, another witness, testified that three or four weeks before Hartung's death, she saw Mrs. Hartung go to this jar, remove some of its contents with her fingers, throw it into the food which she was preparing for deceased, and afterwards wipe her fingers on a towel; that this towel acquired thereby a peculiarly offensive smell; that the "tea, coffee, beer—soup and everything which was cooked" were similarly contaminated; that she (witness) "tasted the soup and had to vomit terribly;" that she often saw Mrs. Hartung use the contents of this jar during eight days or two weeks before Hartung was confined to his bed.

In view of this testimony, we are at liberty to infer that this material (phosphorus) may have been the exciting cause of the illness under which deceased lingered until the dose of arsenic which terminated his life was administered. On this supposition we have no difficulty in accounting for those marks of chronic inflammation which Dr. Rheinhart thought he recognized, and which he was unwilling to attribute to the effects of arsenic administered so shortly before death.

However this may be, it is hardly proper to claim that one, merely by a physical examination of the exterior of an organ and the indications of inflammation observed, can with any degree of certainty determine the time when such inflammation was

produced. On the contrary, it is necessary, in order to entertain any correct opinion on this point, to know both the condition of the subject's system, and the nature and quantity of the poison taken.

In regard to the ulcerated patches in the duodenum, it is to be remarked that ulceration is but rarely observed as an effect of arsenic: it has been found, however, in the stomach of a person who survived the effects of the poison but ten hours. It may be observed here that ulceration has been noticed as an effect of poisoning by phosphorus.

The gamboge-yellow spots observed on the walls of the stomach, and upon the exterior of the liver, are not unfrequently met with in deaths from arsenic where the body has been buried some time, (in this case, thirty-one days.) It is a most characteristic appearance, and is not likely to be mistaken for any other substance. The application of ammonia to the yellow matter, when the tissue is broken up, will at once remove any doubts, by dissolving it if it be sulphid of arsenic.

Of these spots Christison well says: "It is the effect of a chemical test applied to the poison by Nature."

Case No. 4.

Sarah Harrington was tried at Delhi, Delaware county, in March, 1861, for the murder of her husband, James Harrington, by poisoning him with arsenic.

1. *Symptoms and circumstances.*

James Harrington, a laboring man, residing in Clovesville, Delaware county, being taken ill in May, 1860, was attended by Dr. O. M. Allaban, from whose testimony at the trial we condense the following record of his fatal illness:

May 6. Patient complained of severe pain in his head and sore throat. His eyes were red, his countenance flushed, his pulse was strong and rapid, and he was expectorating a stringy mucus. The case was diagnosed as Pneumonia; his throat was cauterized and a blister applied to his chest; Dover's powder and calomel and jalap were administered, and an antimonial expectorant mixture prescribed.

May 10. Patient complained of pain in the head and severe cough; pulse strong and "high;" in other respects better than before. A blue pill was prescribed to be taken at night and in the morning and followed by castor oil.

May 13. Less pain in the head and less suffering in general.

May 15. Febrile pulse; patient was bled.

May 18. Patient generally better; antimonial preparation discontinued and an emulsion of oil of turpentine and gum prescribed.

May 19. Patient worse; had vomited much during the night; had great thirst and pain and burning sensation in the stomach; rapid and strong pulse. Discontinued the turpentine emulsion, and gave soda and morphine, also ipecac as an expectorant.

May 21. Had been delirious during the night; lungs relieved; action of heart laborious with a peculiar tinkling sound; pulse rapid and strong; patient suffering from thirst, nausea and vomiting. A blister was applied to the back of the neck, and careful directions given about diet.

May 22. Patient much worse; face flushed and swollen, pulse rapid and feeble, delirium, fever, numbness of limbs, and burning pain in the stomach; previous symptoms all aggravated.

May 23. Extremities cold, profuse perspiration, pulse imperceptible, pupils much dilated; delirious muttering. Death ensued in half an hour.

2. *Post-mortem Examination.*

On the sixth of June, 1860, fourteen days after death, an autopsy was made by Drs. Allaban, Street, Crawford and Ford.

External Appearances.

Externally the body appeared blackened, swollen, and considerably decomposed.

Abdomen.—The abdomen being opened, the stomach appeared distended with gas. Its external surface presented traces of inflammation, its blood-vessels being enlarged. The stomach contained from one-half pint to a pint of dark colored fluid. Its mucous coat was of a dark red color, and was thickened and easily detached by the finger.

The upper portions of the small intestines also presented marks of inflammation; the large intestines, the liver, kidneys, and other abdominal viscera were in a healthy condition. The lower portions of the lungs were dark colored, and the mucous surfaces of the bronchial tubes inflamed. The brain was not examined.

The stomach and its contents, and portions of the small intestines were placed in jars and reserved for chemical analysis.

Subsequently the remains were re-exhumed, and the tongue' kidneys, liver, spleen, œsophagus, and portions of the muscular tissue also removed, placed in jars, and delivered to me for chemical examination.

3. *Chemical Examination.*

As usual, before proceeding to the analysis, a careful physical examination was made of the various organs. The interior surface of the stomach presented marks of great inflammation, the principal indications being the engorgement of its vessels, the deep redness of its color, the thickening of the mucous coat, its loss of consistence, and the readiness with which it could be detached from the walls of the stomach. The duodenum also exhibited traces of inflammation, but the remaining viscera appeared natural.

The tissues of the different organs having been decomposed by hydrochloric acid and chlorate of potash as above, the resulting solutions were systematically tested for various poisons, and arsenic and mercury detected. The amounts found in the several organs were as follews:

The tongue contained .034 grains of arsenic.

The substance of the stomach contained 2.142 grains of arsenic, and .872 grains of mercury.

The contents of the stomach contained .452 grains of arsenic.

The small intestines contained 1.402 grains of arsenic, and a *trace* of mercury.

The large intestines contained 1.004 grains of arsenic.

The liver (the surface having been pared away) contained .351 grains of arsenic.

The kidneys and the muscular tissue each contained a *trace* of arsenic.

The entire amount of arsenic, which was collected from the remains and weighed, was 5.385 grains; the entire amount of mercury collected and weighed was .872 grains.

Resumé.

The mercury found in the tissue of the stomach and small intestines originated, without doubt, in the "blue pills" ordered by Dr. Allaban. It cannot be considered strange that no larger quantity was found in the remains; because, in the first place we have no means of knowing how many pills were administered; and secondly, it is most probable that the larger portion of the

mercury contained in them was carried out of the system by the excretions, the patient having lived twelve days from the time when they were ordered. On the contrary, it could not have been considered remarkable, even if no traces whatever of mercury had been detected.

The same principle holds good in regard to the *antimony* prescribed by Dr. Allaban on the first day of Harrington's illness, *i. e.*, seventeen days previous to his death. It was an *expectorant*, and therefore ordered to be given in very small doses; moreover, we have no evidence that much or even *any* of it was taken. But on the supposition that it *was* taken, its ready solubility, its undoubted excretion by the fæces and urine, together with the frequent emesis by which it may have been rejected almost as soon as it was swallowed, all conspired to render its detention in the tissues, and consequently its detection after death, exceedingly doubtful.

There is one feature in this case deserving of mention, both from its rarity, and as introducing a question which has not, until comparatively lately, received much attention.

During the trial, it was urged by the defendant, through her counsel, that the deceased had, for a long time before his death, indulged in the habit of arsenic-eating. It was clearly established by testimony that he had, for years, used arsenic as a medicine for horses, by mixing it with their fodder, and, on one occasion, thus caused the death of two horses, and severe illness of three others.

Two witnesses testified that deceased had arsenic commonly in his possession.

Two witnesses testified to having heard deceased say that he frequently took arsenic himself.

One witness testified to having seen him touch his tongue to a white powder which he called arsenic; another to having seen him take up arsenic on the blade of a knife and swallow it; another, to having seen him swallow a portion "as large as a kernel of corn," after mixing it with oil; a fourth testified that he saw deceased swallow half a teaspoonful mixed with oil, and that it produced vomiting in about twenty minutes.

From the testimony, we must conclude that the deceased occasionally tampered with arsenic, taking it internally in greater or less quantity. The particular occasions to which the witnesses testified where he took arsenic, occurred a number of years previous to his death. Even assuming, and it is a mere assumption,

unsupported by the least proof, that he was in the habit of eating arsenic, the case is still to be regarded as one of a criminal character, for it is to be noticed that the symptoms of arsenical poisoning occurred at a time when the deceased was prostrated by disease, and unable to help himself. Again, arsenic was found on his tongue and in the contents of his stomach, thus showing that in all probability arsenic had been taken a short time previous to his death.

Case No. 5.

Mrs. Mary Rosa was tried at Syracuse, Onondaga county, Feb. 17, 1858, for the murder of her husband, Herman Rosa, by poisoning him with arsenic.

1. *Symptoms and circumstances.*

Mr. Rosa was a farmer living in Skaneateles, N. Y. His relations with his wife were represented variously during the trial, the witnesses for the prosecution testifying to her using indecent and profane language, and swearing at and striking and kicking him on many occasions. On Thursday, May 7, 1857, Mr. Rosa drank some tea prepared for him by his wife, and in about twenty minutes afterwards was seized with violent vomiting and muscular spasms. The vomiting continued at intervals during the night, and in the morning Dr. Strong, a practitioner of homœopathy, was called in to attend him. For the details of Mr. Rosa's illness and death we are dependent upon Dr. Strong's testimony as given at the trial, and which we condense into the following record.

Friday, May 8. Patient complained of pain in the eyes, headache, great thirst, muscular spasms, pain in the back, coldness of the extremities, sour and burning eructations and dryness, smarting and constriction of the throat. His pulse was 80 and feeble, his eyes congested and watery, throat red and dry, and tongue coated with a yellowish white fur. There were two or three evacuations of the bowels, preceded by colic pains and accompanied by a burning sensation in the bowels. There was no tenderness of the abdomen upon pressure. The treatment consisted in the administration of homœopathic preparations of ipecac and veratrum.

Saturday, May 9. Pulse 85, skin hot and dry, burning thirst; all the previous symptoms aggravated. Homœopathic doses of arsenicum and veratrum given.

Sunday, May 10. Tongue more heavily coated, skin cool, pulse 85 and feeble; hiccough, thirst, burning pain in the throat and stomach, bilious vomiting, and purging at intervals.

Monday, May 11. Much exhaustion; thirst and burning pain continued. After administering a few more homœopathic preparations, Dr. Strong gave three or four grains of *calomel*, and repeated the dose twice at intervals of an hour, following it by oil. Soon afterwards vomiting and purging began anew with the burning sensation, but with less pain in the bowels. Dr. Strong now desired counsel.

Tuesday, May 12. Drs. De Voe and Baker called in consultation, and found the patient rapidly sinking. His skin was cool and of a livid color. Brandy and quinine were administered, but he soon became unconscious, and at two o'clock expired

2. *Post Mortem Examination.*

On the fourth of June, 1867, thirteen days after death, autopsy was held by Doctors Fuller, Porter and Benedict.

External appearances.

The surface of the body was of a livid hue, excepting over the region of the stomach, where the color was unchanged. Nothing else was seen worthy of remark.

Head.—The skull was opened, and the brain and its membranes found perfectly normal.

Thorax.—The lungs and heart were normal in position and appearance.

Abdomen.—The stomach and intestines were distended with gas, and exhibited some slight marks of inflammation exteriorly. On opening the stomach, its internal surface was found to be of a dull red color, which became brighter by exposure to the atmosphere. There were also several purplish red spots scattered over its internal coat. On its lower side there was a *yellow* coating covering a space as large as the palm of one's hand. The intestines were also opened, and found to be unusually red on their interior surface.

The œsophagus was opened and a pasty substance removed from it and preserved, together with the stomach, œsophagus, intestines, and a portion of the liver.

On the 28th of January, 1858, the remains were re-exhumed, and the remaining portion of the liver removed.

3. *Chemical Examination.*

The stomach and its contents, and portions of the liver, œsophagus and intestines, were given to a Doctor James Fuller for chemical examination. He professed to be a chemist, and stated at the trial that he had taken portions of the contents of the œsophagus and stomach, placed them in test tubes, and applied to one ammonia-nitrate of silver, and to the other ammonia-sulphate of copper. After boiling the liquids, one exhibited a yellow, and the other a green color, upon which he assumed the presence of arsenic. He made no attempt to analyze the substance of any of the organs, but boiled some of the fluid contained in the jar with the liver, with hydrochloric acid and metallic copper. The latter became coated, after boiling three minutes, with a black deposit, which he assumed to be metallic arsenic. The precipitate from the liquid test above mentioned, he reduced, as he said, to metallic arsenic, converted this into *arsenic* acid, and then reprecipitated with ammonia-nitrate of silver. No further description of his processes is furnished us.

Another analysis was made by Dr. William Manlius Smith, physician and chemist, of portions of the large and small intestines, the liver and œsophagus. He testifies that he decomposed the organic matter by hydrochloric acid and chlorate of potash, and found arsenic in all the remains examined by him. From fourteen Troy ounces of the liver, after it had been cleansed from extraneous matters by washing, he obtained two and one-third grains of arsenious acid, which was weighed in that form. The details of the various processes employed by him are now inaccessible. The results of his tests were exhibited to the court during the trial.

4. *Resumè.*

A brief examination of the symptoms recorded in the beginning of this case, is sufficient to establish their identity with the effects of an irritant poison like arsenic; and we can have little hesitancy in ascribing Mr. Rosa's death to poison. As regards the nature of the poison administered, there can be no doubt that arsenic was demonstrated to exist in the remains in considerable quantity. The yellow patch, as large as the palm of one's hand, found in the stomach, (undoubtedly the sulphuret of arsenic,) furnished valid grounds, by itself, for assuming the presence of

arsenic. and the analysis made by Dr. Smith supplied the confirmation. In the absence of anything like an extended detail of the processes he employed, we cannot of course either deny or endorse its accuracy, but it is most probable that it was correctly performed. One thing, however, in this analysis is worthy of remark, viz.: the product obtained from the examination of the liver, fourteen Troy ounces of which furnished, according to Dr. Smith, *two and one-third grains* of arsenious acid. Assuming the portion examined to have been an average specimen, the whole liver, weighing probably obout four pounds Troy, contained *eight grains*, which is undoubtedly a very large amount to be found deposited in that viscus. Dr. Geoghegan, of Dublin, it may be remarked, in his experiments, never found more than two grains in the whole organ.

With regard to the so-called analysis made by Dr. Fuller, however satisfactory it may have been to his own mind, it cannot be regarded in any other light than as utterly worthless and unreliable, especially in a criminal case involving the life of the accused. From his own testimony at the trial, its deficiencies are glaring, and it is very proper that some of them should be pointed out in a paper like this, which has for its object the description of an accurate method.

1. The materials employed by Dr. Fuller, such as the metallic copper, and the hydrochloric acid and other liquids, may have contained arsenic; we have no assurance of their purity.

2. There was no attempt made, whatever, to destroy or remove the organic matter present; on the contrary, the tests were applied directly to the contents of the stomach and œsophagus. It is scarcely necessary to repeat here what has already been stated concerning the errors sure to occur in such an operation.

3. He admitted that he could not distinguish between the precipitate of sulphid of arsenic and those of the sulphids of other metals having a similar appearance, viz.: tin, antimony and cadmium, to say nothing of its admixture with sulphur and organic matter.

4. He stated that he converted metallic arsenic into *arsenic acid* by heating it in a glass tube, and that this product gave a brick-red precipitate with ammonia-nitrate of silver, whereas such a treatment of metallic arsenic would result in the formation of *arsenious* acid which would produce a *yellow* and *not* a brick-red precipitate with ammonia-nitrate of silver.

5. When called upon in court, he was unable to exhibit any of the results of his experiments; this fact alone casts a certain amount of doubt upon his accuracy.

In reviewing this case there is one more point which is sufficiently interesting to be briefly mentioned.

It was proven during the trial, and admitted by the defendant, that she purchased a small quantity of arsenic three days before the death of her husband. This arsenic, she claims, was thrown into a stove and destroyed. Upon this statement I was summoned by defendant's counsel to ascertain whether this could have been the case. Accordingly, I went to the house and removed the soot from the stove-pipe for analysis.

After destroying the organic matter present, the remaining solution was found to contain arsenic, which had probably been deposited in the pipe by sublimation from the body of the stove.

How much or how little bearing this fact, showing that some arsenic had been thrown into the stove, ought to have upon the question of the guilt or innocence of the defendant, each is at liberty to judge for himself.

Case No. 6.

Clarinda Yourdon was tried at Rome, Oneida county, December, 1859, for the murder of her husband, James A. Yourdon, by poisoning him with arsenic.

1. *Symptoms and Circumstances.*

James A. Yourdon, a laboring man, aged about 35 years, lived unpleasantly with his wife. The day previous to his sickness, she was proved to have purchased arsenic. On Friday, (August 28th, 1858,) soon after eating his dinner, he was attacked with nausea and great pain in his stomach. For a while he could not vomit, but after a time he vomited freely. His indisposition, however, during the afternoon, was not so great but that he could work. The next morning there was a renewal of the symptoms, and with increased violence. The sickness continued, with varying intensity, until Monday evening, when he died, evidently in great agony.

The deceased was seen, by the neighbors only, until the day of his death, when a physician was called in. The symptoms described by the witnesses, were the same as those generally produced by arsenical poisoning. Thus there was an intense burn-

ing pain in the stomach, great thirst, almost incessant vomiting and purging, attended with great prostration.

2. *Post-mortem Examination.*

The brain was not examined. The lungs were engorged and filled with dark colored blood. The stomach and upper part of the intestine appeared inflamed upon an examination of their external surface. The other organs were healthy.

I received the package containing the stomach September 5th, five days after the death. Externally the stomach did not present any peculiar appearance, excepting a slight inflammation in those parts corresponding to the great curvature and pylorus, the orifices were secured by ligatures. Upon opening the stomach there was found within a fluid of a dark color, resembling strong coffee, mixed with coffee grounds, this was placed in a tall glass cylinder, that any solid matter might be deposited. The surfaces of the stomach were then carefully washed with distilled water, and the washings added to the original liquid. There was no appearance of ulceration or perforation of the mucous coat, this was highly inflamed, of a bright red hue, much thickened, easily separated from the muscular coat, and readily torn. In some parts of the great curvature the mucous membrane was more than usually thickened, and of almost a pultaceous consistency, readily breaking down on slight pressure. Beneath the mucous membrane were small patches of effused blood.

3. *Chemical Examination.*

It has already been stated that the stomach was thorougly washed in distilled water. Its mucous surface was then carefully examined by means of a lens, no solid particles were detected adhering to the mucous membrane. The stomach was then finely divided, and two-thirds of the resulting mass submitted to analysis, arsenic was found in it, its weight was 14.58 grains. This quantity seemed to me so extraordinary, that I took the precaution before reporting to the coroner to oxydize the sulphid, the form in which the arsenic was weighed, and reprecipitate it, and again determine its weight. The result was substantially the same as before, after the trial of the case, I submitted the reserved third of the stomach to analysis, and obtained from it 6.82 grains of arsenious acid.

The contents of the stomach and the washings it was stated

were placed in a tall glass cylinder; after a time the liquid was carefully poured off from the deposit. This liquid which contained a little solid matter suspended in it yielded 2.38 grains of arsenious acid. The deposit found in the cylinder consisted of a single mass, of an irregular oval form (its diameters being respectively $\frac{4}{8}$ and $\frac{7}{8}$ of an inch). This mass had a smooth surface, and was of a dirty white color, it weighed sixty grains. Its consistency was considerable, on being cut into it was evident that it contained gritty particles. A portion, at least one-fourth of it was used in a preliminary examination. After being finely divided, it was treated with ether, the etherial solution after evaporation left a yellow residue of the color and consistency of butter, and which melted readily by a moderate elevation of temperature. Treated with iodine the reaction for starch was obtained, the presence of arsenious acid in considerable quantities was also demonstrated. The remainder of the mass was then treated by the general method, arsenic was the only poisonous metal found, the quantity of arsenious acid obtained was 24.76 grains.

We will sum up the arsenic contained in the tissues and contents of the stomach. In the stomach there was (14.58+6.82=) 21.40 grains; in the liquid contents 2.38 grains. In (not more than) three-fourths of the solid mass 24.76 grains. Making the total amount actually weighed 48.54 grains. To this ought however to be added, that contained in that portion of the solid mass used in the preliminary examination, and which was not less than one-fourth of the whole mass. As it was apparently homogeneous throughout, we must add (24.76÷3=) 8.25 grains. Hence we have, as the whole quantity of arsenious acid present in the stomach and its contents (48.54+8.25=) 56.79 grains.

The body was exhumed sixteen months after burial and the liver removed. This organ was softened, but it did not appear much decomposed, it emitted, however, an extremely offensive odor. On examination arsenic was found in it in considerable quantities. Its weight was not determined, owing to the limited time at my disposal.

4. *Resumé.*

This case presents certain interesting features, which we will briefly allude to. We may note first the large amount of arsenic contained in the tissues of the stomach, the quantity was so

great, that as I have already stated, I took the precaution to dissolve, reprecipitate and weigh it a second time, to avoid any possible error. How so large an amount could be contained in the tissue, I am not prepared to say That a considerable quantity was encysted or covered over with mucus, and thus remained undiscovered, I can hardly believe after the careful examination I made of the internal coat of the stomach.

In regard to the mass made up of arsenic, and (in all probability) bread and butter, it may be noticed that at the coroner's inquest the accused made the following among other statements. She said that she knew he had taken arsenic, that on Friday night (it was in the afternoon of that day that he was taken sick) she spread butter mixed with arsenic on a slice of bread, and laid it on a bench by the side of a pail of water, in the morning it was most all gone, she remarked that she knew he had eaten it by the prints of his teeth on the fragment left. How it happened that the masticated particles of bread and butter had not been acted upon by the gastric juice, but became agglomerated into a single mass by the peristaltic action of the stomach, I do not clearly see.

The transmission and reception of the package containing the stomach, may properly be remarked upon. The stomach as received by me was contained in a tin box soldered tightly, this was inclosed in paper secured by strings and seals, and directed to me. I made notes of the appearance of the package, its size, the means by which it was secured, &c., but failed to record the precise direction inscribed upon it. Knowing that the package came by Express, I feared from the number of persons through whose hands it must have passed, that it might be impossible to identify it as satisfactorily as the defendant's counsel might wish, or rather as he would say it ought to be identified. After finding arsenic in the stomach, I informed the District Attorney of the facts mentioned above, and advised an exhumation of the remains, and an examination to be made of other parts more directly transmitted to me; this course he deemed it unnecessary to pursue. At the trial, however, it turned out that the package could not be satisfactorily identified, no two of the half dozen witnesses sworn, being found to agree as to the direction upon it. For this and other reasons, the prosecution, during the early part of the trial deemed it necessary to have the body exhumed, sixteen months had then elapsed since the interment. The liver was then obtained

and delivered to me, and an examination made with the results already mentioned.

This difficulty in identifying the remains demonstrates the necessity of placing remains supposed to contain poison under charge of a responsible party, out of whose immediate supervision they should not pass until personally delivered to the analyst.

Case No. 7.

Elizabeth P. McCraney was tried at Cooperstown, Otsego county, for the murder of Huldah Ann McCraney, by poisoning her with arsenic.

1. *Symptoms.*

Huldah Ann McCraney, a young lady seventeen years of age, residing in Oneonta, Otsego county, was taken ill with slight diarrhea, on the 28th of April, 1860.

The various symptoms of the illness following this indisposition are only accessible through her nurse and physician. The former, her step-mother, could not be expected to give reliable details. The report of a person unacquainted with medical science, and hence, ignorant how and what to observe, can never, taken by itself, be satisfactory to men of science, particularly in any complicated or unusual case. In addition to this, another difficulty presents itself in the fact that in this case the nurse was the person accused of administering the poison, and for this reason liable to suppress or modify facts which might be of importance.

The testimony of her attending physician, Dr. Samuel H. Case, furnished all we have to depend upon, and is as follows:

Sunday, April 29. Patient slightly indisposed. Tongue furred and white; pulse and skin normal. Diagnosis, disordered stomach and bowels. Treatment, calomel and rhubarb followed by castor oil and senna.

Monday, April 30. No change, excepting that the medicine given yesterday was vomited. Ordered calomel to be followed by castor oil and senna in six hours, and if the bowels should not move, enemata.

Tuesday, May 1. Medicine had been vomited again. No movement of bowels. Ordered a pill of podophyllin every third or fourth hour. An enemata of salt and water. A syringe was provided by Dr. Case.

Wednesday, May 2. Circulation and skin normal. Tongue

colored black. Pain in the limbs; two very slight evacuations of the bowels, about an ounce in quantity.

Thursday, May 3. Bowels confined. No swelling or tenderness of stomach or intestines. Pulse and skin natural, tongue becoming clean; stomach iritable. Ordered to continue enemata.

Friday, May 4. Pulse 80, skin natural, bowels confined, nausea and thirst. Ordered calomel, one grain repeated every third hour. Also sinapism to stomach, and demulcent draughts. Enemata to be continued. (Dr. Case removed his syringe this day.)

Saturday, May 5. No change in any respect.

Sunday, May 6. More irritation. Skin and extremities cool, bowels confined, but not swollen or tender. Ordered Croton oil pills, one every fourth hour, if retained. Enemata continued. (Syringe owned by patient's step-mother being used.)

Monday, May 7. Increased irritability, nausea and thirst. No swelling or tenderness of the abdomen. Pulse soft and more rapid, skin cool. Medicine ordered yesterday had been vomited. Ordered blistering wash to stomach. Enemata continued.

Tuesday, May 8. Pulse 90, increased nausea, thirst and restlessness. Much nervous irritation. Bowels still confined. Symptoms of gastritis. Continue blister to epigastrium and enemata.

Wednesday, May 9. Great nervous irritability, sleeplessness, sighing, and dyspnœa. Slight œdema of eyelids, face and neck. Pulse 100, and feeble. Bowels still confined Ordered ether and assafœtida; also 1-6 grain morphine, which was vomited. Enemata continued. (This day Dr. Case brought back his syringe.)

Thursday morning, May 10. Patient much worse. Increased œdema of eyelids and face; loud and stertorous respiration, skin and extremities cold, pulse 130, pupils contracted, general exhaustion. Symptoms appeared of congestion of the brain. Enemata ordered of warm water containing podophyllin.

Afternoon. Brain symptoms disappearing. Respiration more tranquil; skin and extremities cold, copious evacuations of the bowels. Pulse more rapid and feeble, tongue swollen, and deglutition difficult. Ordered chicken broth and brandy.

Evening. Countenance natural but slightly swollen. Body and extremities cold; much thirst, pupils contracted and vision lost. Intellect unimpaired, heart's action very feeble, pulse scarcely perceptible.

Death ensued on the next morning.

2. *Post-mortem Examination.*

The body was exhumed and an autopsy held on the eighteenth of May, seven days after death, by Drs. Sprague and Lathrop.

External Appearances.

Face and neck swollen, eye-lids œdematous. Nothing else worthy of notice in the external appearance.

Head. The skull was opened and the brain carefully examined and found healthy.

Thorax. In the right cavity of the thorax were observed old pleuritic adhesions. In the œsophagus small black points were noticed, similar to those described in the stomach and rectum. The internal coat exhibited no inflammatory redness. The remaining viscera of the thorax were perfectly normal.

Abdomen. Externally all the abdominal viscera appeared normal. Stomach ligatured and opened. Contents consisted of about a gill of dark fluid matter, which was transferred to a glass jar. Internal coats of stomach healthy with the exception of a discolored spot two inches in diameter, near the pylorus. Intestines healthy and nearly empty. Rectum opened and examined. About three inches from the anus a dark spot was observed, of the size of a five cent piece, containing an ulcerated point in its center. The mucous coat was softened and thickened in parts.

All the remaining abdominal viscera were perfectly normal in appearance and position.

At this examination the following organs were put up in clean glass jars and reserved for chemical analysis.

Jar No. 1. The stomach and contents.
Jar No. 2. Rectum and other intestines, and œsophagus.
Jar No. 3. Spleen, pancreas, lung, heart, and part of liver.
Vial No. 4. Fluid blood from cavity of thorax.

3. *Chemical Examination.*

The four jars and bottle mentioned were delivered to me for analysis on the twenty-fifth of May, and the examination commenced on the next day.

The stomach contained no metallic substance whatever, but the portion of the liver in my possession contained a *trace* of arsenic. The method pursued in these investigations was the general method of research detailed above. Having found that arsenic was plainly shown in the small portion of the liver exam-

ined, I directed that the body be exhumed, and that various other organs and tissues be delivered to me. This was accordingly done, and on the tenth of June I received the following:

A jar containing ten pounds of muscular tissue.

A jar containing the remainder of the liver.

A jar containing the uterus and appendages, the urinary bladder, kidney, and tongue with its appendages.

Subsequently the following were delivered to me for analysis:

1. A quantity of a dried mixture of corn meal and water, mingled with plaster.

2. A metallic syringe which had been used during the illness of Miss McCraney.

By treating the various organs, tissues and articles above mentioned, the following results were obtained:

The heart and lungs contained a *trace* of arsenic; also the pancreas and spleen.

The two kidneys together contained .05 grains.

The liver, from which the outside had been pared off, contained .10 grains.

The ascending and transverse colon together contained .173 grains.

The descending colon and rectum contained .868 grains.

The remainder of the small intestines, and also about three pounds of muscular tissue, each revealed a *trace* of the poison. The total amount of arsenic thus collected and weighed was 1.191 grains.

Syringe.—This was one of the ordinary pewter instruments, about eight ounces in capacity, and contained a trifle over four grains of arsenious acid. The substance of the metal was thoroughly cleansed and dissolved, and subjected to analysis without detecting the least trace of arsenic.

Meal.—An ounce and a quarter of the dried cake of corn meal, which was alleged to have been prepared for poisoning rats, was examined and found to contain two grains of arsenious acid.

4. *Resumé.*

This case is rendered peculiarly interesting from the *outré* nature of one of its features. Leaving entirely out of view the moral evidence, including the points bearing on the *motive* and *character* of the murderer, attention is requested to the *mode* in which the poison was administered. The testimony demonstrates

that Mrs. McCraney administered enemata to the deceased during her illness. The instrument which she admits having used on one occasion, and which we are warranted in supposing may have been used oftener, was carefully examined.

On withdrawing the piston, drops of oil were seen adhering to the interior of the barrel. Besides this, it was encrusted in spots with a white deposit, which was tested and found to be arsenious acid. The piston presented a similar appearance, and its packing was encrusted and stiffened by the same white material. The entire amount of arsenious acid obtained from the syringe was more than four grains (4.16).

This is precisely the state of things to be expected from the imperfect solubility of arsenious acid, and its density which would cause much of it to be retained in the syringe when the piston was pressed forward, unless the nozzle was depressed lower than the body of the instrument. It needs hardly to be mentioned that this is almost *never* the case in administering an enema.

Now when we compare the analysis of the syringe with that of the rectum, the case admits of only one interpretation. The former contained about four grains of arsenious acid, the latter .868 grains, or more than double the entire amount collected from all the other parts of the intestinal tract.

The question may arise why the lining coat of the rectum did not exhibit greater evidences of local inflammation than were found at the post mortem examination. The presence of the globules of oil found in the syringe throws considerable light upon this.

We have no means of knowing precisely the nature of the enemata administered, but we are at liberty to assume that oil was an ingredient, and under this supposition, we should not expect to find evidence of much local irritation, it being the nature of oils to protect mechanically the mucous coat of the intestines, and also to render arsenious acid less readily dissolved, thus materially interfering with the absorption of the poison.

The administration of the poison by injection has been particularly dwelt upon from the rarity of such cases, and the peculiar malignity it argues in the perpetrator. Yet, it must not be taken for granted that this was the sole way in which the poison was introduced into the system.

A careful examination of the symptoms reported by the attend-

ing physician would tend rather to support the idea that arsenious acid was at first administered in small does by the *mouth.*

There was almost constant nausea, and there was much vomiting, whereby the greater portion of the poison would necessarily be rejected, and thus escape detection in an analysis of the stomach, even although sufficient be absorbed to produce the symptoms observed, among which were œdema of the eye-lids and face, thirst, nausea and vomiting, and intense nervous irritation and exhaustion, the usual train of symptoms to be expected to follow the exhibition of repeated small doses of arsenious acid.

Is it not altogether probable that the rejection of the greater part of the poison by vomiting, and the consequent protraction of the illness, suggested to the mind of the poisoner, a more effectual method by which the arsenic would be retained in the body, and thus accomplish its destructive work with greater rapidity, and as she perhaps supposed with less liability of detection?

It may appear to some remarkable, that while the stomach was found free from arsenic, it yet was detected in the liver, &c., this is not however unusual when the patient lives for a considerable time after taking the poison, both Taylor and Geoghegan refer to such cases.

This case is interesting from the character of the symptoms and the mode of administering the poison; it is also important as showing that the absence of arsenic from the stomach does not prove its absence from other parts of the body, it thus illustrates the necessity of a through examination of various organs in cases of supposed poisoning.

Case, No. 8.

Elizabeth P. McCraney was tried at Cooperstown, Otsego county, February, 1861, for the murder of Allen Baker, by administering to him arsenic in the months of June and July, 1850.

1. *Symptoms and Circumstances.*

June 28, 1850.—Deceased was taken violently ill immediately after eating dinner, he went out into the yard groaning as if in great pain, and began vomiting profusely. He returned to the house where he continued vomiting, groaning aloud, the perspiration streaming from his face. The servant coming in with a pail of water, he asked for a drink. As she was about to hand it to

him, Mrs. Baker (now Mrs. McCraney, the person suspected of poisoning him) first carried the water into her own room, and then returned with some in a glass and gave it to him. After drinking he began vomiting again, and continued to vomit throughout the night.

The next day the domestic prepared some broth for him—on the pretext of *cooling* it, Mrs. Baker took it from the servant and carried it to her own room, (in a part of the house remote from that where deceased was,) and afterwards returned with it and gave it to the sick man—soon after drinking it, he began to vomit anew.

This same circumstance recurred in the case of some porridge which was prepared for him.

From the beginning of his illness to his death, which occurred on the 7th day, the symptoms may be briefly described (on the authority of various individuals, including one of the physicians who attended him), as follows: Dryness of throat, nausea, dyspnoea, great thirst, incessant vomiting and retching, intense burning pain in the stomach and bowels, dimness of vision, restlessness, anxiety, prostration, and muscular spasms.

The body was interred and remained undisturbed till January 9, 1861, a period of nearly eleven years. At this time the minds of the public were occupied by the disclosures made during the trial of Mrs. McCraney, for the murder of her step-daughter, by arsenic. This trial resulted in an acquittal, but so far was this result from quieting the suspicions already aroused, that it only tended to excite a review of Mrs. McCraney's antecedents. The circumstances attending the death of Allen Baker (her brother-in-law) very naturally furnished grounds for investigation, and accordingly his remains were exhumed and delivered to me for chemical analysis.

I have already described some of these circumstances, including a summary of the symptoms of deceased's last illness, but without alluding to the moral evidence which does not properly belong to a paper of this description. Therefore, it only remains to speak of the appearance of the remains, and of the results of the chemical analysis.

2. *Appearance of Remains.*

At the request of the coroner, I went to Milford, Otsego county, January 9, 1861, and there witnessed the exhumation of certain remains, said to be those of Allen Baker.

I took from the grave two jars of earth, as follows: Jar A. contained earth from above the coffin and around the walls of the grave. Jar B. contained earth from below the coffin; these jars were sealed up and remained in my possession till they were analyzed.

The shell (or outer case) and the coffin, with their contents, were removed from the grave, then enclosed in a strong box, properly secured, and delivered to me, remaining in my possession till they were analyzed. Receiving thus, the above, without their having been disturbed, I am able to furnish a description of their condition, which has many points of decided interest both to chemists and medical men.

Among these are:

A. Progress of decomposition of the case, and the coffin and its furniture.

B. The progress of decomposition of a body which has lain in the ground more than ten years, as affected by the presence of arsenic.

C. Identification of the remains as those of the body of Allen Baker.

A. Progress of decomposition of the case and the coffin and its furniture.

The case was considerably decomposed. The pine wood of which it was formed being very friable around the edges and surfaces. In the central portions the wood was quite firm, the cover, for example, was found capable — its ends being supported — of sustaining a heavy weight (300 pounds) without breaking.

The wood (pine) of the coffin had suffered little change by decomposition, so little that it was not more easily broken than ordinary wood of the same kind.

The lining of the coffin (muslin) was completely decomposed. The shroud had disappeared from the limbs and upper surface of the body, but was more or less completely preserved on the sides and under surface; that on the sides scarcely holding together, while that on the under surface was tolerably firm, but could easily be pulled apart; although the case was so much decomposed there was no earth between it and the coffin.

About one quart of water was found in the coffin, demonstrating how little it had been affected by its burial.

B. Progress of decomposition of the body.

1. *Bones.* The remains were blackened, the skull nearly bare, the ribs projecting and destitute of covering. Most of the bones of the skeleton were in their natural position. The lower jaw had fallen down and rested immediately below on the upper part of the chest. The ribs had fallen forward, but nearly all retained their relative position to each other, a few were more displaced and rested upon others and upon the bottom of the coffin. The bones of the arms and legs were in their natural position. The bones of the feet had separated from their connections and lay together at the foot of the coffin.

The skull was sound, as were all the bones, so far as could be ascertained, they weighed twenty pounds.

In the upper jaw the following teeth were present: On the right side the third molar, the bicuspids, the canine and first incisor. On the left side the incisors, the canine and second bicuspid. In the lower jaw the following teeth were present: On the right side the incisors, the canine, the bicuspids and first and second molars. On the left side the incisors, the canine and the bicuspids.

A number of the teeth were loose and so easily detached from their sockets, that in cleaning the skull a number dropped out, as indeed may have happened previously. That this had actually occurred was also probable from the fact that the cavities corresponding with a number of the teeth were not filled by natural growth, as would have been the case, in all probability, if they had been removed during life.

2. *Hair.* There was abundance of hair lying upon the pillow (formed of shavings) immediately back of the head. Hair was also found in smaller quantities on either side of the skull.

3. *Brain.* Upon opening the skull the dense fibrous membrane (the dura mater) which lines its interior, was found quite perfect in those parts corresponding to the occipital and parietal bones.

In other parts it was more or less completely decomposed. Small portions of the arachnoid and pia mater could readily be distinguished.

The brain weighed twenty-seven and a half ounces. It was, generally, of a dull white color, the cerebellum and the posterior part of the cerebrum were but little changed, so that the white and grey substances composing the brain could readily be dis-

tinguished. The medulla oblongata was firm and nearly perfect in its upper part, but soft and pulpy in its lower part.

4. *Muscular tissue.* The muscular tissue covering the head, neck and anterior face of the trunk and limbs was decomposed.

Upon the sides and posterior face of the same parts it existed in considerable quantity, but much modified from its original character. Generally it was of a light reddish color, of the consistency of a moderately hard fat, easily broken down by pressure, some portions were of a darker color and much softened.

The muscular tissue found upon the legs and loins weighed twenty-four pounds, that upon other parts weighed six pounds, giving as the whole weight of the muscular tissue thirty pounds.

5. *Contents of the thorax and abdomen.*

The contents of these cavities were much decomposed, so that with the exception of the liver and lungs (recognized by their structure) the viscera could not with certainty be distinguished. The matter found in these cavities was mostly in a pasty condition, and of a dark color, it weighed somewhat more than five pounds.

6. *Gloves.*—The bones of the hands were enclosed in gloves of a nut brown color, they were of silk, and perfect in every part.

C. Identification of the remains.

In the determination of this important point, there was much less difficulty than might very naturally have been expected in consideration of the length of time that had elapsed since burial.

The grave was recognized and pointed out by the man who had digged it.

The remains were identified by such peculiarities as the following:

1. The length of the skeleton, making due allowance for inevitable changes, as dissipation of cartilages and soft parts.
2. Conformation of the skull.
3. Position and number of teeth, some having been lost during life.
4. Color of hair and whiskers.
5. Length and situation of whiskers, they being found in the coffin, on either side of the skull, and none being found beneath the jaw, thus conforming to the description of *side whiskers* and absence of those on the chin.

6. The silk gloves found enclosing the bones of the hand. These assisted materially in the recognition of the remains, because at the time of the funeral they were generally considered as an infringement, or rather departure from the established funereal costume.

3. *Chemical Examination.*

From the nature of this case the chemical examination was much more laborious than in the case of a recent corpse. This labor did not arise from any unusual difficulty in analysis, so much as from the greater extent, it was deemed advisable to carry the research.

Attention was particularly directed to the following points:

A. Did the remains contain arsenic?

B. Did the material of the coffin contain arsenic originally, and if so, might it not have contaminated the remains?

C. Did arsenic exist normally in the soil; if so, might it not have contaminated the remains?

D. Was the arsenic found in the remains administered during life, or introduced after death?

E. Was there sufficient arsenic present to produce death?

A. Did the remains contain arsenic.

The general course of the examination was conducted in the manner already mentioned, some variations, however, were deemed advisable, which will be described hereafter.

After a most careful and thorough preliminary examination of the various reagents and vessels, four ounces of the material contained in the cavity of the thorax were examined, and abundant indications of arsenic found. It may be stated here, that in consequence of the slight consistency of the materials contained in the thoracic and abdominal cavities, and the disturbance they necessarily underwent during the transportation of the remains from the grave to my laboratory (more than one hundred miles), that it was found impossible accurately to determine what parts were normally contained in each cavity. Hence, in the examinations hereafter noted, it is not at all unlikely, but from the results extremely probable, that parts of the alimentary canal were included in the thoracic portions.

1. *Brain.*—The contents of the skull, after being treated according to the general method, furnished a liquid, which was introduced into a Marsh's apparatus, (which had been running two

hours without the production of any deposit in the reduction tube) two small stains were produced on porcelain, and slight stains were obtained in the reduction tube. The stains on porcelain disappeared immediately on the application of hypochlorite of soda. One of the tube deposits was converted into sulphid; chlorohydric acid gas had no effect upon it, but it dissolved readily in ammonia. Thus demonstrating the presence of arsenic in the brain.

2. *Thoracic contents.*—The matter from the right side of the thorax, i. e., between the vertebral column and the ribs, yielded 0.552 grains of arsenious acid. The matter from the left side of the thorax contained 0.881 grains of arsenious acid.

3. *Abdominal contents.*—The matter from the right side of the abdomen, i. e., between the vertebral column and right pelvic bones yielded 0.349 grains of arsenious acid. The matter from the left side of the abdomen yielded 0.412 grains of arsenious acid.

4. *Muscular tissue.*—Two pounds of the muscular tissue from the right thigh yielded abundant evidence of arsenic, its weight was not determined. The muscular tissue from the loins, legs and back was finely divided and then thoroughly mixed. Two pounds of the mixed mass was examined, it yielded 0.039 grains of arsenious acid; on the supposition that this was an average specimen, there must have been present in the whole mass of thirty pounds, 0.585 grains of arsenious acid.

5. *Bones.* Before examining the bones they were scraped as clean as possible and then thoroughly washed in water. The femur, patella, tibia and fibula of the right side yielded a small quantity of arsenic. In six ribs, the sternum and the clavicle of the right side, arsenic was also found. No quantitative determination was made of the arsenic in the bones.

6. *Debris* from the bottom of the coffin. Two pounds of the debris from the bottom of the coffin yielded 0.030 grains of arsenious acid.

7. *Weight of arsenic found in the remains.*—In the thoracic cavity was found 1.433 grains, in the abdominal cavity 0.762 grains, in two pounds of muscular tissue 0.039, in two pounds of the debris 0.030, giving as the total weight of the arsenious acid found in the coffin, as actually weighed, 2.264 grains. But this does not represent the whole quantity present. The 28 pounds of mucular tissue not examined, contained, according to an average specimen, 0.546 grains, which, added to 2.264 grains the amount weighed, makes the total 2.810 grains.

No reference has as yet been made to the arsenic contained in the four ounces of the thoracic contents used in the preliminary investigation, nor of that contained in the bones; as any calculations regarding the amounts contained in these parts would be rather unsatisfactory, we have not deemed it best to present them. In view of the various results obtained it seems not unreasonable to believe that, at least, three grains of arsenic were present, in and about the remains.

B. Did the material of the coffin contain arsenic originally, if so, might it not have contaminated the remains. This examination was made, not so much in the expectation of finding arsenic as to prevent an ingenious counsel from taking advantage of the omission of such an examination.

1. Two pounds of the wood, composing the lid and upper part of the sides and ends of the coffin were taken for analysis.

The method of Danger and Flandin was used in this case, viz: the wood was finely divided and mixed with one-third of its weight of sulphuric acid, and heated, stirring the mass continually, and finally evaporated to dryness.

Another portion of sulphuric acid was then added and the mass again evaporated. The dry and friable carbon remaining was moistened with a mixture of two parts of nitric acid and one part of chlorohydric acid, and evaporated to dryness. When cold the mass was finely pulverized, boiled with water and filtered. The carbon remaining on the filter was carefully washed, and the filtrate, after concentration, added to that which first passed through the filter. The colorless liquid thus obtained, treated in Marsh's apparatus, gave neither spots on porcelain, nor deposits in the reduction tube.

2. Two pounds of the wood, from the bottom of the coffin, were treated as above, and was found to contain a small quantity of arsenic.

3. The screws of the coffin were next examined, they were nearly perfect, only rusted upon their surface. A number were introduced into a Marsh's apparatus and sulphuric acid added, abundant evidence of arsenic was obtained.

Although arsenic was found in the wood of the bottom of the coffin, where it was in contact with the remains, yet as none was found in the wood of the lid and upper part of the coffin, even in those parts immediately in contact with the screws, we can-

not but come to the conclusion that the materials of the coffin did not contaminate the remains with arsenic.

C. Did arsenic exist naturally in the soil, if so, might it not have contaminated the remains? Although the amount of arsenic found in the remains was large, the coffin quite perfect, and though no earth had washed between the case and the coffin, circumstances, which alone, (from the known insolubility of the arsenical compounds contained in certain soils) would render it impossible for the earth, even if arsenical, to have contaminated the remains, it was deemed advisable to examine the soil. A number of examinations were made of each specimen, two pounds being used each time. The following was the method pursued:

The earth was treated with dilute solution of caustic potash, which was allowed to act upon it for twenty-four hours. The mass was then gradually heated and evaporated, water was then added, and the mixture boiled, then filtered, and the residue was treated successively with chlorohydric acid and chlorate of potash, nitric acid, and finally with sulphuric acid.

These solutions were in different cases examined separately and collectively, with the following results:

In the earth of jar A, that taken from above the coffin and around the walls of the grave, no arsenic was found. In the earth of jar B, that taken from below the coffin, arsenic was found in sensible quantities in the potash solution, and in traces in other preparations.

From the results stated above, we must draw the conclusion that the coffin was the source of arsenic in the soil, and not the soil the source of arsenic in the coffin. If it were otherwise, we would expect to find arsenic in larger proportions upon the exterior of the remains and in the debris on the bottom of the coffin than in other parts, and pretty equally diffused over the whole mass of the remains, while analysis shows the contrary to be the fact.

D. *Was the arsenic found in the remains introduced during life?* This most important question may be answered positively in many cases where the person has been dead but a short time, by an examination of the various organs and tissues; in other cases where the person has been long buried, an answer cannot with certainty be given from a chemical analysis alone. It may be stated that this question was forcibly impressed upon our minds, not alone from the nature of the case, but from the fact that the

coffin was opened, and exposed to the examination of a crowd of people. Before answering the above question, it seems important to consider three others: 1. Was the poison generally diffused; 2. Was the poison equally diffused; and 3. In what combinations did the arsenic occur.

1. *Was the poison generally diffused?* In this case arsenic was found not only in the mass resulting from the decomposition of the viscera, but in the muscular tissue and even in the bones. It was in fact found universally diffused as we might expect if given during life.

3. *Was the poison equally diffused?* In the majority of cases of poisoning it is in the intestinal track, especially in the stomach, that the larger quantity of arsenic is found. The partially decomposed viscera in this case could not with certainty be identified or separated, owing, as has been said, to their consistency and to the agitation to which they were subjected during transportation, and hence separate analysis of the various organs could not be made. The greater part of the arsenic separated was in the thoracic and abdominal cavities, where, under the circumstances, we would have expected to find it if given during life.

3. *In what combination did the arsenic occur?* Arsenious acid is the common form in which arsenic is introduced into the system. By the decomposition of a body containing it, it is converted more or less completely according to the quantity present, and its mechanical condition, into the sulphid of arsenic, by the sulphydric acid generated. When detailing the chemical examination, it was stated that some variations were made from the general method ordinarily pursued. These variations were made for the purpose of answering, at least in part, the interrogation just presented.

The thoracic and abdominal contents were treated similarly, as follows: The mass to be examined was mixed with dilute chlorohydric acid, and gently heated for an hour, when it was converted into an almost homogeneous mass; it was then filtered and thoroughly washed, (this solution was treated according to the general method.) By this means any arsenious acid, and its combinations with the bases, would be obtained in solution. The residue was digested with dilute ammonia and sulphid of ammonium, at a gentle heat. The mixture, while warm, was strained and filtered (operations conducted with extreme difficulty), and the filtrate examined for arsenic. The menstrua just mentioned

it was believed would dissolve any arsenic that might be present in the form of sulphid. From this solution the greater part of the arsenic found in the cavities was obtained; the residue from the above was treated according to the general method.

The following are the results obtained in the examination of the arsenic found in the right side of the thoracic cavity:

The weight of arsenious acid obtained from the chlorohydric acid solution, 0.041 gs.; the ammonia and sulphid ammonium solution, 0.551 gs.; the residue remaining after the treatment with the above menstrua, furnished but an inconsiderable quantity of arsenic: its weight was not determined.

From the above statements and results we conclude that the arsenic was introduced into the body during life.,

E. *Was there sufficient arsenic present to produce death?* How small a quantity of arsenic may prove fatal, we cannot certainly say. In most cases where a person dies from its effects, the quantity taken cannot be ascertained.

The smallest quantities that have proved fatal, so far as I can ascertain. are the following: Dr. Letheby communicated to the Pathological Society of London, a case in which two and a half grains of arsenic, contained in two ounces of fly water, killed a healthy, robust girl, aged nineteen years, in thirty-six hours. Dr. Castle, of Leeds, reports a case where a woman took half an ounce of Fowler's solution (arsenite of potash), in unknown doses during a period of five days. She then died. The quantity of arsenic which here destroyed life, could not have been more than two grains. (Taylor on Poisons.)

Dr. Lachèze (d'Angers), knew two individuals to die, the first after seven, the second after ten weeks, after having taken in two days, and in four doses, two grains of arsenious acid. (Flandin Traitè des Poisons,t. i., p. 493.) Dr. Taylor says that the facts just mentioned will justify a medical witness in stating, that under circumstances favorable to its operation, the fatal dose of this poison is from two to three grains. According to Dr. Lachèze, one or two grains may act fatally in a few days.

The quantity of arsenic separated and actually weighed, was in this case, somewhat more than two grains and a quarter, and as has been already mentioned, the quantity present was in all probability more than three grains.

From a consideration of the facts and opinions mentioned above, we are satisfied that there existed in the remains a quan-

tity of arsenic sufficient to cause the death of an adult, if given under circumstances favorable to its action. It is evident that the amount contained in the remains does not represent the quantity taken, which in all probability was much larger, the greater part being removed from the system during life, by vomiting and purging.