ART. XII.—*A Case of Poisoning by Hydrocyanic Acid successfully treated by the Carbonate of Ammonia; with Observations on the medico-legal Relations of this Poison, and the Mode of detecting the Impurities which the medicinal Acid occasionally includes, &c.* By T. G. GEOGHEGAN, M. D., Professor of Medical Jurisprudence to the Royal College of Surgeons in Ireland.

THERE is no department of medical acquirement, in the prosecution of which it is of more importance to possess an extensive collection of recorded cases, than in medical jurisprudence; and of its various branches, the toxicological one demands it in particular. The physician, when called on to perform his duties as medical jurist, is, when thus provided, enabled, by a careful study and comparison of these, to give evidence, not grounded on loose analogical reasonings, but on an acquaintance with facts. By experience, either personal or derived, opportunity is afforded, of forming correct conclusions as to the average occurrence of the various phenomena which cases present, and of marking those which constitute deviations from the ordinary course, a class of especial interest to the medical jurist. Thus it is of great importance to be aware, that the arsenical poisons may cause death, without producing the usual signs of inflammation in the alimentary canal, and that opium has in a few instances manifested, instead of its ordinary tendency to constipate, a power of exciting diarrhoea and colic. It may be reasonably expected that under the present improved state of toxicology, the cases which have been within the last few years laid before the public, and are still from time to time appearing, will, at no distant period, furnish materials of great value towards the elucidation of the physiology, pathology, treatment, and medico-legal connexions of poisons. The following instance of poisoning with hydrocyanic acid is related with a view of increasing, as far as can be effected by so small a contribution, the

foundation of facts above alluded to. The particulars, which were related to me by the individual who was the subject of the poisonous effects of the acid, and by those who witnessed them, are as follows :

A gentleman, aged 21, having been for some time subject to an uneasiness in the stomach, not actually amounting to gastrodynia, after having tried many remedies in vain, was induced to have recourse to hydrocyanic acid. He commenced with one minim of the acid of the Dublin Pharmacopœia, sp. gr. .998; this dose he repeated twelve times the first day, without any perceptible effect. On the following day he took half a drachm, with the same result. The third day his dose was a drachm, which he repeated the fourth day. On the fifth day he took a drachm and a half, still no effect of any kind. On the sixth day he increased his dose to two drachms. In about two minutes after taking this latter quantity, which produced a sensation of extreme bitterness in the mouth, and having walked a few paces, he experienced a feeling of great confusion, with headach, and loud ringing in his ears; he now with difficulty retraced his steps, and leaning forward on a table, became insensible, and fell backwards. In this state he remained altogether between three and four minutes, during which time he was violent convulsed, and to use the expression of those present, (who were of the medical profession,) affected like a rabbit poisoned with the acid. Two drachms of the *spiritus ammoniæ aromaticus* were diluted with a little water, and applied as quickly as possible to the mouth, but as the teeth were clenched he could not be got to swallow any. The solid sesqui-carbonate of ammonia was then applied assiduously to the nostrils; its beneficial effects were soon apparent, and he was shortly able to swallow a little fluid. Sensibility now speedily returned, and vomiting supervened, from which he experienced great relief; and at the expiration of half an hour he was quite well, with the exception of pain and feeling of distention in the head, which continued for the rest of the day. His old complaint was com-

pletely removed by this extraordinary dose. Those who witnessed this case informed me that after he had become insensible, and while leaning on the table, his thighs were drawn up on the abdomen, and rigid; and as he was about falling they caught him, and placed him on the ground. The upper extremities were then observed to be also rigid; and on drawing them from the side, they forcibly reverted to their former position; the eyes were shut, the teeth clenched, and the muscles of the face violently convulsed. The spiritus ammoniæ being at hand, was applied very shortly after the supervention of the symptoms just detailed. It should be mentioned that the acid taken on the various occasions was diluted with water; the total quantity consumed being a little more than six and a half drachms of an acid purporting to be that of the Dublin Pharmacopœia, the per centage of real acid in which, according to Ure's table, should be 1.5.

The above case presents a very good example of the poisonous effects of the hydrocyanic acid, resembling very much those observed in animals. It is also, I conceive, of considerable interest, as from the circumstances under which it occurred, namely, having been witnessed throughout its whole course by persons competent to observe the symptoms, an opportunity was afforded of acquiring data connected with the determination of some points of importance in the medico-legal relations of the poison, one seldom to be obtained where this agent has been taken by accident, or for purposes of self-destruction. In a paper on the subject of the treatment of this form of poisoning in the *Annales de Chimie*, vol. xliii. by MM. Persoz and Nonat, they divide the symptoms into three stages: 1. that of general malaise; 2. tetanus; 3. interrupted respiration, or what Orfila occasionally terms the stage of flaccidity and insensibility, during which the pulse rapidly fails, and finally becomes extinct. By malaise, they most probably mean to express the agitation, giddiness, and faintness observable at the very commencement of the action of the poison. The other

terms sufficiently explain themselves. I have frequently observed in animals to which this acid had been administered, that they perform rapid motions with the mouth and jaws, as if a powerful impression had been produced on the nerves of taste. Coullon* states that in experiments which he performed on his own person, he experienced an insupportably bitter taste. This symptom, which circumstances might render of some importance, was also present in the instance which I have related. The other effects which Coullon states himself to have experienced from doses varying between twenty and eighty-six drops of the acid (of Vauquelin?) were, nausea, hurried pulse, weight and pain in the head, succeeded by a feeling of anxiety, which lasted about six hours. As far as I have been enabled to judge by a perusal and comparison of cases, it would appear that in man the coma is often well marked previous to the occurrence of convulsions. In animals, on the contrary, convulsions frequently, if not generally, precede coma, or at least occur while the coma is but yet incipient. Nausea and vomiting often present themselves in the commencement of this form of poisoning in animals, and in man they are pretty constant effects of too large medicinal doses; they also occasionally supervene after the long continued use of the acid. In the case detailed vomiting was not present at the commencement. This symptom is mentioned by some writers as one of those indicating the progress towards a fatal termination. If however we examine recorded instances, we shall, I conceive, find reason for concluding, that although it may occur late in the order of symptoms of poisoning, it is generally a favourable one. In the case above related it was followed by great relief; and Coullon mentions many instances in which dangerous, and even alarming symptoms were dissipated by the occurrence of spontaneous vomiting. The headach and sense of distention which

* *Recherches et Considerations sur l'Acide Hydro-cyanique.* Paris, 1819.

remained for the rest of the day, in the instance recorded in this paper,* was probably the result of reaction following the depression of the nervous energy.

Although the phenomena of poisoning by the hydrocyanic acid leave no doubt of its exerting its energies on the nervous system, yet concerning the precise nature of its primary action, there appears still to exist difference of opinion. In its toxicological relations there can be no doubt of the propriety of classing it amongst the narcotic poisons, if these be considered as agents "inducing a state of the nervous system resembling apoplexy, epilepsy, and other disorders usually called nervous."* If it be examined, however, in reference to its therapeutic action, many circumstances appear to demonstrate the propriety of bestowing on it a place amongst "sedatives," as has been done by Dr. A. T. Thompson in his late work.† The distinction drawn by this writer between sedatives and narcotics being, that while both diminish the energy of the nervous system, this diminution of energy is, in the case of sedatives, a primary effect, but in narcotics secondary to an excitant one.

With reference to the particular instance of hydrocyanic acid, as Dr. Thompson justly observes, "the general character of the symptoms induced by that powerful agent indicates a diminution of the nervous energy." It can hardly however be conceded as *universally* true, that the effect of the acid is to diminish the force and frequency of the pulse. In Dr. Elliotson's excellent work on the Medicinal Applications of Hydrocyanic Acid, he states, that in his hands "it has always proved unable to lessen the quickness and violence of the pulse when there was simply excessive action of the heart. Dr. Prout, who made trials of the acid at Dr. Elliotson's request, has never "been able to ascertain that it sensibly affects the pulse;" administered in larger doses than those applicable to the treatment of dis-

* See Christison on Poisons, second edition, p. 577.

† Elements of Materia Medica and Therapeutics, vol. i. p. 419, et seq.

ease, as in Coullon's experiments on himself, the pulse was, on the contrary, accelerated; in fact rose from 58 to 78, and had not regained its usual rate for an hour and a half. In experiments on animals I have no doubt that it has occurred to others, as well as myself, to find the pulse increased in frequency, if not in strength. Dr. Granville, in discussing the poisonous effects of the acid, states the pulse to be either quick and wiry, or slow and vibrating. The first of these conditions however does not prove the existence of an excitant action, as it relates to one only of the group of symptoms which indicate the existence of such action, and that symptom one, not connected directly with the nervous system, but with a function subordinate to it, and secondarily affected. The concomitant faintness, stupor, lowness of spirits, prostration of strength, &c. indicate, whatever may be the state of the heart's action, a depression of the nervous energy. It is scarcely necessary to observe, also, that there are many diseases in which, while the nervous influence is impaired, the pulse is more frequent than in a state of health.

From these observations it would appear, that although, from the general effects which hydrocyanic acid is capable of exerting,* it merits being placed in the class of sedatives, it is not necessary, as it would appear to be, (from the general tenor of Dr. Thompson's remarks on the latter,) that it should uniformly diminish the frequency at least of the pulse. In case of poisoning with opium, where there is an acknowledged impairment of the natural energies of the nervous system, and where the existing symptoms appear on the whole to be those of a sedative action, the pulse is often quicker than ordinary, when slower than in health it frequently is preternaturally full, so that it is possible that under these circumstances the momentum of the circulating fluid does not, on an average, differ essentially from its healthy amount.

The case detailed in this paper presents a circumstance of

* To these it may be added, that, unlike narcotics, it seldom induces sleep.

importance, both in reference to the medicinal administration of the acid, and as concerns medical jurisprudence, namely, that while a dose of a drachm and a half produced not the slightest injurious effect, two drachms gave rise to the violent symptoms of poisoning already detailed. Before proceeding it is necessary to state the strength of the acid used : from a careful examination of two distinct portions, I ascertained the percentage of real acid to be .60, it therefore had a strength bearing the proportion to that which an acid of .998 should have, (according to Dr. Ure's tables,) of .6 to .15 ; in other words, the reputed strength of the acid of the Dublin Pharmacopœia is $2\frac{1}{2}$ times that of the fluid employed in this case, and the percentage of the acid generally used in England, if correctly prepared and carefully preserved, is five times as great. From calculation, however, grounded on the quantity of materials employed, the strength of the acid of the Dublin Pharmacopœia *should* be about three per cent. ; the acid which was used in the instance under consideration was prepared from the ferro-cyanide of potassium, and it should be mentioned, that its chemical examination was not undertaken for a few weeks after its employment ; it had been, however, carefully preserved, and when I got it was perfectly limpid, and possessed strongly the characteristic odour of the poison.* It is also well known to chemists, that acid prepared from the ferro-cyanide of potassium, even when tolerably strong, will remain, when exposed to the diffuse light of day, unaltered for many months, nay, for more than two years. Having premised so much concerning the strength of the acid employed, it is obvious that the difference, as to quantity of real acid, between one and a half, and two drachms must have been very trifling, although the conse-

* It is necessary to recollect, that specimens which include a very minute portion of real acid, may, nevertheless, exhale a comparatively powerful odour, and that therefore no conclusions as to strength are to be founded on the existence of the latter.

quences of their administration totally different. This statement, as to the effect of minute difference in dose, is strikingly confirmed by Dr. Elliotson, and also by the experiments of MM. Parent and Duvignau ; the former administered seventeen minims three times a day to a woman in consumption, “ without inconvenience or benefit ; eighteen minims brought on vomiting and giddiness.” The distilled water of bitter almonds, used by MM. Parent and Duvignau, which must be an exceedingly dilute prussic acid, although it produced very slight effects in doses of eighteen drops, when the quantity was increased to twenty-two drops, gave rise to alarming symptoms, such as convulsions and vomiting. There can be little doubt that in the case which I have related, a dose intermediate between one and a half and two drachms might have been given without inconvenience.

This property of hydrocyanic acid, which appears to have been hitherto little noticed by writers, is obviously of considerable importance, and leads to the consideration, whether under any circumstances it can be considered as possessing an accumulative power. The opinion of toxicologists in general is opposed to this supposition ; nor do I conceive that the case under consideration affords it much support. It should however be recollected that the poison is capable of entering the blood, as is demonstrated by a variety of circumstances, which it would be out of place here to allude to, and indeed most probably absorption is essentially preliminary to the action of the medicinal acid. The facility with which the acid undergoes decomposition, or is exhaled by the pulmonary surfaces, does not preclude the possibility of its possessing a power of accumulation, as digitalis, the active principle of which is no doubt readily decomposed, and iodine, which rapidly passes off by the kidneys, are notoriously cumulative poisons. The continued use of hydrocyanic acid has also, in instances by no means few, produced salivation and ulceration of the mouth. Whether then there be conceded or

not to this poison a power of accumulation, it should be borne in mind, for many reasons, that minute difference in dose is capable of producing the greatest disproportion in effects. Occasionally the acid presents the most extraordinary anomalies in its action. Thus, Richard* states that he has known a patient take from six to eight, and even twelve ounces of laurel water in the twenty-four hours, without any symptoms of poisoning; and conceiving the preparation must have been either inert or spoiled, he had some prepared by one of the first pharmaciens in Paris; its administration was followed however by the same results. Dr. Montgomery has mentioned to me, that while he has failed in killing a cat with a drachm of the medicinal acid, a drop and a half of the same acid (kept for three years longer) almost instantaneously destroyed a rat. Before I was aware that there was any thing in print on the subject, I had formed the conclusion, from experiments, that the acid acts much less energetically on young animals than on old ones. Orfila's statement, I perceive, is the opposite; he does not, however, give the grounds on which his opinion is founded. In the great majority of experiments which I have since made on the subject, young animals have been less sensible to its action; in some few, however, the poison appears to act just as energetically on the latter, as on those which have attained their full growth and vigour. The interval which may elapse between the reception of the poison into the stomach and the commencement of its action, became a question of the greatest importance† in a trial which occurred in England a few years since. Five drachms of the medicinal acid had been taken, and the bottle was found corked and wrapped in paper beside the bed, in which the deceased lay in a composed posi-

* Dictionnaire des Drogues simples et composees.

† Trial of Freeman, for the murder of Judith Buswell at Leicester, April 2, 1829. See also Christison on Poisons, 2nd edition, p. 666.

tion; the question naturally arose, whether the deceased, after taking that quantity, could have had time to perform the various acts which the position of the body and surrounding objects indicated to have been effected. In the instance detailed in this paper, a quantity equal to twenty-five drops of the English acid, supposing it to possess a strength of 3 per per cent. or to fifty drops of the acid of the Dublin Pharmacopœia, (if it contains $1\frac{1}{2}$ per cent.) commenced to act in two minutes q. p. ; if we can suppose the rapidity of its action directly proportioned to its quantity, then twelve times as much, or five drachms, should begin to operate in the one-twelfth of the time, or ten seconds, within which period the acts above alluded could certainly be accomplished. I should not wish to be understood as asserting that this is the exact proportion, but that one possibly not differing very materially from this may be found to exist. As to the smallest quantity capable of producing death, in the case I have detailed the quantity of real acid amounted to .7 of a grain, which was almost the same as that taken by a number of epileptics in a dreadful accident which occurred at one of the Parisian hospitals, and by which seven patients lost their lives; some of them survived for three quarters of an hour; the period however during which life may be prolonged in this form of poisoning must vary considerably according to the treatment employed. The case related in this paper illustrates very strongly the beneficial effects of ammonia or its carbonate; the good results of this remedy are conceived to flow, not from its chemically neutralizing the acid, but in consequence of its exerting on the system an influence of an opposite nature to that of the poison, or, in other words, from its stimulant powers. In proof of this assertion it is stated that the hydrocyanate of ammonia is highly poisonous. That this salt is capable of exercising a decidedly deleterious action is certain; but this may be readily ascribed to its decomposition by the free acids of the stomach, (as has been suggested to me by my friend Professor Apjohn;) to determine this point it would be necessary to ascertain whether if these acids

were first neutralized, or if a solution of the salt were injected into the blood, the same results would ensue. The experiments of MM. Persoz and Nonat, detailed in the paper already alluded to, seem to indicate that chlorine, when applied to a vein, is absorbed, and exercises its action as an antidote by decomposing the poison in the blood ; and as the respiratory surfaces are eminently qualified for performing the function of absorption, there is no reason why both this agent and ammonia may not enter the system by the latter route ; whether, however, ammonia be taken into the circulation or not, a great part of its beneficial influence must be attributed to its excitant powers. On the whole it appears to be one of the agents on which most reliance is to be placed in this form of poisoning. Chlorine, which decomposes the poison, most probably also effects a good deal by its stimulant action. Chlorine water, the most manageable form in which this agent can be applied, is rarely at hand ; at present, however, chloride of lime or soda is as likely to be easily procured as any other medicine, and either of these can be made to evolve its chlorine rapidly by the addition of vinegar, or any of the ordinary acids. Very possibly after the patient has been to a certain degree restored by the use of these antidotes, his more speedy recovery might be promoted by an emetic, and for this purpose the sulphate of zinc, mixed with some stimulant fluid, as wine, or brandy and water, would be most suitable, as less liable to produce depressing effects, than some other medicines of the same class. The great relief occasionally obtained from the occurrence of spontaneous vomiting, naturally suggests the employment of these agents: they are, however, of course merely of secondary importance ; the object of our first attention being the judicious application of the stimulants above mentioned, ammonia or chlorine.

To the case already detailed, I shall add a few particulars of the dissection of one which terminated fatally.

A schoolmaster of this city, who had met with some misfortunes, determined to put an end to himself ; he purchased an

ounce of the medicinal acid, (Scheele's,) and swallowed it, as was presumed, at bed-time. Next morning he was found dead. The body, which was examined shortly after, and the stomach in particular, exhaled strongly the smell of the poison. The only morbid appearance of note discovered, was a patch of dark-red extravasation under the mucous membrane of the stomach, near the pylorus; an appearance which seems to have been mistaken for gangrene in a case related by Hufeland.* This appearance I should conceive to be allied to the black warty extravasation observed in cases of irritant poisoning. The stomach exhaled the hydrocyanic odour, although exposed for three days, at the end of which time the poison was detected by the usual means in the contents.

The method proposed by Orfila for the detection of hydrocyanic acid in mixed fluids, is exceedingly convenient, if a precaution which he has not noticed, be observed. His method is to moisten a slip of bibulous paper with a solution of caustic potash, (carbonate of soda or potash will answer, if the caustic solution be not at hand,) afterwards immerse it for a few minutes† in the suspected fluid, then dip the paper in a solution of the proto-sulphate of iron, (which always contains the necessary quantity of ter-sulphate of the peroxide;) if hydrocyanic acid have been present, prussian blue is immediately generated.

If the experiment be conducted as above directed, there always falls down, along with some prussian blue, a quantity of the mixed oxides of iron, which render the colour of the precipitate a dirty green, instead of dark-blue; and as the fluid is mechanically united with the paper, its particles cannot circulate

* Journal der Praktischen Heilkunde, 40, 1, 85.

† It should be agitated in the fluid, in order that the neutralization of the potash by hydrocyanic acid may be fully effected. Every 9 eq. of hydrocyanic acid decompose 3 eq. of proto-sulphate and 2 of the ter-sulphate of the peroxide; these, together, are combined with 9 eq. of sulphuric acid: to liberate only the quantity of oxide necessary to form 1 eq. of prussian blue, 9 eq. of potash are necessary; in other words, as much as will form with the hydrocyanic acid present hydrocyanate of potash. ($\text{CyK} + \text{H.}$)

and intermix with sufficient freedom to convert the oxides, by contact with the hydrocyanic acid, into prussian blue; it is necessary then to obtain the characteristic colour of the latter; to dip the paper lastly into dilute sulphuric or muriatic acid, by which the redundant oxides are dissolved. If this precaution be not observed we may be led to conclude erroneously that a given mixture contains no hydrocyanic acid.

When the contents of a stomach or the fluid distilled from them are tested for hydrocyanic acid, by the method of Lassaigne, (which Orfila has merely modified by using a slip of bibulous paper, instead of adding the re-agents to the mixture,) it is also necessary, as he has stated, to use dilute sulphuric acid, because unless the proto-salt of iron added contains the per-salt exactly in the proportion of 2 eq. of the latter to 3 of the former, a certain quantity of the oxides of iron must precipitate, as will be obvious when we reflect on the composition of prussian blue. ($3\text{FeCy} + 2\text{Fe}^2\text{Cy}^3$). If, however, the proto and per-salts should happen to be mixed in the above ratio, although at the moment they are added the oxides precipitate, the latter can, by agitation with the fluid for a short time, be converted into prussian blue, provided that the solution of potash have been added in very small quantity, (only sufficient to form hydrocyanate of potash, as before mentioned); the solution of sulphate of iron, however, can very seldom happen to contain the exact proportion of per-salt above mentioned, and therefore the subsequent addition of dilute acid is almost always indispensable. This method is not only, as Dr. Turner has shown, more delicate than that by the sulphate of copper, but more distinctive, and therefore to be preferred. Before concluding this paper, I shall notice a method which has occurred to me for the more ready detection of hydrochloric acid, when it exists in the medicinal hydrocyanic acid; more especially as it is necessary to ascertain the absence of this impurity, and to effect its removal, if present, before we can hope for a successful estimation of the strength of the acid by the usual methods. The insoluble compounds into which chlorine enters, and by the formation of

which chemists usually recognize the presence of hydrochloric acid, are well known to resemble very closely in their properties the cyanides of the same bases. Modes of distinguishing the cyanide from the chloride of silver are laid down in most systematic works, but they are either inconvenient in their application or do not afford accurate indications when small quantities are operated on. The method which I am about to detail is founded on the property which the double salt, formed by the union of the iodide of potassium with the bi-cyanide of mercury,* possesses, of being decomposed by acids, with the development of bin-iodide of mercury. This double salt is readily prepared by mixing, in the proportion of atom and atom, solutions of bi-cyanide of mercury and iodide of potassium, each dissolved in a small quantity of hot water; after a short time silvery scales (resembling acetate of mercury) make their appearance, which constitute the compound in question. The circumstance of this salt being decomposed by all the ordinary acids, (except hydrocyanic,) would at first sight appear to indicate that it is not capable of detecting the hydrochloric in particular; but as the only other impurities likely to be present in hydrocyanic acid are sulphuric and tartaric acids,† if the appropriate tests of these latter do not indicate their presence, then the formation of bin-iodide of mercury on the addition of a crystalline scale, or solution of the above salt, may be considered as affording conclusive evidence of the presence of hydrochloric acid. It may be also stated, that the only hydrocyanic acid likely to contain sulphuric, namely, that prepared from the ferro-cyanide of potassium, can be generally recognized by its possessing a slight bluish or bluish-green colour, which is quite distinctive.‡ The mode of detecting the pre-

* This salt has been analyzed by Professor Apjohn, who finds it to contain an atom of each of its constituents.

† Either free or combined with potash as a bi-tartrate, in the acid prepared by the method proposed by Dr. Clarke.

‡ Owing probably to its holding in solution a small quantity of prussian blue.

sence of hydrochloric in hydrocyanic acid, just detailed, has the advantage over those generally in use of being very readily applied, to which it may be added that the preparation of the reagent is perfectly simple. With reference to the latter it may be observed, that it is not absolutely necessary to obtain this salt in a separate state, with a view to its application as above ; it will suffice to add to the hydrocyanic acid suspected to contain the impurity under discussion, a few drops of a solution of bi-cyanide of mercury, and afterwards a drop of dilute solution of hydriodate of potash. In experimenting, however, in this way, great care should be taken not to add an excess of hydriodate of potash, as it dissolves the bin-iodide of mercury ; this method, where the quantity of impurity present is very minute, is by no means so delicate as the addition of a crystal of the double salt, a yellowish red coloration of which will take place where only $\frac{1}{4500}$ part of hydrochloric acid is present. This method of testing the presence of the latter is inapplicable to the alcoholized acid of Germany, as the bin-iodide is soluble in alcohol, yielding a colourless solution. If the presence of hydrochloric acid (or of any of the other acid impurities) have been ascertained, their neutralization can be readily effected by the addition of successive small portions of precipitated carbonate of lime, as long as any is dissolved. When the acid contaminations have been neutralized, (and filtration, if necessary, performed,) the estimate of the strength of the acid may be proceeded in according to the method of Dr. Ure, substituting for the red precipitate which he employs, per-oxide of mercury, thrown down from a solution of per-salt by an excess of potash, as, independent of minium and other adulterations, the red precipitate, from the mode of its preparation, almost always includes a little bi-per-nitrate of mercury. To those practitioners who are accustomed to chemical manipulation, the method of Orfila, precipitation by the nitrate of silver, is fully as expeditious, and certainly affords more strictly accurate results.

Not only may the peroxide of mercury be used for estimating

the strength of hydrocyanic acid, but also for the detection of hydrochloric acid in it, by the following proceeding, which is less delicate than that already detailed: dissolve in the acid a little peroxide of mercury; when the solution is complete, add either caustic potash, lime water, or carbonate of potash; if hydrochloric acid be present, the two former will give rise to the usual precipitation of peroxide, and the latter of the di-carbonate of mercury, of an ochre-brown colour; if, on the contrary, the hydrocyanic acid have been pure, no change ensues. These phenomena are no doubt owing to the feeble affinity existing between cyanogen and the alkaligenous metals, potassium, sodium, &c. To this same cause also must be attributed the formation of the double salt, of which I have proposed the application already detailed. The uncertainty of the strength of the medicinal acid has been long matter of complaint, and examination of many specimens has convinced me that even where the directions of the Pharmacopœias, as to quantity of material, have been observed, slight variations in the method of conducting the different steps of the process exert a material influence on the strength of the product.

Under these circumstances it can hardly be expected that in preparing this substance on the large scale, an agent of uniform strength can be obtained; our obligations are therefore the greater to those whose recent and successful endeavours* to accomplish this end have furnished the profession with the means of extending the use of this powerful agent, and of prosecuting, with security, inquiries as to its ulterior therapeutic applications.

* The latest method, I believe that devised by Mr. Everitt, Professor of Chemistry in King's College, London—the decomposition of cyanide of silver by hydrochloric acid, with the addition of the requisite quantity of water, appears to be a very simple and excellent one; the cyanide of silver has the advantage over the cyanide of potassium in being very readily prepared and easily kept.