phuric acid, which, however, can be detected by adding muriate of barytes to the solution, when a precipitate insoluble in an excess of muriatic acid will be thrown down, if sulphuric acid be present. One hundred grains of the crystallized acid saturate 200 grains of crystallized subcarbonate of soda.

Medical properties and uses. — Tartaric acid, largely diluted and sweetened, forms a cooling agreeable beverage in fevers and diseases connected with an increased secretion of bile. It is incompatible in prescriptions with solutions of salts containing potass, which it converts into a bitartrate, which being of difficult solution is thrown down in minute crystals. It also precipitates salts of lime and of lead. Dissolved in water, and added to an aqueous solution of carbonate of Soda, it forms a good substitute for soda-water.

APPENDIX TO THE ACIDS.

In the following Appendix I propose to give a short account of two acids, which, although they have not a place in any of the British Pharmacopœias, yet, are of great importance; the one being a remedy of considerable efficacy in a certain class of diseases, and the other demanding the attention of the medical practitioner, from the frequent employment of it as a poison.

I. — Acidum Hydrocyanicum.

Hydrocyanic (Prussic) Acid.

This acid is found in many vegetable productions; such as the bark of the Prunus *Padus*, or Bird-cherry; the leaves of the Peach and Nectarine trees, Bitter-almonds, and the kernels of many fruits; but, for the purposes of medicine it is artificially prepared.

Preparation. The best method of preparing Hydrocyanic acid, for medicinal use, is the following, which was first employed by Scheele.

Mix two ounces of Prussian-blue with six ounces of red precipitate of mercury, and add six ounces of water. Boil the mixture for some minutes, constantly agitating it, when the blue colour will disappear, and the mass assume a yellowish-grey hue. Pour the whole on a filter, and wash the residuum with a little hot water, which is to be added to the filtered liquor. Pour this upon an ounce and a half of clean iron filings, and add three drachms of strong sulphuric acid.

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Shake this mixture well, and, after the powder subsides, pour the fluid into a retort, and distil one-fourth part of it over into a well luted receiver. This is the Hydro-cyanic acid, containing an admixture of a little Sulphuric acid, which is readily separated by means of Barytic water. La Planche recommends $\frac{1}{6}$ only to be distilled over, and this to be rectified, by means of a gentle fire, over $\frac{1}{200}$ of carbonate of lime; drawing off, afterwards, $\frac{3}{4}$ only of the $\frac{1}{6}$ of the whole, thus treated, by a second distillation. The acid is obtained of a uniform strength by this method.

In the above processes, the Iron filings and the Sulphuric acid added to the solution obtained from boiling the mixture of Prussian-blue and Red precipitate of Mercury in water, decompose the water; and the reduced Mercury combines with the Cyanogen, the base of the acid of the Prussian-blue, and forms a Cyanuret of Mercury. This new combination is again destroyed by the heat, and the Cyanogen acting upon the nascent Hydrogen of the decomposing water, forms Hydrocyanic vapours, which are absorbed by the water in the receiver, and constitute the Hydro-cyanic Acid.

Physical and chemical properties. — Hydro-cyanic Acid, prepared in the above described manner, is a colourless, transparent liquid, with a peculiar odour, not unlike that of bitter almonds. It is at first bland and sweet to the taste, but ultimately impresses a pungent acrimony on the palate. It is very volatile; and, owing to this property, crystallizes if a drop of it fall upon paper. Its specific gravity is 0·996.

It is decomposed by a high temperature and by light; being resolved into Carbonic acid, Ammonia and Carburetted Hydrogen gas, which are dissipated, and leave behind a carbonaceous deposit. It should therefore be kept in an opaque stoppered bottle. It is very inflammable, burning with a blue flame: and is soluble both in water and in alcohol. According to Gay Lussac, it consists of a peculiar base, which he has named Cyanogen, acidified by Hydrogen. Cyanogen is a compound, consisting of two proportionals of Carbon and one of Nitrogen. But the acid employed in medicine contains one part only of the acid referred to by Gay Lussac, and eight parts and a half of water.

Medical properties and uses. — Hydro-cyanic Acid, when taken into the stomach, in a large dose, acts as an instantaneous and most powerful sedative, destroying completely the nervous energy and the irritability of the body, and consequently extinguishing life: but, in an animal thus killed, the action of the heart continues for some time after the animal has apparently ceased to live. The observation of this curious

fact led Professor Brera, in 1809 [1], to administer Prussic acid as a remedy in pulmonary inflammation; and he found that it quickly subdued the violence of the disease, "without having any recourse to more than preliminary bleeding." British practitioners, however, were altogether unacquainted with this remedy, until after Dr. Majendie published his first essay on this subject, in 1815; when Dr. Granville, through the medium of the London Medical Repository, directed their attention to its powers: and I refer those who are desirous of tracing the introduction of Prussic acid into use, as a medicinal agent, to his work. [2]

Prussic Acid, *internally* exhibited, is a remedy of great efficacy in spasmodic coughs of every description, particularly asthma, chronic catarrh, and hooping-cough. It has also, been employed with success in palpitations of the heart. [3] In my own practice, I have witnessed its powers in that affection of the *trachea*, which is often mistaken for *phthisis pulmonalis*, and is not less fatal. In true tubercular phthisis, my own experience does not enable me to say much in favour of Prussic Acid; but the mass of evidence brought forward, in testimony of its beneficial influence in this disease, by Dr. Granville, should not be overlooked: and, as I have stated in another place [4], the judicious exhibition of Prussic Acid in the early stage of pulmonary consumption may do much to bring that disease under the controul of art. Prussic Acid has been found extremely useful in the treatment of those epidemic catarrhs, with which this country is occasionally visited: and no remedy is so well adapted, as an adjunct to tonics, for removing those dyspeptic affections which are attended with acidity of the stomach, and accompanied with heat and soreness of the tongue. In these cases it reduces the morbid irritability of the stomach, and thereby enables the juices of that organ to be more slowly secreted and of a more healthy character. [5] Its beneficial effects in asthma and in hooping-

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1 Brera's work is entitled, "Prospetti dei risultamenti ottenuti nella Clinica Medica dell' Imperiale R. Università di Padova, ne' sei anni scolastici, 1809—1815."

2 Treatise on the internal use of Hydro-cyanic acid, &c. 2d edition, London, 1820.

3 *Lond. Med. and Phys. Journ.* Nov. 1823.

4 Vide Dr. Granville's Treatise, 2d. edit. p. 376.

5 Dr. Elliotson has published a small volume containing the result of his practice with Prussic acid in dyspepsia; and has stated that accident led him to try the powers of the medicine in this class of diseases. Respect for my own character obliges me to say, that nothing could surprise me more than this statement of Dr. Elliotson; as he acknowledges having read the first edition of Dr. Granville's Treatise, which contains a letter from me, dated 20th February, 1819, stating my sentiments of the utility of Prussic acid, in dyspepsia, and the modus operandi of the remedy, previously to his having employed it!

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cough are also well established. M. Heller recommends it in aneurism of the heart and aorta.[1] Cases are also on record in which this acid has proved serviceable in the treatment of painful and difficult menstruation, floodings, hemoptysis, and nervous diseases. It certainly is a very powerful sedative; and may be employed in all cases, in which sedatives and narcotics are indicated, with decided advantage.

As a *local remedy*, Prussic Acid is the only application which can be depended on for allaying the itching and tingling which are so distressing in impetiginous affections. I have lately employed it with unvarying success in these complaints, and having published my observations[2], I am in hopes of seeing its value determined in the hands of others. I have found it useful, also, in combination with small doses of oxy-muriate of mercury in acne *rosacea*, and several other cutaneous diseases.

The dose of Prussic Acid is from ♏ij. to ♏viij. It may be administered in distilled water, or in almond emulsion, or in infusion of cinchona bark, as circumstances may require. When an over dose has been taken, its deleterious effects are best counteracted by hot brandy and water, and the ammoniated tincture of iron. M. Heller recommends bleeding, ammoniacal frictions, and acidulated drink; but, more reliance is to be placed on stimulants. As a local application, it may be used in the form of lotion, in the proportion of a fluid drachm to a fluid ounce and a half of distilled or of rose water; or as a cataplasm composed of crumb of bread, soaked in a solution of f℥jss. of the acid in f℥j. of distilled water. It is incompatible in prescriptions with nitrate of silver, the salts of iron, and the mineral acids.

Although the instantaneous power of Prussic Acid, in destroying animal life, when it is taken in doses sufficiently large to operate as a poison, may, perhaps, always prevent medical art from proving beneficial in such cases; yet it is of importance to be able to ascertain in judicial enquiries, relative to suicide or to murder, that Prussic Acid has been administered as a poison. This may be done if the animal be opened from eighteen to forty-eight hours after death. The following means pointed out by Dr. Granville, for detecting its presence in the animal system after death, should be known. Collect the blood contained in the ventricles of the heart, a portion of the contents of the stomach, and of

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[1] Vide *Traité de la necessité de ne point insister sur l'usage interieur des excitans dans l'empoisonnement par l'acide Hydrocyanique.* Par H. S. Heller. Paris, 1824.

[2] Vide *Medical and Physical Journal.* Feb. 1822.

any fluid that may be found in the head, the chest, or the abdomen, agitate the mixture for some time with distilled water, and filter the liquid, taking care to preserve the whole at a low temperature. To a small quantity of the filtered liquid, add a few drops of a solution of Pure Potass in Alcohol; then add a few drops of a solution of sulphate of iron; and if a reddish precipitate of the colour of burnt Terra Siena now fall down, which on the addition of a little Sulphuric acid, changes to a blueish-green, and gradually, on exposure to the atmosphere, becomes a beautiful blue, we may conclude that the death of the individual has been occasioned by Prussic Acid. But the best test is that which M. Lassaigne has proposed. Suppose a practitioner is called to examine the body of a person who has been poisoned by Prussic Acid. The stomach is first to be examined entire, to ascertain whether the odour of that Acid is perceptible in it; after which it is to be cut in pieces under *distilled* water, and a portion of it distilled with an equivalent proportion of the water until one-eighth of the liquid has passed into the receiver. That liquid is to be rendered slightly alkaline with potass, then a few drops of a solution of Sulphate of Copper is to be added to a small portion of it, and afterwards, a sufficient quantity of Muriatic Acid to re-dissolve the excess of the oxide of copper. The liquid will appear more or less milky according to the quantity of Hydro-cyanic Acid present. This test will detect $\frac{1}{20000}$ of Hydro-cyanic Acid in solution in water.[1]

II. — ACIDUM OXALICUM.

Oxalic Acid.

Oxalic Acid exists, ready formed, in many vegetable and some animal bodies. Combined with Potass, it is found in the leaves of Oxalis *acetosella* and *corniculata*, Rumex *acetosa* and Geranium *acidum*; and with Lime, in the roots of Rhubarb, Valerian, and of many other plants. Berthollet procured it from honey, hair, tendons, albumen, and some other animal matters; but that which is found in the shops, manufactured for the purposes of art, is produced artificially by the action of Nitric Acid on Sugar. The following process, which was first described by Bergman, is still adopted for the production of Oxalic Acid.

Into a tubulated retort, put one ounce of White Sugar, and

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[1] *Ann. de Chim.* xxvii. p. 200.

pour over it three ounces of strong Nitric Acid of sp. gr. 1·567. When the whole is dissolved, boil the liquor until it cease to afford nitrous fumes, and acquire a reddish-brown colour; then add three ounces more of Nitric Acid, and continue the boiling until the fumes cease, and the colour of the fluid disappear. Empty the contents of the retort into a wide vessel, and, upon cooling, a crystallization will take place, which is *Oxalic Acid.* On boiling the lixivium with two ounces of Nitric Acid in the retort, until the red fumes almost disappear, a second supply of crystals will be obtained. One hundred grains of sugar, when properly treated, yield fifty-eight grains of crystallized Oxalic Acid. The rationale of the process is very obvious: the Nitric Acid is partially decomposed, and yields up a portion of its oxygen, which is one of its components, to the sugar, which is a compound of oxygen, carbon and hydrogen; and, by this addition of oxygen, is converted into Oxalic Acid. The relative proportion of these components of sugar is oxygen 49·4, carbon 44·5, and hydrogen 6·1, in 100 parts; that of Oxalic Acid, oxygen 64, carbon 32, and hydrogen 4, in 100 parts.

Qualities.—The crystals of Oxalic Acid, when they are properly prepared, are four-sided prisms, with the sides alternately larger, terminated at their extremities by dihedral prisms. They are white, transparent, inodorous, have a very acrid, sour taste, and redden all the vegetable blues except indigo. One grain of Oxalic Acid communicates a sensible acidity to 2633 grains of water. The crystals dissolve in twice their weight of water at 65°, and in their own weight of boiling water. Alcohol at a mean temperature dissolves 40 parts of them, and boiling alcohol 56 parts. They are sparingly soluble in ether. The crystals are in the state of a hydrate, 100 grains containing 52 only of acid, and 48 of water.

Oxalic Acid combines with alkalies, earths, and metallic oxides, forming oxalates. Muriatic and Acetic Acids dissolve it without alteration; but it is decomposed both by Sulphuric and Nitric Acids aided by heat.

Medical properties and uses. — Oxalic Acid in *small* doses, when it is dissolved in a large quantity of water sweetened with sugar, forms an agreeable, cooling beverage, which may be used in febrile diseases, in the same manner and with the same intention as lemonade. It may also be employed to check an external hemorrhagy, which it appears to do by charring the blood as it issues from the wound, and thereby mechanically stopping its flow. It is a virulent poison when swallowed in large doses; and from the resemblance of its crystals to those of Sulphate of Magnesia, many fatal accidents

have occurred from mistaking Oxalic Acid for that purgative salt. The acid taste of the one salt and the bitter of the other would always prevent such accidents, were individuals to taste their medicines before swallowing them; but besides the occurrence of accidents, Oxalic Acid has, of late, been too frequently employed by the wretched suicide for the purposes of self-destruction. It is, therefore, important, that every medical practitioner should be acquainted with the qualities of Oxalic Acid, its effects on the animal economy, and the means of counteracting these, when it has been taken in a sufficient dose to operate as a poison.

The exact extent of the dose of Oxalic Acid, which may be taken with impunity has not been determined; but its poisonous properties are more or less virulent according to the degree of dilution of the dose. From some experiments on animals, which I made ten years since, and the published details of the appearances in dissection of several fatal cases of poisoning by Oxalic Acid, I was led to form an opinion that "the primary morbid action of this poison is on the stomach itself, on the coats of which its chemical action occasions the organized animal solid to enter into new combinations, and thence produces a decomposition both of the acid and the part to which it is applied:" that the acid, however, also enters into the circulation by absorption; but "that the proximate cause of death from Oxalic Acid, is the suspension of the functions of the heart and brain, which are sympathetically affected by the local injury done to the stomach."[1] The subject has been, since then, investigated with much care and great ingenuity by Dr. Christison and Dr. Coindet, and their observations published in the Edinburgh Medical Journal.[2] From the labours of these gentlemen I am induced to change my opinion as to the extent of the injury done to the living stomach, and to believe that the pultaceous state of that organ, which was found by me in my experiments on dogs, is to be attributed to the action of the acid on its coats after death. I am, however, still of opinion, that death is less to be attributed to the sedative power of the poison acting on the brain and spine, to which it is carried by absorption, than to the sympathetic action on the nervous system from the local injury of the stomach, an opinion according with their first conclusions, that "Oxalic Acid, when introduced into the stomach in large doses and highly concentrated, irritates it, or corrodes it, by dissolving the gelatin of its coats; and death takes place by a sympathetic injury of the nervous system."[3]

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[1] *London Med. Repos.* vol. iii. p. 386.
[2] See *Edin. Med. and Surg. Journ.* vol. xix. p. 163.
[3] Toland, p. 185.

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The general symptoms attending poisoning by Oxalic Acid, are burning pain in the stomach, violent and incessant vomiting, the matter ejected being commonly dark-coloured and sometimes bloody; in some cases there have been violent gripings and purging; the pulse soon sinks and becomes almost imperceptible, and this state is followed by deadly coldness of the limbs, attended with lividity of the fingers and nails, and clammy sweats: convulsions, but not in every instance, and insensibility, precede death. With regard to the appearances after death, no particular change in the external state of the body has been noted. On opening the body, the *stomach* is found, generally, to contain a quantity of dark-coloured fluid, which is probably extravasated blood charred by the poison; in some instances, the coats of the stomach have been found greatly injured, presenting appearances of great vascularity, thickening of the mucous coat, the rugæ pultaceous and easily wiped off, and in some cases, the other membranes have been found tender, and even perforated, so that the contents of the organ have escaped into the cavity of the abdomen. The lungs and heart have not been often examined; but, in the lower animal skilled by Oxalic Acid, both have presented indications of inflammation having existed in them, particularly the lungs. The vessels of the brain have been found turgid.

The fatal effects of poisoning by Oxalic Acid are so rapid, that little opportunity is afforded for counteracting them by medical art. The first object certainly, in every case, is to evacuate the poison from the stomach, and, when the stomach-pump is at hand, it should be instantly employed. The vomiting which usually supervenes, precludes the necessity of employing emetics and copious dilution, which, in other cases of corrosive poison is advisable, is more likely to promote the absorption of the acid and, consequently, increase its powers. Before, therefore, emetics are employed, if they should be deemed necessary, the activity of the poison should be weakened by altering its nature by some substance with which, in chemically combining, its solubility is diminished. That chalk produces this effect, I discovered in making the experiments already alluded to, and several instances have since occurred in which its administration has saved the lives of individuals poisoned by Oxalic Acid. The lime of the chalk unites with the Oxalic Acid, and forms an oxalate, which is perfectly inert. Magnesia may be employed instead of chalk, and it has the advantage of not inconveniencing the patient by the extrication of carbonic acid gas, which is copiously evolved when the chalk unites with the acid; but, as the Oxalate of Lime is more insoluble than the Oxalate of Mag-

nesia, and consequently more inert, it may be questioned whether the inconvenience of the gas be equivalent to the greater security from the employment of chalk. A mixture of chalk and water, or of magnesia and water should, therefore, be instantly given when Oxalic Acid has been taken in a large dose; and, after the local effects of the poison have been counteracted, the system should be supported by cordials combined with opium, and the oxalate afterwards carried out of the system by the aid of purgatives.

To obtain legal evidence in cases of poisoning by Oxalic Acid, when none of the poison is found, we may be guided to suspect the nature of the poison by the symptoms and the post mortem appearances: but a correct opinion can be formed only by an analysis of the vomited matter, the contents of the stomach and its coats. For this purpose the vomited matter and the contents of the stomach should be, separately, diluted with distilled water; and the coats of the organ itself boiled in distilled water. These solutions should, then, be separately filtered and decolorized with chlorine, and subjected to the following tests. If Oxalic Acid be present, hydrochlorate (muriate) of lime will occasion a precipitate which is soluble in a small quantity of nitric acid, but not in muriatic, unless a very large quantity of the acid be used. Sulphate of copper throws down a bluish-white precipitate in any fluid containing free Oxalic Acid, which is insoluble in hydrochloric acid: and Nitrate of Silver occasions a heavy white precipitate, which, when dried and heated over the flame of a candle on the point of a spatula, becomes brown at the edge, then suddenly fulminates and is all dissipated in white fumes. This is a very delicate test; for Dr. Christison informs us that, from a quarter of a grain of Oxalic Acid dissolved in 4000 parts of water, he and Dr. Coindet procured enough of the oxalate of silver to show its fulmination twice.[1]

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[1] *Edin. Med. Journ.* vol. xix. p. 198.