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Cyanide of potassium is one of the most formidable poisons known to the chemist; and the extensive use of this salt in certain arts, and especially in photography, has given rise to many accidents, and also afforded facilities for its easy procurement for suicide and poisoning.

Chemical and Physical Properties.

This salt may be produced by the combination of cyanogen and potassium. The metal absorbs cyanogen slowly at ordinary temperature, but when heated, it quickly takes up a volume of the gas equal to the volume of hydrogen which the same quantity of potassium would eliminate from water. It may also be formed by fusing azotized organic matters with carbonate of potassium, by igniting nitrates or nitrites with organic substances, and by passing air over an ignited mixture of charcoal and carbonate of potassium.

Potassic cyanide may be prepared in large quantities, by heating to dull redness, in a covered iron crucible, a mixture of 8 parts of anhydrous potassic ferrocyanide, and 3 of dried potassic carbonate, until the fused mass has lost its yellow color, and ceases to give off bubbles of gas. The iron is separated in the form of a metallic powder, and subsides to the bottom of the crucible; the fused cyanide can then be poured off, and solidifies on cooling. The cyanide thus obtained is, however, always mixed with a portion of cyanate. If the presence of the potassic cyanate be injurious, it may be removed by adding to the mixture of the carbonate and ferrocyanide, before fusion, one-eighth of its weight of charcoal, which at a red heat reduces the potassic cyanate to the form of cyanide. The fused salt, when decanted

from the iron, presents a black aspect, owing to the presence of unconsumed charcoal. If it is to be used in solution immediately, it may be dissolved in water and filtered; but if required in the solid form, it may be purified by treatment with boiling alcohol, from which after filtration, it crystallizes in colorless cubes.

Cyanide of potassium crystallizes in transparent colorless cubes or forms derived therefrom. It is inodorous when dry, but when exposed to the air in the moist state, it is decomposed by the carbonic acid of the air, and exhales the odor of prussic acid.

Its taste is acrid and caustic, somewhat like that of bitter almonds. It is very fusible, melting at a dull red heat to a transparent liquid, which on cooling solidifies to a dull opaque mass, having the aspect of porcelain. At a white heat it appears to volatilize without decomposition. It has an *alkaline* reaction, is easily soluble in water and very deliquescent; it likewise dissolves readily in *hydrated alcohol*, but is insoluble in *absolute alcohol*.

Potassic cyanide is of great value to the experimental chemist both for its reducing and its solvent powers. As a reducing agent, it is nearly equal in power to potassium itself, and is especially useful in blow-pipe analysis. The oxides of a large number of metals, including those of lead, copper, and iron, when thrown into the melted salt, are immediately reduced to the metallic state, while potassic cyanate is formed. It may also be used in the laboratory as a reducing agent instead of black flux, in testing for arsenicum. In solution it dissolves metallic iron, zinc, nickel, and copper, with evolution of hydrogen, while potash is produced. Silver and gold are also dissolved by the solution of potassic cyanide, if air be allowed free access, and soluble cyanides of potassium with these metals are formed. Cupric sulphide is soluble in an excess of potassic cyanide, and may be thus easily separated from cadmic sulphide, which is insoluble in this reagent.

As a solvent, it is much used in analysis for separating metals one from the other, as cobalt from nickel, copper from bismuth, cadmium, etc., also in various processes of volumetric analysis, as the estimation of copper. It is used in medicine for the preparation of prussic acid. By photographers it is employed for fixing proofs on moist collodion, and for removing stains of nitrate of silver from the hands, which it does by forming a soluble double

cyanide of silver and potassium. This mode of employing it is, however, very dangerous, as if it comes in contact with a cut or scratched surface, it is apt to produce painful and troublesome sores, and may even give rise to dangerous symptoms of poisoning. The removal of silver stains may be effected by means of a solution of iodine in iodide of potassium.

Cyanide of potassium is extensively used in galvanic gilding and silvering; indeed the chief consumption of it is for this purpose.

It is evident, therefore, from the preceding well-known facts, that this intensely poisonous salt may be readily obtained, and especially in this country, in which no effective laws exist for the protection of the community from the unrestrained sale of poisons.

It is important to note the fact that, cyanogen was first obtained in the free state by Gay Lussac in 1815, and afforded the first instance of the isolation of a compound radicle. Many of its compounds had been known long before, prussian blue, having been discovered by Diesbach and Dippel in 1704, ferrcyanide of potassium by Macquer about the middle of the eighteenth century, and prussic acid by Scheele in 1782.

The following experiments were performed by the writer at various times during the past twenty years, illustrating the action of cyanide of potassium upon plants and animals.

Action of Cyanide of Potassium on Plants.

In the experiments with this salt, as well as in those with hydrocyanic (prussic acid), rice was the plant selected, and the surrounding conditions of temperature were the same.

Both in closed and unclosed vessels, solutions of cyanide of potassium arrested completely the process of germination. The word *arrested* is here used, because it is difficult in such experiments to affirm that not a single change took place in the organic elements before the complete arrest of the process: it is certain, however, that if any of the numerous changes of germination took place, they did not proceed far.

When the seeds thus acted upon by cyanide of potassium were transferred to pure water, in no instance did germination take place; they simply underwent slow decay. This experiment was repeated with similar results upon more than one hundred rice

seeds. Corresponding experiments were carried on at the same time with pure water.

Solutions of cyanide of potassium in every instance arrested the growth and caused the death of the germs of rice; and the rapidity of the action corresponded with the amount of the poison added. These experiments were in like manner repeated upon more than one hundred stalks of growing rice.

The following conclusions may be drawn from the preceding experiments.

1. Plants as well as animals may be destroyed by certain mineral and vegetable substances denominated poisons.

2. As the vegetable kingdom is without nerves, muscles, or any special circulatory apparatus, similar to the automatic apparatus of animals, it is evident that cyanide of potassium must act upon the individual living cells composing the vegetables subjected to their action.

3. As the living component cells of the vegetable kingdom are capable of elaborating distinct products from the surrounding nutritive materials, and as this power is destroyed by poisons, we must conclude that the functions of secretion, growth and nutrition, may be influenced directly by poisons, without the intervention of the nervous system.

4. As, therefore, poisons may act directly upon the individual living cells of vegetables, arresting the process of germination in the soil, and of the acts of secretion, nutrition and growth in the fully formed cells, it is reasonable to infer that poisons may act upon the individual living cells of animals.

Thus poisons may act directly upon the muscular fibre, or upon the ganglionic cells of the sympathetic and cerebro-spinal system, or upon the secreting and excreting cells of the liver and kidney, or upon the colored and colorless corpuscles of the blood.

The preceding conclusions were verified by about two hundred other experiments with poisons upon vegetables.

EFFECTS OF CYANIDE OF POTASSIUM ON LIVING ANIMALS.

Experiment: Effects of Solution of Cyanide of Potassium on action of Heart of Young Opossum (Didelphis Virginiana), Montevideo, Georgia. April, 1861.

The young opossum was taken out of the pouch of its mother,

and at the time of its removal it was sucking vigorously at the teat of its mother. The thorax was opened, and the heart cut out and dropped into a solution of cyanide of potassium, of the strength of ten grains dissolved in one fluid ounce of water. After falling into the solution the heart beat rapidly, for a few moments, and then ceased in one minute after its first introduction, and could not be excited to any farther action.

Experiment:—Effects of Solution of Cyanide of Potassium on action of Heart of Pided Viper (Heterodon Platirhinos).

Heart of living reptile cut out and thrown into solution of cyanide of potassium, 10 grains to fluid ounce of water.

Action of heart after being cut out, and before being thrown into the solution of cyanide of potassium, 48 per minute. After its immersion in the solution of cyanide of potassium, in one quarter of a minute its beat had fallen to 40 per minute, and in half a minute the ventricle and auricles contracted spasmodically, and the ventricle was corrugated as if portions of the muscular fibres were more contracted than others. In three minutes all action of the heart had ceased entirely, and it could not be excited to contraction even by mechanical stimuli.

Experiment: Effects of Solution of Cyanide of Potassium on action of Heart of female Emys Serrata.

April, 1861. Sternum of large emys serrata removed, and heart exposed; action of heart before being cut out, 70 per minute; after it was severed and removed from the body, 64 per minute. Immediately after throwing the heart into the solution of cyanide of potassium (10 grains to fluid ounce of water), the action was slightly increased from 64 to 70 per minute. In half a minute, however, its action began to decline in frequency, and in three minutes, it beat 40 times per minute. The effect of the poison was very marked in destroying the symmetry of the actions of the heart.

The heart in its natural state in chelonians beats thus: the auricles contract, and then the ventricle in regular order. The cyanide of potassium destroyed this relation of the action of the auricles and common ventricle; under its poisonous influence the two auricles could be seen contracting separately, the auricles and ventricles simultaneously, and one auricle and the common ventricle simultaneously. After this irregular action

had been established for a few moments, the muscular bundles of the ventricle then became corrugated, and irregularly contracted. Nine minutes after placing the heart in the solution of cyanide of potassium, it beats 36 times per minute, the ventricle spasmodically, with contortion of the muscular fibres, whilst the auricles give but little indication of any action whatever; 15 minutes after immersion in solution of cyanide of potassium, action of heart 21, spasmodic and wholly unlike the natural action; in 20 minutes all signs of action had ceased, the ventricles still presenting a corrugated contorted outline, with very slight spasmodic twitching in a few of the fibres; a few moments after this all signs of motion ceased.

In the preceding experiment, the cyanide of potassium appeared to act upon the sympathetic ganglia of the heart, as well as upon the muscular fibres, dis-associating their mutual rythmical impulses; and the rapidity of its action appeared to be inversely proportioned to the amount of the muscular fibre and number of ganglia.

Comparative experiments were instituted by throwing the hearts of living cold-blooded animals into pure water, and this organ continued to beat slowly and regularly for more than 100 minutes.

Experiment: Action of Cyanide of Potassium on Congo Snake (Amphiuma Means), June, 1862.

This reptile was immersed in a solution of cyanide of potassium, 6 grains to ½ pint of water; no special effects were observed for three hours; at the end of this time, the muscular system was thrown into violent spasms, and the muscles of the throat appeared to be permanently tetanized. At the end of six hours, all signs of life were extinct. When the heart was exposed, it was found to be perfectly motionless, and could not be aroused either by mechanical or electrical stimuli. The voluntary muscles, on the other hand, responded vigorously and readily to the interrupted magneto-electrical current, *thus showing that although the powers of the heart were destroyed still the voluntary muscles retained their power of responding to stimuli.*

The intestinal canal was congested with blood, and the abdominal canal contained effused blood, which coagulated upon exposure to the atmosphere.

Under the microscope, the blood corpuscles from the blood of

the heart presented in many cases perfect forms, whilst in some cases they presented an elongated, spindle-shaped appearance, instead of the usual oval form.

Experiment: Illustrating the Action of the Cyanide of Potassium on Warm-Blooded Animal.

April, 1860. Fine, large cur dog, fat, fierce and powerful. Temperature of rectum 103.59°. The attempt was first made to pass a strong interrupted magneto-electric current through the muscles of the thigh; during the cutting through the skin for positions for the terminals of the electrical apparatus, the dog struggled violently, and during these struggles there was a slight rise in the thermometer, which indicated 104°. In a few minutes, however, it fell to 103.79°. After the application of the electricity for a few seconds, his struggles were so violent, and his strength so great (the muzzle was torn off, and the dog bit the four young men who were assisting me in the experiment), that it was found to be impossible to continue the application of electricity, and a strong solution of cyanide of potassium was injected by means of a syringe into the mouth.

In one minute the struggles of the dog became violent (he barked and gnashed his teeth, and struggled in the most violent manner to break loose), and the dog died in six minutes after the solution of cyanide of potassium had been introduced into the mouth. Before death *the tongue and lips became of a brilliant scarlet color*, and the tongue appeared to be swollen.

About three minutes before death the dog became convulsed, the breathing became spasmodic, and at the moment of death the muscles were violently convulsed, and the body and extremities were stretched backwards. The force of the death spasm was so great, that the shaft of the glass thermometer with its porcelain scale, in the rectum of the dog, was broken into small fragments. During the violent spasms preceding death, the temperature rose 1.01°., and after remaining stationary for 20 minutes after death slowly descended.

Post Mortem Examination, 20 hours after death.—When the skull-cap was removed, the blood-vessels of the membranes and of the substance of the cerebrum and cerebellum were distended with dark blood, which assumed a bright arterial hue upon exposure to the atmosphere. Blood-vessels of membranes and

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structures of medulla oblongata and spinal cord greatly congested with blood. The spinal cord was examined throughout its entire length. Heart distended with dark blood; lungs, liver, stomach and intestines congested with dark blood.

Upon exposure to the atmosphere, the blood from the centres of the heart and from all the organs assumed a brilliant hue.

Experiment: Illustrating the Effects of Cyanide of Potassium on Warm-Blooded Animal.

January, 1861. Thirty grains of cyanide of potassium were dissolved in two fluid ounces of water, and half a fluid drachm was injected subcutaneously beneath the skin of the left foreleg of a large cur dog.

The poison excited violent struggles, loud and piercing cries; fulness of respiration, disturbance in the action of the heart, followed by slowness of respiration, and slow and spasmodic action of the heart. The beats fell in 10 minutes to 40 beats per minute. Then followed a long piercing cry; tetanic spasms, long drawn and loud breathing, coma, and finally death in 20 minutes after the injection of the poison. The animal in this experiment, unlike the one in the preceding experiment, died without a struggle.

Post Mortem Examination, 21 hours after death.—Veins of brain distended with dark blood, which exhaled the odor of prussic acid. Brain normal in color and structure. Blood-vessels of brain less congested with blood than in the previous case of poisoning with cyanide of potassium. Spinal cord normal in appearance.

Vessels of stomach distended with dark fluid blood. Hepatic mesenteric and intestinal veins distended with dark fluid blood, as was the case also with the vena cava. Arteries empty. Liver of a dark purplish, greatly congested appearance. Kidneys of a dark, purplish slate color, and greatly congested with blood. Spleen dark colored and congested with blood.

Lungs somewhat congested; veins of stomach distended with blood; mucous surface much corrugated and of a deep pink and purplish color, and covered with thick mucous.

Veins of small intestines much congested with blood; mucous surface pale, and not congested except in the duodenum, near its junction with the stomach. The congestion of the mucous mem-

brane of the stomach appeared to have been due to the local action of the poison. Under the microscope, the colored blood corpuscles in some cases appeared to be smaller than normal, and in others presented a stellate appearance. When abstracted from the body, the blood coagulated imperfectly.

I repeated the preceding experiments upon some forty living animals with similar results.

General Conclusions from the Preceding Experiments, as to the Nature of the Effects of Cyanide of Potassium and Hydrocyanic Acid.

1. After the introduction of cyanide of potassium and prussic acid into the subcutaneous tissue, or after their application to the tongue and mucous membrane, a certain period of time elapses before the manifestation of symptoms of poisoning; and during this period the poison is absorbed, mingles with the blood, and is distributed to the various organs and tissues, and is thus brought into contact with the ganglionic cells of the cerebro-spinal system.

Various statements have been made as to the rapidity of the effects of prussic acid and cyanide of potassium in producing poisonous symptoms and destroying life, which have not been sustained by my experiments.

In the most suddenly fatal cases, the action has been referred by some physiologists to nervous action, transmitted from the points at which the poison touched the extremities of the nerves. The incorrectness of this view has been shown by experiments similar to the following by Blake. The portal vessels of an animal being tied, seven fluid drachms of Scheele's Acid were introduced into the stomach on the "*sentient extremities*" of the nerves on which the poison is said to act. Ten minutes elapsed without the slightest effect; the ligature was removed, and one minute afterwards the effects of the poison manifested themselves.

It is evident that those who give this explanation of the sudden effects of prussic acid, leave entirely out of view the fact that hydrocyanic acid is highly volatile, and that if a drop of the pure acid be approached towards the tongue of a living animal, the acid evaporates and reaches the lungs by inhalation, and is immediately diffused over an immense absorbent surface, before the drop of acid actually reaches the

mucous membrane of the mouth. It is well known that prussic acid is most rapidly fatal in the form of vapor. I have been, upon more than one occasion, most seriously affected by the vapors of the acid during my experiments and post mortem examinations. The time of the action of this poison should be reckoned from the moment that its vapor reaches the capillaries of the lungs; and the place of action should be considered the extensive absorbent surface of the bronchial tubes and air cells. Now it is well established that the poison may reach the heart and cerebro-spinal and sympathetic systems in an almost inconceivable short space of time from the lungs. That a sufficient interval elapses between the application of the acid, and the moment when its first effects are produced, to allow of its being brought into contact with the central ganglionic masses, will be evident from the consideration of the following facts.

Haller and Sauvages were the first to ascertain by experiment, with what velocity the blood is carried through the vascular system; their calculations, however, were erroneous, as they were founded on the supposition that the movements of the blood depended exclusively upon the action of the heart. Haller's conclusions respecting the velocity of the circulation in frogs and small fish, are more correct, as they were confirmed by autopsies, but his observations were confined to cold-blooded animals, and it is scarcely necessary to mention how hazardous it would be to infer from them the velocity of the blood in warm-blooded animals.

The same remark applies to the experiments of Spallanzani and Dollinger.

In more recent works on the subject, the comparison of the quantity of blood contained in the ventricles of the heart, with the whole mass of the blood, and with the number of pulsations in a certain time, was considered sufficient to determine the relative velocity of the blood; a method the uncertainty of which appears from the circumstances, that the quantity of blood cannot be made out with precision, and that the number of pulsations and the capacity of the ventricles differ very considerably in different individuals. Mr. Herring, of Stutgart, found the capacity of the left ventricle in horses differing from 3 to 11 ounces, and that of the right ventricle from 4 to 38 ounces.

M. Herring tried another method which seems to lead to more

accurate results. He mixed a solution of the cyanide of potassium with the blood; he then took, at certain intervals, small quantities of blood from various parts of the body; and from the chemical examination of these different portions of blood, and from the comparison of the time which the substance required to arrive from one vessel into another, endeavored to ascertain the relative velocity of the blood.

The experiments were performed upon horses, and the following conclusions were established.

a. The time within which the cyanide of potassium after having been mixed with the blood passes from one of the jugular veins into the opposite, is from twenty to thirty seconds; into the saphena magna, twenty seconds; into the arteria mesenterica, fifteen to thirty seconds; into the arteria maxilla externa of the opposite side, from ten to twenty-five seconds; and into the arteria metatarsi, from twenty to forty seconds.

b. The cyanide of potassium, within a very short time after its introduction into the blood, is excreted by the serous membranes, but in small quantity. The time varies from two to eight minutes.

c. In the kidneys the excretion appears to take place with the greatest rapidity; in all experiments, within one minute after the introduction into the blood, the cyanide of potassium was found in the cortical, sometimes also in the tubular substance, and in a few instances in the pelvis of the kidneys.

d. Only one minute is required to bring the substance from the jugular vein into the thoracic duct.

2. Cyanide of potassium and prussic acid produce no absolutely uniform alterations in the circulation of the cerebro-spinal system recognizable after death; and the cerebral and reflex symptoms are not due to the engorgement of the vessels. In some cases, the brain was not at all congested; in others the veins were distended with blood; and the blood after 15 hours showed a great tendency to transude through the coats of the vessels, from its disorganization, and thus inducing a much greater appearance of congestion and irritation than actually existed at the moment of death.

The symptoms of cerebral disturbance—delirium, coma, expansion of the pupil—were as strongly marked in the cases in which the brain was not specially congested, as in the cases in which it was most congested. Independent of these facts, it is

evident that the mere state of engorgement of the blood-vessels could not produce death in so short a time. In some cases the spinal cord was not specially congested; in others the veins were distended with blood, and in others still, both the veins and arteries were filled with blood. Violent spasms, opisthotonis and all the phenomena of aberrated spinal action, were as well marked in one condition of the spinal cord as in the other. We are compelled from these facts to conclude, that cyanide of potassium and hydrocyanic acid, produce no absolute uniform alterations in the circulation of the spinal cord recognizable after death; and that the aberrated muscular actions are not due to the engorgement of the blood-vessels of the spinal cord and its membranes. Independently of the fact stated above, it is evident the mere state of engorgement of the vessels of the spine could not produce death in so short a time. Careful microscopical examinations did not reveal any uniform alterations in the nervous elements.

3. The peculiar phenomena manifested by the cerebro-spinal nervous system, in poisoning by cyanide of potassium and hydrocyanic acid, are due to the action of the poison on the nervous elements, conveyed to them by the blood; to the action of the altered blood on the nervous elements, and sudden arrest of the capillary circulation of the cerebro-spinal nerves, in consequence of the action of the poison on the sympathetic system, and muscles and ganglia of the heart; to the reflex action of the sympathetic system, and to the complicated actions and reactions of the poison in the individual structures.

4. In poisoning by cyanide of potassium and prussic acid, the disturbances of the sympathetic nervous system are not less marked than those of the cerebro-spinal nervous system. The slow, full respiration, the slow action of the heart in some cases, and its feeble, rapid action in others; the feeble pulse, the diminution of temperature in the extremities, the rise of temperature in the trunk before death during the first stages of the action of the poison; the subsequent fall in the temperature of the trunk before death in some cases; the accumulation of the blood in the large veins of all the organs and tissues, in most cases of poisoning by hydrocyanic acid; the engorgement of the veins of the stomach, small intestines, spleen, liver and kidneys; the suppression of urine in some cases—all point to aberrated nervous action of the sympathetic system.

The mere congestion of the blood-vessels of the sympathetic nervous system could not account for any one of these phenomena—in fact, if the sympathetic nervous system presides more especially over the circulation, the stagnation of the blood in the vessels of the sympathetic, and in fact, in the blood vessels of the cerebro-spinal nervous system, and of all the organs and tissues, is evidently the effect, rather than the cause, of the aberrated sympathetic nervous phenomena.

From these facts, it appears to be proper to conclude, that the aberrated nervous phenomena of the sympathetic system are due to the direct action of the poison, conveyed in the blood, on the ganglionic cells of the sympathetic; to the action of the altered blood on the same elements, to the congestion of the blood-vessels of the sympathetic, and to the reflex action of the cerebro-spinal system.

If the disturbances in the action of the sympathetic nervous system do not precede, they are certainly coeval with those of the cerebro-spinal system; and are in both systems manifested precisely at the moment when the blood containing the poison reaches the nervous elements.

The arrest of the action of the heart, and of the peristaltic motions of the intestines, must be referred to the direct action of the poison on the sympathetic ganglia, and to the action of the poison on the unstriped muscular fibre.

5. Cyanide of potassium and prussic acid act on both the voluntary and involuntary muscles, and decrease or arrest entirely their property of contractility; and after death from these poisons, in many cases it is impossible to excite contraction of the muscular fibres of the heart by mechanical or electrical stimuli.

6. The blood is altered; its color is changed, as if prussic acid had entered into combination with the coloring matter; in most cases it coagulates imperfectly, and in some not at all.

7. Cyanide of potassium and hydrocyanic acid produce effects on all the organs and tissues with which it is brought in contact; hence we cannot affirm that its action is confined exclusively to the nervous system; and more especially would it be impossible to affirm that its action is confined either to the cerebro-spinal or sympathetic nervous system, or that its primary action is on one or the other. Cyanide of potassium and prussic acid induce alterations in the constitution of the blood,

and through this medium affects all the organs and tissues. We have established also that these and other poisons act on vegetables, which are destitute of nerves, and hence we may conclude that it is capable of acting on all the individual cells of the living animal.

POISONOUS EFFECTS OF CYANIDE OF POTASSIUM ON MAN.

Hydrocyanic acid is as fatal to animal life, when combined with alkaline bases, as when it is free, and hence ammonia cannot be regarded as a chemical antidote in cases of poisoning by prussic acid: it acts merely as a stimulant to the cerebro-spinal and sympathetic systems. It is one of the most formidable poisons known to chemists, and has led to the destruction of life in many instances within the last few years, chiefly owing to its having been administered by mistake for other medicinal preparations, or by those who were ignorant of its intensely poisonous properties.

Fifteen grains of "Kali hydrocyanicum," in a dose, were prescribed by a physician for his patient; he intended to order the ferrocyanide of potassium, but instead of this salt cyanide of potassium was sent. The patient took the poisonous draught, and was quickly destroyed. On inspection, there was no particular odor, but the poison was detected in the contents of the large intestines.

A similar accident occurred in Germany, by which the patient was killed, and the physician had a narrow escape of his life. Two drachms of "Kali hydrocyanicum" were ordered in a prescription, with two fluid drachms of sugar dissolved in two ounces of camomile water, a desert-spoonful to be taken every quarter of an hour. Cyanide of potassium was dispensed instead of the ferrocyanide—the salt intended! The patient, an adult, took a dose (about 100 drops), and the operation of the poison was manifested during the act of swallowing. There was a tendency to vomit, and an immediate loss of consciousness; death took place in an hour. The quantity of cyanide here taken was not less than from thirteen to fifteen grains, equivalent to more than five grains of anhydrous, or 100 drops of Scheele's prussic acid!

The physician who prescribed the medicine was sent for while the patient was still suffering from its effects; and in order to show that he had prescribed an innocent mixture, he put about

a teaspoonful of it into his mouth and swallowed three-fourths. The remainder he spat out, as it gave him an astringent or constricting sensation in his throat, like that caused by alum or green vitriol. He immediately felt severe pain in the back of the head; there was inability to stand, indistinct vision, nausea, a rushing sound in the ears, loss of consciousness, and without complaining of any well-defined pain, he felt that he had lost the power to make a deep inspiration. The loss of sense was as rapid as in ordinary syncope. When an effort was made to swallow some milk, there was a strong feeling of choking followed by copious vomiting. For more than half an hour he could not stand upright. Giddiness, weight in the head, and constriction in the throat, continued for many hours. He passed a restless night; but the next day, with the exception of suffering from a general relaxation and weakness, he had recovered, and was enabled to assist at the examination of the body of his unfortunate patient. Some years since it occasioned the death of a person at St. Malo, under the following circumstances. A physician prescribed for the deceased rather more than one drachm of the cyanide in two ounces and a half of orange-flower water and syrup, and of this mixture three spoonfuls were to be taken daily. It seems that a tablespoonful was taken for the first dose, and the patient died in three-quarters of an hour. None of the poison was found in the stomach, but a portion of the mixture from which the first dose had been taken was examined, and found to contain the cyanide in solution. A criminal procedure was instituted against the physician, and he was fined and imprisoned. MM. Malaguti, Sarzeau, and Guyot, who gave evidence on the occasion, stated that they found no trace of the poison in the body,—that the cyanide was pure and only one tablespoonful was missing from the bottle. They further stated that a dog was killed in a few minutes, after taking less than *three grains* of the cyanide in solution, and that the largest *medicinal dose* to a human being, was five-sixths of a grain. The mixture in this case contained about three grains of the cyanide in one drachm: therefore had teaspoonfuls been taken by the deceased, the quantity would have been quite sufficient to destroy life. The medicine had evidently been prescribed by a person totally ignorant of its poisonous properties. (*Lancet*, Jan., 1843, Ann. d'Hyg. 1843, i. 413; Casper's Wochenschrift, Oct., 1845, p. 657; Taylor on Poisons, 627.)

The formidable nature of this poison may still further be illustrated by the fact, that a dose of five grains has proved fatal in three instances, and in one case the person died in two hours.

The symptoms which the cyanide produces are similar to those occasioned by prussic acid—insensibility, spasmodic respiration, convulsions, with tetanic stiffness of the jaws and body. These appear in a few seconds or minutes, and run through their course with great rapidity.

The rapidly fatal effects of cyanide of potassium were illustrated on the 24th of March, 1877, in the case of Severino De la Barrera, the Spanish Consul of New Orleans.

The following facts with reference to the death of the Spanish Consul were published in the papers of the 25th.

"It becomes our painful task to record the demise of Severino De la Barrera, the Spanish Consul in our city, which occurred at twenty minutes to 1 o'clock yesterday afternoon. * *

"Yesterday morning at half past 11 o'clock, after his breakfast, at the restaurant, he returned to his residence on Dauphine street, and retired to his bed-room with one of his friends, J. A. Bousquet. After a few moments conversation he remarked to Mr. Bousquet, that he had taken poison. Hardly had he uttered the words when he fell senseless. Mr. Bousquet, Signor Rafart, Vice Consul, and Mr. Samuel Rusch, the clerk at the consulate, used every effort in their power to revive him, but failed.

"In the meantime Drs. LeMonnier and Formento were summoned, but the shadow of death was already upon him, and ten minutes later he laid lifeless surrounded by his terror-stricken friends.

"A post mortem examination and inquest was held by Dr. Schumacher, City Physician, and Coroner Rance, and the jury, after the examination, rendered the verdict that death had been caused by prussic acid administered by his own hands."

It is not my intention to examine the question whether this was really a case of suicide; for it is to be hoped that justice to the dead as well as to the living, and the highest interest of this community, will force a thorough examination of all the facts.

Through the courtesy of Mr. H. C. Turpin, to whom the bottle from which the fatal dose had been taken, as well as the brain,

stomach and liver of the deceased, had been delivered by the Coroner, I was enabled to make a careful dissection of the brain and chemical examination of the blood from the various organs, also a quantitative analysis of the contents of the bottle containing the poison. The following general results were obtained from this examination, conducted by Mr. Turpin and myself in my laboratory.

The brain was greatly congested, but was healthy through all its textures. The brain exhaled prussic acid. The blood of the brain upon analysis yielded prussic acid and cyanide of potassium.

The liver was greatly congested with blood, exhaled prussic acid, and upon analysis yielded prussic acid. Both the outer and inner surfaces of the stomach were congested with blood. The mucous membrane presented a deep scarlet ecchymosed appearance, and was softened and eroded, apparently by the action (post mortem) of the gastric juice.

The stomach contained about ten ounces of partially-digested matters, which exhaled a powerful and sickening odor of prussic acid. Chemical analysis revealed the presence of the cyanide and of prussic acid in the contents of the stomach.

The blood from all the organs examined gave out prussic acid and yielded it upon analysis; and although dark-colored when first exposed, changed rapidly to the arterial hue. The coagulating power of the blood was entirely destroyed.

The bottle, labelled Simmons' Regulator, from which the deceased is said to have taken the fatal dose, contained eight and a half fluid ounces of a dark red liquid, which upon analysis contained 904.4 grains of cyanide of potassium. Each fluid drachm contained 13.3 grains of the cyanide of potassium.

The entire capacity of the bottle was ten fluid ounces; therefore one and a half fluid ounces were missing. It is not probable that the deceased took the entire amount, as he is said to have been in the habit of taking 1 or 2 tablespoonfuls of the "Simmons Liver Regulator" a short time after each meal. It is probable that he took about two tablespoonfuls of the poisonous mixture, which would yield 106.4 (one hundred and six grains and four tenths) of the cyanide of potassium—a quantity sufficient to have destroyed at least 21 (twenty-one) men. The entire amount of cyanide of potassium originally introduced into the bottle was

about 1110 (one thousand one hundred and ten) grains, a quantity sufficient to have destroyed 221 men, if the fatal dose be placed at 5 grains.

I administered 20 minims of the liquid from the bottle, which had caused the death of the Spanish Consul, to a dog, and symptoms of poisoning commenced in 20 seconds; in 30 seconds, violent spasms with a long piercing cry were emitted by the dog; coma, preceded by a prolonged spasm of muscles of the back, was established in 60 seconds after the administration of the poison, and death occurred in 100 seconds. The body of the dog was perfectly relaxed and flaccid, for 30 seconds before the extinction of the pulsations of the heart and the cessation of the spasmodic respiration.

The post mortem examination revealed congestion of the brain and internal organs, and distension of the cavities of the heart by black blood.

A strong odor of prussic acid was exhaled from the breath of the dog during life, and from the blood and from all the organs and tissues after death.

TREATMENT OF POISONING BY CYANIDE OF POTASSIUM.

The symptoms occur with such violence and proceed with such rapidity to the fatal issue, that there is scarcely time to institute treatment. If possible the stomach pump should be used, and the stomach washed out with a weak solution of green sulphate of iron, which will decompose the poison. A weak solution of chlorine will also prove beneficial. This gas when inhaled is one of the most potent antidotes to the effects of prussic acid. It must, however, be used with caution properly diluted, from its irritant effects upon the lungs. I have by a long series of experiments demonstrated the stimulant effects of chlorine upon the heart, and its power of overcoming the action of prussic acid.* Ice to the head and spine, cold effusion, artificial respiration, and electricity should not be neglected amongst the other measures, if sufficient time is afforded for their employment.

Ammonia is a valuable stimulant, but it should be remembered that it is not a chemical antidote, but merely a stimulant to the nervous system.

* Medical and Surgical Memoirs, vol. i., 1876, pp. 297, 298, 303, 304, 327,

APPENDIX TO CASE OF SPANISH CONSUL OF NEW ORLEANS, DESTROYED BY CYANIDE OF POTASSIUM, MARCH 24TH, '77.

The following letter from Prof. Y. R. LeMonnier, M.D., the efficient Secretary of the Board of Health, presents many points of interest.

NEW ORLEANS, March 31st, 1877.

Joseph Jones, M.D., Professor of Chemistry and Clinical Medicine, Medical Department, University of Louisiana:

Dear Doctor—In answer to your inquiries about the tragic death of the Spanish Consul I will state that, on Saturday, the 24th inst., at or about 12 m., a messenger out of breath entered my office, asking "for a physician for the Spanish Consul, who was very ill." In haste we hurried to the Consulship, two squares distant, where I was told he had taken poison. I sent for some ipecac immediately, and proceeded to examine the patient. I found him in his bed, lying on his back; respiration deep, difficult and *slow*, with fluttering of the lips, foam at the mouth during respiration, the tongue once in a while protruding between the lips. The face was pale, the pupils normal; the temperature below the normal standard, with a cold clammy skin; pulse at the wrist slow. The muscles were in a state of complete relaxation. Total absence of consciousness. Whatever substance had been taken had penetrated the nervous system. We tried in vain to rouse him. On his forehead were two bruises, caused by striking against his chair in falling. I was then told that he had taken a dose of "Simmons' Liver Regulator"—a table spoonful or two—and a few *minutes* after, had dropped. I smelt and tasted the contents of the bottle; the smell and taste, though familiar to me, I could not *then* recall. In again examining the patient, I detected a strong smell of *prussic acid* in his breath. My diagnosis was now *positive*.

Cyanide of potassium in great quantity was in the *bottle*.

In the meantime Dr. Formento had entered the room. I called his attention to this fact, and he verified the diagnosis.

The ipecac arrived (30 grains), which I put in a tumbler of luke-warm water, and by teaspoonful administered it to the patient. By pouring the draught into his mouth, and placing the hand over it, he would swallow. The act of deglutition was not under control of the will, as the patient was unconscious and

life fast ebbing away. No effect from the ipecac. Prognosis—fatal result. I expressed my opinion to this effect to the surrounding friends, and to satisfy them (for there was no hope of saving the patient), sent for my stomach pump and the antidote for cyanide of potassium. I expressed the opinion that the man would be dead before their arrival. The pulse soon disappeared at the wrist, and the man died without a struggle or moan before the arrival of the stomach pump.

I then examined closely the bottle of "Simmons' Liver Regulator," supposed to contain the fatal draught, sealed it in person, in presence of Dr. Formento and the attachés of the consulship (left the seal in charge of the vice consul), and in propria personæ, delivered the bottle into the hands of Dr. Henry Bezou, Deputy Coroner. I inquired whether the Consul was in the habit of taking the liver regulator, and being answered in the affirmative, I asked if there was in the house an empty bottle of this drug. One was brought containing about one drachm. I carefully examined this, which differed both in taste and smell from the bottle I had just sealed. The color was the same. It is evident that the cyanide had been placed in the liver regulator since the purchase of the bottle; in fact, within the last 24 or 36 hours, as about one-quarter of the contents of the bottle had been taken by the Consul, by tablespoonfuls every morning, as reported by his body servant, an intelligent negro.

Rèsumè.—Reached the bed-side of the patient at about 12.10 m. At 20 minutes of 1 p. m. he was dead, from having taken, at about 12 m., a tablespoonful or two of a bottle of "Simmons' Liver Regulator," containing an unknown but large quantity of cyanide of potassium. When I reached his bed-side he was already unconscious.

Y. R. LEMONNIER,
159 *St Louis street, near Rampart.*

The following extract from the testimony of Mr. Jas. D. Bouisquet, at the coroner's office, on the 31st. of March, throws additional light upon the symptoms of Mr. De la Barrera, immediately after the administration of the poison.

The Jury then adjourned to the coroner's office, at the corner of Dumaine and Royal streets, and the inquest continued. Mr. Jas. D. Bouisquet was the first witness called up. He stated that he had arrived in New Orleans on the 13th of March, and

had come here to wait for his brother, who was coming, and to speak to Mr. De la Barrera on business of importance. He said that on the morning of Mr. De la Barrera's death, he called on Mr. De la Barrera, and both went out to a bank where Mr. De la Barrera collected some money. They then went to Moreau's restaurant, where they spoke about matters personal to witness. After leaving Moreau's they went to the consulate. Mr. de la Barrera, after going to his office, went to his desk and examined some papers. Witness sat at the desk and commenced writing. Mr. De la Barrera went to his room, then returned and said to witness several words, one of which was poison; he returned to the room staggering, his eyes were glazed and his mouth foaming. Witness ran to the room where the Vice Consul and clerk were sitting. All returned to Mr. De la Barrera's room, and found him lying on the floor, face downward. Mr. De la Barrera was picked up and placed in his bed. The Vice Consul and clerk went out for a doctor.