On poisoning by nicotina, with remarks / by Alfred S. Taylor.

Dr Percy with Dr Taylor's compts

ON

POISONING BY NICOTINA,

WITH REMARKS.

By ALFRED S. TAYLOR, M.D., F.R.S.

C

Witt. Hofmann's assistant at the School of Mines. He died in the W.C. close to my Laboratory +

M. W—, æt. 36, a gentleman well acquainted with chemistry, had been for some months in a state of great depression of mind. He thought that he was incompetent to the performance of his duties, and that he had chosen a profession for the practice of which he had neither the mental capacity nor the pecuniary means. He had spoken of suicide, and it appeared that five months before his death he had casually remarked in conversation, that if at any time he took poison, he would select nicotina,[1] because it was certain in its action, and would kill a person quickly. This remark was made in reference to a case of suicide by poison in which death did not take place until after the lapse of some hours. For several weeks previous to his death, he appeared distracted and broken down by over-anxiety as to his professional prospects. It was noticed that he did not rest at night, and that he neglected matters which were entrusted to him professionally. He owed for chemical apparatus a small sum of money, which he was quite able to pay; but on this point his mind had evidently been much excited by exaggerated conscientious feelings. A literary engagement involving great labour and research also

[1] This alkaloid of tobacco is frequently but incorrectly called *Nicotine*. The final "ine" is properly applied only to organic principles, the alkaline nature of which has not been determined, but this, like strychnia or morphia, is an alkaline base and it should therefore have a terminal syllable which marks at once its true nature. Some writers describe it under the name of *Nicotia*.

+ I saw her body at H.M.M – I saw Witt one day preparing for Hofmann's Lecture at Jermyn Street. – he had various alkaloids & amongst them nicotine – I was who said to him if a man wishes to commit suicide that is the thing to take. (J Percy. Feb 21. 1888)

oppressed him. After having deliberately and by the advice of his friends signed the agreement, and entered upon the work satisfactorily, he allowed his mind to be haunted with the idea that he could not execute the task, and that he had neither the knowledge nor capacity to complete that which he had undertaken.

On the night of Friday, June 18th, 1858, it was remarked that he did not return as usual to his lodgings: but from what subsequently transpired, it appeared that he passed the night in a water-closet at the Institution in which he held an appointment. At a little before 8 o'clock on the morning of Saturday, the 19th June, a servant who was passing heard a noise near this closet, and gave an alarm. One of the assistants arrived just in time to catch the deceased in his arms, as he fell forward on the floor from within the closet. By the mere weight of his body in falling, the door of the closet was thrown open before him. Aided by another man, the assistant carried deceased to a table in an adjoining room, but before they could reach it, he was dead. From the statement made by those who were present, the deceased did not at first appear to be wholly unconscious, but it was observed that he stared wildly with his eyes: there were no convulsions, and he died quietly, heaving a very deep sigh in expiring. Before he died, he did not appear to know or recognise those who were around him. On entering the closet, besides a knife, handkerchief, and other articles, there was found a small bottle with a stopper in it. It contained about half a drachm of a brownish-coloured liquid, and had a capacity of from six to eight drachms. It was observed that there was a peculiar smell in the closet, which, however, those who were present could not recognise or identify as having any particular character.

About ten minutes after death, the body of deceased was seen by a medical gentleman. He did not perceive, either about the body or mouth, any odour which could lead him to suppose that deceased had taken nicotina. The only odour which he perceived was that of ether, and it is not improbable that the deceased had mixed some ether with the nicotina, which it was afterwards proved he must have swallowed. The other appearances noticed at this time, were, that the limbs were flaccid,

and all the muscles perfectly relaxed, the eyes were staring and prominent, the features were bloated, and beginning to present a livid discoloration, and it was remarked that there was a puffiness or great fulness about the neck. There was no appearance of convulsion or tetanic rigidity. The fingers were simply closed over the palms of the hands, as it is usual to find them in death. No odour resembling tobacco was at this early period perceived by any of those who were present. Fragments of a label were found, and these when put together revealed the word "Nicotine." The bottle lying near the deceased was missing from its usual place in the laboratory; but whether it was or was not full when removed by the deceased, there was no evidence to show.

On searching his pockets, there was found a letter on which he had recently written,—"I have chosen a profession above my capabilities and the means of my friends."

The body was examined sixty hours after death, the temperature being at the time above 70°. Externally, decomposition had advanced to a great extent; but there was no odour of nicotina or any smell resembling that of tobacco. The only perceptible smell was that of ordinary putrefaction. When the body was again seen, seventy-eight hours after death, the features were much bloated and distorted, resembling those of a person who had died by drowning, and whose body had been exposed in hot weather. The skin was of a greenish-white colour, except in the course of the great venous trunks, where for some space on each side it had assumed a deep green colour. The neck was greatly distended, and putrefaction had obviously gone on to some extent in the course of the large veins: these appeared full, and as if the blood in them were much decomposed. The sides of the face in the bloated parts, and the sides of the chest in the whole of the intercostal spaces, had a deep blueish-green colour, as if from the decomposition of blood effused in the cellular tissue. The green colour was observed also on the skin of the back, and in all the dependent parts of the body. The limbs were relaxed: the lower extremities and feet presented no unusual appearance, but the arms were beginning to be decomposed.

About the upper end of the chest-bone, and at the root of the neck, there was a diffused spongy swelling of the skin,

crepitant under pressure, and discoloured by putrefaction. When this was pierced by a knife, gas escaped, followed by a discharge of dark fluid blood from the areolar tissue in which it had been effused. The mucous membrane lining the lips and mouth was not excoriated. On dividing the scalp, dark liquid blood was found effused to a very unusual and remarkable extent, through the structures covering the cranium. On opening the head, the meningeal vessels and those of the brain generally were turgid with black fluid blood. The substance of the brain was healthy, of a darker colour than usual, and the cortical portion presented a green-grey tint. On slicing the brain, few or no bloody points were observed. The ventricles contained a few drachms of serous fluid. In the chest, the lungs were found filling the pleural cavities, highly crepitant, and presenting on section a remarkable engorgement with black blood, resembling in colour and appearance black currant jelly. The heart was somewhat small, of a fawn colour and very flabby. The cavities were empty, with the exception of the left auricle, which contained about two drachms of blood, resembling in colour and fluidity that found throughout the body. The stomach was distended with gas, and externally it did not present any unnatural appearance. It contained a small quantity of chocolate-coloured fluid of a treacly consistency. When this was removed, the whole of the mucous membrane presented a dark crimson-red colour, as if stained with black currant-jelly. There was the most intense congestion of the whole of the capillary vessels, but there was no abrasion, corrosion, or destruction of the coats. These were not softened: they had their usual tenacity and strength. The deep crimson colour of the mucous membrane was especially marked at the cardiac end of the stomach. No odour resembling nicotina or tobacco could be perceived on opening the cavities of the body, and the stomach and its contents had merely the smell arising from incipient putrefaction. The liver and lungs were almost purple-black from the amount of congestion in their capillary structure. The blood was liquid, but in some parts thickened to the consistency of treacle—the fibrin appeared to be broken up and destroyed. Its colour was peculiar, resembling that of black currant juice. The stomach and contents, with the blood and other portions

of the viscera, were secured in a bottle, and submitted on the day following the inspection, to a chemical examination.

Analysis.—One half of the stomach with the adhering contents was cut into small pieces and shaken with a quantity of ether in a bottle. The contents were allowed to digest for an hour, being occasionally shaken. The ethereal liquid, which had acquired a yellow colour, was then poured off and spontaneously evaporated. The residue had no particular odour; it was a soapy-looking mass having an alkaline reaction. This residue was mixed with a solution of pure potash and distilled, at first at a low, and afterwards at a high temperature. A small quantity of colourless liquid was obtained, which had a well-marked alkaline reaction. There was no odour of ammonia, but a peculiar odour which bore some resemblance to nicotina much diluted with water. On warming a portion, test-paper applied to the vapour indicated a slight volatile alkaline reaction. Chloride of platina gave a yellowish crystalline precipitate, presenting well-defined feathery prisms under the microscope; corrosive sublimate gave a white precipitate; arsenio-nitrate of silver, a bright yellow precipitate; iodine water a turbid reddish-brown precipitate; tannic acid a yellowish-white precipitate; and gallic acid produced in it no precipitate and no change of colour. A portion of the liquid allowed to evaporate spontaneously, left some oily-looking globules, which, on being heated, evolved acrid pungent fumes, resembling nicotina. The soapy residue in the retort was mixed with a sufficient quantity of hydrate of lime to render it a stiff paste, and this was submitted to distillation. An additional quantity of a clear colourless liquid was obtained, which had the odour of nicotina, was strongly and fixedly alkaline, and gave with the tests all the results above described. A portion of this was neutralized by diluted hydrochloric acid slowly evaporated on a glass slide. When examined by the microscope no dagger crystals of hydrochlorate of ammonia were obtained, showing an entire absence of this alkali.

The liver and lungs had been placed in the same bottle with the stomach (cut open), and its contents, so that no inference of absorption and deposition could be drawn from a separate analysis of those portions of the organs which had been reserved.

The remaining half of the stomach, as well as the portions of liver and lungs, were cut into small pieces and divided into equal parts, for the purpose of separating nicotina by the processes of Orfila and Stas, in order that a comparison might be made of their relative value.

Orfila's process—The portions of viscera were placed in a glass vessel, containing five ounces of distilled water, to which five drops of pure sulphuric acid had been added. The animal matter was well stirred with the feebly acid liquid, and allowed to stand for about forty hours. It was then strained and filtered, and the residue pressed. The object of this stage is to produce sulphate of nicotina. As the alkaloid is liquid, and easily unites to acids and forms salts, no heat is required for solution or combination.

2. The highly coloured acid liquid thus obtained was evaporated in a water-bath to one half, and this led to the separation of a thick coagulum. Cold alcohol of a sp. gr. of ·826, was poured on the acid liquid and well mixed by stirring it. This caused a further coagulation. After a short digestion it was filtered, and a clear liquid of the colour of pale sherry wine was thus obtained. The greater part of the organic matter had been thus effectually separated. The liquid was evaporated over a water-bath, and the fatty residue which resulted, was separated by agitation with a small quantity of water and filtration through a wet filter.

3. The aqueous solution procured amounted to four fluid drachms: it was feebly acid, and slightly coloured. It was rendered alkaline by pure potash, and shaken with its volume of pure ether in a stoppered tube. The ethereal liquid was decanted, and portions were allowed to evaporate spontaneously in a number of watch-glasses. Oily-looking globules were obtained in each case. These had the peculiar odour of nicotina, which was only strongly evolved when the watch-glass containing them was heated. The odour was acrid and pungent, affecting the nostrils and throat, and producing headache. The oily-looking residue in each watch-glass was mixed with a few drops of water. It was readily dissolved, and had a strong alkaline reaction. The reagents above mentioned were applied to the solutions thus obtained with the most conclusive and satisfactory results. Chloride of platinum

produced the feathery crystals (visible under the microscope) which it produces with a solution of nicotina, Tannic acid gave a dense yellowish-white, and iodine water a red-brown precipitate, and it was found that a solution of permanganate of potash had its colour immediately discharged.

Stas's process.—Five ounces of distilled water, in which eight grains of crystallized oxalic acid were dissolved, were used for the solvent in this case. The remaining portions of the viscera were digested in this liquid, and the subsequent steps of the process were in all respects similar to those above described. The differences observed were: that the various solutions obtained were of a darker colour; and the quantity of nicotina removed from the viscera by the oxalic acid was larger and in a more concentrated form. The globules of nicotina obtained had a stronger alkaline reaction when dissolved in water, and the precipitates obtained by the reagents were more copious.

Neither of these processes will enable the analyst to separate the whole of the nicotina from the organic matter. In order to determine this question, the brown, watery, alkaline liquid, which remained in the tube after agitation with successive quantities of ether was, in each case, distilled; and a clear, watery product was obtained, containing nicotina and ammonia. By exposure in a dial-glass for twenty-four hours, the whole of the ammonia had passed off, and the oily-looking globules left as a residue were found to consist of nicotina. A larger proportion was obtained from the residue of the sulphuric acid process than from the residue of the oxalic acid process, showing that a greater quantity had been extracted by ether in the process of *Stas*.

It was thus proved that nicotina was present in the body of the deceased. The result of the inquest was that the deceased had died from the effects of nicotina, which he had voluntarily taken for self-destruction while labouring under temporary insanity. The circumstances rendered it probable that deceased had procured the bottle of nicotina from the laboratory in the evening he that had retired to the water-closet, and had remained there the whole of the night; that on hearing persons moving about in the morning, he swallowed a quantity of the poison from the bottle, returned the stopper, and

had probably intended to conceal the means of death by throwing the bottle down the closet: but he fell forward powerless in the act, and the bottle dropped from his hand. The label had been previously scratched off. The quantity of this poison taken by him cannot therefore be determined; it is probable that the greater part of the contents of the bottle were spilt. It is well known that two or three drops of nicotina are sufficient to destroy life; and that this quantity at least had reached the stomach is rendered probable by the result of the chemical analysis. The time which he survived after taking the poison must be a matter of inference. It may be assumed from the circumstances, that he was insensible and powerless within a few seconds, and that he died in from three to five minutes. There were no convulsions. The poison appears, in this case, to have acted as a pure narcotic.

This is, so far as I can ascertain, the only case of poisoning by nicotina, which has occurred in this country. There is only one other on record: this occurred in Belgium, and was the subject of a trial for murder in 1851. The Count and Countess Bocarmé were charged with the murder of the Countess's brother, a M. Fougnies, by administering to him nicotina, while dining with them in the château of Bitremont. The deceased did not survive more than five minutes, and was not seen living by any of the attendants. The possession of the poison, as well as the moral evidence, fixed the crime on the count, and he was condemned and executed. The appearances after death in the case of Fougnies were, to a great extent, altered or destroyed by the pouring of some strong acid (acetic) into the mouth and over the body of the deceased, in order to conceal or remove the odour of nicotina. M. Stas conducted the chemical investigation, and succeeded in detecting the poison in small quantity in the tongue and fauces, stomach, liver, lungs, and in a wooden plank of the floor of the room in which the deceased was sitting.

Properties of nicotina; its effects on animals.—A specimen of this alkaloid was given to me by Dr. Hofmann. It had a pale amber colour: when poured from the bottle it flowed like a thin oil: it gave a greasy stain to paper, which was speedily removed by evaporation; and it evolved a peculiar

odour resembling stale tobacco smoke. When heated on platina it produced a dense, white smoke, acquired a dark colour, took fire, and burnt with a bright yellow flame, giving off an abundance of carbon as a thick, black smoke, and leaving a small quantity of carbon as a residue.

Strong sulphuric acid in the cold did not carbonize it, but the nicotina acquired a reddish colour, which was deepened by heat. When the heat was continued, the mixture became darker, and white vapours of sulphurous acid, as well as of nicotina, were evolved. Sulphuric acid in the cold, with a crystal of bichromate of potash, produced, after a time, a green colour, from the separation of oxide of chromium. Fuming hydrochloric acid brought near to a drop of nicotina, produced dense white vapours of the hydrochlorate, resembling those caused by ammonia under the same circumstances. When heated, the hydrochlorate of nicotina escaped in dense, white vapours, leaving as a residue a carbonaceous stain. Nitric acid produced in the cold no change, but when heated the mixture acquired a dark orange colour. After a time, the acid was suddenly and violently decomposed with the evolution of nitrous acid vapour.

Nicotina, in a concentrated state, is powerfully alkaline. Two drops dissolved in an ounce of distilled water gave to the liquid a strong alkaline reaction. The solution, in this diluted state, had the peculiar odour of the alkaloid. A piece of paper dipped in pure nicotina, when ignited, burnt with a yellow smoky flame, as if it had been dipped in oil. It is very soluble in water, alcohol, and ether; and ether possesses the property of removing it, although not entirely, from its aqueous solution. The solutions have the odour and the other chemical properties of the alkaloid. In spite of its powerful odour, nicotina does not appear to be very volatile. It remains as a greasy-looking spot in a watch-glass, after many hours' free exposure to the air; and even after twenty-four hours, the application of heat to the thin film of moisture in the glass, led to the evolution of the peculiar pungent odour of this alkaloid. The vapour evolved from the pure alkaloid does not perceptibly affect test-paper like that of ammonia, although there are abundant white fumes produced on exposure to hydrochloric acid in both cases. If ammonia

should be mixed with nicotina, that alkali is removed with the water by simple exposure. The hydrochlorate of ammonia forms permanent dagger crystals; the hydrochlorate of nicotina is deliquescent, or only imperfectly crystallizes in short wide prisms crossing each other at right angles.

Nicotina strikingly resembles ammonia in some of its properties, and as ammonia may result from the action of potash on organic matter, especially when heat is employed, it is necessary that an analyst should have the means of distinguishing nicotina from ammonia, and of separating one from the other. They both produce an orange-yellow precipitate with chloride of platina: when examined by the microscope the ammonia-precipitate is in octahedra or dodecahedra—the nicotina-precipitate is seen in groups of feathered crystals peculiar in shape and arrangement, mixed with well-defined octahedra. Both ammonia and nicotina are precipitated of a yellow colour, by arsenio-nitrate of silver, and white by corrosive sublimate. The striking chemical reactions in which they differ are these: iodine water has its colour discharged by ammonia; it is precipitated brown by nicotina: tannic acid produces a red colour with ammonia, without precipitating the alkali; it precipitates nicotina of a pale yellowish-white, like the other alkaloids, but produces no change of colour: traces of ammonia are thus easily detected in a solution of nicotina by this reagent. Gallic acid rapidly imparts to ammonia a pink-red colour, while it produces no change of colour or precipitate in nicotina. The red colour produced by ammonia slowly changes to an olive-green. Chloride of gold gives an amorphous brown precipitate of fulminating gold with ammonia, while it produces a plumose crystalline precipitate of a yellow colour in a solution of nicotina. Nitrate of silver yields with ammonia brown oxide of silver, soluble in an excess of the alkali; with nicotina it produces an opalescence not soluble in excess; and, on heating the mixture, silver is slowly reduced and separated. Permanganate of potash is scarcely affected in its colour by admixture with ammonia; but the colour is rapidly destroyed by nicotina even in a very diluted state. As ether and most organic substances discharge the pink colour of the permanganate, care must be taken that the nicotina is not combined with any of these matters. When

we know that we are dealing with nicotina alone, a standard solution of permanganate of potash may be employed to determine the quantity present. The quantity of permanganate which has its colour discharged on admixture with a certain measure of nicotina, will be great in proportion to the strength of the alkaloid; and if the solution of permanganate be previously tested with a measured quantity of nicotina, the proportion present in an unknown case may be thereby determined. A solution of two drops of nicotina to one ounce of water is sufficiently strong to give all the reactions above described.

As a summary of these distinctions between ammonia and nicotina, it may be stated, that nicotina is specially identified by its strong and peculiar odour, wholly unlike that of ammonia, either in the cold or when heated—by the precipitate, without change of colour, given by tannic acid—the reddish brown precipitate by iodine water—and the immediate destruction of the colour of a solution of permanganate of potash.

If ammonia is mixed with nicotina, it may be separated either by spontaneous evaporation, or the mixture, neutralized by diluted sulphuric acid, may be carefully evaporated to dryness, and the residue treated with alcohol. Sulphate of nicotina is dissolved, whilethat of ammonia remains.

Experiment on a rabbit.—A single drop of the pure nicotina, examined in the above-mentioned analysis, was placed at the back of the mouth of a healthy rabbit. The taste appeared to be affected, the animal frothed at the mouth, and a quantity of frothy mucus issued from between the jaws, which were closed.

Symptoms.—In from fifteen to twenty seconds the animal lost all power of standing on its legs; it fell on its side, and was violently convulsed in its fore and hind legs; these were in rapid motion for half a minute, and the back was arched in opisthotonos, but again speedily relaxed. The animal then lay tranquil for about a minute, when it was again suddenly seized with similar clonic convulsions; these ceased, and the animal appeared to be dead. The heart continued to contract for about half a minute, and then ceased. The animal died in three minutes and a half from the time at which the poison

was placed in its mouth. During the convulsions, and after death, it was observed that a quantity of frothy mucus escaped from the mouth. This was strongly alkaline, and it was supposed to have the odour of nicotina; but as the air of the room was impregnated with the vapour, nothing certain could be said on this point.

Appearances.—The body was examined in an hour and a half after death. The eyes were prominent and staring; the limbs were relaxed, but these became rigid about half an hour later. On opening the abdomen the stomach was found distended with food. When laid open, the only odour perceptible was that of sour green food. The coats were pale; and the blood-vessels were strongly marked in their course by the dark-coloured blood which they contained. The intestines were pale, but there was great congestion of the vessels of the mesentery. The liver and kidneys were congested with dark-coloured blood; the lungs were pale and not congested; the right cavity of the heart contained a small quantity of blood of a dark colour, and in a partially coagulated state. The left cavities were empty; the blood which escaped during the inspection was fluid, and of a dark, claret-red colour, with a pinkish tinge when seen in a thin layer; on exposure to the air it became lighter in colour, but did not pass to a florid red. The colour of the blood was similar to that which I have occasionally seen in poisoning by prussic acid and the essential oil of bitter almonds.

Analysis.—The parts removed for analysis were: 1, the stomach and its contents; 2, half an ounce of blood collected from the vessels of the abdomen; 3, the liver; 4, the heart, kidneys, and lungs; 5, the tongue, palate, and soft parts adjacent. None of these organs or parts had the odour of nicotina. This was only perceptible near the mouth of the animal, but it rapidly disappeared. The stomach contained about two ounces of green vegetable matter, which had an acid reaction—it had obviously undergone fermentation. Although examined within two hours of death, no odour of nicotina or tobacco could be perceived by four persons who were present. This led to the supposition that no part of the drop of alkaloid which had destroyed life could have reached the stomach. The stomach and its contents were treated by Orfila's process

as elsewhere described (p. 350), with the result that a small quantity of nicotina was separated, possessing the odour and properties assigned to this alkaloid.

The half ounce of blood similarly treated also yielded nicotina in sufficient quantity to allow of the bare inference of its presence. The odour of the separated alkaloid was masked by some other organic principle. Some blood of an animal not poisoned by nicotina was submitted to all the steps of the analysis, with negative results. The liver, weighing two ounces, and the heart and lungs together, were separately examined by the same process, but nicotina was not detected in the tissues of these organs. The tongue, palate, and soft parts of the mouth, were similarly treated after a week. The membrane of the tongue was softened and readily peeled off; this effect was probably partly due to putrefaction, as one drop of the alkaloid would not have been sufficient to cause such local changes. In these parts, nicotina was distinctly present. A sufficient quantity was separated in a pure state, not only to lead to the recognition of the odour, but to allow of the application of all the characteristic tests.

Hence it follows that, in poisoning by this alkaloid, even when the quantity remaining in the body is small, it admits of detection in the stomach and in the blood, but not always in the tissues. Of the single drop administered to the animal, a portion had clearly escaped with the frothy mucus and saliva issuing from the mouth. A minute quantity had passed into the stomach, and was diffused through a large quantity of food, while a trace was detected in the blood; but the largest quantity was found in the parts to which the poison had been directly applied, and which it had no doubt penetrated by imbibition. The results do not show that nicotina is not deposited in the viscera in cases of poisoning by it, but simply, when the quantity is small and death is rapid, that none may be found.

Pathological effects of Nicotina.—The action of this poison upon animals has been lately investigated by M. Claude Bernard.[1] His experiments show that mammalia,

[1] 'Leçons sur les Effets des Substances Toxiques et Médicamentensis,' &c. Paris 1857, p. 397.

birds and reptiles, are destroyed by nicotina under similar symptoms; and that whether applied to the alimentary canal, to a wound in the skin, or to the mucous membrane of the conjunctiva, its rapidly fatal effects are equally manifested. The arterial capillary system appears to be specially affected by the poison, through the medium of the sympathetic nerve. The circulation is here arrested, while the heart continues to pulsate. The veins are full, but they no longer convey the blood onwards. Nicotina appears to affect the nervous system of organic life, just as strychnia affects the nervous system of animal life, and convulsions in either case are among the most prominent symptoms. According to this view the influence of the sympathetic nerve is specially manifested on the vascular capillary system.

Nicotina, like prussic acid, is a compound of carbon, nitrogen, and hydrogen. It contains no oxygen. Its formula is C_{10} H_7 N. When exposed to air and light it undergoes a chemical change, and acquires a brown colour; its energy as a poison is thereby reduced. Bernard states that he found the *modus operandi* of the partially decomposed poison to be different from that of pure nicotina. The functions of the heart and lungs were directly affected by it; while the pure poison chiefly spent its physiological action on the capillary circulation. He also found that the perfectly pure nicotina produced tetanic rigidity of the limbs. These results may explain the different views which have been entertained of the mode in which nicotina operates. One set of experimentalists have arrived at the conclusion that it acted exclusively on the muscular system, while another set have contended that the circulation alone was directly affected. The degree of purity of the nicotina employed may, in some measure, account for these differences.

Convulsions are not a necessary attendant on this form of poisoning. There were none in the case of M. W—. They were observed in the experiment on a rabbit, but they were of a clonic, in place of a tetanic character. The temporary production of opisthotonos, however, proves that the spinal marrow was affected by the poison. The effects produced on the rabbit show the fallacy of relying upon the symptoms caused in animals as evidence of their character and course in the human subject.

It is evident from the case which is the subject of this

paper, as well as from the experiment on the rabbit (page 355), that nicotina produces changes in the blood. The microscope shows no appreciable physical differences; but the colour and consistency of this liquid are entirely changed. The whole of the blood, arterial and venous, acquires a purple-black colour, and the fibrine appears to be dissolved or broken up. Is it to be inferred from its chemical constitution that nicotina completely deoxidizes the blood with the rapidity with which it deoxidizes the solution of permanganate of potash, and that death is the immediate consequence of this universal deoxidation of the vital fluid? When exposed to air it reabsorbs oxygen to a slight extent, and acquires a ruddy hue. These facts may theoretically account for the rapid action of this poison on the body; but in addition to this mode of action, it appears to operate by causing a complete stagnation of the altered blood in the overfilled capillaries. In the case of M. W—. the appearance of the various organs, as a result of capillary congestion, was such as I have never before seen. They appeared as if they had been dyed with a deep purple black dye. This condition, it must be remembered, is the result of the action of a poison in a *few minutes*—a period just sufficient for its circulation throughout the body. In the experiment on the rabbit the heart continued to beat, as in asphyxia, for a short time after all other vital actions had ceased; and this fact, viewed in connexion with the condition of the capillary system after death, appears to show that there is some foundation for the theoretical view of Bernard, namely, that this powerful poison destroys life by arresting the circulation from the circumference to the centre.