

MADRAS RECORD OFFICE.

Government of Madras.

Public DEPARTMENT.

G.O. No. 1170	Press Mis.
Dated 12-3-8-	1871. 1870

Not to be folded or roughly handled

34/
7/5/57

*Proceedings of the Madras Government, Public Department,
3rd August 1871.*

No. 5. Read the following letter from the Secretary to the Government of India, Home Department (Public), to the Secretary to Government, Fort St. George, dated Simla, 27th June 1871, No. 3150:—

I am directed to forward 25 copies of a pamphlet by Professor Haldord, of the Melbourne University, on the treatment of snake-bite for distribution among the Medical Officers in the Madras Presidency, and I am to request that any valuable opinions received from them, or from any other officers who may have a special knowledge of the subject, may be forwarded for the information of the Government of India.

No. 6. ORDER THEREON, 3rd August 1871, No. 1170.

Ordered that twenty-three (23) copies of the pamphlet referred to be forwarded to the Acting Inspector-General, Indian Medical Department, for distribution, and that the opinions of Dr. Shortt and other Medical Officers, who have paid attention to the treatment of snake-bite, may be obtained for submission to the Government of India.

(True Extract.)

Captain, R. E.,

*Under Secretary, P. W. D.,
for Chief Secretary.*

To the Acting Inspector-General, Indian Medical Department, with a packet.

Exd. J. Wright.

Govt. of 1871 ~~the~~ address

PUBLIC.

To

THE ACTING INSPECTOR-GENERAL,
INDIAN MEDICAL DEPARTMENT

Dated August, 3rd.

Recd.

Encl.

G. O., 3rd August 1871, No. 1170.

AUGUST.
Nos. 5-6.

Forwarding 23 copies of a pamphlet by Professor Halford, of the Melbourne University, of the treatment of snake-bite, with a request the opinions of Mr. Shortt and other Medical Officers who have paid attention to the subject may be forwarded for transmission to the Government of India.

THE
TREATMENT
OF
SNAKE-BITE
IN VICTORIA.

BEING A PAPER READ BEFORE THE MEDICAL SOCIETY OF
VICTORIA, JUNE 1st, 1870.

BY
GEORGE B. HALFORD, M. D.,

MEMBER OF THE ROYAL COLLEGE OF PHYSICIANS OF LONDON, PROFESSOR
OF ANATOMY, PHYSIOLOGY, AND PATHOLOGY IN THE
UNIVERSITY OF MELBOURNE, &c.

RE-PRINTED FROM "THE AUSTRALIAN MEDICAL JOURNAL."

CALCUTTA:

RE-PRINTED AT THE HOME SECRETARIAT PRESS.

1871.

*Ms. B. 1. 170
7/3/71*

P. 15408/71

THE
TREATMENT
OF
SNAKE-BITE
IN VICTORIA.

BEING A PAPER READ BEFORE THE MEDICAL SOCIETY OF
VICTORIA, JUNE 1ST, 1870.

BY
GEORGE B. HALFORD, M. D.,
MEMBER OF THE ROYAL COLLEGE OF PHYSICIANS OF LONDON, PROFESSOR
OF ANATOMY, PHYSIOLOGY, AND PATHOLOGY IN THE
UNIVERSITY OF MELBOURNE, &c.

REPRINTED FROM "THE AUSTRALIAN MEDICAL JOURNAL."

CALCUTTA:
REPRINTED AT THE HOME SECRETARIAT PRESS.

1871.

THE TREATMENT OF SNAKE-BITE IN VICTORIA.

BY GEORGE B. HALFORD, M. D.,

MEMBER OF THE ROYAL COLLEGE OF PHYSICIANS OF LONDON, PROFESSOR OF ANATOMY,
PHYSIOLOGY, AND PATHOLOGY IN THE UNIVERSITY OF MELBOURNE.

MR. PRESIDENT AND GENTLEMEN,—When for this paper I first took pen in hand, my intention was to answer some false statements concerning me which appeared in the *Lancet* of May 26, and which were republished in some of the daily papers of this city; but, as I reviewed the doings of the past eighteen months, I quite forgot the *Lancet* and the papers. Hence, Sir, I must apologise for saying nothing about them, and for changing the title of my paper from "A reply to the *Lancet*, &c.," to "The Treatment of Snake-bite in Victoria."

The 1st case in which Liquor Ammoniae was injected, from my previous suggestions, into the human veins, occurred at Beechworth, 185 miles from Melbourne, in the practice of Dr. Dempster. A man had been bitten at 8 in the morning, and was insensible and apparently dying at noon. Dr. Dempster injected twelve minims of Liq. Ammoniae Fort., diluted with water, into the saphena vein. The patient woke up immediately, and presently recovered. As this is the first recorded case, it is as well to state that the remedy was used as a *dernier ressort*. Had Dr. Dempster any probability of saving his patient by other means, he would not have injected Ammonia; but having done so, and with immediately perceptible good effects, he attributed the man's recovery to the injection of Ammonia. Dr. Dempster's account of this case at once attracted the attention of the medical profession of this colony.

The 2nd case was in the practice of Mr. Arnold, of Elsternwick, who, assisted by Mr. A'Beckett, of St. Kilda, near Melbourne, failed to arrest by ordinary means the progress of the poisoning. When the man was insensible to sound and light, I at their request injected thirty minims of Liquor Ammoniae, B. P. Sp. gr. '959, into the superficial radial vein. The patient at once roused, and conversed with those about him. The species of snake was *Hoplocephalus superbus*.

The 3rd case is recorded in the New South Wales papers, but I have failed in getting full particulars, Dr. Irwin, the medical practitioner, having since died.

The 4th case—a man was bitten at Moyston, 146 miles from Melbourne. The patient was comatose, and fast sinking. Liquor Ammonia was injected into the basilic vein, and recovery followed. In a letter to me, Dr. O'Grady states that, "but for injection of Ammonia, the man would have died."

The 5th case—a girl, aged 14. The symptoms were total paralysis, complete stupor. Fifteen minims of Liquor Ammonia were injected into the median vein by Mr. Barnett, of Smythesdale, 107 miles from Melbourne, and the patient was roused in a few minutes, and recovered. The species of snake was *Hoplocephalus cinctus*.

The 6th case occurred at Mornington, 35 miles from Melbourne. The boy was insensible. Mr. Lane injected thirty minims of Liquor Ammonia into the basilic vein. The previously dilated and insensible pupils immediately contracted and consciousness returned, and recovery followed.

The 7th case—a child, aged nine years,—was perfectly insensible; pupils fixed and dilated. This happened at Seymour, 61 miles from Melbourne. Diluted Ammonia was injected into a vein at the bend of the elbow, by Messrs. Henshall and Stillman, and the child roused immediately, and recovered in a few hours.

Case 8 is a somewhat doubtful case, the child, aged 9 years, having been brought to the Hospital at Kyneton, 56 miles from Melbourne, 27 hours after the accident. Five minims of Liquor Ammonia Fort., with twenty-five of warm water, were injected into the basilic vein. Before the injection the pulse was intermitting frequently, the extremities cold, and the pupils dilated and insensible to light; there was also locked-jaw. Four hours after, a similar dose was again injected. No apparent effect followed the use of the remedy, and the child died, remaining perfectly sensible to the last.

Case 9.—Dr. Rae, of Bacchus Marsh, 34 miles from Melbourne, injected thirty minims of Liquor Ammonia and thirty of water into the basilic vein of a man who was perfectly insensible, cold, and, according to the Doctor's belief, on the point of dying. The patient roused in one minute after the injection, and in less than half-an-hour walked away recovered.

Case 10.—Symptoms in this case not severe; more like those of drunkenness. Dr. Starke, of Creswick, 109 miles

from Melbourne, injected Ammonia into a vein, and the boy recovered unusually quickly.

Case 11.—In which a man was believed to be sinking, having been bitten twice by an infuriated brown snake (*Diemenia superciliosa*), was roused in one minute by an injection of Ammonia into the vein; but the bitten parts not having been excised, and a ligature loosened after the supposed recovery, all the worst symptoms returned, and a repetition of the injection five times was required in order to thoroughly restore the patient. This occurred in the practice of Dr. Dowling, of Talbot, 131 miles from Melbourne.

Case 12.—A woman was bitten at Tarraville, in Gipps Land, 207 miles from Melbourne. She was described by Dr. Eccles as cold, pulseless, insensible, and on the point of dying. The veins were twice injected with Liquor Ammonia, and consciousness returned in twenty minutes. The circulation was restored immediately upon the injection.

Case 13.—The only interest about this case, which occurred at Taradale, 67 miles from Melbourne, is that Ammonia was injected by Drs. Crooke and Hutchison, both into the vein and subcutaneously; and that after the circulation had been restored by the injection, she roused and recovered.

Case 14.—In the practice of Dr. Langford, of the Kyneton Hospital, in which thirty-six minims of Liquor Ammonia, B. P. Sp. gr. .959, were injected into a vein of the fore-arm of a woman, who was totally paralysed, insensible, and in a most alarming condition. She roused immediately, and walked about the ward without assistance.

Case 15.—A boy, aged 12, was bitten at Devil's Creek, and became pulseless, comatose, and totally helpless; the pupils dilated and insensible to light. Six drops of Liquor Ammonia Fortissimus, with two drachms of water, were injected into a vein of the fore-arm. Consciousness at once returned, the pulse rose, and recovery ensued. My authorities for this case are the boy's own father, Mr. Richardson, and Mr. Walpole.

Case 16.—A man was brought to Dr. Rae, of Colac, 92 miles from Melbourne. He had been bitten at 12-30 P. M., and at 4-30 P. M. was comatose, the pupils were dilated and insensible to light, and the extremities cold. Ammonia of a gradually increasing strength was injected ten different times into a vein in each arm, until one drachm and a half of Liquor Ammonia Fortissimus had been used. The pulse and breath-

ing improved, the pupils contracted, the jaw which had fallen drew up, and to the astonishment of everybody he walked away in two hours.

Case 17.—A woman was bitten at Bambra, and soon became drowsy and helpless. On arriving at Winchelsea, a distance of 14 miles, she was completely comatose, and was carried into the house. The pupils were fixed, dilated, and insensible to light. Dr. Meyler injected ten minims of *Liquor Ammonie Fortissimus*, mixed with fifty of water, into the cephalic vein. During the operation she was quite insensible. Before half a minute had elapsed she roused up into consciousness, the pulse became fuller, and the temperature of the body sensibly increased. In a quarter of an hour she began to eat bread and butter, and from that time rapidly recovered.

Case 18.—A woman was bitten at Tumbacumba, New South Wales, between 9 and 10 A. M., and having had *Ammonia* injected under the skin, was at 5-30 P. M. quite helpless, pale, and nearly insensible. Twelve minims of *Liquor Ammonie Fortissimus*, mixed with twenty-four of water, were injected into a vein of the arm previously laid bare. Half was first injected, and the remainder after the lapse of ten minutes. It had an almost instantaneous and magical effect, consciousness returning, with free use of the muscles, succeeded by cheerfulness. By-and-bye the bad symptoms returned, and the injection was twice repeated and recovery followed. She had no recollection of anything that occurred from the time of stupor setting in, at noon, till near midnight. My authority for this case is Mr. R. D. Mathews, whose hypodermic syringe was used.

Case 19 has been communicated to me by Dr. Bennett, of Albury, 207 miles from Melbourne. A child, aged 7 years, was supposed to have been bitten by a snake in the morning. No particular symptoms occurred till 7-30 P. M. Drs. Bennett and Keating found him pale, the skin cold and clammy, the pulse 120, the pupils widely dilated, very drowsy but easily aroused, and able to answer any question very sensibly. *Liquor Ammonia* was injected into the basilic vein. The child rallied, and was put to bed quite easy and comfortable, pulse 90, skin warm. The next morning the neck, cheeks, and tongue appeared swollen; these symptoms increased till about 1 P. M. He now refused to swallow, the pulse rose to 130, the pupils became again widely dilated, the extremities cold, and drowsiness constant. Injections into the vein were now made four times at intervals of a quarter of an hour each. The child improved very much; his colour returned;

he could drink easily; the pupils were less dilated; he became quite sensible, now and again talking voluntarily to his mother. Dr. Bennett adds, "I felt quite satisfied, and left him for a couple of hours, during which time Dr. Keating saw him, and considered him very much better. Soon after 10-30 I found him greatly changed; pulse 160, very weak. I wished to inject again, but the mother would not allow it, and I have only to regret I did not enforce it." Soon afterwards the child died.

The 20th case is that of a child, six and a half years old, bitten by a snake at Dandenong, 19 miles from Melbourne. Before reaching Dr. Phillips', at 3 P. M., neat brandy was given to him every five minutes, so that half a pint was consumed. On arriving, the pupils were widely dilated, the pulse very small, very irregular. There was great disposition to sleep, and great intolerance of the efforts either to awaken him or to give brandy; but a consciousness, when aroused, very different from a state of intoxication. Two ounces more brandy were given, but no improvement following, diluted *Ammonia* was injected into the cephalic vein, and repeated. Not all of the *Ammonia* passed directly into the vein, and the solution was of uncertain strength, none so strong as it should be. The child also lost some blood, as the vein was opened with a lancet. However, the child died, the *post mortem* examination revealing none of the ordinary appearances of snake-bite, but great congestion of the brain, which it is not improbable was caused by the brandy. Although in my opinion a case of snake-poison, it can scarcely be said to have been treated on my plan alone.

Of the foregoing twenty cases, three then have ended fatally, a child being in each case the sufferer.

In Dr. Langford's case, No. 8, twenty-seven hours had elapsed since the child had been bitten, and before he was brought to the hospital.

In Dr. Bennett's case, the child had apparently recovered from the coma, difficulty of swallowing, and collapse, under the treatment which, to the Doctor's regret, was stopped by the mother. We have seen in cases Nos. 11, 16, and 18, that the amount and strength of the *Ammonia* must be increased in proportion to the severity of the case.

Case 20 was also a child, and possibly beyond any treatment; but cases 7 and 12 were also children of the ages of 9 and 12, and yet recovered.

Of the seventeen successful cases, it may be said that they would have recovered had nothing at all been done. No one can deny this; but I have been at the pains of inquiring of those who had charge of the patients, and this is their reply:—

Dr. Dempster believes the man would soon have died. Drs. Arnold, A'Beckett, and Wooldridge, the same.

A similar opinion was expressed by Drs. O'Grady, Barnett, and Lane, Dr. Rae (of Bacchus Marsh), Dr. Rae (of Colac), Dr. Dowling, Mr. Eccles, Messrs. Henshall and Stillman, Dr. Langford, &c., of the cases attended by them.

I pass now to the consideration of the state of a person dangerously bitten by a snake, and to the effect of Ammonia when injected into the circulation. And here, in addition to a mere statement of facts, I must pass into hypothesis.

In fatal cases of snake-poisoning, whether in this colony, India, America, or Africa, it may be stated, as a rule, with few exceptions, that the blood loses its power of coagulation, and becomes thinner and poorer; its colour resembling the most deoxidised form of Stoke's cruorine. This blood, however, after death greedily absorbs oxygen, when exposed to the air, and it absorbs it more than unpoisoned blood. Since my attention was first directed to this subject, I have met with Dr. Harley's observations on the influence of poisons on the respiratory gases. In a dog poisoned by a puff-adder, the blood absorbed two per cent. more of oxygen than healthy blood similarly treated. Now, as I asked in my first paper on this subject, why, when no impediment exists to the access of oxygen, should the blood become so gradually deoxidised in people bitten by snakes; excepting on the supposition that something had been added to the blood which prevented those actions and re-actions between blood and oxygen upon which the manifestations of life depend? The fluid state of the blood is also in harmony with deficient oxidation, and yet there is no hindrance to respiration; no reason, like in drowning, why oxygen should not reach the blood; it does reach, but in the presence of the serpent's poison, its life-sustaining power is withheld, unless some other agent be added to the blood to counteract it. The deficiency of fibrine and of oxygen I formerly explained on the supposition of the growth of foreign cells within the blood. I now modify that view, and explain the facts differently. The large cells are strangely altered, white corpuscles, greatly swollen, and certainly

increased in quantity; the increase in size apparently keeping pace with the fluidity of the blood, although such changes do not occur in white corpuscles simply placed in water. This change in the corpuscles commences during life, but goes on indefinitely after death, until all the granular matter seen at first in the blood becomes converted into cells. Their average diameter is $\frac{1}{1700}$ inch. The nucleus is round, or kidney-shaped, and the outer cell-wall so extremely delicate as to escape the notice of most observers, until their attention is repeatedly directed to it; in addition, the application of magenta reveals a minute colored spot, like a ruby, at some part of the circumference, resembling the macula seen in the red corpuscles of all vertebrates, as pointed out by Roberts. But this condition of white cell is common to nearly all fluid blood of dogs and cats I have since examined. Where especially it is deficient in fibrine, the cells become very evident after death. But when the blood is rich in fibrine, the corpuscles, being less at liberty, retain their normal shapes. In fact, they swell in serum minus fibrine; on the contrary, in leucocythæmia, where both white cells and fibrine are in excess, these changes do not occur. (*See Appendix*).

I am still inclined, however, to refer all these changes in the blood to the introduction of germinal matter* from the serpent's glands, and all the symptoms to such changes. To explain: there is little if any difference, chemically, between starch and sugar; but, physically, they are very different; little difference, chemically, between fibrine and albumen; physically, they are very different. But both starch and fibrine are rendered soluble by the addition of minute particles of germinal matter: in the first case, from the salivary glands; in the second, from the stomach. True, with the latter is combined an acid, but without the pepsine cells no digestion takes place, and, what is very remarkable, a very minute quantity is able to convert a very large quantity of fibrine into albumen, so long as the mixture remains acid; the pepsine cells require no renewal, since, for want of a better explanation, they are said, by their mere presence, to determine the conversion. A little spittle from a man's mouth will change starch into sugar within one minute. These things being true, is it unreasonable to claim for the secretion of another closely allied gland to the salivary, an equal power in another direction? What the changes produced in the blood are we do not yet fully know; but

* The germinal matter consists of nuclei $\frac{1}{1000}$ inch diameter. The fluid is either slightly acid or neutral.

that which in healthy blood is called fibrine is diminished, digested if you will, in the presence of serpent's venom. If the quantity of venom entering the circulation is great, the changes are greater, and the chances of recovery less. If the animal is small, his chances are still less; if it depends much upon oxygen with a naturally highly fibrinous blood, rapid circulation and absorption, it soon falls a victim. Thus a bitten bird falls in a few minutes from a twig to which it has hopped, to the waiting reptile beneath. Hence the old stories of snakes charming birds. If the animal be in a great degree indifferent to oxygen, *i. e.*, can live for a long time under water, in carbonic acid gas, as a reptile or hibernating animal, with correspondingly slow circulation and absorption, its chances of recovery are greater; it is naturally more indifferent to the presence of venom, and the probability of absorption from a wound is much less.

But, it may be said, the symptoms of snake-poisoning come on too soon for such changes in the blood to be produced; but recollect the nearly instantaneous action of pyraline. Again, if venom enter a vein, one minute will certainly suffice for its entire circulation through the body. Estimating the quantity of blood in the body as 12lbs., and the contents of the left ventricle as 3ozs., then the whole mass of the blood would be circulated by 64 heart-beats; and, taking the normal beats at 75 per minute, this quantity of blood would pass through the heart, carrying with it the imported venom, in 51 seconds. In June, 1866, I showed by experiments that dyes, such as magenta, may be absorbed from the serous cavities, peritoneum, and pleura, and from the subcutaneous connective tissue, and traverse the circulation, and be excreted by the kidneys, and ejected by the bladder, under five minutes. The experiments were made on dogs and fowls. Lately, Drs. Macnamara and Haughton have found iodine pass from the tunica vaginalis testis, and to be discharged by the bladder in four minutes; therefore, in man symptoms of poisoning may certainly be possible in five minutes, in birds in half that time.

Believing, then, that in the blood itself the chemical changes occur which have their resultants in voluntary and reflex acts (will, motion), and in animal heat, let us turn to the condition of our snake-bitten patient. He is usually pale, with a great tendency to sleep, the heart's action is feeble, and in some cases deep coma ensues, from which it is difficult to arouse him; in fact, the countenance is like that of an epileptic after the convulsion. Do not the pallor and

drowsiness indicate an anæmic state of the brain, or rather a diminution of the arterial capacity and extension of the venous surface analogous to that which takes place in a less degree in ordinary sleep, according to the researches of Mr. Durham? In all of the cases brought before you this evening, the functions of the cerebral ganglia and higher sensorium were completely in abeyance, or for a time extinct. Dead the sufferers were to both sound and light, and to this hour they have no knowledge of the injections to which they were subjected. Now it is worthy of notice, that recent views ascribe the phenomenon of sleep to the using up of the previously stored-up oxygen in the blood, analogous to the views I propounded in June 1867, for the accession of sleep in cases of snake-poisoning.

There is yet another symptom of snake-poisoning, which deserves the greatest consideration; I allude to the condition of the pupil. It is that of extreme dilatation, depending, as I believe, upon the condition of the central optic ganglia. Light is pouring into the eye-ball, and yet no reflex acts are produced. An exactly similar condition affects the auditory ganglia, vibration after vibration shocks the tympanum, each falling silently upon the central ganglia.

Sometimes this condition of the sensory ganglia, including probably the corpora striata, optic thalami, and corpora quadrigemina, exists whilst the higher cerebral ganglia either remain a long time unaffected or escape entirely; in the latter case, recovery resulting; in the former, constituting a most dangerous state, and one that should make the physician very anxious, more especially when accompanied by swelling or pain in the neck. From the details of cases I have read, I should fear these symptoms more than the deepest coma. I was very pleased to see, however, that in Dr. Bennett's case 19, the symptoms yielded to the injection of Ammonia. Our esteemed fellow-citizen, Mr. Clement Hodgkinson, thus records in the *Herald* his own experiences, after having been bitten in New South Wales, showing the dullness, if such a term may be used, of the central, and immunity of the higher, ganglia. He says: "There was insensibility to the effect of pungent salts when held to the nostrils, and to pinches inflicted on me by some of the lookers-on, who desired to thereby prevent me from falling into a comatose condition. There was also deprivation of sight. About two hours after I was bitten, this symptom attained its greatest intensity, and I was then scarcely able to distinguish the features of the persons near me." Mr. Hodgkinson, we all know, is no ordinary

man, and I have no doubt his intellectual activity, or will, contributed to save him. Poor Mr. Drummond was conscious to the last, sight and feeling having been for some time deficient. His force of character contributed greatly to prolong his life. I may be better understood, if I contrast them with men of an opposite class. The Hindoos, with will so pliant, or character so impressible, as to be drawn into the mesmeric state with ease; bitten, they soon die, yielding without an effort to avoid their fate.

The treatment that I have recommended is that of injecting dilute Ammonia, say, at the least, 30 minims of the Liquor Ammonia, B. P. sp. gr. .959 into a superficial vein. If properly injected, the vein having been first exposed, and its coats pierced with the nozzle of the hypodermic syringe, the alkali soon reaches the heart, vigorous contractions follow, blood that was recently stagnating in the capillaries passes on, cut vessels which had ceased bleeding bleed afresh, the temperature rises, the colour improves, the muscles contract, the sensory ganglia respond to external impressions, the nearly or quite inanimate mass is now animate. Light and sound are perceived, the faces of friends are recognised. This is no exaggerated picture, but such as I have myself witnessed in dogs (the central organ being exposed, and artificial respiration kept up for an hour) recovering instantly from the stupor of chloroform. I have also repeatedly pierced the heart itself, and there injected the Ammonia, with similar good and no bad effects. I have witnessed the same restoration to consciousness in the station-master at Elsternwick (Case No. 2), and can call to your recollection the same startling assertions from all parts of the colony. Thus, Dr. Dempster's words are: "It affected him at once; he woke up, and became sensible." Dr. Barnett says: "In a few minutes she began to recover from the stupor, and became so excited as to be held down on her bed." In Mr. Lane's case, verified by my friend Professor Wilson, the pupils began to contract, and consciousness return in a few seconds, certainly under a minute. Dr. Rae, of Bacchus Marsh, assured me he thought his patient dying, and yet—not believing then in this remedy—he injected, and within a minute consciousness returned, and in about ten minutes the man walked into the open air unassisted. Dr. Langford says: "Having used the injection three times without effect in the case of the boy Piggins, I used it in this case (No. 14) with the full expectation of failure, and was never more surprised than when I saw my collapsed patient rise up and walk away." Mr. Dallimore, writing to the *Age*, about Dr. Dowling's case,

says: "When I went to see the man while under treatment, I was quite as sceptical of the Ammoniacal injection as the contributor to the *Medical Gazette* appears to be; but its action is so startling, I may say so magical, that if a man on seeing it could not be convinced, he must be singularly constituted." In Dr. Meyler's case, the woman being in a comatose state, was roused to consciousness in half a minute. Dr. Meyler has since written to me on this subject: his words are: "The treatment in Mrs. Parker's case was not only decidedly successful, but exceeded my most anxious hopes, and finally removed any lurking doubts that may have lingered in my mind," and so on of others. But let us bestow the short time that is left, for the paper is already too long, upon considering the *modus operandi* of the remedy.

The remedy, then, is Ammoniacal Gas in solution, an old and favourite one for snake-bite the world over; but instead of putting it into a stomach, the stagnating vessels of which cannot absorb—for all the brandy and ammonia poor Mr. Drummond took were afterwards found in the stomach and intestines, and so no doubt of others—I inject it into the blood itself; the gas, experiencing a rise of temperature, expands, and presently is in direct contact with every tissue in the body, the capillary walls alone intervening—in fact, it becomes both a central and peripheral stimulus, so powerful that as yet no soporific tendency has counteracted it; none of the comatose states of snake-poisoning have failed to be removed by it; but, as its power is expended fresh supplies must be brought. It does not act as a transitory stimulus to the heart, it maintains vigorous pulsations for at least twenty minutes or more, frequently requiring no repetition. Its presence in the nervous system and muscles is shown by the resulting animation; there is also a rise of temperature. It is presumable, therefore, that oxidation is going on in the blood, where before there was little or none; that the abnormal molecular changes going on in the blood are arrested; that electrical action results; and that the capillaries of the muscular system, the whole body over, are inducing to form heat or excite motion—the wheel of life is turning again, so lately on the point of stopping—for the muscles are now recognised as nothing but machines for the conversion of heat into motion; the determining and directing power residing in the nerve tissue; the fuel in the blood. It might be asked, Is it possible that the Ammoniacal Gas, under the influence of electric forces within the body, may be decomposed, that its hydrogen and the active oxygen in the blood may be condensed to form water? If so, the quantity of hydrogen

contained in one half-drachm syringe would yield heat which, by transformation into muscular energy, would enable the patient to raise his own weight his own height. But, indeed, we know little of the molecular actions and reactions taking place in living organisms, and it is difficult to say what is the destiny of Ammonia thus introduced into the blood. But it is also as difficult to trace its functions in, and depositions from, the sap of plants; and yet we know that it stands in as important a relation to both plants and animals as heat itself. It is the source of all the nitrogenous elements of both, the reactions between which and the external forces constitute life. Thus much, however, we can say, viz., that just as the sounds emanating from a musical box are the result of a force communicated from without, so are the signs of animation proceeding from a patient previously insensible, as in these cases, the result of a force communicated from without, potential in the syringe, active in the body.

The lessons we have learnt from those who have used this remedy and have sent their cases for publication to me, are that a good battle must sometimes be maintained ere recovery ensues. As with every other remedy, the amount required must depend, be judged of, by the effect produced; the great fear is that too little, rather than too much, will be injected. *The greatest care should be used that none of the Ammonia is spilt, or sloughing will follow*; but if the canula of the syringe be properly introduced, and the injection be forcibly made so as to mix the Ammonia immediately with the blood, I believe none will follow. A little inflammation may result, but what of that if the patient be saved?

As symptoms of recovery instantaneously follow the use of Ammonia in this way, we are saved the prolonged anxiety attending former treatments.

Objections have been made to the value of this treatment, on the supposition that Australian snakes are not venomous, or at least not dangerously so. Now the cases brought forward to-night are a sufficient refutation of such errors. I find, from public records, that in some instances our snakes are as dangerous as those of India, and certainly quite as deadly as the rattlesnake. Thus Underwood, a snake-charmer, was bitten at 7-30 p. m., and was dead by 8-30 p. m.; this is in one hour. Cartwright, another exhibitor of snakes, was bitten some time after 3 p. m.; by 3-30 p. m. he was insensible, with fixed, dilated pupils, and at 4 o'clock was dead; that is within one hour. One case has been communicated to me by Mr. Casey, Surgeon, of Mel-

bourne, of death within half-an-hour. There are many cases on record of death considerably within twelve hours, and to live beyond twenty-four hours is rare—that is, when the case ends fatally. And, indeed, except in size and length of fangs and quantity of poison, the cobra differs little from our tiger-snake (*Hoplocephalus curtus*), which, like the cobra, erects itself, dilates the neck, and, in confinement or at bay, is very vicious. *Hoplocephalus superbus*, another beautiful species, is exceedingly dangerous. This is popularly called the diamond snake, just as in many parts the tiger-snake is called the carpet snake; but both the true diamond and carpet snakes are harmless. Next, we have the common brown snake (*Diemenia superciliosa*), which, although it does not expand the neck like the cobra is yet, according to Professor M'Coy, in size and structural affinity closely allied to it. The bite is very deadly. The black snake (*Pseudechis porphyriacus*) is also very common in some parts and very deadly. It, according to Mr. Gerard Kreft, of Sydney, "raises about two feet of its body off the ground, flattens out the neck like a cobra, and then darts at its prey or enemy." The same authority states that animals, such as dogs and goats, die usually within one hour from the bite of any of the above species. I have experimented chiefly with the tiger-snake (*Hoplocephalus curtus*) and have obtained the same results; but in one instance one of my tiger-snakes killed a dog in seven minutes. I have inoculated with the poison of all but the black snake, and find them equally deadly.

Further, I feel certain, from my own actual experiments, that equal amounts of poison from either American, Indian, or Australian snakes are equally pernicious, if introduced into the blood. Thanks to Dr. Weir Mitchell, of Philadelphia, whose essay* should be read by all students of this subject, I have examined minutely rattlesnake poison. I find tiger-snake poison exactly like it, acting similarly in the presence of the following agents, viz., nitric acid, hydrochloric acid, sulphuric acid, acetic acid, tannic acid, ammonia, and alcohol. Both cobra and rattlesnake poisons act similarly on the blood; the same fluidity results, with the same *post mortem* production of multitudes of large and maculated white cells. This I have repeatedly verified; and if others cannot see these enlarged cells, it is no fault of mine. I have shown them to many who could not see them, while they were all the time under their eye, and yet many were good microscopists. I find also that, by inoculation, dogs die as

* "Researches upon the Poison of the Rattlesnake"—Smithsonian Contributions to Knowledge, vol. xii.

rapidly from tiger-snake poison as from either of the other two; but the local symptoms are from the cobra and rattlesnake bites severer than from that of our Australian snakes. The general symptoms, however, are the same. Of the man bitten a few years past by a large cobra in Melbourne, Mr. Fitzgerald says: "Five hours after the accident, I found him in a state of stupor; pupils dilated; the extremities and body were colder than natural; the power of speech was lost." Now these are the symptoms of nearly all the cases detailed this evening, which symptoms were dissipated immediately on the injection of ammonia. I do not say they will be similarly dissipated in every case of cobra poisoning, or even of tiger-snake poisoning; but in the majority of cases it may be expected that they will, for what has happened seventeen times in Victoria, may certainly happen as many times again, or oftener, in India or in America. As yet I have seen no account of the injection of ammonia into the veins of men in India. In London, Dr. Tyler Smith used it with the best effects in puerperal fever (blood-poisoning).

Such, Sir, are the observations I have found it my duty to address to this Society. Much more I might have said, but I have limited myself principally to a detail of cases which, I believe, cannot be controverted; and I have to thank those gentlemen who have so kindly and fully communicated to me facts upon which this paper is based, and I sincerely hope, when this is read by them in their scattered and isolated districts, it may be to them a satisfaction.

In the discussion which followed,

The President said, that for some reason or other, Professor Halford had scarcely alluded to the article in the *Lancet*, in reply to which, as they had been informed by circular, he had prepared his paper. He, the President, nevertheless, considered it his duty to make a few remarks in reference to the unjust manner in which Professor Halford had been treated by the leading Medical Journal of England. He was, indeed, unable to understand how a scientific organ of such standing as the *Lancet* should have admitted into its columns statements which it must have known, or ought to have known, to have been untrue from the beginning to end. The Professor was accused of having taken credit for two discoveries, one of which, viz., ammonia, as an antidote to snake-bite, was no discovery at all, and the other of which (the method of treatment by injection) was one of the oldest methods of therapeutics. Professor Halford, however, had never asserted that ammonia was an antidote in snake-poisoning, in a chemical sense of the word, but he simply argued that, if

ammonia had really a beneficial effect in these cases when taken by the mouth, as had been generally assumed, it would exert its influence upon the system much more quickly, and in a much higher degree, when introduced directly into the circulation. He, consequently, instituted a series of experiments on animals, and it was on the strength of the satisfactory results he obtained that a number of independent medical men, whose veracity nobody had a right to doubt, injected ammonia into the veins of patients suffering from snake-bite. Every one, without prejudice, who read the cases as reported by these gentlemen, could but arrive at the one conclusion, that in most of the cases life had been saved through the agency of the Ammonia injections. They knew very well that transfusion of blood had been practised occasionally, and that water containing the saline constituents of the blood had been injected in cholera; but, hitherto, it was always understood that the injection of remedies directly into the circulation was fraught with the greatest danger. He, the President, was not aware that, previous to Professor Halford's experiments, Ammonia had ever been injected into the veins of the human subject; that this, however, could be done not only with impunity, but in poisoning from the bite of snakes indigenous to these colonies, with most favourable results, was a fact for the knowledge of which society was indebted to Professor Halford. In the case of Prussic Acid poisoning, moreover, which occurred the previous week, the remarkable effect of the Ammonia, although injected only a considerable time after the poison had been taken, strongly pointed to this mode of treatment in all those cases of poisoning in which stimulants were indicated.

Mr. LANE said,—It is not my intention, Mr. President, to make any remarks on the nature of the action of Ammonia when injected into the circulation.

Nevertheless, as one of the cases of snake-poisoning mentioned in Professor Halford's paper came under my care for treatment, I may be permitted to state to this Society a few particulars respecting it.

When brought to my house, four hours after the injury, the boy was completely insensible to the almost brutal treatment of his attendants. He was placed on a sofa in this insensible condition. The eyes were fixed, and the pupils considerably dilated. Two punctures were visible in the left leg, from each of which blood had been oozing. I now injected ten minims of the *Liquor Ammoniae Fort.*, mixed with

twenty of water. In ten minutes he answered questions, and in half-an-hour he walked into an adjoining room, and completely recovered.

Now, Sir, I can well understand that persons not belonging to the profession, on seeing a man dying (as they supposed), and in ten minutes hearing that man answer questions when put to him, and in another twenty minutes walking into an adjoining room, may well be excused if they stagger at their previous belief in the existence of the bite. But, on the other hand, when members of the medical profession (men value), after witnessing such a condition, and seeing for themselves the subsequent effective restoration by the injected Ammonia, deny and denounce its efficiency, I simply should doubt their veracity; for I should consider that they were influenced by premeditated prejudice or determined obstinacy.

Dr. THOMAS said that Professor Halford had adduced a sufficient number of cases to establish the fact that Ammonia may be injected into the veins of man and the lower animals with impunity, and, in cases of snake-bite, with the advantage of saving life. Transfusion, we all knew, was not new; no one pretended it was so—it had been practised for ages. He (Dr. T.) had, some twenty-five years ago, performed it in the case of a lady who was sinking from hæmorrhage. Some blood of an attendant was injected into the patient's vein. She rallied for a short time, but expired before the lapse of many hours.

Nearly all the cases recorded by Professor Halford were those of patients under the care of different medical men, living far and in opposite directions from each other. The results of the injection were in each case of great similarity, and were of great value. Such testimony was not that of a man "riding his hobby," but of a number of skilled, intelligent practitioners.

He was glad that Professor Halford was now of opinion that the globules, which he formerly considered as foreign cells, were white blood corpuscles, altered in size according to the density of the fluid in which they floated. That was his (Dr. T.'s) opinion when he first examined the blood of dogs which had died from snake poison, and he expressed it at the meeting of the Royal Society, when the Professor read his first paper on the subject.

There was one remark he should wish to make. It seemed to him that snakes were more numerous now, and their bite

more fatal, than they were many years ago; for during his practice, extending from 1839 to 1852, which was very extensive, he was not aware, at the very outside, of more than half-a-dozen cases, and not one had a fatal termination. The few whom he attended, he recommended stiff and frequent doses of brandy until intoxication was induced. Could the increase be attributed to the extinction of the black race, and the disappearance of the laughing jackass from the populated districts.

He for one was not aware that Ammonia had been injected into the veins before the Professor had done so, and he thought that great credit was due to Professor Halford for having instituted a theory which so many medical men had reduced so successfully into practice. Soubeiran, in 1832, discovered chloroform, but Professor Simpson discovered its anæsthetic properties. Ammonia had long ago been discovered, but only Professor Halford found out that it could be injected into the blood, and that, when so applied, it counteracted the effects of snake-poisoning. Simpson everywhere ranked as a discoverer, and so must Halford.

Dr. McMILLAN remarked, that during the reading of this interesting paper, he had been struck by the remarkable degree of *uniformity* in the results obtained by the injection of Ammonia into the veins in cases of snake-bite; and he considered that this circumstance alone enhanced the value of the testimony, and should go far to convince, even the most sceptical, as to the efficacy of this remedy when applied in the manner proposed by Dr. Halford. Dr. McMillan further remarked, that in connection with this subject it might be well to estimate more accurately the therapeutic value of alcoholic stimulants when exhibited as a remedy in snake-bite. It had been shown by Dr. Halford, that when the circulation was languid, and the nervous system prostrated by the shock, that alcoholic fluids were not absorbed, but that they remained accumulated in the stomach and intestines. Hitherto, people had been accustomed to trust very much to stimulants of this class; and, if it could be shown that they possessed comparatively little value in arresting the fatal tendency of the snake virus, it might lead to a more prompt and general adoption of that which had alone proved worthy of confidence as a remedy in snake-bite. We all remembered that in our class-teachings on this subject, much stress used to be laid on the importance of *topical* treatment. We were told to excise the part; to make an incision, and cause the current of blood to flow outwards, that it might carry the poison with it. We were even told that we might

apply our mouths, and suck the part; with the same end in view, to apply Ammonia to the wound, Nitrate of Silver, &c. It appeared, however, from the evidence adduced in this paper, as well as from the numerous experiments made by Professor Halford, that the poison entered the current of the circulation with such rapidity as to render all local treatment vain and useless.

In reply, Professor HALFORD stated, that he could not enter into controversy with anonymous writers who were either untruthful or ignorant. He had neither the time nor the inclination to do so. The subject was one in which no disguise was required. A great series of experiments on apparently dying people had been done, all over the colony, at all this time on his trial; for had the results been different—had death in any one case been attributable to the injection of Ammonia—there would not have been wanting those to upbraid him. Nothing but a continued series of experiments had led him to suggest this treatment, and he had done it conscientiously, and therefore fearlessly; at the same time, he was aware that it had struck the majority of medical men as a most dangerous and unwarrantable proceeding. To throw into a vein a fluid too caustic to spill upon the tissues or put into the mouth seemed madness. He had never said that Ammonia destroyed the poison; on the contrary, he had long ago stated in *The Argus* that, when the strongest Ammonia was added to snake-poison, and the mixture injected beneath the skin of a dog, all the symptoms of snake-poisoning resulted as regularly as if the poison had been untouched. Dr. Weir Mitchell had previously found the same to be true of the poison of a rattle-snake.

As regarded the exhibition of spirits, he did not believe that, when the dose of poison was large, they *could* act beneficially. They were either rejected, *i. e.*, vomited, or, on account of the depressed condition of the circulation, not absorbed. He had heard many say, "Give spirits so as to make the patient drunk; if you can do this, he is saved; if you cannot, he will die." To his mind, this proved that in the case of patients getting drunk the spirits were absorbed, and therefore the cases not so dangerous from the commencement, and doubtless the spirits were beneficial. But when the patient could not be made drunk the original danger was greater, and no absorption of the spirits took place. It had been in such cases that the injection of Ammonia was so serviceable, urging on the stagnating

streams of life, and leading to recovery. Dr. McMillan had somewhat misunderstood him as to the value of excision. True, if the poison had entered the circulation, little or no good could result from local treatment; but, in the majority of cases, time elapsed before the virus entered the blood, for all punctures were not directly into the veins. Therefore, in all cases, cut out the part at once, rather than neglect it. A glance at Dr. Dowling's case, and at many others which were recorded, would show this. He said, Don't give the poison a chance; if possible, get rid of it at once, rather than fight it afterwards with Ammonia or any other remedy. This was clearly our duty.

In conclusion, he hoped the profession would remember what he had recorded in the *Medical Journal* of last November, viz., the facility and safety with which the Iodide and Bromide of Ammonium and drachm doses of Sulphurous Acid could be thrown directly into the veins. He had also injected as much as four grains of pure Carbolic Acid, dissolved in thirty drops of Glycerine, into the blood of dogs, and repeated it several times. Each injection was followed by clonic spasms, severe or mild in proportion to the dose used, but soon passing off, and perfect health remaining. Those who believe in the germs of disease being in the blood, and that Carbolic or Sulphurous Acid could destroy them, might think over these facts.

Dr. AUBREY BOWEN, in proposing a vote of thanks, remarked that Dr. Halford, in defending himself from the unfair and somewhat personal attack made upon him in the *Lancet*, was not only doing so for himself, but for by far the greater part of the medical profession in Victoria, who had in a very marked manner concurred in giving due credit to Dr. Halford's exertions; and he considered that in recapitulating and reviewing his experiments on the influence of the direct injection of Ammonia into the veins, he had most satisfactorily refuted the aspersions cast upon him.

APPENDIX.

Further Observations on Snake-Poisoning. By GEORGE B. HALFORD, M. D., Professor of Anatomy, Physiology, and Pathology, in the University of Melbourne.

[Read before the Royal Society of Victoria, 27th August 1868.]

In former papers communicated to this Society, I have dwelt particularly on the vast numbers of white cells seen in the blood after death from snake-poison. Subsequent and repeated observation have confirmed my original description equally of the growth, size, and maculated condition under the influence of magenta of these bodies; but lately my friend Mr. Ralph, Surgeon of Kew, near Melbourne, has discovered a nearly similar condition of blood in animals poisoned by prussic acid. I have confirmed his observations, and most probably such bodies will be found and arise wherever after death coagulation of the blood does not take place. The whole subject, therefore, requires reconsideration. The facts are as I stated, but possibly have relations hitherto unknown to me.

From the first I stated these white cells arise in a structureless molecular matter, nucleus first, cell-wall after; and that in some manner they took the place of what is called fibrine, and, further, that the higher the thermometer for the time being, the more numerous and larger were these bodies.

The changes, therefore, take place when the blood is stagnant, but still retained within the veins.

Now it is fortunate that I can direct the attention of this Society to some other phenomena in the growth of cells as observed by Dr. Onimus and recorded in the "Journal de l'Anatomie et de la Physiologie," 1867, and just received in Melbourne. He disbelieves in the doctrine of Virchow that *omnis cellulae cellula*, and holds that *cells arise in an amorphous blastema*.

This agreeing with the origin of the white cells I have described, let us follow Dr. Onimus in his experiments and conclusions.

The fluid from a recent blister was filtered so as to obtain a fluid containing no kind of form, neither white corpuscles

nor epithelial scales. This fluid was enclosed in small tubes of gold-beaters' skin, and placed beneath the skin of a live rabbit.

After two hours—the serum was still transparent, although it had lost its primitive citrine colour. In it were seen a few white cells and granules.

After 24 hours—the serum was turbid, and contained a great quantity of white cells and granules.

After 36 hours—the serum was quite white, milky, and composed entirely of white cells and granules. The white cells having all the characteristics of white corpuscles of the blood.

Increase of animal temperature aided the production of the white cells.

No white cells nor any sort of anatomical element was formed in the serum of blisters, from which the fibrine had coagulated.

The presence of white cells artificially added to serum from which the fibrine had separated, had no effect in causing further development of white cells.

It is certain, therefore, there is some relation between the growth of white cells and those elements which by their separation from the liquor sanguinis constitute fibrine.

It will be remembered that I referred all the morbid agency to the microscopic germinal matter found in snake-venom, and not to any fully formed cells. Dr. Onimus observes that in infectious diseases, miasmatic or virulent changes are not found on the side of elements having form, but in the composition and properties of the plasma. The white cells of the virulent pus of a chancre resemble those from a healthy sore; it is in the serum that search must be made for the difference in the properties of the two purulent fluids.

It is, however, possible, that with increased microscopic power, and more time for such labors, modifications of form and property may even be recognised in the molecular matter of serum.

Now, it has been maintained by some, and by Dr. Weir Mitchell, of Philadelphia, whose writings on snake-poisoning deserve and have my willing respect, that nothing like germinal matter exists in snake venom. I cannot agree with him.

But I have always stated it exists in a very microscopic form, and that to this minute elementary germinal matter the activity of the venom is due. Since this was stated by me, similar conclusions have been arrived at by M. Chauveau (Comtes Rendus, 1868), of the nature of the vaccine virus, which he describes as consisting of—*first*, the serum, an albuminous fluid, holding the various soluble substances in solution; and, *secondly*, the solid elements, consisting of white cells and of elementary granules, both of which are suspended in the serum.

After separating the white cells, the remainder was as virulent as ever, and the clear serum was found to be harmless; but in the elementary granular matter dwelt the activity of the virus.

I hope this short and imperfect communication may induce others to think on the correlation of the animal poisons.

Experiments performed with the assistance of Drs. NEILD and WOOLDRIDGE, to show the action of Ammonia upon the central organ, and that it may not only be injected into the veins, but into the heart itself, without injurious effects, and also that it counteracts in a most powerful manner the lethal influence of chloroform.

EXPERIMENT I.

A large young dog was got under the influence of chloroform; the front of the chest was removed and artificial respiration maintained; chloroform being occasionally dropped into the bellows.

11-27 A. M.—Half a drachm of Liq. Ammoniae B. P. Sp. gr. 0.959 was injected into the left external jugular vein. The heart's action was at once accelerated, but soon settled down to steady pulsations.

11-35 A. M.—Half a drachm more was injected into the right ventricle. Immediate increase of the heart's action ensued. Consciousness returning, as evidenced by the reflex movements of the eye-lids, and by a withdrawing of the leg on pricking the foot. Pulsation powerful and steady.

11-45 A. M.—Completely conscious, struggling to get up. More chloroform was poured into the bellows. Soon became insensible again.

11-50 A. M.—Half a drachm was injected into the left ventricle. This was almost immediately followed by a contraction

of all the muscles of the body, which soon subsided. Heart's pulsation very vigorous.

11-53 A. M.—Dog returning to consciousness; more chloroform poured into the bellows. Soon again insensible.

12 noon.—Half a drachm more injected into the left ventricle. The same increased pulsation, followed by slight universal spasm as before.

12-2 P. M.—Dog quite conscious and struggling; more chloroform poured into the bellows.

12-11 P. M.—Dog again conscious and struggling; more chloroform poured into the bellows.

12-13 P. M.—Again quite insensible, pupils dilated, &c.

12-17 P. M.—Half a drachm more Ammonia was injected into the right ventricle. Heart pulsated forcibly, the same general spasm following.

12-22 P. M.—Dog again conscious; more chloroform by the bellows.

12-26 P. M.—The dog being again quite insensible, I injected half a drachm more into the right jugular vein. In ten seconds the heart's action was increased, the same general muscular spasm following. Sensibility returning as shown by the reflex acts of the eyelids, &c.

12-33 P. M.—Quite conscious and struggling to get up; more chloroform in the bellows; soon again insensible.

12-36 P. M.—Half a drachm more injected into the left ventricle. Pulsations immediately increased, followed by the same general spasm, but in a milder degree.

12-40 P. M.—Heart's action powerful and steady; pulsations good all over the body.

12-43 P. M.—Dog again quite conscious; more chloroform given; soon insensible.

12-48 P. M.—One whole drachm was injected into the left ventricle. Heart's action immediately quickened, followed by the general spasm. Reflex action of eyelids returning.

12-57 P. M.—Dog quite conscious, and struggling hard to get up, he seeming to have as much vitality as ever, and a sufficient trial having been made, the heart was cut out and an end put to the experiment.

On examining the cavities of the heart, there was not the least trace of irritation or inflammation, and the punctures through the muscular substance were scarcely visible. The vigour and persistence of the heart's contractions after remo-

val from the body were greater than I had ever before witnessed.

EXPERIMENT II.

Another large dog was chloroformed, the front of the chest removed, and artificial respiration maintained for one hour and twenty minutes, during which time the heart's movements were carefully observed. As in the former case, the injection of the Ammonia had the effect of continually rousing the dog from the full influence of the chloroform, necessitating always a further supply of the anæsthetic before another quantity of Ammonia was used. In this dog both jugular veins once, the right ventricle once, and the left ventricle three times, were injected with half drachm doses of Liq. Ammonia B. P. Sp. gr. 0.959. The results were precisely similar to those noticed in the other dog, viz., immediate increase of the heart's pulsations, settling down into steady beats. The same muscular spasms followed by returning consciousness, and lastly the same absence of any visible injury to the heart's cavities or walls.

ON THE INJECTION OF AMMONIA INTO THE VEINS.

BY G. B. HALFORD, M. D., F. R. C. P., London.

PROFESSOR OF ANATOMY, PHYSIOLOGY, AND PATHOLOGY IN THE MELBOURNE UNIVERSITY.

ON Wednesday evening, April 7, 1869, I detailed to the Medical Society of Victoria the results of some experiments I had performed, with the assistance of Dr. Neild and Mr. Wooldridge, showing that within one hour and a half as much as four drachms and a half of the Liq. Ammonia B. P. Sp. gr. .959 might be injected into the veins, and even into the heart of dogs completely narcotised with chloroform, with the effect, at each injection of 30 minims, or even 60 minims, of restoring the animal to thorough consciousness and apparent original vigour. When the animals were subsequently killed, no injurious effect could be discovered in any organ of the body—the punctures into the ventricles even not being visible. I, therefore, suggested that in over-prolonged narcotism from chloroform, and in threatening syncope, the injection of ammonia might be used, in the case of syncope, by injecting into the external jugular, or with a proper instrument, into the heart itself.

My detractors in this colony have seized hold of a statement made by Dr. B. W. Richardson, of London, in a lecture printed in the *Medical Times and Gazette* of July, 1870, which is as follows: "It has been hoped to neutralise the physiological action of chloroform by injection of antidotes into the veins. I tried the injection of ammonia into the veins as far back as the year 1854, and, although the injection excited the heart, it did not offer any material advantages."

I had duly read this on receiving our Journals last October, and should have let it pass unnoticed, had it not been recently used against me. I am bound now to examine it and comment upon it carefully.

Now, as Dr. Richardson and myself have ever been the best of friends, and as he has no greater admirer than I, it becomes me to deal with this sentence with the utmost care; and in doing so I shall quote his own words of 1858, and show that what he then believed, and what I too believed, of the effects of ammonia on animal life, was error; and that, so far as I

can find, his experiments of injecting ammonia into the veins, to counteract poisoning by chloroform, have never been published, and I think must really have been forgotten by himself in 1858. I have never heard of them. It will be seen further on why I should have heard of them. But I did not, and that it is which perplexes me, and makes so contradictory his published words of 1858 and 1870, seeing that in 1858 there was an absolute necessity for his alluding to the subject. But, so far as I can find in his writings, he is silent on this point, having only used a small quantity of ammonia to retain the fluidity of the blood during the operation of transfusion. In the appendix to his work *On the Cause of the Coagulation of the Blood*, page 440, he says: "In cases where danger arises from the administration of chloroform, I have seen the patient made to breathe ammonia vapour, not as a mere excitant to respiration (for in this sense it may be used legitimately with due care), but as a supposed general restorative. As the effects of ammonia in a large dose are, however, the same as those of chloroform in their leading particulars, the free introduction of ammonia into the narcotised patient is the addition of one volatile narcotic to another volatile narcotic."

Nothing is here mentioned, it will be seen, of injecting ammonia into the veins. When ammonia really enters the blood it is not a volatile narcotic at all. The fact is, the inhalation of the vapour of ammonia, except extremely diluted, is incompatible with life, not because it enters the blood, but from its interference with the necessary respiratory changes needed in that fluid. Its action as a sudden poison when given by the mouth is due to its deleterious effects on the tissues, and very probably through direct continuous stimulation of the peripheral twigs of the pneumogastric, causing the reflex opisthotonos mentioned by Dr. Richardson at page 113 of his work; for, most certainly, the dose that will produce death when given by the mouth will not produce it when thrown directly into the blood. Therefore, it must kill by its influences before it reaches the blood. This was the origin of my suggesting its direct administration in snake-poisoning, &c. It is the same in slow poisoning with ammonia; there are other elements to be considered besides the blood, which, the organs being healthy, is soon purified of any ammonia that may reach it. Of course, if, as at page 114, ammonia is given to a dog in doses of from five to twenty grains of the Bicarbonate for upwards of a month, and for the last few days in increased frequency and

dose, death will result, not from the presence of ammonia in the blood, but from impairment of function and destruction of tissues. The *post mortem* revealed it. I allude to these things because I wish my readers to understand the advantage that may result in some cases, by avoiding the ordinary portals to the blood-current, *viz.*, the lungs and stomach. Thus seven grain doses of Carbolic Acid, mixed with Glycerine, I have thrown into the veins of dogs, this large dose being only followed by temporary clonic spasms, from which the animal soon recovers. Now it would be impossible to give this by the mouth—it is an actual caustic. Again, more remarkable still, Sulphurous Acid cannot be given in any large dose by the mouth, and if given, most probably never reaches the blood, and yet, in the space of two hours, I have thrown as much as six fluid drachms of undiluted acid into the jugular and femoral veins of dogs, without causing the least distress. This may be regarded as a digression, but it very forcibly shows the advantage of the direct injection of certain remedies, as in the case of Ammonia, over that by the mouth, and the different results that are produced.

I now proceed to extract entire, commencing at page 448 and ending page 452 of the same work, the section which concerns me chiefly. I shall make no additions to, or subtractions from, it, merely introducing a few running remarks. The extract is headed in the work,—

Application of Ammonia to the Operation of Transfusion of Blood.

"Since the time when Lower first performed the experiment of transfusing the blood of one animal into the vessels of another (1666), and Denys, of Montpellier, gained unenviable notoriety for pushing this operation into practical operation with too much enthusiasm, it has been felt a difficulty in the steps of the operation to hold the drawn blood fluid for a time sufficiently long to secure its free transfusion into the animal body. It is true that several ingenious instruments have been devised, which in some measure meet the difficulty, but not effectually. In this section I shall show that the cautious addition of ammonia to the drawn blood answers every practical purpose for sustaining fluidity, and for simplifying the operation.

"EXPERIMENT CCCCVII.—TRANSFUSION OF BLOOD.—On one occasion I had in my laboratory twenty ounces of sheep's blood held fluid by a solution of five grains of ammonia in a

"drachm of water. The blood had been kept fluid, for several
 "hours, in a closely stoppered bottle. I had placed a dog
 "under the influence of chloroform for an intended operation,
 "when I perceived that the heart was stopping from the
 "effect of the narcotic. I instantly laid open the external
 "jugular vein, and blood escaped copiously; but, neverthe-
 "less, death took place. Prevented from following out the
 "original operation, I thought it would be interesting to see
 "how the sheep's blood would run in the vessels of this
 "animal. I therefore warmed a portion of it to 98°, put a
 "tube into the jugular vein, and injected four ounces with the
 "greatest ease. I then laid bare the common carotid, and
 "performed the same experiment with equal facility. The
 "facility with which the operation was done suggested the
 "plan of transfusing blood into a living animal after a similar
 "manner. I have now performed this operation several times
 "with excellent results. As examples, I shall give two repre-
 "sentative experiments; the one showing the dangers which
 "are to be avoided; the other, the operation as it may be
 "safely practised.

"EXPERIMENT CCCCIII.—TRANSFUSION OF BLOOD.—I laid bare
 "the jugular vein of a healthy dog, and drew from it into an
 "evaporating dish two ounces of blood, in which were four
 "grains of ammonia, with a drachm of water. The blood
 "was set aside for a brief interval. Next, I drew two other
 "ounces of blood from the same vein into another evaporating
 "dish, in which there was no ammonia, and set this aside
 "that it might coagulate, the vein being meantime secured
 "above the opening by a firm ligature. When the blood in
 "the second cup had firmly coagulated, an event which
 "occurred about four minutes after its abstraction, I drew
 "into a two-ounce syringe the blood charged with ammonia,
 "and which was still quite fluid, and introducing into the
 "vein the nozzle of the syringe, threw in slowly the ammo-
 "niated blood. The syringe was withdrawn, and the vein
 "was tied below the opening. For a few moments after the
 "injection there was but little change; then suddenly the
 "action of the heart became so bounding and intense that it
 "seemed to heave up the chest-wall. Almost coincident with
 "this, general tetanic spasms occurred, with rigid opistho-
 "tonos; and, in fine, symptoms so strictly analogous to
 "those produced by strychnia, that the action of the two
 "agents could not have been distinguished by a stranger
 "ignorant of the cause of the symptoms. The chest was
 "fixed, and death took place in four minutes. An hour
 "after death the body was opened. The right side of the

"heart and the whole venous system were charged to disten-
 "sion with dark blood, which was perfectly fluid, and remain-
 "ed so for three hours on exposure to the air. In the left side
 "there was also blood, of a bright red colour, and fluid. Set
 "aside, this arterial blood coagulated in fifteen minutes, on
 "exposure to the air at a temperature of 70°. The corpus-
 "cles were very much modified. In this experiment, the
 "first of a series on a living animal, the ammonia was added
 "in a poisonous dose, and the results were strikingly marked.
 "The analogy between the actions of ammonia and strychnia
 "is so striking, when the former is thus thrown in excess
 "into the circulation, that I cannot dwell too strongly on the
 "fact, since it may have an ultimate bearing on the mode in
 "which strychnia destroys life, and the means to be adopted
 "in cases where this alkaloid is fatally administered. In an
 "experiment in which Dr. Halford lent me his assistance,
 "the same results were observed, under the same circum-
 "stances."

In this passage, written in 1858, we have Dr. Richardson's
 assertion, which at the time was assented to by myself, that
 four grains of Ammonia* mixed with two ounces of blood and
 slowly injected into the circulation, were as intensely poison-
 ous as a similar quantity of strychnia. This, he says, is a
 point on which he cannot too strongly dwell. How much, then,
 did he inject into the veins, in 1854, to resuscitate in chloroform
 poisoning? This is, to me, the puzzling question. If he
 had injected four grains of Carbonate of Ammonia, dissolved
 in water, into the veins in 1854, he would not have found it
 produce death like strychnia, and not having found it, he
 would not have attributed the death in the experiment in
 1858 to the Ammonia, but sought for it in the manner of
 injecting the somewhat altered or altering blood into the
 heart. For I found, in 1868, very much to my astonishment
 at first, that four grains of Carbonate of Ammonia, in a
 sufficient quantity of water to just dissolve it, might be
 injected into the jugular vein of dogs without producing any
 injurious effect whatever. I have thrown ten grains into the
 veins in the space of five minutes without the least bad
 symptom following. But was it the Liquor Ammoniac which
 Dr. Richardson used in 1854? Let us see how he speaks
 of this preparation in 1858.

"EXPERIMENT CCCCIX.—TRANSFUSION OF BLOOD.—I laid
 "bare the jugular vein of a healthy terrier-dog, and drew off

* It was the Carbonate of Ammonia.—G. B. H.

"two ounces of blood into an evaporating dish, containing three
 "minims of Liquor Ammoniae, Sp. gr. .880, with thirty
 "minims of water. Other two ounces of blood were drawn
 "off into another dish containing no ammonia, and set aside
 "to coagulate. The vein meantime was tied above the open-
 "ing. After four minutes the blood in the second cup had
 "firmly coagulated. The ammoniated blood was still completely
 "fluid. After five minutes more had elapsed, the nozzle of
 "the injecting syringe was introduced into the vein of the
 "animal, and the ammoniated blood was injected. Dr. Halford,
 "who managed the syringe, took great care to introduce the
 "syringe slowly, and a full quarter of an hour was taken up
 "in this way. Then the syringe was withdrawn, and the vein
 "was tied beneath the opening. In the course of this
 "operation, not a dangerous symptom supervened. The
 "blood ran easily. As it first reached the heart, that organ,
 "which had been flagging, beat with a little more force, and
 "sustained this activity without abnormal increase. The
 "animal recovered without the slightest indication of injury,
 "and it is alive and well now.

"A small portion of the ammoniated blood left in the
 "evaporating dish was observed to coagulate thirty-five
 "minutes after the blood was first drawn; it formed into a
 "firm clot. The temperature of the day was 75° Fah.

"In performing the operation of transfusion by this simple
 "means in the human subject, in the extreme cases adapted
 "to the operation, a few precautions are required. The
 "amount of ammonia first added to the blood about to be
 "transfused, should not exceed two minims of the stronger
 "Liquor Ammoniae to the ounce of blood; for it is quite easy,
 "if a diluted solution of the ammonia be ready at hand, to
 "add a little more in course of operation if the blood should
 "show a tendency to coagulate. The ammonia diluted with
 "water, in the proportion of one part of the alkali to ten of
 "water, should be placed in the vessel in which the blood is
 "caught from the vein; and the blood as it falls into the
 "vessel should at first be very gently stirred. When sufficient
 "blood is obtained, and the injecting syringe is at work, the
 "injection should be made with the greatest care and slow-
 "ness. Indeed, scarcely any pressure on the piston is
 "required, and there is no cause for haste. This is a great
 "advantage, for I take it, one of the dangers of transfusion
 "is the rapid distension of an empty and enfeebled heart
 "with a full charge of blood. Harvey, whose shrewdness
 "seems to have let nothing in his way escape observation,

"refers to the syncope which sometimes occurs in bleeding,
 "not as a result of the hæmorrhage, but on the removal of
 "the fillet; or, as the vulgar say, 'from the turning of the
 "blood.' Harvey thought that this occurred from the cold-
 "ness of the blood, which retreated on the heart, but I
 "think that I have demonstrated by experiment in another
 "place, that the effect is due to the sudden load of blood
 "thrown upon the enfeebled organ.

"With these precautions the operation of transfusion by the
 "process I have described, is at once as simple as it is effectual;
 "and in sinking from loss of blood it has this advantage,
 "that to the new charge of blood there is added an agent
 "having the property of stimulating the flagging heart into
 "renewed force and activity."

I have thus extracted all that Dr. Richardson has said on
 this subject, and I now ask if he thus feared the introduction
 of any more than two or three drops of Liquor Ammoniae
 into the circulation in 1858, how much did he use in 1854 in
 attempting to resuscitate from chloroform. He could not
 have used more than three or four drops, or he would not
 have thus feared this quantity in 1858. For assuredly had
 he used this quantity, or more, he would have given benefit
 rather than have done harm. Liquor Ammoniae is not the
 strychnoid poison that he imagined it was in 1858, and he
 would have known this in 1854 if he had used it at that date
 to restore from chloroform. I have thrown repeatedly from
 ten to twenty minims into the veins of dogs without harm;
 and the human subject has been pretty freely injected with it
 in this colony. Thus of the same preparation, *viz.*, the Liquor
 Ammoniae Fortior. Sp. gr. .880. Drs. Jackson and Cotter
 injected twenty-five minims within an hour or so, with
 recovery from the syncope and vomiting of snake-poisoning.

Mr. Gillbee used forty minims in a case of narcotism and
 syncope from chloroform poisoning, with the effect of restor-
 ing the man to consciousness and to his home, where he lived
 thirty-two hours, and then succumbed to an attack of *delirium*
tremens, from which his liquor-steeped body never recovered.
 In this case nothing but good symptoms followed each
 injection.

Dr. Dowling injected sixty minims in a severe case of
 snake-poisoning, and heroically saved his man.

Therefore, if Dr. Richardson was so fearful of a few drops
 in 1858, could he have used it to restore from chloroform, as
 he says, in 1854? I think he must be making a mistake,

deceiving himself in fact. I beg of him, if he have the notes of the experiments by him, to publish them. At any rate, the statement made in his lecture in 1870 is apparently so contradicted by his written words of 1858, and by all that I remember, as to need some explanation. Nothing in Dr. Richardson's work, or in his edition of Snow's work on chloroform, that I can find, suggests the injection of ammonia for any purpose, the only use he made of it being to hold the blood fluid, at the same time regarding it as a poison analogous to strychnia.

THE
TREATMENT
OF
SNAKE-BITE
IN VICTORIA.

BEING A PAPER READ BEFORE THE MEDICAL SOCIETY
VICTORIA, JUNE 1st. 1870.

BY
GEORGE B. HALFORD, M. D.,

MEMBER OF THE ROYAL COLLEGE OF PHYSICIANS OF LONDON, FELLOW
OF ANATOMY, PHYSIOLOGY, AND PATHOLOGY IN THE
UNIVERSITY OF MELBOURNE, &c.

REPRINTED FROM "THE AUSTRALIAN MEDICAL JOURNAL."

CALCUTTA:

REPRINTED AT THE HOME SECRETARIAT PRESS.

1871.

No. 3/50.

E. C. BAYLEY, Esq., C. S. I.,

Secretary to the Govt. of India.

*The Secretary to the Government
of Madras*

Home Dept.
Public.

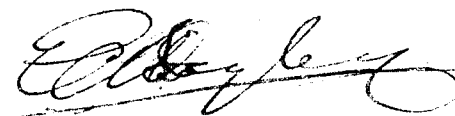
SIMLA, the 27 June 1871.

SIR,

I AM directed to forward 25 copies of a pamphlet by Professor Halford of the Melbourne University, on the treatment of snake bite for distribution among the Medical Officers in the Madras Presidency, and I am to request that any valuable opinions received from them or from any other officers who may have a special knowledge of the subject, may be forwarded for the information of the Government of India.

I have the honor to be,

Your most obedient Servant,



Secretary to the Govt. of India.

Dec. 1871 Dept.

dated 3rd Aug. 1871. 1871.

Thomson
We beg the first of which
None but
No 3150.

Dec. 27th June
Dec. 10th July 1871

6.5.0
No. 1540

of a pamphlet by Rogers
Walton & the volume the
-erity on the treatment of
late date, and by most to
be found with the
of most of the
Presidents in the series.

With me 1874

Ordered that the copy of the
copy of the pamphlet be
to be forwarded to the
sent down to the
pamphlet for distribution,
that the printing of the
other printed copies, who have
attention to the treatment of
this, may be obtained
the pamphlet for distribution
the Government of the
1874

to the higher level. In the
incident of the same.

Govt. of 1871 Madras.

Public

The Insp. Genl. Secy to Govt.

Dated Aug. 3^d }

Recd.

Recd.

G. O. 3^d Aug. 1871, No 170

Nos. 5. 6.

Forwarding to you three copies of
the pamphlet by the present holder
of the Melbourne University on
the treatment of the blacks with
a request that the opinions of
Mr. Shortt & other local officers
who have paid attention to the
subject may be forwarded for
transmission to the Govt. of India.