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ON THE INJECTION OF AMMONIA INTO THE CIRCULATION.

BEING

A PAPER READ BEFORE THE MEDICAL SOCIETY OF VICTORIA,

APRIL 7TH, 1869.

By GEORGE B. HALFORD, M.D.,

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

Reprinted from "The Australian Medical Journal."

ON THE INJECTION OF AMMONIA INTO THE CIRCULATION.

By George B. Halford, M.D.,

Professor of Anatomy, Physiology, and Pathology, in the University of Melbourne.

The injection of ammonia into the veins, as originally advocated by me, was the outcome of many unsuccessful experiments for the cure of snake poisoning. All that resulted after much labour was the hope, apparently very faint, of overtaking and struggling with the poison in the blood itself. I had studied with the greatest care Dr. Weir Mitchell's masterly treatises on the poison of the Rattlesnake, and from this and from my own observations I had learned how useless were all the so-called antidotes. But of all remedies Ammonia, in some form, seemed to me the most worthy of confidence. Owing, however, to its irritating and destructive effect on the tissues, it was impossible to sufficiently and rapidly surcharge the system, I therefore hoped that by throwing it directly into the blood, its caustic properties might be so far diluted as to render its therapeutic action almost instantaneous, since a few seconds suffice for its distribution to every microscopic element of the body. Again, wherever the serpent's poison could reach, the volatile alkali *a fortiori* could penetrate; and although not capable of directly neutralizing the poison, it might so antagonise its terrible effects as to supplement, or even call forth, if suspended, those forces upon which life depends. I was aware of the universal impression, that the injection of Ammonia would be a fatal proceeding, but I think I shall be able to show that our opinion upon this subject must be totally changed, from the facts which are now beginning to crowd upon us.

Being struck with the effects of injecting thirty minims of Liquor Ammoniæ, B. P. sp. gr. 0·959, into the external jugular vein of dogs inoculated with snake-poison, and knowing that I should for some time after be prevented from continuing the experiments, I wrote suggesting a similar treatment in desperate cases among men; and I purpose, without, I hope, the least straining after effect, to detail all that I believe trustworthy on the subject of the injection of Ammonia into the circulation; and if ever it should become as great an agent in medicine as it seems to promise, the credit of its introduction into practice must undoubtedly belong to the profession of this colony.

Up to the present time nine cases of snake-poisoning have been treated by the injection of Ammonia into the veins. Not all of them are valuable, although they have all ended successfully. In some the beneficial effects of the Ammonia have been instantly visible to the bystanders. One case was wrongly reported as fatal

after the injection of Ammonia, for Dr. Nathan, of Sydney, who saw the patient, thus writes me—"I do wish it to be known that your remedy was not used." Within the last week or two a boy, aged nine years, was admitted into the Kyneton Hospital twenty-seven and a half hours after having been bitten, or supposed to have been bitten by a snake. To Dr. Langford I am indebted for the history of which the following are the essentials. On admission there were lock-jaw, intermitting pulse, dilated and insensible pupils, and cold extremities. Five minims of Liq. Ammon. Fort. with twenty-five of water, were injected into the median vein without any apparent effect and repeated. Carbolic Acid was also administered, but he died sixty-five hours, or two and three-quarter days, after the accident. Whether stronger doses of Ammonia might have saved him, or whether what was used did indeed prolong his life, or whether the poison had been too long in the system, are points which further experience can alone decide.

But if this remedy be beneficial in snake-poisoning, how shall we limit its application? In cholera it is simply merciful to adopt any treatment in which there may be the faintest hope, and in the Ammonical injection there is much. For the present, however, I will leave these considerations and pass to the immediate subject of this paper.

The form of Ammonia which I make use of is the Liquor Ammoniæ of the British Pharmacopœia, sp. gr. 0·959, the dose hitherto used being 30 minims. In operating I raise the skin over the vein and transfix it (the skin) with a scalpel so as fully to expose the vessel. Dissecting away any tissue obscuring it, I introduce the point of the hypodermic syringe and passing the nozzle well into the vein, inject towards the heart. On withdrawing the syringe the slightest pressure with the finger stops the bleeding. It is scarcely necessary to say that by this means no air passes into the vein, and even, as I have frequently proved, should a whole syringeful of air be injected no mischief need result.

What I have reliable as to the effect of the injection on man in the order in which the operation has been performed, is as follows:—Dr. Dempster, of Beechworth, was the first to apply the remedy to a human being, and he says, "I injected Liq. Ammon. Fort. into the saphæna vein, and also hypodermically. This affected the patient at once, and after the second injection he woke up, and became sensible; his pupils which had before been very sluggish acted well; and his pulse rose from fifty-six to seventy."

Messrs. Arnold, A'Beckett, and Wooldridge, speaking of the Elsternwick case in which I myself operated say:—"At the time of the operation Mr. Brown was comatose. The effect of the injection of Ammonia into the system was marvellous. In a very short time the patient became sensible, and in answer to a question 'how he felt,' replied 'fine,' a very appropriate and significant word. From that time all symptoms of coma disappeared."

Dr. Barnett, of Smythesdale, describing a case says:—"Countenence swollen and dusky, conjunctiva much injected, cornea glassy,

pulse small and slow, breathing also slow, a complete state of stupor; if support was withdrawn the patient sank to the floor. I injected fifteen drops of Liquor Ammoniæ into the median vein of the injured arm. In a few minutes she became violently excited, laughing, crying, singing, biting, and throwing herself about so much as to require two persons to restrain her."

The same girl was bitten the next day by another snake. However singular this may seem, Dr. Barnett has assured himself of the fact, and it does not become so incredible when the father of the child killed twenty-seven snakes on the premises and in the garden. The spot was formerly known as "Snake Hill." Dr. Barnett speaking of the second bite, continues, "I found no symptoms of poison present. There was a wound on the last phalanx of the ring-finger of the left-hand, which I washed with a solution of Ammonia, and, as a matter of precaution, injected fifteen drops into a vein at the elbow; but wishing to test the efficacy of the injection, I administered nothing whatever internally. In ten minutes the same train of symptoms set in as occurred yesterday, but not so violently."

The case at Mornington, concerning which Dr. Lane writes to me of "the excited delight which he felt at the satisfactory result," was witnessed by my friend and colleague, Mr. W. P. Wilson, the learned professor of Mathematics and Natural Philosophy in our University. He thus wrote me on the evening of the accident. "On Mr. Lane's arrival he made an incision in the skin of the right arm above the elbow, and injected 10 minims of Liq. Ammon. Fort., and 20 of water into a large vein. The pupils which previously were nearly insensible to light, instantly contracted and expanded on opening and closing the eyelids. The pulse remained tolerably steady at from 84 to 90. The injection of the Ammonia was followed by a motion of the eyelids, an opening and shutting of the eyes, a wild rolling of the eyeballs, and afterwards by a spasmodic action of the left arm and right leg which increased so that the arm required all a man's strength to hold it. He understood what was said so as to put out his tongue when told to do so. The expression of his countenance was more intelligent than previously."

The next case is that reported by Messrs. Stillman and Henshall, chemists of Seymour, who say:—"The boy was evidently sinking, the extremities being icy cold. The effect of the injection was instantaneous. The patient from a state of stupor at once rallied and the wound in the foot bled afresh."

I have been careful to get all the particulars of this very striking case. Messrs. Stillman and Henshall thus wrote further to me: "There can be no doubt in our minds of the perfect efficacy of your discovery, and also that this was a case of snake-bite pushed to the last extremity." The manner of operating was subsequently furnished to me by Mr. Henshall.

"You can rely that the vein of the arm was opened, and the nozzle of the syringe inserted into the vein, also that the Ammonia was injected into the cavity of the vein and passed up-

wards through the channel of the vein. My reasons for certainty are, not only having deliberately injected myself, but the trace of the swelling or inflammation of the course of the Ammonia, which was distinctly to be seen by the red apperance assumed along the whole line of the vein from the orifice to the shoulder. The boy had pain only along the vein when touched, for the space of three days afterwards."

As there were some who still doubted whether in any of these cases the Ammonia had really entered the circulation, I determined to see with my own eyes its effect upon the heart itself, and for this purpose I performed the following experiments in the presence and with the able assistance of my friends Dr. Neild and Mr. Wooldridge.

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. Ammoniæ 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 into 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 choloform 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 removal 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. Ammoniæ 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.

These painless vivisections show that the Ammonia acts by at once stimulating the heart and the cells of the cerebral, spinal, and sympathetic ganglia, by which means the whole system, mental and corporeal, is roused into action. Sad indeed must be that case of snake-, chloroform-, opium-, cholera-, or fever-poisoning, in which the paralysis of the nervous centres is so great as to be beyond the action of the alkali. Without further speculation upon the *modus operandi* of this powerful remedy, I will invite your attention to the large quantity of Liquor Ammoniæ thrown without injury into the blood of these two dogs; in the first four and a half drachms within one hour and a half, and in the second three drachms within one hour and twenty minutes. In both cases its beneficial

effects were seen in counteracting the paralysing influence of the chloroform, of which about ten fluid ounces were consumed.

It must not be forgotten that the amount of poison necessary to destroy life differs in the dog and in men. Dogs withstand large doses of Morphia and Atropine, yet succumb quickly to snake-poison and chloroform. Man is soon affected by small quantites of Morphia and Atropine, but is capable of resisting in a very large measure the toxic effects of chloroform and snake-poison. Again, the individual differs in degree among his fellows. *A* may die from the dose of any poison, organic or inorganic, including fever poison, that *B* would resist. So with remedies. If then the Ammonia acts by rousing the nervous centres into function, our knowledge of the varying relation of these centres to each other in the different tribes of animals will lead us to expect correspondingly different results as it is used in this or that case; and in passing from the lower animals to man, it is chiefly in the different degrees of excitability of these nervous centres, in their proportions to each other and to the whole body that individual differences consist; consequently the effects of the injection of Ammonia may be either chiefly emotional excitation, as in Dr. Barnett's case at Smythesdale; spinal, as in Dr. Lane's, at Mornington; or both, as in Messrs. Arnold and A'Beckett's case at Elsternwick; whilst in others, large and repeated doses may be requisite to produce any effect. Each case, therefore, as in every other department of practice becomes largely a case *sui generis*, and must be treated accordingly.

Let us hope, however, that from the full consideration of the facts I have had the honour of placing before you this evening, some good may result to the practice of our profession, some atom to the universal progress.

In the discussion which followed:

Mr. Gillbee thought that the experiments of Professor Halford were most encouraging, and for his part he should have no hesitation in adopting the Ammonia-injection treatment in cases of poisoning by Chloroform. He had seen many cases of fatal anæsthesia where all other remedies had failed, and where the Ammonia injection might very advantageously have been tried.

Dr. Jonasson had been struck by the almost immediately antagonistic effect of the Ammonia upon the Chloroform. It would be remembered that he had some time ago suggested the probability of there being a chemical change as between these two agents, and the experiments of Professor Halford rather confirmed this belief. A further examination of the blood was of course necessary to demonstrate the certainty of this change.

Dr. Thomas was inclined to think that injection of Ammonia into the blood was of necessity fatal. As to snake-bite, he had never known in his own experience a fatal case, and he wished to remind members of the different effect of some poisonous agents when injected into the circulating system as compared with their effect when swallowed.

MR. BRAGGE wished to ask Professor Halford what effect there was on injecting Ammonia into the veins of unchloroformed dogs. He referred to some experiments performed on dogs with reference to alleged antidote in snake-bite, showing that the antidote had no effect. He thought Professor Halford's experiments were inconclusive.

DR. NEILD had assisted Professor Halford in the experiments detailed in the paper, and could speak with the greatest confidence of the remarkable influence exerted upon the system by the Ammonia. The animals experimented upon had been brought completely under the influence of the anæsthetic, in fact, had been as nearly as possible, time after time, killed by Chloroform, but almost immediately upon the injection of the Ammonia there had been, as detailed by Professor Halford, a return of muscular force and a complete recovery of consciousness. He (Dr. Neild) regarded this demonstration of the effects of Ammonia by injection into the circulation as the commencement of an entirely new method of treatment in special cases. Wherever the administration of some powerful heart-stimulant was indicated, the injection of Ammonia seemed to present itself as the means for accomplishing such a result. It was simply foolish to deny the possibility of performing the process of injection, and equally foolish to insist upon its necessarily fatal influence. Nothing could be clearer to his mind than that it was not only a safe method, but a beneficial one. The animals had been directly influenced by the Ammonia, and when it was borne in mind how extremely susceptible dogs were to the influence of Chloroform, it would be seen that it required a very powerful agent to effect recovery from the condition of anæsthesia into which they were thrown. He could also bear testimony to the entire absence of any injury to the endocardium or to the inner coat of the veins as the result of Ammonia injection. He thought the profession was greatly indebted to Professor Halford for bringing this subject before the Society, and he trusted that, as occasion offered, the profession would put into practical operation the valuable hints he had afforded. The question of how the Ammonia acts, whether chemically or vitally, had not been entered upon by Professor Halford; but he would, with the permission of the President, read an interesting letter he had received from Dr. Day, of Geelong, in which this matter was ingeniously referred to. Dr. Day's letter was as follows:—

"Yarra-street, Geelong, April 5, 1869.

"MY DEAR DR. NEILD,—I much regret that I shall not be able to attend the meeting of the Medical Society on Wednesday next. Professor Halford's paper on the injection of Ammonia into the veins will, I am sure, be full of interest, and calculated to open up a new and wide field for investigation.

"I have been unsuccessful in all my attempts to procure snakes for experimental purposes, but hope, next summer, to be more fortunate. Judging from the reports of Professor Halford's experiments with Ammonia injections in the treatment of snake bites, I

should think that the beneficial results follow too soon after the application of the remedy to favour the idea that an organic poison has been destroyed in the blood, and I am more disposed to believe that although the poison of some of the highly venomous snakes, such as the cobra di capella and rattlesnake, may contain some organic acid or other substance which can act on the globules and destroy their power of carrying oxygen, that the poison of all snakes acts chiefly on the sympathetic nerve, rendering it morbidly irritable, and thus inducing abnormal contraction of the capillaries and the small arteries from which they emanate. This condition of the sympathetic, and, as a consequence, of the arteries and capillaries once established, it is not difficult, hypothetically, to account for all the symptoms of snake poisoning as described by Professor Halford. In his pamphlet, 'On the condition of the Blood after Death from Snake-bite,' he says, 'It results, then, that a person dies slowly asphyxiated by deprivation of oxygen, in whatever other way the poison may act, and so far as the ordinary examination of the blood goes, the *post mortem* appearances are similar to those seen after drowning and suffocation.' A passage or two from Dr. Bence Jones' Lectures on Pathological Therapeutics will help me to more clearly explain my views regarding the action of snake-poison on the system, and also the *modus operandi* of Ammonia as an antidote. Dr. Jones says, 'The capillaries generally throughout the body are subject to the vaso-motory action of the nerve. When the sympathetic is irritated, the capillaries contract to the uttermost, and the circulation is retarded; and when the sympathetic is paralyzed, the capillaries become dilated to the greatest degree possible, and the circulation is accelerated. This vaso-motory action of the nerves affects the passage of the blood in the blood-vessels, and oxidation is promoted or retarded as the circulation becomes quicker or slower.' (Page 162.) 'What the chemical action of alkaloids on nervous matter may be is not yet determined. When applied directly to a nerve, Ammonia is found to destroy immediately the electric and all other actions which the nerve can produce.' (Page 292.) 'Of all the medicines that stimulate the muscles probably Ammonia is one of the most remarkable. It has no exciting action on the nerve of motion, but almost immediately deprives them of the power of exciting motion, but it acts as an intense exciter to the muscles.'

"Now, assuming my hypothesis to be correct, soon after a person has been bitten by a venomous snake all the usual symptoms of poisoning by carbonic acid will ensue as an inevitable consequence of the irritation which has been set up in the sympathetic nerve. From this cause the blood, in its passage through the lungs, will be imperfectly oxygenated and carbonic acid will accumulate, and there will be a general check to the processes of oxidation and nutrition in all the textures of the body. In a short conversation I had with Professor Halford on this subject, when I was last in Melbourne, he remarked that if my views were correct the pupils would be contracted, instead of which they were always dilated in snake poisoning. However, this I would explain by referring to Professor Christison's

Treatise on Poisons, in which it is stated that in poisoning by Carbonic Acid the pupils are widely dilated.

"After reading my quotations from Dr. Bence Jones, you will have no difficulty in understanding my views regarding the remedial action of Ammonia injections in the treatment of snake bites. When the sympathetic is *irritated* by the presence of snake poison in the blood, the capillaries contract and the circulation is retarded; and when the sympathetic is *paralyzed* by the presence of Ammonia in the blood, the capillaries are relaxed and the circulation is accelerated.

"The property that Ammonia possesses of acting as an intense exciter to the muscles adds greatly to its value as a remedy for snake-bites, particularly when used in the manner recommended by Professor Halford, as it is then made to act directly on the muscular substance of the heart.

"If I were called on to treat a case of snake-bite I should inject Ammonia into a vein, and also administer large and repeated doses of Etherial Solution of Peroxide of Hydrogen, with a view to supplying the blood with active oxygen.

"Believe me, my dear Dr. Neild, yours faithfully,

"JOHN DAY.

"DR. JAS. E. NEILD."

DR. HAIG thought that the dogs experimented upon should have been allowed to live, so as to demonstrate the alleged harmlessness of the treatment.

MR. FITZGERALD had seen several cases of death by snake-bite. He particularly referred to the case of death by the Cobra, in which none of the ordinary remedies had been successful, and which presented a favourable opportunity for the use of the Ammonia injection. He had tried the Ammonia injection in a case of collapse from pyæmia, in which its effects had been most beneficial, life having been prolonged at least two days by its use.

DR. MCCARTHY was surprised to find that a large quantity of air might safely be injected into the veins.

PROFESSOR HALFORD, in reply stated that he had limited his paper to the details of the effects of the injection of Ammonia into the circulation. Without doubt the profession might be assured of its having been performed in the human being six times in cases of snake poisoning with immediate relief to the patient, and three times in a hopeless case of pyæmia, with the effect, as stated by Mr. Fitzgerald, of prolonging life. The operation was therefore both possible and beneficial. Whether it would ultimately be proved an infallible remedy in snake poisoning, he would not say; time must answer that, but at present it appeared to him to transcend all other forms of treatment. He was glad to hear Mr. Gillbee stating that in any future accident with chloroform he would at once use the Ammoniacal injection. In such a case he (Professor Halford) would suggest its introduction by the external jugular vein or even into the heart itself, in which latter case the wire of a galvanic battery might be connected with the syringe, and the heart be induced to

contract; if this resulted, the Ammonia would at once become diffused, and recovery possibly follow. Dr. Jonasson's remarks led him into the difficult question of the *modus operandi* of the remedy. He would draw the attention of the Society to his (the Professor's) original statement of the action of the snake-poison. It was purely hypothetical, but had attracted the attention of many eminent thinkers, and lately a similar final action had been claimed for prussic acid. It was to the effect that snake-poison perverted the action of the inspired oxygen, by which all manifestation of force was prevented, and finally extinguished. Dr. Broadbent endeavouring to account for the action of Prussic Acid, says, in the *Journal of Anatomy and Physiology*, November 1868, that "Nascent C and H set free in the nervous structure to exercise their affinity for oxygen, would seize it, and anticipate the normal oxidation." So the thoughts of men far apart were tending to the same point. What might not then Ammonia do when distributed so abundantly and universally throughout the system? Its action must be chemical or material. Should we claim for it the power ascribed by chemists to the other caustic alkalies, that of determining oxidation, or in the words of his (the Professor's) former teacher, Dr. Bence Jones—"directly promoting oxidation"? The same master of physiological chemistry said that for this purpose, "the caustic alkalies were more potent than the subcarbonates, and the carbonates more potent than the bicarbonates;" and they would remember that it was the Caustic Ammonia which was here used. Leaving, however, this essential yet at present inexplicable part of the subject, he would pass to the letter read by Dr. Neild from his friend Dr. Day, of Geelong. He agreed with that gentlemen that most of the symptoms might be ultimately explained by irritation of the sympathetic, the pallor, the vomiting, even the dilatation of the pupil which always followed irritation of the cervical sympathetic. Dr. Day must have misunderstood him if in conversation he had said contraction of the pupil would result, or possibly he had said so in mistake; for the conversation lasted only a few minutes. It was not necessary, he thought, to consider the ultimate action of the Ammonia to be that of a paralyser of the sympathetic, for the experiments with the dogs and its action on man showed its effects to be that of directly stimulating the nervous motor apparatus and sensorium generally. This being, so far as secretion goes, antagonistic to sympathetic irritation, the results would be equivalent to paralysis of that nerve, *i e.*, increase of all the vital powers and augmentation of the temperature of the body. Dr. Haig had considered it unfortunate that the two dogs had been killed so soon after the injection of such large quantities of Ammonia, as it would have been interesting to see what injurious effect the Ammonia would produce. He (the Professor) could assure Dr. Haig that he had injected many dogs with Ammonia, and repeated it several times, and without the least harm following. In answer to Dr. M'Carthy, he could tell him there was no danger by this process of throwing air into the vein. He had several times

thrown syringefuls of air into the same dog, and apparently with impunity. It should certainly be known to those who appeared to write so authoritatively on this subject, that Nysten had found that from two to three cubic inches of air rapidly thrown into a vein were necessary to kill a small dog, and from six to seven cubic inches a large dog. Again, Magendie once threw in, with all the force and celerity he could, forty or fifty pints of air into the veins of a very old horse without his dying immediately, though he sank at last. It had been said also that Ammonia thrown into the veins would produce death, and Orfila had been the authority quoted. But it must be remembered that it never entered into that great man's mind to use it as a therapeutic agent; his object had been to ascertain its poisonous effects, and hence he tried it in far larger quantities than he (Professor Halford) suggested. He (Professor Halford) felt greatly indebted to the medical profession here for so confidently trusting in his assertions and acting upon them, and he was pleased that their confidence had not been misplaced. Before concluding he would once more revert to the microscopical condition of the blood after death. He did so because both Dr. Weir Mitchell of Philadelphia, and Mr. Fayrer of Calcutta, had failed to see similar changes in the blood after death from rattle-snake and cobra poison; he (Professor Halford) had seen the same appearances after death from both. For the rattle-snake poison he was indebted to Dr. Weir Mitchell, and the cobra poison he had himself got from a living specimen. The effects upon the blood are the same as in tiger-snake-poisoning, but the local mischief is very different. He had said, in *The Australasian*, February 22, 1868:—"Let us suppose a dog to have been bitten at eleven a.m., and to have died at noon. It is most probable nothing strange will be seen in the blood but granular matter, as mentioned above, for two or three hours, but then in the midst of the germinal matter, which by this time has greatly increased in quantity, will be seen here and there nuclei with very sharp outlines, some single, others double, triple, and quadruple, many of the hour-glass shape, as if dividing, and others, again, kidney-shaped. At this time only the most practised observer could see the cell-wall of a few, and to do this requires a power of 1000 diameters and good management of the light. Numerous unaltered white corpuscles, pearly and opaque, may be seen here and there. By five p.m. the cells will be fully formed, their numbers literally innumerable, the nucleus usually single, division and multiplication having ceased; the macula may occasionally be seen, and the cell-wall, which is of the most exceeding delicacy, fully formed. *As the cells increase the nebulous germinal matter disappears.* Occasionally particles of germinal matter may be seen moving between the nucleus and cell-wall. It is to be understood that I am describing the condition of the blood before any re-agent whatever is applied, but now suppose we add a drop of magenta dye, in the proportion of one part of dye to twenty or fifteen of water. Then immediately the cell-wall becomes coloured and distinctly visible, the nucleus more so, and, lastly, the brilliant

little macula is seen at some part of the circumference of the cell, the diameter of the cell being 1-1700th of an inch, that of the nucleus 1-2800th inch. The cells are of this size before the diluted dye is added. From this time every further observation for several days will show the cells in great abundance, until finally they become destroyed. The blood at the same time getting thinner and thinner." He had never seen these cells before death, but he believed the organic germinal matter of the serpent's poison to be the efficient agent, and the post-mortem changes in the blood to be in some way connected with a metamorphosis of the fibrin of that fluid, which so far as coagulation was concerned appeared destroyed by snake-poison. It was also the case in death from Hydrocyanic Acid. His most able friend Mr. Ralph, of Kew, near Melbourne, after witnessing all the changes in the blood above alluded to, found nearly the same condition of blood after poisoning by Prussic Acid. He, the Professor, had since confirmed Mr. Ralph's observations, and was led to believe that whenever the fibrin does not coagulate these cells will be seen after death. There were some remarkable facts bearing upon this subject by Dr. Onimus. He (Dr. Onimus) believed with him, that cells may arise from an amorphous blastema, and that it is not necessary to suppose, with Virchow, that *omnis cellula e cellulâ.* That the condition of the cell was not necessary to infection, had been proved with respect to the vaccine virus by Cheaveau ; this lymph consisted of white cells, serum, and elementary granules. After separating the cells, the remainder was as virulent as ever. The clear serum, he found, was harmless. In the elementary granular matter dwelt the activity of the virus. So with snake-poison ; he, Professor Halford, had always ascribed its virulence to the microscopic particles he had designated "germinal matter," such as indeed constituted the essential elements of all glandular secretions and which possessed such remarkable powers of transformation, as to have been called, for the want of a better name, animal ferments. He would now leave the subject, thanking the members for their kind attention. He had stated to them facts, facts respecting the post-mortem condition of the blood, facts concerning the injection of Ammonia into the veins, and into the heart itself; facts, which he felt confident might be taken as sure bases for future scientific inquiry and practical application.

The President thought the profession might congratulate itself on the investigations Professor Halford had made on this subject, which he thought was quite in its infancy and suggested a wide field for future inquiry. It was moreover a matter of which the University might be proud, that one of its professors had initiated this most important principle, which he trusted would be still further investigated.

On the motion of Dr. Jonasson, seconded by Dr. McCarthy, the thanks of the meeting were cordially accorded to Professor Halford for his very interesting paper.

STILLWELL AND KNIGHT, PRINTERS, COLLINS STREET EAST, MELBOURNE.