Original Communications.

HISTORY AND APPLICATIONS OF CARBONIC ACID AS A LOCAL ANÆSTHETIC.

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By various extracts and notices, the attention of the readers of the BRITISH MEDICAL JOURNAL has been more than once directed, within the last few years, to the effects of carbonic acid as a local anæsthetic application. (See, for example, ASSOCIATION MEDICAL JOURNAL for September 1856, p. 835; and BRITISH MEDICAL JOURNAL for April 10th, 1858, p. 292.) The question, also, of priority as to the use of this topical anæsthetic has been so far brought forward in the observations of Dr. Johns of Dublin (see BRITISH MEDICAL JOURNAL, April 1858, p. 292); and by a letter from Dr. McClintock, the Master of the Dublin Lying-in Hospital (see *Dublin Medical Press*, March 17th, 1857.) I hope, therefore, that I may be here excused from recapitulating the following observations; first, with regard to the past history of the practice; and second, with regard to the surfaces to which carbonic acid gas may be applied as a local anæsthetic; though most of these remarks have been already published by me in the *Dublin Medical Press* for April 21st, 1858.

HISTORY OF CARBONIC ACID AS A LOCAL ANÆSTHETIC.

In a paper on Local Anæsthesia, and on its modes of artificial production by chloroform and other agents, published in the Journal of the Provincial Medical Association ten years ago (July 1848), it was stated by me, that I had "tried the application of various anæsthetic gases and vapours to the vagina, in cases of vaginal irritation and neuralgia. The stronger forms cannot be borne. I was induced to try them in consequence of the following curious statement regarding carbonic acid, published by Dr. Pereira. (*Materia Medica*, vol. i, p. 155.) A lady who had suffered a considerable time from some uterine affection, and had derived no relief from the treatment adopted, was advised to consult a physician in Italy (Dr. Rossi). After he had examined the condition of the uterus, he assured her there was no organic disease, but merely a considerable degree of irritation, for which he proposed to apply Carbonic Acid as a sedative. This was done by means of a pipe and tube, communicating with a gasometer situated in another room. The patient obtained immediate relief; and, although she had been obliged to be carried to the doctor's house on account of the pain experienced in walking, she left it in perfect ease. On her return to England, she had a relapse of the complaint, and applied to Dr. Clutterbuck to know whether she could have the same remedy applied in London, in order to save her the necessity of returning to Italy." (*Provincial Medical and Surgical Journal*, 1848, p. 365.) When writing, seven or eight years subsequently, on the subject of the topical anæsthetic effects of carbonic acid gas, I took occasion further to observe: "This case and paragraph, however, seemed to Dr. Pereira of so little value, that he omitted the details of it in the last edition of his work. But, from the time of reading it, I have tried at various times, and more particularly during the last two or three years, the local application of carbonic acid to the mucous membrane of the vagina and cervix uteri, in different painful conditions of the uterus and neighbouring parts; and, whilst it has failed in some instances to afford the expected relief, it has in others proved of great, and occasionally of almost instantaneous benefit." (*Obstetric Memoirs and Contributions*, vol. ii, p. 771.)

In the published essay from which I have made this extract, and which was written in the beginning of 1856, at the request of my friend Dr. Stewart Campbell of New York, for the Academy of Medicine of that city, I attempted briefly to prove—1. The strong constitutional anæsthetic effects of carbonic acid when breathed, by referring to the well known experiment of the effects of it upon the dog when temporarily plunged into the gas contained in the Grotto del Cane at Pozzuoli: 2. Its local anæsthetic powers, as shown when a stream of it was directed upon any sensitive part of the surface of the body; and 3. Its curious topical effects when applied to different

morbid and supersensitive parts. At the same time, I took occasion to show that the practice of applying carbonic acid locally was in principle by no means a discovery of late times. In some very practical observations by Dr. Johns of Dublin (part of which has been cited in the BRITISH MEDICAL JOURNAL for April 10th, 1858), that gentleman observed: "I cannot say to whom the credit of discovering its sedative and curative powers is justly due, as that question, I believe, is still in abeyance. Dr. Simpson of Edinburgh is the person who has brought them so prominently before the profession; but (adds Dr. Johns) Mojon used this gas long prior to him; and report now states that some recommended it prior to the latter named gentleman: however, one thing is very certain, that it has been resorted to, in the form of effervescing draughts, and in chalybeate waters, through the medium of baths and injections, as long as the most senior among us can remember, although perhaps the advantages thence arising may have been attributed to other causes."

In the essay *On Carbonic Acid Gas as a Local Anæsthetic in Uterine Diseases*, etc., presented to the New York Academy of Medicine, and published in the second volume of my *Obstetric Memoirs*, I have tried to state at some length the principal historical points, as far as I then knew them, connected with the employment of this agent in medical practice. A brief recapitulation of these points from the essay in question will show that the therapeutic history of carbonic acid gas as a local application not only includes all the matters above adverted to by Dr. Johns, but embraces others of as great, if not greater interest.

In the essay alluded to, I endeavoured to bring evidence to prove the following facts regarding the local application of this gas as a therapeutic anodyne agent to the following surfaces and parts:—

i. Carbonic acid has been recommended as a local anæsthetic in some uterine diseases; in modern times, by Dewees in 1835, Mojon (1834), and Rossi; apparently also by Rueff and Ambrose Paré in the middle ages; and by Paulus Ægineta and Hippocrates in far more remote times.

ii. Carbonic acid has been used in the form of injection into the lower part of the bowel, in diarrhoea and dysentery, by Mr. Parkins in our own day; and in the last century, by both Mr. Hey of Leeds and Dr. Percival of Manchester in 1772; and during the later years of the same century, by Drs. Warren, Henry, etc.

iii. Carbonic acid was about the same time applied in a case stated by Dr. Percival, as a local sedative or anæsthetic in painful aphthous ulcer at the point of the tongue.

iv. Carbonic acid was also, in the latter part of the eighteenth century, applied as a local sedative to the cutaneous surface of the body in ulcers, open cancerous sores, etc., by Percival, Ewart, Beddoes, etc. Indeed, the antiquated yeast poultice of surgeons probably acted principally as a sedative by virtue of the carbonic acid constantly eliminated from its surface.

v. Carbonic acid has been prescribed constantly by physicians, in sickness, vomiting, etc., as a sedative to the interior of the stomach, in the form of effervescing draughts, ever since these draughts were introduced into practice two centuries ago by Riverius.

vi. In the same essay, I suggested that the anæsthetic powers of carbonic acid, when topically applied, afforded a probable explanation of the local anodyne and sedative effects of vaginal, etc., injections of those German waters which contained free carbonic acid; and gave us a clue also to the comprehension of the curative influence of the gas baths and gas douches of Neuheim, Marienbad, etc.

Having adverted in my original paper to all these previous and various therapeutic uses of carbonic acid by different physicians and surgeons, and under different forms, I trust that I will not be accused of having brought forward the practice as anything very novel, when I called, two or three years ago, the special attention of my professional brethren to the curative effects of carbonic acid as a local anæsthetic. I certainly did not, by any means, claim the practice as "Scottish in its origin."

But my esteemed friend Dr. McClintock, the distinguished master of the Dublin Lying-in Hospital, has claimed the idea as fundamentally "Irish". In the *Dublin Medical Press* for March 17th, Dr. McClintock writes, that he has "much pleasure" in stating a fact, the publication of which (says he) "may prevent needless controversy about priority of claims" in reference to this use of carbonic acid; viz., "that the local application of this agent as an anæsthetic was known to the justly

celebrated Dr. David McBride, of Dublin," who "made it the subject of a communication to the Medico-Philosophical Society of Dublin about the year 1775," though his communication is as yet unpublished.

It would surely not be uninteresting to publish Dr. McBride's observations, even thus late, if they are of any value. But from the high and candid character of that physician, I should feel inclined to doubt if he lays claim, in the unpublished paper alluded to, to any priority in the local medicinal application of carbonic acid, as the employment of it had been already spoken of in those published works and letters of Priestley, Hey, and Percival, to which I have referred, and with those writings Dr. McBride was no doubt sufficiently familiar; not to speak of physicians of still more antique date. In a letter of the celebrated surgical author, Mr. Benjamin Bell, published by Dr. Thomson, and written on March 30th, 1772, that gentleman tells Dr. Cullen, among other "London medical gossip" of that day, two circumstances; viz., 1st, that the "*Theory and Practice of Physic*," by Dr. McBride, was published two days ago, but I have not seen it;" and, 2nd, he had heard Dr. Priestley read a paper at the Royal Society, mentioning the trial of an injection of carbonic acid into the bowels in a case of fever. (Dr. Thomson's *Life of Dr. Cullen*, vol. i, p. 648.) Neither in his *Experimental Essays* (1764), nor in his *Practice of Physic* (1772), does Dr. McBride, as far as I remember, allude to any topical use or application of carbonic acid; and yet Mr. Bell's letter shows that the gas was tried therapeutically in London at the date, or rather before the date of the appearance of his last published work. Further, however, Priestley, Hey, Percival, etc., had written and published on the subject two or three years before the supposed date of the reading of Dr. McBride's unpublished paper in 1775. In fact, if the practice is to be claimed as Irish, Dr. McClintock will, I fear, require to prove that Hippocrates, or at least the author of the Hippocratic *Treatise on the Diseases of Women*, was a cadet of some Milesian family, who had returned from Ireland to Greece; and I have rather strong suspicions that adequate evidence of this descent will transcend even the boundless genealogical knowledge of my two learned friends, Professors Currie and Donovan.

PARTS AND SURFACES TO WHICH CARBONIC ACID MAY BE APPLIED.

In the preceding remarks, we have seen that carbonic acid has been formerly applied in some form as a local anodyne or anæsthetic to various parts or surfaces; as—

1. *The Vagina and Uterus.*
2. *The Rectum and Lower End of the Intestinal Canal.*
3. *The Interior of the Stomach.*
4. *The Surface of the Tongue.*
5. *The Ulcerated Surface of the Skin, Mamma, etc.*

There are other surfaces and structures upon which I have found the local application of carbonic acid act sometimes with remarkable success as a local anodyne or anæsthetic; as—

6. *The Mucous Surface of the Eye.* I have used it principally in cases of photophobia and hyperæsthesia of the eye connected with scrofulous ophthalmia, where often it gives speedy and marked relief. A few drops of chloroform evaporated from the palm of the patient's hand and held near the eye will generally, in the same way, allow a photophobic eye to open, and form an application far more easily used, and as curative as any medicated liquids or collyria dropped into the eye.

7. *The Mucous Surface of the Bladder.* In my essay on carbonic acid as a local anæsthetic, I mentioned a case of dysuria and great irritability of the bladder, in which, after many modes of treatment had failed, the injection of carbonic acid gas into the vaginal canal several times a-day at once produced relief, and ultimately effected a perfect cure. I lately heard of this patient remaining perfectly well.

Before 1732 the celebrated Dr. Hales had described to the Royal Society the injection, without injury, into the bladder of the dog of a menstruum, consisting, to use the words of Dr. Willis, "of a mixed solution of bicarbonate of potash, sulphate of potash, and carbonic acid in water." (*Urinary Diseases*, p. 330.) In consequence of his attention being directed to the subject by my paper, as analysed by M. Follin in the *Archives Générales de Médecine*, M. Broca injected carbonic acid into the bladder, and published some of the successful results which he obtained in the *Moniteur des Hôpitaux* for August 1857. More lately (March 1858), Dr. Johns has brought the same method of treatment under the notice of the profession in Dublin. In my earliest experiments upon injecting carbonic

acid into the bladder three years ago, I erred in not having a sufficiently sized catheter, or limb of a double catheter, to carry off the gas as it accumulated in the bladder. I latterly resumed the practice principally in consequence of the representations of success from it obtained in Paris and Dublin. And perhaps I will be excused for remarking that there is no class of ailments more distressing, or more difficult to treat, than the different forms of morbid irritability of the bladder, and in the management of the affections I have obtained far more favourable results from the local application and injection of carbonic acid than I could have ventured to anticipate. I have now repeatedly seen dysuria and extreme irritability of the bladder speedily relieved by a few injections of carbonic acid gas; and patients who were obliged from these causes to rise many times each night have been enabled by its use to sleep continuously for the usual number of hours. The freedom and safety with which carbonic acid and some other medicinal fluids and liquids may be injected into the cavity of the bladder with a double catheter will probably be ere long more fully acknowledged by the profession, and great practical advantage taken of this fact in the treatment of dysuria and other morbid states of the bladder.

In one of his letters to Dr. Priestley, dated 1775, Dr. Percival states that he had found "by repeated trials that calculi are soluble in water impregnated with fixed air," or carbonic acid; and he adds that it had acted in his experiments "upon every calculus which was suspended in it." He and Dr. Home hoped that carbonic acid given in effervescing drinks by the mouth would reach the bladder as carbonic acid, and there act as a lithontriptic upon the contained calculus. But if carbonic acid can act upon some forms of urinary calculus as a dissolvent, we know that it can be introduced freely and continuously by a double catheter into the bladder. In a most interesting case reported by Sir Benjamin Brodie, the repeated injection of a very weak solution of nitric acid into the bladder successfully dissolved and removed a phosphatic calculus; and he has found the same solution relieve chronic inflammation of the lining membrane of the bladder. On the contrary, it has been further long known that a calculus, probably of lithic acid, was broken down and removed by Professor Rutherford and Mr. Butter by free and frequent injections of tepid lime-water into the urinary bladder. Surely the time is not far distant, when a higher chemistry will thus enable us to remove some calculi at least without the horrid necessity of the knife or lithontrite.

8. *The Mucous Surface of the Trachea and Lungs.* In forming carbonic acid for application as a local anæsthetic, I have generally placed together six drachms of crystallised tartaric acid and eight drachms of bicarbonate of soda in a common wine bottle, and added four or five ounces of water. The gas is allowed to escape through a perforated cork, and attached a caoutchouc tube to the part to which it is applied. The conical-shaped perforated cork fixing the flexible caoutchouc tube into the mouth of the bottle, consists centrally of a metallic tube, inclosed in a thin layer of common cork, and the whole sheathed externally with a layer of caoutchouc to render its immediate insertion into the neck of the bottle close and tight fitting. The distal extremity of the caoutchouc is usually provided with a flattened glass tube, which is placed inside the mouth when the carbonic acid is used for inhalation.* In a considerable number of instances of chronic bronchitis, asthma, irritable cough, etc., I have directed the patient to breathe the carbonic acid, which escaped from the above mixture, by placing the end of the tube in his mouth. In a large proportion of these cases the relief obtained has been most striking; and in several chronic instances the benefit has been at once both speedy and permanent. The quantity of gas thus set loose and inhaled is not so very great in quantity as the rapid and continuous rush of it into the patient's mouth would lead a person to suppose; and it acts, I believe in these cases as a local sedative or anæsthetic applied to the whole lining pulmonary membrane, like the smoke of stramonium, or the vapour of chloroform. The common idea that spasm of the glottis will come on whenever carbonic acid is breathed in any considerable quantity, will be found quite incorrect. I will take an early opportunity of stating in the BRITISH MEDICAL JOURNAL the unexpected results of this prac-

* When the gas is applied to the vagina and cervix uteri, the end of the flexible caoutchouc tube is furnished with a gum-elastic extremity, such as is used in vaginal syringes; for the interior of the rectum, I have latterly used a double silver tube; and for the bladder a double silver catheter, fixed to the end of the caoutchouc tube. Mr. Young, cutler, Edinburgh, has made the instruments I have used.

tice; one which, even after all, is, I find, not quite novel, as, in the last century, Dr. Percival tried in phthisis pulmonalis the inspiration of fixed air or carbonic acid "by inhaling the steams of an effervescing mixture of chalk and vinegar, or of vinegar and potash", and Drs. Lettsom, Withering, and Hulme tried a similar method.

9. *External Wounds and Burns.* Seeing, first, the great and speedy relief to pain in cancerous and other sores obtained through the local application of carbonic acid by Ewart and Ingen-Housz; and, second, the tendency to cicatrization observed even in some malignant ulcers when carbonic acid was kept in contact with them, I ventured in my paper on the subject to suggest the topical employment of carbonic acid to surgical wounds and burns, as at once both relieving suffering, and being one of the best means for producing rapid healing and cicatrization. If found successful, it would not be difficult to devise simple means of applying it as a constant dressing. But no sufficient experiments, so far as I am aware, have been as yet made upon the matter.

10. *Extraction of Teeth.* I would suggest that perhaps carbonic acid may possibly be yet found useful as a local anæsthetic under a different form, and in a different mode from those already alluded to. Teeth have been now often extracted without pain when the gum was frozen with ice and salt, or ice and muriate of ammonia. But the application of these freezing mixtures, is tedious, difficult, and uncertain. If the chemist could show us a safe, simple, and cheap means of making and keeping solid carbonic acid, would not the application of the solid flakes of carbonic acid freeze the gum (or, indeed, any other part to which it was applied) sufficiently to produce the necessary degree of local anæsthesia?

In the preceding remarks I have scarcely referred, except incidentally, to the question of the utility of carbonic acid as a local anæsthetic when applied to various mucous surfaces and exposed external structures. Let me only in the meantime add, that all my subsequent experience has, in my opinion, more than confirmed the views which I ventured to publish two or three years ago with regard to its practical utility and efficiency as a local sedative or anodyne agent. The late observations of Drs. Churchill, Johns, etc., in our own country, and of Follin, Broca, Bernard, etc., in France, all tend further to prove and establish the advantages to be often obtained in practice from the employment of this therapeutic agent as a topical anæsthetic.

ON SOME SEVERE FORMS OF DISEASE ARISING FROM THE RETENTION OF DECAYED TEETH.

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[Read before the Greenwich Medical Society.]

[Concluded from page 449.]

I MIGHT mention more evils resulting from the retention of diseased teeth, but they would unduly lengthen this paper; I will, therefore, at once proceed to read a few cases I have selected from my notes, to illustrate those I have already pointed out.

CASE I. *Disease in Antrum.* Mr. D., a gentleman about thirty-five years of age, an architect, of tolerable health, but who suffered occasionally from chronic catarrh, had during the last six months expectorated a considerable quantity of foetid pus or mucus mixed with blood on rising from his bed in the morning. Having lost several members of his family from tubercular disease, he naturally became uneasy, and consulted his usual medical attendant, who prescribed for his cough, but failed to discover the source of the complaint.

He subsequently saw Mr. Holt, one of the surgeons to the Westminster Hospital, who, from the history of the case, at once suspected the cause of the malady, and recommended him to apply to me that his teeth might be thoroughly and carefully examined. The teeth seemed in tolerable order, and quite free from pain; but there was one, the first superior molar, that attracted my notice, not so much from the fact of its having been stopped, as from its displacement from the line of the neighbouring teeth, and its tenderness on pressure. He allowed me to extract it, when I found a fibrous growth of the size of a hazel-nut attached by a pedicle to the extremity of the root. This growth had made room for itself by penetrating the floor of the antrum, and by its presence there had set up inflammation in the lining membrane. The sanguineo-puru-

lent secretion, the result of the inflammation, accumulating and filling the antrum during the day, found its way during sleep, when the body was in a recumbent posture, through the natural opening into the middle meatus of the nose, and thence by the posterior nares into the throat, to be coughed up on the patient's resuming the erect position in the morning.

No pus followed the removal of the tooth, proving that the tumour was under the membrane, and not actually within the antrum. I pierced the membrane with a trocar, and found it thick, tough, and difficult to penetrate; but when it was freely open, a tablespoonful or more of very foetid pus made its escape.

I washed out the antrum with warm water, and injected it occasionally with a weak solution of sulphate of zinc. In the course of three weeks or a month, to the great relief of the patient's mind, the discharge (and the cough) had entirely subsided.

CASE II. *Tumour: an Encysted Abscess in the Cheek.* Mary Overall, aged 24, waistcoat-maker, a healthy, good looking young woman, with a tumour or swelling of the right cheek, came under my care, last November, at the Westminster Hospital. The application was well-timed, for the tumour fluctuated on pressure, and seemed, from its nipple-like protrusion, just about to burst outwardly; the skin over it was tense, but not at all discoloured. On grasping the tumour with a finger and thumb placed inside and outside the cheek, a thickened sac, of about the size and form of an oyster, could easily be traced in a position corresponding with the buccinator muscle. In the upper jaw were the roots of two decayed teeth, a second bicuspid and a first molar, but the patient was "quite sure these had nothing to do with it, as she had never had pain in them, and the swelling had been coming on gradually during the last twelve months from a cold caught in the face, while crossing over from Dublin." I thought it better to remove these teeth notwithstanding, when through the opening thus made the sac immediately emptied itself and filled the mouth. The pressure of the tumour in the cheek or of the pus in the antrum, or both together, had led to the destruction of the outer wall of the maxilla; the gum hung loosely over the cavity, and I could easily pass my finger under it into the antrum. The sac was exceedingly thick; it has taken months to absorb, but is now disappearing, and the cavity in the jaw is filling up; while, the face being naturally round and plump, I do not anticipate any permanent deformity.

CASE III. *Facial Neuralgia, or true Tic Douloureux.* On my arrival in town one morning I was hastily summoned to a lady suffering from facial neuralgia. She was about thirty-four years of age, tall and handsome, the wife of an official in one of the Indian presidencies. She had a young family, and, with the exception of severe periodical attacks of tic douloureux, her health was good. The attacks in question were attributed to ague, intermittent fever, and long residence in India; but after having heard her own history of the case, and having had an opportunity of examining her mouth, I referred them to a totally different cause.

On the occasion in question the attack had come on suddenly during the night, and at the time of my visit the eye was quite closed, and the face and head so swollen, that it was impossible to recognise her; she looked as if she had been suffering some days from erysipelas. She was attended by an old friend, Dr. Wallace, of Carshalton, a retired medical officer of the Indian army. Expressing my conviction that two molar teeth, which I pointed out, were the sole cause of her suffering, Dr. Wallace concurred with me in the propriety of my removing them; a proceeding to which the patient for some time objected, as "the teeth had been stopped for several years, and had not given her pain or uneasiness." They were, however, removed; the pain immediately ceased, and by the next day all the symptoms had disappeared.

In this case, the pain arose entirely from the deposit of cementum in a cavity not large enough to contain it. I preserved and made sections of the teeth in question, and they are here for your inspection. You will perceive they have both been stopped with ordinary amalgam, but that the arrest of the decay is due to the cementum; it surrounds and blocks the decay, entirely fills up the cavity that originally contained the pulp, and envelopes in a solid mass the three roots of the teeth, the ivory-like structure of the latter being easily traced in the midst of the surrounding bone. Now, there was not a trace of vascular tissue in or about the tooth, save in the periosteum enveloping the bone; and to the pressure of the deposit on the periosteum, and the resistance offered to it by the surrounding alveolus, I attribute all the suffering and its results.