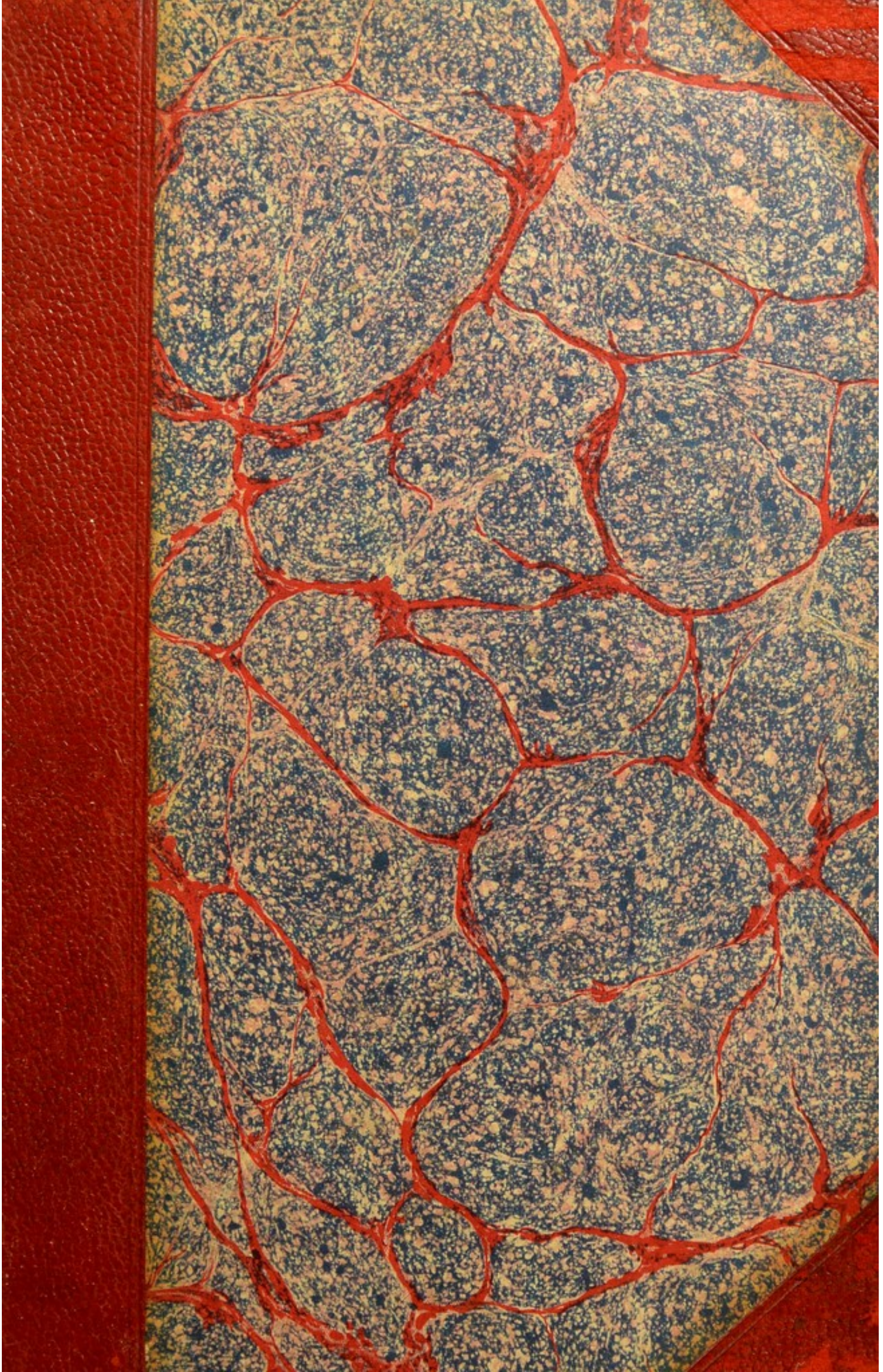
Painless tooth-extraction without chloroform : with observations on local anaesthesia by congelation in general surgery / by Walter Blundell.



PAINLESS TOOTH-EXTRACTION

WITHOUT CHLOROFORM.

WITH

OBSERVATIONS ON

LOCAL ANÆSTHESIA BY CONGELATION

IN

GENERAL SURGERY.

BY

WALTER BLUNDELL.

SURGEON-DENTIST.

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PREFACE.

When Death turns good into evil, and converts otherwise benignant agents into scourging ministers, more or less of grave suspicion comes to be entertained of those means he thus makes servants to his obscure purposes. Etherization, to annul the pain of surgical operations, is a benignant agent, which, for some years, has bidden fair to realise one of the most universal anticipations of humanity; but, of late, it has too plainly manifested an inglorious subserviency to the stronger power of death. This feature of its true character is rapidly developing itself in the form of almost weekly fatal accidents from the administration of chloroform; and, as an inevitable consequence, the former unalloyed delight of the public mind is giving place to increasing disappointment and anxiety;—faith and confidence in the safety of anæsthesia by chloroform, are daily becoming substituted by a very rational fear and wise distrust.

The following observations have been written in advocacy of another agent, which will faithfully and effectually serve mankind as a rational anæsthetic, independent of any subserviency to death. It is one, moreover, which, to render the human body insensible to pain, does not demand for compensation, as all others hitherto have done, the surrender of consciousness in order to accomplish for us its

beneficent results. Thus it will appear, that though chloroform has failed in the one great essential point, the hopes of mankind are not thereby annihilated: and that for the destruction of pain other available and effective means are open to humanity.

If it be deemed presumption to write so freely as I here do, upon surgical subjects, which do not fall within my province as a *dentist*, I must plead as my excuse, a strong participation in the now generally expressed want of an anæsthetic devoid of those dangerous qualities which pertain to chloroform. It may also yet further shield me from reproach, that by considerable expenditure of thought, labour, and money, I have at length rendered completely practicable, a safe and certain method of anæsthesia without abolishing consciousness. And it is not, perhaps, a less interesting circumstance, that by the same means I have succeeded in rendering painless the operation of tooth-extraction, from which hitherto painful process few persons enjoy an entire immunity.

W. B.

London: 29, New Broad Street, City;
September 14, 1854.

PAINLESS TOOTH-EXTRACTION,

ETC.

PART I.

ANÆSTHESIA IN GENERAL SURGERY.

It is not a little curious that the first attempts at modern etherisation were undertaken by a *dentist*, with the object of annulling the pain of tooth-extraction. In the year 1844, Mr. Horace Wells, a dentist of Hartford, Connecticut, U. S., following up the suggestion of Sir Humphrey Davy, respecting the anæsthetic property of nitrous oxide gas, submitted to the loss of one of his teeth, which was accomplished without consciousness, while under the influence of that gas. Several of Mr. Wells' patients afterwards underwent the same process, and with the same happy results. A bitter disappointment, however, awaited him. Full of the new-born joy, and transported with the prospect of a glorious career, he set out for Boston, to make a public demonstration of his discovery to the medical profession. But, through mismanagement, this attempt failed, and the failure ultimately cost him his life. The scorn and derision of the medical public drove him from his profession. He wandered about a year or two, an unquiet spirit, and at length, finding that his own failure was but the forerunner of surer means of anæsthesia, and that to another were to be given laurels of which some were due to him, in reckless vexation he sought relief from disappointment in death. Horace Wells had, however, lived to some purpose. He

lived to restore to humanity, in recent times, the idea of, and to revive attempts at, a *painless surgery.**

The revival of these attempts in the nineteenth century, owing to the great progress of chemical science, and the general advancement of the age, was not likely to be doomed to the same isolated fate as in ancient surgery. We consequently find an old pupil and partner of Wells, W. G. T. Morton, carrying on the experiments. Nitrous oxide gas was abandoned as incompetent. The inhalation of sulphuric ether was destined to replace it. Morton first tested the anæsthetic property of this ether in his own person. It was then tested, and certified to by witnesses as completely successful in the person of one Ebenezer Frost, a timid man, quailing at the agonising prospect of tooth-extraction. He inhaled the ether from a handkerchief, fell into deep unconsciousness, and waking up, found his old enemy, a carious bicuspid tooth, lying upon the floor. And thus, as Dr. Bigelow tells us, at nine in the evening of the 30th of September, 1846, a new era in surgery began by the *painless extraction of a tooth.*

The power of the new agent to annul pain, was soon tested in other surgical operations, and with the same success. The operating theatres of the American hospitals resounded with its praises. The accustomed groans and shrieks of sufferers beneath the surgeons' knives and saws, were all hushed. Stillness reigned around the dreaded operating table. Like placid sleeping infants, smiling at some image in their dreams, men and women lost their

* The idea of painless operations belongs not distinctively to our own times. The ancient works of Dioscorides, Pliny, Apuleius, Theodoric, &c., present us with means used by the olden surgeons for this object. Nor is this idea the peculiar property of *any* particular age; for it has doubtless been the desire of humanity, from the first moment that disease and bodily accidents, with their attendant pain, have fallen to the lot of man. Thus far the idea is common to all ages, and all men, and was as original in the mind of Wells as in that, it may be, of Chiron or Æsculapius.

useless limbs. The sting of surgery was plucked out. The sharpened steel and grating saw lost their cruel power. The surgeon's nerve was now all strung: calmly, deliberately, he could do his work among human tissue. Unimpeded by muscular contractions—unembarrassed by the sufferer's violent contortions—unharassed in his mind by the sensitive cries of woe, he pursued his manipulations as on breathless, lifeless forms. Surgical impossibilities at once became possible. And the mortality from operative surgery gave indications of diminution; for the annihilation of nervous shock robbed death of one of its most formidable shafts. Nor was this pain-destroying ether to be the exclusive agent of the surgeon. To the physician, it alike extended its kindly aid in assuaging the agonies of internal acute disease, and also in soothing the often tortured passage to the grave. Nor was it to be a boon to those alone departing from the world, but also to many on their arrival into it. The agonies of the parturient chamber, often not less fearful than those of the operating theatre, were quelled. Operative midwifery saw many of its difficulties vanishing. And not the least of its benign results, was when it held the Lethean cup to woman's lips, to charm away her hour of greatest sorrow.

The grateful news soon crossed the Atlantic; and speedily, praises of the pain-destroying ether, were uttered in every corner of our land. It came, however, to show its virtues only to have them supplanted. An alarm was sounded, that Death had claimed it as his agent. It had been fatal. The warning was little heeded; by most it was disbelieved as a false voice. Nevertheless, objections and inconveniences were alleged to pertain to sulphuric ether. Its odour was not grateful; it irritated the bronchi during inspiration; its required quantity, to produce its effects, was excessive. Prompted by the conviction, that "we would

ultimately find that other therapeutic agents were capable of being introduced with equal rapidity and success into the system, through the same extensive and powerful channel of pulmonary absorption," Professor Simpson, of Edinburgh, applied himself to the discovery of a new agent. He made many attempts, and met with as many failures. At length, in an interview with Mr. Waldie, of Liverpool, at the house of an old friend and schoolfellow, the conversation turning upon anæsthetics, Mr. Waldie recommended *chloroform*. With a happy facility for reducing theories and ideas into practice, Professor Simpson, forthwith, delaying no time, puts chloroform to the test. It comes out victorious. Its anæsthetic effects are produced with "a greatly less quantity than of ether; its action is much more rapid, complete, and persistent; its inhalation is more agreeable; its perfume is more pleasant, possessing an agreeable, fragrant, fruit-like odour; it leaves no disagreeable exhalation from the lungs, is less expensive,"* &c. &c. From this time (1847) chloroform became the popular anæsthetic on this side the Atlantic. Notwithstanding, its alleged superiority, however, it has failed in acquiring universal ascendancy. Not a few practitioners in this country, and still more on the continent, think they find a better and safer agent in a mixture of chloroform and sulphuric ether; while in America, the latter has always maintained its preeminence. And even in our own country, there is a growing conviction among surgeons, of the far greater safety of ether. And it is a recognised fact, that ether has the decided advantage over chloroform, in producing perfection of muscular relaxation, rendering it the preferable anæsthetic in cases of hernia, dislocations, spasm, &c. Doubtless, chemistry is not yet exhausted of its available anæsthetic agents. And for aught we know, another

* 'Anæsthesia in Surgery and Midwifery,' by Dr. Simpson, p. 194.

material may one day substitute chloroform, as chloroform has, in Europe, taken the place of ether.

Brilliant, however, as has been the career of modern etherisation, whether by sulphuric ether or by the vapour of chloroform, it has proved itself defective in one most essential point. It has, indeed, accomplished the annihilation of pain, but it has not accomplished the other requisite accompaniment; viz., immunity from accidents. Cautious men, not blinded against possibilities, from the first, saw and predicted danger. They saw in chloroform an agent which might possibly *kill*. They lived to see it become the destroyer of life. The alarm was first rung on the banks of the Tyne. A young woman died while under its influence, for an operation on the toe-nail. Professor Simpson was unwilling to see in this instance a death by chloroform; and endeavoured to explain it away as a death by asphyxia, from the means employed at reanimation. Dr. Glover of Newcastle, and others, took from it a graver and truer lesson. Other instances sprung up in different parts of Great Britain, and on the continent, and the blame was now shifted from imaginary asphyxia, to chloroform badly made, or badly administered. Chloroform-deaths marched on apace, but in every case was sought a palliation. At length, death took its stride northward, near home; placed its pale, resistless hand on a poor victim in the Edinburgh Infirmary. Old excuses and explanations were now scattered to the winds. The stoutest defenders of its innocuity were silenced; for in this case the chloroform was undoubtedly good, was properly administered by an experienced hand, and was contra-indicated by nothing ascertainable in the condition of the patient. The inference became inevitable: the most unwilling were compelled to admit the *possible fatal effect of chloroform, per se, without distinction of person or state.* From fifty to sixty recorded deaths confirm the correctness

of this conclusion. The post mortem examinations have revealed nothing satisfactory as to the fatal cause. Nay, they have rather added to the bewilderment. Some have looked with grave suspicion on a fatty degeneration of the heart,—a circumstance that can only come to light too late; viz., when that organ is laid bare by the scalpel. On the other hand, the chemical composition of chloroform throws no ray of light over our darkness; for it is important to observe, that *the same chloroform administered in the same quantity to the same individual, may be innocuous at one time, and fatal at another.* Viewed in this double aspect, the question becomes ominously grave. Men *may* die,—men *have* died, under the influence of chloroform, without any previous monition either to the patients themselves, or to their surgeons. The utter absence of any pathological condition on the part of the patient, or of any chemical defect in the chloroform itself, or in the mode of its administration, to which accidents can be attributed, have led many of our best surgeons to infer that death, in these cases, arises from *paralysis of the heart.* A fearful contingency, this. And who is secure against this contingency? Where is the patient whose *heart may not be thus paralysed?* The wave of life sometimes flows tremulously and uncertain. Who knows, that in the hour of anæsthetic unconsciousness, his own wave of life may not recede, or cease to flow? The question cannot but all forcibly present itself to every and any individual, since the condition determining paralysis of the heart is imperceptible, and unascertainable.

It may be alleged that we are prejudging the question, inasmuch as it is possible that further investigation may reveal the fatal cause. But what if, when ascertained, it be neither removeable nor remediable? What if it leave us to the risks and chances of ever varying constitutional

states? We confess to have our fears. Stern facts have fostered those fears. The graves of those who have never awoke from the unconscious moment of artificial repose, make us tremble.

Let us not be misunderstood. We do not participate in the wholesale repudiation of chloroform, *solely* because it has been productive of a few deaths out of, probably, a prodigious number of cases. For, in all probability, the ratio of fatal cases to the entire number of successful ones, may not exceed, or equal, the ratio of mortality from many medicines in ordinary use. Mercury, opium, &c., may, in a slower and less ostentatious, though not less certain way, have despatched mankind from the theatre of existence in a far higher ratio. There is, however, this essential difference. In the one case, the fatal result is sudden, immediate, irretrievable. In the other, it is less summary, and more under human control. If a practitioner has pushed his mercury or his narcotic too far, he has antidotes or means at hand to arrest its fatal action. But when the heart is once paralysed, the end hath come. And another most important distinction consists in the object for which such powerful agents are employed. The risk incurred in taking almost dangerous doses of a powerful medicine to counteract the fatal tendency of disease, is a far more legitimate course of conduct, than to resort to such dangerous doses merely to become insensible to a temporary pain. A man may be justified, for example, in resorting to partial poisoning, as in salivation, to arrest an inflammation which is hourly reducing his chance of life, when no justification could be awarded for adopting a similar course for the inadequate object of saving pain. It is the inadequacy between the means used, and the end gained, which forms the line of demarcation between chloroform and general medicine. Our objection, moreover, lies rather against the *principle* of the pro-

duction of anæsthesia *by pulmonary absorption.* It is doubtful if any agent, sufficiently powerful to produce complete anæsthesia, can be altogether innocuous, when absorbed into the circulating system. The changes it must necessarily work upon the vital fluids, sanguineous and nervous, must be of a character and extent which cannot be conceived free from danger. Nor does it appear possible to produce anæsthesia by pulmonary absorption without at the same time abolishing consciousness. The anæsthetic that is wanted, is one, which shall so act upon the nervous system as to *annul pain with perfect safety to the general system, without abolishing consciousness.* Neither chloroform nor ether come up to this standard. They are therefore thus far to be condemned, as not fulfilling all the conditions of rational anæsthetics.

It seems most probable, that the anæsthetic possessing that happy combination of innocuity and effectiveness to which we have alluded, will be one of a class of *local* anæsthetics; or an agent, the influence of which shall be capable of limitation, and easily controllable. The dread of danger attending the artificial production of general insensibility, for surgical purposes, appears to have been entertained from the earliest recorded mention of anæsthesia. Dioscorides makes reference to the reputed power of the Memphian stone to produce insensibility in the part to which it was applied. "They say," writes Dioscorides, "that this [Memphian stone], when bruised, and spread over parts that are to be cut or cauterized, produces in them a *dangerless* anæsthesia." A similar opinion as to the nature of the required anæsthetic, seems to have occupied the minds of those who have been most influential in introducing general anæsthesia. Hence we find Professor Simpson himself, not altogether content with the agent he advocated. He shared the common sentiment as to its

radical defect; and alluded to the production of local anæsthesia as vastly preferable, if any effectual method could be discovered. With this view, he undertook a series of experiments in the hope of showing, that in chloroform, locally applied, that end was attainable. But the experiments conducted by himself, as well as others by Mr. Nunneley, of Leeds, convinced them of its inefficacy for surgical purposes. It was not, therefore, without some surprise, that we lately witnessed an attempt at the revival of local anæsthesia by chloroform, by Mr. Hardy, of Dublin. The instrument invented by him to produce a strong local current of the vapour was ingenious enough, but appears to have failed in accomplishing the proposed object; while, in its application to the mouth, before operations on that portion of the body, its effect was no longer local, but general. It was put to the test in the Parisian hospitals and elsewhere, during the last winter, and the unfavorable verdict of the profession has, we presume, consigned it to oblivion. For therapeutic purposes, however, this mode of producing a slight degree of local anæsthesia may have its uses, though we know of no cases in which the application of cold is not far preferable, both as regards its immediate and ulterior results.*

A much nearer approach towards a truly rational anæsthetic, is to be found in an excessive *diminution of temperature*. Dr. Thomson, in his 'Lectures on Inflammation,' (p. 617), observes that "the sensibility to external impressions of the

* One example may suffice in proof of this opinion. Mr. Hardy's apparatus has been much commended to assuage the pain attendant on cancer; and a case is reported by Mr. Conde in the 'El Heraldo Medico' of June, 1854, of its beneficial results in that disease. Now these results only amount to an *alleviation of its distressing pain;* whereas by the application of intense cold, not only is the pain alleviated, but the frightful *disease itself is arrested or retarded.* And, moreover, the experience of Dr. Arnott and others serves to show, that when congelation is applied in an early stage to an accessible cancerous growth, the *disease will be cured by it.*

parts exposed to cold, is always more or less impaired, and the diminution in the sensibility of the nervous system seems to admit of degrees, from the slightest perceptible numbness to that of *the most complete insensibility.*" This benumbing influence and arrestive power of cold, are matters of individual experience in these northern climes. We witness the depressive action of cold in the annual increase of our mortality bills, during the colder months of severe winters. We behold it again in the instantaneous death which sometimes succeeds a draught of cold water, when the body is heated from exercise. On a larger scale, it is presented to us in the gradual diminution of life, as we ascend high mountain-slopes, as also in the barren wastes of frozen regions, and in the arrested development of polar forms of life. The vegetation which, beneath more genial skies, is abundant and beautiful, is stunted and diminutive towards the poles. The huge oak, the king of our forests, becomes but a small tree in the north, and refuses to grow at all beyond 62°; and aggregations of shrubs and shrublets take the place of waving forests. The willow travels further north than all trees; but, chilled by the northern blasts, its development becomes so arrested, that seven or eight of these northern willows would only cover a page of this pamphlet. And such is the effect of temperature on the animal creation, that at the approach of winter, our feathered tribes depart to warmer skies; and at no time beyond 55 N. is the voice of the nightingale ever heard.

Following up the hint given by nature in the benumbing cold of our northern winters, Dr. James Arnott, in the autumn of 1848, suggested the adoption of intense cold as "a safer mode than any hitherto in use of producing insensibility in surgical operations." But the surprise and delight of the medical profession at the discovery of anæsthesia were too fresh and excessive, to allow a calm con-

sideration of the pretensions of this new agent. Two years afterwards, however, Dr. Arnott found a listener to his claims in the person of the celebrated surgeon of La Charité, in Paris, M. Velpeau. Several operations were performed with perfect freedom from pain, the part operated upon having been previously congealed by a frigorific mixture. One case was the opening of a large abscess. In six others the operation consisted of the removal of the toe-nail, ordinarily an agonising procedure. In all these cases, we are told, "the patients watched the different steps of the operation like unconcerned spectators."* Now it is worthy of observation, that the mere opening of abscesses under the influence of chloroform, has proved fatal. And, from some hitherto unexplained peculiarity, the operation of removing the toe-nail has been singularly fatal under chloroform. During the same year (1850) Mr. Thomas W. Nunn removed some warty excrescences, which had been previously only imperfectly anæsthetised by cold, with very slight suffering to the patient, and with very little hæmorrhage, both of which in such cases are unusually severe.† Notwithstanding these successful cases with this new agent, and though it was brought before the Imperial Academy of France, by its own president, it made little progress in popular favour. We can only account for this upon two grounds: the first, from a strong prejudice in favour of anæsthesia by inhalation; and the second, by some misapprehensions as to the ulterior effects of cold anæsthetically employed, and of difficulties in its application. It is not, in fact, until the grim monster Death has again and again stepped in, and with a peremptory grasp of his cold hand, has momentarily claimed the unconscious victim of the surgeon's knife, that the medical profession is aroused from its apathy.

* See 'L'Union Médicale,' No. xlii, for 1850.

† 'Lancet,' 1850, vol. ii, p. 262.

Not till then is there any remarkable readiness manifested to listen to any proposal for the production of a harmless local anæsthesia, in lieu of the hitherto dangerous central anæsthesia.

First in the new field we find Mr. Paget, of St. Bartholomew's Hospital.

The first attempt which this eminent surgeon made with the new anæsthetic, was in the excision of a large fatty tumour on the shoulder of a lady. The skin was previously frozen in the ordinary method, when Mr. Paget made an incision *four inches* long, and proceeded to dissect out the tumour; yet we are told, "no pain was complained of."

In a late conversation with that gentleman, he informed me that his experience in the anæsthetic use of congelation, had confirmed his confidence in its efficacy and availableness. He stated that he had employed it before surgical operations, in at least *twelve cases*, during the last few weeks, with the happiest results. He shared the common sentiment as to the defectiveness of the present methods of applying it, limiting as they do its adaptation to the varied demands of surgery. As well as that he doubted its equal efficacy with chloroform in cases of deep-seated operations.

More lately Dr. Thomas Wood, of Cincinnati, reports, that he has "used cold for preventing pain in surgical operations in various cases," and that "in most of these it has met his expectations." He enumerates a number of operations in which he speaks most decidedly of cold as an anæsthetic being *far preferable* to chloroform, not only because of the non-abolition of consciousness, but because the anæsthetic effect itself, to use his own words "*is more complete than is ordinarily obtained by chloroform, and is fully equal to the most overwhelming dose.*"* In the same communication, however, Dr. Wood mentions several

* See 'Western Lancet,' for April, 1854.

operations in which the application failed. But these very operations, as he admits, have been performed in Europe without pain under the same means, viz., by cold. And, moreover, his failures are attributable, as he acknowledges, to a defective means of keeping up a sufficiently continuous degree of intense cold. This defect, as we shall presently show, is now overcome by a method of applying the cold, so as to retain the same low degree of temperature, however high is that of the part to which it is applied. We have no hesitation in saying that all those operations which Dr. Wood enumerates as impossibilities, have by this new method become possibilities. Nevertheless, a great step, we consider, has been gained in anæsthetic surgery, when a celebrated surgeon of one of the large American cities can write, "I have repeatedly witnessed the most perfect composure of countenance in my patients, while a nail of the toe or finger was rudely torn with a strong forceps, from its matrix, without the least exhibition of a sense of pain, or a consciousness of the progress of the operation, except from sight."*

Still more recently, Mr. Nathaniel Ward, of Broad Street Buildings, has added important evidence on the efficacy of cold as an anæsthetic.

"I was consulted," says Mr. W., "a few days back by a gentleman between 30 and 40 years of age, of a highly nervous temperament, concerning a tumour situated over the right clavicle, and which required removal. It was just one of those cases in which a surgeon, on the one hand, would not have sanctioned the use of chloroform, and, on the other, in which the patient would have protested against anything being done unless it could be accomplished without pain. The tumour was of a sebaceous character, as large as a walnut, had been gradually increasing for two or three years, and gave him inconvenience during every movement of the arm. On informing my patient that chloroform (to which he was much averse) would be attended with risk, but that the removal of the tumour could be effected with safety and without

* 'See Western Lancet,' for April, 1854.

pain by the previous application of cold, his nervous anxiety subsided, and he consented to the operation.

"I mixed together two parts of pounded Wenham-lake ice and one part of salt, and put them in a common white pocket-handkerchief, and kept the mixture pressed on and around the tumour during the space of one minute by the watch. The integument that was submitted directly to the action of the cold became remarkably corrugated. It was then cut into, and the tumour removed without the slightest sensation of pain, and much to the astonishment and delight of the patient, who said the only thing that annoyed him, and that not much, was the burning sensation of the application. No vessel required ligature, the bleeding, in fact, being very trivial, and the wound had healed at the end of the week.*"

Now, the operations we have enumerated, though comparatively few in number, afford ample evidence of the efficiency of the means advocated by Dr. Arnott; viz., the anæsthetic power of intense cold. It is admitted on all hands, that the operation of removing the toe-nail, is one attended with the most excruciating pain under ordinary circumstances. That operation has now been repeatedly performed without pain, and without any untoward accident, under the simple application of cold. In the opening of abscesses, cold is proved to act in the double capacity of annihilating pain, and modifying the inflammatory process. In the cases by Mr Paget and Mr. Ward, we have instances of its perfect adaptation to a very large class of surgical operations, viz., tumours; while in those cases enumerated by Dr. Wood, its adaptation to a variety of surgical operations is made manifest. And it may be added that many distinguished surgeons have adopted this method of inducing insensibility, though they have not as yet publicly recorded the success which we know has attended its employment in their hands.

Intense cold, then, may now be said to take a high place among our available anæsthetics. But we are justified in

* 'Medical Times and Gazette,' Sept. 2, 1854, p. 248.

proceeding farther than this, and asserting, that it has a most decided preference over all other modes of producing anæsthesia yet known. This preference is based on several important considerations. The first of these is, that it accomplishes the great desideratum of a rational anæsthetic, of *annulling pain without abolishing consciousness.* "If," says Professor Simpson, "we could by any means induce a local anæsthesia without that temporary absence of consciousness which is found in the state of general anæsthesia, many would regard it as a still greater improvement in this branch of practice.*" We echo that sentiment. It is but the echo of our natural dread of the artificial loss of consciousness. There is in the human mind a natural abhorrence and shrinking from the power that our fellow man can thus exert over us, of shutting us out, though only for a passing time, from the perception of our material existence. Even our nightly slumbers themselves would be our greatest mental foes, if we were nightly conscious of the loss of consciousness. Happily they steal over us unawares, and we surrender ourselves to them in the full assurance of security under a wise and indispensable ordination of nature. Natural sleep presents us with no terrors. It is a sleep induced by the action of the physical laws of our system. It is a sleep perfectly harmonious with the entire workings of our constitution. It is otherwise with the artificial sleep of anæsthesia. We submit to it with a latent dread that the consciousness we thus resign, may be resigned for ever. We believe that even the boldest man feels this lurking fear. And now that it is demonstrated beyond all contradiction, that perfect security of a return to life and consciousness, when once under the influence of chloroform, can be guaranteed to no man, the fear is one too rational to despise, and too solemn to be ridiculed. Shall we not

* 'Anæsthesia in Surgery and Midwifery,' p. 216.

then give the palm to that anæsthetic, under the influence of which we are able to *see* ourselves operated upon without *feeling* the cut of the knife?

Not only does local anæsthesia by cold, at once supersede the natural dislike of unnecessarily parting with our consciousness, and by that means obviate the greatest source of danger, but in the second place we urge for it, a *freedom from untoward complications.* It is an agent completely under the control of the operator; and its influence does not extend beyond the limits of the part to be operated upon, consequently the general system remains untouched by any possible accident. It is true that the idea of a frozen limb, or of a frozen portion of a limb, presents to us at first view a sensation not altogether agreeable. Our memories recall the histories of limbs lost by a long exposure to cold in high latitudes. We have pictured our enterprising expeditionists to the regions of eternal ice and snow, returning to us with disjointed toes, and fingers; and we have listened to many a sad tale of human life sacrificed on snowy altars. But the notions we have been accustomed to connect with the operation of severe cold on the human body in Arctic regions, are fallacious inferences when applied to the matter before us. In those cases the operation of the cold is unlimited and continuous. It affects the human system universally. The vital fluids of the body are materially changed in state. When used, on the other hand, for the production of anæsthesia, its operation is limited to a small sphere, and is continued only for a very brief period. Hence, its more severe results never accrue. But it will perhaps be urged, *the intensity of cold required to produce anæsthesia is liable to result in devitalising the tissue to which it is applied.* To this we reply, that no mere intensity of cold can of itself produce any such result, without a long continuance of application.

The application requisite to produce sufficient insensibility for surgical operations rarely exceeds two minutes. The objection may consequently take its place among the visions and dreams of unrealities. Besides, *experience* testifies to an opposite result. Congelation of the surface to a sufficient extent to produce anæsthesia, has now been practised some hundreds of times in different diseases, and yet no such untoward event has transpired.

It is, again, alleged, that the pain of returning consciousness in the part anæsthetised by cold, is almost as severe as the pain of the knife itself. This, however, is due to the mismanagement of the operator. A too rapid elevation of the temperature produces an almost intolerably burning pain. The remedy is simple. Graduate the return to the natural temperature of the part by the application of melting ice, or cold water. In many cases of the therapeutical use of this agent, all its good effects have been counterbalanced by this neglect. And we know of instances in which this remedy has been altogether eschewed on this ground. In short, all the outcry about devitalising the tissues, all the visions of impending gangrene and mortification, and all the complications which it is alleged the application of cold of such brief continuance as is required for surgical purposes may produce, are without the slightest foundation. On the other hand, cases of great nervous excitement, irritability, phrenitis, hysteria, and mania, have not been uncommon results of etherisation;* while vomiting is such an ordinary accompaniment, that rules have been laid down for a partial

* That the inhalation of chloroform is capable of leaving behind it a permanent impression on the brain, is manifest in the singular circumstance, that some patients invariably take up the same train of ideas at every repetition of the inhalation, though the interval consist of several years. Cases have, for example, been known, in which a patient has taken up the same strain of conversation at the second and third inhalations as at the first. They have discussed the same subjects, spoken in the same foreign language, sung the same

starvation of patients about to be submitted to its influence. Added to which are other inconveniences unnecessary to name.

By the use of intense cold, then, a state of local anæsthesia can be produced sufficient for the majority of surgical operations, without the slightest caprice of action, or risk of complication; and thus is removed one of the great doubts formerly entertained of the possibility of obtaining sufficient local anæsthesia without a dangerous effect upon the general system.

Again, the anæsthetic use of intense cold *does not place the parts in an unfavorable condition for being subjected to operation.* All local anæsthetics hitherto experimented upon, have this insurmountable objection in common,—that they produce a derivation of blood to the very part where its absence is most desirable; and a consequently increased liability to hemorrhage during the operation, and to inflammation after it. Now this is just the condition which cannot coexist under a wisely directed application of cold. In fact, the very principle or mode of its action, is by producing the complete temporary arrest of the circulation in the part to be operated upon. Its full effect cannot be obtained unless it succeed in blanching the surface it is applied to, thus rendering congestion an impossible occurrence; as well as effectually checking any undue amount of hemorrhage resulting therefrom. Not only has cold, employed anæsthetically, the negative benefit of not placing the parts in an unfavourable condition to be operated upon; but on the contrary, it offers the surest and readiest means for the improved appliances of modern surgery. The application of cold to check hemorrhage, is one of the

sougs, and uttered the same prayer, as those which they adventitiously did at the time of their first inhalation. It is a curious psychological circumstance, independently of its physical relations to the influence of etherization on the cerebral system.

commonest and most effectual appliances offered in surgery. By using cold as an anæsthetic, the great liability to hemorrhage is at once obviated. That complication, in fact, which so often constitutes the most serious part of operative surgery, is not only not left to the risks of being checked or not, but is prevented. It is of equal value in the sequelæ of operations. Cold water dressing, in superseding fœtid, cumbrous poultices, and rancid, irritating ointments, is recognised as one of the best appliances of post-surgical processes. The surgeon applies a simple cold cloth to the parts after operation, to keep down inflammation. What the surgeon sees fit to do *after* an operation, to repress inflammatory action, he cannot reasonably object to being done *before* the operation, to attain the same object, especially when, at the same moment, it renders the part insensitive to the necessary cruelties of his art. "The characteristic tendency of disease, at the present day," [after operations,] says Mr. Druitt, "is decidedly toward phlebitis, erysipelas, diffused inflammations, and other maladies of a low type." Now, we would submit as highly probable, that under the well regulated application of cold as an anæsthetic before operating, especially if combined with a discreet employment of the same agent in deep operations, this characteristic inflammatory tendency which is the drawback of modern surgery, would disappear. Congelation has already been employed many times in cases of idiopathic erysipelas with the best results;* and from the property which cold possesses of preventing vascular excitement, we think there is every reason to believe that under the use of congelation as an anæsthetic, traumatic erysipelas would rarely occur. Whether these opinions be correct or not, we claim for intense cold decided advan-

* See Dr. Arnott, on the Treatment of Erysipelas by severe Cold, &c., in 'London Medical Gazette,' March 9th, 1849.

tages, as placing the parts to be operated upon in a far more favourable condition, both as regards the liability to accidents, primary or secondary, than those parts would possess either without this local anæsthesia, or under etherisation. And the mode of its action is notably in accordance with the principles of after-treatment adopted by our best surgeons.

Another point is here worthy of observation. *The application of intense cold expedites the cure of wounds.* Dr. Arnott, in his pamphlet on 'The Question Considered,' &c. p. 19, remarks, "that wounds of the skin so congealed, have invariably healed, by the first intention, more speedily than under ordinary circumstances;" and in another place, he tells us, "Congelation has often at once converted an irritable into a healing ulcer."* And in Mr. Paget's case, quoted at p. 12, although "the incision was four inches in length, a considerable portion of the wound readily united by the first intention, and the rest soon closed." Again, Mr. Wood informs us that in his case, "the wound had healed at the end of the week." It were vain to insist on the paramount advantage of this result. It accomplishes the most anxious hope of the surgeon, and overcomes what is often a serious difficulty. We would submit whether the frequently tedious continuance of the cold water application after amputations, &c., might not be advantageously substituted, for a time at least, by cold at the intensity of congelation. If the application of cold for anæsthetic purposes is productive of a readier and more effectual healing of incised wounds, it appears only a fair conclusion that a greater intensity of cold water dressing than is in ordinary use would greatly expedite the recovery. Not an inconsiderable advantage, however, to operative surgery will be gained, if, through

* 'Monthly Journal of Medical Science,' July, 1854, p. 36.

the anæsthetic use of cold, union by the first intention become a more frequent and more certain occurrence.

Another advantage attending the production of anæsthesia by congelation is, *that it can be applied to all persons without distinction.* Its influence, extending over only a limited portion of the external surface, leaves unscathed any of the internal viscera. If they be healthy, there is nothing in it to produce in them a morbid state; and if they be functionally or structurally diseased, or even undergoing disorganization, it has no power of hastening, or increasing, or complicating the morbid processes. It is far otherwise with anæsthesia by inhalation; for it *cannot* produce its effects until it has induced a *disease* in the system. An irregular action of the ganglionic system of nerves, consisting of a morbid stimulation and a succeeding depression, has to be superinduced. The blood, which should be in free unrestrained circulation, is pent up in the internal viscera, to the detriment (however transient) of the organs of animal life. And the annihilation of sensibility does not occur until the quantity of blood ordinarily sent to the brain has been materially lessened, or until the equilibrium of pressure has been destroyed. And a passive state of the muscular system is not induced, until the circulation is considerably diminished in the spinal cord—until, in fact, a point is arrived at, to exceed which is *death.* This has been demonstrated by experiments on animals. And the same experiments have shown, despite all former assertions to the contrary, that etherisation is only a *rapid intoxication.* The blood circulating through the brain must be vitiated—must be rendered less capable of sustaining life, and less adapted to sustain the functions of the internal viscera in all their integrity. Hence with what anxious eyes do surgeons watch every heaving of the patient's chest, and how unremittingly does the finger keep guard upon the pulse, fearful,

lest from the presence of unascertained disease, the liability to asphyxia may be increased, or that the poisoned blood arriving at the heart, may be inefficient to stimulate its contractions. In anæsthesia by chloroform, the patient's state is matter of momentous concern; and in many cases is such as to render its use wholly inadmissible. In the adoption of congelation as an anæsthetic, we, on the other hand, cast all fears to the winds. It is an agent destroying sensibility, it is true, by destroying the equilibrium of the circulation; not of the general circulation, but only that of the part to which it is applied; and the disturbance is therefore of only a very limited extent, so limited, as not to reach a vital organ, or affect the brain. No anxious eye watches the respiratory motions; not a finger becomes sentinel to the heart. No state of intoxication is induced; and thus no matter though the lungs be hollowed out by tubercle; no matter though the the brain be surcharged with blood, or disorganizing from disease; no matter though fatty deposits have grown around the walls, and along the cords of the heart; no matter though its contractions be irregular or intermitting; no matter though a *bruit* tells the sad tale of a valve impaired—we have in cold an agent which offers its unrestricted aid to all alike—to all, though death's decaying fingers have already begun to mould the destiny of the vital organs.

Many other prominent advantages which cold, as an anæsthetic, possesses over chloroform, might be pointed out, but we forbear enumerating them. Enough has been said to show that, in congelation, we have an efficient anæsthetic, free from the dangers of ordinary anæsthesia, and more in harmony with the recognised principles and practice of modern surgery.

A rebuff may be ready for us here. It may be alleged *that our anæsthetic does not meet the requirements of all*

surgical cases. There is a semblance of truth in this objection, though it is not valid to the supposed extent. Since the influence of congelation, when applied to a part, is capable, unless long continued, of penetrating only to a limited extent beneath the surface, it is alleged to be wholly inefficient for many capital operations, as amputations, &c., as also for any operations involving the deeper seated tissues. Now, the object of administering or applying an anæsthetic is to annul a pain which would act injuriously on the system. If an anæsthetic accomplishes that, it does all that is essentially required. There are degrees of pain under surgical operations, which are not only quite endurable, but which do not injuriously affect the system. And in many cases such pain is conservative. This principle has been recognised in all our surgical theatres, even at Edinburgh itself, where there is the most profuse display of chloroform.

In operations involving only a slight or easily endurable pain, it is rare that surgeons are at the trouble of mitigating it by anæsthetic application; which we take to signify, that such amount of pain is comparatively innocuous. What, then, constitutes the chief pain of any operation—where is its seat? It is admitted, we believe, on all hands, that the first cut of the knife, or the incision through the skin, is what may be termed *the* painful part of an operation.* And the cause is obviously from that delicate net-work of nervous tissue which is so abundantly distributed on the cutaneous surface, whereby we are endowed with the sense of touch. That which gives to us our tactual perception of material existence, is that which becomes to us a distressing

* Thus, in the 'Medical Times and Gazette,' July 1, 1854, p, 12, it is observed: "As is well known, the cutting of the skin [in the removal of subcutaneous tumours] is almost the only painful part." And again, in the same article it is remarked: "In a very great majority of the cases for which chloroform is now used, the cutting of the skin is almost the only painful part of the operation."

sentinel of danger. The sensibility to pain of the sub-cutaneous or muscular tissue, is comparatively small. Sir Chas. Bell, in his 'Bridgwater Treatise, on the Hand,' remarks, that "when the bones, joints, and all the membranes and ligaments which cover them are exposed, they may be cut, pricked, or even burned, without the patient or the animal suffering the slightest pain."—(p. 153.) It would then appear that, if the extreme sensitiveness of the skin to pain could be destroyed by any anæsthetic application, the chief and only injurious portion of pain in surgical operations would be annihilated. And this is just what we claim for congelation. It does destroy the sensitiveness of the skin; it has power to abolish the really agonising part of operations. For proof of this, we appeal to the foregoing cases by Mr. Paget, Dr. Wood, and Mr. Ward. The first incisions were rendered painless by congelation of the surface, and the dissecting out the tumours caused no appreciable suffering. But, even providing the sub-cutaneous tissue were sensitive to pain to a high degree, there are few operations which would not admit of the application of cold following the first incision to destroy even that amount of pain; so that even as regards deep-seated operations, we claim for congelation an anæsthetic power of far greater extent than at the first blush would appear.

But all operations are not capital operations—all are not deep-seated. The majority of operations are superficial. Consult the records of any large surgical hospital, and it will be found that the minor operations greatly predominate;—a fact which the private practice of every surgeon must confirm. And in all these cases, not a doubt can now be raised of the desirableness of the method we advocate. If, again, we select from the recorded list of fatal cases of chloroform those cases in which the application of cold was admissible to its full extent, we shall find that, in no less

than *three fourths* of the whole, the agent we advocate would have effected the desired state of perfect anæsthesia. We are justified, then, in asserting that at the least, three fourths of the lives which have been momentarily sacrificed by the inhalation of chloroform, to annul pain, would have been saved to the world, while the desired immunity from pain would have been gained.

We arrive, then, at this fact, that in by far the great majority of surgical operations, pain may be abolished by the anæsthetic power of cold to the requisite degree without periling life, and without risk of grave complications. And what though it be inapplicable in the smaller number? Is it at greater disadvantage than chloroform? We think not. There are cases, and they are pretty numerous, in which chloroform is inapplicable. That insidious disease so peculiar to our climate—pulmonary *consumption*—constitutes nearly one fifth of the whole annual mortality of these islands, and carries away one in every 310 of the population. Diseases of the heart also increase our mortality bills in a very high ratio. In these cases there are few who would not hesitate to administer chloroform, while there is nothing whatever in them to contra-indicate the practice of congelation; so that what congelation may lose in one direction it gains in another. If it fail in some of the deeper seated operations in producing an entire abolition of pain, it has the advantage of being *universally* applicable. It will render painless, operations on the bodies of a large proportion of the population, which chloroform cannot do. In this respect, therefore, it offers a compensation amply sufficient to warrant us in giving a decided preference to congelation over etherisation for anæsthetic purposes.

To the art of the accoucheur, we confess congelation does not hold out the same advantages as to that of the

surgeon. Its influence does not extend to the parturient chamber, though in many obstetric operations on the cervix uteri and vagina, it is as serviceable for anæsthetic purposes as in operations on other parts. Those ladies who wish to be unconscious during the physiological process of labour, must still find the accomplishment of their desires in other agents. It must be remarked, however, that the anæsthetic state required for operative surgery, and that required for midwifery, is vastly different in degree. In the one case anæsthesia has to be pushed to the point of danger, while in the other, the requisite degree is very far short of danger, except in rare cases, where extreme muscular relaxation is desirable. And we know it to be the opinion of eminent accoucheurs who use chloroform when requested by their patients, that its benefits in midwifery can be realised with an exceedingly small quantity of the vapour. To this limited degree of anæsthetic effect is to be attributed the safety of chloroform in midwifery. No fatal cases under its influence, in midwifery, have yet been recorded.* It may, however, be asserted that, notwithstanding the strenuous efforts which have been made to bring anæsthesia into popular use in midwifery, its adoption is still the exception rather than the rule. In England, it has never made much progress in this direction. It is neither extensively

* We have heard it reported of an eminent accoucheur in the North, who is never without the chloroform bottle in his pocket, that not long since a case of sudden death occurred during delivery in his practice, in which there was no hemorrhage, internal or external, to account for the *alleged* cause, viz., rupture of the uterus. The result of the *post mortem* was never made known; and the ungratified curiosity of the profession led to general whispers of its being a *death from chloroform*. The mystery has always remained unexplained. We know not why mystery should be fostered by any professional man, unless it be to hide the mishaps and dangers of a practice he has wedded; a course highly reprehensible, but one, alas! even among the champions of medicine, too common.

advocated by the accoucheurs, nor demanded by the ladies.* It has not yet come to be considered a *relic of barbarism* for ladies to endure the appointed pains of a physiological process. Most persons still look upon the production of anæsthesia in midwifery as a contravention of a religious ordinance. Whether the objections thus raised against anæsthesia for this purpose are grounded in reason or not, the fact remains unaltered, that among the general population, insensibility in midwifery is rarely sought for, and rarely induced. And, in so far, the objection to the incompetency of cold as an anæsthetic loses much of its weight.

The supposed trouble and difficulties attending the use of congelation, have doubtless deterred many from adopting it. The methods hitherto prevalent of inducing insensibility from cold, have been by the admixture of ice and salt, in given proportions, enclosed in a net bag and applied to the part; or by the application of a metallic ball previously buried in the same mixture; and other metallic instruments have been constructed for this purpose, upon the same principle. It is obvious, however, since the conduction of heat from the part of the body to which these are applied, is great and rapid—that their temperature is as rapidly raised above the desired intensity of cold; so that what has been hitherto wanting, is a means of *keeping up an unalterable temperature* at any given point, without interfering with the rapid conduction of heat. For

* Dr. Merriman, for example, thus writes in the 'Medical Times and Gazette' for April 22d, of the present year, (1854): "Chloroform may produce alarming results in midwifery practice, and, if given at all, it should be in small quantities only." And he adds: "The more I hear and see of the use of chloroform in midwifery, the more I am convinced, that though it may occasionally, be useful, and even desirable in the small quantities now administered in London, its administration is not desirable in ordinary cases." Dr. Merriman, in the same communication, relates the painful history of a patient, whom the administration of chloroform, in her last labour, has driven within the walls of a lunatic asylum.

some time past I have directed my attention to the attainment of this object, and I am happy to say, with the desired result. I have had constructed an apparatus by means of which a continuous supply of cold at from 5° to 20° below zero can be kept applied to any part of the body. It is unnecessary here to enter into any minute description of the mechanism of this apparatus, full particulars of which will be forwarded to any one on application to Messrs. Horne and Thornthwaite, 123, Newgate Street, London; suffice it to state, that it is so constructed as at the same time to carry away the heat that is conducted from the body, and to renew the original intensity of cold. In short, there can be kept applied to the body, an *invariable intensity of cold, and that of unlimited duration.*

The advantages of this mode of applying cold are seen: First,—In the circumstance that the process is more rapid. The heat that is conducted from the body, instead of being allowed to raise the temperature of the cold, as in the ordinary method, is carried away; and since the rapidity in producing the anæsthetic effect, depends upon the rapidity of the conduction of heat from the surface, it follows as a necessary consequence, that the absorption of this heat must be more rapidly and more extensively effected, when the intensity of the cold is preserved at an invariable standard. Secondly,—in cases requiring a more lengthened application, as in deep operations, the amount of heat conducted from the body into the ordinary mixtures, or into the metallic balls, is sufficient soon to destroy the congealing effect; whereas, by the method I propose, the same intensity of cold can be kept applied *for any length of time*, whatever be the quantity of the absorbed heat. This circumstance also makes the state of anæsthesia far deeper and more effectual. Thirdly,—Net bags, and metallic balls or spoons, cannot be applied to all parts; whereas, by a

simple and easy modification of the terminal portion of this apparatus, cold can be applied to any accessible portion of the body; thus bringing many operations before inadmissible by the application of cold, perfectly within the province of its anæsthetic influence. Fourthly—The net bag, besides its not being an artistic mode of application, admits of the passage through the interstices of the network, of the *irritating ingredients* of which the freezing mixture may be composed; which, when applied to already wounded surfaces, become a source of great injury. Through this apparatus the fluid cannot penetrate; and thus the parts are preserved from every source of irritation and danger. Fifthly,—Net-bags, &c. produce a more widely extended insensibility than is required for many operations. With this apparatus, the action of the cold can be nicely adjusted or limited to the amount of surface to be operated upon, while it is equally adapted for anæsthetising a large surface; so capable of limitation is it, that the surgeon can keep up the most intense action of cold over a surface not greater than the size of a split pea. Sixthly,—The refrigerating mixture in this apparatus, flowing out in a fluid continuous current, obviates the more capricious action of the net-bag mixture, which can only produce its effects as it is passing from a solid to a fluid state. A regular and certain action is kept up, instead of an irregular and uncertain one. And many other minor desiderata are accomplished by this apparatus, whereby, it is hoped, the use of cold, as an anæsthetic, will speedily take an undisputed position in operative surgery.

The question of the anæsthetic application of cold in preference to chloroform, &c., now becomes to our mind one of professional morality. It is no longer a doubtful point, whether cold is capable of effecting sufficient insensibility for surgical operations. The toe-nails which have

been torn away, the tumours which have been dissected out without pain, and other painless operations, have for ever silenced scepticism. There can be no fear of its perfect safety; for there is nothing in its composition or mode of administration to affect a vital organ. It is equally innocent as to giving rise to any serious complication. No person, whatever be the condition of the more important viscera, is excluded from its benefits. These collateral advantages do not belong to chloroform. This latter can annihilate pain to any extent, it is true. But it does so for no one but at the risk of life. It can render men unconscious; but, for that temporary unconsciousness, it often demands the lifetime penalty of reason, or of a long endurance of ills. If, then, there be a means of annihilating pain unattended with these risks, and these possible ills, what is the manifest duty of the profession in regard to such an agent? Have not the public a right to demand of their medical guardians, that at the least, in all those cases in which the substitution of cold has been proved effective, human life should no longer be sacrificed to prejudice? Have they not a right to demand that they have all the advantages which the progress of science presents, and that the cures of their disordered frames should be wrought by that means which is attended with the most certain results, and with the least pain consistent with the least danger? Will the surgeons of this age continue to abolish consciousness during their operations, when those operations can be made painless, without depriving their patients of intelligence? Will the surgeons of this age be content to see their patients coming into the operating chamber full of hope, carried out lifeless corpses? We do not believe it. Death wears as grim an aspect to the surgeon as to other men. His visits are welcomed neither in the hospital ward, nor in private practice. Death is the

great foe whose invasions on the human form, in ever varied aspects, it is the surgeon's office to repel. Humanity is the mainspring of his art, kindly cruel though it be. And we feel no apprehension that a class of professional men, holding such a high moral position with the public, would discountenance the realization of a painless surgery, without the abolition of consciousness.

PART II.

ANÆSTHESIA IN DENTAL SURGERY.

In the preceding observations I have taken a cursory view of the anæsthetic uses of cold in general surgery. I proceed now to consider its paramount advantages in that special department of surgery which I myself practise, viz., Dentistry.

Few operations, perhaps, are more painful than tooth-extraction. The operation itself consists of a violent dislocation,—of a forcible separation of bony plates,—of the division of nerves and blood-vessels,—and of a separation of the gum. The excruciating character of the pain is, in all probability, dependent rather upon the separation of the osseous plates than, as popularly believed, upon the division of the nerves entering the fangs. But to whatever cause attributable, it is a pain from which most men shrink, and is one which many fruitless attempts have been made to abolish. As we have seen in the foregoing remarks, it is this pain which brought about the modern revival of anæsthesia; and this pain it was which was the first abrogated in modern times. (See *ante*, p. 1.)

Many of the more enterprising followers of this portion of surgical art have, at various times, directed their energies to the attainment of a painless dentistry. It has been reported that a certain dentist at Limoges, in France, M. Pernot, had discovered a method of extracting teeth with little or no pain. This method was described as consisting in the application of an "obtunding agent" to the gums. What that agent was, has not, as far as we know, transpired; and the method does not seem to have extended

itself beyond the private practice of that dentist. If the object were really attained by him, he seems to have had a greater regard for his own aggrandisement than for alleviating the sufferings of his fellow-men. It is, however, much to be doubted if complete insensibility was accomplished; for the same experiment has been tried with the whole range of obtunding agents, by various individuals, without adequate success. I have also heard rumours of a dentist on the south coast of England, professing painless tooth-extraction, by directing a current of chloroform around the tooth to be removed—a remedy which, we conceive, belongs to the same class as Perkins' Metallic Tractors of the last century;—or a remedy, if one at all, acting through the imagination of the patient; and doubtless the imagination may be as effectively wrought upon by the dentist as we know it is by the physician. The populace who know little of the properties or action of chloroform, may have their one idea of it so designedly wrought upon, as to *imagine* the absence of pain.

The introduction of etherization, combined with the brilliancy of its career, has doubtless had the effect of repressing these attempts at the production of a local anæsthesia for tooth-extraction. Nothing in fact seemed likely to supersede it. And thus, up to this present time, we have only been able to obtain relief from the pain of tooth-extraction by inducing a state of general insensibility. Unquestionably, under the insensibility of chloroform, dentistry may have the privilege of becoming a painless art; and had that insensibility been unattended with any of those risks we have already recounted, nothing better could be desired. Its later history, however, has brought it under condemning judgment. The irrefutable fact, that human life is in danger whenever brought under the influence of chloroform, has materially changed the aspect

of anæsthesia so produced, for the purpose of tooth-extraction. So long as its dangers were unknown and unrealised, dental operations under its influence seemed as justifiable as other more severe operations of surgery. Under the new state of matters, we have no hesitation in saying that *dental operations under the influence of chloroform are not justifiable.*

This conclusion is based on two grounds. First, the pain of tooth-extraction, though severe, is brief in duration. In numerous instances, the mere pain itself rarely is productive of graver consequences than the momentary shock. In persons highly susceptible of pain, or in certain states of constitution, it is doubtless often of the utmost importance to obviate even this short duration of pain, though certainly not at a possible sacrifice of life itself. Secondly, it is not ordinarily an operation attended with very grave results. It is not often that the mortality tables of the Registrar-General are increased by untoward results in dental surgery. The wound caused by extraction is in its nature comparatively slight, and easy of reparation. There is no large mass of tissue to be united,—no structures likely to take on extensive inflammation,—no pyohæmia, nor phlebitis; no deleterious influence, in fact, bears upon the general system capable of producing the great mortality of many surgical operations. In many of the capital operations, for example, the chances of recovery are extremely small, and indeed in some they are almost reduced to *nil.* The difference then lies in this, that in many surgical operations fatal results are *expected* to occur in certain proportions; while in tooth-extraction such a result may almost be said never to occur. A patient, yielding himself to the doubtful result of returning to life under chloroform in the one case, only throws away so many chances as he might have possessed from the peculiar nature and attendant mortality of the operation itself; while in the other case, the mortality being

nil, he makes, in inhaling chloroform, an unconditional and unqualified surrender to the possibility of death. The value of a man's life, in the one case, is but as 1 in 2, 3, 4, or 5, and so on; whilst in the other, it is equal to that of the average of the community to which he belongs. Now, putting aside the consideration whether a man has any moral right to trifle with the destinies of human existence, we say, viewing the subject in this double aspect, viz.—the value of any given life under the two kinds of operation, and the brief duration of pain sought to be escaped from,—that it is not justifiable in such an operation as tooth-extraction, to resort to an agent to produce insensibility, which may result in the loss of life. It is this conviction, we have no doubt, which has ever prevented the general adoption of etherization in dentistry. If a man undergoing an operation, knows that his chances of life are small, and that the severity of the accompanying pain is such as to diminish even the few chances he has, then he may perhaps, in the *absence of better means,* legitimately resort to chloroform; but on the other hand, if his chances of life are equal to those of the general community, and the accompanying pain of the operation is of but brief severity, he may not legitimately yield himself to such an anæsthetic agent. The circumstances attending the loss of a thigh may warrant the risk of life by anæsthesia; but to say that the circumstances attending the loss of a tooth should be put on equality with the *possible loss of life,* is an anomaly, at which our moral sentiment recoils.

Is dentistry, then, to form an exception to the use of anæsthetic agents? To the use of such as have hitherto prevailed, we say most decidedly—yes. But we speak very differently, though as decidedly, in regard to *local* anæsthesia. I have been long impressed with the conviction that some obtunding agent, capable of only a local applica-

tion, might be found for the purpose of painless tooth-extraction. From the moment that I found chloroform in dentistry contraindicated by moral sense, I instituted a series of experiments with various substances, hoping to find one competent for the desired object. Of all the diversified agents which, for the last few years, I have thus tested, none have been comparable in their anæsthetic effect, and in their collateral advantages, to the *application of intense cold.*

Not a few difficulties had to be surmounted before the efficiency of intense cold, as an available anæsthetic in tooth-extraction, was demonstrated to my perfect satisfaction. Theoretical notions, somewhat corroborated perhaps by the unpleasant sensation so often experienced in hastily despatching an ice on a hot summer's evening, seemed opposed to the practice; and for a long time I was doubtful, if the pain of the application would not equal or exceed the pain of the extraction. The seat of operation itself, both from its peculiar anatomical form, and from its high degree of temperature, presented new obstacles. Undaunted by repeated failures, I at length overcame all obstacles. By a slight modification of the terminal portion of my apparatus, alluded to in p. 29, adapting it to operations on the mouth, I am able to produce the required anæsthetic effect; and hence, I am now in a position to say, that I can accomplish PAINLESS TOOTH-EXTRACTION WITHOUT ABOLISHING CONSCIOUSNESS.

In proof of the efficacy of the means I have adopted, I select the few following from my list of cases.

CASES.

CASE I.

This patient has been from early youth a sufferer from dyspepsia. The teeth sympathising (if it may be so termed) with the disordered state of the stomach, and acted upon by the vitiated salivary secretions, became the subjects of extensive caries. The mouth had become seriously affected by a succession of alveolar abscesses from the irritation of the dental caries, which again, in its turn, kept up the deranged condition of the alimentary canal. From dread of the operation, she had delayed seeking advice, till at length increased suffering led her to consult me. I found it would be necessary to extract no fewer than *seven teeth*. These were extracted at two separate times. They consisted of three molars, two stumps, and two bicuspids. Some difficulty was experienced with the second molar in the upper jaw, from an irregularity in its formation, and from the firmness with which it was fixed in the alveolus. Yet even with this there was no appreciable pain. It was, in fact, with difficulty she could be convinced that an operation she had so much dreaded could possibly be so painless.

CASE II

Was the extraction of a lower bicuspid. The patient had suffered for a considerable time from pain in that portion of the jaw in which the bicuspid tooth is located. It commenced with a slight gnawing sensation, succeeded by violent throbbing, and terminating in a distressingly dull heavy pain, with a swollen and œdematous condition of the face on the left side: in fact, all the usual symptoms of a general inflammation of the pulp had presented themselves; which fact was corroborated upon making a section of the tooth after extraction. The face was so much swollen that it was with some difficulty sufficient space could be gained to fix the forceps. Notwithstanding, from the small space occupied by the apparatus for destroying the sensibility of the part, this swollen condition presented no obstacle to the induction of a full and perfect state of local anæsthesia. The consequence was, that the tooth was withdrawn without any appreciable pain.

CASE III

Was one of those by no means uncommon instances, in which one or more of the fangs of a molar tooth become necrosed or dead. In this case, the outer fang of an upper molar alone had become affected with necrosis, as was evident by the uninterrupted passage of a probe down into the socket. The gum on that side had partially sunk down, leaving a portion of the surface of the fang denuded. It was discoloured, rough and unattached. The other portions of the tooth were sound and pretty firmly attached. The patient, a middle-aged gentleman, from the country, had observed for some months past a growing uneasiness, sadly interfering with the pleasures of the table. For some time he fought the battle between pleasure and pain, and at last, after extorting from me a promise that I would be lenient with him, he placed himself in my hands. The result was, the removal of the tooth with little or no sensation.

CASE IV

Was that of a patient who had suffered, among other injuries, fracture of a tooth from a fall. Upon examination I found the crown had been chipped, leaving the pulp and dentine exposed. The slightest contact either of the tongue, of the atmosphere, or of any foreign body, against the exposed surface, produced the most excruciating pain. As this was the first case of fractured tooth in which I had had an opportunity of testing my apparatus, I was apprehensive that the extreme sensitiveness of the surface of the dentine, and the exposed pulp, would contra-indicate its use. It was, however, applied. A momentary pain only was experienced, as the intense cold was placed on the tooth; after which the parts became blanched and insensible. The remaining fragment of tooth was then extracted free from pain.

CASE V

Was a double operation at one sitting, consisting of the extraction of an unusually large stump of the left lateral incisor of the upper jaw, and of an anterior molar on the same side, a portion of the crown of which tooth was in a carious state, and exquisitely sensitive to the touch of a small stopping instrument. This patient had suffered for a very long period from periodical attacks of violent pain on the left

side of the face. She had been unable, as is very common in these cases, to masticate her food efficiently, and was suffering the ordinary result of dyspepsia. No arguments could prevail upon this lady to submit her teeth to the dentist's forceps. She buoyed herself up with the hope of a cessation of her dental troubles, when her general constitution was improved. Dental disease, however, once established, rarely yields to the physician's medicines. Her hope was vain. The pain became more constant and distressing; and not until severe constitutional symptoms appeared from the local irritation, was she aroused to the desirableness of parting with these enemies to her peace. When she found both of these teeth taken out without suffering, her self-reproach was equal to her previous fears.

CASE VI.

In this case, it was the first time that the patient had submitted to the operation of tooth-extraction; and the circumstance that she sought to be relieved from two *stumps* was an additional source of dread. They were two detached stumps of the second molar of the right side of the lower jaw, fixed in the socket with unusual firmness. The cold, as usual, was applied to the farthest stump, which was speedily extracted without the slightest pain, much to the surprise of the patient. Unfortunately an accident happened to my apparatus, which prevented me applying the anæsthetic to the second stump; but as this patient appeared to possess excellent general health, and was also remarkable for great strength of mind, and for an unusual amount of moral courage and endurance, I suggested to her, that she should submit to the extraction of this second stump without its being rendered insensible to pain. Having a secret misgiving in her mind that the pain attendant on tooth-extraction had really been vastly overrated by her friends, she at length consented to the extraction without the anæsthetic application. Consequently, after waiting a short time, to allow the anæsthetic influence which had been previously applied to the other stump entirely to pass away, I proceeded to extract this second stump. The pain she endured was quite decisive. Her incredulity as to the pain of the operation was removed, and her full sympathies were aroused. To use her own words, "such experience was indeed convincing." And to me it was convincing in more ways than one: for, as observed above, these two stumps were detached portions of one and the same tooth, conse-

quently there were no circumstances (apart from the anæsthesia) to render the extraction of the one more painful than that of the other; and it further showed that moral courage and physical strength do not avail to abolish the crushing pain of tooth-extraction.

CASE VII.

This was one of the somewhat rare cases, in which defective growth of the lower jaw had given rise to malposition of the wisdom teeth. This patient had suffered for some months from a series of distressing symptoms, which had altogether defied the skill of the family doctor. The principal seat of pain was about the angle of the jaw, but it appeared to have extended itself to all the teeth of that jaw, which were extremely tender to the touch; and the gums were so sensitive, as to be painfully affected by any fluid of a temperature either above or below the natural standard of the mouth. For some time also the patient had been unable to masticate solid food. The tonsils were considerably swollen, and a dull tormenting pain was experienced in the side of the head and down the shoulder. The character of the pain being described by the patient as differing from that of ordinary toothache, the medical attendant was thrown off his guard, and had resorted to a great variety of constitutional treatment, to overcome what at one time was thought to be rheumatism, and at another violent neuralgia. In spite of all physic, topical applications, change of air, &c., the painful symptoms increased in intensity, at which period this patient consulted me. From the swollen state of the tonsil it was difficult to make a minute examination of what I at once suspected to be the source of the derangement, viz., some irregularity in the development of the wisdom tooth. My suspicion, however, was confirmed upon finding a misplacement forwards of the wisdom tooth—the crown resting upon the posterior surface of the second molar. As the tooth was altogether useless for mastication, and was, moreover, the *origo mali* undermining the patient's constitution, its withdrawal was the only remedy. The cold was again applied to the tooth, which was extracted with scarcely any pain, notwithstanding the high degree of periosteal inflammation which existed. From that day the symptoms subsided, and the patient was restored to the enjoyment of health.

CASE VIII

Was that of a lady, who, from early youth, had been remarkable for the regularity, beauty, and soundness of her teeth. The deforming

influence of disease, to use her own words, was destined to wound her pride. A severe attack of scarlet fever, which so generally leaves sad marks upon the constitution as records of its invasion, left, among other sequelæ, its traces upon her once healthy teeth. Several teeth, which before were sound and ornamental, rapidly succumbed to destructive caries. In the present instance this lady applied to be relieved from the stump of an upper incisor. It was certainly one of the most difficult and rebellious cases of stump-extraction that I have witnessed for a long period. Repeated gum-boil, from continuous absorption, and consequent softening of the dentine, had produced an excessive tenderness of the gums; and the tooth was so much worn away, that the operation of punching was the only available mode of extracting it. A sharp-pointed elevator was thrust down the side of the stump, and considerable force was exerted to remove it from its socket. The chief cause of the difficulty in this case was manifested after extraction, in the form of a small exostosis, or outgrowth of the fang, which was as usual, firmly impacted in the osseous structure of the socket. The immunity from pain which this patient enjoyed, under an operation ordinarily of the most agonising character, gave one of the most remarkable evidences I have as yet had of the efficiency of my method of inducing insensibility to suffering.

CASE IX.

This was a case, interesting rather from the peculiarity of its accompanying circumstances, than from any unusual dental abnormity. The patient was a young married lady, in whom the condition of pregnancy had the effect of exciting diseased action in the teeth. She was now far advanced in her second pregnancy, but much exhausted and enfeebled by the constant excruciating pain of a carious tooth. Up to the third month of pregnancy, she suffered very little; but as the uterine tumour enlarged in volume, violent dental pain set in, giving rise to a train of alarming symptoms. In her former pregnancy, she had suffered similarly with another tooth, and had resorted to a dentist for its removal. It was accordingly extracted in the ordinary way; but a most distressing accident succeeded immediately afterwards. The lady miscarried. The fear of a repetition of this sad event, had for months prevented her making a similar application to a dentist in this new pregnancy. She consequently continued to endure the daily increasing pain, till it became evident to her obstetric physician, that serious consequences would speedily occur,

and in fact, that the accident she sought to avert by abstaining from dental operation, would very likely be brought about by the intensity of pain she was enduring; or, if not that, that the development of the fœtus in utero would be seriously arrested from her increasing emaciation. Strong religious scruples, combined with the lamentable effects of chloroform on a near relative, which she had witnessed, led to a most decided and peremptory refusal of its aid. Under these circumstances she was induced to consult me. After satisfying myself that disease was really present, and that it was not merely an exaggerated form of the toothache so common in pregnancy, I advised extraction. After being assured that if the former accident had arisen from the mere pain of the tooth-extraction, as was believed, that same cause would not now operate, this patient consented, though with a degree of nervous excitement which I have rarely ever witnessed. Sensation was thoroughly destroyed,—the tooth was extracted, and no accident occurred. She went to her full time, and was duly delivered of a fine child.

CASE X.

This case, like the foregoing one, was remarkable for the connexion between dental pain and the production of a constitutional malady. Several years ago, the patient consulted a dentist, to be relieved of a tooth which had been the source of considerable suffering. This tooth was extracted by a most skilful practitioner; but no sooner was it withdrawn, than the patient uttered the loud and piercing cry so pathognomic of epilepsy, and slid out of the chair on to the floor. She remained in a convulsive state for a few minutes, but recovered consciousness after a deep sleep of two hours. Nothing whatever could be discovered, either in the state of the tooth or its attachments, to account for the singular occurrence of the fit; which was consequently attributed to the acute pain of the extraction, acting upon a constitution hereditarily predisposed to epilepsy; for this lady's grandfather had suffered from the same disease. No return of the epilepsy took place. She again, however, became the victim of a carious tooth. For many months she endured excruciating pain, which at last became so intense, as to disturb the normal action of the senses. Sounds like the booming of artillery seemed occasionally to fall upon her ear, and orbs of every hue, at times, spread out in long perspective before her eyes. It was, in short, evident to her medical attendant, that the pain of toothache was about to bring on the same calamity as the previous pain of extraction.

The tooth was stopped, but only with temporary relief of the pain, or abatement of these premonitory symptoms. Extraction appeared the only remedy. She was strongly advised to have the tooth withdrawn under chloroform ; but the family physician more strongly and successfully objected to it in such a case. She was led to consult me, and the result was, that the tooth was extracted without pain, and without any return of an epileptic attack. It may be further observed, that from a slight curvature of the fang, the extraction was rendered a much more difficult operation than the former one, and but for this new method of destroying sensibility, would have been an incomparably more painful one.

The successful issue of these cases at once removes beyond the region of doubt, the question of the possibility of producing local anæsthesia for dental operations. They are facts as indisputable as they are grateful in dental surgery. Several points, worthy of being noted, may be culled from these cases.

All the patients, with one exception, had previously been the unfortunate victims to dental manipulations, and consequently were in a position to compare the relative amount of suffering under the two different modes of operating. Most of them, again, were of a temperament highly susceptible of pain, and they belonged to that sex which generally manifests less endurance of the suffering of this particular operation. Far be it from me to write a disparaging word against the courage of the fairer sex, so notoriously undaunted in great emergencies ; but it is nevertheless a fact, that men do generally submit to the operation with a degree of stoicism, not expected from the more tender and more susceptible sex. Case I, may especially be singled out. This lady was not only of a highly nervous temperament, which led her to shrink with horror at the possibility of suffering as she had formerly done ; but she was at the time in that delicate state of health which increased her susceptibility to suffering, as well as exposed

her to far more than ordinarily severe results of pain. A slight pain was calculated at that time, to tell far more injuriously on her constitution, than a far greater intensity of pain would have done in her ordinary state of health. This, therefore, may be taken as the type of a very large class of cases, in which not only is the pain of the extraction annulled, but all those bad effects of pain, which so often arise under these circumstances in weakened constitutions, are obviated.

Again, it will be observed that several of the foregoing cases belonged to that class of dental operations which is generally the most difficult and painful; viz., the extraction of *stumps*. It is not without good reasons, that most persons have an insuperable dread of the extraction of stumps. The difficulty, nay, the frequent impossibility of gaining sufficient purchase to extract them with a single operation, compels the dentist at times to resort to the exquisitely painful application of the elevator, or the operation commonly known as punching, &c., to do the work which the simple forceps cannot accomplish. The mutilation which is thus at times almost unavoidable,—the different steps of the operation, and the greater amount of time occupied,—all render this an operation of far greater dread than the simple extraction of an entire tooth. Now, notwithstanding the essentially more painful nature of the operation of extracting stumps, it is in these very cases that my method presents the most unparalleled success. I have not met with finer or more satisfactory results in all my dental experience, than in the cases of stumps extracted under the anæsthetic influence of cold. It is in these instances, in fact, where the anæsthesia is most complete and certain.

Case VIII, for example, presented a combination of difficulties, fortunately not of everyday occurrence. The diseased state of the stump had rendered it so brittle, that

upon application of the requisite force to extract it, it was only by the greatest possible nicety of manipulation that it escaped being broken into a number of fragments; and, in addition to all this, the fang was bound down in the socket by a small exostosis, which acted as a lock, confining it in a cavity of the alveolus. Yet, notwithstanding the time occupied in the operation, and the great severity of the procedure, it was submitted to with the greatest complacency, without a muscular twitch, or any of the ordinary manifestations of acute pain. The inference from such a case is but fair, that if the anæsthetic application of cold be equal to effect painless extraction in a case attended with such severity of manipulation, it must be fully equal to secure the same immunity in the common run of cases. And that it is thus equal to such cases, was remarkably manifested to the amusement of the bystanders in Case I, in which the patient was so unconscious of the removal of a stump, that she thought I was cajoling her, until feeling with her own finger the cavity in the gum, and seeing the stump between the teeth of the forceps, convinced her it had been removed.

Again, Case VI presents a striking comparison of the relative amount of suffering in the extraction of stumps, with and without this local anæsthetic. It is to be observed that in this case the stumps both originally belonged to one and the same molar tooth, and that there was nothing beside the anæsthetic itself to make the extraction of the first so painless, while that of the second was so excruciating.

Other equally instructive cases of stump-extraction might have been advanced, but those adduced suffice to show that one of the opprobria of dentistry may now be removed. And thus, while the undeviating success which has attended my method of local anæsthesia in the case of stumps is a

progressive step in dental surgery, it at the same time removes from the mind of many patients one of the greatest horrors of the dental art.

Cases I and V, are instances of a double and multiple operation at the same sitting. The value of the local anæsthetic in such cases is manifest from the circumstance, that few persons could endure the nervous shock of rapidly-repeated extractions, without more or less of injury to the system; and circumstances often occur in which it is peremptory that all the diseased teeth should at once be removed. Besides this, the profuse hæmorrhage which would ordinarily follow the simultaneous extraction of a number of teeth would contra-indicate that practice, except in rare circumstances. Under the anæsthetic application of intense cold, such hæmorrhage is obviated; and it is not one of the least of its advantages in ordinary extraction, that profuse hæmorrhage is prevented or repressed.

Again, in instances similar to that related in Case VII, where malposition of a wisdom-tooth excites general inflammation in its neighbourhood, it is by no means an unusual practice with some dentists to give it space by the extraction of the second molar against which it presses. This proceeding effectually and immediately remedies the patient's sufferings, which, in such cases, are due to the pressure of the misplaced tooth on the neighbouring teeth. But such practice removes a sound, useful, masticating tooth, to make room for a deformed tooth useless for mastication. It would appear singular that a surgeon of such eminence as M. Velpeau, of Paris, should ever have adopted the principles of a practice so apparently opposed to sound reason. Yet in his published reports of dental surgery, he evidently homologated the principle. Upon what grounds? So far as can be gathered from the cases described by him, mainly on the ground of the *overwhelming pain* which would

be caused by the extraction of a wisdom-tooth in such an abnormal position. That an almost insuperable difficulty to the removal of the tooth in such circumstances may occasionally arise, must be admitted; but that in the majority of cases the misplaced tooth may be withdrawn, is, I think, irrefutable. In this opinion I am supported by the authority of Mr. Tomes, who has frequently practised it. But, as we learn from the same authority, such an operation is attended with considerable pain—and incomparably more pain than that attending the extraction of a normal molar —yet, it has justly been argued, it is better that temporary pain, though excessive, "should be suffered, than that the second molar should be lost in order to give space for a tooth, which, when fully developed, will be useless in mastication." In the one case an agonising pain, though of no long duration, is inflicted, and the integrity of the masticating surface is preserved: in the other case, a pain, still somewhat severe, is endured, and in addition, the masticating surface is destroyed. And with that destruction, comes that long train of dyspeptic evils, which can so frequently be traced to the mal-apposition of the upper and lower teeth, from irregularity in the opposing line of crowns, when a large member and prop of the group has been removed. Now, the annihilation of that agonising pain, which has been the objection to withdrawing the tooth that is altogether inferior in value and function, enables us now to obviate an operation most prejudicial to the general health of the patient. Every dentist, conscious as he must be of the serious constitutional disturbance often arising from deranged teeth, is bound so to adapt his operations, as to harmonise, as far as possible, with the general health and comfort of his patients. It is not alone, in every case, that he is to regard merely immediate relief, but he is to look forward and anticipate ulte-

rior consequences. He is bound, in short, for the time being, to assume the office of a dental *physician* as well as dental surgeon, and to make his calling, not only an art to relieve temporary suffering, but conducive to general health. And for the duties of such an office he has the local anæsthetic power of congelation to aid him.

The same case (Case VII), further shows the peculiar advantage of my apparatus, in its applicability for operations in so small a space as that allowed by the angle of the jaw where the wisdom teeth are located. In p. 29 of these observations, I have alluded to the power we possess by this instrument of limiting the application of the cold to so small a surface as that of a split pea. It is consequently highly serviceable in all instances where space is limited. Whereas, upon the ordinary methods hitherto adopted, the complete anæsthetic effect of cold required for operating on teeth situated so far back in the mouth, could not be produced—not only from their larger size, but from the greater amount of heat to be absorbed.

In Case IV—that of a fractured tooth—it may be remarked, that all the conditions were present which usually keep up an inflammatory action after extraction; and for which it is customary to order fomentations, aperients, &c., by way of anticipating constitutional irritation. Notwithstanding all these conditions and predisposing circumstances, no inflammation ensued. No constitutional treatment was required. This favourable circumstance, I think, may fairly be attributed to the antiphlogistic property of the anæsthetic application itself. Cold is frequently used to repress inflammatory action; and I am convinced, that inflammation and irritation after dental operations, are far more seldom occurrences when cold is employed as an anæsthetic before operating, than when the operations are conducted without it, or with chloroform.

Case IX, in which the patient had unhappily suffered miscarriage from the pain of a previous tooth-extraction, is interesting in several points of view. It is remarkable as a *physiological* fact. After the lucid description and diagram in Dr. Marshall Hall's work on the nervous system, it is not difficult to understand how an enlarged uterus may, through the great sympathetic system of nerves, produce a sensation of pain in those branches of the fifth nerve supplying the tooth. But that the irritation so conveyed should be of a character to excite a carious action in an apparently sound tooth, so violent and rapid, as this case presents, is, so far as I am aware, unexplained. Unquestionably there must have been a strong predisposition to carious inflammation in the teeth, though, as far as I could ascertain, in no other of the osseous structures of the body.* It is remarkable also as a *domestic* fact. For, from the peculiarity in the nervous system of this patient, it would appear that, for every child she bears, she must lose a tooth. It is remarkable again as a *dental* fact, as showing what serious accidents may arise, in a certain state of the system, from the *mere pain* of dental surgery. It is true, that sometimes a comparatively slight pain or cause, when sudden, will throw the uterus into muscular contraction, ending in the premature discharge of its contents; but such a sad event rarely super-

* Doubtless many of the functional disturbances to which the human subject is liable, are due to some irregular action of the nervous system as the *prima causa*. And upon the principle, *ubi irritatio ubi fluxus*, the excitement of morbid action, in a part predisposed to disease, can be easily comprehended. But we as yet know too little of the mode of action of the nervous system, to do more than generalise on a number of facts. I am acquainted with a gentleman, who has possessed, to all appearance, a fine set of teeth, but in which a painful amount of irritation is successively set up, on the supervention of every great anxiety. Every such period of anxiety, when of long duration, has terminated in the loss of a tooth from carious degeneration, while his general health in no way suffered. This affords an example of how the mind can wear away the hardest structures of the body.

venes on tooth-extraction. And, lastly, it is not the less remarkable as an *anæsthetic* fact. In all probability, another human life would have been sacrificed by premature birth, had there been no local anæsthetic to annul the, in this case, murderous pain of tooth-extraction. I feel satisfied, moreover, that the future health and well being of the *fœtus in utero* have often been materially altered and endangered by the long-endured and exhausting pain of a maternal tooth; which tooth, the pregnant mother would not part with, from fear that the pain of such a parting would separate from her the immature one she was carrying in her womb. This evil is now remedied by an anæsthetic, which holds out its beneficent influence to the mothers of our race, without demanding, as its penalty, the abolition of consciousness; and which, in conserving their strength, tends to invigorate the life of their yet unborn.

It is not often that alarming cerebral symptoms are induced by the pain of tooth-extraction. Case X, however, presents us with one of these instances. This case is chiefly instructive as evidence of the serious consequences which are liable to follow from the presence of mere *pain*. Unless in a person predisposed to epilepsy, there is no necessary connexion between tooth-extraction and the supervention of an attack of that fearful malady. Such a case, also, is a convincing commentary upon the decided advantage which local anæsthesia possesses over general insensibility. And this instance further proves the competency of cold as an anæsthetic to avert some of the most terrible calamities which can befall a human being.*

These reflections on the cases which have been submitted to the anæsthetic influence of congelation, all tend to show, that in this simple local anæsthetic, we have a means

* M. Jourdain mentions a case of epilepsy supervening on tooth-extraction, which, unfortunately, was immediately fatal.

applicable to almost every case which usually comes under the care of the dentist. Its efficiency is proved by the difficult nature of many of the operations. Its desirableness is confirmed by the many unfavorable conditions it meets; and its preeminent advantage over chloroform, is seen in its immunity from accidents.

Very little has ever been made of the fatal results of chloroform in dentistry. It is not, however, to be inferred that this branch of surgical practice enjoys any greater degree of immunity from its dangers than are recorded of general surgery. Fatal cases, under its use for tooth-extraction, have been recorded, and we are convinced that others have occurred which have never been disclosed. The use of chloroform in dentistry is the exception. And taking the proportion of the deaths to the number of inhalation cases, in both departments of practice, we have no hesitation in saying that the ratio of sudden deaths from chloroform in dental surgery, is quite equal to, if not above, the ratio in ordinary surgical practice. The assurance, therefore, which is held forth by the advocates of general anæsthesia in dental surgery, loses its force when brought to the test of statistics. It is, in fact, a seductive argument, based on delusion. We are, indeed, at a loss to conceive how such an argument can ever again be urged with propriety. For the circumstances attending the various fatal cases to which we have alluded in these remarks, are of a nature to debar a prudent practitioner from offering such an assurance. It availeth nothing now to advance the minuteness of the dose, or the slight degree of narcotism required; for a few minims of chloroform have been sufficient to separate soul and body.

It has been remarked that accidents and injurious constitutional consequences have been more frequent after tooth-extraction under chloroform, than after surgical ope-

rations on other parts of the body. If this be true, the foregoing argument, as to the immunity enjoyed from the slighter degree of narcotism required, loses still more of its force; for, it would appear that there is some connexion between that slighter degree of narcotism and the production of these morbid states. We do not attempt to solve the difficulty, though we can understand how the brain may, under the stage or degree of intense excitement, especially if continued, take on diseased action, resulting in temporary mania.

But, apart from the dangers of chloroform, its employment in dental surgery is attended with several inconveniences. Of these, for example, I may mention, the *restlessness of the patient*, unless the anæsthesia be pushed to the imminently dangerous degree of perfect relaxation; and, even in the state of relaxation, it is difficult for one person to keep the head immoveable, and, at the same time, to operate. This inconvenience is especially felt in long and difficult cases, when the operation is unavoidably rather complex. Now, the nicety and perfection of the dental art depend, as all know, upon the precision with which the instruments are applied. If there be much motion or restlessness on the part of the patient, that precision is apt to be greatly interfered with. The skill of the operator may be perfect, the application of his instruments most exact,—but a restless, unmanageable, semi-conscious patient may frustrate all. Such a state of restlessness would be obviated, were the patient in full possession of voluntary power, but at the same time insensitive to pain And this is precisely the condition which is attained under the new anæsthetic means I now advocate.*

* Some time ago, I was consulted by a patient who had previously sought relief from the pain of tooth-extraction in the hands of a chloroform dentist. Much to her surprise, the old pain of toothache returned, after a few hours, in the same spot, in all its virulence. Upon examining the state of her mouth in

Another source of inconvenience to the dentist is from the anatomical structure and relations of the upper and lower jaw, or, in other words, from the firm closure of the mouth of the patient when under chloroform. Many a chloroform-dentist's thumb, doubtless bears upon it traces of this inconvenience, in the form of indentations from the teeth of patients who, in their wakeful moments, have no remarkable momordial propensities.* Some dentists, unwilling that their patients should become their tormentors, take the precaution of placing a piece of soft wood in the patient's mouth before inhalation. But even then, the space acquired is less than the natural cavity of the open mouth. The possession of voluntary power is here again of immense advantage over the *brute force of the bit.* And having this advantage also, combined with insensitiveness to pain, under my method, I have the full space of the oral cavity for dental manipulation.

All persons, again, admit the impropriety of the operator being the administrator of the chloroform. A second person is thus required to do what, under my method, can better be done by the operator himself. In all these respects—the preservation of perfect composure, the patency of the mouth, and other circumstances—the anæsthetic use of cold in dental surgery is greatly preferable to chloroform.

What, it may be asked, is the *modus operandi* whereby

the looking-glass, she was still more surprised to find the old carious tooth remaining, and a sound one gone. The mystery was at once solved. The dentist had mistaken the tooth. I afterwards ascertained that this lady, when under the influence of chloroform, was so intractable, that less blame, perhaps, is to be attached to the inadvertent slip of the dentist's forceps, than to the patient who demanded a state of insensibility, which unavoidably renders difficult and complicated an operation that is otherwise simple and certain.

* It has unfortunately happened to some patients, not only to suffer the intentional loss of their teeth, but through the struggling efforts induced by chloroform, to endure the very unintentional loss of a portion of the *tongue.*

cold produces this complete anæsthetic effect? The principle of its action consists in an *arrest of the circulation* of the part to be operated upon. Every person in these climates must have experienced the diminished sensibility of the fingers, for example, when the minute vessels ramifying on the skin, are contracted and rendered bloodless by the severe cold of winter. It is precisely by the same process, carried to a more intense degree, that the benumbing effect is produced which renders surgical operations painless. It is, in fact, an imitation of a common natural process. Our lessons in this respect have all been taken in the school of nature. And, in so far as our method accords with the ordinary process of a natural phenomenon, it commends itself to our reason in a way which blood-poisoning by inhalation can never do.

In the application of cold to dental surgery, there are three ways in which it acts. In the first place, the circulation in that portion of the gum surrounding the condemned tooth is completely arrested. Not until the gum assumes a blanched appearance, is the full anæsthetic effect produced. In the second place, the cold is conducted into the two outer sides of the alveolar process or jaw, through the cellular tissue covering it on both sides; and by a continuance of the application, the cold is conducted still further through the alveolus to the periosteum lining the socket of the tooth. The tooth again, from its crown and sides, conducts the applied cold downwards through its mass to the dental periosteum, which is attached to the socket. All these bony processes are thus easily rendered bloodless and benumbed. It is of importance to notice this, for my experience convinces me that it is the wrenching away of the tooth from these attachments, which is the principal source of the pain in tooth-extraction, rather than, as is popularly believed, the divi-

sion or tearing of the nerve supplying the fangs. This process of the cold inwards and downwards to the attachments of the tooth, will also explain the great success attending the extraction of stumps, as already described; for, a great portion of the crown and sides of the tooth being already destroyed, the length of the conducting medium (which, as is well known, is not a good conductor) is greatly diminished, consequently inducing a deeper degree of anæsthesia. In the third place, by the conduction of the cold down to the extremity of the fangs, the branches of nerves entering them are equally benumbed with the surrounding parts, and thus the pain, whatever it be, resulting from that source, is at once arrested.

That this is a correct explanation of the mode in which the cold acts on the tooth and its socket, &c., has repeatedly been proved to me. I may adduce Case VI. in point. This lady had the first stump extracted after the parts had been rendered completely insensible by cold. The temperature of that stump manifested a marked absence of heat, and the small pieces of gum which had unavoidably been brought away adhering to it, *were perfectly cold and blanched.* The second stump was withdrawn in the ordinary manner, without being rendered insensible by cold, and its substance was not only of a higher degree of temperature, but, both its periosteum, and a small portion of gum attached to it, were *highly injected.* The contrast of these two stumps, as they lay side by side, was so remarkable, and so corroborative of the theoretical correctness of the application of cold as an anæsthetic, that I have preserved exact representations of them. Other cases have been equally fertile of similar proofs. In repeated instances, for example, I have, immediately after the extraction of a tooth, applied its lower extremity or fang to a very delicate thermometer, and it has invariably resulted,

that when the tooth was extracted under the anæsthetic influence of cold, the column of mercury was *reduced* some degrees; while in those cases in which the operation was performed *without* the application of cold, the column of mercury *rose* some degrees. Thus, not only are we satisfied of the philosophical accuracy of the application of cold as an anæsthetic, but we have the further advantage of *knowing precisely every effect of the process*. We do not apply it in ignorance of how it produces its effects,—it is no mere piece of empiricism.

These results have not been realised without, as already hinted, powerful obstacles being overcome. I specify one of these, because I find it has hitherto been an insuperable difficulty in the performance of other operations where similar circumstances obtained. (See *ante* p. 27.) I refer to the difficulty presented in the application of a sufficient intensity of cold, on or in a medium of a high temperature. The mouth—the seat of dental operations—is one of these high media. Any intensity of cold placed in the mouth is rapidly diminished by the absorption of its heat; and it was not until I had established the principle of keeping up any given degree of cold continuously and unchangeably in any medium of temperature, however high, that painless tooth-extraction became a possible and practicable art. The apparatus which I have constructed upon this principle meets every exigency of the case. A minute description of this apparatus, modified for dental surgery, may be had of Messrs. Horne & Thornthwaite, 123, Newgate Street, London.

There is a disorder of the gums, originating mainly from the presence of decayed teeth and tartar, but which may come on as the sequelæ of fever, salivation, pregnancy, &c. commonly known as *scurvy* in the gums; in which the properly directed anæsthetic application of cold often acts as

a remedial agent, of greater certainty than those in common use. This disease, most distressing to the patient when it has advanced far, makes itself known by a spongy, turgid, vascular state of the gums. They bleed freely under the brush, and upon pressure discharge a fœtid pus, which gives its disgusting odour to the breath, almost debarring the unfortunate victim from society. When the disease is extensive, carious devastation and osseous deposits push the teeth from the sockets; the issuing pus trickles down into the stomach and contaminates the whole system. Occasionally it yields to no treatment, it may be from hemorrhagic diathesis. But no treatment can be successful except the gums be suddenly and perfectly unloaded to produce contraction of the blood-vessels. Cold astringent lotions, a touch with the nitrate of silver, or repeated perpendicular and horizontal incisions, are among the means ordinarily employed. Not a word need be written of the excruciating character of the two latter means. Now, nothing has such power of producing vascular contractility as intense cold. Every essential feature of the treatment of this malady is combined in this one agent. It unloads the overcharged vessels, and contracts their dilated calibre; it arrests the progress of the fungoid inflammation, and gives to the spongy tissue firmness and tonicity. And while it destroys the pain of the trivial pressure of the materials of food, renders unnecessary the vastly greater torture of the deep incising lancet, or the writhing agony of lunar caustic.

There is yet another important aspect in which the advantage of local anæsthesia in tooth-extraction must be viewed, fully to comprehend its true value. Hitherto, I have only alluded to its benefits as connected with the *destruction of pain*. But its benefits do not terminate there. It may be equally beneficial in the prevention of a vast amount of *disease*. In no disease, perhaps, is there

such *delay* exercised by its victims, as in diseases of the teeth. If an individual be troubled with an incessant cough, he at once seeks the aid of his physician: if he be harassed with a pain in the side, he demands a speedy remedy: if a tumour is growing from his body, he sends for his surgeon. The horrors of consumption, of hepatic abscess, or of a deformed frame, stare him in the face; and alarmed at the possible fatal tendencies of the disease, he delays not an hour in seeking relief. Again, except in cases requiring operative surgery, he knows that the remedies are of a kind unattended with little more than inconvenience, and are generally painless. Pills, mixtures, draughts, &c., beyond being repulsive to the taste, do not involve much physical suffering. There is nothing, in fact, in the cure to deter him from its speedy application. On the other hand, fatal results of diseased teeth are never for a moment suspected. There is a pain, violent it is true—more violent even than the pain accompanying most diseases. But there exists the delusion, which lulls the patient into feelings of security, that the disease is purely local, and limited to the tooth itself. And, as its only effectual remedy, he has the prospect before him of all the agonies of tooth-extraction. These two circumstances lead to very different courses of conduct in the two cases:—in the one, the remedy is speedily sought; in the other, it is as long delayed. The *physician* is summoned the moment that the sentinel of pain announces an impending danger; the *dentist* is summoned not, until the unanswered sentinel of pain reiterates its claim in unendurable severity. In the one case, the danger is apparent; in the other case, it is insidious, though equally impending. What are the too frequent results of this delay? I reply, a series of constitutional disorders, which are too rarely attributed to this cause. Without any desire to exaggerate the evil consequences of a neglect of early treat-

ment of diseased teeth, it must nevertheless be urged, that a great variety of general diseases are derived from this source. This human machine—which we call body—pervaded as it is by intermingling blood-vessels, nerves, &c., all in the closest relationship, and presided over by general laws, has all its parts in reciprocal reaction and sympathy. Its general derangement disturbs the normal action of its parts; and hence, no circumstance is more accredited than that the teeth, as parts of that machine, do suffer from its general disorder. Again, as this machine is one harmonious whole, its several parts, when out of order, must more or less disturb the harmony of that whole. According to the office the part may have to fulfil, or its vital relationships, will be the greater or less amount of that derangement. Now the teeth happen, in their nervous connections and anatomical position, to be in close proximity to the great centre of sensation and vital force—the brain. In their functions, again, they are intimately related to that great conductor of life—the blood. In the former case, a long-continued pain proceeding from them, cannot fail to affect the cerebral mass; while in the latter case, their disorganisation disqualifying them for their important functions in relation to our food, lays the foundation of many fatal diseases from the blood. Hence, Hufeland, proceeding upon the principle, that good and strong teeth are always a sign of a sound strong constitution and good juices, was not far wrong in stating, that "those who lose their teeth early, have, in a certain measure, taken possession of the other world with a part of their bodies."

Without dwelling upon that common and sufficiently distressing form of disease engendered by diseased teeth—dyspepsia—I may adduce the following case as showing the power of dental irritation in exciting latent disease into fatal activity.

"The patient, a delicate young lady, many years ago, suffered from a carious tooth. On applying to a dentist, he found some difficulty in extracting it; and consequently only removed that portion of the tooth which was diseased, leaving a stump behind. The patient was at once relieved of her intense suffering, and all unfavorable constitutional symptoms disappeared. For several years she enjoyed excellent health, when it was again interfered with by the return of an intermittent pain in the remaining stump. Residing at the time in the Highlands of Scotland, she was left to the mercy of the country surgeon of the district, who made ineffectual attempts at extraction. The severe pain she suffered in this ordeal deterred her for a long period from seeking efficient aid. Chest symptoms shortly afterwards presented themselves, accompanied with increasing emaciation and debility. The diseased tooth was altogether overlooked by the physician under whose care she was then placed, and who accordingly treated the symptoms without combating the cause. Despite the persevering use of cod-liver oil internally, and oil frictions externally, the disease continued its fearful invasions, when it was thought desirable to remove her to the South Coast of England. Since consulting the Highland doctor, she had not uttered a word respecting the diseased tooth, from the mere dread of the pain of its extraction. A short time after her removal to the South Coast, the dental pain left her, and all her symptoms were considerably alleviated—an improvement which was attributed to change of climate. It was, however, but a delusive interval; a time of greater suffering was at hand. A few months afterwards, when she was about to return home full of hope, the dental pain reappeared, and it was followed, in rapid succession, with aggravated symptoms of pulmonary consumption. She now revealed to her physician the circumstances respecting her tooth, upon which he sent for me. I extracted the offending stump;—but it was too late. Death had carried on its destructive work too far for human power to arrest its progress. But a small portion of lung remained to her—and that destroyed, she left the world a victim to her dread of pain."

Many similar examples abound. There are also cases on record, in which the fatal progress of consumption has been arrested by the timely extraction of an irritating tooth. In these cases the dental irritation doubtless acts as an exciting cause of disease to which patients may be hereditarily or otherwise predisposed. But, perhaps, considering that the

origin of this most insidious and fatal disease is generally in mal-assimilation, defective teeth, either from disease or the loss of them, in impeding digestion, may frequently be the unsuspected starting point of the constitutional malady.*

Many other general diseases, besides dyspepsia and phthisis, might be enumerated as resulting from disordered teeth, as, for example, various neuralgic affections, epilepsy, ophthalmic diseases, obstinate headache, &c. It is sufficient for our present purpose that, like as a small worm in the intestine may give rise to dropsy in the brain, so a small organ like the tooth may, under certain conditions be productive of general disease. How then is local anæsthesia in dentistry calculated to avert these evils? Because, we reply, the *dread of pain*, which is the main cause of delay in seeking the remedy, is abrogated. It is that delay which is so fertile in evil omen. It is during that delay that the imperious finger of death first places its chilling impress on some vital organ. It is the long period of that delay which so often tends to fill the ever-insatiable grave. Go, interrogate the graves—and the still voice of many a tenant will proclaim that dental irritation took up for them the first sod. But it may be alleged that *chloroform* likewise abrogates that pain, and consequently dismisses that fatal incentive to delay. True, chloroform is fully capable of

* African dentistry presents a somewhat curious illustration of the effects of the *loss* of teeth upon the general health. The Kroo tribe of South Africa are possessed of remarkably fine teeth, on which, consequently, they set a high value; and no present is so greatly prized as that of a tooth. The aid of a dentist is rarely sought by them, with one exception, viz.—when they fall in love; when, as a sure mark of esteem for their sweethearts, the men place in the hands of their fair ones *two of their teeth.* Hence we are told, in Sierra Leone men of this tribe are commonly met with minus two of their teeth, which they have sacrificed on the altar of love. But the sacrifice costs them more suffering than the brief pain of extraction, for they speedily fall a prey to gastric complaints; and thus African sweethearts demand a price for their love which sows the seeds of disease in their betrothed.

banishing the pain; yet chloroform has never banished this tendency to delay. Why? Because in the cup it offers to the patient's lips there is poison; and the consuming flame of death plays upon its ethereal fluid. Local anæsthesia, free from these dangers, is that alone which can inspire a confidence which will abridge that delay, and in its abridgement prevent the frequently unchecked ravages of disease. Excuse now for putting off the evil hour there is none. The procrastination, which, while it is the thief of time, is in this case the thief also of health, becomes a less pardonable folly. For now that in anæsthetic cold we have an agent which destroys the pain of dental surgery, and over which the shadow of death never passes, no plea is left for that lethean draught, in inhaling which, to save us pain, we may be breathing in the still and unseen ether of another world.

The advantages of the anæsthetic use of cold in dental surgery may be thus summed up:

1. We can, by it, now accomplish the painless extraction of teeth without the loss of consciousness, and without danger to life.

2. It not only obviates the nervous shock of the operation itself, but it also dispenses with the injurious effects of the circulation of a poison through the system, as in etherization.

3. Under its influence some of the most unmanageable, difficult, and painful of dental operations are rendered the most painless.

4. The patient retaining consciousness, though insensible to pain, is able to preserve a far greater degree of composure and quietness, than when under the influence of any other anæsthetic agent.

5. The rigidity of the muscles of the jaw, and the consequent difficulty of keeping the mouth open, so universally experienced under anæsthesia by chloroform, are entirely superseded. We have, in short, the additional advantage of the will of the patient.

6. The amount of time occupied in the induction of insensibility by chloroform, and in the recovery to consciousness afterwards, with all the inconveniences attending the passiveness of the state, are saved both to dentist and patient.

7. The expense incurred in the use of cold for anæsthetic purposes is less than that of chloroform.

8. It checks undue hæmorrhage after extraction. It is rarely that the hæmorrhage of tooth-extraction proves fatal. The occurrence may be said to be almost an impossibility under this new anæsthetic.

9. Fewer complications arise as the sequelæ of tooth-extraction than either under chloroform or without any anæsthetic, the antiphlogistic properties of cold being repressive of inflammation and irritation. Recoveries are more speedy and certain.

10. It is of great efficacy in scurvy of the gums, and similar hæmorrhagic affections of the mouth.

11. It may be the means of preventing a vast amount of constitutional disease resulting from delay, through dread of pain.

12. The application of cold is highly serviceable in many cases of acute tooth-ache.

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