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LOCAL ANÆSTHESIA:

NOTES ON ITS ARTIFICIAL PRODUCTION BY CHLOROFORM, &c., IN THE LOWER ANIMALS, AND IN MAN.

By J. Y. SIMPSON, M.D., F.R.S.E.
Professor of Midwifery in the University of Edinburgh.

A few months ago I published some remarks with the object of shewing that the artificial production of a state of general anæsthesia before the performance of surgical operations was not, altogether, an idea of modern times.* Several ancient writers aver that such a state of general anæsthesia can be produced by using mandragore,—as Dioscorides† Pliny,‡ Apuleius,§ &c.|| In the thirteenth century, Theodoric,¶ published a receipt for producing it by the inhalation of vapours arising from the watery extracts of various narcotic herbs, and in our own days, (1832,) this receipt of Theodoric's has been, apparently, found quite sufficient for the purpose by Dauriol.**

* "Monthly Journal of Medical Science," Vol. for 1847-48. p. 451.

† Dioscoridis Opera. Liber iv. Cap. 76. In this chapter on the mandragore, Dioscorides mentions its anæsthetic virtues repeatedly. 1. "Some (says he,) boil down the roots in wine to a third part, and preserve the juice thus procured, and give one cyathus of it in sleeplessness and severe pains of whatever part; also (it is given) to cause the insensibility (*πολλὴν ἀναισθησίαν*) of those who are to be cut or cauterized."

2. "There is prepared also, besides the decoction, a wine from the bark of the root, three *minæ* being thrown into a cask of sweet wine; and of this three cyathi are to be given to those who are to be cut or cauterized, as *foresaid*; for, being thrown into a deep sleep, they do not perceive pain."

3. Again, of another mandragore, called "morian," Dioscorides observes, "Medical men use it also for those who are to be cut or cauterized."

‡ C. Plinii Secundi Natur. Hist. Lib. xx. Cap. 13. Speaking of the circeus or mandragora, he says, "It is drunk against serpents and before cuttings and puncturings, lest they be felt. (*Bibitur et contra serpentes et ante sectiones punctionesque, ne sentiantur.*)"

§ L. Apuleii de medicam. herbarum Liber, published in a collection of works, entitled, "*Parabulum medicamentorum scriptores antiqui.*" p. 294. Apuleius remarks, "If any one is to have a member mutilated, burned or sawed, (*mutilandum, comburendum, vel serrandum.*) let him drink half an ounce with wine, and let him sleep till the member be cut away without any pain or sensation, (*et tantum dormiat, quoque abscedatur membrum aliquo sine dolore et sensu.*)"

¶ Ambrose Paré's Works. Liber xxi. Cap. 35. When "*Mandrage* is taken in great quantity, (says Paré,) the patient falls asleep in the same posture as he was in, just

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The ancients also seem to have entertained the idea of the possibility of producing a state of local and limited anæsthesia in any part to be operated upon. Dioscorides, who, as we have seen repeatedly, mentions the production of general anæsthesia by mandragore states it as a matter of report that local anæsthesia in a part was capable of being produced by the Memphian stone. "The Memphian stone (says he,) is found in Egypt near Memphis, of the size of a calculus, fatty and of different colours. They say that this, when bruised, and spread over parts that are to be cut or cauterized, so anæsthetizes these parts that they do not feel pain."††

Whilst we may entirely doubt whether local anæsthesia was capable of being produced by such an apocryphal application as the above, the passage is curious, as evidence that the idea of obtunding a single part of the body against the pain of an operation was not unknown nor unthought of in former times. Nay, many old authorities believed that against the fire-ordeal any part of the body could be so protected and

as if he were in a lethargy. Wherefore, in times past they gave mandrage to such as were to be dismembered."

¶ See page 146 of a collection of Surgical Treatises in blackletter, printed at Venice, in the year 1519, and entitled, "Cyrurgia Gurdonis de Canbaco, et Cyurgia Brunai, Theodoric, Rolandi, &c." In the rubric of the work the receipt is described as "*Spongia somnifera.*" and is described thus:—"The preparation of a scent for performing surgical operations, according to Master Hugo; it is made thus:—Take, of opium, and of the juice of the unripe mulberry, of hyoscyamus, of the juice of the hemlock, of the juice of the leaves of mandragore, of the juice of the woody ivy, of the juice of the forest mulberry, of the seeds of lettuce, of the seeds of the burdock which has large and round apples, and of the water hemlock, each oz. j.; mix the whole of these together in a brazen vessel; and then in it place a new sponge, and let the whole boil; and as long as the sun on the dog days, till it (the sponge) consumes it all, and let it be boiled away in it, [or, in other words, let a watery extract be so formed.] As often as there is need of it, place this same sponge into warm water for an hour, and let it be applied to the nostrils till he who is to be operated upon (*qui incidendus est.*) has fallen asleep, and in this state let the operation be performed, (*et sic fiat chirurgia.*) When this is finished, in order to rouse him, place another sponge dipped in vinegar frequently to his nose; or let the juice of the roots of fennugreek be squirted into his nostrils. Presently he awakens."

** "Journal de Médec. et de Chirurg. de Toulouse," Tom. x.

†† Dioscoridis Opera. Liber v. Cap. 158. "Hoc tradunt trito et illito partes quæ urendæ secandæve sunt, citra periculum, ita obstupescere ut non sentiant cruciatum, (*ἀναισθησιὰν ἀναισθησίν τιφίγου.*)"

defended by previous applications; that the human hand, for instance, should not feel the contact of the red-hot iron. The writings of Eusebe, Salverte, and of Beckmann, contain ample notices on this disputed question. Upwards of half a century ago, our countryman, Dr. Moore, ingeniously proposed to effect a local anæsthesia of any limb that was to be operated upon, by previously compressing with tourniquets and pads the nervous trunks going to that limb; and he has left us one interesting account* of a case of amputation at St. George's Hospital, in which this plan was tried, with partial success, by John Hunter.

The possible production of local anæsthesia by this or other means is certainly an object well worthy of study and attainment. Surgeons everywhere seem to be more

and more acknowledging the facility, certainty, and safety, with which the state of general anæsthesia can be produced at will before operating, and the moral and professional necessity of saving their patients from all unrequited pain. But if 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. If a man, for instance, could have his hand so obtunded that he could see and yet not feel the performance of amputation upon his own fingers, the practice of anæsthesia in surgery would, in all likelihood, advance and progress still more rapidly than ever it has done.

In the following remarks it is my object to state the results of a number of experiments which I have performed upon the lower animals, and two upon man, with a view to the possibility of the production of such a state of local anæsthesia, by the local application of chloroform or other anæsthetic agents, to individual parts of the body.

* *A Method of Preventing or Diminishing Pain in several Operations of Surgery. By James Moore, Member of the Surgeons' Company London.*—"I communicated (says Mr. Moore, p. 80.) the experiments I had made, and all my ideas on the subject, to Mr. Hunter, who was so obliging as immediately to offer me an opportunity of trying the effect of my compressor, at St. George's Hospital, on a man whose leg he was to take off below the knee within a few days. I went to the Hospital the day before the operation to try the instrument. The patient had lost all his toes, and had a large ulcer on his foot. This was so much inflamed and so irritable that dressing it in the gentlest manner gave him acute pain. I applied the instrument; after the compression had been continued for about half an hour, his limb became so insensible that rubbing pretty smartly with the finger upon the ulcer gave no pain. Next morning, the patient being carried into the operation room, I began the compression of the nerves at a quarter before eleven o'clock. The numbness of the limb followed at the usual time. At a quarter before twelve I gave him one grain of opium to diminish the smarting of the wound after the operation, when the compression should be taken off. A few minutes after twelve the tourniquet was applied, and the amputation performed by Mr. Hunter, at the usual place below the knee.

"At the circular incision through the skin, the patient did not cry out, change a muscle of his face, or shew any symptoms of pain. At the subsequent parts of the operation, particularly during the sawing of the bones, he shewed marks of uneasiness in his countenance, but did not cry out. As it was thought necessary to take up no less than five arteries, the operation lasted a longer time than is usual, and towards the end he grew faintish, and desired to have some water, and afterwards asked if they were nearly done. When the operation seemed to be over, and the bleeding stopt, the tourniquet was relaxed, and I also removed the compressor; but a small vessel bleeding unexpectedly, it was thought necessary to tie it also. Here the patient shewed very strong marks of pain, and afterwards declared that tying this last vessel gave him much more pain than all the others, although the great nerves had been included in the ligatures. When he was put to bed the wound smarted, as is usual after amputations. The compressor being now entirely removed, this was to be expected. But some time after, being questioned concerning the pain he had suffered during the operation, he declared that he had felt hardly any, except (as he himself expressed it,) at the rasping of the bones, which, he added, had shaken his whole limb. This seems a little extraordinary, as sawing the bones is usually the least painful part of amputations." • • • "This trial had all the success I expected; there was evidently a most remarkable diminution of pain, particularly during the first incisions through the skin and muscles, which are generally by far the most severe parts of the operation, and I am convinced that what pain the patient felt was chiefly owing to some small branches of the lumbar nerves which extend below the knee, and were not compressed."

I. THE PRODUCTION OF LOCAL ANÆSTHESIA IN THE LOWER ANIMALS.

At a meeting of the Medico-Chirurgical Society of Edinburgh, held on the 17th March, I took occasion to state that I had successfully chloroformed several of the lower animals,—annelida, crustacea, fishes, &c.; that in some, especially in the common earthworm, (*Lumbricus terrestris*), I had been able to produce local anæsthesia by applying the chloroform vapour locally, and had thus, at will, rendered anæsthetic, individual parts and portions of the worm, as the head merely, or the tail merely, or the middle part of the worm merely, the head and tail remaining unaffected. At the same time I recapitulated what I had stated at one of the February meetings,—that, in the human subject, local anæsthesia of a portion of the gums could be produced by rubbing the part with hydrocyanic acid. After the date of the above meeting, I was led to make some additional experiments upon the possible production of local anæsthesia in man; and in reporting the proceedings of the preceding seditur of the Society, in the last number of the "Monthly Journal of Medical Science," the Editor has stated, in a short foot note, some of the results of those experiments upon the human subject, which I here intend to detail at greater length.—See "Monthly Journal," No. xci., p. 48.

Nothing could be more curious or satisfactory than the experiments alluded to on the production of local anæsthesia by the local application of chloroform vapour to different parts of the body of the earth-worm. The resulting degree of local anæsthesia in the part exposed is generally, in the course of two or three minutes, most complete, as regards both sensation and motion; in fact, after being sufficiently exposed, the chloroformed portion of the animal is quite flat and flaccid, does not move under any irritation, and can be doubled and twisted up upon itself like a piece of loose wetted cord. If the part paralysed by the chloroform is small, it will be dragged along by the movements of the other unaffected portions of the worm. Generally, in the course of a few minutes,

it gradually regains its powers of motion, and its irritability and contraction under stimuli.*

The easiest method of performing this experiment, is to place a small quantity of chloroform in the bottom of a tumbler, paste over the mouth of it a covering of paper, and making an aperture in this covering sufficient only to admit the portion of the animal that is to be chloroformed. When held in this position, the part of the animal below the paper and exposed to the vapour of chloroform, is generally thrown into violent movements, for a minute or two before the state of anæsthesia supervenes. I have repeated the same experiments with the vapours of sulphuric æther and of bisulphuret of carbon.

I have tried the same experiment with the same results upon the medicinal leech.

The results were, if possible, still more marked in another of the articulata that was submitted to experiment. A small myriapede or centipede, (*Iulus sabulosus*?) was rendered completely anæsthetic and motionless in the posterior segments of its body, by exposing that part alone for a few minutes to the vapour of chloroform. The five or six last rings of the centipede, with the suspended and motionless feet attached to them, were, for a short time afterwards, dragged about in a kind of paraplegic state, by the brisk and lively movements of the anterior and unaffected portion of the animal. The animal soon and completely recovered, each segment with its corresponding feet regaining its power of motion, and this in regular order from before backwards.

In other centipedes experimented upon, a small quantity of fluid chloroform was applied by a slight brush to the head, or to two or three of the middle rings of the animal, or to the tail, and always with the effect of anæsthetizing and paralyzing the part or parts only with which the chloroform came in contact. Sometimes when the head and anterior rings were alone touched, the animal after vainly trying to push its motionless head forwards, reversed the movements of all its limbs for a time, and dragged the paralysed head behind it. All of the centipedes experimented on recovered in a few minutes from the effects of the chloroform.

By immersing the tail of the water-newt in chloroform vapour, the insensibility and motions of that part were rapidly destroyed, and returned in a few minutes afterwards. By a longer degree of immersion of the tail alone, the whole animal became anæsthetic; and in several experiments it was found possible, but difficult, to give the animal in this way a fatal dose of the vapour.

The hind-leg of the frog becomes anæsthetic when exposed for four or five minutes to the vapour of chloroform. Immediately after, it drags the limb in progressing, and bears, apparently without feeling, pricking and irritation of it; but a galvanic current passed through it excites both sensation and motion. In one case, the

motory power of the limb was not restored at the end of the third day. No effect appeared to result from keeping the hind-leg of this animal immersed in strong tincture of Indian hemp.

One hind-leg of a healthy, active rabbit, was confined in a large bladder containing the vapour of chloroform. At the end of an hour the common sensibility of the limb to pinching and squeezing was much impaired; but a current of galvanism passed through it produced crying and signs of pain. The power of moving the limb seemed unimpaired.

The hind-leg of a guinea-pig, similarly treated, exhibited the same phenomena at the end of an hour; but the anæsthesia was more complete. The skin of the leg was red and congested.

The posterior extremities and pelvis of a strong guinea-pig were enclosed in a bag containing the vapour of chloroform. At the end of an hour, no signs of pain could be extracted by pinching and squeezing either limb; and a current of electricity passed through a hind-leg evidently caused much less pain than when the same current was passed through a fore-leg. The whole hinder parts were very red and congested. The animal was also, in some degree, paraplegic, and dragged itself along by strong efforts with its anterior limbs.

In an interesting communication addressed on the 7th of June to the Yorkshire Branch of the Provincial Association, and published in the last number of the *Provincial Journal*, Mr. Nunneley, of Leeds, has stated that he has produced complete paralysis of the individual limbs of frogs and toads, by immersion or exposure of them for a few minutes, to the vapour of chloroform; that by a similar but longer immersion, he had rendered the leg of the rabbit sufficiently anæsthetic to bear mutilation without pain; that he had immersed his own finger in anæsthetic fluids for about half an hour or an hour, and at the end of that time it was nearly powerless and insensible, nor was entirely recovered for forty-eight hours; that in operating on the human eye he had rendered the organ anæsthetic by previously exposing it for about twenty minutes to the vapour of chloroform; and that, in his opinion, the action of all, or of most anæsthetic agents might be produced locally by their local application, the sensorium being unaffected, consciousness retained, and the limbs not subjected to their influence being unaffected. This naturally leads us to the consideration of—

II. THE PRODUCTION OF LOCAL ANÆSTHESIA IN THE HUMAN SUBJECT.

Early in February last I was led to make the experiments to which I have previously alluded, relative to the artificial production of *local anæsthesia* in a portion of the human gums by friction with hydrocyanic acid, in consequence of being assured, on what I believe to be satisfactory evidence, that a dentist at Limoges, in France, M. Pernot, had the secret of extracting teeth with little or no pain, in consequence of previously applying some obtunding agent to the gums. I tried at the time a great variety of substances, in order to obtain this local anæsthesia, such as various æthers, bisul-

* These experiments become the more interesting in a physiological and toxicological point of view, when we recollect, that in the articulata the vascular system is general and distributed longitudinally, while both the nervous and respiratory system of this class of animals is, in a great measure, segmentary and isolated, like the action of the anæsthetic.

of carbon, benzin, aconite, &c. Among all the agents employed, the effect of prussic acid was by far the most decided and complete; any part of the gum strongly rubbed by it, speedily became benumbed and insensible; but the resulting degree of anæsthesia was by no means sufficient for the purpose required. The results of these experiments were stated orally to the Edinburgh Medico-Chirurgical Society, at their meeting on the 16th February.

Before that date I had met with one instance in which local anæsthesia of the human hand had been produced in a young lady, in consequence of her accidentally holding in it for a considerable time a scent-bottle containing some chloroform. I tried at various times to reproduce a similar result in myself and in others, by keeping my hand wrapped in a napkin soaked in chloroform and other anæsthetic agents, but with little or, indeed, no decided success, till I used the vapour of chloroform raised by heat, the hand for the purpose having been immersed in a deep jar, into which a small quantity of chloroform was poured—the jar temporarily placed in a basin of water of the temperature of 130° or upwards, and the wrist or fore-arm being surrounded by handkerchiefs, so as to prevent the escape of the vapour.

A number of circumstances influence, however, the effect and the degree of it; and as I have made a considerable variety of experiments, both upon myself and upon others, in order to ascertain these points, I will shortly state the results. Let me premise, that in the experiments upon which the following results are founded, the hands of the same individual were generally held simultaneously in two different jars, differently arranged in regard to material or otherwise, in order to make two different and comparative experiments at the same time; and the relative degree of anæsthesia in each hand was ascertained during the experiment by pinching the fingers with the thumb nail, without removing the hand from the jar. After they were removed, these and other more severe measures were used with the same view, as tests of the degree of anæsthesia. Most of the experiments referred to were repeated and tried upon several different individuals. The general results were the following:—

1. When the hand is exposed to an anæsthetic vapour, it betimes presents the sensations of a limb benumbed, by compression of its larger nervous trunks,—the sensations, in fact, of partial or commencing paralysis. Usually after a short time, a glowing or burning feeling is perceived in the parts most exposed, and gradually there supervenes a sensation of thrilling and prickling (like a limb asleep,) which deepens more and more. The skin turns red, and the hand at last becomes stiff and clumsy, and feels as if enlarged, and painful impressions, as pricking, pinching, &c., are felt less and less than in the other unexposed hand. After the hand experimented upon is removed from the vapour, it is generally half an hour or more before its usual normal feelings are quite restored: The nerves of motion are usually apparently as much affected as the nerves of sensation.

When the jar containing the chloroform or other anæsthetic fluid experimented upon, was immersed in

warm water, so as to raise the vapour of the fluid more fully and quickly, the resulting anæsthetic effect was always greatly increased, both in rapidity and intensity.

3. The vapour of chloroform proved stronger than any other that was tried. When one hand, for instance, was immersed in a jar containing the vapour of sulphuric æther, and the other in a jar containing the vapour of chloroform, (both jars containing similar quantities, and being subjected to the same degree of heat,) the hand in the chloroform jar was both more speedily and more deeply affected than the other. In addition to the vapour of chloroform and æther, I have tried comparative experiments with the vapours of aldehyde, bisulphuret of carbon, iodide of methyle,* &c. The aldehyde had little or no effect of any kind. The iodide of methyle produced a very severe burning sensation, and left the hand intensely red and erythematous for a day or two afterwards, but with no marked anæsthetic influence. Among several of us that tried the vapour of bisulphuret of carbon, only one bore it for any length of time, (about an hour,) and in him it did not render the hand anæsthetic in any very appreciable degree; in myself and others the sensation of heat and burning became so utterly intolerable, as to force us to withdraw the hand in two or three minutes. Immersion of the hand for half an hour in Dr. Fleming's very powerful tincture of aconite,† or in a strong tincture of opium and of Indian hemp, and in a strong solution of belladonna, produced no appreciable anæsthetic effect.

4. The hand, when plunged in liquid chloroform, is usually somewhat more deeply apathized than the other hand simultaneously held in the vapour of chloroform. This was the more general result with those who tried the experiment; but in some the chloroform vapour was as anæsthetic, or more so, than the liquid. Few persons can keep the hand for any adequate length of time in liquid chloroform; the sensation of burning becomes so intense and insufferable, as to force them to withdraw it in a very few minutes. On one occasion I held my hand for upwards of an hour in liquid chloroform without the part being more deeply apathized than it would have been by exposure to the vapour. One of my pupils, Mr. Adams, perseveringly retained his hand in the liquid chloroform for upwards of two hours: no great or very marked degree of local anæsthesia resulted. In these cases, in which the hand was long steeped in liquid

* Two or three months ago I began a series of experiments with the intention of testing the anæsthetic effects (if any) of the various respirable compounds of methyle, acetylene, &c. I was proceeding far in the inquiry, in consequence of the effects following the inhalation of the compound mentioned in the text,—viz., iodide of methyle. I found it very powerfully anæsthetic, but dangerously so. After inhaling a small quantity of it for two or three minutes, I remained for some seconds without feeling much effect; but objects immediately began to multiply before my eyes, and I fell down in a state of insensibility, which continued for upwards of an hour. I did not recover from the effects of it for some days.

† Some other forms of preparations of this and the other substances may possibly produce different results, as we know that aconite, when chewed, causes a numbness and tingling in the lips and tongue, lasting for some hours.—See "Christison on Poisons," p. 2.

chloroform, the sensations of burning returned severely, from time to time, as if in waves, during the experiment; and on removing it from the jar, the feelings of heat were temporarily aggravated; the normal sensibility of the parts speedily returned, and was completely restored within an hour or two in all, but the skin sometimes remained red and injected for a longer period, occasionally for several hours.

5. The anæsthetic effect of chloroform, &c., is increased, both in rapidity and in degree, by immersing the hand, with the cuticle softened and moist. When one hand, for instance, is immersed without any preparation, and the other is prepared by being bathed and fomented for ten or twenty minutes previously, the latter almost immediately begins to tingle under exposure to the vapour, the dry hand not for some minutes; the degree of anæsthesia is also ultimately deeper in the moistened hand:

6. The degree of delicacy of skin in the person or part exposed to the anæsthetic vapour influences the result. In females I have seen the degree of the local anæsthesia of the hand that was produced, much greater and deeper than I could ever render it in the male subject. In applying the vapour of chloroform in small cupping glasses, &c., to different parts of the body, as the insides of the arms, &c., the resulting degree of local anæsthesia seemed, in a great measure, regulated by the tenuity of the skin of the part experimented upon. The skin of the axilla seems too tender to allow of the vapour being applied for a length of time sufficient to produce anæsthesia. One of my students, who kept both his lower extremities enveloped in strong chloroform vapour for three continuous hours, felt no appreciable local anæsthetic effect from it.

When strong chloroform vapour is locally applied to mucous surfaces, the attendant sensations of heat and smarting are too severe to allow of its sufficient continuance; at least, this is the result that I have obtained in applying it with small glasses to the inside of the lips, the tongue, and eye. Mr. Nunneley states, as we have already mentioned, that before operating on a difficult case of artificial pupil, he had applied for twenty minutes, a small quantity of the vapour of chloroform to the eye, by means of a small jar which accurately filled the orbit, with the effect of rendering the parts nearly insensible. Dr. Duncan and myself have repeatedly tried this experiment upon ourselves; but in none of the trials which we made, with the eye either shut or open, could we endure the burning action of the vapour upon the part above two or three minutes, and with no other result except always rendering the eye experimented upon red and injected, and suffused with tears.*

* I have tried the application of various anæsthetic gases and vapours to the vagina, in cases of vaginal irritation and neuralgia, but hitherto without much success. The stronger forms cannot be borne. I was induced to try them in consequence of the following curious statement regarding carbonic acid, published by Dr. Pereira, ("Materia Medica," Vol. I., p. 155).—"A lady who had suffered a considerable time from some uterine affection, and had derived no relief from the treatment adopted, was advised to consult a physician in Italy. (Dr. Rossi.) After he had examined the condition of the uterus, he assured her there

The degree of anæsthesia produced in the hand by exposure of it to the strong vapour of chloroform, does not, in general, perceptibly increase after fifteen or twenty minutes. The same sensations continue if the hand is still retained in the jar; but an increased length of exposure does not, after a time, produce a corresponding increased degree of local insensibility.

But, finally and specially, I would observe that the degree of local anæsthesia produced in the human hand or skin, by exposing it to the local action of the vapour of chloroform, has never, in my experiments, been by any means so deep and complete in its character as to give the chance of annulling the pain of any severe operation, such as the deep incision, or amputation of a finger. As compared with the other non-exposed hand, the chloroformed hand is generally rendered, to a marked amount, *less* sensitive; but the insensibility is never, I fear, so entire and perfect as will save the patient from the pain of the surgeon's knife. In short, I entirely doubt, whether, in the human subject, we shall ever be able to reduce the knowledge of this possible production of partial local anæsthesia to any practical purpose. It is principally interesting in a toxicological and physiological point of view, and in relation to the doctrine of the mode of action of anæsthetic agents.† Its bearings are more upon the theory than upon the practice of anæsthesia.

These remarks relate to local anæsthesia as capable of being produced by the anæsthetic agents with which we are at present acquainted. Others may no doubt yet be detected, much more powerful than any we at present know,‡ and their local application may enable us to

was no organic disease, but merely a considerable degree of irritation, for which he proposed to apply carbonic acid as a sedative. This was done by means of a pipe and tube, communicating with a gasometer situated in another room. The patient obtained immediate relief, and although she had been obliged to be carried to the doctor's house on account of the pain experienced in walking, she left it in perfect ease. On her return to England, she had a relapse of the complaint, and applied to Dr. Clutterbuck to know whether she could have the same remedy applied in London, in order to save her the necessity of returning to Italy."

† The distinction, which exists between the structure and functions even of the skin in the lower animals, as compared with the skin of the human subject perhaps sufficiently explains the differences in the degree of local anæsthesia, capable of being produced by the local application of anæsthetic vapours and fluids in the one and in the other. "In animals, (says Mr. Jackson, see American Cyclopædia of Pract. Med. and Surgery, &c., vol. i. p. 115,) whose skin is moist, and which possesses a very delicate cuticle, cutaneous absorption is a constant and important function. Such are frogs, salamanders and similar animals. The experiments of Edwards have established the skin in them to be entirely absorbing, and instrumental in their support. It is the opinion of Fohmann, that while the *fœtus* is in utero, cutaneous absorption from the liquor amnii by which it is surrounded, is one of the means of its nutrition."

‡ Perhaps some special modification in the application of galvanism or magnetism to the part to be locally anæsthetized, may yet be found capable of effecting this object. I have tried several experiments, but hitherto without much success. The possibility of deep local anæsthesia existing in diseased states, (as in colica pictorum, hysteria, hypochondriasis, &c.) without the general sensibility consciousness being affected, is well shewn in an interesting essay of M. Beau, in the "Archives Gènes de Médecine" for January, 1845. He relates one case

effect the local anæsthesia desired. At the same time, this consummation, even, seems doubtful; for, perhaps, any agent possessing a deeper and more rapid anæsthetic local power, would, by absorption, affect the system generally, and it may be, dangerously, before complete local insensibility of a part could be effected. Some time ago, in attempting to produce local anæsthesia in my hand, by exposing it to the vapour of hydrocyanic acid, ere the hand was much, or very perceptibly benumbed, I began to feel the constitutional effects of the poison; my respiration became irregular, and I felt giddy and faint, when my assistant removed my hand from the jar. All due care was taken to prevent me breathing any of the vapour, and I sat during the experiment in a current of air. I felt the benumbing influence of the acid extending from the hand upwards along the arm a minute or two before the experiment was stopped.

In addition to the liquids and vapours experimented upon, I have tried long immersion of the hand in various gases, as carbonic acid and common coal gas, (both of them powerful general anæsthetics when inhaled,) without any effect. Chaptal, however, alleges that he had felt the limbs plunged in carbonic acid much benumbed; and Collard de Martigny* found that when the general surface of his body was immersed in carbonic acid, (arrangements being made so that none of it was breathed,) giddiness, ringing in the ears, and the other symptoms produced by the action of this gas supervened in eight or ten minutes, proving that it was absorbed. Davy† felt the premonitory exhilaration of nitrous oxide gas by exposing the surface of his body to it in the same way.

Chaussier‡ inclosed the leg of a dog in a bag containing sulphuretted hydrogen, and found that he could in this way, in a few minutes, induce the poisonous effects of this gas; and similar experiments were repeated by Lebkuchner§ and Nysten,|| and my friend Dr. Madden,¶ on the rabbit, &c., with similar results. I have held my hand inclosed in a bag filled with the constantly renewed vapour of sulphuretted hydrogen for about half an hour, without feeling any local effects.

And even supposing that we could, by any means, so benumb the sensibility of a part to be operated upon as to render it anæsthetic, I doubt much if this state of local anæsthesia would place the parts in a condition at all favourable for being subjected to operation. It is quite possible, nay, probable, that other more powerful agents than those which I have experimented upon, may, by their local application, produce a greater and deeper local anæsthesia on the human subject than I have yet

witnessed; but all, or almost all of those that I have used, have, along with the anæsthesia, led to such a congested and injected condition of the part, as to give every likelihood, both of a greater tendency to hæmorrhage at the time of operating, and of a greater tendency to inflammation in it immediately afterwards.

Other and more simple agencies than any which I have mentioned are capable of producing a certain amount of local anæsthesia. A mere exposure of the hand, for instance, to great changes of temperature, either in the way of increase or of diminution, has the power of deadening the sensibility of the part. I have tried, and seen others try, to hold the hand, with a view to this, immersed in broken ice, or dipped in ice-water, and with the effect of inducing a degree of anæsthesia in the part, as deep as, if not deeper than, exposure of the same part for a greater length of time to the local action of chloroform would have effected. In his admirable and classical "Lectures on Inflammation," the late Dr. Thomson remarks, (p. 617,) that "the sensibility to external impressions of the 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." But he also correctly adds—"This diminution, however, of the sensibility to external impressions, is not unfrequently accompanied with severe degrees of pain." In fact, in making the experiments to which I have above adverted with the pounded ice, few of us could allow the hand to be retained in it above two or three minutes, in consequence of the intense pain which ensued; but still that brief period produced, as I have said, a most distinct and well-marked degree of local anæsthesia.

Keeping the hand immersed in water, of as high a temperature as it can conveniently bear, has also the same effect of rendering it, in five or ten minutes, partially anæsthetic and benumbed, as compared with the other unexposed hand, and this without the pain and suffering connected with the other extreme of temperature.

It is not my object here to inquire in what relative diseased or other conditions of a part, heat or cold are respectively calculated to act anæsthetically. But I would beg to make strongly this general remark, that the action of the above, and other applications, which we use to inflamed, burned, neuralgic and pained surfaces and parts, (such as preparations of opium, conium, aconite, belladonna, tobacco, &c., &c.) still require to be studied, which they have not yet been, in another and a new light,—viz., as LOCAL ANÆSTHETICS. Therapeutical writers will, I believe, perhaps betimes study and describe them in this novel point of view; and when attention comes to be directed to them with this object, some new facts and precepts may be elicited that will enable both the physician and surgeon to exhibit and apply local anæsthetics with more science, precision, and success, than hitherto.

The experiments and observations which I have detailed in the preceding pages, perhaps entitle us, in the present state of our knowledge, to draw the following

insane patient who broke his fibula, and continued to walk about without pain till the limb became inflamed and gangrenous. It was then amputated, and still without the patient suffering in any degree during the operation.

* "Archives Génér. de Médéc.," vol. xiv., p. 209.

† "Researches on Nitrous Oxide."

‡ Sedillot's "Journal de Médéc.," vol. xv., p. 25.

§ Diss. Inaug. utrum per viventium adhuc animalium membranas materiæ ponderabiles permeare queant, p. 10, &c.

|| Nysten. "Recherches Physiologiques," p. 137, &c.

¶ See his excellent "Experimental Inquiry into the Physiology of Cutaneous Absorption," p. 133.

CONCLUSIONS.—

1. In animals belonging to the class of Articulata, complete local and limited anæsthesia can be produced by the local and limited application of the vapour or liquid of chloroform to individual parts of the body of the animal.

2. In Batrachian reptiles, the tail, or an individual limb, can be affected in the same way with local anæsthesia, by the local application of the chloroform; but, in addition, general anæsthesia of the animals usually results in a short time, in consequence of the chloroform absorbed by the exposed part coming to affect the general system.

3. In the smaller Mammalia a single limb, or even the whole lower or pelvic half of the body, can be rendered anæsthetic by local exposure of these parts to the influence of chloroform.

4. In the human subject partial, and, perhaps, superficial, local anæsthesia of a part, as the hand, can be produced by exposing it to the strong vapour of chloroform; but the resulting degree of this local anæsthesia is not sufficiently deep to allow the part to be cut or operated upon without pain.

5. Any agent possessing a stronger local benumbing, or an anæsthetic influence, would probably be dangerous, by its acting too powerfully on the general economy, before the local anæsthesia was established to a depth sufficient for operating.

6. Artificial local anæsthesia, from any known anæsthetic agents, seems objectionable in any part intended to be operated upon, in consequence of the vascular congestion and injection which attend upon and accompany this local anæsthesia.

7. There are few operations in which there is not previously a local broken surface; and the application of chloroform, &c., to such a surface, would be far too painful to be endured, no small degree of suffering sometimes arising from even the exposure of the unbroken skin to their action.

DR. FORBES IN REPLY TO MR. NEWNHAM
ON THE PRESENT ASPECT OF MEDICINE.

TO THE EDITOR OF THE PROVINCIAL MEDICAL AND
SURGICAL JOURNAL.

SIR,—I hope I am sufficiently tolerant of criticism to feel but little concern at anything depreciatory that may be said of my humble writings by the public press; and I am too careless and indolent to notice statements that merely relate to me personally. I would not, therefore, have troubled you or your readers with any remarks on the long paper of my friend Mr. Newnham, now brought (as I suppose,) to a conclusion in your pages, had I not felt, that by so doing, I might possibly, in some little measure, promote an object of professional importance. What I now propose to say, while it corrects some mistakes into which my friend has fallen, may have the effect of calling the attention of your readers, still more closely,

to Mr. Newnham's excellent paper, and thereby aid the great cause which we have both so much at heart—the real advance of medical science and practice.

Of the numerous contributions and remarks, public and private, from personal friends and unknown critics, which have been called forth by the article commented on by Mr. Newnham, none has been, on the whole, so satisfactory to me as the paper in your Journal. Putting entirely aside the compliment implied in the fact of Mr. Newnham thinking the article of sufficient importance to call for so elaborate a commentary, I cannot help feeling particularly gratified to find a man of such long and extensive experience, and of such acknowledged talents—and, moreover, a general practitioner,—recording his concurrence in most of the views, both scientific and practical, contained in that much-discussed paper. And my gratification is not a little enhanced by the circumstance, that Mr. Newnham's concurrence in my opinion has been, as it were, forced upon him by the strength of his convictions—through the honesty of his nature and his paramount love of truth—in direct opposition to his obvious predilections and prejudices. My friend's first impressions on reading the article, were evidently unfavourable to my views; and he took up his pen in a hostile, or at least in an antagonistic spirit, to battle for what he deemed the truth imperilled, as he thought, in my unlucky pages. But Mr. Newnham is not the first man who, in combating a supposed heresy, has himself been converted, or who, on a holier occasion, having gone to scoff remained to pray. In making this statement, I am far from claiming the credit of converting my friend by my arguments: I am quite content with the honour of having supplied Mr. Newnham with the occasion of reviewing in his own mind, in a more particular manner, the results of his own observation and experience. The consequence to a man of his acuteness and candour, was inevitable.

It is indeed true that, while assenting wholly to several of my principal positions, Mr. Newnham only partially agrees with some, and dissents altogether from others; it will be found, however, that, even in regard to these latter, or at least to several of them, the difference between us is much widened, and in some cases entirely created, by a misapprehension on his part, of my meaning. In taking up my pen, I at first intended to restrict myself to the correction of some of these mistakes of my friend; but I now feel unwilling to let slip so favourable an opportunity of strengthening my cause, by the very effective, though unintentional aid of so doughty a champion as Mr. Newnham.

Mr. Newnham makes a strange mistake in confounding what is termed in the article, "The Natural History of Disease," with the plan or plans of *treatment* advocated in it. Nothing could be further from the truth than this; and I cannot see how Mr. Newnham could have made the mistake. Throughout the whole article, the *Natural History of Disease* is merely spoken of as a thing of essential importance to be known, with the view of regulating practice; but nowhere is it contemplated, much less recommended,