which can be so advantageously used in this and other disarti-
culations; grasping the head of the bone, therefore, with my
fingers, I readily completed its disarticulation, and carrying
the knife down the inner aspect of the upper arm, effected the
separation of the limb, having reserved the whole of the intrin-
ses in place as a new stump, an auxiliary, or rather, the brachial artery was divided at the ter-
mination of the last incision.
On the limb being separated, the main artery was at once
seared, and the other vessels, a small portion of the disease that I had shaved off from the
limb in forming the inner flap, and with it, a large portion
of the healthy muscle, were removed; the anterior boundary
of the diseased tissue, clearly cut away, and the
\vphantom{1}\vphantom{1} upon the minds of those present, that all the disease, and
much of the healthy structure surrounding the tumour, had
been excised. The flaps were laid together, and united by
four or five sutures, and a neat appearance
and the patient, who had borne the operation with the
most fortitude, was placed in bed. On a careful dissection of
the tumour being made, it was found to consist of a cerel-
iform of, surrounded by a distinct cellular capsule, which
separated it from the surrounding muscles. In the centre of
the tumour was a large cavity, filled with portions of the
tumour broken up; this cavity communicated above and
beneath with the cavity on the humerus, and the
finger could be passed. Intermingled with the walls of the
cavity were portions of the cortical structure of the
humerus, much thinned, the head and neck of the bone being,
in fact, with the two sutures, and the shaft of the humerus, and
the bone was found to be perfectly healthy; but in the
upper extremity of the tumour, the portion of the humerus, a small
mass of the bone was found filling up the medullary cavity, and

- extending down the canal for an inch, when it abruptly ceased,
and all further traces of the disease were lost. Various mem-
hraneous septa, imperfect at some points, traversed the sac, dividing it
into cavities communicating with one another. The muscular
structures in contact with the tumour were healthy, except
at their insertions, which were involved, with the periosteum, in the
disease. In colour and consistence the tumour inti-
\vphantom{1}\vphantom{1} resembling a cavernous gland; and its anterior surface
was marked by a deep groove, in which the long tendon of
the biceps rested.

Five p.m.—No haemorrhage; has suffered some pain; com-

plains of, sore; in other respects comfortable. 22nd.—Had passed a good night; pulse 120; skin hot;
tongue moist. 23rd.—The bandages, straps, and stitches were removed; authorising the
wound, with one, at a front, where a small portion of the pectoralis major pro-
traded; the wound was dressed with straps and warm water
dressing; his bowels had been fully relieved; the pulse was 108; his temperature was cool. He was, however, returned to
favourably, (two ligatures separating on the eleventh day) until
the opposite side, as the tumour was developed at its side, resembling that removed by
operation from the other arm; the stump at this period became swollen, and in a very short time a bleeding fungous
mass protruded from it. The disease appeared to progress more rapidly in the stump than in the remaining limb; he
continued to linger on until the 8th of January, 1847, when
death terminated his sufferings. A post-mortem examination
in no other obtained.

The remarks on this case will appear in a future number.
Gower-street, Bedford-square, Sept. 1847.

ON THE

INHALATION OF CHLOROFORM AND ETHER.

WITH DESCRIPTION OF AN APPARATUS.

BY JOHN SNOW, M.D.

In January last I laid before the Westminster Medical Society
an apparatus which supplied the means of regulating the propor-
tions of ether vapour and of air during inhalation. By means
of this apparatus the patient might be rendered insensible to ether, and that all
failures must arise from inefficient means of administering the
ether, and not from any idiosyncrasy of the patient. After
this uniform way, I was enabled in the course of last autumn
to submit to the profession a description of etherization
divided into degrees, which I still consider to be correct, and
to be equally applicable to the effects of chloroform, and
other agents of a similar kind.
I divide etherization into five degrees, which may be
called degrees of narcotism. The division was made accord-
ing to symptoms which may be observed before an operation
begins, leaving out of the classification the immunity from
pain, which can only be ascertained during the operation
and which, curiously, does not correspond uniformly with
the state of the patient on other occasions. In what I called
the first degree, there is exhilaration, or altered emotions and
sensations of some kind, but the patient still retains
consciousness and volition. In the second degree, the mental
functions may still be performed, but only in an irregular
manner; there may be ideas of a dreaming kind, and voluntary
efforts in accordance with them, or the patient may be pas-
sive. When mental excitement occurs, it is chiefly in this
degree, in which the functions of the cerebral hemispheres
seem to be impaired, but not yet abolished. In the third
degree, these functions appear to be totally suspended, but
those of the spinal cord and its nerves still continue to some
extent; a slight degree of blood is drawn, and when the
eyelids are touched, they may be other involuntary motion
resulting from external impressions, and groans or cries may
occur, but no sounds of an articulate kind. There are also

drawings of the apparatus, and a description of the use of the
the Heyward pinchcock, as an effect of the vapour—apparently a kind of excitement
of the spinal cord. In the fourth degree, no movement i
obvious, except that of respiration, which is unaffected by external impressions, and goes on regularly, though often with a greater or less degree of vigour; is a sensation that the whole of the nervous centres are paralyzed by the vapour, except the medulla oblongata. In killing animals with vapours, I have frequently found this to be difficult, or found the animal to be injured, before it is capable of being produced; a small stage I call the fifth degree. There can be no doubt that these degrees of narcotism correspond with different proportions of vapour which are dissolved in the blood at the time—proportions which I hope to be able to determine. A certain quantity of vapour disturbs the functions of the cerebral hemispheres; an additional quantity appears altogether to suspend these functions, and to impair those of the spinal cord and medulla oblongata; a still larger quantity to suspend their latter functions, but to leave the medulla oblongata more or less unaffected. As the vapour escapes from the blood by its effects go off, the patient passes from the fourth degree to the third, from that to the second, and so on, if the inhalation be not renewed.

It is seldom possible to perform an operation without signs of pain unless the narcotism is carried as far as the third degree, although it is a greater inconvenience to the patient, being unconscious, might not remember the pain, memory being the continuance or revival of knowledge or consciousness, which is something superadded to mere sensation, and not that of the sense of which it is stated that patients felt no pain, although they had never lost their consciousness. I have not seen any such case. I do not, however, deny the possibility of it, but I am inclined to think that the person who has done it has had an extent of reason beyond the ordinary cases the patients had been unconscious without knowing they had been so, and had recovered their consciousness whilst still inhaling, before the operation began. My reasons for believing this are that all the chloroform patients have strength of them diminishes as the process goes on, by the cooling of the sponge or other apparatus, or by the liquid becoming exhausted, thus affording the patient an opportunity to breathe, and as less spring, obtaining, the patient often asserts that he is not yet insensible, until he finds proof of his error; and that I have often found patients to be conscious during some part of an operation which has been conducted in this state. The point is on my hand not to have the operation prolonged by the patient's resistance, but to stimulate the function as the operation proceeds.

It is, then, generally necessary to carry the effects of chloroform or ether to the third degree, and sometimes to the fourth degree, to be certain of avoiding the pain of an operation, for whilst patients are recovering from the effects of the vapour, there is a great inconvenience to the patient, and with the same degree of narcotism, than when they are first getting under its influence—consequently, it is seldom necessary to keep up the effect even to the third degree, especially with ether, to a certain degree, or on any anesthetic effect, in proportion to the narcotism, than chloroform. If some persons consider the anaesthetic effects of the new agent which Dr. Simpson has introduced to be superior to those of chloroform, the contrary belief is on my hand. The effects further than those of ether—perhaps perhaps further than they had the power of carrying the latter with the means they employed. After narcotism has been carried to the fourth degree, the patient is nearly always insensible to the operation in the third degree; and when insensible in the third degree, generally remains so when narcotism has diminished to the second degree. With ether, indeed, it was frequently observed that the patient remained insensible to the knife after he had recovered his consciousness of surrounding objects, and could even talk rationally. This I have never yet observed with chloroform, although I have taken a particular care to ascertain it. This is not the only case in which the effects of ether have been seen a state which is insensible to the operation or other. I believe, never explained. I have an hypothesis to offer in explanation of it. I have looked over my notes of cases of etherization, and have found that the instant in which the insensibility to the operation outlasted the unconscious state, with only one exception, occurred in subjects under twenty-five years of age.

This peculiarity, then, must depend on something in the patient, which is not likely to be present in the second degree of narcotism. The first characteristic difference between the opposite periods of life—the rotundity and smooth-flowing outline to which youth owes its beauty and its chief feature: On what do they depend? There is no such likeness between the insensibility to the operation or other, and the fourth degree of narcotism, than the fourth to the fifth stage. There is at least one instance of the great insensibility which is going on. The patient is no longer insensible to the operation or other, and the fourth degree of narcotism, than the fourth to the fifth stage.
proceed a degree further on account of the cumulative property of the vapour after it is discontinued. Let us look at this matter in another point of view. 100 cubic inches of the vapour of chloroform contain 128 grains of the liquid. Half of this quantity is enough, if inhaled within a minute or two, to produce the most complete insensibility. the whole quantity, if inhaled rapidly, might undoubtedly cause death; for I have observed that animals may generally be killed by half as much vapour than will produce narcotism to the fourth degree. If, for instance, an animal is rendered completely powerless in two minutes by vapour of a certain kind and strength, death takes place by continuing it for another minute; if rendered powerless in one minute, then it dies in about half a minute more. Now 100 cubic inches of vapour of chloroform may be contained in 800 or even in 500 cubic inches of air. When air is saturated with the vapour of chloroform at 60°, 800 cubic inches contain 100 of vapour, at 79°, 500 cubic inches contain the same quantity. it is therefore to be supposed that 128 grains of chloroform might all be inhaled in four or five deep inspirations, and consequently, a person breathing deeply might inhale a fatal dose of chloroform in a quarter of a minute. This should be borne in mind, especially by those who recommend that patients should breathe deeply when inhaling. I always tell persons to breathe quietly, and when I find, during the inhalation of chloroform, that the inspirations are deep, I open the valve for admitting the external air to further dilute the vapour. I seldom induce total insensibility in less than two minutes, and occasionally take three minutes. The exhibition of the chloroform requires great care when it has to be repeated to keep up insensibility in a patient already under its influence, during an operation; and under all circumstances, it will require additional care in summer, except an apparatus with a cold water bath is used.

I for some weeks employed the same apparatus in the exhibition of chloroform which I had used for ether; but afterwards I contrived a more portable one, still employing this face-piece, which I have used with ether since June last. The

The dotted lines indicate the position of the expiratory valve, when turned aside for the admission of unvapourized air.

sides are composed of thin sheet lead, which can be moulded to fit the patient's features; and the expiratory valve turns on a pivot, so that it can be moved aside from the opening it covers, and external air admitted at the beginning of the inhalation, and at any other time if required. Mr. Hawley, of the Nottingham Infirmary, was the one which suggested this, and I got it to its present form by several suc-

In this inhaler, which I now use, I retain the water-bath, but of smaller dimensions, the calorie absorbed in the evaporation of chloroform being very much less than in the case of ether. I never employ water of a higher temperature than 60°. The inhaler is suspended to the face-piece by a short piece of elastic tube, merely to allow of its being applied in all positions of the patient. The fibrous paper which absorbs and gives out the chloroform, only extends half-way up the cylinder, so that there is little or no loss by spontaneous evaporation, the air saturated with vapour being rather heavier than the air above. I consider that, on the whole, chloroform is superior to ether for adults, and that we are greatly indebted to Dr. Simpson for the introduction of its use. For children I prefer ether to chloroform, when the choice is left to me, on account of the greater rapidity of action of these vapours on them, as I stated to the Society a month ago, although I have administered chloroform several times to young children—one of them aged only ten months—and with perfect ease, safety, and success. I consider the less powerful agent of the two, however, sufficiently strong for very young patients, and this chloroform inhaler serves very well with the small face-piece for exhibiting it to them.

Children are brought under the influence of ether, sufficiently for an operation, in two minutes, and I think it impossible for the imagination to conceive any anesthetic agent more mild and efficient than ether is in its effects on children—a less degree of narcotism than in the adult producing an immunity from pain, and the liability to excitement being absent. The ether, however, requires to be given to them with an apparatus, by which the vapour can be introduced into the air they are breathing, in the most gradual way; otherwise the pungency of the vapour, when suddenly admitted, makes them hold their breath, which is the case with chloroform also when given to children on a sponge or handkerchief. If it is desirable, as I believe it to be, that we should have an agent which can be safely and generally

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* It was described in the last Lancet, p. 154.
administered in this way to children, to women in natural labour, and even in cases of strangulated hernia, is of no special experience in the matter, it should be something much less powerful than chloroform, and much less pungent than either of these vapours.

The speed with which, being in rapidity of action between chloroform and ether, I requested permission to give benzoin in St. George's Hospital lately. It was made for me by Mr. Bullock, by distilling benzoic acid with slaked lime; it consists of a mixture of benzoin and olibanum, and the same thing as the bichlorid of hydrogen discovered by Dr. Faraday, and obtained by him from condensed oil gas. It succeeded very well in four cases of tooth-drawing without any ill effect. In one of them, after ether had been given, the patient knee it totally prevented the pain, and was followed by no ill effects; but being pushed rather further than in the other four cases, the patient, a woman, had some convulsive tremors for about an hour afterwards, but lasted only a short time. The vapour when its effects reach the third degree, as the same vapour caused the same symptoms in two white mice and in some guinea pigs, and I never saw similar effects from ether or chloroform. One dracont was in the cases of tooth-drawing, and two dracontis the amputation, but being less volatile it does not act so quickly.

The property of totally preventing pain in severe operations, and on other occasions of acute suffering, is most valuable and important, yet these anaesthetic vapours sometimes confer still more important advantages.

I administered the chloroform, several weeks ago, to a gentleman, aged fifty-eight, on whom Mr. Coulson performed the operation of lithotomy. This patient had been suffering from a diseased bladder for more than two months, and the operation was recommended and submitted to as the only means affording a prospect—and that but a doubtful one—of recovery. He was so nervous and irritable, and the bladder so sensitive, that he could be sounded only with the greatest difficulty. Sir B. Brodie and Mr. Sams, of Blackheath, the usual attendant of the patient, were present at the operation, which was extremely difficult and protracted on account of the scarious tissue, the flatness of the bladder, and the breaking and when it was grasped with the forceps. It occupied three quarters of an hour, the patient, of course, being kept perfectly insensible the whole time. Sir B. Brodie remarked that he had only seen one case of lithotomy so difficult, and he, Mr. Coulson, and Mr. Sams, expressed their conviction that the operation could not have been performed except for the insensibility produced by the chloroform.

This patient was gradually and quietly recovered his consciousness in the course of a quarter of an hour after the operation was completed, and is going on well, but requires to have his bladder washed out, on account of phosphates and mucus in the wound, and inhales the chloroform at his own request on these occasions.

I administered the chloroform also lately to a gentleman, to enable Mr. Henry Charles Johnson to reduce a compound dislocation a back, and, in the last phase of the fourth, which he had previously endeavoured to reduce without success, as the patient could not bear the attempt to be continued. When insensible, the dislocation was speedily reduced.

I am not aware that any disease, or any state of the general health, forbids the inhalation of ether or chloroform, and it is fortunate that the least favourable subjects for inhalation are those least likely to require it—viz., persons in robust health. The patient who was so critically situated was a person of strong constitution; but there is occasionally a little difficulty, as they are more liable to excitement in the second degree, and to rigidity and struggling in the third degree of vapourous narcosis. It has been said, and I stated the same opinion myself in the Medical Gazette in March last, that disease of the heart or lungs, to any notable amount, contraindicates inhalation. I do not now deny this, but I am of opinion, that when persons so situated are to have their general health benefited by the inhalation, it would be less liable to do mischief than the pain, or even the anticipations of it. The inhalation of chloroform quickens the circulation somewhat; in ether, still more; and the patient who is aware of the former would be prevented by this feeling of consciousness, as if the affection of the heart or lungs. I have given both vapours to patients with diseases of these organs, and have seen beneficial effects. Mr. Thomas Wakley, after detailing an extensive series of experiments in The Lancet, (present vol. No. 1,) draws the conclusion, that ether, and more especially chloroform, cause congestion of the heart and vessels, and that when there is no special experience in the matter, it should be something much less powerful than chloroform, and much less pungent than ether.

The extraction in THE LANCAST, in which animals were killed, I have met with the same sensation in animals killed by chloroform when confined in certain circumstances, but I do not consider it any proof that congestion exists during inhalation, confined within safe bounds. The arteries are nearly always found empty after death, but we do not conclude that they are empty during life. The congestion of which I am speaking arises from the circumstance, that in many instances in which animals are destroyed by these vapours the respiration ceases, whilst the circulation is still going on, and the heart is full of blood. It is on this account that, to avoid danger in exhibiting vapours, we should attend to the state of the respiration, rather than the pulse.

Frith-street, Soho, Jan. 1848.

ILLUSTRATIONS OF THERAPEUTICS.


(Continued from vol. i. 1847, p. 291.)

Atomic Paraplegia.

If any disease merits the appellation of a living death, that disease is unquestionably paralysis. Fearful in its accession, attended by few mitigating circumstances in its progress, without certainty in its results, and, when once established, not to be wondered at that its premonitory symptoms should be accompanied by the most awful apprehensions of immediate or future consequences, seldom admitting of removal or alleviation. Paralysis, however, is of a milder character, as extremities, is not necessarily accompanied by mental imbecility, and is of one of those forms of paralysis which admits of occasional restoration to health. The following case is a striking exemplification of the truth of these observations, and I trust its publication may afford assistance to the clinical observer, who, whilst he derives instruction from experience, is not a little indebted for his success to professional literature.

"Ex facto jus oritur."

Aug. 16th, 1845.—The widow of a marine officer, about fifty years of age, and the mother of several children, about a fortnight since felt a numbness across the loins, passing to the lower extremities. I found her tottering in her walk, with a depressed pulse of 86, mouth dry, slight thirst, and no appetite. She is in the habit of sleeping with an aged mother, and has frequent occasion to lie in and out of bed at night, which probably may have laid the foundation of the remote cause of her complaint. Although she has not, during the former part of her life, been seriously ill, she has not the appearance of being a healthy person; she is thin and weak without being emaciated. Prognosis disastrous. Pain in the limbs, however, is not a striking difficulty, but local sensibility is not destroyed; it is therefore paralysis of motion only. The urinary function is unimpaired, and the natural desire to pass the bowels remains invariable; but when the excreta's discharge is less in-