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BY

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HYDRATE OF CHLORAL.

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By Charles W. Parsons, M. D.

Fownes' Manual of Chemistry, published in 1844, a few years before the ethereal anaesthetics came into use, describes the mode of obtaining "a thin, oily, colorless liquid, named *chloral*, of peculiar and penetrating odor, which excites tears;—it has but little taste. * * * * It forms, with a small quantity of water, a solid, crystalline hydrate. * * * * Solutions of caustic alkalis decompose it, with production of a formate of the base, and of a new volatile liquid, *chloro-form*."

This is an early notice of two substances, each discovered some years before, and now well known far and wide to physicans and their patients, and which have since assuaged many more tears than they have excited. Liebreich of Berlin began his experiments from the point reached many years ago by the chemists; that the hydrate of chloral meeting an alkali in solution yields chloroform. He inferred that this would take place in the blood, on account of the soda in that fluid, and that the anodyne effects of chloroform—which meanwhile had become well known,—might be thus obtained, the chloroform being evolved gradually, and hence producing more moderate and prolonged results. His inference was soon confirmed by trials upon animals and men, and the hydrate of chloral, till then only a chemical curiosity, passed into the hands of the profession at large. The observations of Dr.

Benjamin W. Richardson of London were of the greatest value, especially in introducing the new agent to English and American practice.

The symptoms produced in different animals are essentially the same in all classes, of Vertebrata at least;—in moderate doses a natural but heavy sleep, or continued drowsiness, in which the animal may wake naturally and go to sleep again in the same way;—in heavier doses, a complete anaesthesia, muscular relaxation, a marked lessening of animal warmth, and in excessive doses death. "In the case of every animal," says Dr. Richardson, "sleep is induced not merely without pain, but with an expression of pleasure; the sleep is gentle, seems to be attended with no symptoms of distress, and leaves no serious evil behind." Cats purr while coming under its influence.

The symptoms caused by chloral in men are in the main the same as in lower animals. It has been given by the stomach, by injection to the rectum, and subcutaneously. The fact that it needs considerable dilution when applied to mucous surfaces shows that it is not well adapted for hypodermic use. Its introduction in that mode has been followed by abscesses, though in experiments on lower animals, in whose flesh suppuration is not so easily induced as in man, it has often been injected beneath the skin, with a certain advantage in definiteness and promptness of action. It acts readily when introduced either to stomach or rectum. When swallowed, it should be diluted in the proportion of not much less than a drachm of water to the grain.* Stronger than this, it is liable to irritate the stomach. Like other solutions, it is more quickly absorbed if given so as not to mix with food. When thus absorbed, chloroform is evolved in the blood, not rapidly as it would be in a strong alkaline solution, but gradually, in proportion as the chloral meets alkali enough in the blood to react upon it. It is not poured suddenly into the great mass of blood, as in inhalation.

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*Professor Edward H. Clarke.

Chloroform appears to be eliminated by the same channel as when it is inhaled, viz.: by the pulmonary mucous membrane. I am not aware that it has been found in urine or other secretions. The breath smells of chloroform.

The well-known leading symptom produced by chloral is a continuous gentle sleep, more or less prolonged. A medicinal dose causes drowsiness, usually, where there is no counteracting influence, in a few minutes, and sleep within a period, ranging from a quarter of an hour to an hour and a half. In this condition, the patient will awake, attend to the calls of nature, or to any care that weighed on the mind, sometimes eat a meal, and go back to the same quiet repose. Pain is annihilated for the time. The muscles are relaxed, though sometimes, as a part of the early effects, there are convulsive movements, as frequently in inhalation of ether or chloroform. In the words of Professor Clarke, of Boston: "The limbs lie in natural attitudes. The respiration is easy. The skin is normal, or a little cool. The pupils are contracted, but easily dilate. A sufficient noise or disturbance arouses the sleeper, who asks, what is the matter, and directly falls asleep again."

We may theoretically suppose that chloral has a primary exciting effect, preceding its sedative influence, but usually the stage of excitement, is hardly to be noticed, or at any rate is very transient. Some temperaments are unpleasantly stimulated by it; I have noticed this in two members of one family; it made them wakeful and talkative.

The anæsthesia of the early part of chloral sleep is not to be safely relied upon for surgical operations. Chloroform being produced gradually, does not saturate the blood enough for this, unless in dangerous doses. In a French hospital, a leg was amputated under chloral-anæsthesia, and the patient for seven hours had alarming symptoms, coma followed by delirium and excessive prostration.

The circulation and respiration are lowered in activity,—slightly by medicinal doses, dangerously by very large doses. The pulse is often quickened at first, but as a general rule becomes slower and feebler as the genuine symptoms of chloral

come on. Respiration becomes somewhat slower. Animal temperature is lowered by a large dose. A rapid and great change in this respect, as for instance, of two degrees within an hour, implies danger.

Such, as generally observed, are the effects of chloral on the great heat-producing functions. In cases of feeble circulation, it has sometimes been found to act as a gentle stimulant, restoring and equalizing circulation in the extreme parts, and quickening breathing in the first stage of its action.

The influence of chloral on circulation within the cranium, has been best illustrated by the experiments of Dr. William A. Hammond, with the ophthalmoscope, and with an instrument for measuring cerebral hæmostatic pressure.* These experiments show that "the first effect is to cause congestion of the cerebral vessels, and that subsequently it induces directly the opposite condition; with a small dose, this latter effect is not reached, congestion only being produced." This idea tallies with the unpleasant symptoms sometimes following soon on the administration of chloral. A few patients have severe headache soon after it. I have known two to be relieved from headache by going to sleep after taking it, and both compared the sleep to that procured by chloroform; but on waking, the headache was worse than before. In a few patients, the primary excitement amounts to delirium. At the Royal Infirmary, Edinburgh, we are told that "in upwards of fifty observations, where forty grains were given, in seven, the patients were greatly excited, four being wildly delirious shortly after taking the medicine. This temporary delirium passed off in all cases in two hours, with profuse diaphoresis."

The dangers of chloral appear to be such as might be expected, on the theory that it acts by gradually evolving chloroform in the blood. Most of the sudden deaths by chloroform may be ascribed to paralysis of the heart, by the over-

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* New York Medical Journal, February, 1870.

whelming effect of this powerful agent thrown suddenly into the blood. The severe symptoms, and even death, sometimes produced by chloral, point to a like danger from this drug, though it has usually a slower, and, hence, safer influence. Its most characteristic action on the heat producing functions, is that of a depressant,—on the muscular fibres of the heart, and the pneumo gastric nerve. When the heart is weak,—fatty, thin, or dilated,—it is therefore dangerous; and also in cases of considerable pulmonary congestion.

In congestion and inflammation of the brain, or its membranes, it must be considered unsafe.

A few cases of threatening symptoms following the use of chloral, will illustrate its possible dangers. Happily, I have none to quote from my own observation.

Dr. Reynolds, in the Practitioner, reports the following symptoms, after a dose of 40 or 50 grains: "excessively rapid, weak and intermittent pulse, jactitation, intolerable sense of sinking and oppression at pit of stomach, gasping breathing, confusion of thought."

Dr. Habershon relates a case of thoracic aneurism, where 30 grains were given at night to relieve pain and dyspnœa, and procure sleep. This was followed by immediate unconsciousness, with livid and cold face and hands, breathing at long intervals; and for about five hours death seemed impending. Next day the man was no worse for it. It seems to be generally conceded that this remedy is not a good one for cardiac sleeplessness, or cases of greatly obstructed respiration.

A few instances of death from chloral have been reported in newspapers and medical journals, not generally with enough detail to enlighten us much as to the manner in which it has destroyed life. A death took place in Pawtucket, of an intemperate woman, who had first taken it from giving it to her husband with delirium tremens. Between a Sunday morning and Monday evening, she took, as was inferred from an empty bottle found near her, about six drachms; and she was found dead in the woodshed.

In the London Lancet, March, 1871, Dr. H. W. Fuller relates the cases of two patients who had very serious symptoms, in one case fatal, from 30 grain doses. One had Bright's disease, with slight anasarca and bronchitis. The chloral was given at night for sleeplessness. Soon after, he jumped up in bed, clutched at his heart, and complained of a burning. In a few minutes he became delirious, and after delirium subsided, there was so much depression that it was difficult to sustain the heart's action. Gradually the pulse returned, and in a few hours he was out of danger. It being thought that this might be from an alkaline condition of the stomach, evolving chloroform rapidly ; it was afterward given once with an acid, but with similar results.

The second case is a very important one, being the only circumstantial account I have seen of death from a medicinal dose. A young lady, aged 20, having been restless and nervous from some digestive derangement, though previously in fair health, took 30 grains about 10 p. m. She almost immediately became much excited, and complained of pain in the chest. In about an hour the excitement passed off, and she fell asleep and slept heavily all night. In the morning she was sleeping so heavily, and looked so pale, that the family became alarmed, and sent for the gentleman who had seen her the previous day. When he arrived she was very pale and breathing heavily, a deep sighing respiration ; there was no pulse at the wrist, and her extremities were rather cold. It was impossible to rouse her in the slightest degree He gave her stimulants, and applied warmth to the extremities, and gradually the pulse returned at the wrist, though at the best, it was only just perceptible.

At 2 p. m. next day, when Dr. Fuller saw her, she was lying on her back, with her eyes closed and breathing heavily, the respiration having a distinctly sighing character. She was very pale and somewhat cold ; the skin was dry ; the pupils were large and dilated, but acted sluggishly under the influence of a strong light ; the pulse was scarcely perceptible, but the heart was beating regularly, about 120 in a minute, and

though its action was very feeble, its sounds were clear, and its rhythm was normal. There was no distension of the abdomen; indeed it was flat and soft; there was no contraction or rigidity, or undue flaccidity of the limbs. It was impossible to rouse her in the slightest degree; but when fluid was put into her mouth she swallowed without much difficulty, so that she took a full-sized wine-glass full of brandy and water in the course of ten minutes.

The indications for treatment being obviously to sustain the heart's action, it was determined to give brandy and diffusible stimulants, as far as possible, by the mouth, and to supplement our efforts in that direction by repeated injections to the bowels of strong beef-tea and brandy. However, everything proved unavailing. She continued in much the same condition until about 9 o'clock the following morning, when she sank, without having exhibited the slightest consciousness, or moved a muscle from the time she fell asleep, about thirty-four hours previously.

This case shows that thirty grains may be dangerous. On the other hand, Simpson named as a common dose for an adult 50 or 60 grains. Dr. Richardson, who has connected his name so intimately with this subject, said in February last, that the largest dose he had known given at one time was 120 grains. This caused long and dangerous, but not fatal stupor. He calculates that the body of an adult cannot decompose and throw off, on an average, more than 5 to 7 grains an hour; and that an amount of 120 grains within 24 hours, is as much as can be given without risk.

For myself, I believe it is best, generally, to begin with about 15 grains, repeating, if necessary, at first after an hour's interval, afterward at longer intervals. This is the usual dose at the Rhode Island Hospital.

Dr. Richardson thinks that its continued use rather increases, than lessens the danger from an excessive dose; that in this respect it is entirely unlike opium, which may be given in steadily increasing doses without immediate danger from the increase, within certain limits.

I have known the free use of chloral for a long time, given to relieve pain and asthma connected with uterine disease, to be followed by great impairment of the power of attention and memory. Its long-continued administration is thought to vitiate the composition of the blood, somewhat like a long course of alkalies; the blood becoming less coagulable, and its corpuscles shrunken. This danger would probably be lessened by putting such intervals between the doses that it might be completely discharged from the system, between times.

Dr. N. R. Smith, of Baltimore, observed in four patients who had been in the habit of taking it, a peculiar and similar form of erythema, with desquamation and ulceration about the finger-nails of both hands.

In spite of these risks, chloral has some positive advantages over other hypnotics and anodynes. It is more certain than hyoscyamus and the narcotics usually classed with it; and it does not affect digestion and secretion as opium does. It is borne by many patients who do not bear opium well. Simpson wrote of it as follows: "In sufficient doses I have found it, as a general law, as sure a producer of sleep and soother of pain, as opium or any of its preparations. It is usually swifter in the induction of its narcotism, more tranquil in its action, and more prolonged in its effects than opiates are when taken as hypnotics; and seems in a great measure free from some of the minor drawbacks and disagreeable accompaniments produced by a full and large dose of opium. In this respect, it appears to me to fulfil successfully the indications of being a narcotic *as* powerful, and, indeed, more powerful than opium, and yet without either its direct constipating effects, or its indirect tendency to excite subsequent nausea, vomiting, &c. The sleep induced by a full dose, steals on without any premonitory symptoms. It is usually deeper and yet more quiet and calm than that produced by opium; and it does not leave, subsequently, the thirst, dry throat and tongue, disturbance of stomach and appetite, and languor of mind as well as body, which most persons unaccustomed to the use of opium commonly feel after a deep and narcotic use of that drug."

I think a full dose is liable to be followed by languor of mind and body, for a day after; but, as Simpson says, without the digestive derangements caused by opium.

The very fact that chloral-sleep is generally recovered from with so little unpleasant feeling afterward, adds to the danger of its being used as a habitual luxury and intoxicating agent. Any medicine which will soothe the brain, irritated by care or study or passion or pain or liquor or strong tea, and procure a sweet prolonged sleep, with no remorseful headache next morning, is likely to be abused.

In England, this danger has been realized. Dr. Richardson spoke as follows, in a lecture in February last: "We of the profession are becoming conversant with cases of what may not improperly be called chloral-drinking, in which serious and singular symptoms are presented. Three classes of persons specially resort to hydrate of chloral, viz.: alcoholic devotees, who take the substance to counteract excess of alcohol, and to relieve alcoholic delirium; sufferers from neuralgia and other painful chronic diseases, who find in the substance temporary relief from pain; and persons having much mental worry, grief or care, who, flying to it at first in order to obtain sleep, continue it until the occasional practice becomes a persistent habit. As an indication of the quantity used in this country," he continues, "since its introduction here about a year and a half ago, I may state, on what I have every reason to consider reliable authority, that one commercial house, alone, has supplied the English drug-market with ten tons of this substance; three other houses have, it is supposed, supplied as much."

I have seen nothing here of its habitual use for pleasure. Two leading druggists of Providence tell me they have seen nothing to indicate its being bought to take without medical direction.

Perhaps it does not do much good to warn the public against the abuse of these comfortable but delusive sedatives. When chloroform was a new thing, some people found its intoxication very pleasant and abused it. I was called to a lady

whom I found lying perfectly insensible, in bed, with a bottle of chloroform emptied on the bed clothes before her face, and her delicate hand almost scalded where it had spilled over her. She revived in due time. Moved by that case, and the indiscretion of youth, I wrote an article for a newspaper, on the danger of taking chloroform without medical supervision. Soon afterward, another article appeared, referring to my own, and saying that *cold water* may be so applied as to be dangerous, but that it is not thought necessary on that account to restrict its administration to the medical faculty,—which would be as difficult as it would be to restrict the faculty to the use of cold water. I met this lady afterward in some company; and she learned, during our conversation, that I had written the article of warning; and I learned that she was author of the counterblast which had given our profession this clever, though undeserved hit.

The powers of chloral-hydrate, as now described, point to its usefulness in three kinds of cases:

1. In any conditions attended with morbid wakefulness; or as a hypnotic.

2. In any very painful or distressing diseases; as an anæsthetic.

3. In convulsions, or any forms of motor excitement.

1. Morbid wakefulness may be in itself a symptom so distressing as to call for medical interference. In cases not too urgent, I think it our duty to seek its relief by hygienic means, (such as exercise, a cold foot bath at night, followed by good rubbing, avoidance of indigestible food at night, or of strong tea, sometimes forbidding study late in the evening, &c.) As drugs, the bromides are more safe, and generally effectual in wakefulness, not dependent on great pain or organic disease. But some cases call for stronger measures, and certainly no hypnotic so well combines the advantages of efficacy, with freedom from distressing after-effects, and general safety under careful and graduated administration, as chloral.

In *typhoid fever*, it has proved very useful, saving strength by winning a quiet and refreshing sleep, and thus increasing

the chances of safety, and lessening the duration of the disease. It was extensively used in this way by physicians of the Royal Infirmary at Edinburgh, and with good results. They report having given doses of 30 grains, repeated, if necessary, for two or three times, at intervals of an hour; when there were violent head-symptoms, the dose was increased to 40, or even 60 grains. They did not find it lower the temperature in this disease; nor materially lower the pulse.

I have given it in only one case of typhoid, and there I might have used it earlier if I had read as much on the subject as I have done in preparing this paper. The patient was a boy, 9½ years old, who lay in the deep stupor of this disease through the third week, and about its close had symptoms of meningeal irritation, opisthotonos, spasmodic thrashing of the right arm, with a disposition to travel over the bed from left to right, grinding of the teeth, and afterward violent screaming delirium. Chloral was used rather late in this case, and was very useful, for the time, in procuring sleep; but the final recovery was more attributable, I think, to the good condition of the stomach, the general absence of diarrhœa, and steady ingestion of liquid food with alcoholic stimulants, than to any special drug. After consciousness returned, this little patient had neuralgic pains in the same arm that had been spasmodically jerked at the time when meningeal trouble seemed imminent.

In *insanity* with excitement and obstinate wakefulness, and especially in acute mania, chloral hydrate is generally regarded by those superintendents of hospitals who have published their experience with it, as a remedy of great power. Dr. Ray has so expressed himself to me in conversation. Dr. Kirkbride is rather less sanguine than some; he speaks of it as valuable, but not as a full substitute for morphia and bromide of potassium.

It would take too long to read the analysis I have made of the articles by hospital physicians in Great Britain and in this Country. Two of the most valuable are by Dr. Andrews

of the State Lunatic Asylum of New York, and Dr. Keniston, lately assistant physician at the Butler Hospital, Providence. Dr. Andrews reported 90 lbs. used in 370 cases, of which 345 were of different forms of insanity, mania 188, melancholia 89 and dementia 68. These physicians generally agree in pronouncing this medicine an immense improvement on the old narcotics, very seldom producing unpleasant results, while it saves the strength of many patients and so aids a tonic treatment, and greatly promotes the quiet of the wards. There is one special difficulty in giving it to the insane, arising from its pungent properties, or if sufficiently diluted to conceal them, from its bulk. Many think it poison.

As none of these articles express the facts better than Dr. Keniston's, and all agree on the essential points, I shall quote only from him. He speaks of its usefulness in acute mania, and in chronic cases with excitement. "In high maniacal excitement," he says, "the patient, under proper hygienic conditions, with good nutritious food, and a *good night's rest*, will soon become quiet. Generally 20 grains of hydrate at bed-time are sufficient to procure 6 or 7 hours sleep; and where more is required, it is better to give it in two doses, the first an hour before retiring. Not more than 60 grains have been given in a day, larger doses being inexpedient if not dangerous. Twenty or thirty grains, at bed-time in ordinary cases of acute mania, will procure a quiet, natural sleep of 6 or 8 hours, from which the patient awakes less violent. If excitement comes on after rising, ten grains generally suffice to quiet it."

Dr. Keniston's general conclusions are as follows:

"The sleep produced by chloral approaches more nearly a natural sleep than that caused by any other drug. Acute mania, almost invariably preceded or attended by insomnia, would be cured in many cases by the hydrate, given early in the disease.

"In cases of chronic mania attended with outbursts of excitement; in the excited stage of circular mania; and in general paralysis, it acts as an excellent hypnotic by night, and soothing agent by day.

"The insomnia of melancholia is much relieved, and sometimes wholly cured by it.

" In cases needing no treatment but proper hygienic surroundings and seclusion, sleepless nights often occur, which are annoying to the patient, if not injurious. Here chloral in small doses, as 20 grains, acts like a charm."

These reports from physicians of hospitals for the insane give cases which confirm all that they claim.

On the other hand, Dr. William A. Hammond in his recent work on Diseases of the Nervous System, writes: "The hydrate of chloral is a dangerous remedy. I have seen it produce great increase in the maniacal excitement. Its first effect is always to augment cerebral congestion; and though it eventually lessens the amount of blood in the brain and calms nervous irritability, the dose must be large for these results to be obtained, and the same ends can be accomplished by safer means."

In puerperal mania, chloral has procured sleep when bromide of potassium, opium and chloroform have failed, and with the result, as far as can be judged, of turning the scale in favor of recovery. In a marked case of this kind, the patient regained calm and rational consciousness in about five minutes after taking 60 grains, soon became drowsy, was asleep in ten minutes more, and though the mania recurred, it was repeatedly quieted by the same means.

Our President will remember a case which we both visited, in connection with Dr. Clapp, in the autumn of 1869, of a young married lady, who had been under treatment for some uterine disease, and then received a shock by the sudden illness and death of her mother. She was seized with acute mania, and continued for several days in a state of constant agitation, talking and sleeplessness, refusing and spitting out medicine and drinks. In looking back on that case I cannot help thinking that if it had been possible to introduce a full dose of chloral, in any mode,—by the stomach, by injection to the rectum, or even hypodermically—at an early period in the attack, life might perhaps have been saved. I note it as a proof of the rapidly increasing interest of my subject, that at that date neither of us three, I believe, had any ex-

perience with the chloral hydrate. Late in the case some attempt was made to give it, but it was spit out; no good resulted; and death ensued from exhaustion.

In July 1870, I was called to see a youth who five days before had been bathing in the ocean, with a party, under an intensely hot sun, when he was suddenly seized with insanity; he jumped into a vehicle of one of the party, drove off rapidly, was pursued and caught by his friends who supposed it was a horse thief, and who did not suspect the truth till they had overhauled him rather roughly, and found his condition. My first visit to him, in consultation, was on July 23d. He was silent and morose; head hot, pulse rapid, not remarkably strong or full; I was told that he had not slept for five nights, and this was almost literally true The attending physician, Dr. Newhall, and myself agreed in recommending the use of chloral. His father, a gentleman of education and intelligence, has at my request furnished the following interesting narrative.

"His illness commenced on Monday, July 18, an intensely hot day. He was just completing his nineteenth year. I went for and brought him home on Tuesday, July 19. His mind was exceedingly confused; his memory gone; and he seemed insensible to anything going on around him. Tuesday night he was quiet but sleepless; and through the remainder of the week it seemed next to impossible for him to sleep. A few times, from the effect of bromide of potassium, he apparently slept for a little. But it was for a little only, and he again returned to that intense state of wakefulness, which it seemed impossible that anything should subdue. He could not sleep.

"On Saturday evening following the commencement of his illness, the chloral was given him. He soon began to feel the effects of it, and fell into a quiet sleep, that continued for thirteen consecutive hours. When he woke on Sunday morning, he seemed very weak; but his mind was clearer and he was more calm than he had been since taken sick. He was evidently refreshed and helped by his long sleep.

"From this time, the effect of the chloral seemed so satisfactory that we continued to give it. Sometimes he would refuse to take it, but whenever we could get it down, which was usually the case, it soon tranquilized him and caused him to sleep. He would almost invariably be asleep within fifteen minutes after taking the chloral.

He would not sleep without it. Under its influence he would sleep from five to six or eight hours. There were times however when it seemed to have but little effect upon him ; when he would sleep not more than two or three hours, and wake in a very irritable and ugly state of mind. On the night of August 1st, he slept quietly for ten hours, and when he woke seemed greatly improved. But his states of mind were very variable. At times he seemed quite like himself ; was gentle and pleasant, and would seem entirely rational. Then again he would talk and act in a manner that indicated a complete confusion of his ideas. Whether this was in any degree the effect of the medicine, I am unable to say. The 9th of August was the most hopeful day, since he was taken sick For a longer period during the day, his thoughts seemed clear and connected. He went quietly to sleep at nine o'clock, and slept an hour. But then waking, I, fearing a restless night, gave him the chloral, after which he soon fell asleep and slept quietly until morning. On the night of August 10, he slept without it, waking but once for a moment. For several nights succeeding this, he appearing disinclined to sleep, and I being almost exhausted with constant watching, I gave him the chloral, which would ensure his sleeping at least part of the night.

" About this time, August 18, a month after his illness commenced, I thought I perceived that he was apparently much better in the afternoon and towards evening than during the morning. Mornings he would be wandering, abstracted, irritable, wilful, sometimes defiant. Toward evening he would calm down, be pleasant, quiet, social, rational. I could not account for this change. At length it occurred to me that it might be owing to the chloral, that he seemed so different in the morning from what he was at evening. Naturally it would seem that he should be more fretful at evening than in the morning. On August 18, after riding with him, I resolved, cost what it might, that I would try to get through the night without the chloral. I was alone with him, and had a hard battle. He was resolved not to sleep, and was very restless, at times violent. I began to fear that I should have to give up my purpose. But persevering, after a while he became more calm, and consented to go to bed, and about half past one in the morning fell asleep, and remained quiet for the rest of the night, though not sleeping all the time. The day following, through the day, he was more quiet than I had before seen him ; and slept quietly the succeeding night.

"I gave him *no more chloral.* Though I know not what we should have done without it in some stages of his illness, he had now reached a point where it was no longer serviceable to him, but I think injurious. After this he usually slept quietly all night. Yet he was not well. His illness assumed an intermittent form ; for a week

together he would be quite regular and inclined to assume his ordinary habits and duties ; then for the like period he would be in a confused, abstracted state of mind, seemingly indifferent to everything around him. These intermittent stages continued in their alternations, the normal states gradually gaining upon the abnormal, until the last week in November, (now a year ago,) when he had his last erratic turn, and has since given no indication of the return of the disease."

In *delirium tremens*, with its obstinate wakefulness and muscular tremors, we have a combination of symptoms that we might expect would be quieted by chloral; and the remedy has been found very useful. It generally produces sleep, and this sleep is followed by relief. The hallucinations disappear, and the irritability of stomach, anorexia and costiveness are often relieved after chloral-sleep. Dr. Leonard, of this city, mentions its use in the institutions at New York, combined with bromide of potassium.

The most accurate account of its use in this disease that I have seen is in Dr. Keniston's article before quoted. He says, in an analysis of 20 cases : "The average length of treatment was 88 hours. The shortest was 20 hours, and the longest 240 hours. In one case, sleep was produced in 5 minutes by 30 grains. In another case, 150 grains were taken before sleep came. In two cases, chloral, given in very large doses, failed. As a rule, the more excited the patient, the larger and more frequent were the doses required to produce sleep. There were some exceptions, however. The largest dose given at any one time was 90 grains, which produced a sleep of only two hours' duration. As a rule, 20 or 30 grains, repeated every two hours, have a better and more permanent effect than a single large dose. In one case, 70 grains had no effect, and in ten hours sleep was obtained from tincture of digitalis. In most of the cases where chloral has been effectual, sleep has been caused by it in from 15 minutes to 2 hours. * * * The earlier the patient comes under treatment, the smaller the amount of chloral required, and the better the result. In every case the sleep was very sound and gentle, and in no case were there any unpleasant symptoms. The pulse and tem-

perature were reduced, the bowels relaxed, and the appetite improved. In but one case was it refused; thus affording a marked contrast to cases of mania, where, as a rule, the patients look on it with suspicion."

As an incident of its hypnotic usefulness, chloral has sometimes effectually cured nocturnal incontinence of urine in children,—acting more promptly, and with less inconvenience than bella donna.

2. In any condition of great suffering, not presenting special contra indications, the hydrate of chloral will find its use as an anæsthetic. It is not likely to supplant opium, and especially the subcutaneous use of morphia, the most elegant and rapid of all methods of relieving severe pain. But where opium is not well borne, or where an anodyne must be kept up so long that the disturbing effects of opium on digestion become a serious evil, chloral will be a precious resource, in all very painful affections. In neuralgia, the subcutaneous injection of morphia appears to have something of a curative as well as a palliative power; at least, it not only relieves pain for a time, but when its first anodyne effect has passed away, the pain sometimes fails to return, and its repeated use tends to prevent the attacks from recurring. I hope to see the same permanent good from chloral.

The discomforts of advanced *phthisis* have been much relieved by chloral. Dr. J. Hughes Bennett, to whom we are mainly indebted for the use of cod-liver oil in this disease, speaks of its advantages over opiates. In giving those, he says, "we choose the least of two evils in procuring, even, unhealthy sleep. But matters are greatly changed, when we are able to procure the natural sleep that chloral produces. By its aid we can lull irritation, and give rest for a time, in many cases, without any injury whatever."

After an analysis of 21 cases, he writes: "I think it will be admitted that no kind of opiate would have produced such uniformly good, and so few bad results, in 21 cases of phthisis, as is here shown to have been the effect of chloral."

Among the affections accompanied by severe pain in which chloral has been used, are cancer, gall-stones, neuralgia, burns, and various surgical injuries. It will undoubtedly be of use in the passage of calculi, in senile gangrene, painful diseases of joints, &c. It may assist in the setting of fractures and even in prolonged surgical operations, but probably will not supplant inhalations of anæsthetic vapors.

The surgeon of the Cancer Hospital, London, speaking highly of its use in that painful disease, recommends as sufficient. 10 grains, 3 times a day, and 20 grains at bed time.

A lady, past middle life, had suffered many years from neuralgia in the lower limbs, and within a year in the epigastrium and præcordial region. She had for many years lived quite abstemiously, especially during her pregnancies. When called to her, I found that she had been attacked the day before with vomiting and distress in the epigastric and right lumbar regions. She had been reduced to a state of great exhaustion, retaining nothing on the stomach, retching, and vomiting some bile, her voice a faint whisper. For a few days she was sustained entirely by enemas of beef tea and brandy, nothing being given by the stomach except ice. We were assured that opiates could not be borne in any form; a subcutaneous injection of morphia for her neuralgia had once been followed by so much distress and vomiting, that we could not think it wise to use it now. Chloroform also could not be breathed, she said, without causing nausea. We tried the chloral, added to an enema; and it was the first medicine that gave relief, stopping the emesis and procuring sleep, after which her pain was less, and stomach less irritable. For several days she was fed by enemas of strong broth; with the addition sometimes of brandy,—after the first few days, of quinine; and whenever there was suffering enough to require it, of chloral. It was not till after a few weeks, when the nausea had been mainly relieved, and she was having regular supplies of mutton tea, that we ventured on giving chloral by the mouth. It always gave her ease, and did not disturb the stomach.

The history, since then, has been one of gradual improvement on the whole, but with attacks of neuralgia in the lower limbs nearly every week, generally traced to fatigue or mental agitation. There have, also, been several distressing complications at different times. Chloral nearly always produces sleep within an hour or so. The established dose for her is 15 grains, repeated in an hour, if necessary. Sometimes, when a severe attack has been threatened, 30 grains were given at once. On one occasion, the pain continued severe through the night, and six doses of about 15 grains each were given within 12½ hours; soon after the last dose, she went to sleep, and slept most of the time, rousing to take liquid nourishment through the next day. No alarming symptoms followed. This repetition of chloral is followed by dullness of mind, and redness of the eye-lids. Various tonics have been given; quinine being continued in moderate doses for months; but no marked effect has been observed from treatment, excepting nourishment with wine given steadily and often, and chloral when needed as an anodyne. Valerianate of ammonia has also acted well as an anodyne, in the absence of severe pain; and has sometimes enabled us to do without the chloral, which is reserved for the more urgent occasions.

[For a few months after this paper was read, this patient continued to improve somewhat, becoming strong enough to ride out on pleasant days. She then slowly grew worse again; suffering alternately from neuralgia in the limbs, and an indescribable sinking and distress in the gastric region. Early in April, 1872, she again required large doses of chloral, with inhalation of chloroform. It has lately appeared that more comfort could be got, with less disturbance of intellect, by the occasional inhalation of chloroform, in small quantities, than by the use of chloral. The case is the most severe and obstinate specimen of neuralgia I have ever had to treat. It has been increased, if not caused, by the long continuance, from erroneous hygienic opinions, of too abstemious diet]

Chloral has been employed to relieve the pains of *labor*. The conclusions of Mr. Lambert, of Maternity Hospital, Edinburgh, given in full in the Edinburgh Medical Journal, August, 1870, are founded on 11 cases of its administration. It appears from these, that chloral-sleep can be safely obtained, and the whole labor go on without consciousness, and this gentleman thinks its course will be found to be more rapid than without the drug;—that any primary exciting effects are very transient; and the influence lasts after delivery is complete, and the repose enjoyed by the patient afterward is one of the pleasant effects.

A physician, practicing in Bombay, reports in the Lancet, three cases, where the repose of some hours obtained by chloral in tedious labor was followed by very prompt, efficient pains, and speedy delivery.

I have no experience with chloral in obstetrics, and till I know more about it should prefer not to induce its protracted sleep in uncomplicated cases. In ordinary obstetric practice, there is no need of producing the deep, complete anæsthesia required for surgical operations; the edge of suffering can be taken off by inhaling a teaspoonful or two of chloroform from a napkin at the beginning of each pain; and the dangers of chloroform in surgery need not, therefore be incurred. I prefer chloroform used in this way to ether, having found the excitement caused by ether troublesome, by destroying the patient's self control, and so interfering, inconveniently, or even dangerously, with manual or instrumental aid; while its protracted use causes a longer insensibility than is desirable, except in cases where some painful obstetric operation is necessary.

3. The hydrate of chloral has been used with advantage in a variety of convulsive affections, on account of its power to relax the muscles, as well as to ease the suffering caused by spasmodic movements. It has thus been useful in convulsions of infants, in hysteria, chorea, hooping-cough, asthma, obstinate hiccough, and puerperal convulsions.

[Since this paper was read, I have given chloral in one case of puerperal convulsions, without success. The patient was a primipara, aged 24. Her confinement took place a fortnight earlier than was expected. I was called to her early in the evening, and learned that for a few weeks she had been having headaches, with occasional failure of vision, flushing of the face and neck, oedema of feet, hands and face, scanty and very dark-colored urine. That day she had swallowed some orange peel at dinner, and had complained of pain in the stomach before the convulsions, which had begun about 6 p. m. I gave her about ten grains of calomel, and soon afterward got down a tablespoonful of castor oil. I also tried to give her bromide of potassium by the mouth, but this being difficult, gave it by enema. The convulsions were repeated with increasing frequency, and increasing coma, the intervals of consciousness becoming less complete, with great restlessness and complaints of distress in the stomach and head. Dilatation of os uteri had not begun, and there was no uterine action, in the early part of the night. About midnight I gave her about 40 grains of hydrate of chloral, and bled her freely. No treatment had any control over the convulsions. The breathing became sibilant and prolonged; insensibility complete; and convulsions more frequent. About 4 a. m., dilatation of os having come on rapidly, I delivered her easily of a dead child, with forceps. About 5, a severe convulsive paroxysm rather suddenly ended her life.

In this case, the rapid onset of congestion or oedema of the lungs hastened the fatal event. The result does not encourage me to employ the chloral again, if I should be so unfortunate as to meet with another case; it seemed to me to have no influence over the disease. Within three years I have had three cases of this formidable affection. In the other two, I relied mainly on beef-tea and large doses of bromide of potassium, given by enema, because the stomach was very irritable; neither was bled. Both recovered. In one of these, the convulsions came on an hour after the birth, and continued for twelve hours; the mother had had several

children, and had never had convulsions; oedema of the lungs came on afterward, requiring appropriate and active treatment. The other was a primipara; eight months pregnant, who had had dropsical effusions and scanty urine. Exactly a month after, she gave birth to a dead child, without convulsions, or any special complication.]

In the more intractable convulsive diseases, its results have been less satisfactory, though it is found to be a valuable palliative. In hydrophobia, it has relieved suffering, nothing more.

In *tetanus*, it has frequently given relief, relaxing spasm and procuring sleep, but not generally ensuring recovery. In a list of 21 traumatic cases gleaned from journals, in which chloral had formed part of the treatment, there were 11 recoveries and 10 deaths; but I presume this proportion would not hold good if unsuccessful cases were reported as faithfully as successful ones. The value of these reports, as illustrating our subject, is also lessened by the fact that other medicines also were used in most instances. Mr. Macnamara, an East Indian physician, who used it as the only treatment in ten consecutive cases, reports seven of these traumatic, of which only one recovered; two idiopathic, of which one recovered, one coming on 15 days after childbirth which recovered. He writes, "After a little experience of the effects of chloral, it seemed to me that it had no specific influence over the tetanic spasms; nevertheless there can be no doubt that even in the most severe cases of tetanus this drug has the power of sending the patients off into a deep sleep, and thus for the time being of preventing the tetanic spasms; but in several instances it appeared as if the hydrate of chloral, by thus keeping back the tetanic energy, rendered it more concentrated—after deep sleep from chloral the spasms sometimes returning with such terrible violence as speedily to destroy the patient." "As a hypnotic it seemed invaluable, but we must if possible do something more than put our patients to sleep in the management of bad cases of tetanus."

In trismus nascentium, it has appeared more successful.

In an epidemic of cholera at Riga, chloral was used successfully to relieve cramps at the beginning, to assuage praecordial suffering, to arrest vomiting and procure sleep. In one case where death seemed imminent, a drachm of chloral was giving with only four drachms of water. Sleep began in a few minutes and lasted three hours; after which breathing was easier, the warmth and fullness of surface returned, vomiting and purging ceased, and the patient got well.

Although chloral given without sufficient dilution may irritate the stomach as well as burn in the throat, still it has some power, after its absorption into the blood, to quiet vomiting. It obviously had that effect, when introduced by enema, in the case of a lady very much prostrated by vomiting and pain, to whose history I have already referred. In the Lancet for September, is a case reported of chronic obstruction of the bowels, with stercoraceous vomiting, in which the first liquid retained was a solution of chloral, (25 grains in half an ounce), which checked the vomiting, after which copious enemata acted successfully.