the calomel must be pushed so as to affect the system rapidly; and I would remind you that, in young children, the best evidence we have of the constitutional effect of mercury is the passing of green motions resembling chopped spinach.

The patient was very restless during the following night; and the next day (30th) he was quite conscious, but perfectly deaf. The fluid still flowed from the ear. An ice-bag was kept to the head, and the calomel continued. At midnight, the boy was noticed to be little less conscious than before. At 3 A.M., the house-surgeon found him partially comatose; he gave a short sharp cry, and appeared to be in pain. At this time, the pupils were normal, and there was no squinting. At 10 A.M., the temperature was 100.2 deg., and pulse 132. He continued in much the same state till 3.15 P.M., when he suddenly became very livid, the respirations fell to four per minute, and he rapidly died.

At the *post mortem* examination, twenty-four hours after death, on the calvaria being exposed, you will remember that I called attention to there being no fissure or fracture opposite the bruise on the forehead, nor in any other part of the vault; and I shall have to refer to this point again. There was considerable congestion of the membranes of the brain, which was a little opaque. There was some recent lymph in the cavity of the arachnoid, especially on the left side and within the circle of Willis. On the brain being removed, the dura mater over the temporal bones was seen to be uninjured; but a clot of blood lay beneath the dura mater and the bone on the left side, and a smaller quantity in the same situation on the right. On stripping up the dura mater, we found a crack in the left temporal bone running from the upper border of the squamous portion, along the anterior surface of the petrous bone, as far as the foramen lacerum medium. Another small fissure extended from the jugular foramen of the left side to the petrosal sinus, lying a little external to the auditory meatus, and not joining the other. On the right side, there was a fissure at right angles to the axis of the petrous portion, passing from the jugular foramen through the internal auditory meatus. The membrana tympani was ruptured on the left, but entire on the right side. On the under surface of the brain were two spots of ecchymosis on the right side, corresponding to the position of the fissure. There was fluid in both lateral ventricles, but not in large quantity; otherwise the brain was healthy.

The *post mortem* examination thus confirmed the diagnosis made during life. The patient had a fracture of the base of the skull, involving both temporal bones, and hence the deafness; and he died of incipient meningitis, with effusion into the ventricles. This effusion was not sufficient to distend the ventricles; but, no doubt, occurred suddenly, and was sufficient to destroy life by pressing upon the great ganglia in the floor of the ventricle.

And now let me say a few words on the causation and pathology of this serious accident—a fracture of the base of the skull. The boy fell from no great height, but he fell on his head, and his head came into contact with the pavement. Now, according to the old and now exploded pathological doctrine, this would have been a good example of “fracture by *contre-coup*”; for one side of the skull was struck, and that opposite to it was broken; but we know now that fracture by *contre-coup* does not really exist, and that any fracture found must be the result of force applied to the bone more directly. When this boy fell, the weight of his trunk gave him the momentum which brought him violently to the ground; and when his skull was suddenly “brought up” against the paving stones, the whole of the impetus which his body had acquired came suddenly upon the base of the skull. No doubt he struck the left brow against the stones; and it was this that determined the direction of the fracture, which is in the line of force transmitted from the condyles (upon which the vertical column would impinge) towards the frontal bone; and had he fallen more directly upon the top of his head, the force would have been transmitted upwards from the condyles; and then the fracture would probably have been in the posterior, instead of in the middle fossa of the base of the skull. I must tell you that this view is not maintained by all surgeons; and notably Mr. Prescott Hewett, in his valuable article on Injuries of the Head, expresses the opinion that the fracture starts from the point of impact, and spreads to the base of the skull. In this case, however, I was most careful to examine the vault of the skull for any fissure, and none was discovered, the fracture through the squamous portion of the temporal bone being completely covered in by the temporal muscle and fascia, and there being no evidence of a blow at this point. Mr. Hewett quotes some experiments of Dr. Aran in support of his view; and in so far that “the part of the vault which first struck the ground gave, as it were, the key to the fracture which would take place at the base”, I agree with him, but simply because the direction of the line-force transmitted from below is no doubt thus determined.

Then with regard to the flow of fluid from the ear: this was not

noticed at first; but, half an hour after the accident, it was seen by Mr. Collings, the house-surgeon, and at once decided the question of the admission of the patient. Fortunately, every child that falls on its head and is stunned for a time, does not break the base of its skull; but you must be careful not to give too confident an opinion as to the nature of the case directly after the accident, lest a symptom of such great gravity should develop a little later. And yet, let me say, although we all nowadays lay so much stress upon this flow of fluid from the ear, it is remarkable that the older surgeons, who must have seen it often enough, appear to have attached no importance to it. It is less than forty years since the symptom was recognised as denoting fracture of the base, although one or two cases of its occurrence had been put on record at a much earlier date. And even when it was recognised, surgeons were not agreed as to the source of the fluid. Now, there is but one fluid which is clear and alkaline, and contains a trace of albumen and some sugar; and this is the cerebro-spinal or sub-arachnoid fluid. You will remember that, on one occasion, when the patient vomited, the fluid is reported to have shot out of the ear—*i.e.*, that when, by the effort of vomiting, the brain became more congested, the fluid was driven out of the cavity of the skull; and Mr. Hilton narrates an experiment he made on a case of fracture of the base to prove the same fact, in which he temporarily produced congestion of the brain by closing the patient's nose and mouth, with the result of causing this fluid to shoot out. All authorities are, I think, agreed as to the nature of the fluid; but it is a little difficult to explain its escape. As Mr. Hewett tersely puts it, “the escape of the cerebro-spinal fluid implies a fracture cutting across the meatus internus, and communicating with the tympanum, a laceration of the tubular sheath of the cerebral membranes surrounding the seventh pair of nerves within this meatus, and a laceration of the membrana tympani”. Now, on the left side, we had a rupture of the membrana tympani, and a fracture involving the meatus internus and tympanum. I could not demonstrate to you that the tubular sheath of the seventh pair was ruptured; but we may conclude that this was the case; and there could be no doubt about the escape of the cerebro-spinal fluid. On the right side, there was no fracture into the meatus internus, but no rupture of the membrana tympani, and, therefore, no flow of fluid from the ear. There was a fracture into the tympanum; and this had, no doubt, broken the connection of ossicula across that cavity, and hence the deafness. It would have been interesting to have ascertained, had the gravity of the case been less, so as to justify the inquiry, whether the child could have appreciated the note of a tuning-fork or the sound of a watch applied to the bones of the head, since this would have shown that the auditory nerves themselves remained uninjured. His best chance of life, however, consisted in maintaining perfect quietude, and I did not like to have him disturbed.

CLINICAL LECTURE

ON

THE ADVANTAGES OF ETHER OVER CHLOROFORM.

BY JAMES SAWYER, M.D. Lond., M.R.C.P.,
Physician to the Queen's and Children's Hospitals, Birmingham.

GENTLEMEN,—I purpose to offer you a brief comparison of the relative values of chloroform and ether as anæsthetics. It has very frequently been my duty during the last ten years, in hospital and in private practice, to induce anæsthesia for the performance of surgical operations. Until a year ago, I invariably used chloroform; during the last twelve months, I have always employed ether. I shall offer for your consideration some reasons why ether should be preferred to chloroform—reasons which have induced me to rely upon ether as the better anæsthetic.

Surgical anæsthesia was unknown in modern times until thirty-one years ago. I say in modern times, because there is good reason for believing that some means by which the painless performance of operations could be ensured were known to practitioners of the art of surgery long before the present century. In Middleton's comedy, *Women beware Women*, printed in 1657, the following passage occurs.

“I'll imitate the pities of old surgeons
To this lost limb; who, ere they shew their art,
Cast one asleep, then cut the diseased part.”

On December 11th, 1844, nitrous oxide gas was successfully used as an anæsthetic by Mr. H. Wells, of Hartford, Connecticut. (Townsend's *Manual of Dates*.) From this time, the use of anæsthetics has rapidly spread in surgery. Anæsthesia has become a want of the age; the

public demand it at our hands; and with us rests the grave responsibility of determining how it can be supplied most safely. Nitrous oxide soon fell into disuse. On September 13th, 1846, in Boston, United States, a man named Frost had a tooth extracted painlessly while he was under the influence of ether, given by a dentist named Morton. (*Chloroform, its Action and Administration*, by A. E. Sansom, M.D., 1867.) This was the real commencement of modern surgical anaesthesia. The news of the discovery of the means of rendering the performance of operations painless soon reached England, and ether was at once largely employed by Mr. Liston, Mr. Fergusson, and other surgeons. In March 1847, Flourens laid before the Academy of Sciences of Paris some observations of the anæsthetic powers of chloroform upon animals. (Sansom, *op. cit.*) On November 4th, 1847, the late Professor Simpson of Edinburgh, who for some time, in the hope of finding a better agent for producing insensibility to pain than ether, had been experimenting with various substances, first tried the effects of the inhalation of chloroform upon some medical friends in his own house, and he saw at once that he had found a prompt and pleasant anæsthetic. Six days afterwards, Dr. Simpson brought the subject before the Medico-Chirurgical Society of Edinburgh. Chloroform was at once accepted by the profession; it soon displaced ether, at least among the British; and it has since held amongst us, until a few years ago, an undisputed priority over ether and other anæsthetic agents. I think I may safely say that chloroform was almost the only anæsthetic used in operations in these islands eight or ten years ago. Since that time, however, various new substances have been employed in place of it. About five years ago, an ether-revival began, and it has gradually grown, until ether-inhalation now seems likely to supersede all other means for the production of insensibility during painful surgical procedures.

A medical practitioner never assumes a greater or more direct responsibility than when he undertakes to induce general surgical anaesthesia. Insensibility to the knife is not allied to sleep; it is more nearly akin to death. In sleep, a very feeble stimulus—a noise, a touch—is often enough to rouse the perceptive faculties into vigilance. But in perfect surgical anaesthesia the perception of painful impressions, even the most painful, is annulled; the will is extinguished; the intelligence is suspended; nothing remains of life but the organic functions; the nervous centres are paralysed down to the parts which preside over the performance of respiration and circulation. Life hangs in a trembling balance. No hands can be too skilled to hold the scales. Perhaps unskilfulness has killed some of those who have died under anaesthetics.

We must answer two questions before we give up chloroform for ether. Can we produce as perfect anaesthesia by means of ether as by chloroform? Is ether safer than chloroform? I believe both these questions may be confidently answered in the affirmative.

No one who has given ether a fair trial, even in one case, can doubt or disparage the perfectness of ethereal anaesthesia. I have employed ether very frequently in private and in hospital practice. I have given it for the severest and for the most protracted operations: for ligation of the common carotid artery, ovariectomy, amputation at the hip-joint; and, in eye-surgery, for squint and for enucleation of the globe; for excision of the breast, the gouging out of diseased bone, the removal of piles, etc.

But is ether safer than chloroform? This is the most important question. No complete anaesthetic is perfectly safe. We cannot fairly attribute all deaths which have occurred during artificial anaesthesia to the anaesthetic agent in employment at the moment. I wish to make the fullest allowance for all deaths from other causes. I will remind you that the first patient to whom Dr. Simpson intended to give chloroform was a boy who was about to undergo lithotomy. When all was ready, the boy unexpectedly died. No chloroform had been given. Had a few whiffs been taken, death might have been attributed to the anaesthetic. A surgeon, about to perform lithotomy, marked out a line on the patient's skin with his finger, and the man fell dead. Other similar instances might be quoted. But I have seen a hale and hearty labourer, free alike from all emotional excitement and organic disease, laid with a crushed foot upon the operating-table; chloroform was given; and before the operation was commenced, without any previous embarrassment of the respiration, the man suddenly died: died because the heart was stopped by chloroform. Of this event I was only a spectator. I believe the man died because the chloroform was given without due dilution with air. In its depressing action upon the heart lies the greatest danger from chloroform. Any one who has given chloroform largely, and with attention to the evidences of its action, knows that it usually diminishes the force of the pulse. In a few cases, however, in which the pulse is small and weak before the operation from emotional disturbance, the beats become fuller and

stronger as insensibility is coming on and the circulation is liberated from emotional control; but, as a general rule, the inhalation of chloroform weakens the pulse. It is often necessary to suspend the administration because the pulse has become feeble and flickering, without the occurrence of any signs of respiratory difficulty. Here, in the fewest words, is a typical case of a cardiac death from chloroform. "A young lad named G. J. Weston, aged 14, died at the Royal Free Hospital whilst under the influence of chloroform. Mr. F. J. Gant, surgeon, said that, when the deceased was admitted, it was thought that the hip had been dislocated. When he examined the lad, it gave him great pain. He ordered the house surgeon to administer chloroform. The chloroform was administered for about two minutes, during which time about sixty drops were inhaled. The deceased seemed to be half-sensible; and, on looking round, they saw the lad fainting and in a dangerous state. Silvester's respiratory method and galvanism were applied, but without effect, for the lad died at once. A *post mortem* examination was made. All the organs were sound. The cause of death was syncope from the effects of chloroform." (BRITISH MEDICAL JOURNAL, December 19th, 1874.) I have selected this case, because it is a typical example of death from sudden stoppage of the heart's action during the administration of chloroform. No one can maintain that degeneration of the heart's walls existed in this young lad. Chloroform, however, like ether, can kill, and has killed, by interfering with the regularity of the respiration, and finally stopping it before the cessation of the cardiac contractions. Death is more avoidable when impending in this manner. The suspension of the inhalation of the anaesthetic, the free admission of fresh air to the lungs, and the performance, if necessary, of artificial respiration, will generally save the patient when dangerous symptoms of respiratory embarrassment show themselves while the heart continues to beat. But we are powerless, or nearly so, when the heart fails first. There is no room to dispute the fact that, in those recorded cases of death from chloroform in which the signs of danger have been sufficiently noted, indications of cardiac failure have greatly prevailed over those of respiratory difficulty. Taking one hundred and nine fatal cases, in nearly all of which the mode of death was assigned, and which were embodied in the Report of the Chloroform Committee of the Royal Medical and Chirurgical Society, we find a decided preponderance of cardiac over respiratory deaths. Here is the table, as given in Dr. Sansom's excellent book on chloroform.

Syncope	56
Syncope during stage of excitement	6
Died suddenly	6
Died in a fit	10
Pulse and respiration ceased together	9
Failure of respiration (pulse not noted)	6
Failure of respiration (pulse remaining)	2
Not stated	14

109

Dr. Snow, to whom we are indebted for much valuable information concerning chloroform, made a series of experiments and observations with the view of determining the manner in which death occurs in the human subject from chloroform. He arrived at the following conclusions. "Chloroform-vapour, if it be inhaled in large proportion with atmospheric air, destroys life by paralysing the heart. In smaller proportions, but long continued, it produces death apparently by the brain, and by interfering with the respiratory function. In such cases, the heart is found to beat after respiration has ceased. Chloroform-vapour, if it be blown upon the heart, paralyses it immediately." (Quoted in Dr. Farre's *Abridgment of Dr. Pereira's Materia Medica*, 1865.)

It is not fair to make a comparison of the absolute number of deaths from chloroform and from ether respectively. As yet, in this country, chloroform has been given infinitely more frequently than ether. Only the ignorant deny that ether-administration has ever been fatal. Trousseau collected details of nineteen deaths from ether. But chloroform has had hundreds of victims. Writing more than ten years ago, Dr. Sansom puts the number of deaths attributable to chloroform at "nearly 300". Perhaps the number may have now reached 500. I know that many deaths from anaesthetics have never been recorded.

Just as the great danger of chloroform lies in its power as a cardiac depressant, so does the relative safety of ether consist in its action as a cardiac stimulant. No one can give ether without being struck by its favourable influence over the circulation. In most of the cases in my experience, I have found the pulse improve in force and volume during ether-inhalation. Mr. Clover, who gave chloroform for many years, and than whom we have no more careful or more experienced administrator of anaesthetics, concerning the comparative safety of ether

and chloroform, writes: "Ether is undoubtedly safer; that is to say, life is not so quickly destroyed by it." ("Remarks on the Production of Sleep during Surgical Operations." By J. T. Clover, F.R.C.S. BRITISH MEDICAL JOURNAL, February 14th, 1874.) In Dr. Neligan's well known work on *Medicine*, edited by Mr. Macnamara, I find it stated that "the great recommendations (of ether) are the complete state of anaesthesia it produces, and the safety attending its employment—a safety so remarkable that its exclusive use has become a law in the Massachusetts Hospital".

But we may ask some further questions before we decide to give up chloroform for ether. Are the more remote ill-effects arising from ether-inhalation greater than those which spring from the use of chloroform? So far as I have seen, vomiting, the chief troublesome after-effect of anaesthetics, is met with as often after one agent as after the other. Speaking of the remoter consequences of breathing ether, Mr. Clover says: "Sickness is about as frequent as after a moderate use of chloroform." Dr. Neligan mentioned, as one of the disadvantages of ether, "the subsequent persistent taste and odour of ether experienced even for days by those to whom it had been administered". There is, perhaps, a little truth in this: but, with the liberal admission of fresh air, the taste and smell of ether, which are not unpleasant to most people, soon pass away. It has been said that bronchitis may arise as a consequence of ether-inhalation. I have never met with such a result, nor with anything approaching to it. The condition which has probably been mistaken for bronchitis is one which I have observed, and one to which Mr. Clover has drawn attention in the following words. "The flow of saliva is considerable; and the larger air-tubes are often obstructed by fluid, which makes a loud moist rhonchus; but it does not appear to be of much consequence, as it passes off afterwards." Patients who have taken ether usually complain of nothing more than a slight feeling as of recovery from drunkenness. Are there any other inconveniences attending the administration of ether as compared with that of chloroform? It takes a very few minutes longer, as a rule, to produce anaesthesia with ether than with chloroform. But I have induced perfect surgical anaesthesia with ether, so as to permit the painless performance of the operation for squint, in three minutes. Ether is not quite so pleasant to breathe as chloroform, and it is more apt to cause a feeling of suffocation during the first few inhalations. But no inconveniences of such a trivial and temporary kind as those I have mentioned—inconveniences involving time, or taste, or trouble—ought to deter us from using the safest anaesthetic we possess. If our patients were able to decide the question, safety would be the paramount consideration with them.

I have generally found it best to give a little chloroform at first. One drachm is usually sufficient. I give a drachm as a dose, poured upon a thickly folded towel, held about two inches from the patient's mouth. After this quantity of chloroform has been inhaled, ether can be borne, in most cases, without giving rise to any choking. There is rarely more effect from this quantity of chloroform than a little mental obscurity. I then give the ether, in doses of an ounce at a time, poured upon a sponge, fixed at the top of a cap-shaped inhaler, made from an ordinary bedroom towel. The inhaler I use has been devised and described by my friend Mr. Lloyd Owen. It must be applied closely around the nose and mouth; I like it to be large enough to include the nose and the chin. But little air must be admitted. The dose of ether must be renewed about every two minutes, removing the inhaler completely from the face, and allowing one or two inspirations of air, until anaesthesia be induced. When the insensibility is perfect, it may be maintained by giving smaller doses of the ether, half an ounce, at less frequent intervals. We can only judge whether to stop or continue the administration by the condition of the patient. We must give enough ether to produce anaesthesia, and we must continue to give it so as to maintain anaesthesia, so long as the operation may last. But it must never be forgotten that even ether is not absolutely safe when given to full anaesthesia. The administrator must never cease to watch the patient closely, observing, with undistracted attention, the breathing, the pulse, and the colour of the face; he must have nothing whatever to do with the operation or the operator, not even to look at it or him; he must be wholly occupied with his own most important and responsible work. Whether chloroform or ether be given, it must be given with carefulness, but yet with confidence; "we must get rid of fear, we cannot act at all till then"; we must avoid alike timidity and temerity.

And now, gentlemen, I have done. I have been obliged, from a regard to time, to leave unsaid much that I should like to have said concerning anaesthetics, concerning more especially the relative values of the various methods of administration. I have been obliged to omit all mention of many little practical details which I have acquired in a somewhat lengthened experience of the employment of chloroform

and ether. But I have striven to confine myself to the question before me, and to discuss it fairly, which is the better anaesthetic, ether or chloroform? I have endeavoured to justify my conclusion that ether must have the preference. I hope I shall not be misunderstood when I say that, on giving up chloroform, I had to overcome that kind of prejudice which springs from habit. We ought to have no prejudices in such matters as those before us; we can none of us advance in scientific or in any other kind of truth until we can more or less completely get rid of prejudice. Its "rotten pales" should never confine us. But I was insensibly and not unnaturally biased towards chloroform, because I had given it largely for several years, because I had given it safely more than a thousand times. But I have had a growing sense of the danger of chloroform; and the results of my reading and of my experience, and my sense of duty towards those who have been placed in my hands, have led me to give up its use for that of ether.

RAILWAY PATHOLOGY:

CASE OF HARRIS *versus* THE MIDLAND RAILWAY COMPANY.

By JOHN CHARLES HALL, M.D.,

Senior Physician to the Sheffield Public Hospital; Lecturer on Medicine at the Sheffield Medical School; Physician to the Midland Railway Company; etc.

IN a leading article, the BRITISH MEDICAL JOURNAL of November 27th directs attention to the case of Harris *v.* the Midland Railway Company, recently tried at Westminster Hall before Baron Pollock and a special jury; the case being one in which the plaintiff claimed compensation for personal injuries said to have been sustained on the defendants' line, through the negligence of their servants. As the consulting physician to a large portion of the line over which the trains of this company run, as it was in my district that the accident happened, as I saw Harris the day after the accident, and as, owing to the case being settled out of court, the defendants are as yet medically unheard, I venture to supply some pathological particulars which cannot fail to be of interest to our profession.

It is said in the article referred to, "We should very much like to see a *verbatim* report of a dozen or two of railway cases in print". I have already supplied a good many to the JOURNAL,* and promise ere long to send more. In this case, the medical men called in by Mr. Harris were Dr. Sterling, Mr. Maunder, Mr. Erichsen, Dr. Hardwicke, Dr. Ramskill; by the Midland Company, Mr. Saville, Mr. Skelding, Mr. Gay, Mr. Jonathan Hutchinson, Dr. Radcliffe, Dr. J. C. Hall. It must be remembered that part of the attendance was at The Holmes, near Rotherham; part in London. Hence the number of medical men engaged.

We may have had to deal with what my lord was pleased to term "*questions of the highest physiological and scientific refinement, concerning which there might be difference of opinion amongst the most distinguished members of the profession*"—questions which I deeply regret an opportunity was not afforded of discussing before Baron Pollock and the jury; but, in a £s. d. point of view, it doubtless saved the Midland Company money to get rid of the enormous costs of another day's trial, as the very able counsel and solicitors of the company, on the suggestion of the judge, at once perceived. No one denied for a moment that the man was entitled to some compensation; the points in dispute being the nature, amount, permanence or otherwise, of the injuries alleged to have been sustained; and was there, or was there not, great exaggeration? I think all the medical men engaged were of opinion that the man would recover. In how short a time—the case settled, the trial over, the verdict of the jury given, and the damages paid—was a question about which there would have been, no doubt, a difference of opinion. For my own part, I thought, and, for the sake of Mr. Harris, most sincerely hoped, he would very soon be restored to his usual health. The evidence of his own witness, Dr. Ramskill, as reported in the *Times*, is well worthy perusal.

The accident happened near The Holmes Station, on the night of Thursday, December 10th, 1874. (This date will be found of importance in considering the length of time the patient's symptoms lasted.) Plaintiff was in a third-class carriage; he had come that day all the way from Exeter, a distance of about two hundred and seventy-five miles. The weather was very cold, and there was a deep snow on the ground. I may say that, at the time of the accident, the train was "pulling up"; and, so far as my experience goes—and few men living have seen more of these cases than myself—in estimating the probable severity or otherwise of the injuries sustained, it is most important to

* Now published separately, "Medical Evidence in Railway Accidents".