chemical action in the *muscles* themselves. With these results, I conclude my paper, conscious that the importance of the subject demands much greater care and research than up to the present I had time to give them; and hopeful that, in the investigation of such questions, we will more freely avail ourselves of the labours of natural philosophers than hitherto has been done, and thus place physiology in its proper position as a beautiful and all-important science.

CHART—Disposal of Thermal Units.

Weight of body experimented on.....	108 lbs.
Loss of heat which the body experienced under ordinary circumstances of life 6 deg. Fahr. per hour x 24 hours per diem=	144

This would accurately express the amount of heat expended, provided the specific heat of the body was 1000..... 15,552 thermal units.
Specific heat of animal tissues, muscle, tendon, bone, fat, etc., ascertained by direct experiment 0.48

Actual expenditure of heat = 7464.96 thermal units.

Loss of heat by skin and lungs by conversion of exhaled water into state of vapour, 16 ounces = 967 thermal units F., 39.2 oz. = 2369.1
— Heat derived from conversion of 13 oz. of water from state of vapour to liquid condition in system, 16 ounces = 967, 13 ounces = 785.6
Heat lost in raising temperature of respired air, 20 cubic inches x 18 x 60 x 24 = 518,400 = 300 cubic feet 24.1 lbs.
Temp. of air entering lungs... 63 deg. F. } x
" " leaving " 99.5 deg. F. } 36.5

Specific heat of atmospheric air..... 0.236 }
879.65 } = 208.4
9256.86

Total thermal value of food ingested per diem 11,900 thermal units, Fahr.
Total value of heat expended as shown above..... 9256.86

Available over thermal wants 2643. 14 x 772 ft. lbs. = 910.94 ft. tons

OBSTETRIC MEMORANDA.

[UNDER this head, we shall, from time to time, as materials come to hand from correspondents, publish records of cases remarkable in themselves, or illustrating points of interest in obstetric practice, therapeutic or manipulative. We shall probably in this way preserve from oblivion the notes of very many useful and instructive occurrences in private practice; for the great obstetric experience is that—for the most part hitherto unwritten—of the great body of general practitioners throughout Great Britain. We will only ask those who may forward cases for record, to relate them with the utmost brevity, and equally to condense any appended remarks.]

LABOUR: ADHERENT PLACENTA: TEMPORARY ARREST OF THE BILIARY SECRETION.

By GEORGE B. BRODIE, M.D., Physician-Accoucheur to Queen Charlotte's Lying-in Hospital.

A.B., after having miscarried frequently, went to the full period, and was delivered of her third child. The placenta was extensively adherent, and was removed with some difficulty; the patient complaining of considerable pain. An excellent night was passed; and the following day the bowels acted freely and naturally. In the evening of the second day, the patient was seized with nausea and vomited twice; she passed rather a restless night. On the third morning, the bowels acted again; but now the motion was almost colourless, and in the evening there was a second action, quite colourless, but solid. On the fourth and fifth days, the same appearances were observed. On the sixth day, bile in small quantity began to pass; and the secretion gradually became re-established. During the whole time, the urine was quite clear and of the usual colour; there was no yellowness of the skin or conjunctiva. Beyond the first attack of vomiting, there was no constitutional disturbance. The patient made a good recovery.

MEDICAL EVIDENCE IN RAILWAY ACCIDENTS.

By JOHN CHARLES HALL, M.D., F.R.C.P., F.R.C.S.,
Senior Physician to the Sheffield Public Hospital, and late Lecturer on the Practice of Medicine at the Sheffield Medical School; etc.

III.—ILLUSTRATIVE CASES.

CASE VII.—*Railway Collision. Singular Symptoms. Heavy Damages. Rapid Recovery.* CASE VIII.—*Railway Collision.* CASE IX.—*Railway Collision. Concussion of the Brain.* CASE X.—*Railway Accident. Injury to the Upper Part of the Arm. Difference in Temperature Between the Two Sides.* CASE XI.—*Railway Accident. Injury to the Right Arm. Conflicting Medical Testimony.* CASE XII.—*Serious Injury on a Railway. Feeble Slow Pulse. Increased Heat of Skin. Ultimate Recovery.* CONCLUSION.

CASE VII.—C. W., aged 23, whose income was about £70 a year, was injured in an accident on a railway, June 1866. He was shaken and bruised, and sustained a simple fracture of the fibula. At the end of July, he complained for the first time of having "nervous fits" and a "peculiar sensation in his head." This state of things continued until the end of August, when he told his medical attendants that "his eye-sight was impaired." In September, the sense of taste was said to be lost; there was loss of sensation also, and he swallowed his food with apparent difficulty.

The case came before a jury at the Assizes, the end of the same year. He came into court on crutches. He could bear strong ammonia (NH₃) to the nose, which only produced a little watering of the eyes. The loss of taste was shown by the impunity with which he could take a spoonful of mustard; and the loss of sensation, by his indifference to the application of a pin to all parts of the face and neck.

The medical men called on his behalf told the jury that, "as four of the special senses were impaired or lost, there must be disease of the base of the brain, resulting from the accident; that he could never be in so good a condition of health as before the accident; and that he might die in less than two years."

The Company, under the advice of counsel, called no witnesses—relying on a speech in mitigation of damages. The jury returned a verdict for the plaintiff—damages £1,500.

Very soon after the trial, he was seen walking in the town with the help of a stick. Next, he was observed running after a railway train when in motion, for the starting of which he was too late, and which he was prevented from entering by the officials. The last report I had of him was, that "he was in good health, going about as usual, and no worse for the injuries he had sustained."

CASE VIII.—W. B., aged 30. This gentleman was in the same train as the last patient, whose case has been narrated. After the accident, he had symptoms of cerebral and spinal concussion, and also many of the nervous subjective symptoms so often present in patients who have been in a collision on a railway. These symptoms will be found fully described in the next case.

The medical attendants of this gentleman expressed their opinion that "it was altogether impossible that he could resume his occupation as a commercial traveller in less than two years." On the Company proposing a compromise, £1,500 was demanded. The sum paid in the end was £1,000.

I am informed that "three weeks after the settlement of his claim, this person resumed his usual occupation, and that he has been perfectly well and able to do his work ever since."

CASE IX.—Mr. H., aged 46, a stout and well formed man (who although of a nervous temperament, had always enjoyed good health), was waiting in one of the third-class carriages of an excursion train, at a station, expecting every minute that it would start, on the return journey; when, owing to a mistake in the signals, his train was run into by another. The door of his carriage being open, he was thrown by the force of the collision upon the platform. He remained for some time insensible. Mr. Benson, his medical attendant, informed me that at the time of the accident Mr. H. had symptoms of concussion of the brain, and that the right arm and shoulder were bruised, much discoloured, and very painful.

The accident happened on the 12th of June; but he was not seen by me until the 6th of the following August. At first, he appeared to have had the usual symptoms of slight concussion of the brain. Then he slept but little; and, when he did so, he awoke with a start, and fancied that he was falling. He told me "that his sleep was broken and uncomfortable"; that he did not know what it was to enjoy a good night's rest;

that he had fearful dreams; and, he added, "I have not had a good night's rest since it happened."

The power of attending to his business in a great measure was lost, for he could not direct his attention to any one subject long together. He was one of the Board of Directors of a large company, and it had been his duty to reckon the wages, and to cast up the books of the workmen. He could no longer do so. His family told me "he was a changed man, and now irritable and discontented." His tongue was furred. He had no appetite; no inclination to do anything; "felt best when sitting in his chair." He could walk well, though he felt very weak, and as though his legs would give way under him. The utterance was not affected; still, he appeared, now and then, at a loss for the right word to complete a sentence; his taste and smell were not impaired; there was slight intolerance of light. He stated that "loud noises distressed him very much." The sense of touch was not impaired. He could read, but it made him "mazy." There appeared some difference of power on the two sides; he did not grasp with the right hand so firmly as he did with the left. He had perfect command over the sphincters; the bowels were inclined to be constipated; pulse 76.

He was advised to go immediately to the sea-side; to keep his mind altogether at rest; and to leave his warehouse to the charge of others for a month or two.

The case was settled out of court by the payment of £500. When I saw this gentleman some months afterwards, all traces of the accident had passed away.

Two other persons, both young, were in the same carriage with this gentleman, and were also injured. One, a young gentleman, whom I saw, had ptosis, the result of a cut over the eye-brow, but perfectly recovered in a few months. The other was a young lady, who had slight concussion of the brain. There was nothing in either of these cases calling for comment, and they are only noted as illustrative of the different degrees in which persons travelling in one carriage may be injured by the same collision on a railway.

CASE X.—Mrs. —, aged 32, married to a respectable artisan, and the mother of several children, three days before I saw her, in consultation with Mr. Morton, had been in a collision on the railway. She was at the time of the accident for a short period insensible; and, on recovering consciousness, felt sick and faint. I found her in bed, unable to move, from "feeling sore and bruised all over". There was much pain in the left shoulder, also over the collar-bone, and in the axilla on that side. There was a somewhat severe contusion just above the collar-bone, and extending backwards. She said, "she was thrown forward against some part of the carriage," and the shoulder had evidently been severely struck, probably in the recoil. The pulse was 86; the pupils acted well; there was no intolerance of light. She had some pain in the head, and slight tenderness on pressure at the cervical portion of the spine.

There was a marked difference of temperature between the two sides. This was tested carefully by a thermometer, which showed the difference to be no less than 4 degrees. The difference of temperature, however, was also quite evident to the touch. The pulse on the left side was weaker than on the right. She described the left hand as being "dead". A silver spoon dipped into hot water could be felt along the spine and over the right arm; no sensation was produced on passing it over the left arm and fore-arm.

Mr. Morton and myself came to the conclusion, that the present condition of the left arm was the result of pressure from effused blood; and that as this became absorbed the symptoms would disappear. I was the more decided in this prognosis, because it was clear to me that the cause was local, and that the brain and spinal chord had sustained no injury.

The treatment consisted in keeping the patient in bed; rubbing the arm, neck, and shoulder with belladonna liniment, and wrapping the arm in a flannel bandage. Day by day the difference in the temperature became less and less; in a week, there was no difference between the two sides as regards temperature; neither was there any difference in the pulse. When I saw her last, about a month after the accident, beyond looking a little thin and pale—and her surgeon said "she always did so"—I could detect nothing to lead to the conclusion that her recovery would not be perfect; and she was left with the assurance that she would very soon be quite well. The case was settled by a payment of £100; and, I am happy to add, when I last heard of her she was in every respect as well as usual.

In this case of somewhat severe railway accident, there are many points of very great interest; 1. More especially, the marked difference in pulse and temperature between the right and left sides. 2. That this only came on two days after the injury had been received. 3. That, as the effused blood became absorbed, the parts resumed their normal condition. 4. The perfect recovery.

CASE XI.—Mr. R. M., aged 62, a very temperate, respectable, and

industrious hard-working smith, using a very heavy hammer in his trade, was in a carriage next to the one which was thrown off the line in a railway collision.

I saw him a few days after the accident, in consultation with my friend, the late Mr. Sykes. When I called he had gone out to the back of his house; and he came into the room where we were seated, walking with difficulty, and leaning on a stick. He told us "that at the time of the accident he was looking out of the window of a second-class carriage; that his head was knocked backwards and forwards; that he fell with his back on to the top of one of the seats; that his eye was bruised; and, that two of his teeth were knocked out"; that, "he was bruised all over, more particularly on the back, and on the right arm; that he could not walk without great pain and difficulty; and that he had lost the power of grasping with the right hand." There was pain on pressure over the lower portion of the spine; this was red from the application of hot fomentations and embrocations when I saw him; but the principal injury appeared to me to be over the right gluteal region, the skin over that part being tender, swollen, and discoloured. There was also a somewhat large bruise over the right elbow, extending up the arm for some inches on that side. The pulse was 76. He complained of pain in the head, and there was a slight cut on the right side of the head near the eye. The eyes were carefully examined with the ophthalmoscope; no intolerance of light or impaired vision was at this time complained of.

He was under my care for about five weeks, during which time he gradually improved, although he still told me that "he had lost all power over the right hand and arm, and that he had no power to grasp anything."

The opinion I formed was that the injury was not permanent; that the brain and spinal chord had not, in any degree, been injured; and that it was in the highest degree ridiculous, to suppose for a moment that such a blow as had been received at the elbow and on the front of the arm, could possibly lead to a permanent loss of power.

The case was tried at the Assizes, and very heavy damages were claimed. The plaintiff appeared with his arm in a sling; said "he had still little or no power in his right hand and right arm; that he had lost flesh"; and complained of such an affection of vision as set at naught all our previous notions of optics.

Three medical gentlemen swore that, "in all probability the injuries received would lead to a permanent loss of power in the right hand and arm." How such an injury could possibly lead to such a result, after long teaching anatomy, physiology, and the practice of medicine, and after an experience in fields for observation, such as few men have had the good fortune to enjoy, during the last thirty years, I confess freely my inability to discover. I was not examined; but three medical practitioners of the highest attainments, and very large experience, confirmed my opinion on oath in the witness-box. They testified that it was only a matter of time; and that the man would soon be able to work again at his trade. No one denied that the man had been injured; the only question was the *degree and probable duration of the effects of the injury*.

The Company had paid, I think, £75 into court. The jury doubled the damages, giving £150. Mark the result. On the 13th of November—exactly six months after the accident—R. M. called at my consulting-room. He showed me his arm. He had the most perfect use of it (he doubled his fist, flexed his fore-arm, and firmly grasped my hand); for a man of his age, he was well nourished and muscular. He said "he was going to commence his work in a day or two." The last time I saw him was in the street; not a trace of the accident remained. He had the perfect use of his arm.

CASE XII.—Mrs. M., aged 37, married, and in the seventh month of pregnancy, was in the third carriage from the engine in a railway collision. I attended her, in consultation with my friend Mr. Morton. She was removed from the carriage by her husband in a state of insensibility, and so she continued for many hours. When in this state, she was seen by Dr. Younge and Mr. Browning.

At the time of the accident, she had been thrown forward on her stomach; the abdominal muscles and the muscles over one hip were swollen and the skin discoloured; from the time of recovering her senses, she had been constantly sick; temperature of the body increased; pulse slow and feeble.

Her medical attendant was fearful that premature labour would come on; but I am correct in stating that such is not a very usual result of railway accidents. The increased temperature, and slow pulse, were to me by far the most serious causes of anxiety; for, in all cases of severe concussion that I have seen, nothing points so clearly to the probability of an unfavourable termination as a feeble slow pulse and an increased heat of skin.

After a long and tedious illness, this lady improved, went to her full time, and ultimately recovered. The case was settled out of court for far less than is usual where injuries so severe have been sustained.

CONCLUSION.

I have thus ventured—I hope carefully, faithfully, and truthfully—to place before my brethren of the British Medical Association, and the medical professional generally, the bench, and the bar (for this is a question in which all classes are most deeply interested), the conclusions at which I have arrived, after thirty years extensive experience in hospital and private practice of railway and other similar accidents.

My conclusions I have endeavoured to support by cases, the like of which, had space been at my disposal, could have been repeated again and again.

The cases now published will, however, I trust, lead every physician and surgeon for the future to admit that, in forming an opinion as to the probable effects of a railway accident, nothing can be so likely to lead to error as the basing of that opinion on subjective symptoms only.

ACTION AND USE OF OXYGEN GAS, WHEN ADMINISTERED AS A THERAPEUTIC AGENT.

By S. B. BIRCH, M.D., M.R.C.P. LOND.

It may, *in limine*, be taken for granted, that the old *dicta* of chemico-physiologists have within the last few years given way to the general admission that undiluted pure oxygen, as well as oxygen in large proportions to atmospheric air, can and does convey *even to the healthy* organism of man and animals a modified force or influence, varying according to individuality of human constitution or the class of animal experimented upon. The scientific gauntlet fabricated from the later experiments of Sir Humphrey Davy, with those of Allen and Pepys, more recently of Regnault and Reiset, and their representatives, has turned out but partially proved armour wherewith to fight the battle against the therapeutic value of oxygen exhibited beyond atmospheric proportions.

To endeavour to explain the *modus operandi* of oxygen gas as a therapeutic agent, is by no means the easy task which some recent supporters of and writers on the remedy would superficially assume—viz., superoxygenation as the *direct* effect of the administration of increased quantities of the gas. In fact, to assume this amounts to a practical admission of the correctness of the conclusions of the older experimenters, while ignoring those conclusions in treating disease. For my own part, I have for the last ten years felt the force of scientific reasoning, and have acknowledged that we must go much more deeply than the shallow idea of superoxygenation, or otherwise evade any attempt at explaining *modus operandi*—a most unsatisfactory alternative, in these days of advancing science. Placing oxygen simply on a par with medicines in general, we might certainly rest contented with a basis of *rational empiricism*; but, where the great life-supporting element is concerned, more accurate knowledge may be fairly anticipated sooner or later. Clinical experience may be ample; but, in the instance of a remedy like oxygen gas (demanding considerable experience in the selection of cases, unusual care in administration, and judgment in the use of cooperative remedies), clinical success depends too much upon the individual practitioner to be admitted without due caution as conclusive evidence.

In what follows, whenever the phrase “artificial oxygen” or “non-atmospheric oxygen” is used, it is intended to refer to oxygen gas chemically produced, and more or less diluted with ordinary air.

The *modus operandi* of oxygen gas, as a remedy in disease, involves three distinct considerations, in order to attain some approximation towards a correct apprehension:

1. The modified condition of the gas, as compared with that in atmospheric air.
 2. The constitutional predisposition, and the abnormal conditions incidentally existing in the organism of each patient.
 3. Cooperative measures which may assist or interfere with the remedial influence of the gas.
1. To the mind of any one who may have had a very moderate experience of oxygen as a therapeutic agent in suitable cases, there can hardly remain a doubt of the difference in effect between small doses of oxygen artificially prepared and the oxygen ordinarily breathed as the principal life-supporting constituent of atmospheric air; for, although we meet with plenty of cases where tolerably large doses are demanded, and where, consequently, it may be fairly argued that the *extra quantity* may have been the sole cause of the immediate and more or less continuous effect, yet abundance of evidence will from time to time present itself, to the eye of the clinical observer, of the absurdity of supposing materially increased oxygenation as the *direct* result of (say) two to six

pints of the gas added to from twenty-five to ninety pints of atmospheric air, and inhaled once in twenty-four hours. Still, however, certain superficial writers on the subject, who have latterly come forward advocating oxygen-inhalation, will harp upon the old string of burning up the superfluous carbonaceous matters, etc.; whereas such conception could only be correct on the supposition that the patient were kept in a largely superoxygenated atmosphere for several hours daily; while the fact is overlooked, that, were the extra quantity to be regarded as the criterion of benefit to be derived, the patient could usually, by a very little increase of exercise or natural inflation of the lungs, obtain all the advantage that a few additional pints of non-atmospheric oxygen could afford. Assuming, then, that benefit can arise from non-atmospheric oxygen in comparatively trifling proportion to atmospheric, and inhaled during a very limited period daily, such benefit can scarcely be explained, except by a modified condition of the gas employed. To such modification I formerly applied the practically significant but scientifically rather loose term, “quasi-nascent,” when the oxygen used was not actually nascent, yet for a time retained that special activity of its atoms to which I wished to draw attention as an essential point in its administration as a remedy in disease; while I added, that I had no confidence in oxygen which had been long released from combination, unless it had been kept in a largely compressed state, in suitable bottles.

Although the modified conditions of oxygen are still but partially known, yet the researches of Schönbein, Brodie, Tait and Andrews, Meissner, Soret, Clausius, Daubeny, Richardson, etc., have collectively so far cleared scientific view as to show that heat-carrying power and polarisation (with, perhaps, a varied arrangement) of the atoms of oxygen may be received as a satisfactory *general* hypothesis explanatory of the marked difference in action between oxygen artificially prepared and oxygen as it exists in the atmosphere.

As in the manifestation of electrical force, it would appear that active oxygen is never generated otherwise than in company with an opposite principle. As, on the application of heat to water (evaporation induced), the positive and negative principles, ozone and antozone so called, become developed, the former in the water, the latter in the vapour (Tobin); so, in employing heat in the artificial preparation of oxygen, ozone can be tested at the moment of liberation, but very slightly (and for a limited period only) in the reservoir after mere passage through the tubes of transit. Doubtless, the distinct polar conditions quickly give place to neutral oxygen; but it may be fairly surmised that this neutral oxygen will for a time remain in very active condition for motion and combination; and that this activity may be for a lengthened period preserved by condensing it, and may be further promoted by the expansion of the gas in the contact with atmospheric air, which takes place just prior to its use. It may even be surmised, with some probability of truth, that the mere mixture of the gas with the atmospheric air, by isolating and individualising its particles, may permit a freer therapeutic action than would otherwise obtain; just as the phosphate of lime in animal charcoal isolates and individualises the carbon therein, and thus renders the carbon-particles active in more directions of force than could possibly be, if they were closely posited.

Again, the recent chemical theories advanced to supersede the original electro-chemical theory of Berzelius—viz., those of Gerhardt, Laurent, etc.—accord to oxygen a di-atomicity, or (as Dr. Thudichum has recently suggested) dynamicity, which clearly points out a double plane of action, in which the gas may fairly be supposed to be capable of working out therapeutic results.

Dr. Richardson has ably impressed upon physiologists the fact that the agencies of heat and electricity have a very similar influence in rendering oxygen more active when freely exhibited to animals, and apparently infers the propriety (if not necessity) of the gas being warmed before inhalation in disease. He has also shown that oxygen gas, rendered inert for respiratory purposes by being breathed repeatedly, can be again made active by the electrical current passed through it. But it may be asked, Can its subjection to *heat* external to the body restore its activity? Certainly not, except through the direct (concentrated) rays of the sun; no more, indeed, than the heat within the lungs can preserve its activity after a certain time. Hence a force must have been existent in the atoms of the oxygen, affecting its heat-carrying power, and removed by the process of respiration; and electricity, being the result of solar action stored up and constantly available as an excitor, and under the influence of *motion*, can effect in the atoms of oxygen what artificial heat cannot. Thus heat and electricity, though analogous in result in some respects, must possess different planes of action in modifying the polar condition of the oxygen-atom; and the admission of such distinction will be observed to bear considerable practical import in attempting to explain the relations of heat and oxygen, in a pathological point of view, under the second head of our subject.

To ensure, then, the requisite energy of oxygen in small quantity as a