that the uterus should not be subjected to its influence, because I feel certain that there is less mischief to be apprehended from the pain inflicted by incising the organ, than what is likely to accrue from the playing of the ether-spray on the part when the abdomen is laid open. I do not apprehend that the edges of the abdominal wound are likely to suffer in the way. Dr. Kidd (*loc. cit.*) states that the lips of the abdominal wound after ovariectomy may mortify; he says, "under ether-spray the lips of the wound, too, may mortify."

In conclusion, I think I may fairly state that, although the maternal statistics of this operation present an unfavourable aspect, I am fully warranted, after a full and candid investigation of the causes of the death of the mothers, in concluding that they are not, in most of the cases, to be attributed to the operation. Some of these causes are avoidable, or preventable; some are controllable.

My opinion as to making the Cæsarean operation conditionally one of election remains unchanged.

THERMAL VALUE OF FOOD.*

By WILLIAM H. O'LEARY,

Lecturer on Anatomy and Physiology, Ledwich School of Medicine; Surgeon to St. Vincent's Hospital, Dublin; etc.

II.—ITS APPLICATION FOR CALORIFYING PURPOSES AND WORK DONE.

HAVING arrived at a determination as to the thermal value of the food ingested, the next point of inquiry to which we will direct our attention is its capability for supplying the heat necessary for calorifying purposes, and for accounting for the various opera accomplished by the system. In the determination of this, I have departed from the course pursued by such illustrious physiologists as Lavoisier, La Place, Dulong, etc. I have struck upon a new path more in accordance with the spirit of philosophy, and the sound principles of living physicists, as taught in the present day. Although this is one of the most important questions in the entire range of physiology, I have ventured to look with the eye of a physicist upon the inquiry; and have availed myself of the well-established laws of physics as aids in arriving at my conclusion.

A few years hence physiology will have been erected into a science, resting upon chemistry and physics, both bound together by, and exhibiting themselves, as vitality. I believe, therefore, it is all the more important to endeavour to arrive at a conclusion guided by these laws, rather than depend upon the results of former experiments, or the same ones repeated, no matter with what degree of extraordinary care, as, from the manner in which they were conducted, inevitable aberrations attend them; and their results are ever covered with a grave shadow of doubt: while, by appealing with confidence to the results of the ever-accumulating labours of the scientific physicist, we gain a sure foundation upon which to base our investigations. I will here state that I do not look upon the results I have obtained as perfectly accurate. I have had to rely upon data which the progress of science may alter and improve; but, as far as an earnest desire to arrive at accurate conclusions could assist, it has been brought to bear by me.

In endeavouring to ascertain the amount of heat required by the living body, I have pursued the following inquiries.

First. What amount of caloric would be necessary to give a similar amount of heat to any substance of the same weight and temperature of an animal? This, from a physical point of view, is easily determined; and I have followed the mode which a physicist would have adopted. I have selected water, therefore, as my standard. Having determined upon this point, my next step was to obtain the specific heat of the animal tissues as compared with that of water. My experiments for this purpose occupied several months of the present year, during which I laboured under serious disadvantages in consequence of the high temperature of the atmosphere. The instrument I first employed was Lavoisier's calorimeter, consisting of an inner chamber, containing the body, the specific heat of which was to be determined, surrounded perfectly with an ice-chamber; this I again surrounded by another chamber containing a further quantity of ice. The body in the inner chamber gives out its heat, and effects the liquefaction of a certain quantity of the immediately surrounding ice. By weighing the water so produced it is easy to calculate the heat given out by the body while cooling; as for every pound of ice liquefied to 32 deg. Fahr., heat is required equal to 79.4 deg. centigrade. Thus, having previously ascertained the weight and temperature of the body experimented on, we obtain its specific heat. The high temperature of the atmosphere seriously interfered with

this mode of experiment; as, when I endeavoured to verify it, I found I could not rely upon it for entire accuracy. I then adopted Black's calorimeter, which consists simply of a large mass of ice, within which the body for experiment is imprisoned. The principle upon which it yields results is precisely similar to Lavoisier's; and unfortunately I found it still liable to error from similar causes, but the results obtained by this method were tolerably constant. I further employed the method of mixture, which is an extremely simple one, but depending very much for accuracy upon surrounding influences. However, the result of my experiments leads me to fix the specific heat of the tissues of an animal at 0.48, as marked on chart.

The next point of inquiry is, the number of degrees which a body will lose in a given time. This depends very much upon two conditions—specific heat and conductivity. With the object in hand, I made numerous observations upon the dead human body; and my observations lead me to conclude that unless there be some special reason, such as peculiarity in the cause of death, etc., an amount of heat is given out equal to 5½ deg. Fahr. per hour. This result is much modified by circumstances other than the cause of death, such as the calibre of the limbs and the body covering of adipose tissue, etc. I have fixed the cooling number of my own body at 6 deg. Fahr., being rather of diminutive stature, and not overburdened with adipose tissue. The caloric necessary for this purpose I have calculated to be equal to 7464.96 thermal units. On referring to the accompanying chart, the mode of calculation will be easily understood.

The next subject of inquiry was the amount of heat lost to the system through the important agencies of the skin and lungs; this I divided into two parts: first, the consideration of what heat is expended by the conversion into a state of vapour of the water exhaled from the skin and lungs; second, the caloric expended in warming respired air. The result of the first I have based upon the six days' experiment. Having ascertained the amount of water exhaled from the skin and lungs, and its being necessarily converted into aqueous vapour, the calculation becomes a simple one. The laws of physics are very applicable here. For every pound of water converted into a state of vapour, an amount of heat is required sufficient to raise 537 lbs. of water 1 deg. centigrade, or 967 lbs. water 1 deg. Fahr. The expenditure of heat by this source equals 2369.1 thermal units. But, on referring to my former paper, it will be seen that an amount of hydrogen united with oxygen in the system capable of producing thirteen ounces of water, which at moment of combination was at combustion heat; but in the act of being reduced to the liquid state in the system, an amount of heat is produced equal to 785.6 thermal units. This gain subtracted from the loss, ascertained by the last calculation, viz., 2369.1, shows a net loss to the system of 1583.5 thermal units, as shown on chart.

With regard to the amount of heat expended in warming the respired air, I take 20 cubic inches as the amount of breathing or tidal air × 18 respirations per minute × 60 per hour × 24 per diem = 518,400 cubic inches = 300 cubic feet. One foot of air, by weight, equals 1.29 ounces; 300 feet equal 24.1 lbs. The temperature of the air entering and leaving the lungs was respectively 63 deg. and 99.5 deg. Fahr.; difference = 36.5 deg., which × 24.1 lbs. = 879.65 thermal units. This would be the amount of heat expended, provided the body heated was water. But the specific heat of atmospheric air compared to water = 0.236, which × 879.65 gives, as total loss of heat sustained in this act, = 208.4 thermal units Fahr.

There is an apparent loss of heat by the urine passing from the bladder at a high temperature; but, from observation on this point, I consider, if there be any, it is very trifling, as the food, and fluids, such as tea and the more invigorating tumbler of punch, ingested, nearly cover the difference between the cold fluid ingested and the urine and feces excreted. On reference to my former paper, it will be found that the food ingested daily, and oxidised in the blood, produced an amount of caloric equal to the raising of 6711.2 lbs. of water 1 deg. centigrade. Deducting from this the thermal value of the organic portion of the feces, which I have calculated, with as much accuracy as I could, as being equal to 100 thermal units, leaves 6611.2 thermal units centigrade. This, converted into the Fahrenheit scale which I adopted in my investigations, gives 11,900 thermal units Fahr. Subtracting from this 9256.86, the amount I have already shown as necessary for heating purposes, gives a surplus over thermal wants equal to 2643.14 thermal units, to be disposed of in the production of muscular force; the exact amount of which is easily ascertained thus: each thermal unit equals the raising of 772 lbs. one foot high × 2643.14 = 2,040,519.52 foot-pounds = 910.94 foot-tons, which is perfectly competent to cover all the opera required by the system.

From experiments in which I am at present engaged, I am induced to believe that the muscular force thus indicated has its source direct from the heat produced in the arteries, and not, as heretofore supposed, from

* Read before the Physiological Section at the Annual Meeting of the British Medical Association in Dublin, August 1867.

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;