The advantage of division of tendons in such cases—structural shortening of muscles and consequent limitation of movement and function of articulations and deformity—cannot be exaggerated. These are the cases in which the greatest permanent benefit accrues to the patient, and to the reputation of the surgeon. The previously contracted, *structurally shortened* muscles, evince comparatively little tendency to re-contraction after operation.

On the contrary, especially during childhood, when the contracted articulation can be moved through a considerable portion of the natural range of movement, when the resistence is elastic instead of being rigid and unyielding, when in the foot, for example, the patient, by throwing the weight of the trunk upon the member, as in the act of lounging in fencing, can bring the knee over the point of the foot (toes), when the atrophy of the member does not amount to, or approach to, a loss of one-sixth (it is often as great as one-fourth) in its circumference, tenotomy is not required.

The means by which, in such cases, tenotomy is superseded, are those already recommended—diligent, painstaking manipulations, appropriate mechanical supports, and appropriate exercise.

Brook-street, Grosvenor-square, 1857.

ON A

METHOD OF DETERMINING THE QUANTITY OF AIR BREATHED IN A GIVEN TIME,

AND THE

PROPORTION OF CARBONIC ACID CONTAINED IN THE EXPIRED AIR.

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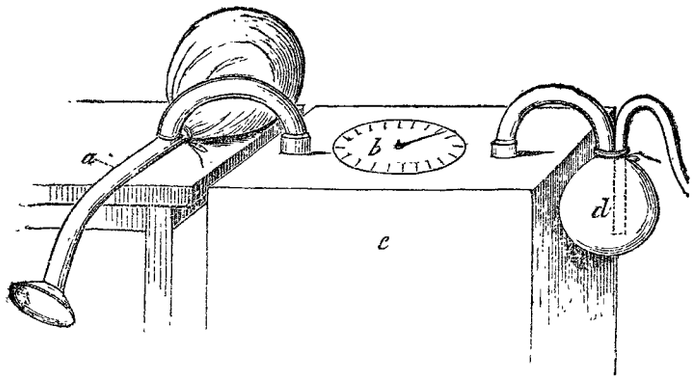
WHENEVER the physiologist requires to estimate the activity of the vital exchange of material which constitutes the process of nutrition, it becomes absolutely necessary that he should be provided with the means of determining the rate of the excretion of carbon in the form of expired carbonic acid. For this purpose the expired air must be analysed, and the quantity breathed must be measured. There are many methods of doing this; but most of them are either too long and difficult to be often repeated, or are wanting in accuracy. The problem is to combine exactitude with simplicity.



A. To determine the quantity of air respired in a given time. The apparatus which I use consists of—

1. An eight-light gas-meter, by Glover, *c*. The employment of this metre was suggested to me by Mr. Pope, engineer. Edgeware-road; and was adapted to my purpose by Messrs. Horne and Thornthwaite, of Newgate-street. 2. A pair of bellows, the nozzle of which is furnished with a flexible tube, terminating in the elastic bag, *d*. From this bag the air passes, by another tube, in a more or less continuous current, into the meter. 3. A bag of vulcanized caoutchouc, *e*, of 600 cubic inches' capacity, the membrane of which is of such extreme tenuity as to weigh only 150 grains, and to have the thickness of about ·0008 inch. 4. A funnel-shaped mouth-piece of gutta-percha,* which is connected by a wide flexible tube, *a*, with the bag, *e*. Near the termination of this tube, it is joined at right angles by a similar tube, by which it communicates with the meter. The mouthpiece is adapted to the face with the aid of an annular air-cushion of the thinnest caoutchouc. It is thus rendered perfectly air-tight—a result which is attainable by no other means that I have seen employed. About half-way between its free margin and its junction with the tube, it is closed by a diaphragm. This diaphragm has an aperture of 1·07 in. area, which is furnished with a valve opening inwards. At each side of the mouthpiece is an aperture closed by a similar valve opening outwards.

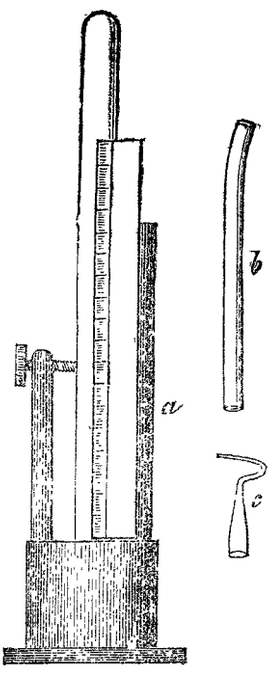
In the use of the apparatus, the subject of experiment breathes out of the bag, *e*. To supply the place of the air inspired, a constant current is impelled by the bellows through the meter, the observer taking care to maintain an unvarying degree of impletion of *e*. The quantity of air thus serving for inspiration is indicated on the dial. The individual breathes wholly without effort, the air in *e* having precisely the tension of the atmosphere, and the valves of the mouth-piece being of such size and material as to afford the smallest conceivable resistance.

B. To determine the proportion of carbonic acid contained in the expired air.

The first step is to collect the product to be analysed—the expired air—and here lies the main difficulty.* Various forms of receptacle have been employed by observers, all of which are more or less liable to the objection that the individual breathes with effort, and that the product of respiration is unnatural. My apparatus consists of, 1, a caoutchouc bag, of the kind already described, capable of containing 500 or 600 cubic inches of air; 2, two glass tubes, of the form shown in the second diagram *b* and *c*.

The bag, after having been completely exhausted by aspiration, is fitted to the tube, which is then introduced into the mouth along the upper surface of the tongue, until its extremity reaches the margin of the epiglottis, the observer at the same time holding the mouth of the bag between the finger and thumb, so as to close it completely. So soon as the breathing appears to be natural, he relaxes his hold, a portion of every expiration enters the bag, its return being prevented by compressing the neck of the bag at the commencement of inspiration, by which means it is easy to prevent the same quantity of air from being twice breathed.

The observation may be thus continued during 20 or 30 respirations. As soon as it is completed, the neck (still compressed between the finger and thumb) is plunged under water. The tube *b* is withdrawn, and the tube *c* substituted, the neck being maintained in the same position. The bag may then be safely laid aside for a few minutes, for the quantity of water which remains in the capillary part of the tube effectually closes it.



* The mouth-piece is represented in the woodcut very much too shallow.

* Dr. Snow (in his researches respecting the inhalation of vapours) obviates the difficulty by causing the individual to expire through a series of weighed Woulff's bottles, containing strong solution of caustic potash. Dr. Edward Smith has applied the same principle in his admirably-contrived apparatus recently exhibited at the Medical Society of London.

The Anthracometer, employed for the determination of the carbonic acid in the air collected as above, will be best understood from the diagram. It consists of a cast-iron mercurial trough, furnished with two vertical supports, by means of which the glass tube, inverted in the trough, may be maintained at any height in a vertical position. On one of these supports, a scale, divided into 50ths of an inch, is so fixed as to allow of a limited vertical motion. This scale, like that of a barometer, terminates in a steel point, which coincides with its zero. An accurate preliminary determination is made first of the capacity (v) of the tube measured up to a certain point near its open end, coinciding with the zero of the scale, and indicated by a transverse line on the glass; and, secondly, of the capacity of one inch of the tube measured upwards from this point.

A portion of the air contained in the bag is introduced into the anthracometer as follows:—The mercurial trough and the measuring tube having been previously filled with mercury, and the drop of water expelled from the tube, the point of the latter is introduced under the open end of the measuring tube, and then raised until it is above the level of the mercury in the trough. As soon as a sufficient quantity of air has passed, the tube and bag are removed. The anthracometer is allowed to cool for at least an hour. The reading of the barometer and thermometer is then noted, and the exact height of the column of mercury in the measuring tube read on the scale, by the aid of a lens, which is so placed as to avoid error of parallax. A potash ball is then introduced, and allowed to remain twelve hours. After its removal, the same observations are repeated. The result in either case is calculated according to the following formula:—

$$Vo. = \frac{(H-h-f)\cdot(v-h)}{1+0{\cdot}00366\,t}$$

Where $Vo.$ = Volume required.
H = Reading of barometer.
t = Reading of thermometer.
h = Height of the column of mercury.
f = The tension of aqueous vapour due to the temperature.
v = The capacity of the tube.

The application of this formula to the measurement of the air contained in the anthracometer before and after the introduction of the potash is the same, with the exception that in the latter case the correction for tension of aqueous vapour is omitted. The difference between the first result and the second is the volume of carbonic acid introduced into the anthracometer.

November, 1857.

ON THE

VALUE OF ARSENIC IN CHOLERA.

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THE importance of arsenic in the treatment of cholera is a matter of such vital consequence to public health, and of such interest to the physician in a therapeutical point of view, that it is my intention to place, from time to time, before the profession the results of my experience of this remedy in choleraic disease.

By the production, in this way, of a mass of incontrovertible data of its efficiency in cholera, it will, I trust, force itself upon the attention of medical men; and, as certainly as it shall do this, it will prove to them its *specific power* over the disease which has hitherto yielded such scanty results to the best-directed efforts of medical art. In placing this high value on the anti-choleraic virtue of arsenic, I yield, not to *enthusiasm*, but to *experience*—an experience which, at the present moment, embraces the treatment by this remedy of nearly two hundred cases, in none of which has the arsenic ever failed to produce a *speedy* and *permanent* cure. What other remedy, empirical or rational, has produced such results? It is certain that the records of medicine, so far as I know, do not furnish a parallel. If, indeed, the want of experience *had* lacked the justification of its adoption, the pathological views which are entertained by the majority of the proximate cause of cholera, and the knowledge which physiological science has educed of the behaviour of one poison in the presence of another within the human body, would have placed it in the category of *rational*, and not of *empirical*, remedies. But experience *has* justified what theory sanctioned. Not only has it done this, but it will further show, in the details of the following cases, that the remedy in question is applicable to every phasis of choleraic disease, from that which threatens with death within the lapse of a few hours, to that which, by a slower process of passive drain from the bowels, consumes days in bringing its victim to a premature grave.

CASE 1.—L. G——, aged forty-eight years, married, by trade a basket-maker, at six P.M. on September 22nd, 1857, began to suffer from diarrhœa. From this hour until ten P.M. the bowels were moved four times, the evacuations being thin, watery, and offensive in odour. At ten the purging became much more frequent and severe, and was accompanied by almost incessant vomiting and cramps of the abdomen, legs, and even the muscles of the back of the neck. From the time above mentioned until five A.M. of the 23rd, the patient is reported to have vomited and purged at least forty times. Shortly after this hour I saw him. He was writhing to and fro upon a bed, which was placed opposite his house-door, in a room ten feet by twelve, with a ceiling not more than six feet high. The apartment was lighted by a small window, which, together with another window of a foot square and the door in question, afforded the only means of ventilating the whole house. His countenance was haggard and shrunken in the extreme; eyes hollow; nose and the parts around the mouth of a deep leaden hue; skin very cold; breath cold; voice hollow, squeaking, and tubular; frequent thirst; pulse scarcely perceptible; breathing hurried and laboured. He had not passed urine since four the night before. A constant moaning was heard, except on the return of cramps, which occurred every three or four minutes, when his sufferings excited loud cries of pain. The purging and vomiting were all but incessant, the vomits and dejections being copious, thin, and evidently serous in their character. He was ordered five drops of liquor arsenicalis every fifteen minutes until the symptoms became less urgent, and then to have the same dose every hour until my next visit. — Twelve A.M.: After the first dose of arsenic there was no return of cramps; the third dose was followed by a complete arrest of purging, whilst vomiting had occurred but three times during the interval of my first and second visits. The countenance still maintained a haggard expression; the nose in part its leaden hue; a slight degree of warmth was beginning to creep over the skin, and the pulse was now distinct at 120 per minute. Thirst was much less frequent; the breathing less hurried and laboured; but neither had the voice lost its peculiar tone, nor had the secretion of the kidneys as yet been restored. He was ordered to take the usual dose of arsenic every hour.—Nine P.M.: The bowels were moved once at three P.M., the evacuations being scanty, and of increased consistence. Has vomited twice, but has experienced no return whatever of cramps. Skin warm; no secretion of urine; pulse 100, larger. To take three drops of the arsenical solution every third hour.

Sept. 24th.—Nine A.M.: Neither purging, vomiting, nor cramps since last visit. Skin hot; face flushed; thirst; pulse 96 per minute, full and strong; passed half an ounce of urine at six this morning for the first time since the commencement of the attack. To discontinue the further use of arsenic, and to take a mixture consisting of the acetate of ammonia, potassio-tartrate of antimony, spirit of nitrous ether, and water.

25th.—Quite well.

Remarks.—This case presented, in the time of its occurrence and the manifestation of its symptoms, all the characteristics of a malignant attack; yet five drops of the arsenical solution completely allayed the cramps, and fifteen the purging; whilst a few more doses placed the patient in perfect safety. Confident of the power of my remedy to control the disease, notwithstanding the extreme degree in which the case was when I first saw it, I neither ordered friction to be observed, nor the application of external heat to the body; nor did I administer or cause to be administered, a single drop of any stimulant whatever. On the contrary, the door of the house was allowed to remain open, and a cold draught of air to play upon my patient, whose only drink consisted of a moderate supply of cold water. These apparent disadvantages I purposely incurred in order to test, as far as possible, the curative power of the arsenic. How well it answered my expectations, the easy, rapid, and complete recovery of the case amply testifies.

CASE 2.—H. S——, aged forty-four, married, was seized with sickness and purging at noon Sept. 24th, 1857. These symptoms did not become urgent until six o'clock in the evening, at which time they became more frequent, and were accompanied by occasional cramps of the abdomen. There were now, in