the Great Northern Hospital up to that date; nor do I see that any of the speakers in the debate which followed referred to any others.

Fatal Cases of Diffuse Peritonitis from Perforation.

Name	Age.	Date.	Duration of Symptoms.	Part Perforated, Found or Not.	Surgeon.	Remarks.
F. H.	16	Sept., 1890	12 days	Appendix cæci not found	Mr. Pick	This operation had been too long postponed, but was done at once after admission.
A. P.	18	June, 1894	5 "	"	?	Operation immediately after admission.
A. (M)	44	Jan., 1888	3 "	"	Mr. Turner	The peritonitis had resulted from bursting of a pericæcal abscess into the peritoneum.
M. M.	17	May, 1890	2 "	"	Mr. Dent	Two bands of adherent omentum were divided at the operation. Possibly this prevented a careful examination of the bowels.
W. L.	21	April, 1890	6 "	"	Mr. Pick	This operation was done at once, but too late.
G. F.	—	May, 1894	3 "	"	Mr. Haward	Operation at once. He was too collapsed to bear much examination. Several collections of pus existed in the peritoneal cavity.
M. C.	24	May, 1890	?	"	Mr. Bennett	In this case also the operation was immediate, but she was too far gone. She had had symptoms more or less severe for a fortnight, but was at work three days before admission.
H. J.	39	Aug., 1888	5 days before admission	"	Mr. Pick?	Operation only performed two days after admission, when <i>in extremis</i> .
P. C.	25	June, 1891	?	"	Mr. Bennett	The symptoms were those of peritonitis. Exploratory operation two days after admission failed to detect the cause.
A. S.	5	May, 1894	?	Small intestine, probably from tuberculous peritonitis	Mr. Dent	He survived the operation nine weeks, and died from general wasting.

Yet I suppose many cases of alleged success have been published, for a paper on Abdominal Section for Peritonitis by a Russian surgeon is abstracted in the *Annals of Surgery*, 1891 (vol. xiii), in which reference is made to 24 cases of laparotomy for "idiopathic peritonitis," in 19 of which recovery is claimed. The references, however, are not given, so that the cases could not be followed without great labour, and I must say that the result would not repay the trouble. No such ratio of success can reasonably be anticipated in any continuous series of cases. But Mr. Lockwood's and other published cases may encourage us in attempting the operative cure of the disease; and the suggestions which he gives for the details of operation seem eminently calculated to assist the operator in obtaining success.

I must allow that in looking over this series of cases the difficulties which stand in the way of success in the operative treatment of diffuse suppurative peritonitis come strongly before me. When the inflammation is purely traumatic I cannot doubt that the free irrigation and drainage of the peritoneal cavity will succeed in a large proportion of cases, but they are rare. No instance has been put on record here in these seven years. When the cases are classed as "idiopathic," this can only mean that the cause has not been discovered, and we cannot therefore feel much confidence either

that incision and drainage will remove that cause, or will enable the patient to survive its continued action. Tuberculous peritonitis seems to me to hold out but a poor prospect of permanent recovery, though a large proportion of cases are noted in the paper just referred to, in which the patient has survived the operation, and there is one such case in the foregoing list; but the list of cases just produced shows in how large a proportion the peritonitis is caused by perforation, especially of the appendix; and it shows also how liable the surgeon is to overlook such perforations, and this must be much more frequently the case if the operation is delayed till the patient is *in extremis*, and unable to bear a prolonged and exhausting search amid the contents of the abdominal cavity. If the surgeon will bear in mind the frequency of ulceration of the appendix, which is covered and concealed by adherent intestine and masses of lymph, and if there is the opportunity for that deliberate separation of the intestines from each other which Mr. Lockwood recommends, the source of the peritonitis could be discovered and removed, and the patient's chance of survival indefinitely increased.

This course was pursued in three cases, with results which are encouraging as far as so small a number permit of any deduction, two of them having recovered after the removal of the perforated appendix.

THE CROONIAN LECTURES. CONTRIBUTION TO THE HISTORY OF THE RESPIRATION OF MAN.

Delivered before the Royal College of Physicians of London.

By W. MARCET, M.D., F.R.S.

LECTURE III.

MR. PRESIDENT AND GENTLEMEN,—In my last lecture the first three forms of breathing were considered. Let us now proceed to the fourth, which applies to respiration under the influence of volition; but before doing so allow me to recall the remarkable experiment of Professor Mosso, of Turin. This gentleman constructed a metal instrument, a sort of glove, through which his fingers were inserted, with the exception of the middle one; with this finger he worked a weight up and down until the digital muscles concerned in the labour were completely exhausted; at this stage the muscular contraction was carried on by means of electrical excitation, and he found that if, after a short period, the excitation was discontinued, the finger was able still to maintain its work, showing that the muscles had not ceased contracting from actual fatigue, but from exhaustion of the will which had been exercised to move them.

There is an interesting borderland between psychology and physiology which is narrowing daily. The discovery of the electrical excitability of the brain by Fritsch and Hitzig, and of the motor centres by Ferrier and Yeo, followed by Horsley and Schäfer, has opened altogether a new field of research, and brought the mental and physical functions nearer to each other. We do not know much of the physical effects exerted on the body by the perception of our senses. Moleschott, as far back as 1855, showed that from one-tenth to one-fourth more carbonic acid was exhaled by frogs under the influence of light than when in the dark, and also that this increase varied directly as the intensity of the light, which acted through the eyes and skin.

It occurred to me that if light exercises a distinct physical action on the living body, perhaps sound would produce a similar effect; but even a fairly loud sound, such as that produced by the beating of a gong close by, gave no positive result; the carbonic acid emitted under the influence of the sound being sometimes a little more and sometimes a little less than normal, and the same could be said of the oxygen absorbed. There was, however, a slight excess of air breathed (expired) while the noise was continued, which varied from 0.036 litres to 0.733 litres per minute in eleven experiments; and this slight excess was balanced by a corresponding diminution of the volume of air exhaled during the first five or six minutes after the sound had ceased.

The perceptions of our senses are certainly independent of our will, still the sight and hearing may not be entirely unconnected with volition; or it would, perhaps, be more correct to say that objects may act on the brain through sight, and sounds through hearing, without producing any corresponding impression. Take the case of a person lost in a brown study: he does not see objects though with eyes wide open, nor will he hear a sudden noise.

By submitting our senses to the exercise of volition, we train them and improve their perception. Thus we train the sight to the better appreciation of the beauties of Nature. Those thrilling descriptions of Alpine scenery must be the outcome of the training of the sight to the thorough enjoyment of mountain views. The rapture into which Sarasate or Joachim throw their hearers requires a certain training of the audition.

Mosso has shown that volition is a cerebral act attended with fatigue. I need hardly remind you of the fatigue experienced in listening to good music; two hours thus employed will, as a rule, be amply sufficient, and it often happens that in less time the attention begins to flag and the impression to subside. Operatic music may be listened to much longer, for the obvious reason that in an opera the exercise of volition is distributed between two brain centres—those of hearing and of sight—instead of being concentrated on a single one, and is on that account less exposed to fatigue.

We now come to the influence of volition on muscular movements. There are instinctive muscular movements in which volition is not concerned—for example, those required to balance the body—but these have been acquired in the first instance by the exercise of volition or by training. Hence it appears that training is of fundamental importance in all muscular exercise, such training being at the same time applied to the *volition* excited by the cerebral motor centre concerned in any special form of muscular work. Learning to play on a musical instrument is certainly training volition quite as much, if not more, than training the muscles; the surprising rapidity with which the fingers run over the notes of the piano in response to the will is also a case in point, although, if I understand rightly Dr. Bastian's views contained in his book on *The Brain as an Organ of Mind*, it is very possible that such training, especially in young people, should develop a certain set of nerves through which these rapid impressions are conveyed, becoming automatic in their character. We shall see that volition has a direct action on respiration, hence training volition is at the same time training respiration. Let us now pass on to the subject which forms the substance of this lecture—the influence of volition on respiration.

Under ordinary circumstances, when sitting in repose, the mind is at rest as well as the muscles, and the breathing quiet and regular. Should a strong effort of volition be made, although unattended by any muscular contraction, it may be observed to react immediately on the respiration. If after a tracing of normal respiration has been obtained, the person under experiment sets his mind to work and exerts his volition strongly towards carrying a heavy weight, running to catch a train, or pursuing another person uphill, the tracing recorded on the chart will be observed to ascend more rapidly than in the case of mental rest, showing a greater volume of air breathed in the same time. After, say, one or two minutes, let the influence of the will be withdrawn and respiration continued under mental repose; the first effect will be the production of a respiratory pause, the tracing taking a more horizontal direction, as seen in forced breathing, though perhaps somewhat less marked, after which the breathing will return to the normal, the tracing obtained being much like that of forced breathing.

Similar experiments on different persons invariably yielded the same kind of curve on the chart. It follows that the influence of the will is to increase the volume of air breathed, and that on releasing volition a pause is produced very like that which follows forced breathing; but there is this difference with forced breathing, that when the will is applied say to the act of locomotion, the increased pulmonary ventilation is absolutely automatic, while forced breathing is the direct effect of volition applied towards the expansion of the chest.

An explanation of the pause or apnoea after forced

The tracing "under exercise" is shown to contrast with that for breathing "under volition."

breathing is that forced breathing produces an increased absorption of oxygen, and this oxygen being used for the requirements of the body lessens for a few seconds the calls for pulmonary ventilation. This idea suggested that perhaps such an accumulation of oxygen in the body might be employed by the muscles for a temporary increase of power. The following experiment was therefore made: while sitting in an armchair a weight of 10 lbs. was alternately raised and lowered with the hand in keeping with the striking of a metronome, and to my surprise it was observed that after a succession of deep inspirations the weight could be raised a much greater number of times than after normal breathing; indeed, the increase of power was such that the weight could be lifted to the same height before exhaustion perhaps two-thirds or twice as often after forced breathing as after natural respiration.

For a time this effect of forced breathing was to me absolutely unaccountable as there was no apparent call for an accumulation of oxygen in the tissues, and no proof of any such absorption; moreover, the excess of carbonic acid formed by the muscular power added was infinitely greater than could be accounted for from any excess of oxygen absorbed in the body. But perhaps in forced breathing there was really an increase of oxygen absorbed, which was taken up by the brain centres of forced breathing, and gave "volition" the power of doing so much additional muscular work through increased respiration. This view was subsequently investigated and its correctness shown, by experimental methods.

Allow me to quote the experiments which show to what extent muscular power may be increased by the preliminary exercise of "volition" exerted in the form of forced breathing. It might be added that in order to succeed with these experiments, the attention or "volition," should be given to the act. It failed once or twice when first tried, though successful on

every other occasion with that same person, probably because the will was not applied with sufficient power or was not yet possessed of sufficient training for that kind of experiment.

Person under Experiment.	Weight Lifted.	Number of Times Weight Lifted Normal.	Time of Forced Breathing.	Number of Times Weight Lifted after Forced Breathing.	Ratio of Increase.
Author	Lbs.		Min.		
"	8	24	2	65	2.71
"	8	26	2	50	1.92
"	8	26	1	34	1.31
"	10	21	2	36	1.71
Assistant	8	30	2	32	same
"	8	33	2	49	1.47
"	8	33	2	41	1.26
"	8	39	2	63	1.62
"	10	41	2	69	1.68

It is remarkable to what extent the arm becomes accustomed to this kind of work, and can develop more and more strength with time from mere training. This is seen in the figures given later on, but it is important to observe that the present remark does not apply to the experiments taken singly, when the increased work was clearly due to increased power from a temporary cause. This point was set at rest by a very simple experiment. Two consecutive series of liftings were made without the intervention of any forced breathing. The weight was lifted till stopped by exhaustion 26 times in the first series and 26.5 in the second; hence it cannot be said that any influence of training was exerted in the comparative experiments.

The effect of forced breathing in increasing muscular power can be tested by anyone while sitting quiet in his own room. My friend Dr. Louis Parkes lifted a weight of 8½ lbs. 50 times while in a state of physical and mental repose; and after forced breathing for 1½ minute, applying his mind to the act, he raised the same weight to the same height 125 times.

A lady reclining in an arm chair lifted with her right arm a tea-kettle weighing 4 lbs. 13 ozs. 60 times, and after resting ten minutes and breathing forcibly for one minute, raised the same teakettle 100 times to the same height.

The greatest effect was produced on a medical friend, who after ordinary breathing lifted a weight of 4 lbs. 203 times in succession, and after a rest and forced breathing for two minutes lifted the same weight the same height no fewer than 700 times. In this case volition taxed the muscles to the utmost, and the arm remained tired and stiff for some days afterwards. The weights in all these experiments were lifted under natural or automatic respiration after forced breathing had been discontinued.

The absorption of an excess of oxygen in the body under forced breathing was so far an assumption, and it became necessary to determine experimentally if such were the case; the methods in use for the determination of carbonic acid and oxygen in the expired air being extremely delicate, the results obtained may be looked upon as thoroughly reliable.

The experiment was undertaken in the following way. After resting for some time in the arm chair the expired air in normal breathing was collected for subsequent analysis, then forced breathing was taken for about two minutes and the air expired collected separately. As soon as the appointed time had elapsed a signal was given, and the person under experiment relapsed suddenly into automatic breathing, while at the same time, by means of a three way stopcock, the air expired was diverted into a third receiver, breathing being continued until it had come back to its normal condition in repose, which took place within six or seven minutes. There were thus three samples of air for analysis. The volumes of air inspired in each stage were calculated, as previously explained, from the nitrogen found, which underwent no change; the volume of nitrogen obtained yielding by a simple proportion the volume of air inspired. The difference between the volumes of air inspired and expired (after the application of a correction for carbonic acid emitted from the blood, into which subject it would take too long to enter at present) gave the volume of oxygen absorbed, and it is the excess of this oxygen absorbed in the body in

forced breathing over the oxygen absorbed in normal respiration which concerns the present question.

In eight experiments, the increase per minute above the normal of oxygen absorbed under forced breathing, or rather under volition for forced breathing and response, varied from 0.8 to 36.4 c.cm. with a mean of 13.9 c.cm. (53.0 c.cm.—mean absorbed normal and 67.3 mean absorbed under forced breathing). At the same time the volumes of air expired were greater under forced breathing by 69 per cent. of normal. Therefore, in these experiments considerably more air had been inspired, and there was a marked increase of oxygen absorbed.

If the excess of oxygen absorbed in forced breathing has for its objects the exercise of volition, surely this absorption must take place in the motor centres of the brain concerned in forced breathing, and, therefore, in the medulla oblongata. So far the argument stands thus—forced breathing is accompanied by an excess of oxygen absorbed in the body and leaves in its wake increased muscular power, but this excess of oxygen absorbed is very insufficient to account for the increase of CO₂ produced, hence it does no such thing. Nothing, therefore, is left to explain the excessive development of power but an increased effect of volition, brought about by the absorption of an excessive amount of oxygen in its motor centre, which is in the present case the motor centre of respiration.

This is a new departure, and one which appears to me fraught with interest. If the exercise of the will necessitated the absorption of oxygen in forced breathing, it was natural to conclude that the exercise of volition for forced breathing though without response would be attended by a similar result; and, if so, it should also produce an increase of muscular power as observed after forced breathing.

This reasoning gave rise to the following experiment. When in a state of mental repose I lifted a weight of 10 lbs.

42 times to a height of 18 inches, after which the arm became too tired to continue the work. After a sufficient rest the will was applied to forced breathing, but without response, for two minutes; and on suspending its action I was able to lift the weight 76 times, being an increase of 34 liftings.

A similar experiment with another person gave 70 liftings for normal, and 96 after the exercise of volition towards forced breathing without response; therefore, in both these instances, the increased development of muscular power was clearly the effect of volition only. The proof that the effort of volition in the present case was unattended with response is to be found in the form of the tracing obtained.

When volition attended with response is exerted towards forced breathing, the record on the chart invariably shows a pause or state of apnoea on returning to automatic breathing in repose; but when volition towards forced breathing is unattended with response there is no pause, or the pause is barely appreciable, as seen in the second chart on page 6. The same experiment was repeated with volition applied to various other forms of exercise, and an increase of power was invariably obtained; thus after volition for running without response I raised a weight of $8\frac{1}{2}$ lbs. 77 times against 47 for normal. This increase of power must have been produced through the agency of the respiratory centres, as whatever be the form of volition it must supply the oxygen necessary for the heat required towards the increased muscular exercise.

If, after exerting volition without response, greater development of muscular power is obtained in the same way as when exerting volition towards forced breathing, and if the latter is, as I have shown, attended with an increased absorption of oxygen, it appeared probable that an excess of oxygen would also be absorbed under volition, though without response, exerted towards various forms of muscular exercise, and a number of experiments were made which showed most conclusively that such was the case.

In a first series of seven experiments, the will being applied without response to running or rowing, the excess of oxygen absorbed in four of the seven experiments varied from 7.7 c.cm. to 19.4 c.cm. per minute, with a mean increase of 12.4 c.cm. per minute, while in two of the other three there was a slight decrease in the volition stage by 2.1 c.cm.; one of these, however, showed an increase in the after stage, as if in this case the oxygen in excess had been taken in the first instance from that in store in the muscles and other tissues, and returned from the atmosphere on the resumption of mental repose. On releasing volition and relapsing into normal automatic breathing, the mean oxygen absorbed was less than normal, the deficiency compensating very nearly the excess taken in under volition. Therefore, after the phenomenon was over the absorption of oxygen had apparently undergone no change or combination in the motor centre.

The oxygen absorbed was now determined on three different occasions after applying the will without response towards lifting a heavy weight; the results in these cases were well defined. In one experiment the excess of oxygen absorbed per minute under volition was 15.6 c.cm., in another 13.8 c.cm., and in the third 35.8 c.cm., with a mean of 21.7 c.cm. The oxygen absorbed in the after stage again very nearly compensated the excess under volition. This series, though consisting of only three experiments, therefore confirms the former in every way, and shows that volition towards lifting a weight causes an accumulation of oxygen in the body, clearly in the motor centres of the muscles of the arm. A third set of six experiments was made by applying volition without response towards forced breathing. The increased absorption of oxygen in the volition stage varied from 1.5 c.cm. per minute to 48.0 c.cm. per minute, with a mean of 23.9 c.cm., and this excess was also nearly balanced by a corresponding diminution of oxygen absorbed in the after stage. Probably these experiments, in which the oxygen determined "as absorbed" is taken from the air, do not show the total volumes of oxygen absorbed by the motor centres as it is impossible to ascertain how much is supplied from the tissues.

It thus appears that whenever volition is applied towards any form of exercise, there is an absorption of oxygen in the cerebral centres concerned in the phenomenon; and apparently with an excess of oxygen absorbed more work can be done than if the excess be wanting. The following experi-

ment in which a mixture of oxygen gas and air was breathed is a striking confirmation of this view. The author lifted a 10 lbs. weight 41 times before being exhausted. After a rest he exercised his volition strongly towards lifting a weight for $1\frac{1}{2}$ minute, and then raised it 61 times in succession. Again, after another rest, he exercised the same kind of volition as before while inspiring a mixture of two-thirds of air and one-third oxygen containing nearly 43 per cent. of oxygen, instead of 20.9 per cent. as in atmospheric air: and immediately afterwards lifted the weight 87 times before being arrested by fatigue; therefore under the influence of volition and air twice as rich in oxygen he could lift the weight 26 times oftener than when inspiring atmospheric air, the will being applied in a similar manner. This experiment repeated on another person gave with volition and atmospheric air 77 liftings, and under the influence of volition and a mixture of air and oxygen, similar to the previous one, 94 liftings, or an increase of 17 liftings.

Returning to the respiratory tracings under the influence of volition, we find that whether the will be applied without response to locomotion, to manual labour, or to forced breathing with response, the curve is about the same; that is, first the tracing is steeper than normal; then on releasing volition there is a pause, followed by another rise, showing an increased volume of air breathed beyond the normal. One tracing under volition differs from all the others; it is that for volition towards forced breathing without response, when the pause is altogether wanting or hardly visible.

This pause at first appeared to be due to the accumulation of oxygen in the motor centre under the action of volition, but the absence of any pause in the records of respiration under volition for forced breathing without response, even after breathing air mixed with oxygen gas, showed the present view to be mistaken, since this form of volition is also attended with an accumulation of oxygen in the respiratory centres. The only explanation I can now offer for this pause is the following: All the centres concerned in volition, whether they be the motor centres for locomotion or manual labour, etc., act on the centres of respiration; and when volition is accompanied by response, a very large increase of breathing is produced which is controlled by the requirements of the centres concerned. As soon as volition without response is arrested there is no longer any excess of pulmonary ventilation required, and normal automatic breathing follows; but before the centre of respiration has shaken off the influence of the other centres, a short lapse of time intervenes during which the oxygen stored up in the tissues comes into use. This is the reason which appears to me to account for the pause, a view confirmed by the fact that, as shown in the breathing records, immediately after the pause, there follows a slight but decided increase of air inspired beyond the normal, whose object would be to replace the oxygen taken from the tissues. Now in volition towards forced breathing without response when the will is suddenly released no lapse of time is needed as there is only one centre concerned in the phenomenon, that of respiration; hence there is no pause and the tracing returns immediately to the normal. Even if a mixture of two-thirds of air and one-third of oxygen be inhaled whilst volition is exercised towards forced breathing, there is no pause; but a considerably increased pause is observed after inhaling the mixture of air and oxygen, and at the same time applying the "will" to other forms of exercise, as seen in the first chart on the next page.

It might be objected that the oxygen absorbed from the air in natural respiration is possibly liable to change every few minutes and that the increase obtained under volition is due to some other cause than the exercise of the "will." In order to answer this objection the following experiments were made:

Air was expired while in mental repose, and reclining in an arm chair, in three successive bell jars, each receiver taking seven or eight minutes to fill. The three samples of air expired were analysed separately and the experiment being repeated on three different days gave the following figures for oxygen absorbed per minute:

Cubic Centimetres of Oxygen Absorbed per Minute.					
Experiment I.		Experiment II.		Experiment III.	
a—49.5		a—43.0		a—42.3	
b—53.9		b—42.0		b—41.5	
c—48.6		c—46.6		c—38.5	

BREATHING CHART.

The greatest difference per minute in each experiment was therefore 5.3 c.cm. in the first experiment, 4.6 c.cm. in the second, and 3.8 c.cm. in the third, showing but little change in the oxygen absorbed in three successive experiments and giving much confidence in the method of analysis.

It may therefore be safely concluded that in the experiments on volition it was the effort of the will, and no other circumstance, which increased the volume of oxygen absorbed. Out of 24 experiments there were 3 with an increase of less than 1.5 c.cm. per minute, and 2 with a decrease of 2 c.cm. The increase was marked in the other 19. In two series of experiments it amounted to means of 22 and 23 c.cm. There is no other way of accounting for that increased absorption of oxygen but through the agency of volition. Now, where can that oxygen go to in the body? it cannot remain in the blood, as hæmoglobin on leaving the pulmonary circulation is considered as charged with oxygen as it can be. On the other hand, there must be a demand for oxygen somewhere, because, as I have shown in my first lecture, no oxygen is taken into the body unless it be required. Of what use can be that oxygen taken in for the requirements of volition if not to exercise some sort of direct action on the motor centres concerned in volition; a parallel case would be the absorption of increased volumes of oxygen for the performance of muscular exercise, although the mode of action in volition appears to be of a very different character.

The fact that oxygen is required in the body towards volition is shown by the increased volume of air breathed under volition. If this air was wanted for an excess of carbonic acid, we should find an increase of carbonic acid produced. There is indeed a very slight increase, but it is wanted for the extra work done by the muscles of respiration, and there may be some slight oxidation of hydrocarbon in the brain substance, and in some cases it is impossible to find any production in excess of

carbonic acid, this being probably due to physiological irregularities which it is impossible to control. We find, also, a certain volume of carbonic acid displaced from the blood by the increased volume of the air breathed. It might perhaps be objected that out of twenty-four experiments five results failed to agree with the other nineteen; but these exceptions occurred in the early part of the inquiry, and volition had very possibly not been brought to bear so earnestly as it was in subsequent experiments. It is a fact that the more experienced we became—my assistant and myself—in these volition experiments, the greater the volume of oxygen which was found absorbed.

There is evidence in favour of this view in addition to chemical analysis: this is increased muscular power, and I shall again beg to direct your attention to this phenomenon.

If additional power is given to the muscles by a preliminary effort of volition, naturally there must be an increased amount of carbonic acid produced in proportion to the increase of strength developed. Three experiments were made which showed clearly that such was the case. The mean relation of the strength developed was 1 to 1,300, that of CO_2 to CO , while engaged in the extra work was 1 to 1,396; there was not, therefore, much difference between those relations for such a small number of experiments.

If after exercising the will, instead of returning immediately to the state of physical and mental repose the weight of 10 lbs. be raised in the usual way for one minute, followed by repose, while a record of breathing is taken on the chart, the pause which has been checked by the exercise now appears, and afterwards respiration returns much increased in volume.

Finally, if immediately after the exercise of volition for one or two minutes, stepping exercise is taken for one minute, followed at once by a return to the sitting position, and lifting the weight, say, ten times in succession, on assuming

BREATHING CHART H

the state of rest the pause will again appear, though perhaps less marked, and there will be for a time a considerable increase in the pulmonary ventilation beyond the normal in repose. This is clearly seen in the second chart on page 8 recording the experiment.

If anybody should be still disposed to question my contention that the increased muscular work in these experiments is due to the influence of volition, the experiment of Mosso showing that fatigue of "volition" suffices to arrest muscular contraction would go far to dispel any doubt in that respect. The following experiment, which I have not seen quoted, confirms remarkably Mosso's discovery, while at the same time it is a strong argument in favour of the view advocated in this lecture, and differentiates very clearly the motor centres of the brain.

Let a person, while sitting in an arm chair, raise a weight as in the experiments related above until his arm is too tired to continue the work. He then takes a rest in mind and body of say one minute, and again resumes lifting the weight as long as he can. The number of times the weight is lifted is counted in both cases. Next a rest is taken perhaps for ten minutes, and the same kind of exercise repeated until the arm is exhausted; at the expiration of that time the arm is placed in a state of repose, but the "will" continues being applied as strongly as possible towards the exertion of lifting the weight, and this is continued for one minute. At the end of that minute the weight is again raised with that same arm, when it is found to be so tired that it is not equal to raising the weight by perhaps more than about one-half the number of times the weight was lifted under precisely similar circumstances without the application of the will.

If, however, during the interval of one minute between the liftings, the will be directed towards a different kind of muscular work, such as running uphill, on resuming the lifting, the arm is found to be fresh and rested, and can raise the weight the same number of times as if the mind had been at perfect rest for that minute.

The following are two experiments which illustrate the phenomena:

While reclining in a deck chair, I raised a weight of 10 lbs. 49 times, and gave up from fatigue; after resting for one minute the same weight was lifted to the same height 40 times; a long rest was now taken and the weight lifted 47 times, when the work was stopped by fatigue; then the arm was rested while applying volition as strongly as possible to a continuation of the same effort of lifting for a lapse of one minute. Lifting was now resumed, when the weight felt very heavy and could only be raised 21 times—clearly not because of the fatigue of the muscles as they were rested, but from the exhaustion of the power of volition. A similar experiment on my assistant gave the following results:

Normal liftings, 42; after one minute's mental and physical rest, 41 liftings; after a prolonged rest, 44 liftings: after one minute's physical rest, but with volition exerted towards a continuation of the same exercise, 31 liftings.

The same experiment was repeated by both of us without applying the will towards the continuation of the same exercise, but towards an exercise quite different, such as running, thereby resting the motor centre on which volition had exerted its action towards lifting the weight. After a minute the arm felt perfectly rested and raised the weight the same number of times to the same height as before.

ARTHUR DURHAM MEMORIAL.—The friends, and they are many, of the late Mr. A. E. Durham, have resolved to perpetuate his memory by the endowment of two beds at Guy's Hospital, one in each of his old wards, Lazarus and Martha, to be called the Arthur Durham beds. For this purpose a sum of £2,000 is requisite. Contributions may be paid to Mr. C. H. Wells, at the office of the Medical School, Guy's Hospital; and they will be acknowledged from time to time in the *Guy's Hospital Gazette*. All subscribers of one guinea and upwards will receive a platinotype enlargement of a life-like photograph of Mr. Durham. The circular asking for funds was posted on June 11th, and in ten days the sum of £653 was collected, being almost one-third of the entire amount that is required.

SELECTIONS FROM MY CASEBOOKS.

By ALFRED SHEEN, M.D.,
Senior Surgeon Cardiff Infirmary.

I.

I.—IMPACTED FRACTURE OF THE NECK OF THE FEMUR IN A VERY OLD MAN.

J. H., aged 91, a hawker, was admitted into Cardiff Union Hospital on January 17th, 1893. He had been a heavy drinker all his days, and had suffered from bronchitis for some years.

On admission he stated that he had been knocked down by a cab a few hours before, but was not run over. He could not get up without help, and complained of pain about the left hip, loss of power in the left leg, and great pain on the least movement of the limb. The left foot was everted, the limb lay flat on the bed, and was nearly 2 inches shorter than the right. No definite crepitus was obtained, but great pain was caused by manipulation, and there was thickening about the trochanter.

The limb was steadied by means of extension with pulley and weight, and a large sandbag on each side of thigh. After a few days he was allowed to sit up in bed, and six weeks later was allowed to get up on crutches, and he continued to get about until his death in April, 1894, from acute nephritis. The accompanying reproduction of a photograph of the upper

part of the femur will give a good idea of the displacement and the amount of repair.

II.—LEFT SUBCLAVIAN ANEURYSM CURED BY LARGE DOSES OF IODIDE OF POTASSIUM AND REST IN BED.

R. D., aged 36, single, a lampman, was admitted to Cardiff Infirmary on March 21st, 1893, with a history of an illness beginning suddenly four years earlier whilst under treatment for a wound of the leg. The knees swelled, and he had pains in most of his joints and limbs, attributed to rheumatism. The patient had had these pains off and on ever since. The left arm had for some years been getting weaker. Six months before admission, when rubbing oils in, the patient discovered a swelling under the left clavicle, but did not seek advice till a month before admission. There was an obscure specific history. He was a fairly healthy man of good physique; just below the left clavicle was a smooth pulsatile swelling, the borders of which were not determinable. Pulsation ceased