justifications for the operation—namely, the gain in any event to the patient who recovers of a period of hopeful life.

REFERENCES.

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OXYGEN AND MUSCULAR EXERCISE AS A FORM OF TREATMENT.

By LEONARD HILL, M.B., F.R.S.

Lecturer on Physiology, London Hospital Medical College.

FROM further observations made on athletes, on myself, and on horses, I have come to the conclusion that oxygen inhalation followed by, or accompanying, exercise is a most active and effective form of treatment. I have confirmed the results obtained by Mr. Martin Flack, Mr. Just, and myself on athletes, and these results have also been confirmed in America by observations on swimmers made by Professors E. Smith and Gies and Dr. Darlington, and also by Mr. Martin Flack, who demonstrated the effect of oxygen on Wolfe in his last Channel swim. Wolfe refused the help of oxygen until he was so far done that he talked about coming out and was thoroughly disheartened. On breathing oxygen, the done-up man, who was wasting his breath in talking, quieted down; his breathing became slower and less distressed, he stopped talking, and "plugged" away again in workman-like fashion. The sculls had to be again taken out and used to keep the boat up with the swimmer; before, he and it had been drifting with the tide. So long as Wolfe complained of being done up, a fresh administration of oxygen restored him; but after some time he complained of being "frozen," and at last gave up, after the oxygen had kept him going for an hour and a quarter, and brought him within almost a quarter of a mile of the shore. Within a few minutes of being taken out Wolfe was helping to clean the grease off his body. His respiration and pulse were both good. It was the cold that prevented his finishing his great effort.

By the kindness of two neighbours—dairy farmers—I have been able to prove that horses in their ordinary condition, resulting from the wear and tear of daily life, are able to climb hills faster and with far less distress after breathing oxygen. For example, I quote the case of a horse, which for five years had been a tram-horse, and is now somewhat short of wind, although strong and willing. This horse, urged by the driver, pulled him and me in a milk cart up a steep hill in three and a half minutes; the animal was blown by the effort, its respiration deep and panting, and on turning round walked all the way down the hill. On then giving it oxygen, the panting at once became less and quickly subsided. After breathing oxygen for ten minutes, we set off for the hill once more; the usually staid horse set off at a gallop for the foot of the hill, and reached the top in 2 min. 8 sec. The panting and distress of the animal were far less in this case, and on turning round the horse at once trotted briskly down the hill. In another case a milkcart horse after breathing oxygen for ten minutes set off on its daily round. When it came to a hill which it habitually walks up it trotted up to the top and effectively winded me. I was following on my bicycle, and had omitted to fill myself with oxygen before the start.

In striking contrast with these horses is the case of a racehorse in perfect training, on which I was able to try oxygen by the kindness of Mr. W. R. Clarke, of Debenham Hall. Mr. Clarke had two two-year-old horses which had just finished their racing season, and were going out of training. They were in the perfection of their youth, and in the perfection of condition, having been bred out of the best blood, and trained for a year with that tireless, patient attention and fullness of knowledge which alone produces these masterpieces of art. Running one's fingers down the side of these horses, it was not possible anywhere to pick up a fold of skin. The muscular, circulatory, and respiratory systems were built up to the perfection of their working powers by graduated exercise, massage, and diet, the exact control of which had been in the hands of the trainer since the horses were yearlings.

The form of these horses was known exactly; a week before one had beaten the other in a six-furlong race by four lengths. To the loser I gave oxygen for fifteen minutes, and the two horses then trotted gently down to the starting post, and arriving there started on the six-furlong race seven minutes after the inhalation. The result showed that the form was not altered in the slightest degree. The horses were neither blown or distressed by the race, and, as the trainer said, "a candle held in front of their nostrils would not have been blown out." These animals were so fully supplied with oxygen that the result depended simply on their relative muscular power. Durig has shown on the resting man that excess of oxygen has no influence on metabolism, and this appears to be the case in the working horse or man so long as the supply is adequate. If heart and lung fail to give enough oxygen to the muscles the working power is lessened, and then oxygen-breathing has its effect, not otherwise. Neither heart nor wind failed the perfectly trained racehorse in a sprint of this length.

In agreement with this result I find that two men thoroughly trained in the use of a work machine and inured throughout their lives to heavy work do not increase their output of work in a two-minute period; while I, quite untrained to the effort, am able to do so to a notable extent on breathing oxygen beforehand. The work consists of lifting a 60 lb. weight 20 in. high by means of a pulley and rope worked simultaneously by hand and by a foot-pedal. In the two-minutes period I lost my breath, the workmen did not. Breathing oxygen continuously with the aid of the Fleuss Siebe Gorman dress—designed for rescue work in mines—these two men lifted the weight in two hours 1,461 and 1,315 times respectively. The breathing bag became very hot during these extreme efforts owing to the active absorption of the exhaled carbonic acid by the caustic soda in the bag. This was against the men. Wearing the apparatus but breathing air in place of oxygen, the men lifted the weight 1,267 and 1,219 times respectively, and in this case they were not impeded by a hot breathing bag. Thus in one case the increase in work done under oxygen was one-sixth and in the other case one-twelfth. The man who did one-sixth more is one possessing great nervous energy and resolution to carry out the tests thoroughly. In my own case I have found myself able to ride hills on my bicycle after breathing oxygen which I could not ride without. The breathing after such an effort is deep, owing to the CO₂ produced, but not distressing. The heart is working rapidly but not with any sense of discomfort or feeling of dizziness or anxiety. During the vacation oxygen has unquestionably enabled me to take harder exercise and to get the exhilaration from such exercise, and has got me into training for climbing hills which I never should have attempted without it. I have had a tobacco heart and 1,000 c.cm. knocked off my vital capacity by a pleurisy, and so consider my hill-climbing efforts under oxygen a great improvement on my former condition.

In the case of a Marathon runner who came to me for a trial of oxygen in the first week of his training, I found after I had let him run five miles, that oxygen lessened his time for another three-quarter mile by thirty-eight seconds. There can be no question that its influence is very great on the untrained or fatigued man. It enables a man to increase very considerably the metabolism of his body. It should be, therefore, of value in the treatment of people fat and scant of breath, and those who over-eat and take too little exercise, and in cases of emphysema and of heart disease treated by graduated exercise. Possibly it may find a use in tropical climates to make exercise easier, and in men exhausted by the day's mental work and worry, and who want a spin on their bicycle to make the blood circulate and the appetite good. To make the trial of oxygen easy and simple I have constructed a little apparatus—a combined generator and inhaler. With this oxygen can be made almost as easily as soda water with a gazogen. The apparatus consists of a rubber bag with a mouthpiece and tap at one end and metal pot attached to the other end. Into the pot, which is held higher than the bag, a cube of oxalith (Na₂O₃) is put, and into the bag, squeezed empty of air, 2 or 3 pints of water are introduced. Bag and pot are then closed, and some of the water allowed to run from the bag into

the pot. Oxygen is then set free and caustic soda formed. The subject breathes in and out of the bag and shakes the caustic soda solution in it to absorb the exhaled CO₂. One cube of oxalithe gives enough oxygen for some minutes' breathing. With this little apparatus any one can make a "go" of oxygen and try the effect on his power to take exercise and the result therefrom. Messrs. Siebe, Gorman, and Co., 187, Westminster Bridge Road, have the apparatus in hand.

ADDENDUM.

The Effect of Oxygen on Wolfe in his Channel Swim of September 19th.

By MARTIN FLACK, M.A., M.B.

In furtherance of a research by us into the effects of oxygen upon the organism, I accompanied Mr. Jabez Wolfe in his attempt to swim the Channel on Saturday, September 19th. So far as records go, no one to our knowledge has ever administered oxygen to a person engaged in hard muscular work over a number of hours. The chief point of interest in such an observation is to ascertain whether by graduated amounts of oxygen fatigue can be staved off and the work of the performer rendered more efficient. Unfortunately such an observation was denied us, but the effect of oxygen in relieving fatigue was strikingly demonstrated.

Wolfe is a man of splendid physique, with the requisite combination of good muscle and covering fat necessary for the accomplishment of hard muscular work when exposed to a low temperature. Of medium height, his chest measurement is 51 in., and his weight 13 st. 7lb. Previous to leaving the yacht, the swimmer was well rubbed with a liniment, the essentials of which are whisky and turpentine. The final preparations were made on shore; these consisted in covering and well rubbing in a coat of lanoline, anointing the head with olive oil, and carefully adjusting goggles for the protection of the eyes. Just before the start Wolfe's pulse was 68, forcible, and of good volume; his respirations 14. The swim began at 6.6 a.m. from the Shakespeare Cliff, Dover. The swimmer was in splendid condition and in excellent spirits. He swims the left over-arm stroke, 23 to the minute, and from this stroke he never varies; it is marvellous to behold—powerful in action, perfect in co-ordination. He took his meals hourly. These consisted of a cup or so of Nursing Oxo with Plasmon biscuits, usually alternated with warm weak tea and sponge fingers, although on occasions Oxo would be given twice in succession, according to the swimmer's wishes. It will be noticed that there is not the amount of dextrose present in the diet that one would like to see on such an enterprise. From the very start it was obvious that Wolfe and his friends meant to "have a go without oxygen." The day was too good for scientific experiment, and the conditions for the swim were ideal. The weather was fine but hazy, the sea smooth, and there was little drift up and down channel. The progress made by the swimmer was extraordinary, the first fourteen miles being covered in about eight hours. The course kept was so true that the Calais packets passed quite close. On several occasions oxygen was offered, but Wolfe was so confident and going so well that its help was declined. Just before 5 o'clock it was obvious that the swimmer was far from comfortable, and then oxygen would undoubtedly have been of the utmost value. But popular opinion carried the day. Wolfe managed to get over this "bad time," but it had told its tale. Thenceforth the progress made was not nearly so marked. The same mechanical precision of stroke was there, but its potency had gone. Soon after six the swimmer began to get anxious and asked to be accompanied by the pilot (Captain Birchfield) in the small boat. Up till then he had been accompanied in the water at frequent intervals by his friend Kellingley. From now on fatigue symptoms began to manifest themselves with increasing force, but the swimmer plodded manfully on. At 7.45, when he would undoubtedly have given up, any aid that oxygen could give was accepted. The apparatus was lowered into the small boat and taken out to the swimmer. He was now showing manifest nervous symptoms; his breathing was very laboured; his muscles were doing but little efficient work; altogether he was very "done." The oxygen was administered through a long rubber tube

leading to a mouthpiece with inlet and outlet valves. Close to the cylinder a large rubber bag was interposed so that the amount of gas coming from the cylinder could be gauged. The pilot held the mouthpiece to the swimmer, while M. F. manipulated the cylinder and watched the effect of the gas. This was, to say the least, somewhat striking. The effect of a dyspnoeic 51-in. chested man at the end of a tube of oxygen is perhaps not easily appreciated at first. The bag was emptied with such amazing rapidity and completeness that a leak seemed probable, and a big one, too. A leak indeed there was, but careful inspection showed that it was only into the alveoli of an oxygen-starved man. Gradually the breathing quietened, the pressure of gas had to be reduced to less than half, and after about four minutes the swimmer quietly turned away from the tube and started swimming again in resolute fashion. For the time being nervous symptoms had gone, dyspnoea was relieved, and the swimmer was again doing good, efficient work. The general improvement was manifest to all, but especially so to the occupants of the small boat. Oxygen was now administered about every quarter of an hour. During this time the progress was good, the tide being favourable. Unfortunately, when about a quarter of a mile from the shore Wolfe complained of the cold, and shortly after he turned on his chest with extended limbs. The muscles were overburdened with fatigue products, and, together with the effect of cold, brought about the final collapse. The "cramp" was not tonic, and did not persist. When we got aboard the effect of the oxygen was still wonderfully manifest. The pulse showed that the circulation was good, there was no dyspnoea, the muscles only had gone, and the swimmer was in no danger. After a few minutes' rubbing with paraffin Wolfe was on his legs, rubbing himself down with a towel. Shortly afterwards he was peacefully sleeping in his bunk after a parting dose of O₂. Two hours later he changed his bunk and had a few minutes' conversation with the writer. Even then there was nothing to suggest the prolonged exertion Wolfe had endured. At 7 next morning he was up as usual; all that he then complained of was a slight stiffness of the deltoid and pectoralis major. Altogether it was an exhibition of magnificent swimming, fine perseverance and pluck. Had the later hours of the swim not been in the dark, Wolfe would undoubtedly have accomplished his task. With the oncoming darkness the fading from view of the French shore must have had a powerful mental effect. Could the swimmer still have seen the shore, which he had watched and to which he had striven so hard a few hours before, he would, under the favourable conditions that prevailed, have reached his goal. It was hard luck that he did not. From a scientific point of view, although barren as regards the effect of oxygen in staving off fatigue, the result was fruitful in demonstrating its great value in relieving fatigue, even of the most far-advanced type.

MR. J. SCOTT RIDDELL, M.V.O., Senior Surgeon to the Royal Infirmary, Aberdeen, was elected a member of the Société Internationale de Chirurgie at its recent meeting in Brussels.

As usual, when cholera or other great epidemic disorder appears on the near horizon, the Local Government Board has issued a circular to certain port and riparian sanitary authorities informing them of the seaboard localities in Russia which are regarded as infected by cholera, and requesting special attention to the terms of the general order issued in September, 1907, relating to cholera, yellow fever, and plague on ships arriving from foreign parts. The number of cases which occurred during the early part of the outbreak in St. Petersburg is also given. In the first fortnight, ending September 20th, 1,653 cases and 492 deaths occurred, so that the rate of mortality was very low. Subsequent to the date mentioned there was a slight increase both in the number of cases and the rate of mortality, but these increases have not been maintained, and the outbreak appears to be abating. On September 29th it was estimated that the number of cases during the previous week were equal to a daily average of 1 case for every 6,000 of the population, and 1 death for every 15,000. On the other hand, there is evidence that the disease is spreading, as was to be expected, among the smaller towns of the empire, and cases have been notified in many of the ports on the northern and southern coasts.