AN ADDRESS ON THE EMPLOYMENT OF COMPRESSED AND RAREFIED AIR IN THE TREATMENT OF CASES OF CHRONIC BRON- CHITIS, EMPHYSEMA, AND SPASMODIC ASTHMA.

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By ARTHUR GAMGEE, M.D., F.R.S.,

Fullerian Professor of Physiology in the Royal Institution of Great Britain; late Physician to the Manchester Hospital for Consumption and Diseases of the Throat.

It is not my intention in the present communication to bring before the Section a systematic account of the various methods of employing compressed and rarefied air in the treatment of pulmonary disease, but rather very briefly to state the general results which I have hitherto obtained by the employment of a method which, though constantly in use on the continent of Europe, has not received at the hands of English physicians the attention which it deserves.

The careful studies which have been made of late years concerning the physiological action of variations of atmospheric pressure on the pulmonary and cardiac functions—in particular, the fine researches of Paul Bert incorporated in his classical work *La Pression Barométrique*—have shown the remarkable influence which these variations exert, and have supplied the groundwork for the rational treatment of certain cases of chest-disease.

Until the publication, last year, by Dr. C. Theodore Williams¹ of his interesting lectures on the compressed-air bath and its uses in the treatment of disease, in which he gave a brief systematic account of this method of treatment, as well as the results of his own experiments in its use, no English physician had given evidence of having paid any attention to a therapeutic method, which, *prima facie*, appears most promising, whilst it has been advocated by many continental physicians of great and deserved eminence.

Three principal methods of employing compressed and rarefied air in the treatment of disease present themselves; to wit,

First, by means of air baths or chambers capable of holding one or several individuals, and the air of which may be rarefied or condensed by powerful pumps, the degree of rarefaction or condensation being measured by means of mercurial gauges. Such chambers, of which examples are to be found at Ben Rhydding, Ikley, and at the Brompton Hospital, are of costly construction and working. In some cases, as in some of the air-baths existing on the Continent, arrangements exist which allow the employment of either compressed or rarefied air. Usually, however, as is the case with the chamber at Brompton, only a set of condensing pumps exists, so that the method of treatment by compressed air alone can be carried out. As a rule, therefore, patients subjected to treatment in the air-baths are placed there for a considerable time, usually for about two hours; the air is gradually compressed to the desired extent, and then, after a certain pause, the pressure is very gradually reduced to the normal, abrupt diminutions of pressure being liable, as the experience of divers and the experiments of Paul Bert have shown, to induce most serious consequences. In the air-bath, as it is usually employed, both the exterior of the body and the interior of the lungs are subjected to an increased or a diminished pressure, as the case may be, the conditions being similar to those which exist, in the first case, when a person ascends a high mountain or goes up in a balloon; in the second, when one is carried down to low depths in a diving-bell.

Secondly, by means of an air-bath provided with arrangements by means of which the air upon the exterior of the body may be either compressed or rarefied, whilst the patient breathes air at normal pressure either saturated or not with medicinal vapours. It was Hauke who first applied this method, and applied it particularly to bring about

increased thoracic movements in atelectasis and many other pulmonary conditions of childhood.² A very practical apparatus of this description appears to be the pneumatic cabinet devised by Mr. Kitchener, and at present employed in America, the effects of which have recently been subjected to a scientific examination by Professor Martin and Dr. Donaldson.³

Thirdly,⁴ by means of more or less portable apparatus, usually in the form of single or double gasometers, provided with masks or face pieces which fit closely to the mouth, or to the mouth and nose, and which permit of the patient respiring either compressed or rarefied air or air at the pressure of the atmosphere, and expiring either into a gasometer containing air under a pressure higher or lower than that of the atmosphere or into the atmosphere. The number of these apparatuses, as the reader will convince himself who peruses the sections in Oertel's work on Respiratory Therapeutics, which treats of them, is exceedingly great.

"The number of apparatuses," says Dr. Theodore Williams, "devised for condensing and rarefying the air is very large; for, in addition to air-baths to be described presently, there are many methods in which the air is inspired through a mask closely fitting to the nose and mouth. Of these, Hauke's was, perhaps, the earliest, of which Waldenburg's, alluded to before, is a modification. This consists of a hollow metal cylinder or bell, containing a certain volume of air, which is plunged into a second and reversed cylinder, containing water. By means of pulleys and weights, an equilibrium is established, and a pipe is passed from the air-cylinder, through a drying box, to a mask fitting the patient's mouth, enabling him to respire the air, which can be either rarefied or condensed by raising or lowering the cylinder in the water. This is done, in the first instance, by drawing off water, in the second, by placing weights on the cylinder. Schnitzler's is a further and simpler modification of the same system. Some, as Cube's, and Schnitzler's second form, are double apparatuses, and consist of two cylinders, one for condensing and the other for rarefying the air; both are connected by pipes with the inhaling mask, and taps regulate the supply of one or the other to the patient's lungs. A third form is Biedert's, who arranged a species of leather bellows to compress or rarefy the air as required; but the most ingenious example of this form is Fraenkel's, which consists of a kind of portable concertina, simple and cheap, and capable of being worked by the patient himself, the objections being the contracted attitude necessary for this purpose, and the impossibility of regulating the pressure. This little instrument is recommended by Oertel for the treatment of asphyxia by artificial respiration. "A fourth form is the apparatus of Geigel and Mayer, constructed on the principle of the centrifugal pump, by which air is stored up in a central reservoir, being compressed by the action of water. "Ingenious as the above methods are," adds Dr. Williams, "all have this objection, that their efficacy depends on the completeness with which the patient applies the breathing mask, and also on the amount of pure air available. As a rule, the use of the mask is exceedingly irksome, and many complain of its inducing faintness and headache. It is also impossible to keep up a proper supply of fresh air at the requisite pressure, and consequently there is the danger of rebreathed air. For these reasons, the surrounding a patient with an atmosphere of condensed or rarefied air, which he can respire without let or hindrance from artificial mouth-pieces, is preferable, and air-baths are consequently more easy of application. Nevertheless, the above forms are of great use when compressed air-baths are not available, and when it is advisable, after a course of such baths, to carry on the treatment by condensed air for long periods in the patient's home."

I think it almost impossible that any one should peruse the vast literature relating to the uses of compressed and rarefied air, to which many of the most distinguished physicians of Germany have contributed, without desiring to have the means at his disposal, which, we are told, have restored to comparative health and comfort, and in a brief period, some cases of extensive pulmonary emphysema, for instance, in which the patient's life had become a burden, and for which all other therapeutical means were of no avail. An air-bath such as I have referred to is, however, an apparatus so costly in construction and maintenance that no physician could contemplate its erection for the use of his patients alone; only one of the portable apparatuses is available to him. After carefully considering the various forms of these apparatuses, I procured about a year ago one of Professor Schnitzler's continuously acting machines, as made by the mechanician

² In Oertel's *Respiratory Therapeutics*. Vol. 3 of Von Ziemssen's *Handbook of General Therapeutics*, p. 589 et seq.

³ *The Pneumatic Cabinet and Pneumatic Differentiation*. By F. Donaldson, Jun., M.D. *The Maryland Medical Journal*, Feb. 23rd, 1886.

⁴ Preliminary account of Experiments in regard to the Circulatory and Respiratory Changes observed in Animals placed in the Pneumatic Cabinet. By H. N. Martin, F.R.S., Professor in the Johns Hopkins University and Frank Donaldson, Jun., M.D.

¹ Lectures on the Compressed-Air Bath and its Uses in the Treatment of Disease (*BRITISH MEDICAL JOURNAL*, April and May, 1885, and Smith, Elder, and Co. 1885).

Hauke, of Vienna, and with this I have treated a few cases of pulmonary disease. As our information concerning the beneficial results to be obtained by the use of such an apparatus is entirely obtained at second hand from our continental brethren, I thought it might be of interest to some English physicians to have the results of my first experiences of it.

The apparatus, of which I shew you a diagram on a reduced scale, consists of a large oval trough, which is partially filled with water, within which are two gasometers. The two gasometers, which slide up and down on guiding rods, are so connected together by cords running on pulleys that they always balance one another, and one rises and the other falls, and *vice versa*. Through the centre of the two gasometers pass two tubes, which reach to their summit; these tubes may be made to communicate with the exterior by two stop-cocks placed near the base of the outer trough, which stop-cocks in the ordinary working of the apparatus are kept closed. They end, however, in a brass-plate soldered in the middle of the anterior surface of the apparatus, and which forms part of a very ingenious discoid valve. This consists of two circular brass plates, the inner one previously referred to soldered to the apparatus, and the outer one turning round a pivot. This rotating plate bears two tubes, one which we may call the respiratory tube being longer than the other. By rotating the outer circular plate we may either shut off all communication between the gasometers and the exterior, or we may at will bring the respiratory tube in connection with either of the two gasometers or bell jars. When this has been done, the other gasometer communicates by means of the shorter tube with the atmosphere. In the centre of the apparatus here is a winch, by the aid of which two iron rods, supporting an iron platform for the reception of weights, can not only be moved up and down, but the effect of the weights may be transmitted by means of a movable and jointed metallic arm to either gasometer, so that we may at will press on the one or on the other. When the disc is unweighted, and made to press on one of the gasometers, it exerts a pressure equal approximately to a load of five kilogrammes. Two additional weights of five kilogrammes are provided, and can at will be placed on the platform. A mercurial gauge, which is in connection with the respiratory tube, indicates the pressure, positive or negative, which exists in the gasometer with which the respiratory tube is connected. Lastly, the apparatus is provided with a mask, which fits over the mouth and nose, and with a most ingenious valvular stop-cock, which is easily worked by the patient, and which enables him either to establish a communication with the gasometer, or with the external air, so that he may, for instance, inspire atmospheric air at ordinary pressure, and expire into a gasometer containing a partial vacuum, or inspire compressed air, and expire into the atmosphere; these are, in fact, the two uses to which the apparatus is usually put.

When we wish our patient to inspire compressed air, the discoid tap is turned, so that the respiratory tube communicates with one of the gasometers which is full of air, and which has been raised to its highest position. We then bring the arm of the iron platform, more or less weighted, according to the pressure which we desire, into the position in which the effects of the weight shall be transmitted to this cylinder; the mercurial gauge indicates the pressure of the air, which is usually made to vary between 0.76 and 15.2 millimetres (corresponding to a water-pressure of from 10.3 to 206 millimetres). The patient, then placing the mask over his face, by simply pressing with his finger on the valve, inspires the compressed air contained in the bell, which enters the air-passages with a pressure corresponding to the weight of the bell. On removing the finger from the valve, this flies up of itself, and allows the lungs to communicate with the atmosphere.

With each inspiration the bell sinks, in proportion, of course, to the amount of air inspired. But in the same manner the lower bell rises, as air is continually passing into it from the tubes connected with it. When one bell reaches the bottom, its companion has then reached the top, and is full of air. We have only then to close the valve by rotating the circular plate, and to wind up the weights, so that they may now press upon the full gasometer, an operation which is most rapidly effected, and the patient commences to inspire the air of this gasometer. In order to inspire rarefied air, the respiratory tube is brought into communication with the lower of the two bells; the upper one being weighted, the pressure in the lower bell will be a negative pressure, depending upon the amount of weight pressing upon its weighted companion bell.

Theoretically, and I believe practically too, such an apparatus as Schnitzler's presents some advantages over an air-bath; and in this respect, that we may vary the modes of respiration in a manner impossible in the air-bath. We may, for instance, in one case—as, for example, in a case of chronic bronchial catarrh with profuse expect-

tation—cause the patient to inspire compressed air, and to expire into the atmosphere; whilst in another—say a case of emphysema—we may cause the patient to inspire air at ordinary pressure, and to expire it into a partial vacuum.

In practice I have not realised some of the drawbacks which Dr. Théodore Williams has referred to as connected with the portable apparatus, as, for instance, that the mask is irksome, and induces faintness and headache. In my experience, the chief inconvenience has depended upon the fact that the mechanical details of the apparatus, as made by Hauke, are not so carefully carried out as one could wish, especially in that the friction of the bearings is too great, so that the pressure, as observed with the mercurial gauge, does not correspond exactly with the theoretical pressure due to the load; and that the adjustment of pressure, on increasing or diminishing the weight on the cylinder, does not occur instantly. I intend, however, to have certain parts of the apparatus reconstructed in England, and these drawbacks will then cease. The one chief objection, however, to the method depends upon the time taken up by the process. If the physician has not a trained assistant to superintend the process, he will find that the time which it occupies constitutes a practical objection to its constant use. I intend in the future to publish a full account of all the cases in which I have the opportunity of employing the method of treatment now under consideration, especially as it is of great importance to establish in what respects the results with a portable apparatus, permitting of the employment both of compressed and rarefied air, differ from those obtained with the compressed air-bath. I may, however, refer briefly to two of the cases, in which I have recently obtained results which could not have been obtained by other methods.

The first case was one of a young lady, aged 26, who, since childhood, had suffered from attacks of spasmodic asthma of great severity. She had the physical signs of marked emphysema, as evidenced by the form and slight movement of the chest, the very diminished cardiac dulness, and the position of the liver. She complained of great breathlessness on going upstairs or ascending hills, and could only sleep when propped up with pillows. In this case, I usually caused the patient to inspire air at ordinary pressure, and to expire into rarefied air, though at each sitting I also employed, for a short time, inspiration of compressed air. Her symptoms underwent a marked change within the first week of treatment, and, at the end of a month, the change which had occurred was surprising. The patient was able to run upstairs, to take long walks, and to lie flat in bed. Her asthmatic attacks also diminished considerably in frequency and severity. She left St. Leonard's, and I have since heard that there has been a partial return to the old state of things, though her condition is now very much better than when the treatment was commenced.

The second case to which I shall refer is one of a middle-aged woman, who has, for the last fifteen years, suffered from chronic bronchitis, and has had occasional attacks of acute bronchitis. She has also been subject to asthmatic attacks. She had not, for a long time before she came under my care, been free from bronchial catarrh. In her case, also, there was marked evidence of emphysema.

I employed, in this case, treatment both by compressed and rarefied air, continuing it, however, for a longer period than in the first case. The results have been quite as remarkable. The chronic bronchial catarrh has well nigh disappeared, the asthmatic attacks have become exceedingly unfrequent, and the patient is able to undergo an amount of exertion previously impossible to her.

In both these cases, the improvement in the free movements of the chest, as determined by the erythrometer and the spirometer, has been remarkable, and fully bears out the experience of previous observers.

I trust that the few remarks which are contained in this paper will tend to direct the attention of medical practitioners to a valuable therapeutic measure, which is not, in my opinion, so well known as it deserves to be.

Dr. Bowles had no doubt of the efficacy of compressed-air in suitable cases, but it was essential that it should be viewed rather as a means of mechanical relief in a mechanical difficulty, than as a cure for asthma. Dr. Bowles did not admit that there was such a disease as asthma; he looked upon it as a symptom only, similar to coughing, sneezing, hiccough, and many other reflex phenomena, and considered this method of compressed-air treatment valuable as a means of affording time and opportunity for investigating and treating the disease which gave rise to the reflex phenomenon of so-called asthma. He had heard from an experienced physician at Meran that there the cases recurred, after this mechanical treatment, as in Dr. Gamgee's

cases, and probably this was to be accounted for by the fact that the mechanical treatment was alone treated, and the true course of the disease left undealt with.

OBSERVATIONS

ON

DR. BERGEON'S TREATMENT OF CHRONIC DISEASE OF THE LUNGS AND AIR PASSAGES BY MEDICATED GASEOUS ENEMATA.

By J. HENRY BENNET, M.D., Paris,
Late Physician-Acoucheur to the Royal Free Hospital.

DURING a residence last summer at Evian les Bains, on the south or cool shore of the lake of Geneva, Dr. Bergeon, of Lyons, came to see me, in order to bring under my notice his new treatment of phthisis and other pulmonary diseases. Dr. Bergeon is a well-known and experienced Lyons physician, and *agrégé*, or assistant-professor, at the school of medicine of that city.

When Dr. Bergeon first told me that he had discovered a new mode of treatment by which pulmonary phthisis, and other pulmonary diseases—asthma, chronic bronchitis, etc.—could often be cured, and nearly always alleviated, and retarded in their evolution, I smiled internally. I have so often heard of and tried new remedies, only to fall back on the old, that I was incredulous. His explanation of his treatment, however, at once dispelled this frame of mind, leaving me with the impression that he had hit upon something absolutely new, and of serious import. Indeed, I felt bound to admit that he had opened out a new field in pulmonary therapeutics, and that his views deserve, and must imperatively obtain, serious consideration and trial. The following is a condensed statement of his theories and practice.

Dr. Bergeon commenced his inquiries and experiments some years ago. Imbued with the parasitical, microbic, bacillary views of the day, he wished to discover a mode of destroying these morbid germs. Like many other experimentalists, he tried to do so by medicinal means, by inhalations, by hypodermic injections, but all in vain. He then remembered the experiments made by Claude Bernard thirty years ago on the absorption of gases by the large intestine. That eminent physiologist discovered that carbonic acid gas, when injected, was absorbed by the intestines in large quantities, without any toxic effect whatever. The same result was obtained with sulphuretted hydrogen, although it is poisonous if inhaled. Dr. Bergeon repeated these experiments on animals, principally on rabbits, with the same result. He then tried the injection of large quantities of the carbonic acid gas in human beings—to the extent of two, three, or four litres (quarts) two or three times in the twenty-four hours, with absolute immunity from any toxic effect. The gas is expelled by the mouth in the course of a few minutes after injection, without oppression, dyspnoea, or intestinal disturbance. The carbonic acid gas appears to be innocuous, but without any decided medicinal effect. It is the sulphuretted hydrogen, a powerful microbicide, which appears to exercise the therapeutic influence.

Dr. Bergeon, having got so far, having obtained an innocuous medium in the carbonic acid, began a series of experiments with various medicinal agents, which it would be too long to enumerate, stopping at last at sulphuretted hydrogen, as evolved from natural mineral waters. He found the most efficacious to be that of the Eaux Bonnes in the Pyrenees. By passing the carbonic acid through a bottle charged with this water, it becomes impregnated with the sulphuretted hydrogen gas which it contains, and this is well borne by the intestines. It is absorbed by the intestinal venous system, and rapidly exhaled by the mouth through the lungs. In two or three minutes, on applying the nose to the patient's mouth, the air emitted is found to be tainted by the sulphurous gas. Twenty minutes is the time prescribed for the slow, gradual injection of four litres. The abdomen becomes distended; but without pain, unless atmospheric air is, from imperfect manipulation, injected with the medicated gas. If this is the case, there are intestinal colics, or tormina, atmospheric air being apparently an irritant. It is singular

to feel with the hand placed on the abdomen the gradual distension of the latter, even in a very emaciated subject, often without pain or even discomfort. Within half an hour after ceasing the injection, all the gas is absorbed and expelled through the lungs and mouth, the abdomen regaining its usual shape and softness. This I have repeatedly witnessed.

Dr. Bergeon claims marvellous therapeutic effects for this medication. He says that he has been applying it for the last two years to all the cases of chronic pulmonary and throat disease that have come under his observation; indeed, in more than two hundred cases, although the experiments were made at Lyons, where the climate is bad, the results have been successful to a degree that has surprised and astonished him. He says that, in early phthisis, even in acute general phthisis, a form of the disease nearly always rapidly fatal, in two or three weeks there is generally an arrest, and in a few months a cure. Even in advanced, incurable phthisis great amelioration is obtained. The pulse is lowered, the temperature falls, the night sweats cease, the appetite returns, the expectoration rapidly diminishes, losing its purulent character, and the cough becomes less harassing and frequent. The amelioration, he says, is also rapidly obtained in advanced laryngeal phthisis, when all local or constitutional treatment has failed to give ease, or to arrest the ulcerative process. Asthmatic attacks are relieved with more certainty than by any other means, including the hypodermic injection of morphine.

These are very marvellous statements; but, coming from a scientific man of mature age, occupying a prominent orthodox position in a great medical centre (Lyons), and brought forward as the result of several years of trial and observation, they must command attention and counter-trial. Certainly, to pass from eight to ten or twelve litres of medicated gases through the intimate structure of the lungs several times in the twenty-four hours is a tangible reality, and a new departure in thoracic therapeutics. The entire structure of the lung is certainly reached; both the healthy and the morbid tissues are thoroughly searched out and permeated.

I am one of the least disposed to admit the local origin and nature of phthisis. I have always thought and taught that it was a constitutional disease, depending on hereditary and general conditions manifesting themselves locally, and have never believed in panaceas. I have only succeeded, according to my own lights and convictions, in arresting and curing the disease (which I have very often accomplished during the last twenty-six years) by hygienic treatment, coupled with such medicinal agencies as the complications of the disease treated required. Thus, *a priori*, I am not prepared enthusiastically to accept and endorse any new local mode of treatment; but facts are stubborn things, and Dr. Bergeon adduces facts, or apparent facts, in support of his views. At present he courts publicity and the most searching inquiry. After waiting two years, he says, until his experience became confirmed by successive series of cases, he has brought his views before the scientific world without the slightest reserve or reticence. He has communicated them to the Paris Academy of Sciences (*Comptes Rendus*, July 12th, 1886, p. 176), to the French Congress for the Advancement of Science, 17th August, 1886, to the Paris Academy of Medicine, through M. Cornil (*Bulletin de l'Académie de Médecine*, 2^{me} série, s. xvi). Moreover, his pupil, Dr. Morel, has recently published an exhaustive pamphlet, entitled "Nouveau Traitement des affections des Voies respiratoires d'après la Méthode du Dr. Bergeon." (G. Masson, Paris, 120, Boulevard Saint Germain.) In the *Bulletin de Thérapeutique* of November 30th, Dr. Dujardin-Beaumetz has also published an interesting article.

In September I was in Geneva, and saw several physicians there who were trying this treatment, as they stated, with apparent benefit. On my arrival at Mentone in October, I found a young Russian patient of former days, aged 21, dying of advanced phthisis, under the charge of her travelling physician, Dr. Cacace, of Naples. We tried the injections merely to see if we could give her ease. This was certainly done, and at first the treatment was attended with such an unhopedorally, that the family wished to see Dr. Bergeon himself, so I summoned him from Paris, where he then was. The rally, however, was only temporary, and she has since died. I had previously attended her here successfully at the age of 9, for scrofulous swellings in the neck; and at 16 for amenorrhoea and chlorosis, and this was her end. She thus went through the various phases of hereditary phthisis. The last therapeutic effort could only be expected to ease her sufferings in some measure.

Dr. Bergeon, who has remained a while with us to rest, has given a lecture to the twenty-two doctors who practise here, has seen several other patients in consultation, and has answered all our questions. He says that non-success is generally the inevitable result of inefficient application of the treatment or of the bad quality of the sulphur