LECTURES ON THE COMPRESSED AIR BATH AND ITS USES IN THE TREATMENT OF DISEASE.

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LECTURE II.

LET us now consider the effect on a man in ordinary health of a compressed air-bath; the pressure not exceeding ten pounds, and the bath occupying two hours, of which one half-hour is spent in raising the pressure, one hour in maintaining it at the same height, and the reduction of pressure occupying the last half-hour.

The first sensations experienced are noises in the ears, slight headache, and an unpleasant sensation in the throat, referred especially to the pharynx and immediately behind the tonsils, which is relieved by swallowing saliva, and still more effectually by drinking some fluid. Pain is sometimes experienced in the membrana tympani, which can be prevented by inserting cotton-wool into the ears. The reason of these unpleasant auditory sensations is to be found in the different calibres of the external auditory meatus and the Eustachian tube. As the channel of the latter is very much smaller than that of the former, the column of air penetrates with difficulty to the internal surface of the membrana tympani, and any change of pressure is but slowly communicated; whereas through the meatus the air passes freely, and on the larger surface gives rise to a convexity inwards of the auditory membrane. This is the case during increase of pressure, but during reduction the contrary effect is produced. The middle ear is then filled with air of greater density, the change being slow; whereas the external auditory meatus contains air of which the pressure is being reduced more rapidly. The membrane consequently becomes convex outward; hence the unpleasant sensations in the ear and throat during the commencement and end of the bath. Some people notice an impairment of the special senses, and state that touch, taste, smell, and hearing are all diminished in intensity; the voice sounds shrill; whistling becomes impossible. An instance is given by von Vivenot, where a professional singer gained half a note in her voice during a bath. It is noticed that the arched form of the abdominal walls is flattened, which Panum ascribed to compression of the intestinal gas.

The most important changes are in the organs of respiration and of circulation; the individual finds he breathes *slower, deeper, and with greater ease*. Physical examination demonstrates that the diaphragm descends lower, that the liver is displaced downwards, that the heart-sounds are less audible, the cardiac dulness is less perceptible, and the whole chest becomes more resonant. This diminution of the cardiac dulness does not appear to be mainly due to the displacement of the heart, but rather to the further expansion of the lungs; and the faintness of the sound, arises from the intervention of a larger amount of those badly conducting air-cushions. Measurements show a considerable increase to take place in the mobility of the thorax at various levels during inspiration. Von Vivenot found an expansion after one bath of 5.75 millimetres, and after seventeen baths of 9.47 millimetres. The respirations are diminished in number to a considerable extent; this seems to occur even in one bath, but after several it is still more marked, for they have been known to fall from 16 or 20 a minute to 4 or 5, or only to 3 or 4 a minute. The relation of inspiration to expiration is often, but not always, changed. Inspiration is easy, and expiration appears comparatively less so; and whereas the ratio at the usual pressure is normally 4 to 3, it becomes in compressed

Fig. 1.

air 4 to 6, 4 to 7, 4 to 8, or even 4 to 11, according to von Vivenot, from

whose work the annexed diagram is taken, which well illustrates the prolonged expiration, and the depth of the respiration in compressed air, which are indicated by the dotted line, as compared with the lower line, which is that of normal breathing.

The circumference of the chest increases considerably, though slowly, as will be seen by our experiment, to be narrated presently.

Spirometric observations show a marked augmentation of lung-capacity. Simonoff found in 11 persons a mean increase of 108 cubic centimetres after twenty minutes of the bath; after one hour and twenty minutes, 94 cubic centimetres; and at the end of the bath the increase was still 24 cubic centimetres. Von Vivenot's numbers are still larger for this increase. Our own showed in one case an increase of from 250 to 286, and in the other from 255 to 302.

There seems to be every reason to conclude that the inspiration of compressed air increases the lung-capacity, and it is probable that the effect is at first a mechanical one, more alveoli being brought into play than in normal breathing. The diminution in the number of respirations is the result of this, as we may conclude that their frequency is in inverse ratio of their amplitude; consequently we get, with an enlarged respiratory surface, fewer and deeper respirations, and this effect is more or less permanent.

The influence on the circulation is, that the pulse is slower, smaller in volume, but of increased arterial tension, the capillaries are smaller, and the veins are less full of blood. The amount of diminution varies from 4 to 20 beats a minute; and, if the pulse have been somewhat excited before entering the bath, the diminution may be still greater. Sphygmographic tracings show a great lowering in the height of the pulse-wave, due apparently to contraction of the vessels, and also reduction of the diastolic wave. But this change is only maintained during the bath, for tracings, taken immediately after leaving it, are precisely similar to those before entering. The subjoined tracings were taken from Mr. B., one of my clinical assistants, a very healthy young man, and indicate the influence of the different pressures on the pulse.

Fig. 2.—Before bath. Ordinary pressure.

Fig. 3.—Pressure, 3 lbs.

Fig. 4.—Pressure, 6 lbs.

Fig. 5.—Pressure, 9 lbs.

Fig. 6.—After bath. Ordinary pressure.

The recovery, as shown in Fig. 6, is very complete. To the touch the pulse appears small and hard. The influence of compressed air on the circulation was admirably shown by von Vivenot's observations on a white rabbit in the bath. Under normal pressure, with the rabbit quiet and at liberty, the ears were full of blood, and the vessels of the conjunctivæ injected; the iris and the pupil were tinted deep red. During the increase of pressure, the vessels of the conjunctivæ became finer and more pale, and in one experiment they alternately filled and emptied. The iris and pupil became decolorised when pressure was kept up at the maximum; the ears, when seen by transmitted light, showed empty vessels, the larger ones were scarcely visible; a little later, the ears became quite pale and flabby, and the vessels completely disappeared. During reduction of pressure, the ears and conjunctivæ remained pale, and at the normal pressure, for one hour after the bath, the ears still remained bloodless and flabby.

These experiments and observations indicate that compressed air exercises an intropulsive influence affecting naturally those surfaces most exposed to it, such as the skin and the lungs; the blood is thus driven into the organs protected from air-pressure, such as the brain, the heart, liver, spleen, and kidneys. The pressure is exerted more on the capillaries and superficial veins than on the deeper veins and arteries, and its tendency would be to reduce pressure on the right side of the heart, and to increase it on the left. The retardation of the pulse is assigned by some to diminished heart's action, owing to the great obstacles the circulation meets with in the superficial vessels. A proof of the fulness of the arterial system is found in the colour of

the blood, which is bright red, as has been seen during bleedings which have sometimes taken place in the bath.

Another proof is found in the sphygmographic tracings of the radial pulse, which indicate increased arterial tension. The diminution of the pulse-rate is explained by Dr. Burdon Sanderson (*Practitioner*, October, 1868) as follows. "The effect of the diminished fulness of the venous system is to retard the filling of the ventricles during their period of relaxation, and, consequently, to lengthen the diastolic period, and thus diminish the frequency of the pulse; for, as the time occupied by the heart in contracting is subject to little variation in the same individual, the interval between successive contractions depends on the duration of the diastolic pause."

Though this emptying of the veins is no doubt the principal cause of the slowing of the pulse, something must be assigned to the great obstruction which the increased air-pressure causes to the circulation, for instance, through the capillaries of the skin. The temperature is slightly raised, sometimes half a degree, in the mouth; that in the axilla is said to be diminished by Stembo; but in the rectum, according to the same authority, it rises considerably, a clear confirmation of the intropulsive influence before alluded to. The kidney-secretion is largely increased, another piece of confirmatory evidence. The saliva is also more freely secreted. To the same influence may be assigned the excitation of the menstrual function, which is often brought on during compressed air-baths; and defæcation is said by Oertel to be occasionally due to the pressure on the abdomen.

The compressed air-bath also produces physiological effects on the system. The introduction of a large amount of oxygen in each respiratory act causes increased absorption of that gas by the lungs and blood, and leads to further oxidation and tissue-change. This is proved, first, by the colour of the blood before alluded to, and, secondly, by the increased quantity of carbonic acid excreted by the lungs, in spite of the number of respirations being fewer than at normal pressure. The urine, too, contains more urea, and, in some cases, Hadra found the increase to amount to two grammes daily. The muscular power is increased, for Lange found two men could carry more in their hands with outstretched arms after the bath than before it. This is to be expected, when we consider that the blood is determined to the muscles, which are not under the influence of the direct action of the compressed air.

Appetite is generally improved; increase of weight does not follow at once, but often a decrease is noted at the beginning of a course; and later on, however, after a course of twenty baths, there is marked increase of weight. The increase of appetite is probably a physiological effect of the larger supply of oxygen, and the first decrease of weight may be attributed to the more rapid tissue-changes which afterwards, with greater powers of digestion and assimilation, becomes surpassed by fresh production.

To illustrate some of the above conclusions, I will relate an experiment carried out under my direction, in the air-bath, by two of the clinical assistants of this hospital, aged 28 and 22, both healthy young men, who took observations on each other before, during, and after the bath. Notes were taken when the pressure had reached 3, 6, and 9 lbs. respectively; but, unfortunately, owing to the Turkish bath in the adjoining chamber being at work at the same time, the atmosphere was hotter than it should have been, and at one time a temperature of 78° was reached.

These gentlemen remained in the bath 3 hours 20 minutes. Both felt the heat, and perspired slightly; both said that, beyond slight fulness in the ears and forehead, not amounting to headache, nothing uncomfortable was experienced; Mr. B. also complained of slight oppression in the front of the chest; Mr. S. of temporary deafness. After the bath, they dined with great appetite, and each took 1½ glasses of beer and 3 glasses of wine, which probably accounts for the increased pulse and respiration-rate three and a half hours after the bath.

Pulse-rate.—Mr. S.'s was 84, two hours before the bath, of good tension; it fell to 78 in the bath, and rose to 96 after he dinner. Mr. B.'s was 64 before bath, rose to 70 under pressures of 3 and 6 lbs., but fell to 60 under 9 lbs. pressure. After dinner it rose again to 78. The tracings from Mr. B.'s pulse at the various pressures, and before and after the bath, have been given in Figs. 2 to 6. These show the gradual depression of the tidal and dicrotic waves, which is quite distinct at 6 lbs. pressure, but more marked still at 9 lbs. The influence of the stimulant, in addition to return to normal pressure, is shown, and the tracing taken on the following morning (6) is almost identical with the one before the bath (2), demonstrating the influence of the compression to have been purely temporary. In Mr. B.'s case the capillaries of the face were somewhat injected, but this may have been due to the heated air.

Respiration.—The number of respirations in Mr. S. was, before the

bath, 16. Under 3 and 6 lbs. pressure, they rose to 18, but under 9 lbs. pressure, fell to 15. After dinner and wine they rose to 20. Mr. B.'s respirations, before the bath, were 15; under 3 and 6 lbs. of pressure they rose to 17, but at 9 lbs. fell to 16. After dinner they rose to 20. The relation of inspiration to expiration does not seem to have varied much.

Chest-Circumference.—Mr. S. decreased ½ an inch in girth, at the nipple-line, noted during full inspiration and full expiration; while Mr. B., on the other hand, increased an inch under both the above conditions.

The spirometric observations gave for Mr. S., before the bath, 250. Under each pressure there was a steady increase, reaching at 9 lbs., 286; after dinner, it fell to 262. Mr. B. also increased from 255 before the bath to 302 under the highest pressure, falling, after dinner, to 288. Undoubtedly, the overheated atmosphere interfered with some of the results, notably the pulse and respiration-rate; but the sphygmographic tracings and spirometric readings entirely agree with those made by von Vivenot on healthy subjects, and on the whole, confirm the conclusions previously arrived at.

Our principles of action in the treatment of disease by compressed air must be derived from its effects on the healthy organism; and we must bear in mind that its influence is by no means neutral, but productive of very decided results, beneficial or harmful as it is suitable or the reverse.

Now the action of compressed air on the human body is, mainly, twofold: mechanical and physiological—*Mechanical*, as shown first in its influence on the circulation. We have seen that it has an intropulsive agency, driving the blood from the surface of the skin and aerial mucous membranes into the deeper tissues, such as the muscles, bones, and internal organs, especially those wholly or partially protected from air-pressure by bony cavities, like the brain, the spinal cord, the heart, the liver, spleen, and kidneys, the uterus and ovaries. Now, it is obvious that its use is contraindicated in congestions, or hæmorrhages, or inflammations of any of these organs; and we have seen by the accidents occurring in the pneumatic tubes, and among divers, that very severe lesions of the brain and spinal cord follow excessive pressures, especially when quickly produced.

On the other hand, this intropulsion of blood may do good, by causing fulness and increased action of certain organs, such as the kidneys, the liver, the ovaries, the salivary and other glands, and by drawing away or deriving blood from the lungs and air-passages, when these latter are congested. Where there is fever, which means congestion of internal organs, this influence will aggravate it. Remembering the reduction of the number of pulse-beats, and the prolongation of the cardiac diastole, we may conclude that compressed air will benefit cases where congestion of the right side of the heart and of the liver is the chief feature.

Compressed air exercises a mechanical influence on the lung-tissue. Besides reducing the amount of blood in the bronchial passages and alveolar walls, it distends both the bronchi and the alveoli, especially those portions of the lung which, from not being penetrated in ordinary respiration, become partially blocked with secretions, and impenetrable to air at the ordinary pressures. This is proved by the appearance of the respiratory murmur, after compressed air-baths, in portions of the chest from which it has been absent for long periods; also by the diminution of dullness and the freer expansion of the chest-wall, and by an increased pulmonary capacity.

Physiologically, the introduction of more oxygen into the blood, thus supplying it with a richer combustion-element, may lead to more rapid tissue-changes, and is another reason against the use of compressed air in inflammatory affections; though it is, at the same time, a strong argument for its employment in all those affections where there is imperfect aëration of the blood, such as emphysema and chronic bronchitis. From these considerations we may expect benefits to accrue in old exudations of the pleura and lung, as in chronic pleurisy, chronic pleuropneumonia, and chronic pneumonia, where both the mechanical and the physiological influence of compressed air may be brought into play with great advantage. There is another effect which I do not pretend to understand, which, nevertheless, has been noted in many of my cases, that is, a *sedative* influence on the nervous system, and especially on the nerves of the mucous membrane of the air-passages; compressed air subdues cough and bronchial spasm. From the mechanical effects, we should expect it to be beneficial in all catarrhal affections of the air-passages, such as laryngeal and bronchial catarrh and asthma, and it is in these affections that it proves most successful. As these are generally closely complicated with pulmonary vesicular emphysema, it will be convenient to consider the influence of compressed air on this disease, and then on the numerous conditions with which it is associated.

Emphysema.—We know that, in the tense or large-lunged variety of this affection, the thorax is distended to the utmost, the diaphragm is pushed down, the heart and liver are displaced downwards, the thoracic dulness of the latter generally entirely disappearing, and the impulse of the former being detected in the epigastrium. The breathing is shallow, and the dyspnoea great; percussion and auscultation teach us that the chest contains air, but that, owing to its being more or less stagnant, the blood does not get that perfect aëration which it requires, and consequently we see a dusky complexion, blue extremities, and sometimes a livid countenance. A course of compressed air-baths effects a wonderful change; after them the patient states he can breathe more freely, and can ascend steps and hills with greater ease. His cough and expectoration are decidedly reduced. The respirations are slower and deeper, the pulse is slower and firmer. Physical examination shows the thoracic distension to be diminished. The line of hepatic dulness, long absent, reappears, and rises to the normal level. Cardiac dulness is again detected, and the impulse is felt no longer in the epigastrium, but in the normal position between the fifth and sixth ribs. The excessive resonance gives place to something approaching the ordinary note; and, although prolonged expiration and wheezing sounds are heard, there is no longer the weird stillness formerly existing over large tracts of lung, for breath-sounds are audible in all directions, some healthy and some morbid.

Cyrtometric measurements show that the girth of the chest at various levels has diminished as much as from half an inch to two inches. Nevertheless, the vital capacity, as ascertained by the spirometer, is increased, and it would appear that most of these changes are more or less permanent.

Simonoff considers that the great improvement in emphysema is arrived at partly by raising the general standard of health and nutrition, and partly by preventing catarrh. He does not believe in opening up and developing healthy lung-tissue. It is not likely that actual development does take place, but some important change must occur to account for the above phenomena; and when we consider this result of the compressed air-bath, we can hardly regard vesicular emphysema as an invariably progressive disease, which is its usual description. The great improvement may be due partly to the presence of the condensed air on the bronchial vessels and muscle, whereby congestion and catarrh are reduced, and the muscular spasms allayed; but most of it must be owing to the healthy tissue being freed from obstructions, and rendered more available for respiratory purposes, and to the recovery of their normal dimensions by a large number of pulmonary alveoli, hitherto emphysematous; otherwise, how could we account for the diminished girth, the return of organs to their normal position, and the increased spirometric measurements?

Let us now take some illustrative cases.

CASE I.—William B., aged 41, bricklayer, admitted September 24th, 1884, fifteen years ago, had pleurisy, and had been subject to winter cough for many years, but enjoyed fair health till three years ago, when he had severe bronchitis, and since then cough had persisted, accompanied, at first, by free expectoration, and dyspnoea on exertion. The breath had improved, but was still short; he had not lost flesh; cough was severe, expectoration scanty. Weight, 9 st. 6½ lbs; Pulse, 112; respirations, 24, shallow. *Physical Signs.*—Chest somewhat flattened, with little expansion, and superficial veins much enlarged. Excessive resonance in upper parts. Wheeze and sonorous rhonchi heard everywhere; some fine crepitation audible in the left interscapular region. No cardiac or hepatic dulness to be detected.

On October 15th. Since last date, his cough had been more troublesome, and he had had nocturnal dyspnoea regularly. His breathing was always wheezy, and, although various forms of treatment had been tried, he was not relieved; he was ordered the compressed air-bath.

On November 8th. After the fourth bath, felt his breathing much easier. Cough more moderate, and expectoration free.

	Pulse.	Respiration.	Temperature.
Before bath	108	18	98° Fahr.
After bath	86	12	98.4° Fahr.

On November 12th. Sixth bath; pulse, respiration, and temperature records much the same as the last. Spirometric observations, before the bath, 159; after bath, 167.5; after the next bath (seventh) these rose to 181.5.

On November 15th. Physical examination showed the chest resonant, but there was some cardiac dulness below the fifth rib on the left side, over a small triangular space, close to the sternum. Hepatic dulness was detected one inch above the lower border of the seventh rib on the right side. Inspiration was still wheezy, and expiration prolonged and musical. In the posterior regions there was more breathing, but still sonorous rhonchi. No crepitations were audible in the left interscapular region.

	Right.	Left.
Measurements at level of the third rib	18 in.	17½ in.
Measurements at level of the nipple	17½ in.	17 in.

November 24th. He had had ten baths. Cough not so distressing, and expectoration reduced since this treatment commenced; the patient felt he could take breath easier. Spirometer, 183. The wheezing sounds had ceased, and respiration was harsh, with prolonged expiration.

December 20th. The patient had had twenty-one baths; cough less, breathing easy; expectoration trifling. Breath on going upstairs was equal to what it was before the attack of bronchitis three years ago. He slept soundly, and there was no nocturnal dyspnoea. The pulse had generally fallen during the bath, and the respirations had diminished, occasionally to as low a number as 12. The temperature had not varied greatly, but had ranged between 97.8° and 99.6° Fahr., generally rising slightly in the bath.

	Right.	Left.
Measurements at level of the third rib	17¾ in.	16½ in.
Measurements at level of the nipple	17 in.	17 in.

This is a diminution at the upper level of one inch, and at the lower level of half an inch.

Chest is resonant; some cooing sounds were audible in both fronts; respiration was much freer, but sonorous rhonchus was present. Hepatic dulness 2 inches above the lower border of ribs on the right side; the heart's position the same as in last report. The patient was now suffering from a cold, caught four days ago, on going to the bath, and his spirometric standard, which had risen to 183, had fallen, since, to 156. Weight, 9 st. 12 lbs., showing a gain of 5½ lbs. during his stay in the hospital.

The improvement in this case was steady and well marked. There was distinct diminution of the cough, entire disappearance of the nocturnal dyspnoea, and reduction in the amount of emphysema, as proved by the size of the liver and heart, and the diminution of the thoracic girth at various levels. The most remarkable feature was the rapid increase of the spirometric standard, unfortunately reduced later on by fresh catarrh; and, as the observations were taken very carefully, each result being the mean of three trials, they may be relied on as correct. Those taken before and after the sixth bath are also interesting, showing that a considerable increase of vital capacity may be due even to one bath. Judging by the above, and also by the patient's own statement, that his breath on ascent was as good as before the bronchitis three years ago, we may conclude that the improvement is likely to be permanent.

CASE II.—Frederick A., aged 10, was admitted November 5th, 1884. His father had phthisis; his mother suffered from chronic bronchitis; one brother died of bronchitis. The patient had whooping-cough seven years ago very severely, followed one year later by bronchitis, and had been subject to a winter-cough ever since, which continued all through last summer. He had lost flesh during the last two years. He complained of pain over the sternum, and had had attacks of vomiting lately. The cough was troublesome, chiefly at night, but there was no expectoration. The diagnosis was chronic bronchitis and emphysema.

Physical Signs.—Chest somewhat flattened under both clavicles. The cardiac impulse was felt in the epigastrium, and was altogether absent between the fifth and sixth ribs. Cardiac dulness commenced below the fourth rib on the left side. The whole chest was over-resonant, but breath-sounds were tolerably distinct everywhere; hepatic dulness was absent.

	Right.	Left.
Measurements at level of the third rib	11½ in.	11½ in.
Measurements at level of ensiform cartilage	11½ in.	11½ in.

November 11th.—He was ordered compressed air-baths.

November 12th.—He had had one bath.

	Pulse.	Resprtns.	Temp.	Spirometer.
Before bath	106	28	98° F.	82.5
After bath	80	18	98.2° F.	87.5

November 17th.—He had had three baths. Cough nearly gone. Hepatic dulness could be distinguished below the sixth rib, and, posteriorly, for a finger's breadth at the right base. On the left side, stomach-note was audible between the sixth and seventh ribs. The spirometer-observations gave 90. Pulse, respiration, and temperature about the same.

December 20.—He had had seventeen baths, and seemed greatly improved. He had lost cough and gained colour and one pound in weight. The pulse and respiration had steadily fallen in frequency, the former averaging between eighty and ninety, and the latter once reached as low as 14. After the seventeenth bath, they were as follows.

	Pulse.	Respirns.	Temp.	Spirometer.
Before bath ...	90	20	98.4° F.	
After bath ...	84	16	98.4° F.	90
			Right.	Left.
Measurements at level of the third rib...			11½ in.	11½ in.
Measurements at level of the ensiform cartilage ...			11½ in.	11 in.

showing a reduction of half an inch at the upper, and of a quarter of an inch at the lower level.

Physical Signs.—The chest was no longer over-resonant, and the note was fairly normal. Cardiac dulness could be detected as high as the third interspace; the impulse was felt in the normal position, and had disappeared from the epigastrium. Hepatic dulness could be detected, as at the last examination. The breath-sounds were fair everywhere, except in the lower posterior regions. The boy took two more baths, and left the hospital, January 5th, greatly improved.

REMARKS.—As no other treatment but the bath was used in this case, we may give it the credit of the reduction of cough, the large diminution of the emphysema, as evidenced by the smaller chest-measurements, the return of the organs to their normal positions, and the spirometric observations. Doubtless, the youth of the patient rendered him more susceptible to atmospheric influence.

CASE III.—C. D., aged 33, bricklayer, was admitted September 24th, 1883. His father, mother, and brother died of phthisis. Three years ago, he was confined to his bed for six weeks with cough and expectoration, which had lasted ever since, and had lately been accompanied by shortness of breath on exertion. Expectoration had lately increased, and averaged about four ounces a day; and cough was troublesome, chiefly at night and on rising in the morning. Weight, 8 st. 5 lbs.

October 15th. Examination of the chest showed a well marked pigeon-breast malformation; great collapse of the lower portions of the chest beneath the mammae. Heart's impulse visible in epigastrium on the left side of the ensiform cartilage. Cardiac dulness commenced below the fifth rib, about two inches from the line of the cartilages; hepatic dulness was altogether absent. The whole chest was over-resonant, and respiration was weak everywhere.

	Right.	Left.
Measurements at level of the third rib ...	17 in.	16 in.
Measurements one inch below the nipple-line ...	16½ in.	16 in.

Pulse 84; respirations 20. The diagnosis was bronchitis and emphysema.

November 5th. The patient had had two baths, and found his cough better, and the expectoration diminished. His breathing also was easier. After the second bath, the pulse fell from 108 to 96, and the respirations from 22 to 17.

	Right.	Left.
Girth at third rib ...	16½ in.	15½ in.
„ one inch below nipple ...	15½ in.	15½ in.

Hepatic dulness could be detected below the seventh rib on the right side.

December 10th. He had had sixteen baths, and improvement continued. The measurements showed no great change; the right side, at third rib, 16½ inches; the left, 17 inches; at the ensiform cartilage, 15½ inches at the right; and at the left, 16½ inches.

The patient continued to take baths until he had had thirty-eight, and always felt relief to his breathing during the bath and for some hours afterwards. For the last month of his stay in the hospital, he had no baths, on account of suffering from acute pleuro-pneumonia; and complained much of the deprivation. The relief from them, though marked, was only temporary; but the prominent results—namely, reduction of pulse and respiration—were noticed throughout, although the chest-measurements gave a negative result. The rise of the diaphragm was shown in the increased area of hepatic dulness.

Chronic bronchitis is held by the Germans to be greatly benefited by the air-bath; the improvement being due to the increased pressure on the larger tubes causing diminution of the blood in the bronchial membrane, and consequently less exudation of serum into the coats of the bronchi; hence less pressure on the lymphatic system. Oertel finds this treatment to answer best in pure bronchial catarrh, but to be less effective when either emphysema is present, or the thorax is deformed, or

again where the right side of the heart is dilated. My own experience is that the cough is quieted, and that the amount of expectoration is reduced. There appears to be an improvement in the muscular tone of the bronchial tubes; and this improvement may be due partly to the pressure on the vessels, and partly to the larger amount of oxygen supplied without effort. I do not hold with Oertel; for, in most of the cases of bronchitis under my care, emphysema has been present, and in some also malformation of the chest, and yet all have considerably benefited by the compressed air-bath.

Subjoined is a case of chronic bronchitis and emphysema.

CASE IV.—Henry F., aged 48, shopkeeper, admitted September 19th, 1884. Sixteen years ago, he had sunstroke, from which he recovered in one year. He had had winter cough for fifteen years, which has been continuous during the last three, and had obliged him to relinquish work. In this period, he had been subject to nocturnal attacks of dyspnoea, occurring generally between 12 and 4 A.M. He had not lost flesh lately. The cough was exceedingly severe at night, and the effort produced sweating: the expectoration was abundant, thick, purulent, and contained no tubercle-bacilli. Breath was very short on exertion. Weight, 8 st. 9 lbs.

Physical Signs.—Chest over-resonant everywhere; no hepatic dulness to be detected; cardiac impulse perceptible in the epigastrium; and cardiac dulness was noted over a small triangular space, limited above by the upper edge of the fifth rib, and below by the seventh rib, and internally by the median line. Breathing was very feeble over the whole chest; some crepitation at the left base. Pulse 100, feeble, and at times irregular; respirations 24.

September 24th.—

	Right.	Left.
Measurements at level of the third rib ...	17 in.	16½ in.
Measurements at level of the ensiform cartilage ...	16 in.	15½ in.

The patient's cough was very severe, and in addition he had double inguinal hernia, and was so feeble that he was confined entirely to bed.

November 9th.—The cough had been reduced by treatment, but was still troublesome; he had a double truss for the hernia, which answered well. The expectoration was less. The appetite was very poor. Pulse about 100. The patient was now up and dressed. The nocturnal attacks of dyspnoea continued. He was ordered the compressed air-bath. Spirometric observations gave a mean of 67.5.

November 11th.—First bath:

	Pulse.	Respirations.	Temperature.
Before bath ...	100	32	99° Fahr.
After bath ...	80	30	98.6° „

Spirometric observations, 92.5° after bath.

November 15th.—He had had three baths, and no more attacks of nocturnal dyspnoea. He was improved in cough and breathing. After the last bath, the respirations were 28, and the temperature 98.6° Fahr. Pulse fell after last bath from 108 to 98. The patient was still too weak to walk to the bath, and was carried there and back. He had had phlebitis of the right forearm, which confined him to bed for one day. Since then he had been up, and had not missed any baths.

November 18th.—Spirometric observations had been taken twice since the 11th, and showed an increase, the last being 88 before the bath of to-day, and 94 after.

November 24th.—He had had seven baths, and during the last two had complained much of headache. The cough and expectoration had greatly diminished. The phlebitis was much better. There had generally been a reduction of pulse and of respirations after the bath, though the latter were always somewhat hurried.

Seventh bath:

	Pulse.	Respiration.	Temperature.	Spirometer.
Before bath ...	92	32	98.2° Fahr.	90
After bath ...	84	28	98.6° „	94

Strength was increased, and the patient could now walk to and from the bath.

	Right.	Left.
Measurements at level of the third rib...	16½ in.	16½ in.
Measurements at level of the ensiform cartilage...	15½ in.	15½ in.

showing a decrease at first level of one inch, and at second of half an inch.

Physical Signs.—Chest less resonant generally. Liver-dulness was now perceptible along the upper edge of the seventh rib. Cardiac dulness was detected between the left nipple and the sternum; the impulse was felt between the fifth and sixth ribs, beating very feebly, but

some pulsation was still detected in the epigastrium, this indicating that the heart had returned nearly to the normal position. Respiration was clearer, and the breath-sound was tolerably free. Slight crackle was audible just below the right nipple.

December 8th.—After the seventh bath, the patient suffered so much from headache, that the treatment was discontinued, and four days later the headache ceased. He was leaving the hospital improved in every respect, and had gained in weight. Measurements and spirometric observations gave the same result as after the last compressed air-bath.

REMARKS.—This was a well marked case of chronic bronchitis, in which acute symptoms had supervened; but the complication of the double hernia, and his great feebleness and extensive emphysema, rendered it doubtful if any benefit could be expected from the compressed air treatment. The return of his strength was, perhaps, as remarkable as his improvement in cough and breathing; and it was unfortunate that the headaches caused by the compressed air stopped the use of it. The increase in the spirometric measurements after the first bath was very great.

NOTES ON THE MEDICAL CORPS OF THE SWISS ARMY.

By G. J. H. EVATT, M.D., Surgeon-Major, Army Medical Staff.

I HAD an opportunity, some time ago, of being present at the mobilisation of a large body of medical officers of the Swiss Medical Service, and seeing something of their system of organisation; and it seems to me worthy of study by the medical officers of our regular army, as well as by the militia and volunteer surgeons.

1. *The Army generally.*—The Swiss army is really a compulsory national militia, in which all males must serve for a certain number of years, and it is called out annually for training by districts, as our militia is called out by battalions. It is, however, infinitely more complete than is our militia, which is in no sense an army, but simply consists of a number of battalions of infantry, some garrison-artillery, and two or three battalions of engineer-militia. Our militia has no cavalry, is entirely devoid of a transport-corps, has no commissariat units of any kind, and the medical service of the militia is practically non-existent.

From Switzerland, we may learn how, in some measure, to combine a completely localised and popular national army with many elements of military efficiency. Until our militia is the result of universal military service, and until it has a defined commissariat, transport, and medical service, it cannot compare to the Swiss national service.

2. *The Medical Officers.*—In common with all males in the country, all medical men practising in Switzerland are liable for service in the national army between certain ages.

If I had to-morrow to choose from amongst the various European armies, except England, a most workmanlike, well organised, and completely contented medical corps, I would choose the Swiss service. After seeing something of the medical services of several foreign armies, the Swiss medical men seem to me to be men of great self-reliance, full of confidence in themselves, full of belief in the dignity of their work, and have, from their army-rules, complete and absolute equality in the national service. With such men, and under such rules, success is always possible. Without these conditions, however great the substantive advantages may be, failure is inevitable, and initiative impossible.

I attribute the high morale of the Swiss Medical Service to the dignity of manhood produced by the free government under which they live, and to the importance attached to the soldier's life in a country where, for long years, a wide popular suffrage has obtained.

The Swiss Medical Corps officers are really civil physicians called in annually, at certain centres, for compulsory drill and training in hospital-administration by permanent instructors. Every autumn, such local mobilisations occur in the district, and one may see the medical officers and the non-commissioned officers of the medical corps, at the appointed town, on the parade-ground, practising the "goose-step," and brushing themselves up in their military drill, before the rank and file of the medical corps join a few days later.

When these men join, they are posted to the various units of field-hospitals which compose the companies of the mobilised medical regiment; they are drilled and lectured, and finally take part in the autumn manoeuvres with the mobilised army corps to which they may belong. The men were lodged in various houses in the town, and the officers lived at the hotels, all dining together at noon daily, in the

chief hotel of the town. The principal medical officer, Colonel Goldlein, presided, and I had the honour of dining with the sixty medical officers on one occasion.

The medical officers wear a special light blue uniform, and a shako like the remainder of the army, having on its plate a Geneva Cross. The men wear similar shakos similarly distinguished.

Only educated and completely trustworthy private men are allowed to serve in the medical corps, and I should think them the most reliable and trustworthy of any rank and file in Europe so employed, for there is still much to look for in the development of such men in every European army.

The quartermasters of the Medical Corps wear the dress of the quartermasters of the Army Quartermaster Corps, and are apparently attached for duty. There are also a small separate body of apothecaries belonging to the Medical Corps.

3. *Rank and Grading.*—The Swiss Medical Corps, like the medical services of the American, Italian, Turkish, Dutch, and other armies, is graded into military ranks with military titles, from colonel, the highest title in use in the army, downwards through lieutenant-colonel, major, and captain, to lieutenant. These titles are used on duty, and the officer commanding the medical mobilisation was always spoken to and of as Colonel Goldlein. This rank seemed equal to the average army-rank of the remainder of the national service, lieutenants of the Medical Corps being graded with average lieutenants, captains with captains, and so on.

In a medical corps working as a disciplined body, there must be defined ranks and gradings, and they must be more or less equal to the average of the army in which the medical officers serve. The drawback of relative rank is its want of definiteness, and its want of recognition, and, worse than all, its tendency to be showered in too great a quantity on its recipients. The result of such systems is that rank is cheapened, and discipline suffers. If we were to abolish the lieutenants' grade to-morrow, and make all our young men captains, their position would not be practically improved, for somebody must still be junior, and do the junior duties; but by abolishing the junior grade, discipline would be injured by abolishing a check over which men should pass either by selection or examination. The Swiss say that, as a rule, rank should be equal for all corps and classes in the army for length of service, and that social intercourse between corps is destroyed by confining high nominal rank on any special corps, and thereby throwing it out of gear with the remainder of the army. As to the military title, they say it produces a feeling of equality in an army, which is entirely absent in those which do not have it. They say it paralyses the attempts of any class in the army to degrade those who do not have it; and it brings into the fold of the national army those lost sheep who without it are, officially, mere camp-followers. They deem it a protection against personal rudeness; and they consider that it teaches to the whole army the fact that the central government of the State recognises in its service no depressed class. For them it is the true test between a national and a caste or class-army. But, say they, it acts in an entirely opposite direction, in being an agent of discipline in a corps of specialists, who, presuming on the supposed value of their specialism, would claim high nominal rank, and thereby derange from another side altogether the equisope of the military machine. Military organisation demands that, however high or important the specialism may be, the specialist shall enter the national service just on the same footing as any other officer, and rise in his corps by steps equal to the average ranks of the other classes in the army. It is practically equality by discipline and organisation; and in the end the officers of the special corps do not lose, for their reputation does not depend on their mere army-rank so much as on the good name and high morale of the corps. The mere fact of being a lieutenant is not important, for we all know that a lieutenant in a very special corps d'élite has ever more consideration shown him than the same rank in some unimportant regiment; but officially, and for discipline purposes, they are alike, and in the eyes of the national administration there should be no difference in treatment.

Officers of every branch of the Swiss army have military titles, and, on meeting or passing each other, salute as a matter of discipline, the junior taking the initiative. This salute may be regarded as a good outward test of internal discipline in any army, and it is thoroughly carried out in Switzerland.

4. *Technical Training of the Officers and Men of the Medical Corps.*—The officers and men are trained in infantry-drill; and on it is grafted the special technical ambulance-drill, including the pitching and administration of field-hospitals. If we could imagine that, for fifteen or twenty days every year, the whole of the medical officers of the regular army, militia, and volunteers, with the rank and file of the medical staff corps, militia medical reserve, and volunteer ambu-