STUDIES PHYSIOLOGICAL AND PRACTICAL.

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ON THE EFFECTS OF THE HORIZONTAL POSITION OF THE BODY IN SYNCOPE, WITH OBSERVATIONS ON THE RELATIONSHIP THAT EXISTS BETWEEN THE BRAIN AND HEART.

PART III.

In the preceding parts of this study, it has been my object to show that, during syncope from loss of blood, the good effects of the horizontal position rest on the mechanical fact that, by laying the body recumbent, the direction of the circulating currents is changed, and a portion of reserved blood is impelled into the heart.

But there are many other cases of syncope, in which the recumbent position affords relief.

I refer especially to cases where the heart succumbs, either from being itself debilitated, or from being overburdened with blood. In instances of this kind, the recumbent position relieves in a manner varying somewhat with the nature of the case. If the failure of the circulating organ arises from simple debility of its muscular walls, as after a prolonged and exhaustive disease, say fever, or from some form of slow degeneration, the effect of the horizontal position is nearly the same as during loss of blood. The enfeebled organ fails in these cases, while the body is erect, in sending such a current of blood up the ascending aorta and over the arch as shall suffice to supply the wants of the capillary system, or feed the returning venous current; and the heart empties itself, therefore, without receiving a new supply. But the moment that the body is laid recumbent, the condition is changed, the arterial tide is quickened, the course of blood through the veins is modified from the perpendicular to the horizontal line, the right auricle is fed, the pulmonic circuit is more easily made, and the whole circulation is relieved of the difficulty into which it had been cast.

In cases of syncope from mental emotion or fright, the effect of the recumbent position is always remarkably beneficial. Indeed, I do not think that people would ever faint outright from fear, if they would take the precaution to lay themselves horizontal the moment they felt the symptoms of sinking. I have shown that, in cases of this class, the failure of the system commences with failure in the respiration; that the mental emotion checks temporarily the inspiratory movements; that the pulmonic circuit therefore is obstructed; that the right cavities of the heart become surcharged with blood; and that the left ones do not receive their normal share. Under these conditions, it is no wonder that all the muscular force speedily fails while the body remains erect, for the arterial tide is too much reduced in quantity to stimulate the heart to raise it over the aortic arch; and, without arterial blood in due proportion, muscular action, nervous function, and animal heat, are soon checked. But the very rapid muscular failure in these instances, is in reality the natural cure; the compensatory act for the vital accident; for, as the body falls, the dangers are admirably and hastily removed. In the first place, as soon as the body is placed in the horizontal line, the small proportion of blood which the left ventricle contains, having no longer to make a perpendicular ascent over the aortic arch, is poured out more freely into every part of the system. In the second place, the right ventricle, enfeebled as it soon is by the load of blood cast on it, finds it a much easier task to drive the blood round the lungs in a horizontal current, and contracts also with renewed power, from receiving a new supply of stimulus from the abdominal veins. Lastly (and this is most important of all), as soon as the body is laid low during syncope, a natural balance between the respiratory movements and the pulsation of the heart is set up. For the fact that the beat of the heart varies with the different positions of the body, being quickest in the erect, and slowest in the horizontal position, and that this arises from the respiration being subdued during recumbency, are facts not less accurate than that in health there is a mutual

relationship of action between the organs of respiration and circulation, and that any sudden interruption of this relationship leads of necessity to symptoms more or less marked, either of syncope or asphyxia, or of both combined.

The question of syncope from pain is one which I ought not altogether to omit. I do not believe, however, that people ever faint from mere pain, let it be of the severest kind, unless it come suddenly as well as intensely. Syncope then ensues as much from fright as from pain, and arises doubtless from the same cause, viz., from checked respiratory movements.

PRACTICAL INFERENCES. Having described in the preceding observations the mode in which the recumbent posture relieves in syncope, I might leave the subject; but it occurs to me that some practical inferences are deducible from the experiments and ideas which have been recorded. To these inferences I would briefly allude in the way of conclusion.

I. The inference is clear, that in all cases of syncope, it is merely necessary to lay the body in the horizontal line; and that to do more—to raise the lower half of the body, for instance, to an angle several degrees higher than the head—is, as a general rule, worse than superfluous. For when blood is being lost from the inferior half of the body, i. e. from below the heart, and fainting is the result, it is unnecessary to lay the head and arms lower than the heart, inasmuch as by so doing those parts are placed in such a position that the blood they may contain is made to return to the heart more or less ascending, and therefore with less freedom; while, if the hæmorrhage springs from a part of the body above the heart, the placing that part below the level of the heart encourages the flow of blood towards the bleeding point, without materially improving the flow toward the centre from the vena cava and other abdominal veins.

If, indeed, the mechanical arrangement of veins and arteries be for one moment considered in connexion with their origin from the heart, and their relations to each other throughout the system, it will be seen plainly that the horizontal position of the body is by far the best for securing both the free, constant, and equal distribution of arterial blood from the heart into the system, and the return of venous blood from the system back to the heart, in all cases where the central organ is beating feebly either from loss of blood, or from its own debility. For as we cannot place an artery in a depending position without placing its veins in an opposite position, it is obvious that if the outgoing blood is made to descend, the returning blood must needs ascend, and nothing is gained. Something, indeed, would in many cases be lost; for the balance between the arterial and venous currents of blood is often much disturbed, even in what may be considered healthy conditions of the body—the arterial tide being under the direct influence of the heart-stroke, the venous under the indirect influence of that stroke, and under the direct influence of certain chemical or osmotic changes ever going on during life in the ultimate parts of the circulation. Veins, too, in I may almost say the majority of persons who are past middle age, dilate in the extreme points of the body, and become large receptacles of blood, to fill which powerful circulatory action is required, and through which blood travels with unnatural slowness. In such instances, to weaken the force of the arterial current, when the heart is failing, by raising the artery to an angle much above the heart itself, is absolutely bad practice.

In the experiments I performed I took especial pains to observe the effect of holding the body in inverted positions. The results confirmed in a striking manner the opinion that the horizontal posture of the body is the best in syncope, and that any modification of it retards rather than assists recovery.

II. Another inference derivable from the experiments is, that in instances where the heart is enfeebled by loss of blood from the system, it is exceedingly liable to be brought to a complete stand by the reception of a sudden and large re-supply of its stimulus. Having caused the right auricle to empty itself

and collapse on several occasions while the animal was suspended by the head, I suddenly inverted completely the position of the body. In an instant the auricle was refilled with blood, and, as a general rule, recontracted immediately. But exceptional cases occurred in which no such recontraction took place; and at first the cause of this puzzled me exceedingly. At last I found that by bringing the body to the horizontal line in these instances a little blood ebbed back into the inferior cava, and that, as the auricular cavity became thus less distended, its muscular wall began to react vigorously. The exceptional instances, to which reference is here made, always occurred after the system had been subjected to free and long continued loss of blood. In a word, in proportion as the power of the heart declined, just in proportion did it become paralysed from over-distension of its cavities with blood.

The fact here noticed has certain physiological and practical bearings of no slight interest. It shows, in the first place, that the stimulus of the blood does not excite contraction of the heart by merely distending the cavities, as some have supposed. It indicates rather, as I believe, that a heart, having itself lost its muscular power by being robbed of its coronary supply of blood, cannot respond to the stimulus of blood thrown into its cavities, unless the quantity at first be small and be slowly introduced. In this respect the heart resembles the voluntary muscles of a man much reduced from disease, which are easily and at once prostrated by sudden over-exertion, and which only gain ability to act as they gain size and strength by nutrition.

It was long since remarked by Harvey that during the operation of phlebotomy, the patient after having been freely bled did not faint until the fillet was removed from the arm and the bleeding was suppressed. This observation, the correctness of which every one must admit who has been accustomed to draw blood, was supposed by the discoverer of the circulation to arise from the return to the heart of blood rendered cold by being retained in its course. The following are his words:—

"Moreover, he whose arm or wrist has been bound for some little time with the medium bandage, so that it has not only got swollen and livid, but cold, when the fillet is undone is aware of something cold making its way upwards along with the returning blood and reaching the elbow or the axilla. And I have been myself inclined to think that this cold blood rising upwards to the heart was the cause of the fainting that often occurs after blood-letting; fainting frequently supervenes even in robust subjects, and mostly at the moment of undoing the fillet, as the vulgar say, from the turning of the blood." (*Willis Harvey*, p. 58.)

The idea that syncope arises under the circumstances just related from the ascent of retained and cooled blood to the heart, does not accord with any of our present views regarding the animal temperature and the circulation. But the fact of syncope thus occurring is obvious enough on the principles and inferences which I have endeavoured to draw from my own experimental observations already before the reader. It is not the ascent of cold blood to the heart that stops the play of that organ, but the sudden reception by it, while in an enfeebled state, of a load previously held in bondage by the ligature around the limb.

The subject here broached has, moreover, an importance in regard to the application of some remedial measures. I especially allude to the act of transfusing blood in cases of great prostration from hæmorrhage; for if there is any truth in the arguments used above, it is obvious that, in transfusing blood into an exhausted system, too much care cannot be taken to inject it with the least possible amount of force and rapidity; and indeed practice itself verifies this supposition and places it beyond dispute.

III. *The experiments have an important bearing as illustrative of the importance of keeping the body recumbent in diseases where the blood is so modified that it fails to be a proper stimulant to the heart.* I refer to such diseases as purpura, typhus, cholera, phthisis in its late stages, and many other diseases of the exhaustive type.

In these cases, the blood is variously modified, being in some

reduced almost to the fluid consistence of water itself; in others, inspissated and even churned into solid masses in the cavities of the heart. In all it is so changed as to be more or less unfitted for supporting the natural processes of life. The heart is thus thrown into a double difficulty: First, the direct stimulus for exciting its contraction is modified; and secondly, its own private supply of nourishment is either deprived or suppressed. The central organ of the circulation is thus doubly unable to meet the difficulty of driving the blood over the ascending aorta—or up into the pulmonary substance; and if the body be raised suddenly into the erect position during such states, syncope, more or less marked, is often the result. I believe that no matter is of more importance in the treatment of the diseases I am now speaking of than that of keeping the body recumbent. In cholera, this precaution is so necessary that I am almost bold enough to say that the labours of the practitioner in endeavouring to check the discharge from the bowels, or to meet the loss, are well nigh worthless, unless the friends about the patient or the nurses fail not to act rigidly up to a maxim which should be preached to them at every visit—*keep the head always on the pillow*. The same holds good in typhus, in the close of inflammatory diseases, in purpura, in cases of hæmorrhage, and in short, in instances of every kind where the body has been seriously reduced and the blood much modified in character.

IV. *The experiments and arguments described throw much light on the results of cases where, either from cardiac or systemic change, the balance that should exist between the central organ of the circulation and the body at large is disturbed.* The disturbance in the balance of the system to which I allude here is of no uncommon occurrence, and arises in a variety of cases. It is met with in its simplest form when, from great fatigue, exhaustion, or deprivation of sustenance, the action of the heart is depressed to a great degree. It is met with when, from some pathological condition, as atrophy or degeneration, the heart is rendered more or less incompetent for irrigating the system with blood. It is also met with when an obstruction of the circulating currents exists in or near to the left cavities of the heart, such as valvular consolidation, abnormal growths, or contraction or great dilatation of the ascending or transverse aorta. Lastly, it may be occasionally found without any structural or actual abnormal condition of the heart itself, in persons who, having been of spare habit up to the meridian of life, begin frequently to enlarge in their corporeal boundaries. In these persons, the increase of bodily size is rarely if ever attended by increased muscular development: on the contrary, the muscles become debilitated rather than more powerful; and the heart, though it may be loaded with adipose substance, gains no additional power, but loses its contractile force. Under such circumstances, with the heart failing in strength, or at least remaining the same, and with the demands for its services increasing, it is no way wonderful that exercise soon becomes burthensome, or that the circulating organ should fail sooner than it did when its strength was in proportion to its duties. In the course of my observations of disease, I have met with two cases in which plethoric persons have died suddenly, apparently from this cause alone; the heart in each instance being found healthy as regarded structure, but collapsed and empty; and with no other visible reason for the suddenness of the death. I shall place the details of these cases on record at another time.

Now, in each of the conditions to which I have now alluded, the persons in whom they are present can be in no way better saved from a fatal syncope than by laying the body recumbent. It would be quite superfluous to explain, after all that has been written above, how this remedial measure produces its good effects in such cases. I would, however, remark that, in the case of an obstructed heart, recumbency relieves as much by quieting the heart, and enabling it to overcome the embarrassment arising from the presence of a barrier in its chambers, as by securing a free and equable distribution of blood throughout the system.

Connected with this point, I should not avoid reference to the value of the horizontal position in such a case as that described by Sir George Lefevre, and quoted at length in a previous part of this communication. I mean a case where such an enlarged condition of the veins exists that these vessels become, in the erect posture of the body, large receptacles of slowly circulating or almost stagnant blood. I have already fully explained that the value of recumbency arises, in these instances, purely from the mechanical fact that the arrested blood finds an easy passage to the centre of the body when the effects of gravity are removed.

v. *An inference can be drawn from the experiments as to the manner in which syncope is produced after operations in which a large quantity of watery fluid is rapidly extracted from the system.* It will be seen that syncope after the operation of paracentesis abdominis arises merely from the rush of blood into the abdominal veins previously compressed by the fluid pressure around them; and that, next to applying a due amount of equal external pressure over the abdomen during this operation, there is no practical fact of so much importance as laying the body in the horizontal line.

I have thus endeavoured to illustrate several points connected with the effect of the horizontal position in syncope. I have tried to show that there is no *direct* relationship between the functions of the nervous system and the action of the heart. I have shown by experiment that the blood is the only stimulus to the heart's motion, and have done my best to prove that the good effects of recumbency rest in every case on mechanical causes alone. Lastly, I have made an attempt to turn the experiments and the opinions deduced from them to some practical account in the treatment of disease—a course which, if my own feelings on such matters are correct, ought to be pursued by every physiological inquirer who ventures on the important step of sacrificing inferior animals for the purpose of investigating the intricate laws of life.

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CASE OF EMPYEMA SUCCESSFULLY TREATED BY THORACENTESIS AND IODINE INJECTION.

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[*Read at the Anniversary Meeting of the Provincial Medical and Surgical Association, at Manchester, Sept. 14th 1854.*]

In the fifth volume of the *Transactions* of the Association, I related some "facts illustrative of the effects of chronic pleuritis;" on the present occasion, I purpose describing rather briefly a case which has recently come under my observation and treatment, and which may be considered as supplementary to the paper above alluded to.

CASE. Thomas Norris, aged forty-five years, an operative spinner, residing at No. 11, Butler Street, Oldham Road, Manchester, called at my house to consult me on the 7th, and again on the 13th of April 1854. He presented a pale sickly aspect, but in other respects apparently a well-built frame. He said that when in bed he could lie only on his left side. He had a troublesome husky almost dry cough, but had never spat any blood. His pulse was 108 in a minute, small, and rather indistinct, especially in the right wrist. His tongue was covered with a whitish, or rather, brownish-white fur. He complained of soreness, and of what he called "a mass of pain," on the left side. By auscultation no respiration could be heard in the left lung, except anteriorly somewhat indistinctly just below the clavicle, and slightly also opposite posteriorly. The left side was everywhere dull on percussion. On measuring the two sides of the chest, there was little difference (only from a quarter to half an inch more in the left) in their width; but the right ribs were seen to move in respiration rather more than the left, and the intercostal spaces were more

visible on the right side. The pulsations of the heart were not audible in the usual place, but were very distinctly heard on the right side, especially near the right nipple.

About last Whitsuntide he first began to feel out of health, with cough, dyspnoea, and uneasiness of his left side; these symptoms never left him since, although varying at times in severity. He did not remember having ever had any very severe pleuritic stitches. Excepting for three weeks at the commencement of his complaint, he had continued his occupation to within a week of the time when he consulted me. He had used very little medicine, except homœopathic, during the first three weeks of his illness.

I prescribed for him a cough mixture, containing oxymel of squills and poppy syrup, with a little tincture of digitalis, ipecacuanha wine, and antimonial wine; also some alterative aperient pills, of equal parts of compound extract of colocynth and blue pill.

April 14th. Accompanied by my son, Thomas Windsor, and pupils C. Jullott and N. Pickford, I visited him for the first time at his own house. He had passed a bad night from dyspnoea, pectoral oppression, and occasional cough, with slight mucous expectoration. The pulse was 108, small, and feeble; in the right wrist scarcely perceptible. He said he was totally devoid of appetite, and felt great prostration of strength. Being satisfied, by the preceding and a further exploration now of the chest, of the probable existence of fluid in the left pleural cavity (an opinion in which my son fully concurred), I passed a grooved exploring needle along the upper surface of the seventh rib, when a quantity of turbid or somewhat puriform fluid issued. I, therefore, after elevating the integuments about an inch upwards, so as to have afterwards a sort of valvular covering to the aperture made into the chest, passed in a small trocar also just along the upper surface of the seventh rib. The fluid passed out freely through the canula, until about fifty-two ounces were withdrawn. During the period of its evacuation, the thumb was placed for a short period four or five times on the mouth of the canula, so that the pleural cavity might not be too suddenly emptied. The punctured part was simply covered with a little lint, adhesive plaster, and a few light turns of bandage. His breathing and the pectoral oppression seemed relieved by the operation; but he was troubled just afterwards by a rather severe attack of coughing, with slight mucous expectoration, which went off after drinking a little tea. The pulse was now 66.

When I visited him again in the evening, he expressed himself as being pretty easy altogether, and had not been troubled with cough since the morning.

April 16th. His pulse, which yesterday was 96, was this day 88, and fuller. He was now in good spirits, and had scarcely any cough. His appetite was pretty good; he had no pain; his bowels were regular, and the urine free. His respiration was somewhat improved on the left side both anteriorly and posteriorly, but it was still scarcely audible below the nipple, or in the opposite portion of the chest behind. There was corresponding dullness on percussion. The sounds of the heart were now heard most distinctly under the middle of the sternum. Last night he was able to sleep pretty well on his right side.

April 19th. Since last report he had gone on favourably. The pulse was about 84; the tongue was pretty clean. He had a little cough, occasionally with slight mucous expectoration. There was no particular pain; his appetite was fair; the bowels were regular, and the urine was apparently natural in appearance and quantity. He slept tolerably well on either side. Percussion and auscultation afforded about the same signs as before.

April 25th. He was much the same. For the last few days he had walked out several times. The mixture was continued, and the pill to be taken when required.

May 3rd. For some days he had not been so well as to his breathing, cough, and decubitus, although his pulse, appetite, etc., were pretty good. I thought it best therefore again to withdraw the fluid, which on this occasion amounted only to about thirty ounces, but was of the same