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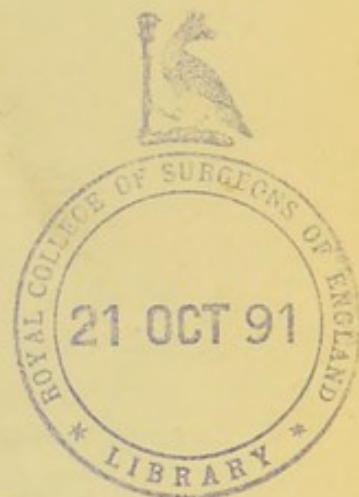
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THE
RESUSCITATION OF THE APPARENTLY
DROWNED.

BY
R. L. BOWLES, M.D., F.R.C.P.

Read May 28th, 1889.



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THE resuscitation of the apparently drowned has, on several occasions, been discussed by this Society, and much real work was done by its Committee in 1862 to clear up doubtful points and to afford a settled basis for the management and judicious treatment of apnœa and drowning.

Since, however, the issue of the very valuable Report, published in the 'Transactions,' new methods of treatment have been promulgated and new experiences on the management of cases allied to drowning have arisen, which must influence very materially any views we may formerly have entertained.

These proposed new methods have aroused doubts in the minds, not only of the public, but of the profession, as to which method should be adopted in any given case: such doubts are fatal to effective action and should at once be dispelled.

The knowledge of the treatment of the apparently drowned must not be confined like other medical treatment

to the medical profession: it is essential to the commonwealth that its details should be clearly laid before the public in as simple a form as possible, and that this should be done by an authority in our profession, such as this Society possesses. The Royal Humane Society, the National Lifeboat Society, and local authorities generally, would gladly avail themselves of our proffered assistance and advice, and would arrange to have their officials trained to treat cases of drowning instantly, on the spot, whilst a medical man was being sent for, if only they had the support of a proper authority. The doctor can never be in time unless he happens to be present when the accident occurs.

That the public recognises this, and very much appreciates our advice and assistance, is proved by the following note which was added to the instructions of the Royal Humane Society: "The above directions are chiefly Dr. H. K. Sylvester's method of restoring the apparently drowned, and have been approved by the Royal Medical and Chirurgical Society."

Now I felt at the time that our Society was premature in giving its imprimatur to Dr. Sylvester's method of treatment, as his method was opposed to the principles indicated by the experiments performed by our own Committee. The Committee showed "that in drowned animals not only were all the air passages choked with frothy fluid more or less bloody, but that both lungs were highly gorged with blood, so that they were heavy, dark-coloured, and pitted on pressure, and on being cut exuded an abundance of blood-tinged fluid with many air-bubbles in it." I quote this from remarks made at the time on the experiments, by Dr. C. J. B. Williams¹ the distinguished chairman of the Committee. Here we have positive evidence of the lungs being already full of fluid; further, that this fluid had been introduced with very great force, sufficient to raise a column of mercury four inches, and further still, that at each expiration, as air was expelled, water took its place

¹ 'Lancet,' July 12th, 1862.

with the next inspiration. The Committee up to this point made a distinct advance ; it settled an important point of pathology in a clear and definite manner. Before this time, although Sir John Simon and a few other pathologists asserted the *presence of water in the lungs* in cases of drowning, the opinion of Sir Benjamin Brodie prevailed both in the profession and at the Royal Humane Society, to which the public always turns for advice in this matter : Sir Benjamin says in his work on 'Pathology,' p. 88, "That the admission of water into the lungs is prevented by a spasm of the muscles of the glottis cannot, however, be doubted, since we are unable to account for the exclusion of it in any other manner ; and a multitude of circumstances prove that these muscles form a sphincter to the windpipe as perfect in its functions as any sphincter in the body." The Committee showed by their experiment that Sir Benjamin Brodie's theory of the non-existence of water in the lungs was incorrect—for they proved that water *did* exist.

Now instead of showing how this water, of which they admit the lungs to be full, could be first removed and then replaced, *pari passu*, by the introduction of pure air, the Committee advised the adoption of a method which would introduce the largest amount of air into *empty* lungs. I would ask how it was to be introduced into lungs shown to be already full of water ? The only effect of forcibly driving in air, which the Sylvester method certainly does, would be to drive the water forcibly forward into the minute bronchial tubes, and into the air-cells, giving rise to a spongy or doughy feeling instead of the natural light elastic crepitation of healthy lung tissue. Moreover, the water becomes inspissated with mucus, and frothy, by mingling with the air remaining in the lung : an exaggerated condition of what I have formerly shown produces, in apoplexy, "mucous stertor."

It must have surprised the Committee to have found their results, although confined to animals, so entirely opposed to those of Sir Benjamin Brodie, and caused them

to wonder how such differences could have arisen. It occurs to me that Sir Benjamin, and others at that time, must have drawn their conclusions from the fact that at times, in drowning, no water was found in the trachea and larger air-tubes: this, however, could not be so surprising when we reflect how easily water will make its way out of the trachea and large tubes during the many and irregular movements to which the body is subjected whilst being removed from the water to a suitable place for treatment, and further, when we reflect how rapidly water evaporates on exposure to the air. At all events, it is now quite certain, thanks to this Society, that the previous observers were in error. In 1862 I had a case of drowning, and observed it very carefully during the whole course of its treatment. I made it, in fact, the subject of an experiment, and I found that for three quarters of an hour a little fine white foam was expelled from the mouth or nostrils at each pronation of the body. A second case soon followed, and my observation of it gave precisely similar results. I then critically examined the many cases of drowning reported by Professor Casper, and in nearly all of them was to be found most positive evidence that the lungs of the apparently drowned were gorged with water. He says in the following extracts (vol. ii, p. 238, *et seq.*):

“In the recent bodies of those who have been suffocated by drowning we find, besides the cinnabar-red, vascular injection of the tracheal mucous membrane, sometimes only a few isolated, white, but very distinct, small, pearl-like bubbles; sometimes a much greater quantity of froth, which is generally white, and more rarely bloody, and sometimes the whole tracheal canal is completely filled with this finely vesicular white foam. This extends into the bronchi, or rather, extends out from them and their ramifications, as is distinctly evinced by exerting strong pressure on the as yet untouched lungs, when this froth will be seen to ascend into the opened trachea, even in those cases in which little or none of it had been originally found.” “I have found this appearance in the trachea” (in those

entirely submerged from the first), "precisely the same as in those other cases in which a repeated emergence above the surface of the water, though not positively known, might yet have been supposed to have taken place. At all events, since this froth is the product of the mixture of the inhaled fluid, in which the drowning has occurred, of the natural mucus of the passages, or even of blood from some ruptured vessel with the air contained in the lungs and trachea, and caused by the final forcible respiratory movements, it must be regarded as an indubitable sign of vital reaction—that is, that life must be regarded as having existed at the period of its formation." The lungs completely distend the chest, "they appear to be inflated like a balloon, and are not like ordinary healthy lungs, tolerably firm and crepitating, but feel exactly like a sponge. A similiar condition is not found so constantly after any other kind of death, excepting only the most acute oedema of the lungs, which, however, is not present in this case, and, occasionally, after suffocation in irrespirable gases. The distension of the lungs is in part an actual hyperæria, in consequence of the most violent inspiratory acts carried on at the momentary emergences of the head of the drowning person above the surface of the water, but partly and chiefly a consequence of the inhalation of the fluid, in which drowning occurred, into the lungs, as has been indubitably proved by experimenting on animals with coloured fluids, and by my own experience in regard to specific fluids. When the lungs are incised there is a copious outflow of sero-sanguinolent froth. Though, in the controversial writings regarding death from drowning, it has been maintained on the one hand, on the ground of experiments on animals (by Daniel, Morgagni, de Haen, Metzger, Orfila, &c.), and controverted on the other, on the same ground (by Goodwyn, Haller, Maier, Wistrand, Albert, &c.), that water can also get into the air-passages after death, or finally, that it can only then be introduced by means of artificial contrivances (Löffler, Riedel, Kanzler) ; yet there is a criterion which makes this controversy only interesting in a scientific point of view, and

of no importance practically ; I mean the *frothy* condition of the fluid found in the lungs and throughout the air-passages, which, under no conditions can be produced in the dead body, not even by artificial means, as injections, &c., since it (the froth) is the product of the forcible respiratory struggles of the individual while dying.

“The fact, proved by experiment beyond the possibility of a doubt, that the increased volume of the lungs does not exclusively depend upon mere hyperæmia, explains why this condition of the lungs is found even in those cases of drowning where death has been caused, not by asphyxia, but by neuromyolysis, and this adds very much to the value of this most important appearance.”

I attach much importance to the work of scientific observers who have devoted themselves to the study of forensic medicine, for they always work with the consciousness of great responsibility and of their statements being subjected to stringent criticism and cross-examination.

We have, then, arrived at this position :

1st. It has been demonstrated by the Committee that water always is present in animals that have been drowned.

2nd. I have adduced living cases, and Prof. Casper has shown in the dead that the same conditions obtain in man under similar circumstances.

3rd. I and others had observed and recorded cases in man in which water had continued oozing away from the lungs for a long period during the application of the Marshall Hall method.

The second part of the Committee's Report now comes under consideration. The application of reflex stimulants to the surface and to the nasal mucous membrane was found to be practically useless for general adoption. Artificial respiration naturally comes next, and the two rival methods, the Marshall Hall and Sylvester, were fairly tested by experiment. It was found that the amount of air introduced into healthy lungs was quite double as much by the Sylvester as by the Marshall Hall method, and it was on that ground that the Committee recommended, “In the

absence of natural respiration, artificial respiration, by Dr. Sylvester's method should be forthwith employed" ('Lancet' July 12th, 1862, p. 38).

Dr. Champneys, in his able researches on 'The Respiration of Stillborn Children,' also found that more air was introduced by the Sylvester than by the Marshall Hall method, and I had, long ago, in the early days of my practice, acquired good reasons for considering the latter method absolutely useless in the treatment of the still-born; but I pass on to the subject more immediately under consideration.

In the case of drowning it was recommended, by the Committee, in addition to "place the body with the face downwards, and hanging over the edge of a table, shutter, or board raised to an angle of about thirty degrees, so that the head may be lower than the feet. Open the mouth and draw the tongue forward. Keep the body in this posture for a *few seconds*, or a little longer if fluid escapes. The escape of fluid may be assisted by pressing once or twice on the back." I forbear for brevity's sake entering into a discussion on the differences between the amount of air introduced by us in our experiments for Dr. Marshall Hall and the experiments of the Committee; and I admit without question that much more air may be introduced by the Sylvester method than by the Marshall Hall method; but I wish now to adduce reasons and experiments to show that not only is the Sylvester method, as above recommended, useless, but that it is even pernicious in cases of drowning; and, moreover, that it is not always applicable even to cases of apnœa generally.

I take up the general subject at a point, in fact, where the Committee ended its labours. In the discussion on the Report, Dr. Edward Smith pointed out that not "any of their inquiries were applicable to the *drowned human subject*," and contended "that the report was but the commencement of the inquiry," and although he recommended a continuance of the inquiry of the Committee, he considered that the solution of the undetermined questions

would be best effected by the patient investigation of individuals."¹

The cases I would now shortly reproduce are contained in my second paper to this Society (1870), but as they are typical of cases of drowning in the human being, rather than of animals, and as they extremely well illustrate the main features which indicate the relative utility of the Sylvester or Marshall Hall methods of resuscitation, I must be excused for again referring to them.

In 1861, a woman who had been taken out of the Serpentine and treated by the hot bath at the Receiving House, was brought to St. George's Hospital about one hour afterwards. Mr. Jones, the resident medical officer, states that on admission, "her breathing was fair, with loud rattling noise; her lips were livid, her pulse *very good*, her surface and extremities very cold; she was sensible and able to speak." Warmth and appropriate measures were employed, but in half an hour Mr. Jones was suddenly summoned, and only arrived to see her draw her last breath. The Marshall Hall method was immediately employed for half an hour, without the slightest signs of recovery, *but a large quantity of frothy fluid* came from the mouth. At the post-mortem examination next day, it was reported that "both lungs contained an immense quantity of frothy fluid, the bronchi were filled with fluid and injected." In this case the lungs were loaded with and paralysed by water. There cannot be a doubt that the Marshall Hall method would have unloaded the lungs, but I cannot doubt, also, that had she been placed on one side on her arrival at the hospital the upper lung would have cleared and acted quite sufficiently to sustain life. A lung containing frothy fluid does not clear immediately; the bells of foam must gradually coalesce and ooze slowly away, and to assist this, nothing is more adapted than the Marshall Hall method.

Dr. Trollope, of St. Leonards-on-Sea, was called to a man who had been taken out of the sea. The man could

¹ 'Lancet,' July 12th, 1862, p. 39.

speaking a little, and vomited a quantity of water; but he rapidly became worse, insensibility came on, the breathing was slow and faint, and the pulse flickering.

The Sylvester method was being used, and Dr. Trollope persisted in it for some few minutes. "Meanwhile," Dr. Trollope reports, "his respiration had ceased, beyond a slight mucous rattle in the windpipe; his heart's action could not be felt; jaw clenched, and lips livid. . . . I then, finding these alarming symptoms supervening in spite of the persistence in Dr. Sylvester's method, immediately had recourse to Dr. Marshall Hall's prone and postural, or 'ready' method, and was gratified to find *fluid escape from the mouth each time the body was laid on the chest*, and respiration gradually set up, commencing with long-drawn respirations, or rather gaspings, at intervals. I persevered in the prone and postural movements for three-quarters of an hour, till respiration was thoroughly and satisfactorily established. The man then again vomited between a pint and a quart of water, and was afterwards able to swallow a few tablespoonfuls of tea, and went on satisfactorily."

In March, 1862, I was called to a man who had been knocked into the sea by a heavy chain. It was calculated that he had been under water three minutes. On getting him ashore he was believed to be dead, but one of the men thought "they ought to get the water out of him," and so proceeded to roll him from side to side, and whilst this was done, a quantity of water was expelled from the mouth, and they perceived some attempt at breathing.

A few minutes after this I was on the spot, and found the man apparently dying, making occasional and feeble attempts to breathe, with a very feeble and irregular pulse. He was lying on his side with his head upon a coat, and a quantity of froth tinged with blood lying on the coat in the neighbourhood of his mouth. I observed that clear water and froth welled out of his mouth at the end of every inspiration. Active friction of the limbs, hot bottles and bricks, were carefully applied, and ammonia to the nostrils.

Nearly an hour elapsed before we thought it possible he could live. He then began to moan, and in a short time a small quantity of brandy was swallowed.

In July, 1864, a man was capsized in a boat at sea. After being in the water some time he was picked up and rowed ashore. On arrival he was cold and livid, but breathing with great labour. He was immediately turned on his side by the coastguardsmen, and a quantity of frothy fluid came from the mouth. He was taken to an inn, where he was kept on his side, and where I saw him a quarter of an hour afterwards. He was then breathing with difficulty. A fine white froth, almost like milk, was oozing from his mouth and nose; his face was very livid, and meaningless in expression; his breath was cold; the limbs and body generally were almost stone cold; the pulse could not be felt. There were a few moist râles in the left side of the chest, the side which was uppermost, but the breathing was tolerably free; the breathing on the side upon which he lay was very feeble and obscure, and moist râles more abundant. He could not be roused. In half an hour he became a little restless, and then vomited a quantity of water. The pulse could now be felt, but not counted; this gradually improved. Attempts at vomiting supervened, and occasionally a partial restoration to consciousness. After another attack of vomiting, the pupils which had been widely dilated, became contracted, and he went off into a sound sleep. He passed a most trying night from restlessness, and pain at the epigastrium; and the next day he was still livid, but better and easier. The following day pleuropneumonia of the right side (that which was downwards) supervened. From this he slowly recovered.

The following extract from a letter from Dr. Colbeck, of Dover, are corroborative and worth relating:

“Some years ago I had a case of drowning at the Sailors’ Home in which I distinctly made out water to be present in the lungs, as there were loud mucous râles throughout both lungs; after long and persevering efforts with the Marshall Hall method, I succeeded in resuscitating the

man. During the whole period some water flowed from the mouth, much of it doubtless from the lungs as it was very frothy. He had a severe attack of broncho-pneumonia subsequently and was very ill, but from this he also finally recovered."

On August 11th, 1871, I was summoned to a case of drowning. I found a young man about nineteen years of age lying on his back on the beach and men engaged rubbing his limbs.

The face was livid and there was froth about the mouth and nostrils, the eyes were open, conjunctivæ congested and pupils dilated and fixed; there was no pulse, no respiration, nor other sign of life. On percussion both sides of the chest were dull but less so in the subclavian regions.

The patient was turned on his face and a quantity of clear water and froth issued from the mouth and nostrils; he was then turned on his side and the Marshall Hall method continued steadily for three quarters of an hour; up to the last a little froth issued from the nostrils when pressure was applied to the spine in the prone position. From time to time I examined the chest, and found the upper (right) lung gradually clear until at last it gave forth quite a natural resonant sound on percussion, whereas the lower lung remained perfectly dull.

After using the Marshall Hall method for ten minutes, when I thought most of the water had come from the upper lung, I had the upper arm (for the patient was kept on one side, the left, the whole time) raised up over the head, in the manner described by Dr. Sylvester; more air now appeared to enter the tubes, and froth was, on compression of the thorax when the body was pronated, expelled. I could hear râles in the chest during the artificial respiratory movements. The face became less livid, and this was the only apparent change which occurred during our efforts. The temperature of the body was sufficiently preserved by the heat of the sun. I had no galvanic apparatus at hand. On careful inquiry there is no doubt that the patient had been under water for twenty minutes, for he was bathing

half a mile from the town, and this distance had to be traversed and a boat rowed to the spot before assistance could be afforded. He was found near the bottom face downwards, in a sort of stooping position, and rose readily to the surface when an arm was placed beneath the body.

This case, although unfortunately unsuccessful in its results, was most valuable as an experiment; like others I have seen before, it affords proof that water *does* enter the chest, and that before air can be introduced the water must be removed; for this purpose, no method hitherto suggested can equal the Marshall Hall method as it is both simple and certain to effect its object. Moreover, it proves that the application of the Marshall Hall method, for from two to five minutes as proposed by the Committee of the Royal Medical and Chirurgical Society, will not suffice to clear the lungs.

Stretching the pectoral muscles by raising the shoulder undoubtedly increases the respiratory action, but in issuing rules to the public I think it better omitted, for it tends to confusion; whereas it is impossible for anyone to misunderstand the simple instructions of the Marshall Hall method.

The general press now almost daily records cases of death by drowning in which because the *appearance* of death is present, its reality is assumed and no intelligent efforts at resuscitation are employed, although in many instances the bathers have only been missed for a very few minutes. I would suggest that the profession should press upon the municipal authorities the urgent necessity of having a good boatman in the neighbourhood of bathers. He should be well instructed (drilled from time to time) in the Marshall Hall method, so that when the medical man arrives he will find the most important preliminary steps have already been taken, and perhaps the life already saved. In the case I have now recorded the boatman rowed the body along shore for half a mile and did nothing, instead of at once going ashore and commencing the work of resuscitation.

A case almost identical with the foregoing was under the joint care of Dr. Tyson and myself. The young man, aged twenty, had been in the sea submerged for about the same time, the appearances were similar, a similar treatment was adopted, similar changes took place in the lungs during the treatment, and the froth continued to ooze from the mouth about the same length of time. Both cases were carefully observed, and might be fairly looked upon as experimental and scientifically accurate.

The following case has been kindly supplied to me by Dr. Tyson:

A man, aged about forty, was brought into the Folkestone Hospital. He had fallen into the harbour, and was believed to have been in the water from ten to fifteen minutes. On admission he was very cold and in a collapsed condition. There were feeble attempts at respiration. The Marshall Hall method was immediately applied, and continued for thirty minutes.

During its employment the man was always kept on one side, and was turned from face to side from sixteen to twenty times in the minute. Sea water of a frothy character escaped from the mouth during each expiratory action for twenty minutes or longer. The man was manifestly better for the treatment adopted, but it was not considered safe to discontinue the artificial respiration for at least half an hour. The man eventually made a good recovery.

These examples show very conclusively that in cases of drowning in man, water *does* exist in the lungs; that the water only very gradually, and after a long time, is effectually expelled; and that it is absolutely impossible that any relief should be afforded in this way by the Sylvester method.

In 1863 I advanced another step, and in an experiment on a patient suffering from mucous stertor demonstrated that it was dangerous to change the position of the patient from one side to the other, as recommended by Dr. Marshall Hall; for, after the patient has been lying on one side for

a time, the mucus and fluids gravitate into the lowermost lung, and upon the patient being rolled over on to the other side, the mucous fluid found its way across the trachea to the opposite lung, but in doing so, it had been whipped into foam with the ingoing air, which foam, by filling up the larger bronchial tubes, quickly caused suffocation of gradually increasing intensity.

Other cases soon after occurred in which I was able by experiment and by examination of the chest during life to confirm the above observation, especially in a case of active hæmoptysis in which blood took the place of mucus.

Of course water, slightly inspissated with mucus, would necessarily follow the same course in changing the side, and this I have fully proved *does* take place in cases of drowning.

Further, in one case in which I did *not* allow the side to be changed, pleuro-pneumonia supervened on that side *only* which had been lowermost. The change of side therefore which Dr. Marshall Hall had originally advised to be adopted during the use of his method must on these grounds, in future, be carefully guarded against.

I had become entirely convinced that the prono-lateral positions were the only positions to be depended upon in the management of these cases, and that the removal of the tongue and epiglottis from positions of danger was a part of such management. The advice given by the Committee in 1862 "to open the mouth and to draw the tongue forward" again raised the question of the possibility of treating cases in the supine position. I would quote the following account of three experiments in the supine position in which some obstruction was encountered in attempting artificial respiration on the dead subject, and I quote as well, the account of the dissection made by me at the time to ascertain the cause of the obstruction (Marshall Hall 'On Drowning' 1857, pp. 65 and 66).

"A middle-aged man, very much emaciated, having suffered for a long time from abscess of the brain; rigor mortis still present; the brain had been removed.

“*Experiment 1.*—Alternate pressure and relaxation on the thorax, the body supine; no effect.

“*Experiment 2.*—On pronation about one third of the tube—on applying pressure, nearly the whole tube—was filled; on removing the pressure, the tube was emptied to one third; and on resuming the lateral position it was quite emptied. These movements were several times repeated, and invariably with the like series of results.

“*Experiment 3.*—Experiment 1 was repeated. No effect was at first produced; but on pressure being applied by a *sudden jerk*, some obstacle seemed to be removed, and expiration was the result, to such a degree that the tube was nearly filled, as in Experiment 2, and on removing the pressure the corresponding amount was inspired. After this, alternate pressure and relaxation, in the supine position, produced inspiration and expiration with ease. On removing the tube no obstacle was to be seen in the pharynx.

“*Remarks.*—Experiment 1 proves that in the supine position *something* does at times prevent respiration in the dead subject; and although in Experiment 3 respiration was produced in this position it could not be done at the commencement; some obstacle had first to be overcome, probably adhesion of the epiglottis to the back of the pharynx by viscid mucus, as the following observation would tend to prove.

“On cutting down and removing the right side of the pharynx with corresponding halves of the hyoid bone and thyroid cartilage, in another subject, a tolerable view of the position of the parts was obtained. The epiglottis was in direct apposition, by its laryngeal surface, with the posterior wall of the pharynx, so as to preclude the possibility of the passage of air. When, however, the head was allowed to hang backwards over the edge of the table, the bending of the cervical vertebræ caused the posterior wall of the pharynx to recede from the epiglottis, so as to allow the free passage of air. If the tongue had been drawn forwards, would the epiglottis have been removed from the

pharynx? or would the prone position cause it to fall forwards?"

It will be seen by this, and especially by the question asked at the end, that I at that time doubted the propriety of trusting to the pulling forward of the tongue as a remedy.

In my paper on Stertor ('Med.-Chir. Trans.,' 1860) is another dissection of the pharynx, which besides "demonstrating the respective positions of the tongue with the opened and closed mouth, suggest the necessity of caution being used in raising the head with pillows; for if the head be too much bent forward on the chest, the tongue may lie in dangerous proximity to the pharynx, even if the mouth be closed." This observation applied to the lateral position in a minor degree, but more especially to the *recumbent* position; and I never fail to adopt in practice the teachings to be derived from these dissections. I further made sure by experimenting on myself that dragging on the tongue's tip would not affect its base or the epiglottis sufficiently to make it a trustworthy procedure, so that, as before, I was driven to conclude that nothing could be ever safely trusted as a remedy whilst the patient was supine.

In 1873 Dr. Benjamin Howard, of New York, presented an Essay to the National Lifeboat Institution; in it he says, "The foundation of all true progress in the art of resuscitation was first well and truly laid by Marshall Hall."¹ Dr. Howard had employed and taught both the Marshall Hall and Sylvester methods, but in trying to obviate some defects which he found in them, he took a new line of departure and advocated the employment of what he named the "Direct Method." He claimed for it greater exchange of air, greater facility and ease of application, and greater facility for the drainage of obstructive fluids, and that it is more easy to be understood.

You all doubtless know that this method consists mainly of pressure on the lower ribs, in the supine position, the chest being elevated by a roll of clothing underneath the back,

¹ 'Lifeboat,' Feb. 1st, 1873, p. 381.

so that the chest is on a plane inclined towards the head, which is now at a lower level. It seems that at this time Dr. Howard was not aware that the drawing out of the tongue was not to be depended upon for elevating its base or the epiglottis, for he says, "If there be another person present, let him with a piece of dry cloth hold the tip of the tongue out of one corner of the mouth."¹

In a paper in the 'Proceedings of the Royal Medical and Chirurgical Society' of May 14th, 1878, he gave "the results of various and repeated examinations and experiments," and said, "The facts to be represented confirm the alleged respiratory obstruction from the tongue, epiglottis, and velum palati in apparent death, in the ordinary supine position, and show how such obstruction is promoted by the customary flexion of the head and neck; that traction on the tongue, however firm, may open the pharynx its retreat had closed, but nothing more, the epiglottis remaining unlifted."

Dr. Howard made, as he said, "a thorough investigation of the whole subject," and proclaimed and again impressed upon the public mind principles previously contended for, and demonstrated by Dr. Marshall Hall, through work carried out by us in the post-mortem room of St. George's Hospital in 1856, and carried on and elaborated by me soon afterwards in my various papers on Stertor, Drowning, and the Apoplectic Condition.

Dr. Howard soon proceeded to apply these principles to his own method, to perfect it, and in the 'British Medical Journal' of June, 1881, we find a paper on "The Direct Method of Artificial Respiration for the Treatment of the Drowned." He says, "Having myself corroborated, both by experiments and in practice, the conclusions of the first Resuscitation Committee of the Royal Medical and Chirurgical Society respecting the swallowing and inspiration of water, either the one or the other, or both, according to certain conditions of the submersion, the direct method, in contrast to the method curiously enough recommended

¹ 'Lifeboat,' Feb. 1st, 1873, Rule 3, p. 382.

by that same Committee, begins by emptying the waterlogged thorax, relieving the distended stomach, releasing the otherwise immovable diaphragm, and thus making an inspiration possible."

He pointed out how hopelessly useless were the attempts to follow the instructions of the Royal Humane Society, which provided no practical way of dealing with the many obstructions that may, and do more or less, occur in every case of drowning, apnoea, or syncope, and contrasts with those instructions his own, as he believed, more excellent way.

He has shown clearly enough that no doubt should now remain in the professional mind as to the existence of obstructions in the pharynx, and that they must be removed, and the effectual drainage of the lungs provided for as the first step in the treatment of the apparently drowned. To me, of course, every word he said was at once clear and undeniable, because he exemplified and accentuated everything I have worked at and taught for over thirty years, and in addition I have verified in practice the *utility* of these, to me, primitive principles. I am not, however, prepared to admit that his method of carrying out the details of the artificial respiration is the best possible. His objections to the Sylvester method are evident and true, but his objections to the Marshall Hall method are neither evident nor true.

Dr. Howard claims that by his method there is a greater exchange of air. This may be so, but I do not remember to have seen that he has ever measured the relative amounts of air exchanged in the two methods, and during our experimental researches in 1856 we found that on bending the spine backwards *expiration* took place from the abdominal muscles dragging upon the lower part of the thorax.

But even if I admit that more air is introduced by Dr. Howard's method, I contend that that is, if anything, an objection to it, for, as I have pointed out, air too forcibly inspired, whether by traction on the chest walls by means of the pectoral muscles, or by the rapid recoil of ribs and

diaphragm previously very strongly pressed upon, only drives the fluids deeper into the air-cells.

Theoretically one may, too, be doubtful as to the inspiratory power of this recoil, in the position of the body advocated by Dr. Howard, for not only are the lower ribs dragged upon, as I said before, by the overstretched abdominal muscles, but a large organ of several pounds' weight, like the liver, would have to be lifted at each recoil.

It is by no means easy, moreover, on a river's bank for the uninitiated to arrange properly the patient's position; his clothes, folded and placed beneath the back, would not be sufficient to maintain the proper inclination of the body, and, even if this could be effected, it would practically be difficult to maintain continuously the "head-back" position that Dr. Howard advises. The movements employed to effect respiration would be continually shifting the position of the body, and would tend by pressure on the vertex to bring the chin and sternum into closer proximity.

Again, the long-continued dependent position of the head must be objectionable; apnœa implies a gorged condition of the right side of the heart and therefore of the vessels of the brain; to empty those vessels and lighten the oppressed nervous system should be our object. This position of necessity raises a barrier at once dangerous and difficult to overcome, even under less critical conditions. I do not see how this dependent position of the head can be defended, especially when one knows that in the hands of the unpractised, the removal of pharyngeal obstruction is not even by such a position absolutely certain to be effected.

In the Marshall Hall method, slightly modified to embrace the corrections of experience, we have, I believe, the best of all methods.

1st. It is truly a very "ready method" and requires no apparatus.

2ndly. The instructions are easy to be understood by ordinary unprofessional people.

3rdly. On account of the immediate adoption and con-

tinued use of the pronolateral positions this method is more to be trusted than any other for keeping the pharynx clear of obstruction.

4thly. It empties the stomach and gradually clears the lungs of the watery and frothy fluids, and will surely and gently introduce sufficient air at each inspiration to take the place of the fluid which has been expressed.

5thly. The pressure, applied to the back when the patient is prone, exerts an influence on the heart, the blood is moved onwards towards the lungs which are by the next movement opened up to receive it, and thus the right side of the heart and the cerebral vessels are relieved of the engorgement which we know to exist.

6thly. The safety of the patient is more perfectly secured by keeping him on one side during the whole treatment, one lung being thus kept quite free.

7thly. In apnoea, or, after a time, in drowning, when the upper lung is believed to be freed from water and frothy mucus, if more air is required, it can be introduced by elevating the upper arm above the head each time the patient is turned on his side, an addition, in part, of the Sylvester to the Marshall Hall method.

A patient in a state of apnoea or syncope with greatly diminished circulation needs but little air for the preservation of life, and in drowning still less, on account of the presence of water in the lungs. It would be better to lay the patient on one side and trust to nature alone than to have recourse to measures which would cause the forcible inspiration of air, before the evacuation of water had been successfully effected. Artificial respiration, although undoubtedly the best and really only remedy when properly applied, becomes a source of increased danger if used injudiciously and too violently. It is not necessary in the Marshall Hall method to place a roll of clothing or anything else to elevate the chest when the patient is prone; we found by experiment that elevating the chest, even for a few inches, when the patient lay on his face, caused expiration.

In this paper I have not alone passed in rapid review the general question of drowning, but I have demonstrated some new principles upon which our future treatment should be based, principles not theoretical, but which have stood the test of experiment and have been already many times successfully applied in practice. It only remains for me to express an earnest hope that this Society will see its way to reconsider the whole subject and express itself freely and fully for the guidance of those Societies to which the public looks more immediately for instruction and help.

APPENDIX.

The following notes and observations appertain so essentially to the subject of drowning generally, that I think it desirable to add them to my paper.

Brodie's 'Pathology,' p. 70.

"In some instances, after remaining for a considerable time in a state of coma, respiration is again suspended; so that if recovery had been effected in the first instance by means of artificial respiration the animal may be said to die a second time. In others, although sensibility is restored, and with it the power of locomotion, it is only for a time; another attack of coma follows, and this is fatal.

"These statements are founded chiefly on experiments made on the lower animals, but there is no essential difference between the phenomena which occur in them and in the human subject. The case which I am about to mention justifies this observation. It was communicated to me by Mr. Rose, under whose care the patient was placed. A boy of the name of William Claridge, seventeen years of age, attempted to hang himself on the evening of the 17th of July, 1820. He was discovered after a short period of suspension (the exact length of the period being un-

known), and immediately cut down. He was at this time completely insensible; his face was livid, his lips were of a dark purple colour, the pupils of his eyes were dilated and motionless, his pulse not perceptible at the wrist. A pair of bellows being at hand, artificial respiration was immediately had recourse to. In about a quarter of an hour the diaphragm began to act. The artificial respiration was now discontinued. He breathed at irregular intervals, with stertor, and a rattling noise, from the air passages being choked with mucus. The pulse was now perceptible, but often flagging, and the surface of the body was disposed to be cold. The countenance was still of a livid hue, but the breathing became more frequent and regular, and there was also an improvement in the pulse. At the end of another hour an attempt was made to take some blood from the arm, but it was not successful; and from the coldness of the surface of the body it was thought expedient to place him in a warm bath. During the night he continued to breathe; the stertorous breathing continued. In the morning a vein was again opened in the arm, and twelve ounces of blood were taken away, but no relief followed. He continued insensible, cold on the surface, and frothing at the mouth, and died at the end of twenty-four hours from the time of his having been cut down.

“The body was carefully examined. The vessels of the brain seemed to be turgid, with dark-coloured blood, but there were no other morbid appearances.”

The case above related is an instance of what may be called secondary apnœa, and the cause of death is evidently looked upon by Sir Benjamin as some failure in the nervous system; whereas from my observation on the causes and course of “mucous stertor,” I am led to believe that death ensued in this as in other similar cases from bronchial suffocation, a sort of suffocative bronchitis, and that if the patient had been placed on one side and left to nature he might have survived,—the patient was really drowned by his own mucus.

I visited some of the principal receiving houses on the

banks of the Seine, and found that what the men in charge knew and employed in their treatment was derived from English methods, the Marshall Hall and the Sylvester, and that they jumbled the two systems indiscriminately, and used first one and then the other as the fancy took them. The men were very convinced that the patients sometimes recovered after a much longer immersion than was generally supposed.

Dr. Waters, of Liverpool, showed that blood easily passed through the lungs in apnoea if blood was removed from the pulmonary veins ('Medico-Chirurgical Transactions,' vol. xlv).

A butcher, when the ox is knocked down and pithed, quickly opens up its chest in front of, or as we should say in man, above the sternum and freely severs the innominate artery; the blood of course at once rushes out in enormous volume, but it soon becomes a feeble stream; the man or men then commence artificial respiration by pressing forcibly on the hinder ribs with one leg and releasing the pressure rhythmically at intervals, the animal being on its side. Air passes freely in and out of the nostril with force sufficient to blow out the flame of a large taper or suck it in, on ex- or in-spiration, in accordance with the respective movements of the chest wall; the blood-stream, which had become feeble and sluggish, now rushes out with almost as much violence as at first, and for a short time in almost as continuous a stream,—a very good experiment, I think, to show in practice both the truth of Dr. Waters's observation and the value of artificial respiration conducted in this way, in carrying on the circulation and relieving the oppressed right side of the heart.

Notes on a Drowned Porpoise.

In October, 1889, I was engaged with my assistant, Mr. John Stainer, in investigating the internal anatomy of the porpoise. On cutting into the trachea, which was strong and large (one inch in diameter), and completely

surrounded by its cartilaginous rings, I was surprised to find it three parts full of sanguinolent spumous fluid. On squeezing the lungs, more frothy fluid exuded, and with it a number of slender white worms four or five inches in length. The lungs themselves were dense and spongy, and here and there were cysts containing worms in embryo. From these conditions I inferred—

1st. That the animal had been drowned in the element in which it lived.

2ndly. That its larynx must be closed or the fluid would have drained away or have been poured out or have evaporated during the many rough handlings the creature had been subjected to since its death three days beforehand.

Further inquiry and investigation corroborated these assumptions, for the animal had become entangled in a fishing-net deep under the water, and was thus deprived of its breathing requirement, air, and brought up dead.

On dissecting the pharynx from behind, I found that the larynx passed upwards and forwards as a tubular prolongation far into the postnarial cavity, and that about one and a half inches below its orifice it was encircled and firmly clasped and closed by the palatopharyngeus muscle. It would appear that the laryngeal tube was, when in a state of rest, kept closed by this outside sphincter (the palato-pharyngeus), so as to prevent the untimely entrance of water when the animal was beneath the surface of the sea. The tubular portion was composed of the elongated cornicula or cartilages of Santorini above and the epiglottis in front and below, loosely joined together by soft expansile tissue and mucous membrane. The cavities of the mouth and nares were completely separated by the velum-palatinum.

The fluid extracted from the bronchial tubes amounted to six drachms; it was of sp. gr. 1026, precisely the same as the sea water in which the animal was drowned.

CAMBRIDGE; Sept. 14th, 1889.

MY DEAR BOWLES,—About a fortnight ago I was called in consultation to see a gentleman in the country who a few days before had been thrown out of his dog-cart on to his head; he had been seen by Professor Humphry a few days previously, and in his absence the local doctor sent for me. I found the patient lying on his back and making such a noise during breathing that one might have heard him half way down the stairs. I looked at my patient and immediately realised the danger he was in; his throat was full of mucus, which was oscillating between his velum and trachea or some higher point. He was quite insensible and every now and then, in the midst of irregular and shallow breathing, associated with a tremendous rattle, he seemed as if he were going to choke instantaneously. Your aphorism, "Turn him on his side," immediately occurred to me, and in less time than it takes me to write this, the noisy breathing had almost disappeared. I had him turned at first somewhat on his face, to let a quantity of mucus run out of his mouth and then left him, with strict injunctions to his attendants that he should on no account be allowed to lie on his back. When I first saw him I was exceedingly alarmed and thought that he had but a short time to live, for he had deep stertor, a bluish face, and swollen, turgid veins. Had I not been sent for I believe the patient would have been dead before many hours had elapsed—instead of this, on visiting him the next day, his wife said that he had been sleeping "beautifully and quietly." He gradually regained consciousness and is now convalescent.

Ever yours sincerely,

E. CARVER.

(For report of the discussion on this paper, see 'Proceedings of the Royal Medical and Chirurgical Society,' Third Series, vol. i, p. 137.)

CHAPTER I
THE DISCOVERY OF AMERICA
The discovery of America by Christopher Columbus in 1492 is one of the most important events in the history of the world. It opened up a new world of discovery and exploration, and led to the establishment of a new global economy. Columbus's voyage was the first of many that would follow, as European powers sought to claim and colonize the newly discovered lands. The discovery of America also led to the introduction of new crops and animals to the Old World, which had a profound impact on the development of agriculture and industry. The discovery of America is a testament to the human spirit of exploration and discovery, and it is a reminder of the power of human ingenuity and courage.