become lax; ultimately the humerus falls from the scapula, and the head of the bone leaves the socket completely. This condition of parts has been observed in cases where the rest of the muscles of the upper extremity have retained their normal power and law of development. Whenever there is loss of nerve power atrophy or imperfect development ensues; and to this cause must be attributed some of those instances, of which I lately showed you a specimen, in which the whole upper arm is, in an adult, cold, flabby, and four inches shorter than the opposite,—while the forearm, sustained by nerve power, is of its proper size and strength. No treatment is here of avail.

THE HOT BATH: ITS PHYSIOLOGY, USE, AND ABUSE.

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General remarks on the treatment of drowning and the hot bath.
—Marshall Hall's experiments upon animals: their object.—
New experiments.—Conclusions.—Deductions.

THE aim of this communication is as follows: to lay before the profession certain *facts* concerning the hot bath, also certain evident conclusions deducible from those facts, and to apply those conclusions to the physiological consideration of the drowned.

The employment of the hot bath, as the main treatment adopted by the Royal Humane Society for so many years, must have had considerable influence in diffusing the *hot* mode of treatment throughout the country; the adoption of it as "*the treatment for drowning*" must have gradually taken root in the minds of many, who in all probability employed it more from routine, because others used it, than from any physiological reasoning of their own as to its practical value.

During the last few years, however, the plan has been less adopted by thinking men than before, in consequence of the strong denunciations of it by Marshall Hall, who deemed that he spoke not too forcibly when he denounced the hot-bath treatment as the "*poison-to-poison system*." Whether the drowned should be treated by the hot bath or not turns upon this question—Whether the drowned person requires a cardiac or respiratory stimulant to revive him?

This hinges upon whether the cold, insensible, breathless, and pulseless body, just taken from the water, has been brought into that condition from (1) a certain effect produced on the lungs; or (2) upon the heart.

There are advocates for both sides of the question.

1. There are those whose physiology—I presume to be from their treatment—is, that death is impending from cessation of *cardiac* action, who therefore think that all treatment must be for the heart, who recognise in the agent *heat* the best cardiac stimulant, and who consequently apply heat as speedily as they can, both externally and internally, beginning with the hot bath, and going on with the hot bed, the hot room, bricks, bottles, and hot brandy-and-water.

The advocates for this treatment consider, I believe, that the other phenomena, such as the coldness of the skin and the insensibility, are secondary evils, and due to the deficiency of the cardiac action they strive to re-establish.

2. Then there are those who view the matter differently, who look mainly to the respiration, who also know that the body is cold and insensible, who remember that it is *breathless* also, and who consider that to restore the respiration is of the utmost importance, and the first thing to be seen to; and they think that the cold skin will improve as they, by artificial respiration, free the lungs from carbonic acid gas, and they even think that, by thus restoring lung action, they are helping to remove one or more obstructions to free cardiac action.

It is quite time that some definite decision was come to upon this point. If the one plan of treatment is right, surely the other is wrong; if the one does good physiologically, surely the other must physiologically do harm. If it is that the state of the lungs is the chief fault, and that they are mainly deficient in action, or, perhaps, full of fluid, which ought to be got rid of, whilst all the treatment is directed towards stimulating the heart, and nothing is done for the lungs, what can we say but that the poor patient is fortunate indeed if he survive!

But if the lungs are only at fault *because* the heart is mainly affected, how far from true physiology are they in their treatment, and how culpable, who, following the theories of Marshall Hall, treat the state of the lungs as the main evil.

Two chief societies for saving life from drowning exist—the Royal Humane, and the National Life Boat. The former employ the heating system; the latter the Marshall Hall Method. Surely the call for investigation of this matter is great; for if the one society are doing that which is right, the other is doing quite the reverse.

In our investigation of this subject we may make our observations upon man or upon animals. We may make them by complete or partial submersion. It has been observed, that experiments upon animals *completely submerged* "can hardly be called fair" with reference to the merits of the hot bath. Such experiments have, however, been made by Milne Edwards, Brown-Séguard, and Marshall Hall. These experiments were to determine the difference of length of time that life would last according to the temperature of the water used. From the observations of Edwards and Brown-Séguard, we find that "within certain limits, which may in general terms be fixed at 60° and 100° Fahr., the duration of life, in the case of suspended respiration, is inversely as the temperature; above and below those temperatures respectively, heat and cold have each a directly injurious effect."

Marshall Hall mentions *four* similar experiments made by him at the Receiving House of the Royal Humane Society, witnessed and recorded by Mr. Williams. These experiments were made to show that in hot water animals drowned quicker than in cold.

The experiments I am about to relate were made by myself and Mr. Denham Tomlinson, in and after December, 1858, to corroborate or disprove the observations of Marshall Hall. The result of our inquiry was, that we also distinctly found signs of vitality to continue longer in the animals drowned in cold than in hot water. I shortly give some of the experiments, but for another object—namely, because I examined the lungs and hearts of the animals after death, which does not seem to have been done by Marshall Hall.

These experiments will, I presume, be admitted fair, with the new object of employing them to observe the *state of the lungs* in animals drowned in hot and cold water.

Experiments 1, 2, and 3.—I completely submerged three kittens a fortnight old, all of the same birth: one in hot water, at the temperature of 110° Fahr.; another in warm water, at 83° Fahr.; the third in cold water, at 45° Fahr.

Exp. 1.—The kitten in hot water ceased to struggle in one minute, and to gasp in two minutes. Post-mortem, twenty minutes after: Lungs congested, and full of blood on section.

Exp. 2.—The kitten in warm water gave its last gasp in three minutes and a half; the last expired air was in one minute and a quarter. Post-mortem, twenty minutes after: The lungs were congested in patches, and, upon section, full of frothy and bloody fluid.

Exp. 3.—The kitten in the cold water gave its last gasp in six minutes; the last expired air was in five minutes. Post-mortem, twenty minutes after: The lungs were less congested, or less full of blood, than in kitten No. 1; they contained more air and more clear fluid; they were also larger (and fuller of frothy fluid) than were the lungs of kitten No. 1.

In neither of these three animals was the heart found distended with blood, but rather contracted; it was most contracted in kittens Nos. 2 and 3; the right auricle was most dilated in the third.

Experiments 4, 5, 6, and 7 were all made on kittens of the same birth, three days old; March 24th, 1859.

Exp. 4.—Temperature of water 53° Fahr. The last air expired was in one minute and a half; the last gasp was in *twenty-one minutes and a half*.—Post-mortem: The heart was full of blood. The lungs were congested, but to no great extent; their bulk was by comparison a little increased; on section, frothy fluid poured from them.

Exp. 5.—Temperature of water, 103° Fahr. Air was expelled at *two* minutes; at *eight* minutes a very fine stream of air issued from one nostril; the last gasp was at nine minutes. —Post-mortem: The lungs were very much enlarged in bulk, and deep-coloured; they were not crepitant to the finger; there was less air in them than in the lungs of kitten No. 4. The heart was contracted and small.

Exp. 6.—Water at 53° Fahr. No air expired after *one* minute; gasping continued *eighteen* minutes.

Exp. 7.—Water at 98° Fahr. Air last expired at six minutes

and a half, but in very small quantity; the last gasp was in ten minutes.

The state of the lungs of Nos. 6 and 7 tallied with that of Nos. 4 and 5 respectively.

From these experimental facts we can but draw the following simple conclusions:—

1. That kittens drowned in hot water manifest a different series of phenomena from those manifested by kittens drowned in cold water.

2. That in the hot water they expel air from the lungs a little longer than in the cold; they struggle to respire more violently, but they do not continue to gasp nearly so long as the animals drowned in the cold water.

3. That the lungs of the kittens drowned in hot water are found more full of blood, and deeper coloured; but in the other kittens the lungs are much less full of blood, but more full of frothy fluid in the air-tubes.

4. That the heart is found more contracted in the animals drowned in hot water than in cold.

These conclusions indicate these physiological deductions:—

a. That the different anatomical states of the lungs after drowning in hot and cold water indicate a *physiological difference in the mode of death*.

b. That in the hot water the heart is stimulated to more powerful action, to propel its blood with greater vigour into the lungs; whilst the lungs and the respiratory muscles are, from receiving more blood, rendered stronger just at first, and more capable of expiring air; but in proportion to the excitement so is the exhaustion, and they cease to gasp in half the time that the lungs would do of animals drowned in cold water.

c. But in the cold water it does not seem that the heart is so stimulated. Vitality, therefore, lasts longer; less blood is sent into the lungs; they are enabled to gasp for air longer; but by their longer efforts to respire they take in more fluid from the medium they are immersed in, and hence the great amount of frothy fluid, void of colour, found in the lungs of these kittens.

In the case of kittens drowned in hot water, the apnoea is two-fold—partly from want of air, and partly from great congestion of lungs.

In the other case it is more purely apnoea from want of air, which is replaced by the fluid in the breathing tubes.

One other point of interest there is with regard to these experiments—namely, the bearing that they have upon *our treatment* of the drowned human body. This will be considered after a more important series of experiments, showing the effects of the hot bath on the healthy human body, have been detailed.

(To be continued.)

OUTBREAKS OF YELLOW FEVER IN SHIPS OF WAR.

By GAVIN MILROY, M.D., F.R.C.P. Lond.

(Concluded from page 359.)

HER MAJESTY'S ship *Termagant* arrived at Port Royal from the Havanna, on the 16th April, 1866, in a healthy state. The *Malacca*, it has been seen, arrived there from St. Domingo ten days later, with yellow fever on board, and had landed her crew. On the 9th of May the first case of the disease occurred in the *Termagant*, and between that date and the 24th, altogether forty-five of her men had been attacked. On the evening of that day she left Port Royal. Two days afterwards, while becalmed off Cuba, and the weather being hot and oppressive, the disease quickly assumed a very malignant type, which induced them to hasten back to Port Royal, where she anchored on the 1st of June. Between that and the 10th, thirty-eight fresh cases occurred. As the fever was at this time prevailing on shore amongst the white troops, &c., it was determined to run to a cooler climate; and accordingly, after sending twenty-three sick to the hospital, the ship again left the harbour. Before eight o'clock on the morning of the 11th, ten men were attacked, and before the following evening ten more. On the 13th there were seven fresh cases; on the 14th, three; on the 15th, none, and on the 16th, 17th, and 18th, twelve, but these last attacks were much less severe. Between the last date and

the 26th, when the disease ceased,—the thermometer had then fallen to 60°,—nine additional cases occurred. When the ship reached Halifax on the 30th, there were eighteen men on the sick list; but they all recovered. Out of 163 cases, only eight had proved fatal. The *Termagant* returned to Port Royal at the beginning of September.

Four or five weeks after the *Malacca* and *Termagant* left Port Royal, H.M.S. *Hermes*, which had arrived from the Mosquito Shore, was attacked with yellow fever, while other ships lying there at the same time escaped. She left on the 7th of August, and reached Halifax on the 18th. During the passage a few cases occurred, but they were comparatively slight. Out of a crew of about 100, fifty-five were attacked, and seventeen died.

Some of the other vessels on the station had a few cases only of yellow fever; but in none did it spread, save in those above-mentioned. This comparative exemption is variously attributed to the special care taken by the executive officers of their men; to sudden meteoric changes occurring immediately after the appearance of the disease; to improved ventilation of the vessel, and to the removal of the crew for a time into an empty hulk, as in the case of the *Basilisk* at Bermuda.

Altogether, in the course of this year, (1856,) there had occurred in different vessels, 459 cases of yellow fever, and of these, 114 proved fatal.* No fewer than ninety-two of the deaths occurred in four vessels out of the thirty-seven employed on the station, and having a total mean strength of 7845. If the mortality from yellow fever is excepted, the deaths from disease amongst the entire squadron were only sixty-three. The French West India squadron also suffered severely this year from yellow fever. The corvette *Fortune* lost fifty-six out of 212 persons on board. On her arrival at Brest, two of the men who boarded her sickened and died. The pilot was also attacked, but recovered. The *Armida* also lost nearly a quarter of her crew from the fever.

In 1857, H.M.S. *Brilliant* was extremely sickly. A large number of the crew died of the fever at Grenada; there had been nearly 100 cases on board, according to the statements in the medical journals at the time. During the eighteen months the ship was in commission, she had lost no fewer than 130 men before her return to England.

In this year the American frigate *Susquehanna* suffered very severely. The fever commenced on board at Belize. After landing forty sick at Port Royal, she sailed for New York, where she arrived six days afterwards, having had thirty-five fresh cases (of which five had proved fatal) during the passage. The disease continued to appear amongst those who remained on board, and subsequently amongst the labourers and others employed in discharging her stores, &c. It has been stated that the ship for long afterwards was very sickly, and that the bilges had not been thoroughly cleaned out and purified before she was recommissioned.

The recent case of the *Icarus* is in some respects more disastrous than any which have preceded it. Here was a vessel but lately arrived from England, which not only loses nearly one-third of her entire crew within seven weeks, but seems to have been the cause of the extension of the fatal disease to other ships of war, occasioning a melancholy loss of life, and other serious consequences to the public service. Altogether it has been one of the most painful occurrences in our navy that has taken place for many a year, and one which, if thoroughly examined in all its bearings, could not fail to be most instructive for future guidance.

With such facts as the preceding before us, every one will, I think, agree that it is most desirable that a large and sifting inquiry should be made into all the circumstances connected with such dreadful disasters every now and then occurring in our ships of war from epidemic sickness. When a vessel sustains any serious damage or loss, a court of inquiry is invariably held to ascertain what led to it, and whether it was inevitable, or might have been prevented in part or altogether. It would be a fine thing for naval hygiene if the same course were followed when the injury or loss is that of human life, in order to ascertain, if possible, the cause or causes of the calamity, with the view of preventing or mitigating the like occurrence in future. Such inquiries could not fail to be most acceptable to medical officers, as it would afford them an opportunity of publicly recording their opinions on subjects connected with the health of their ships' crews, which should surely be as

* One vessel on the Brazilian station, the *Express*, suffered severely from the fever in the course of this year. In a crew of ninety persons there were no fewer than eighty-five cases, of which thirteen proved fatal, between the beginning of April and the end of June. The other vessels, nine in number, of the squadron, all but entirely escaped.