

ART. XX.—*Experimental Researches on the Post-mortem Contractility of the Muscles, with observations on the Reflex Theory.* By BENNET DOWLER, M.D. (Reprinted from the *New York Journal of Medicine*, for May.) 8vo. pp. 39. New York, 1846.

THIS essay, or monograph, as the author is pleased to term it, though written in not very good taste, nor with much attention to accuracy of arrangement, is, nevertheless, the production evidently of a mind deeply imbued with the spirit of inquiry, but one better adapted to observe and record facts than to weave the conclusions to which these facts lead into a consistent theory.

The essay is replete with matter of very deep interest, and which, by directing anew the attention of the physiologists to the once popular, and perhaps correct, doctrine of a *vis insita* inboreot in the muscular fibre, and constituting its *vita propria*, may be the means of introducing more correct views of the functions of the nervous system, and a modification of at least some of the pathological theories of the day.

The main object of the publication before us, is to prove the continuance of muscular contractility for many hours after death, and that it may be then called into action by a blow inflicted upon the muscle. The author adduces in proof of this fact, the summary of forty-three cases, in which the muscles, when struck with a single, cane, the flat side of a hatchet, or the operator's hand, contracted forcibly, fifteen to thirty minutes, and even one, two, three, five, ten or more hours after death, and the limbs were, in consequence, caused to perform slow and regular contractions, relaxations, pronations and supinations, which simulated the living voluntary movements. The contractions were, in many cases, so forcible as to cause a heavy weight to be lifted by the limb in which they occurred. For the production of these post-mortem contractions, the integrity of the corpse is not at all necessary; they were excited by Dr. Dowler, hours after the dissection of the body, and after the limbs were severed from the trunk.

The bodies operated upon were of individuals of both sexes, and of different ages, varying from 20 to 58 years. The majority of the subjects, however, were young; thus of 39 cases in which the age at which the subject died is given, 31 were below 33 years, and 18 below 26.

The author, without attempting to give all the details in relation to post-mortem contractility, presents thus a few of its leading features.

"Béclard asserts that the most remarkable and best established fact in the muscular action is, the shortening of the muscle during contraction; that its swelling is caused by its shortening, each compensating the other mutually.—*Gen. Anat.*

"It is natural to every muscle, says Haller, to shorten itself by retracting its extremities towards its belly or middle; when in action, becoming shorter and thicker. Whether this doctrine be true of galvanic muscular contraction, I do not know, but I am certain that it does not apply to post-mortem contraction, because it often happens that both the forearm and elbow joint are stiff and immovable, while the biceps may be powerfully contractile, its belly swelling up into a hard lump, relaxing and contracting repeatedly, and unavailingly, owing to the rigidity at and below its insertion in the arm. Here it is evident that the indurated swelling is not owing to the approximation of the two extremities of the muscle, for they are fixed. The increase of volume seems to be owing to an expansion, with rigidity, among its elementary fibres; a zigzag oscillatory motion, upon the summits of the contracting masses, is visible to the naked eye."

The author adduces three cases of post-mortem muscular contraction, without shortening, in yellow fever subjects.

Six cases (five of them yellow fever subjects), are given to illustrate the increase, declination, and subsequent resuscitation of post-mortem contractility. In one, "from four to five hours after death, and two hours after dissection and the removal of the entire viscera, the *cadaver* being warm and rigid, great force was found necessary to extend the arm to a right angle with the body; extensions, flexions, and frictions were used, after which, a blow caused the forearm to rise

until the hand pointed to the zenith—the motion was slow and equable; a second blow caused a slight motion without elevating the arm."

In another case, in a few minutes after death but feeble contractions were presented, which ceased, for a time, in half an hour.

"But soon after, the contractile function returned to the same arm with much force; but after repeated blows it was exhausted a second time. Again, after a similar interval, it returned with a like force, a third time. In three hours the rigidity, beginning in the neck, extended itself to most parts of the *cadaver*. The blows were found to have caused well-marked contusions, cellular ecchymoses, &c."

In a third case, observed from five minutes to an hour after death—

"The contractility was found to be active, but after appending a weight of two to three lbs. to the hand, the arm was unable to raise the weight more than twice; a third blow caused the biceps to be convulsed; it gathered up in a knotty heap, which, by forcible extensions and frictions, was, at length, removed temporarily, but in half an hour it returned, and was unchanged as long as observed, being to the touch like a bony tumor."

In a fourth case, observed from fifteen minutes to two hours after death:

"The contractility, though strong, was extinguished, in the right arm, by five or six blows. The left arm, about two hours after, was somewhat rigid, but frictions and extensions caused the contractile function to revive again."

In a fifth body, dead two and a half hours—

"A single blow with the flat side of a hatchet produced flexion, but exhausted the contractile force for half an hour, when it slightly returned. The supinators and pronators acted for an hour longer than the flexors of the arm; the experiments ending five hours after death."

According to Dr. Dowler, the destruction of the contractile function in one arm does not affect the other.

"If several blows," he remarks, "on the same spot, follow each other rapidly, there is but one contraction, but they exhaust the contractile function more than a single blow. If the force be greatly augmented, the contractility may be killed, almost immediately, in the muscle struck, without impairing the action of any other part.

"This force has no resemblance to that purely physical property of bodies called elasticity. A man may stand on the hand of the *cadaver* while the blow is being made on the biceps; let him then step off the hand, and the contraction will follow as usual. If the power be feeble, the relaxation will be quick in most cases; the arm will fall back upon the plane from all points short of the perpendicular, each elevation being less than the preceding one, until the force is expended. Should the hand pass its meridian, gravitation will, of course, aid the contraction in bringing it to the trunk.

"The blood has no appreciable influence upon post-mortem contractility, because when the limb is severed from the trunk and drained of its blood, its action is not thereby diminished."

"The continuance of, or rather the degree in which post-mortem heat is evolved bears no proportion to the intensity of post-mortem contraction." "I find, however," remarks Dr. D., "on examination of the original papers, not yet published in detail, that for the most part, when the heat had declined, the contractility was exhausted, but that the presence of great heat, ranging as high as 113°, did not by any means imply the presence of contractility, nor the absence of rigidity."

"Post-mortem contractility, in the human *cadaver*, Dr. D. found to have no connection with, or dependence upon, the spinal marrow. This may be received," he remarks, "as an axiom, though directly opposed to the reflex theory, and is easily proved by amputating the shoulder in a proper manner. In performing this operation, it is best to leave a few portions of the skin undivided, so as to tie the arm down to the trunk, that the former during action may not turn quite over."

"Post-mortem contractility, when excited by percussion, is, according to our author, the best fundamental type of the periodicity of the contractile function, better, certainly, than that originating in galvanic electricity; voluntary action may be much more perfect, electrical action necessarily more rapid. The contraction operates for several seconds or minutes. Relaxation, by which the muscle is

made to assume its normal figure, presents another distinct interval. The counter motion, though less prolonged, is equally distinct. Then comes the period of repose (analogous to that following the fatigue, in living muscles) the forerunner of renewed efforts; efforts, however, which must speedily exhaust the quantum of contractile force forever. The period of exhaustion may be hastened or deferred, in many cases, according to the manner of procedure. The contractility may be killed by a severe blow, especially if at the same time a weight be fastened in the palm. It is worthy of remark, that by a proper application of blows all the elemental motions of the arm may be produced more or less perfectly."

Dr. D. has attempted to show that muscular contraction occurs spontaneously after death. We have ourselves seen it repeatedly after death from cholera, and the author thinks or rather hints that the changes in the position of the limbs said to be observed after death, and which have given rise to frightful tales of persons having been buried alive, are to be explained by the occurrence of spontaneous post-mortem muscular contraction.

The results of Dr. Dowler's experiments are, we confess, as unexpected as they are important. That the muscles were capable of being excited to contract for some time after death was well known to physiologists, but it was admitted that the period this capacity to contract existed was very short, and that it could be excited into action only by some powerful agent, as electricity or galvanism, but that genuine muscular contractions could be produced for many hours after death by a simple blow of the hand, was a fact no one suspected until the appearance of Dr. D.'s original paper.

Our author believes that post-mortem contractility is altogether independent of nervous agency. Now, although it is more than probable that the capacity to contract does exist in the muscular fibre as an inherent property unconnected with any special nervous influence, and may be excited into action by stimuli applied directly to the muscle, without the agency of motor nerves, still we cannot admit that the experiments before us prove this conclusively; they certainly, if no error shall hereafter be detected in them, prove that regular muscular contractions may take place independently of the brain and spinal marrow, but still we are to recollect, that the muscles of the limbs, as of other parts, even after separation of these from the trunk, contain a certain amount, more or less, of nervous matter, by impressions made upon which it is possible, though the idea is ridiculed by the author, their contractions may be produced for a limited period. We are still too little acquainted with the true physiology of the nervous matter to assert positively that a portion of a nerve disconnected with the nervous centers is incapable of calling forth action when stimulated.

The remarks of the author upon the doctrine of the reflex action of the nerves of the spine are destitute of that philosophical spirit which would render it a very easy or pleasing task to enter upon their examination. His experiments prove, what we think was very evident before they were undertaken, that muscular contraction is not necessarily or invariably a reflex action; and in this they are so far important, but they do not prove that during life, in the state of health and disease, muscular contraction takes place independently of the brain and spinal marrow. The division of certain of the nerves going to a part suspends, we know, its muscular action under all the ordinary stimuli applied to it, while, on the other hand, violent contractions or rapid contractions and relaxations in the muscles are frequently excited by irritations seated in the brain or spinal marrow, or in some organ remote from the muscles which are thrown into action. There are, in truth, many phenomena connected with the muscular system, which go to show incontestably the dependence of their action upon the nerves distributed to them, and many which can with difficulty be explained unless we admit the truth of the reflex theory.

We recommend to Dr. Dowler the further prosecution of the inquiry he has so successfully begun. We at the same time suggest that the adoption of a more dignified style than that of the essay before us, with more systematic arrangement and less of sarcasm, would have a tendency to recommend the author's views to a more favourable notice by the profession, both at home and abroad; ridicule is not argument, and, by arousing partizan feelings, often prevents the perception and adoption of truth.

D. F. C.