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SOME OBSERVATIONS

ON A

CASE

OF

PARTIAL PARALYSIS OF THE FACE.

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OBSERVATIONS,

&c. &c.

Case of Concussion of the Brain, with Partial Paralysis of the Face.—Local Injury to the Portio Dura from Blows on the Head, not uncommon.—Cases.—Explanation on the principle of Contre-coup.—The Condition of the Uvula remarkable.—Motion of the Eye-lid.—Revolving of the Eye-ball.—Compression of the Eye by the Orbicularis in violent Expiration.—Venous Circulation within the Eye.—Use of the Vasa Vorticosa.

Geo. Kearsley, æt. 20, was admitted on the evening of September 3d, with a severe injury of the head, received by falling out of one of the carriages of the Birmingham Railroad, when the train was at its most rapid speed. It appears that, being intoxicated, and sitting on the end seat of an open carriage, his hat fell off. He turned sharply round to recover it, when he was suddenly thrown from the vehicle, and alighted a little way from the iron rails. When brought to the hospital he lay comatose, breathing heavily, occasionally vomiting, and when roused, he struggled and became noisy. There was an open contused wound of the scalp, near the tuberosity of the occipital bone, a little to its left. Blood flowed freely from the right ear. His head was shaved, and cold lotions applied.

Sept. 4th.—It is difficult to rouse him; the pupils contract on exposure to the light; he vomited, in the morning, a quantity of bile; his bowels have been freely evacuated by a dose of calomel and jalap, followed by a colocynth enema. He was ordered—

Calomel, gr. ij.; Antimon. Tartariz. gr. ¼, every four hours. A poultice to the wound. The cold lotions to be continued.

5th.—Having had some increased heat of skin, attended with flushing of the face, twelve leeches were applied to the head. He lies crouching in bed. Mustard cataplasms have just been applied to the calves of his legs; and these, together with the leech-bites, appear to make him restless; nevertheless, he is difficult to rouse. The blood still oozes from the tube of his ear.

6th.—The muscles of the right side of the face (except those that move the jaw) are found to be paralysed. On a close examination, these are the only parts similarly affected. The sensibility of the side of the face is not impaired. He protruded his tongue, after much rousing. The nurse informs us that he exhibits signs of being desirous of using the close-stool, and gets out of bed for that purpose with her assistance. The bleeding from the right ear has ceased.

7th.—The symptoms are nearly the same. Although the distortion of the features is more remarkable than it was yesterday, the right eye is closed as in natural sleep; and even after the eyelid is raised, it descends again, so as to cover the eye. A considerable ecchymosis is now seen behind the ear.

The pills to be taken at intervals of six

hours. A blister to be applied to the back of his neck.

11th.—As it appeared, from his frequently raising his hand to the right side of his head, that he suffered some pain at that part, six leeches were applied; and it was observed that this was followed by an improvement in the condition of his face.

The pills to be taken three times a day.

13th.—The features are now so near being equally balanced, that the distortion of the face can only be perceived with distinctness when he is roused, and uses the right side of his face.

16th.—All his symptoms are improved, but the amendment in his face has not continued. He was found at the visit with a book in his hand. For the last three days he has had a constant hacking cough, as if he were clearing off mucus from the palate. On inspecting the throat, the uvula was found to be turned obliquely to one side, so that its point was directed towards the right amygdala; yet, when he inspired, the velum was elevated on both its sides. The eyelids were observed to be closed, as before, although their margins did not quite meet; and after elevating the upper eyelid, it descended again when he was asked to wink. But it was noticed that the eyelid did not descend with any degree of force; on the contrary, it presented a looseness and flaccidity which proved that the orbicularis was passive. On narrowly watching this motion, it was seen to depend, in a principal manner, upon the revolving of the globe of the eye, which takes place when we wink; for it was only after the cornea had been elevated, so as to be hid behind the raised eyelid, that the eyelid dropped over the white part of the eye.

He was ordered to use an astringent gargle, and to rub the skin behind and under the ear, twice a day, with mercurial liniment. Simple dressing to be applied to the wound, in place of the poultice. The pills to be discontinued.

22d.—He has been out of bed for some days. The eye is slightly inflamed, and he finds it weaker than the left, especially during candle-light

A blister was ordered behind the ear.

27th.—Hitherto, owing to the general stupor with which he has been affected, it has been difficult to ascertain to what degree his hearing was injured on the right side. At one time it was our impression that the sense was entirely lost; but he now hears apparently quite well on this side, and only complains of a crackling noise in the ear.

October 6th.—When asleep, his eyelids were noticed to be perfectly closed; and he afterwards mentioned that it was without his consciousness that they were shut. A marked difference, however, is observed in their position when he is awake. A short time ago, when he lay comatose, they were always shut; and even after he recovered, the eye-lids closed when he made the attempt to wink; but now they remain wide apart, and the upper one no longer descends, even if he winks with all his force. Indeed, it appears raised to a higher level than before.

10th.—He has been made an out-patient: a second blister was lately applied behind the ear; he has also continued rubbing the cheek frequently during the day, to excite the muscles. There is a manifest improvement in the appearance of the face, but he cannot close the eye any better.

Remarks.—The circumstance that gives the principal interest to this case, is the occurrence of partial paralysis of the face, in connexion with concussion of the brain. Previous to our improved knowledge of the functions of the nerves, such a combination could not have been explained in any satisfactory manner. No reason could have been assigned for certain muscles of the face alone being paralysed, while others immediately adjoining those that were affected retained their power; nor could it have been understood how any of the muscles of the face should have become paralysed without the integuments being deprived of their sensibility. The only way of accounting for this kind of paralysis would have been by supposing that the injury to the brain, occasioned by the fall, had given rise to it. Yet such an explanation would only have increased the obscurity that already characterizes the symptoms resulting from blows on the head; for no lesion of the brain hitherto described has ever been found to produce a loss of power so limited in its nature as that presented in the foregoing case. When it is known, however, that each nerve of the brain is endowed with its appropriate function, it becomes an easy task to distinguish between the effects of a local injury

to one of them, in its course from the brain, and the symptoms denoting a general disturbance of this important organ itself. Here, for example, no doubt can be entertained, that independently of the violence to the brain giving rise to the usual symptoms of concussion, the portio dura of the seventh pair has received an injury in some part of its course; and that this has occasioned the partial paralysis of the face. The portio dura, it has been ascertained, alone controls the particular muscles that have been paralysed; it is known, also, that in its passage through the bones of the skull, it pursues a different route from the rest of the nerves; it can easily be understood, therefore, that it alone may have been injured, while the others escaped. Such an explanation will account for the sensibility of the skin, and also for the power over the muscles of the jaws remaining unimpaired, since neither of these properties depends upon the portio dura, but they are both conferred by the fifth pair, which takes a distinct course through the bones from that nerve.

This case is a correct parallel to others that I have witnessed. Indeed, it may be stated that partial paralysis of the face, of the same kind as was exhibited in this patient, is not an uncommon effect of injuries of the head. It is, at all events, remarkable that from such accidents the portio dura is more liable to be injured than any of the other cerebral nerves. There is evidence of this in the recorded cases of affections of the different nerves of the head. If we refer to the papers on Partial Paralysis*, by Mr. John Shaw (containing the first illustrations submitted to the profession, of the practical benefits to be derived from the discoveries in the nervous system), or to the collection of cases in Sir Charles Bell's work on the nerves†, where a most extensive series of local nervous affections from different causes is given, it will be found that a considerable number of these resulted from blows received on the head. Ten such cases, at least, may be counted. Now in all of these the portio dura was injured; and in one alone, characterized by Mr. Shaw as uncommon in its occurrence, the fifth pair was partially involved in the injury, along with this nerve. Hence it is interesting to inquire, what is remarkable in the anatomy of the portio dura, that should render it so peculiarly subject to have its function destroyed in these cases of blows upon the head. The explanation, as it appears to me, is to be sought for by attending to the course which this nerve takes through the bones of the cranium, and by bearing in mind, at the same time, the principle of *contre-coup*.

It is by a circuitous route, through a canal of some length and complexity, that the portio dura pierces the temporal bone. Now, it is at this very part of the skull that we learn, both by experience and by studying the forms of the bones on the principle referred to, that the vibrations caused by a severe blow on the head are most powerfully felt: it is here that fissures produced by injuries received at distant parts of the skull are most frequently found. We cannot be surprised, therefore, when the portio dura (which, notwithstanding its name, is extremely delicate in its texture) has to pass through the temporal bone, inclosed in a narrow canal, with boundaries of such great density, that it should be peculiarly liable to have its function destroyed by the vibrations of the skull. Blows may be inflicted on the head, of every different degree of violence short of producing actual fracture of the bone, which will, at the same time, cause a considerable spurring out of the bone at the temple, and consequently a shock extending through the canal that contains the portio dura; and no one can venture to say what slight degree of concussion communicated to the nerve thus enveloped may not produce the immediate loss of its power; or by occasioning the effusion of blood, or of serum, or of lymph, around it, give rise to the subsequent destruction of its function. Just as hæmorrhage from the ear, which was one of the symptoms in this case, may either indicate a trifling laceration in the tympanum, or a fracture extending through the base, so may paralysis of the muscles of the features indicate either a slight or a formidable injury to the temporal bone. But let this opinion be correct or not, I conceive that I am borne out in saying, that the frequency with which paralysis of the face, hæmorrhage from the ear, and, I may add, effusion of blood at the temple from rupture of the meningeal artery, attend

* Quarterly Journal of Science, 1821. Medico-Chirurgical Transactions, 1822.

† Bell on the Nerves. Third edition, 1836.

violent blows on the head, is to be accounted for by the tendency which the vibrations have, on the principle of *counter-fissure*, to be concentrated towards the temples.

Without hazarding an opinion as to the exact nature of the injury received by the nerve, in this particular instance, I may be allowed to make a few observations on the subject. When we consider the kind of accident that befell the patient, the state of insensibility in which he lay for more than a week, and that the hæmorrhage from the ear lasted even for three days, we cannot help concluding that there must have been a fracture extending across the temporal bone, lacerating the portio dura in its canal. A fissure through part of this bone might have existed, even although the symptoms were only those of concussion. Nor will the recovery of the patient be offered as an argument against this opinion. I have, in the museum of the school, two interesting specimens of skulls, exhibiting fissures (one complicated with fracture) extending into the temporal bones in both instances; the fissures approach closely to the canal for containing the portio dura; yet it is obvious, from the signs of reparation, that the individuals from whom they were taken survived the accidents. But if there had been a fracture, in Kearsley, we should have expected to find, along with the hæmorrhage from the ear, some puffiness or discolouration of the integument at the temple. It may also be argued, that had the injury to the bone been of such a severe nature, the paralysis would have immediately succeeded the accident, instead of appearing, for the first time, on the fourth day. Besides, the manifest improvement in the condition of his face, shortly after the first accession of the paralysis, is inconsistent with the idea of the nerve having been torn through. It is to be presumed, likewise, that if the bone had been fractured to any extent, the portio mollis could scarcely have escaped; yet when the patient left the hospital, his hearing was scarcely, if at all, impaired. In a case that occurred, not long ago, in the same ward where Kearsley was lying, a patient had partial paralysis of the face, similar to that with which he was affected, and produced from the same cause, a fall from a height: like him, he had also hæmorrhage from the ear corresponding with the paralysed side; this hæmorrhage continued for some days, when it was succeeded by a copious discharge of clear serum from the ear, which only ceased when the patient died, which was in the course of about ten days. It was found, upon examination, that a fissure extended across this side of the skull, towards the foramen magnum; that the dura mater had been torn where it lines the temporal bone; and that this had permitted the serum, secreted by the membranes of the brain, to distil through the crevices of the bone and escape by the external ear. The preparation of this bone which is in my possession, shows that both the portio dura and the portio mollis have been torn across in the interior of the petrous portion: and it leads us also to reflect on the improbability of these nerves ever recovering their functions after such an accident. It will, perhaps, therefore be more consistent with the facts observed in the case of Kearsley, if we consider that instead of there being a fissure extending completely through the bone, there was only, in consequence of the shock communicated by the fall, a partial breaking up of the thin partition in the interior of the temporal bone that divides the portio dura from the cavity of the tympanum. Such a fracture would be attended with laceration of the lining membrane of the tympanum, and might have given rise to the hæmorrhage from the ear, without being sufficient of itself to disturb the functions of the portio duro, so long, especially, as the blood continued to escape from the ear. When, however, the blood ceased to flow, it is probable that it accumulated in the tympanum, coagulated and pressed upon the nerve, thereby producing the paralysis. This corresponds with the manner in which the paralysis of the muscles took place; for it did not commence till the hæmorrhage from the ear ceased; and it corresponds also with the partial recovery of the patient, for it is not unlikely that the effused blood would be gradually absorbed in part.

In the narrative, a peculiarity was noticed in the appearance of the uvula, which deserves some attention. I must state, however, that the appearance to which I refer has been observed in such a small number of cases that it is questionable whether I ought to draw any conclusions from it; but perhaps the observations I am about to make will

induce others to attend to the subject. On looking into the patient's throat, and directing him to inspire, the uvula was seen to turn obliquely to that side on which the muscles of the face were paralyzed; and this appearance continued to be observed during all the time he was in the hospital. The question therefore arises—had this condition of the uvula any thing to do with the affection of the portio dura? Now this will not appear an improbable supposition, if we recollect that a branch of this nerve may be traced, if not directly to the soft palate and uvula, at least into that plexus of nerves which supplies these parts. A twig derived from the digastric branch of the portio dura joins the pharyngeal plexus; and anatomy, which is a better guide than experiment, in questions relating to the functions of nerves so deeply seated, would lead us to conclude that, as it is through this plexus that the motions of the soft palate are performed, the branch of the portio dura that assists to form it may possess a certain influence over the muscles which move the palate *.

The fairest and most unexceptionable mode of verifying this observation will be to examine the appearance of the soft palate in numerous cases of disease affecting the portio dura, while it is still contained within the temporal bone—that is, before it has given off the digastric branch. Hitherto I have only observed a similar condition of the palate in one other case; and it was favourable for the observation, as the paralysis of the face arose obviously from the nerve being injured in its course through the temporal bone. The following is the memorandum that I made:—"On looking into his throat, and making him inspire, the uvula became corrugated, but there was an apparent distortion of the arches of the palate; they were contracted on the side corresponding with the sound side of the face, and relaxed on the other." In a thesis by M. Montault, on Hemiplegia of the Face, I find that he likewise has observed an obliquity in the arches of the palate, in a patient who had partial paralysis from disease of the portio dura; but the description that he gives of the case is not sufficiently exact to allow me to draw any conclusion from it. If future observation shall confirm the idea that I have here offered (and I beg to repeat that I propose it with considerable diffidence), that the motions of the velum palati are in some degree, for I do not suppose that they are wholly, subject to the influence of the portio dura, it may then be asked what is the meaning, in the case that I have related, of the point of the uvula having been turned towards the paralytic side? Now this is the very position which we might expect the depending part of the uvula to assume, by the contraction of the muscles of one side of the palate alone. As the levator palati draws the velum nearly directly upwards and backwards, it will not have any considerable influence upon the uvula; but as the circumflexus or tensor palati stretches the palate laterally towards the hamular process of the sphenoid bone, round which its tendon winds, it will draw the highest part of the uvula that is attached to the centre of the velum to that side, and, by so doing, cause the point of the uvula to turn obliquely to the opposite side. In short, we may expect the same to occur with regard to the uvula that takes place in the tongue: if the muscles of one side of the tongue be paralyzed, and the patient be made to hold it out, the tip will be inclined towards the palsied side; the explanation of which is, that owing to the muscles at the root of the tongue on the sound side operating most powerfully, the root itself is drawn towards the sound side, and the point is consequently directed towards the paralytic side.

I may now be permitted to make a few remarks on the condition of the eye-lids. It was observed, for about a fortnight after there were the most unquestionable signs of the muscles of the forehead and eye-brow, as well as of the cheek, nostrils, and mouth, being paralyzed, that the patient continued to keep his eye shut, and when the eye-lid was elevated it descended again, in correspondence with the left eye. These appearances caused some who witnessed the case to surmise that the orbicularis oculi preserved its power, probably because the nerve had been only partially injured. But this opinion could not be maintained, when the loose flaccid con-

* I performed the experiment of cutting across the portio dura in a dog, with the view of ascertaining whether it would produce any effect on the motions of the palate; but I confess that I could not obtain any satisfactory result. To divide the branch that joins the pharyngeal plexus, it is necessary to cut very deeply; and the injury to the adjoining parts is consequently so extensive that no legitimate conclusion can be drawn from the experiment.

dition of the eye-lid, as it descended to cover the eye, was observed; for it was obvious, as it has been noticed in the case, that although the lid moved, the fibres of the orbicularis did not contract. A question therefore arises, what can cause the eye-lid to close, when the muscle on which its motion directly depends is paralyzed? How does it happen that the levator palpebræ, which is the antagonist of the orbicularis, does not lift the eye-lid and keep it so elevated? Looking at the patient's countenance, we had a striking enough exemplification, in the distortion of the features, of the tendency that is common to all muscles that retain their power to drag those that are paralysed towards them. In the case of ptosis, resulting from paralysis of the levator palpebræ, we know that the orbicularis, when it preserves its power, keeps the eye-lid incessantly closed. Is it not strange, when the circumstances are reversed, the orbicularis being paralysed and the levator palpebræ retaining its power, that the eye-lid should still be depressed?

It may assist in solving this question, if we recollect that, during the time referred to, the patient was comatose; and accordingly there was no reason to expect that the levator palpebræ would be brought into active use. But independently of this, we have to remark that this muscle has an action of a peculiar kind, corresponding with its office, and distinguishing it from other muscles. During the third part of the twenty-four hours, while we are asleep, the levator palpebræ is constantly relaxed; and while we are awake, it relaxes, in the act of winking, about once every minute. Hence it is difficult to say whether, if left to itself—that is, if it be unopposed by other muscles—its natural condition will be to remain in a state of contraction or relaxation. In the present case, owing to the paralysis of the orbicularis and the insensibility of the patient, the levator palpebræ was in a continued state of relaxation, and the eye-lid was perfectly passive, as if both its muscles were paralysed. We can, therefore, understand why the eye remained shut.

But this view will not throw light upon what has been further stated in the case—that the patient, when he was so far recovered as to understand our wishes, could close the eye after the eye-lid had been previously elevated. Such an effect could not be produced in a mere passive condition of the parts. To explain how it took place, we must turn our attention from the eye-lid to the eye-ball, and observe that the action of winking does not consist in a mere dropping of the eye-lid, but that at the same time that the eye-lid descends, the globe of the eye ascends, and even mounts to a very considerable height—to a greater height than the eye ever rises to when employed in vision. The motion to which I refer was first pointed out by Sir Charles Bell, and proved, by a course of ingenious observations and experiments on living animals, to result from the alternate action of the inferior and superior oblique muscles, and to be independent of the action of the recti. In the patient Kearsley, this revolving motion of the ball of the eye remained unimpaired, because the nerves that regulate it proceed from within the orbit; so that when he winked, although the eye-lid did not perform its share of the action, the globe of the eye executed its part, and ascended towards the lachrymal gland. Now it is not difficult to understand how the motion of the eye here described should have the effect of communicating a motion to the eye-lid that might be mistaken for the muscular action of the orbicularis. We have, in the first place, to recollect that the cornea forms a considerable prominence in the front of the eye, and that the margin of the lid even rests upon its convex surface. As the eye-lid, in consequence of the paralysis of one of its muscles and the relaxed condition of the other, in the present instance was quite passive, it is obvious that, upon the eye-ball being elevated, it would be carried up along with it. But the eye-ball could not elevate the lid to any considerable extent, without causing it to receive a sudden check when it had reached its highest point of ascent: by this means the elasticity of the ciliary cartilage, contained within the eye-lid, would be brought into operation; it would recoil, and the eye-lid would again slip over the eye. An additional circumstance is to be remarked: when the prominent cornea passed beneath the margin of the stiff eye-lid, it would meet with some obstruction, and have to push the cartilage forwards to some extent. This would necessarily cause a certain degree of tension in the eye-lid; its elasticity would be brought again into play, and, when the tension was relieved, the eye-lid would glide downwards by its

own resiliency, and with an impulse resembling the action of the orbicularis muscle.

Before leaving this subject, I may revert to the revolving motion of the eye-ball here referred to. It is not for a moment to be supposed that this action of the eye has any particular connexion with affections of the portio dura: the only circumstance that may associate it with such cases, is, that as disease of this nerve causes the eye-lids to remain apart, the rotation of the eye is more easily observed in them than on common occasions. The rolling motion of the eye-ball takes place every time we wink, or when we close the eyes in dropping asleep. It is owing to it, principally, that we experience that aching sense peculiar to drowsiness, when an almost irresistible disposition to turn the eyes upwards, as well as to close them, seizes upon us. But the motion may be observed likewise in a person fainting; as I have witnessed it, with a more appalling expression, in a patient dying. There are, nevertheless, some authors who profess to believe that no such motion of the eye-ball as that on which I have been dwelling ever takes place. Had these gentlemen seen the eye, in this case, travelling upwards to such a degree that the cornea was completely concealed behind the raised eye-lid, and the white part alone exposed, no doubt they would have attributed it to the injury received by the brain—called it a symptom of effusion—applied the term strabismus to it, or perhaps described it as a singular spasmodic disorder of the superior rectus muscle, heretofore unobserved by pathologists.

I beg now to draw attention to the observation, that after the patient had enjoyed the power of closing the eye in the maner that I have endeavoured to explain, he gradually lost it upon recovering from his state of coma, and the eye was in consequence permanently open. That this change did not take place from the power over the muscles of the face becoming diminished, was obvious, because at the very time that it occurred a manifest improvement was observed in their general condition. Two causes, it appears, tended to produce this new feature in the case. First, in consequence of the levator palpebræ being unopposed in its action, and the patient resuming the exercise of the eye in vision, it is natural to conceive that this muscle would acquire a power of contracting to a disproportionate degree, from which cause the margin of the eye-lid would be elevated to a higher level than formerly; and consequently it would be removed from the influence of the revolving motion of the globe of the eye, to which I have attached importance as causing its descent. But another circumstance may have contributed to produce the same effect. In the natural condition, the eye is held within the socket, balanced as it were, between two opposing forces; at its back part it has a bed of fat and cellular substance, which tends by its elasticity to thrust the eye forwards, while on the other hand, the eye is supported and confined within the orbit by the orbicularis occuli acting on its fore part. It follows that when the last-mentioned muscle is deprived of its power, the eye-ball will advance to a certain degree, and become more prominent than the other. This is a condition of the eye which was not only noticed in the present case, but has been referred to as generally observed in affections of the portio dura. If it be allowed that this prominence might become gradually greater after the first accession of the paralysis, we may conclude that it formed an additional cause why the patient was unable, towards the end, to close his eyelids, although he had possessed that power at first.

Having thus had occasion to advert to the compression exercised by the orbicularis muscle upon the globe of the eye, I may be allowed to dwell a little longer upon it, as it may lead us to discover the design of a very peculiar structure in the interior of the eye, to which the action of this muscle seems subsidiary. It has to be remarked that the delicate textures of which this organ consists, are liable to be destroyed, independently of the effects of disease, not only by injuries proceeding from without, as blows, or the intrusion of foreign substances, but also by forces operating from within. This has been especially dwelt upon by Sir Charles Bell, in explaining why the orbicularis oculi should be under the control of the portio dura, a respiratory nerve. It will be seen that, although the action of this muscle has the chief share in defending the eye from both the sources of injury referred to, yet there is a beautiful provision in the eye itself for protecting its fine textures, that has hitherto been overlooke

First let me attend to the action of the orbicularis. At all times the globe of the eye is compressed by this muscle to a certain degree; but at particular periods it is embraced and pressed into the socket much more powerfully than at others. If we watch these occasions, it will be obvious that the violent action of the orbicularis has a relation both to the respiration generally, and to the circulation of the blood within the head. When we cough, sneeze, blow, or strain in any way, we are sensible that, instinctively, or, as it were, spasmodically, we close the eye-lids, and brace the eye firmly in the socket. Now what is the condition of the circulation at these periods? It is familiarly known that the blood contained in the veins flows to the heart with different degrees of freedom, depending on the state of expansion of the thorax; if the breathing be natural, the blood has an equable motion; if a deep inspiration be made, it is admitted in greater quantity than usual; but if, on the contrary, a full expiration be made, it is suddenly checked. Thus the variety in the capacity of the chest influences the admission of the blood to the heart, as it does the admission of the atmospheric air to the lungs. But as the veins of the neck and head are unprovided with valves, the interruption to the free course of the blood in the acts of respiration will be attended with more remarkable effects in them than in the veins belonging to other parts; the large trunks, for example, will be first over distended, and then a regurgitation will take place, reaching even to their minute branches. In a patient who had attempted to cut his throat, and only wounded the external jugular vein in the middle of the neck, I observed that as he coughed the stream of blood spirted upwards as high as the temple, as if the wounded vessel had been an artery going to the head, in place of a vein descending from it. This proves, what will be the condition of the eye, when we cough or sneeze, or perform any other violent act of expiration. The blood will be thrown back into the minute veins ramifying on the tender tunics, by which its soft humours are sustained; and, if not prevented, there will be the same turgescence in these delicate parts that we see exhibited in the red and suffused skin of the face and neck of an asthmatic. How admirably, then, is it provided, that the orbicularis oculi should act powerfully at this very moment, and press the eye-ball firmly into the socket, thus preventing the back current of blood from gaining an entrance into the interior of the eye. The necessity of this compression will be more strongly evinced when we consider what takes place in the brain; for it is to be remembered, that the veins of the orbit belong to those of the encephalon, inasmuch as the ophthalmic vein, after leaving the orbit, joins the sinuses of the brain; and it will accordingly be subject to the same impulses that are occasionally propagated through the veins of this organ. When a circular piece of the skull has been removed in trephining, or, in other words, when a portion of the brain has been deprived of its uniform support, we have an opportunity of observing the nature and extent of the force which sometimes operates through the great venous trunks during the irregularities of the respiration. Every time that the patient breathes heavily, or struggles, or coughs, the dura mater will be seen swelling up to the level of the outer surface of the trephined hole, or, if the dura mater has been lacerated, a quantity of cerebral substance will be protruded on each of these occasions. As these phenomena are only to be accounted for by the blood being retarded in its flow, and consequently accumulating in the veins, and thus squeezing out the brain where it was unsupported by the skull, so may we suppose that if the eye were not duly compressed, its vascular membranes would be disorganized, from the over distension of its vessels.

But I have referred to another provision in the interior of the eye for assisting in the same object. It appears to me that the remarkable distribution of the veins in the choroid coat, which has obtained for them the term *vasa vorticosa*, is designed as an additional means of protecting the delicate textures composing this organ from the same dangers to which I have been adverting—that the force of the returning blood will be diffused and broken, by this peculiar arrangement of the veins, before it can reach the soft and easily-injured parts in which their minute extremities ramify. This appears to be the reason why the veins of the eye do not proceed directly backwards, in straight lines, but before uniting to compose a single trunk, describe those

circular concentric sweeps so much admired in an injected preparation of the eye. This arrangement must cause the blood conveyed from the different vascular parts in the interior to flow, in the first place, in a contrary direction to the current in the larger vessels, so that it will oppose more effectually the impetus of that which is regurgitating. But the oblique manner in which these vorticose vessels enter into the larger veins, towards which they converge, will also serve to check the course of the back current. The mechanism is, in effect, nearly the same that we observe in the veins of the brain, as they fall into the longitudinal sinus: and which, we can have no doubt, is provided to prevent these delicate vessels, which are sustained in the interior only by the soft pulpy substance of the brain, from being gorged with the blood thrown back into the skull during forcible expiration*. In observing the course of these veins, as they ramify on the surface of the hemisphere of the brain, it is seen that they commence at the back part, and then advance forwards in an arched direction, till they fall with oblique openings into the longitudinal sinus. Now, if we exercise a little fancy, and exaggerate in our minds the curves described by the vein of the brain, we may consider the arrangement which they present as not differing greatly from that which exf ists in reality in the vasa vorticosa o the eye. In conclusion, I have to state that the opinion here expressed as to the uses of the vasa vorticosa is confirmed, if we observe the difference in the distribution of the veins in the eyes of fishes, as contrasted with the mammalia. The appearance that has given rise to the name is common to the mammalia; and these are all exposed, more or less, to interruptions of the breathing, as in contending for their prey, or uttering their wild cries, &c. They are consequently subject, also, to the irregularities in the circulation of the blood within the eye, such as we have been considering. But the fish, being a voiceless animal, living in a different element, never exhibits, by the expression of its features, or the movements of its body, any indications of its respiration or circulation being disturbed in a similar manner. Its apparatus for breathing and its circulating system, are, in fact, completely different from what we find in the mammalia. Accordingly, as the fish has no eyelids with which to close the eyes in a troubled state of his breathing, so I have not been able to find any appearance in the interior of the eye corresponding with the vasa vorticosa; on the contrary, the veins which ramify on the choroid coat, in place of taking a vorticose direction, run in straight lines like those of other organs.

* In a case of fracture of the skull, where the longitudinal sinus was wounded, the blood flowed in such torrents each time that the patient struggled or coughed, that I had much difficulty in restraining the bleeding, although it ceased almost entirely when he remained quiet.

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