

ON CERTAIN MINOR INJURIES OF THE BRAIN.

BEING THE ANNUAL ORATION, MEDICAL SOCIETY OF LONDON,

BY

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INTRODUCTORY.

THE choice of the subject upon which I am to have the honour of speaking to-night has been guided by two considerations. In the first place, the unity of structure which is so characteristic a feature of our society seemed to point towards some topic of which the interest is not limited to any special department of medicine. In the second place, the occasion appeared to be one, if I rightly interpret its tradition, in which a very close restriction to technical matters need not be insisted on; while, if the subject chosen developed naturally towards regions outside the strictly medical field, some glance into such wider sources of interest might be, in the circumstances, legitimate.

It will, I think, be admitted that the subject of head injuries is of practical interest and importance to the great majority of us, whether our work lies exclusively or chiefly in a special department of medicine, or is distributed over all. It is, however, only to a very much limited part of this large subject that I propose to invoke your attention. My primary object will be not the gross and at the same time relatively definite conditions that we meet with in immediate consequence of obviously formidable accidents, but the conditions at first sight relatively indefinite, and not obviously serious, which occur as late results or sequels to head injuries of all grades of severity. It will be convenient at once to define our subject yet more exactly. We are to consider a group of phenomena, including headache, giddiness, and other less definable sensations in the head, defects of memory, concentration and attention, alterations of disposition and mood, and certain kinds of mental deterioration. This group of phenomena is to interest us when arising after, and in obvious consequence of, a head injury. It will not be necessary to deal with each member of the group, as the single one of headache can be selected as the most characteristic, and as fully representative of the others. What can be said of headache, the commonest of them, can be said with all reasonable probability of most, if not all, of the others. We have now pruned down our subject until it is adequately represented by that of headache as a sequel of head injury. There remains, however, one further stage of definition to be accomplished. Headache, and others of the associated group of symptoms, is common as a sequel to head injuries of all grades of severity, and bears no obvious relation to the amount of gross destructive damage that has been inflicted. In considering its significance here, therefore, it will simplify the problem if we limit ourselves to headache occurring as the sequel of head injuries of minor severity, and without evidence of local damage to the brain, either through destructive injury or in consequence of haemorrhage. It might be thought that these restrictions of our subject have reduced it to insignificance. This is, however, far from being the case, and it is often of utmost practical importance to recognize the fact that seriously disabling headache is a common sequel to head injuries of an apparently minor kind, in which evidence of any direct local injury of the brain has been altogether lacking.

We have, then, ultimately before us the subject of serious headache as a sequel of apparently slight or trivial head injury.

HEADACHE AS A SEQUEL OF MINOR HEAD INJURY.

It is quite a mistake to suppose that the conditions we are considering are clinically indefinite and difficult to recognize. In well marked cases one of the most fully characteristic of clinical pictures is produced.

The Causal Injury.

There are two types of accident which fulfil the conditions we have laid down. Both are fairly common, of quite moderate severity, and seem at the time of infliction to have caused no definite or severe cerebral injury. In fact, the mildness of the whole affair often causes both patient and doctor, if one is consulted, to congratulate themselves on no harm having been done, and to ignore the necessity for precautionary treatment.

In one type the accident is a fall on the head, as, for example, from a horse. The patient develops slight concussion of the brain; there is momentary unconsciousness, which is quickly recovered from, and followed by dizziness and headache, which clear up in a comparatively few hours. I may say at once that I use the term "concussion," as I think it should only be used in the strict classical sense to indicate an essentially transient state due to head injury which is of instantaneous onset, manifests widespread symptoms of a purely paralytic kind, does not as such comprise any evidence of structural cerebral injury, and is always followed by amnesia for the actual moment of the accident.

In the second type of injury the violence is characteristically limited to a localized area of the skull. This may be produced by the patient accidentally running against some obstacle, by a blow from such a weapon as a stick or sword, or by the grazing impact of a bullet. In these cases concussion is characteristically absent; there is no loss of consciousness, and the patient retains a clear memory of the moment in which the injury was received. If the blow was over some part of the brain, slight functional disturbances in which are capable of being manifested in symptoms, there may be transient numbness, and tingling in the corresponding limb, or clumsiness in the use of it. Such phenomena are not relevant to the limited subject we are considering, and perfectly characteristic cases of post-traumatic headache commonly occur without them.

We have then a patient who has sustained one or other of these accidents. He has been shaken and is in some discomfort for a few hours, or even a day or two, but has already begun to feel that, ugly as the affair seemed at the moment, no harm has been done, and then he begins to suffer from headaches.

As I have already said, I take headache as a representative symptom, ignoring for our present purpose the constellation of minor manifestations of which it is undoubtedly the most important and outstanding figure. It is necessary now to define the clinical characters of these headaches.

CLINICAL CHARACTERS OF TRAUMATIC HEADACHE.

Onset.—If headache has been a well marked immediate consequence of the injury it may be continued into the sequelar headache we are considering. If the patient has been laid up as the result of the injury, the headache is apt to come on when he resumes active life. In any case it is often a week or two before the patient realizes that he is faced with a distressing and disabling trouble that shows no tendency to early spontaneous recovery.

Occurrence.—It is usual and almost characteristic for the headache to occur in attacks which last for periods varying from a few hours even to two or three days. Between attacks the patient may feel absolutely well in every way. The attacks are apt to be brought on by physical exertion, severe or prolonged, or by mental excitement, anxiety or fatigue, and by such combined influences as walking in bright sunlight or in crowded streets, and the many, not always obviously exacting, activities of town life.

Quality of the Headache.—The pain is of a severe throbbing, bursting character. Like that of migraine, it is made worse by any effort, and by bright light or loud noise. It may prevent the patient from sleeping, but, like many other kinds of headache, is often brought to an end by prolonged sound sleep. During the attack the patient is usually restless, intolerant of company or of any kind of attention, and irritable. In severe cases, there may be during the attack almost maniacal irritability and some-

times a semi-delirious excitement. The severest attacks do not usually last more than a couple of days.

Results of Physical Examination.—It is possible, and indeed quite common, for these symptoms to occur without there being any physical signs of definite brain injury, such as even the minor grades of sensory disturbance of cortical type, defects of finer motor co-ordination, or alteration of reflexes. There is, of course, nothing in the nature of the cases to prevent such a severe grade of injury being present as would produce these signs, but I wish to put emphasis on the statement that many cases of the typical headache are met with in which no physical evidence of brain injury is to be made out.

PATHOLOGY.

It has sometimes been supposed that these symptoms are due to a psycho-neurosis determined by the injury. Such an opinion has found support in the total absence of objectively discoverable evidence of cerebral injury, in the fact that the symptoms tend to subside under rest and easy conditions, and to be aggravated on the resumption of active life, and in the supposed fact that head injuries are particularly apt to lead to the so-called traumatic neuroses.

I need not criticize this hypothesis, as I shall immediately be setting before you what I regard as a definitely established organic pathology; but I may pause a moment to remark on the conception that traumatic neuroses are especially likely to follow head injuries. It seems probable that an injury is related to the neurosis it determines as a painful and terrifying experience, the memory of which does not lapse in the normal way but becomes associated with other unassimilated memories and repressed impulses. It is clear, therefore, that the survival of an actual memory of the accident is an essential factor in the production of a neurosis. Now in a large proportion of cases of head injury (including a considerable number of the special group of cases we were considering) the onset is with concussion, and therefore, since a localized absolute amnesia for the accident is always produced by concussion of the classical type, there is no memory at all of the occurrence of the injury. This conclusion is supported by actual clinical experience, which thus confirms the view implied above, that the concussion amnesia is a true organic absence of memory caused by cerebral disturbance.

There can be little doubt, however, that these traumatic headaches are due to definite organic disturbance within the skull. The immediate pathology of headache in general, by which I mean the actual mechanism by which it is produced, has not been the subject of very much attention, though the facts available admit of a reasonably probable sketch being made. In the first place, there is no reason to suppose that disease or injury of the brain itself can be the immediate cause of headache, in the strict sense of the term. As with other serous cavities, the contained organ itself is relatively, if not absolutely, insensitive, and pain can be aroused only by disturbances of the lining membrane and its septa. As with other serous membranes also, it is probable that the most effective pain-producing stimulus is stretching. Now the arrangement of the dural septa is such that variations in the amount of intracranial pressure and inequalities in its distribution tell on them by causing alterations in tension. Thus it comes about that headache of organic origin is a direct expression of disturbances of intracranial pressure however these may be produced. Such a conclusion is in obvious agreement with clinical experience. It is probable that in nature a reduction in intracranial pressure is but rarely the cause of headache. It is plain, however, from the arrangement of the dural septa that a local reduction in pressure can give rise to painful stretching, until the disturbance has become equalized. This, of course, is the mechanism by which is produced the headache that often follows the withdrawal of fluid by a lumbar puncture.

When a disturbance of intracranial pressure is severe or rapidly progressive the consequent headache is continuous. When the disturbance is moderate, and either stationary or only slowly progressive, the headache is apt to be only paroxysmal. This latter is the case with a certain number of slow-growing cerebral tumours in their early stages, and,

as we have seen, is almost characteristic of traumatic headaches. As to the nature of the disturbance in the case of traumatic headaches, we have a large body of direct evidence observed at operations. On such occasions there is always some increase in the intracranial tension, but usually this is only moderate in amount, since an operation is not likely to be undertaken during the actual course of an attack. This increase of tension is associated with one or other of two conditions of the brain itself. In cases where the headache has followed an injury causing concussion, the brain is oedematous and exudes an undue amount of fluid when exposed. In cases where the headache has followed a localized blow on the head and the region struck has been explored, the brain shows by its swelling and blood-staining that it is the seat of a localized bruising. It is highly probable, therefore, that in both cases the increase of intracranial tension is due to the brain being swollen as the result of bruising—in one type of case probably throughout its substance, in the other type chiefly at any rate at the point struck. If it be granted as reasonable to ascribe traumatic headache to a disturbed intracranial tension consequent on bruising of the brain, three points yet remain somewhat obscure and in need of discussion. These are the long persistence of the symptoms and the mechanism by which the bruising of the brain is produced.

THE PERSISTENCE OF CEREBRAL CONTUSIONS.

Traumatic headaches are notoriously capable of persisting for many years, and a difficulty at once presents itself in supposing them to be due to a mere bruise of the brain. This difficulty can be met only by the recognition of a very important, and perhaps the only really special, principle of intracranial pathology. This principle is concerned with the unique status of the brain as the one organ in the body enclosed by a capsule which is wholly inextensible by any physiological force. When any other organ is contused and its substance distended by extravasated blood it can swell as a whole practically without limit, so that its circulation can be liberated from embarrassment by pressure, and the effused blood carried away relatively soon. Again, it is possible for such an organ, only very slowly, or perhaps never, to regain exactly its normal size, and yet in no way to be for this reason a cause of symptoms.

Neither of these possibilities is open in the case of the brain. Enclosed within its inextensible capsule, the skull, the organ can undergo compensatory swelling only to a strictly limited extent. The result is that the circulation through a contused area remains embarrassed by the extravasated material present in it, and resolution by absorption of the bruise is indefinitely prolonged. It is surprising how long after the injury the signs of contusion will remain evident in the injured area. I have myself exposed by operation an area of brain that has been bruised by the glancing contact of a bullet with the skull no less than four years earlier. The brain showed a bruise that appeared as fresh as if it had been inflicted within a few weeks. This inordinate and unique delay in the resolution of contusions is fully adequate to account for the striking persistence of traumatic headaches.

THE INTERMITTENCE OF THE SYMPTOMS.

Although the skull encloses the brain with a certain closeness, it does not do so so closely but what a margin of accommodation is left which permits freely of the variations in the size of the brain due to the circulatory mechanism. An encroaching lesion, therefore, such as an early tumour or a moderate contusion, may have its effects, as it were, contained entirely within this marginal space as long as the circulatory movements are tranquil and small. The moment, however, that such movements become active the fact that the intracranial space is actually encroached upon becomes manifest in an evident elevation of the intracranial pressure and consequent symptoms. Patients at such a stage often observe that every repetition of an act like stooping, which, of course, raises the venous pressure and expands the brain, causes a momentary qualm of dizziness and headache. Along such lines as these are to be explained the intermissions in the symptoms of unresolved

contusions without improvement in the actual condition itself and the mode of action of the various causes that precipitate the attacks.

MECHANISM BY WHICH CEREBRAL CONTUSIONS ARE PRODUCED.

We have spoken of the complete rigidity of the skull in relation to forces of physiological magnitude. We must now turn to its entirely different behaviour in relation to forces of another order. It seems natural to think of the skull as a very strong shield and enclosure of the brain, which yields only to extreme violence, and only when it is broken. The natural result of the attitude is to put fractures of the skull into a position of primary importance, and to treat injuries of the brain as mere complications of them. This conception is, of course, nowadays quite exploded, and I refer to it merely that, by calling attention to the relative pathological insignificance of fractures of the skull, I may give emphasis to the importance of head injury without fracture.

In relation to forces of adequate magnitude and kind the skull behaves as a yielding and highly elastic structure, capable of undergoing considerable distortion and recovering its form without fracture. It is this property which permits of the occurrence of a whole range of important cerebral injuries altogether apart from fracture of the skull. It is out of the question that we should enter here upon a discussion of the many hypotheses that have been produced to explain the various intracranial effects of violence applied to the head. It would also be useless, since there can be no reasonable doubt that the essential primary mechanism in almost all cases is distortion of the skull.

The skull is apt to be distorted in two different ways. One is the result of a fall on the head when the cranium is compressed between the surface the patient lands on and the weight of the body conveyed to the base by the spine. In this case a general deformation occurs, diminishing the volume of the cranial cavity as a whole, and causing the acute compressive anaemia which is represented clinically by the instantaneously on-coming paralytic phenomena known as concussion. The second type of distortion is a local deformation due to a localized blow on the head. Here, of course, there is no general squeezing of the brain and no concussion. In both forms of deformation the brain is apt to be bruised, and when this occurs without fracture of the skull and without other cerebral injury we may get the pure form of traumatic headache due to simple unresolved cerebral contusion. I would again lay the strongest possible stress on the fact that these conditions can be set up by comparatively trivial-looking accidents, and that once established they are distressing and seriously disabling afflictions.

TREATMENT.

The headache of unresolved cerebral contusion is fortunately sometimes preventable, and almost always curable. Prevention is possible chiefly in relation to the widespread but slight degrees of contusion associated with general deformation of the skull and concussion. It is to be attempted by the strict application of the old clinical maxim that every case of concussion must be treated by a definite period of rest in bed, and the very slow and cautious resumption of active life. The duration of such precautionary treatment may, to some extent, be regulated by the presumptive severity of the contusion in the given case. The best measures of this are the extent of the patient's loss of memory for the period of the accident, and the intensity of the so-called phenomena of reaction that have followed the concussion. Supposing headaches to have developed in spite of proper preventive treatment, they may be dealt with by another and lengthened period of rest in bed. This failing, a moderate decompressive opening in the skull and dura is practically certain of success. It should be made at the place of election low down in the right temporal fossa under the muscles. Localized contusion, as it has to be more intense to produce similar symptoms, is less amenable to precautionary treatment by rest, and

is more likely to call for primary operative treatment. This consists in making an opening in the skull and dura over the contused region, so that the latter may be released from pressure, its normal circulation re-established and resolution occur. There are certain cases in which the occurrence of a serious amount of local cerebral contusion may be assumed to be present from the very nature of the injury. Such an injury, for example, is a glancing blow by a rifle bullet. Here, though the skull seems to be intact, and even the scalp is only grazed, cerebral contusion may be assumed to be present, and operation advised, even in the absence of symptoms.

We have now reviewed a limited but very definite and compact section of the great subject of head injuries. This review has, I hope, illustrated to some extent an important branch of cerebral pathology—the functional relations of the skull and brain—and at the same time remained in close contact with the practical realities of medical work.

The Vulnerability of the Brain in the Individual and in the Race.

We may now ask whether this same series of facts and inferences is capable of yielding any idea of more general scope, and capable of application outside the technicalities of medicine. There is one suggestion at least conveyed by these facts, which to my mind tempts further inquiry, and that is that, as compared with what one might perhaps have expected, the brain is shown to be a relatively vulnerable organ, and that this vulnerability is due to the failure of the protective function of the skull in face of even comparatively moderate violence of certain kinds.

That in very early life the brain has a high vulnerability is no unfamiliar idea. We owe our knowledge of the fact largely to the well known researches of our President, published, as I may perhaps remind you, no less than thirty-three years ago. He showed in a long series of examinations of stillborn infants that in somewhere in the neighbourhood of half the subjects there was definite intracranial injury in the nature of haemorrhage and bruising.¹ It is a good example of the essential unity of all branches of medicine that is upheld in the very structure of our society, that the student of cerebral pathology can still turn gratefully to this classical paper in obstetrics. The similar though doubtless less pronounced vulnerability that exists in the adult is revealed to us not so much by direct evidence as through the unique obstacle to the resolution of minor traumatic lesions that is produced by the bony encapsulation of the brain. Any extended consideration of this vulnerability of the adult brain brings to light the probability that it is in some special degree a consequence of the characters of the modern European skull. It is more or less common and accepted knowledge that, for example, the African races are on the whole much less susceptible to the minor traumatic lesions of the brain than are Europeans. Blows on the head that would paralyse the latter are sustained with comparative indifference by the former, and it is obvious that this variation in susceptibility depends on a difference in the resistiveness of the skull in the two races. We thus find that our subject, in the first instance purely medical, has led us, as we suggested it might, into matters of a more general interest, and that we are now faced by questions less medical than anthropological. It is necessary, therefore, though, of course, with every precaution of diffidence, to inquire whether it is possible for medicine to contribute in any useful way towards the solution of problems specifically those of anthropology. In the study of the evolution of man, and the differentiation of the various races, the anthropologist is to a great extent limited to anatomical considerations of form and structure, and to him what may broadly be called functional considerations, though admittedly to be desired, are most often not available. The student of medicine, on the other hand, is primarily interested in function, and makes use of structural observations only in so far as they explain function. The tendency of medicine is more and more to lay stress on function, and to give emphasis to the principle that, at

any rate in the individual, disturbance of function lags far behind disturbance of structure, while the study of function is a far more delicate method of differentiating the status of living matter than is the study of structure. The two races I have mentioned, African and European, afford incidentally a very good illustration of the difficulties of the anthropologist as seen by the student of medicine. We have full accounts of the differences of form presented by the two races; we learn that while in detail they are not very great, they are in sum at least considerable; but we get nothing in the way of a rational explanation of the immense functional difference that is represented by the fact that while one race is capable of producing a continuously evolving culture, the other remains in this respect completely stationary, both in its native habitat and in transplantation. It does not seem that there are differences of cranial capacity or convolitional complexity marked or constant enough to be correlated with this great functional disparity; it would appear, therefore, that the problem is insoluble by anatomical methods, or that the anthropologist must tend to minimize the significance of the functional difference that from our point of view is so great.

We have seen that the European skull does not protect the enclosed brain from injury so efficiently as does the African skull. This must be because the latter is the stronger and more rigid. From the anatomical point of view this superior strength is evidently not very striking, since, as far as I know, it has attracted but little attention and led to no attempt being made to measure it. From the functional and medical point of view the superior strength of the African skull is at once obvious, and is plainly a very important racial character. The superior rigidity and massiveness that in the African are not anatomically very obvious at once become unmistakable in the skulls of prehistoric and admittedly more primitive races, such as Neanderthal man and Piltdown man, in which the massiveness of the cranium has impressed all observers. The relative slightness and flexibility of the European cranium is, then, a leading character of the race, and since, as we have already shown, it brings with it gross functional disadvantages in the resistance of injury, we may assume that it has some deep and real significance in compensation. That is to say, it "paid" the European, so to speak, to develop a type of cranium which put him at a serious physical disadvantage in contest with his primitive competitors and even with contemporary races of to-day; what can have been the "price" he got in return that prevented the transaction from being the bad bargain it so manifestly might have been but was not?

THE EVOLUTION OF THE SKULL IN RELATION TO FUNCTION.

If we survey the evolution of the skull in a very broad and general way, it is plain enough to see that the factors that destined the anterior ganglion of the primitive animal to be the brain of the higher vertebrate, rendered it inevitable that the part of the skeleton that should ultimately furnish the capsule of the brain should be from the first involved with other functions—such, for example, as nutrition and respiration. The cranium, therefore, in addition to acting as the capsule of the brain, has had to take part in forming the nasal respiratory apparatus, the apparatus of mastication, and in providing extensive areas of attachment for the trunk muscles. It cannot but be supposed that these various functions have interacted on one another, and that the interaction has compromised the perfection of the individual function. Thus, for example, the more the cranium had to provide for the attachment of masticatory and neck muscles, the less fully and sensitively could it fulfil its function of cranial capsule, and allow the smaller individual variations of the brain to have their fullest and least restricted scope. It is interesting to notice that when the skull was involved in yet another function—providing attachment for horns—cerebral development seems to have been abruptly checked. In man, even of the most primitive types, the liberation of the cranium from accessory functions took a large step forward but long remained imperfect. In Neanderthal man the

brain was not uncommonly as large, or even a good deal larger, than it is in the average European; and yet the great brain was enclosed, and perhaps we may say imprisoned, in a hugely massive cranium that gave attachment to very extensive masticatory muscles, and was encroached upon posteriorly by neck muscles far more widely than is the skull of any other race. It cannot be supposed that in such a veritable fortress of bone the brain was as free to develop its potentiality for small individual variations as is a brain less formidably enwalled.

It seems probable that a progressive civilization—that is to say, a cultural evolution which, though perhaps aimless, is continuous—depends less on the appearance of unusually able and original individuals in the race than on the free production of quite small variations round the mean. Contributions of originality, in order to be continuously and securely built into the fabric of a culture without disturbance, should be individually small or even infinitesimal; and it is this condition that appears to be realized when the brain is free to develop its minor variability, and to be lacking when the brain is subject to the slight restricting effect of a cranium loaded with accessory functions. There seems, therefore, a certain plausibility in the hypothesis that the secret of the modern European type—and I use that term, of course, in the sense of the anthropologist rather than in that of the historian—lies in the capsular function of the cranium having acquired in that type for the first time a definitive supremacy over the accessory functions. If it is this *supremacy* of the one function that was the original variation that constituted the European type, and is an inherited character in it, then it must be capable of producing progressive effects, and we ought actually to be able to detect evidence that the accessory functions of the cranium are undergoing decay. The relative slightness and low rigidity of the European skull in comparison with the African is possibly a manifestation of this process, and is probably progressive. European skulls are without any doubt remarkably variable in density and thickness, as anyone with operative experience can testify, and such variability is at any rate highly suggestive.

It is generally recognized that the masticatory apparatus of modern man is undergoing atrophic changes, and at no very slow rate. This is, of course, most clearly seen in the teeth, in which the process of suppression of the molars from behind forward has gone so far that already we may almost regard two fully erupted molars on each side as more properly representing the normal than three. It is to be remembered that the molars are still physiologically the most valuable of the teeth, and those the loss of which produces the most serious effects. On this account alone, and apart from far more serious theoretical difficulties, it seems impossible to assign any value in the explanation of their suppression to disuse. A more trustworthy line of speculation is suggested by the fact that it is the anterior teeth which seem least to show the tendency towards suppression—those teeth, that is to say, which are actuated by the masseter muscle, which is not directly connected with the cranium. On the other hand, the teeth which do show the tendency to suppression are those associated in function with the temporal muscle, which arises directly from the cranial wall. The cranium is, so to say, throwing off the remnants of its masticatory function, and the temporal molar group is consequently tending to disappear.

No one could acknowledge more readily than I do the speculative nature of these suggestions; at the same time, it may perhaps fairly be said that they bring into some kind of relation a body of facts that possibly has not been viewed in connexion before. However that may be, I would rather claim my justification for troubling you with them in the attempt to show that even a strictly technical subject, and one of everyday practical importance to the medical man, cannot exist in isolation, but tends inevitably to throw out implications of wider and wider reach and of more and more general significance.

REFERENCE.

1 H. R. Spencer: On Visceral Haemorrhages in Stillborn Children; *Trans. Obst. Soc.*, 1891.