tion—namely, to split the tongue down the middle, to loosen it from all its attachments beneath, and then divide with the *écaraseur* far back, taking one-half of the tongue at a time. Of course in many cases you remove only half; it is not necessary to remove the whole. We have most of us now given up that operation and gone to the intrabuccal operation with the scissors, generally known as Mr. Whitehead's operation. It is extremely simple. All you have to do is to gag the patient thoroughly—it is important to have a good gag; then, getting a firm hold of the tongue, with the scissors you divide the mucous membrane under the tongue and the muscles, and, drawing the tongue well forward, next divide it at the root, cutting steadily through till the lingual artery is exposed, when you can often pick it up before dividing it. Having done one side, you go to the other, if you remove the whole tongue, and treat it in exactly the same way. The result is that you get the tongue away as far back as you like with very little hæmorrhage.

Let me say, on the subject of hæmorrhage, that I myself introduced an improvement in the operation about the tongue some years ago, which I find most surgeons have adopted, namely, that when there is hæmorrhage and you require to stop it, you simply put your fingers down the patient's throat and hook up the base of the tongue and the hyoid bone. I found that out when assisting my colleagues in removing the tongue. We used to have occasionally sharpish hæmorrhage. It was my business to help to pick up the arteries, and I found that by putting the fingers well down I could stop the bleeding, making the tongue bloodless, and pick up the arteries quietly, as you might pick up an artery in a limb.

But then supposing you have disease of the tongue with enlargement of the glands, should you or should you not operate upon them? For myself I am not particularly fond of removing glands, yet I am obliged to do it from time to time. Where I find a patient has an ulcer of the tongue which is distinctly cancerous with infiltration in the submaxillary glands, I do not hesitate to make an incision and take the glands out. It becomes a little different when the glands of the neck are affected. In my experience cases where the submaxillary lymphatic glands are not affected and the glands under the sterno-mastoid are affected are the worst possible cases. If you cut out one gland, you find very soon afterwards that another becomes affected; and those patients, as a rule, have very short lives. Cases where you can remove the glands under the jaw merely do fairly well, as well perhaps as any of these cases. Because, after all, you must remember that recurrence is almost invariable, and one hardly knows of a patient with *bonâ fide* epithelioma living more than two years. Then in these cases where the glands are affected you may have seen some of my colleagues do a very large operation called Kocher's operation. You make an incision into the neck, turn up a large flap, and get down upon the glands; you then get hold of the tongue, and you can undoubtedly remove numerous glands and extensive disease of the tongue through that incision. I am not particularly favourable to it. It seems to me that in cases in which there is such extensive disease as to warrant an operation like that, we had better not interfere with the neck, but content ourselves with removing the tongue. That, however, is my individual opinion.

You saw me in the beginning of last session do an extensive operation on a man in the private ward, No. 1. He was sent up from the country with extensive disease of the tongue and of the submaxillary tissues. He was in a miserable state, and anxious to have something done. I told him plainly that I would operate if he wished, but I could not promise him anything more than temporary relief. On November 2nd I operated on him. The disease was so extensive that I thought it better to do tracheotomy first. I do not usually do tracheotomy in these cases; I do not hold with preliminary tracheotomy in ordinary operations on the tongue; but this was so extensive a case that I thought it right to do it. I was then able quietly to remove the whole tongue down to the hyoid bone, and a piece of jaw right up to the masseter on each side, and all the infiltrated submaxillary tissues. It is not the first time that I have done an extensive operation like that. The first case I had was in 1876, and the result of it is in the museum. The patient lived certainly four years after the operation, but he did not appear to have many weeks to live at the time I operated.

Still these extensive operations are not very satisfactory. This very patient, before he was really well, had a recurrence. The operation was on November 2nd, and he went out on December 2nd convalescent from the operation, but having already evidences

of a return of the disease. I heard from the friends that he had a recurrence, but I have not heard whether he is dead; the poor fellow cannot have long to live.

The satisfactory cases are those where the disease is entirely confined to one part of the tongue, where you can get well behind that portion and remove it at once, and where there is no infiltration of the glands. It rests with you, who will see these cases early, to insist upon the patients having an operation in early days if there is evidence of disease. When we get that sufficiently insisted on, unquestionably our rate of mortality and our rate of cure will very much improve.

The Registrar-General has pointed out that cancer is much on the increase. There are two or three explanations. No doubt many cases are put down as cancer which formerly were not recognised as such. Still even if that be so, I think, from my own observation, there can be no doubt that we do see more cases of cancer of the tongue than we did twenty or thirty years ago. One explanation is, I believe—you will excuse my saying so—the greater spread of smoking; and another, I think, is the greater spread of syphilis. Those are the two main elements which have to do with cancer of the tongue being so much on the increase. I hope that we shall be able to diminish it, and that by taking the cases early and by removing the diseased part thoroughly, we may be able to hold out some prospect to the patient of prolongation of life—we cannot honestly do much more than that at present.

THE PROCESS OF COMPENSATION AND SOME OF ITS BEARINGS ON PROGNOSIS AND TREATMENT.¹

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MR. PRESIDENT AND GENTLEMEN,—When my old friend, your esteemed Secretary, asked me in the name of your Council to read a paper and introduce a discussion at this meeting, I felt that it was impossible to refuse such a complimentary invitation, for which I now beg to return you my warmest thanks; but I did not, I fear, sufficiently appreciate the difficulties of the task to which I was committing myself; indeed, it was only after I had accepted your courteous invitation, and when I came to look about me for a subject, that those difficulties became fully apparent. After much consideration and not a little hesitation in coming to a decision, the subject which finally commended itself to me was "the process of compensation and some of its bearings on prognosis and treatment;" and I trust that in selecting this subject my judgment may have guided me correctly, and that it may prove both acceptable to you and the source of a good debate.

Speaking generally, and using the term in its widest sense, compensation may be said to include all those processes by means of which Nature endeavours to repair a damage done by disease or injury, to protect herself against the injurious results of disease, or to relieve, reduce to a minimum, and make bearable those results.

The basis of all compensation is the fundamental fact that the human organism as a whole, and each of its individual parts in particular, is, in ordinary circumstances—and granting, of course, that the condition is one of health—working below its full strength; that, in short, it possesses a large balance or reserve on which it can fall back when any sudden or unusual demand is made upon it.

Now the success of the result—in other words, the completeness of the compensation—depends upon several factors, the most important of which are:

1. The amount of the reserve.
2. The suddenness and extent of the call; or, in other words, whether time is allowed for the realisation or development of the reserve.
3. Whether the demand is temporary or continuous; in other words, whether the lesion is stationary or progressive.

I may perhaps be able to make my meaning clearer if I make use of a financial illustration.

¹ A paper read before the Border Counties Branch of the British Medical Association at Carlisle on February 24th, 1888.

Suppose, then, in the *first* place, that a call is made upon a trader which exceeds his reserve, the result will, of course, be bankruptcy or financial death. The same result may follow when a demand for a sum, well within his reserve, is made so suddenly that he is unable to realise his resources and so to meet the call which is thus unexpectedly made upon him. In the latter case, the risk of bankruptcy will, of course, be greater when the reserve is already partly mortgaged and tightly tied up.

Now both of these conditions have an exact parallel in disease. A severe case of malignant scarlet fever, which rapidly proves fatal, and in which, from the intensity of the attack, the case is clearly hopeless from the first, may be taken as an illustration of the former; while the latter is exemplified by the fact that sudden destruction of a comparatively small portion of the motor cortex of the brain will produce paralysis or loss of function—bankruptcy of the muscles, as we may term it—while much more extensive destruction, provided that it is slowly and gradually established, or, in other words, provided that time is allowed for compensation or realisation of the reserve, may be unattended with any paralysis (see Figs. 1, 2, 3, and 4).

In the *second* place, a heavy call made upon a man in a large way of business and who has an ample reserve, may severely tax his energies and resources for the moment; but, provided that he is able to keep himself afloat and to tide over the great and sudden strain which is placed upon him, his position is ultimately little, if any, the worse. For a time, it is true, he may be debilitated and shaken; but his business is so sound, his credit is so good, in other words, his vitality is so great, and the local damage which is left behind is comparatively speaking so slight, that he soon makes up his loss, and is ultimately in no way deteriorated. As examples of this condition, acute croupous pneumonia and those inflammatory and febrile diseases, such as typhus, which leave little or no permanent local damage, may be mentioned.

In the *third* place, a demand, which falls short of producing bankruptcy, may so seriously reduce the trader's reserve and so materially damage his credit that it leaves him permanently crippled. Under such circumstances, a wise man appreciates the difference in his position, reduces his expenditure, is careful to avoid risks and hazardous speculations, and above all, to guard himself as carefully as possible against a repetition of the conditions which produced his previous reverse. Permanent compression of the lung, the result of a pleurisy with effusion or an empyema, destruction of one kidney by suppuration, and syphilitic disease of the larynx with resulting stenosis, may be mentioned as cases in point.

In the *fourth* place, instead of, as in the former cases, a single call being made, the demand may be repeated from time to time, or it may become more or less continuous. At first the effect may be unnoticed, for, the call being small in proportion to the reserve, it may excite no anxiety or apprehension. But frequent repetitions of the call may so reduce the reserve that ultimately a period may arrive when the reserve is exhausted and the income is only just sufficient to balance the expenditure. Under such circumstances, a trifling extra demand, which formerly would have been laughed at because of its insignificance, may now be sufficient to upset the balance, to throw the trader into great difficulties, or even to produce bankruptcy. Illustrations of this group are numerous in disease; perhaps the best that can be cited is a slowly progressive cardiac valvular lesion, such as aortic regurgitation.

Turning now to actual disease, let me mention some of the chief means by which compensation and compensatory protection are effected in the human subject.

In the case of doubly or bilaterally represented organs, when one is disabled or destroyed, compensation is effected by enlargement or true hypertrophy of the remaining sound organ on the opposite side. Familiar illustrations are the hypertrophy of one kidney or of one lung which follows destruction of the kidney or lung on the opposite side.

The very important practical bearing which the condition of the remaining and apparently sound organ has, both for prognosis or treatment, is self-evident. The success or failure of an operation for the removal of a diseased kidney to a large extent depends upon the condition of the kidney on the opposite side.

And here I would raise a practical point, and ask whether there is any other means than palpation and percussion of the kidney

(in other words, than the presence of localised pain or tenderness on pressure, or of distinct enlargement of the organ), by which it is possible to ascertain the condition of the kidney which is to remain. The condition of the urine discharged *per urethram*, is an uncertain guide, for, representing as it does the products of both kidneys, any abnormal constituents which it contains may, of course, be derived from the diseased kidney. I would like to ask whether it may not be possible, by the aid of the electric endoscope which Mr. Hurry Fenwick has recently described, to catheterise the ureters in the male, and by obtaining the urine direct from either kidney, to ascertain the functional condition of each organ individually.

The relative value of life after one of two bilateral organs, such as the lung or kidney, has been destroyed or removed, is a question of distinct practical importance, and one which, so far as I know, has not yet received the attention it deserves. The subject is one which might I think be profitably taken up by the Collective Investigation Committee of the Association.

It is quite obvious that the life of an individual who has lost one lung in consequence of an empyema or a long standing and badly treated pleurisy with effusion, or of a patient who has lost one kidney either as the result of a pyelitis, or in consequence of its having been excised by the surgeon because it was the seat of a tumour, or affected with hydro-nephrosis, hydatid or cystic disease, is a bad one, quite apart from the risks entailed by the diathesis or special pathological tendencies of which the original disease was a manifestation. A limited pneumonia or a small pleuritic effusion, which in a normal individual would be a comparatively trifling condition is, as we all know, attended with the greatest danger when the opposite lung is useless. But irrespective of such obvious and well-known risks, does not, I would ask, the increased strain and functional activity which is thrown upon the remaining sound organ, when its fellow has been destroyed, entail special risks, and predispose it to disease? When, for instance, one kidney has been destroyed or removed, is not the risk of Bright's disease greater than it would be in the same individual, provided that he had two kidneys? I would ask the members of the Branch to give us their experience on these points—to detail, for example, the life-history of cases in which one lung has been rendered useless by a previous pleurisy or empyema.

Compensation in Brain Lesions.—There is perhaps no organ in which the results of unilateral damage are more interesting, or require more careful observation than the brain. Consisting as it does of two hemispheres or halves, the different portions of which (areas or centres of grey matter) are, as modern investigation (experimental and clinico-pathological) has shown, endowed with special functional activities, it is a most interesting and important question to determine whether the corresponding centres in the two hemispheres are functionally separate and distinct, or whether they are so related that when one, say a centre in the right hemisphere, is destroyed, the damage may not be compensated, in other words, the function taken up and carried on by the corresponding centre on the opposite (say the left) side.

The question is a difficult and complicated one, and the facts which we at present possess are not sufficient to enable us to give a definite answer in all cases. The result would appear to depend chiefly upon two factors, namely (1) the function of the centre which is destroyed, and (2) the age of the patient at the time when the destruction takes place.

The motor centre for speech in right-handed persons is, as we all know, located in the posterior end of the lower or third left frontal convolution. Destruction of this centre is followed by motor aphasia, but the permanence of the speech derangement depends, to a large extent at least, upon the age of the patient. In children the aphasia is usually of quite temporary duration, and in young adults the condition may be entirely or to a large extent recovered from, but in old people recovery is usually very imperfect; indeed, in many cases after the temporary disturbances (speech defects) due to shock, inflammatory oedema, and cerebritis have subsided, the aphasia which is due to the actual destruction of nerve tissue (that is, to the lesion itself, and not to the temporary disturbances in its neighbourhood) remains, and little or no improvement in the condition subsequently takes place.

Now in those cases in which Broca's convolution has been destroyed, and in which recovery from the aphasia takes place, compensation is in all probability effected by the corresponding centre on the opposite side (posterior part of the right lower frontal convolution) taking on the function of the part which has been de-

² The paralysis which follows a sudden but small lesion of the motor cortex may be, in fact usually is, merely temporary.

stroyed. That this is the manner in which compensation is effected in such cases seems proved by a case of great interest and importance which Barlow has recorded; the chief details of which are as follows. A boy, aged 10, affected with aortic disease, was suddenly seized with right hemiplegia and aphasia, the paralysis chiefly affecting the face and arm. The aphasic symptoms soon passed off, and at the end of a month he had apparently quite recovered. He was then seized with left-sided hemiplegia, which chiefly affected the face and arm. There was now complete aphasia, with paralysis of all the muscles of the face and tongue, reflex movements, such as deglutition, being, however, unaffected. The aphasia continued until the time of death, which resulted from the cardiac lesion. At the necropsy a lesion was found in exactly the same situation in each hemisphere, namely, a yellow softening of the posterior part of the middle and lower frontal, and of the lower end of the ascending frontal convolutions. In this case, therefore, destruction of the left motor speech centre produced aphasia, which was soon recovered from, while subsequent destruction of the corresponding part in the right hemisphere (destruction of which, it will be observed, does not as a rule produce any aphasic disturbances in right-handed persons) was followed by complete and permanent aphasia, and, in addition, by paralysis of the facial and tongue muscles (JOURNAL, July 28th, 1877, p. 103).

In the case of the motor centres more strictly so called, the result (that is, whether compensation will or will not take place) seems to depend largely upon the fact whether the movements which are represented in the centre which is destroyed are in the habit of being performed bilaterally or unilaterally.

Fig. 1.—Diagram illustrative of the manner in which paralysis is compensated in the case of muscles which are in the habit of acting in association. The letter B points to the right, and B' to the left, cerebral hemisphere; n and n' to the nerve nuclei in the spinal cord, for the muscles m and m', which are in the habit of acting together. A lesion, in the position of 1, will arrest the motor nerve force, passing down from B to m' through n'; and will therefore cause paralysis of m'. Compensation is effected, and the paralysis recovered from by the motor nerve force from B', passing through n and n' to m', as shown by the arrow.

The movements of the two eyes, of the two sides of the face, chest, and trunk are, for the most part, performed in concert. We laugh, for example, with both sides of our faces, and although some persons are able, by means of a voluntary effort, to put each individual muscle of expression into separate and independent action, for most of us this is impossible without long practice. Many people even find it difficult to wink with one eye alone.

In short, there is every reason to suppose, from the observation of muscular action in the healthy man, from the results of experimental investigation on the brains of monkeys, and from observation of spasms due to localised cortical irritation in the human subject, that those muscles on the two sides of the body which are in the habit of acting in true association or concert may be thrown into action from either hemisphere.

Possibly this associated bilateral action is effected, as Broadbent has ingeniously theorised, by means of commissural fibres connecting the nerve cells of the trophic nerve nuclei in the pons Varolii, medulla oblongata, and spinal cord. (See Fig. 1). But be that as it may, there can be little doubt that when a cortical centre which innervates muscles which are in the habit of acting in concert with corresponding muscles on the opposite side of the body is destroyed, compensation is effected and permanent

paralysis prevented by the function of the destroyed centre being taken up and carried on by the corresponding centre in the opposite hemisphere of the brain.

The more highly specialised movements, on the other hand, seem, so far as we at present know, to be represented only in one—the opposite—cerebral hemisphere. If this is so we should expect that complete destruction of the cortical centre, say, for the muscles of the forearm and hand, would be followed by permanent paralysis, and that such is actually the case seems proved by the experiments of Ferrier, Horsley, and Schäfer, in the monkey, and by the results of disease (destroying lesions) in the human subject. In those cases, for example, in which hemiplegia results from a lesion in early life, though the leg regains a considerable amount of power—indeed, in some cases, almost completely recovers, the muscles of the hand and forearm may, and often do, remain markedly paralysed. Such cases seem to prove conclusively that the motor centres for the muscles of the hand and forearm of one side are only represented in one, the opposite, hemisphere; and that when the muscles concerned in the production of the highly specialised movements of the hand are paralysed, compensation cannot be effected by the corresponding centre on the opposite side of the brain taking up and carrying on the function of that which is destroyed.

Cases are occasionally met with which seem at first sight, at all events, to form exceptions to this law. The most remarkable case of this kind with which I am acquainted is one which I have reported in the *Edinburgh Medical Journal* for February, 1879, page 693. In it, a large sarcomatous tumour, almost the size of the closed fist, had apparently destroyed the greater part of the motor area on the right side. So far as one could judge with the naked eye, the whole of the motor centres for the face and upper extremity were destroyed (see Figs. 2, 3, and 4), and on microscopical examination the grey matter in this region seemed to have completely disappeared. And yet there was absolutely no trace of paralysis.

Cases such as this suggest at all events the possibility of substitution being in some rare cases effected, even when the movements paralysed are highly specialised and differentiated by the corresponding motor centres in the opposite hemisphere.

A more probable explanation is, however, that which supposes that the grey matter in the affected area was not entirely destroyed. In considering cases of this description, it must be remembered that the different cortical centres are not sharply defined and separated one from the other, that to some extent at all events they run one into the other. Such an overlapping has been clearly demonstrated by Horsley and Schäfer in the case of those centres which are situated on the inner side of the cerebral hemisphere (that is, in the marginal convolution).

The importance of this overlapping, and the possibility of compensation being effected by undeveloped or embryonic nerve-cells in the immediate neighbourhood of a centre which has been destroyed has been clearly set forth by Victor Horsley. "Since," he says, "in a complete piece of mechanical apparatus we find that loss of function is in proportion to the amount and seat of the injury inflicted on it, analogy will surely lead us to imagine that unless it is specially provided with a reserve of embryonic tissue in every part, the nervous system is no exception to this general rule. Although the purport of this paper is briefly to discuss the scientific value of the theory of substitution or compensation, it is impossible to go further without referring to the saving clause above mentioned, namely, the possible existence in the cerebral cortex at least of numbers of small nerve-corpuscles, connected with the veteran corpuscles of well-marked centres, but which have not yet themselves subserved psychical function. The existence of such corpuscles has been assumed by several writers at the present day, and with fair ground, seeing that in the first place the gradual accretion of knowledge by the child, and in the second place the intellectual acquirement of some new subject late in life, are both best explained theoretically on the assumption that fresh tracts are opened up with each new and complete idea. The bearing that this view has on the question of substitution is of course of fundamental importance, since, supposing it to be true, it is very easy to imagine that if a centre be destroyed, the elementary corpuscles in the uninjured area around having within themselves a faint echo of the nerve disturbance which before was normally existent in their immediate neighbourhood can be educated gradually so as to replace the part injured" (*Lancet*, July, 1884, p. 7).

In order to illustrate this theory of substitution, and to show

the important difference that there is between rapid and slow destruction of a motor centre, I am in the habit of making use of the following simile: Supposing a peal of bells, each rung by a ringer especially trained to ring his own bell and that bell only (the bell-ringers representing the discharging motor centres in

of whom may be able to establish lateral connections, and to train themselves to carry on the work of their disabled colleague.

In the case of the sensory cerebral centres, compensation by the action of the opposite hemisphere seems to occur much more readily.

Fig. 2.—The outer surface of the right hemisphere of the brain in the case of M. D. (large sarcoma growing from the dura mater, which had produced extensive atrophy of the motor centres, but was unattended with paralysis) showing the tumour *in situ*. (Copied from a photograph, and somewhat reduced in size.) The letter A points to the outer surface of the dura mater over the centre of the tumour. The leading features of the case are detailed in my work on *Intra-cranial Tumours*, page 11.

the cerebral cortex, the bell-ropes the conducting fibres of the pyramidal tract, and the bells the muscles); and suppose that one of the bell-ringers or discharging centres is suddenly disabled—say, killed or put *hors de combat* by an apoplectic seizure—paralysis of the bell or muscle, which he, and he only, has been trained

The tactile centre (which according to Ferrier is situated in the hippocampal region, and according to Schäfer in the gyrus fornicatus as well as the hippocampal lobe) appears in the adult, at all events, to be distinct and separate from its fellow on the opposite side; but it is doubtful if its complete destruction in the child is

Fig. 3.—The outer surface of the right hemisphere of the brain in the case of M. D., showing the brain after the tumour was removed. (Copied from a photograph, and somewhat reduced in size.) The letter B points to the extensive depression on the surface of the brain into which the tumour fitted.

to ring, will necessarily result; but if instead of being suddenly destroyed, one of the ringers is gradually and slowly disabled by some chronic disease—say cancer of the stomach—he will be able to communicate his failing condition to his fellow ringers, some

ever followed by permanent hemianæsthesia; in other words, it would appear that the tactile centre in one hemisphere can, in the child, take up and carry on the function of its fellow on the opposite side. The extensive connections which the tactile centre

has with the other portions of the cerebrum, and the important fact that when one sense is placed *hors de combat*, compensation may be effected by one of the other senses supplying the place of that which is destroyed, are shown by the facts that blind persons may be taught to read and that they may be largely educated by means of the sense of touch, and also by the most interesting and remarkable circumstance that in some cases in which there is complete word-blindness, in which the patient is unable to decipher a single word or letter by the aid of sight, he is able to read, when he writes the letters or even when he traces the letters with his finger in the air. In the latter case the loss of vision is compensated by means of the muscular sense.

In the case of sight, destruction of the posterior part of the occipital lobe—the half vision centre as it has been termed—seems to be followed in the adult by permanent loss of vision towards the opposite side (that is homonymous hemianopsia). Whether this is so in the child, in other words, whether the half-vision centre in one occipital lobe is able, even in the child, to take up and carry on the function of the half vision-centre in the opposite occipital lobe, has not been as yet ascertained.

Central vision seems to be bilaterally represented, so that complete destruction of the whole of the visual centre in one hemisphere need not destroy the acuity of vision, since central vision is bilaterally represented. It is said, however, by Munk, and his observations on this point seem supported by Schäfer, that destruction of the half vision-centre in both hemispheres is followed by complete and permanent blindness.

It seems certain that the special senses of hearing, taste, and smell are bilaterally represented, but the exact position of their respective cerebral centres is not yet definitely decided. Schäfer's recently published observations being opposed to some of Ferrier's observations on this point. Clinico-pathological observation in man has as yet failed to throw any very certain light upon the subject. Loss of hearing, taste and smell, very rarely, if ever, result from a localised lesion such as a tumour in either cerebral hemisphere,² though a peculiar form of loss of hearing, "word-blindness," does seem to result from a lesion of the first temporo-sphenoidal convolution in the left hemisphere. The fact too, that localised lesions in the temporo-sphenoidal lobe are in some cases attended with an auditory or olfactory "aura" a noise or a smell, seems to support the view that the auditory and olfactory centres are situated in this region. It would appear, therefore, that the cortical centres for hearing, taste, and smell in one hemisphere can take up and carry on the function of the corresponding centres on the opposite side.

As regards the mental and intellectual defects which result from localised lesions in parts of the cerebral hemispheres other than those parts or centres which have just been referred to, our knowledge is also somewhat indefinite; but there is reason to suppose that localised destruction of the prefrontal lobe on one side can, to some extent at least, be compensated by the action of the corresponding centre on the opposite side. In this, as in other cases, the compensation is more perfect in those cases in which the lesion is slowly and gradually established, and in which the patient is young. The size of the lesion or the amount of de-

struction is also, of course, a most important factor in determining the result.

Extensive lesions of the prefrontal lobe are probably, in the adult, attended with lasting alterations in the mental faculties and disposition; small localised lesions may, in all probability, be compensated to some extent; but in investigating such cases it is necessary to remember that slight mental defects and alterations are difficult to detect, and may therefore easily pass unnoticed. In dealing with purely mental symptoms, in other words, with cases of localised brain destruction in which there are no motor or sensory derangements properly so called, the greatest caution is required. We can only determine whether any mental defect has resulted from a lesion (in other words, whether perfect compensation has resulted or not) when we are in a position minutely to compare the mental condition after recovery with the mental condition before the occurrence of the lesion; and it is unnecessary to say that in most cases we are not able to make such a comparison founded on our own personal knowledge. We have in most cases to rely upon the statements of the patient's friends and relatives—in many cases an uncertain and unsatisfactory method of ascertaining the normal mental condition of the patient, even when dealing with educated and intelligent people. That severe lesions of the prefrontal lobes

which produce no obvious motor or sensory disturbances do produce permanent mental alterations, in other words, that such lesions are not compensated, in the adult, at all events—and the same also applies to the child—is abundantly proved by clinical observation. The extraordinary case, which is known under the name of the "American crowbar case," shows how profound these mental symptoms may be; and at the same time illustrates the enormous reserve which Nature possesses, and the marvellous recoveries which sometimes take place after the most serious injuries. The details of this remarkable case (I quote from Ferrier) are as follows:

"The subject of the lesion was a young man, Phineas P. Gage, aged 25. While he was engaged tamping a blasting charge in a rock with a pointed iron bar, 3 feet 7 inches in length, 1½ inch in diameter, and weighing 13½ lbs., the charge suddenly exploded. The iron bar, propelled with its pointed end first, entered at the left

angle of the patient's jaw, and passed clean through the top of his head, near the sagittal suture in the frontal region, and was picked up at some distance covered with 'blood and brains.' The patient was for the moment stunned; but within an hour after the accident he was able to walk up a long flight of stairs and give the surgeon an intelligible account of the injury he had sustained. His life was naturally for a long time despaired of; but he ultimately recovered, and lived twelve years and a half afterwards. Unfortunately, he died (of epileptic convulsions) at a distance from medical supervision, and no *post-mortem* examination of the brain was made; but, through the exertions of Dr. Harlow, the skull was exhumed and preserved. Upon this the exact seat of the lesion can be determined. The line of union of the cicatrices of entrance and exit, however, allowed a pretty accurate estimation of the track of the bar during life, and Dr. Bigelow did so with considerable accuracy.

"Dr. Bigelow, who examined the man two years after the accident, thus describes the appearances presented: 'A linear cicatrix of an inch in length occupies the left ramus of the jaw near its angle.....The eyelid of this side is shut, and the patient is unable

Fig. 4.—Transverse vertical section through the right hemisphere of the brain in the case of M. D., showing the tumour in section, and the depression in the brain tissue produced by it. (Copied from a photograph, and somewhat reduced in size.) The letter A points to the tumour; B is placed on the inner (left) side of the right hemisphere, which has been separated from the opposite (left) hemisphere by a section made from before backwards, in the middle line.

² Loss of hearing of course may result from a localised cerebral lesion, such as a tumour, which presses upon the auditory nerve.

to open it; the eye considerably more prominent than the other. ... (Vision lost.—Harlow.)... Upon the head, and covered by the hair, is a large unequal depression and elevation..... A piece of the cranium of about the size of the palm of the hand, its posterior border lying near the coronal suture, its anterior edge low on the forehead, was raised upon the latter as a hinge, to allow the egress of the bar; it still remains raised and prominent.'

"From his examination of the skull itself, Dr. Harlow thus describes the track of the bar: 'The missile entered, as previously stated, immediately anterior and external to the angle of the inferior maxillary bone, proceeding obliquely upwards in the line of its axis, passed under the junction of the superior maxillary and malar bones, comminuting the posterior wall of the antrum, entered the base of the skull at a point the centre of which is an inch and a quarter to the left of the median line, in the junction of the lesser wing of the sphenoid with the orbital process of the frontal bone, comminuting and removing the entire lesser wing with one-half of the greater wing of the sphenoid bone, also fracturing and carrying away a large portion of the orbital process of the frontal bone, leaving an opening in the base of the cranium after the natural efforts at repair by the deposit of new bone of one inch in its lateral, by two inches in its antero-posterior, diameters.' (See Figs. 5, 6, and 7.) Dr. Harlow does not describe the further track of the bar through the frontal bone, but you will clearly see from the figures that the whole lesion is situated anterior to the coronal suture. If, now, you will compare the track of the bar through the skull and brain with the diagram before you (Fig. 8), showing the relations between the skull and the brain, you will, I think, have no doubt in convincing yourselves that the whole track is included within that region of the brain which I have described as the prefrontal region, and that, therefore, the absence of paralysis in this case is quite in harmony with the results of experimental physiology. The only other region which the bar could have injured is the tip of the temporo-sphenoidal lobe and the outer root of the olfactory bulb. Respecting the condition as to smell, nothing is, however, said either by Bigelow or Harlow. This case is generally quoted as one in which the man suffered no damage bodily or mental. But hear what Dr. Harlow says as to his mental condition: 'His contractors, who regarded him as the most efficient and capable foreman in their employ previous to his injury, considered the change in his

Figs. 5, 6, and 7.—Illustrations of Dr. Harlow's case of the passage of an iron bar through the head. (Copied from Ferrier).

mind so marked that they could not give him his place again. The equilibrium or balance, so to speak, between his intellectual faculties and animal propensities seems to have been destroyed. He is fitful, irreverent, indulging at times in the grossest profanity (which was not previously his custom), manifesting but little deference for his fellows, impatient of restraint or advice when it conflicts with his desires, at times pertinaciously obstinate, yet capricious and vacillating, devising many plans for future operation, which are no sooner arranged than they are abandoned in turn for others appearing more feasible. A child in

his intellectual capacity and manifestations, he has the animal passions of a strong man. Previous to his injury, though untrained in the schools, he possessed a well-balanced mind, and was looked upon by those who knew him as a shrewd, smart, business man, very energetic and persistent in executing all his plans of operation. In this regard, his mind was radically changed, so decidedly that his friends and acquaintances said he was "no longer Gage".⁴

(To be continued.)

ON A CASE ILLUSTRATING THE PROGNOSTIC SIGNIFICANCE OF THE BLOOD PRESSURE IN ACUTE RENAL DISEASE.

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It is well known that kidney disease is attended with increase of tension in the arterial system. This is most marked in the contracted granular affection of these organs, but it is present in almost every form of renal disease. I have, however, met with cases in which the arterial tension has been much below instead of above the normal average, and all such I have watched with unusual interest. I have twice seen low tension when the character of the urine, the age, antecedents, and condition of the patient have indicated cirrhosis of the kidney; in both the disease proved fatal with unusual rapidity. In acute renal dropsy I have found persistent pulse of low tension more frequently, and it has always been associated with an intractable character of the disease. A fatal case of this kind was the subject of a clinical lecture some years since.

In acute renal dropsy the artery is usually at first full between the beats, and rather large, but the beat is short and easily arrested. This corresponds to a period of temporary dilatation and weakness of the left ventricle. In the course of a week or ten days, however, the heart recovers itself, and the pulse acquires the character of moderate tension, which, in a case ending favourably, is sustained up to the time of complete recovery. I have learnt, therefore, to look for the supervention of a certain degree of tension in the pulse as an indication of favourable progress; but as has been said already, in some cases it is missing. The defect of tension may be due to persistent weakness of the heart, the capillary or arterio-capillary resistance being present, but the driving power on which the degree of pressure in the intermediate arteries ultimately depends being deficient. That weakness of the central organ of circulation is of unfavourable prognostic import is easily seen, but the low tension is not always so caused; there is sometimes diminished resistance at the periphery; the capillaries and arterioles are relaxed, and allow the blood to slip through them as in pyrexia, and the pulse is not only weak but short. It is not so easy to understand why this should be of bad augury, and it is only by observation that this conclusion has been reached.

The case to which these remarks lead up is summarised in the following account.

J. L., aged 27, a carman, married and having three healthy children, of sober and steady habits, and previously in the enjoyment of good health, was admitted into St. Mary's Hospital on October 29th, 1887, on account of acute renal dropsy. His mother, still alive, was much addicted to drink, which brought her to the workhouse, where she then was. There was no other unfavourable family history.

The patient was born and had lived all his life in London, and had had no illness since childhood, when he had small-pox. He underwent a certain amount of privation two years previously, when he was out of work for four months, but did not apparently suffer in health. For the last eighteen months he had been a carman. Without any special exposure to cold, he had four days previously noticed on rising that his face, arms, and legs were much swollen, and he had a bad cough. He remained at home for two days, and then returned to work, but on the day of his admission to the hospital the scrotum became swollen, and with this the face was pale and swollen, the eyelids puffy, and the extremities—the arms and hands more than the legs—affected by the characteristic firm, waxy œdema of early acute desquamative nephritis. The urine was found to have a specific gravity of

⁴ *The Localisation of Cerebral Disease*, by David Ferrier, M.D., F.R.S., p. 28.