cultivation of vaccinia; on the use concomitantly of vaccine and of variolous lymph on the same animal; and on the want of care as to the cleanliness and freedom from vaccine contamination of lancets and "points" used in the experiments.

Objection of similar sort against the variolations of the calf which have been achieved in recent years is hardly valid. In some of the more recent cases, at least, special precautions have been taken to ensure that the instruments and table were sterilised, and to render the environment of the animal such as to afford no likelihood of the communication of vaccinia. Most especially was this so as regards Klein's investigations and my own.

The number of successful cases which have been recorded is now so large that it is difficult to believe that sources of fallacy of the above sort should have been present in every instance, and it is therefore well-nigh impossible to resist the conclusion that a change of small-pox into vaccinia must really have come about. Nevertheless, there are found even at the present day those who, like Juhel and Dupuy (1894) and Layet (1895), maintain the essential duality of variola and vaccinia. It is, however, difficult to understand how the results obtained by the last-mentioned especially can bear the interpretation he would place upon them, seeing that he obtained, as the result of inoculating heifers with small-pox lymph, a vesicular eruption, the lymph derived from which reproduced the disease on other heifers. Moreover, subsequent vaccination of all his series of animals was either abortive or wholly without result.

Hervieux (1895), the Director of the Vaccine Institute attached to the Académie de Médecine, takes up a similar position to that of Layet and his collaborators, Le Dantec and Benech. He asserts that the only point of similarity between variola and vaccinia which has been brought forward by those who believe in the relationship of these disorders is the likeness between the vesicles which are found in either case, and denies that this point forms any argument in favour of their identity. He also considers that the use of lymph of variolous origin is fraught with danger; and so, doubtless, it may be when that employed is derived—as in Chauveau's and Martin's cases, for instance—directly from the animal first inoculated.

If, as I believe, it can be conclusively proved that small-pox lymph, by passing through the system of the calf, can be so altered in character as to become deprived of its power of causing a generalised eruption, while inducing at the site of inoculation a vesicle indistinguishable from a typical vaccine vesicle; and more important still, if it be shown that when transferred again to man, it has by such treatment completely lost its former power to produce an infectious disease, it may fairly be asserted that cow-pox—or rather, that artificially-inoculated form of the disease which we term vaccinia—is nothing more or less than variola modified by transmission through the bovine animal. Perhaps the most reasonable interpretation of such results may be that small-pox and vaccinia are both of them descended from a common stock—from an ancestor, for instance—which resembled vaccinia far more than it resembled small-pox. It is conceivable, indeed, that the seeming vaccinia, obtained in the calf by inoculation of small-pox matter into that animal, may after all be but a reversion to an antecedent type; and in this connection we may call to mind a fact of universal experience, namely, that vaccinia, however it may have arisen in the past, or is made to appear in the present, exhibits little tendency to "sport" (as, for instance, by manifesting a "generalised eruption") in the direction of small-pox.

Mr. Picton and Dr. Collins, in their addendum to the report of the Royal Commission on Vaccination, lay much stress on the want of "evidence to show that inoculation of the pox of the cow on the human skin has ever produced small-pox."

Variola and vaccinia may, nevertheless, have a common ancestry, since it is not unlikely that variola may have departed widely from the original type, and have gained an exalted virulence by repeated passage through man under conditions favourable to its propagation and activity. If this evolution of the disease has in fact taken place, variola may have suddenly reverted, under greatly changed conditions—as, for instance, implantation on the bovine animal—to an ancestral type. But the reverse process—that is, sudden "sport" of vaccinia in the direction of small-pox—is not to be expected.

It is most unlikely that a less differentiated form (cow-pox), also emanating from the common ancestral stock, should attain to the most exalted virulence in a single individual, and, *per saltum*, declare itself as small-pox, as the dissentient Commissioners insist that it ought to do.

CLINICAL LECTURE

ON

A CASE OF LOCALISED MYELITIS,

AFFECTING THE FIFTH LUMBAR AND THE SACRAL SEGMENTS OF THE SPINAL CORD, THE RESULT OF A SLIGHT TRAUMATIC INJURY;

AND

A CASE OF PARALYSIS OF ALL FOUR LIMBS,

DUE TO A SPINAL INJURY.

Delivered at the Edinburgh Royal Infirmary

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(Concluded from page 1174.)

ALTHOUGH we have arrived at the conclusion that the lesion is situated within the spinal cord, we have by no means exhausted the anatomical diagnosis. We have next to endeavour to determine the exact part of the spinal cord (in its vertical and transverse diameters) which is involved. This point of diagnosis is decided by observing the exact distribution of the symptoms (the motor paralysis, sensory derangements, disturbances of reflex action, the vasomotor and trophic derangements).

The spinal cord consists of a series of segments placed one above the other; each segment consists of two symmetrical lateral halves to which a pair of spinal nerve roots is attached, and each segment of the spinal cord may be regarded as a separate spinal cord for the portions or areas of the body to which the spinal nerves connected with it are distributed. Now, as I pointed out in the first edition of my book on the spinal cord, published now a good many years ago, the essence of the clinical examination of the spinal cord consists in the examination of the motor, sensory, reflex, vasomotor, and trophic functions of each of the individual segments in detail.

In this case there is no difficulty in coming to a conclusion as to the exact part of the spinal cord which is affected, for the symptoms are very remarkably localised to the areas of distribution of certain spinal segments. This case may in fact be regarded as a physiological experiment made by disease in the animal man. It is rare to meet with cases of cord disease. I refer, of course, to indiscriminate lesions in which the symptoms are so accurately localised and limited in their distribution, and it is for this reason that cases such as this are of so much scientific interest and importance.

It is by the careful observation of cases such as this that we are enabled to increase and advance our knowledge of the functions of the spinal cord. The case is an excellent illustration of the importance of clinical observation, and confirms the view that I am never weary of expressing—that the observation of the effects of disease in man is, for the purposes of human physiology (and that, be it remembered, is the physiology which chiefly concerns the practical physician and the practical surgeon), quite as important—in fact when we are fortunate enough to meet with cases in which the lesion is so localised and the symptoms are so sharply defined as they are in this case I would say much more important—than experimental observations on the lower animals. But I must not allow myself to be diverted into a discussion on this point—the value of accurate clinical observations as a means of elucidating the physiology of the nervous system of man.

In dealing with such a case as this, the first point is to get the facts accurately. This necessitates care, time, much patient clinical observation, and above all the most scrupulous exactness and truthfulness. Dr. Colman and I have given

much time to the investigation of this case. As the result of our observations, we have determined that the motor paralysis is practically limited to the muscles below the knee. There is, as I have already told you, complete paralysis of all of the muscles below the knee, and of the glutei maximi muscles, some paralysis of the bladder and rectum, and some, though very slight, paralysis of the muscles of the thighs. The paralysis of sensation involves the feet, the lower part of the legs, the scrotum and penis, the perineum, a saddle-shaped area on the buttocks, and a narrow strip on the adjacent part of the back of the thighs (see the areas marked black in Figs. 1 and 2). The disturbance of reflex action involves the plantar and sexual reflexes (which are completely obliterated), the vesical and rectal reflexes (which are impaired but not completely destroyed), and in a slight degree the knee-jerks (which are diminished in intensity). The cremasteric reflex on both sides is, you will remember, quite unaffected. The vasomotor and trophic disturbances are limited to the parts in which the sensory paralysis is present.

Now, it is obvious, from this distribution of the symptoms, that the lesion involves the lower end of the spinal cord (the last lumbar and the sacral segments); the cervical, dorsal, and the greater part of the lumbar enlargements are quite unaffected. There is no disturbance of function in parts supplied by nerves coming off from the cervical and dorsal regions of the cord. The lumbar enlargement may require a little further consideration. The nerves coming off from the lumbar and sacral segments of the spinal cord are distributed to the lower extremities and to the pelvis. The exact motor and sensory distribution of the different nerve roots connected with the lumbar and sacral segments of the cord is (approximately) shown in Figs. 3, 4, and 5.

Figs. 3 and 4.—Outline chart of sensitive areas of the skin (after Theodor Kocher). L1 and 2, area of distribution of the first and second lumbar nerves; L3, area of distribution of the third lumbar nerve; L4, area of distribution of the fourth lumbar nerve; S1, 2, 3, 4, areas of distribution of the first, second, third, and fourth sacral nerves respectively.

From the detailed description of the symptoms present, which I have already given you, there is no difficulty in concluding that the lesion involves the first, second, third and fourth sacral segments of the spinal cord, and, to a slight extent, the fourth and fifth lumbar segments, the first, second and third sacral segments being more particularly involved.

The next question which has to be determined is what part

of the transverse section of the spinal cord is involved. Each segment of the spinal cord consists of two symmetrical lateral halves; each half segment consists partly of grey and partly of white matter. The grey matter of the anterior horn contains the multipolar nerve cells, which are the trophic centres for the muscles and the centres for reflex action. The grey matter surrounding the central canal has important functions, as we shall presently see in connection with the transmission of pain and heat and cold. The grey matter of the posterior horn, perhaps, exerts a trophic influence upon the skin.

The white matter consists of various tracts which have a definite physiological function. Now, in this case there is not only paralysis, but there is extreme atrophy and absence of the faradic contractility in the muscles which are completely paralysed—the muscles supplied by nerves coming off from the first and second sacral segments. This seems to show that the lesion involves, and has extensively destroyed, the grey matter of the anterior horn—at all events, in the first, second and third sacral segments, the segments which supply the calf muscles, the glutei muscles, the peronei muscles, the flexor muscles of the ankle, the intrinsic muscles of the foot, and, perhaps, the muscles of the penis.

The paralysis of the bladder and rectum appears to be incomplete; the muscles concerned in the production of these important reflexes receive their motor supply from the fourth and fifth sacral segments. It is reasonable therefore to conclude that the grey matter of the anterior horn in the fourth and fifth sacral segments is not completely destroyed.

With regard to sensation, tactile sensations are conducted up the white matter in the lateral columns, whereas painful sensations and sensations of heat and cold appear to be conducted up through the central grey matter.

Now, it is important to observe that in this case the tactile sensibility is less impaired than the sensibility to pain, and the sensibility to pain less impaired than the sensibility to heat and cold. It is reasonable therefore to conclude that the lesion affects the central grey matter more than the white columns; but it is probable that the lateral white columns in the sacral segments are, to some extent, affected. There is complete anaesthesia of the skin, of the perineum, external genitals, and of a saddle-shaped area on the buttocks and adjacent parts of the back of the thighs—these parts are supplied by the third and fourth sacral segments (Kocher)—and of the outer parts of the feet and lower parts of the leg (these parts are supplied by the second sacral segments, according to Kocher, by the fifth lumbar according to Thorburn, by the fifth lumbar and first sacral segments according to Head).

We may therefore conclude: First, because of the manner in which the paralysis of motion, sensation, and reflex action is distributed, that, as regards the vertical extent of the lesion, the first, second, third and fourth sacral segments are very markedly involved, and the fifth and fourth lumbar and the fifth sacral segments are in a less degree involved.

Secondly, because of the extreme muscular atrophy and the presence of the reaction of degeneration in the muscles supplied by the first, second, and third sacral segments (the muscles of the legs and feet and the glutei maximi muscles) that the grey matter in the anterior horn in these segments is markedly affected.

Thirdly, because of the complete anaesthesia of the skin of the penis and scrotum, of the saddle-shaped area on the buttocks and on the outer parts of the feet and legs, that the white matter in the lateral columns of these segments is perhaps also implicated, though it may quite well be that the anaesthesia is due to a lesion of the grey matter (the nerve fibres which conduct tactile impressions into the cord being involved as they pass through the grey matter in order to reach the lateral columns on the opposite side of the cord).

Fourthly, because of the disassociated character of the anaesthesia (the fact that the thermal anaesthesia is more extensively distributed than the analgesia, and the analgesia more extensively distributed than the tactile anaesthesia), that the central grey matter in these segments is more involved than the white lateral columns.

It would be difficult to imagine a case of spinal cord disease (in which the lesion was an "indiscriminate" and not a

Fig 5.—Diagram illustrative of the muscular distribution of the lumbar and sacral nerve roots (after Theodor Kocher).

"system" lesion) presenting more satisfactory data for an exact anatomical diagnosis than this one.

Further, the distribution of the tactile anæsthesia, which is present in cases such as this, is (more especially of course if the case should prove fatal, and the exact position of the lesion should be verified by *post-mortem* examination) of importance from a physiological and scientific point of view.

We are largely indebted for our knowledge of the functional distribution of the nerve roots in man to the observations of Thorburn, Head, Sherrington, Theodor Kocher, and other observers. These authorities differ as to the exact distribution of the sensory nerves to the skin of the thighs and legs; and it is only by the careful observation of a large number of different cases (of disease in man) that we can hope to ultimately reconcile these differences.

It is impossible to argue from one case alone, for it must be remembered that the exact sensory distribution of the individual nerve roots probably varies somewhat in different individuals. The data for an exact average statement have not yet been obtained, but observations such as those of Kocher, in man, are steadily accumulating, and will in the course of time enable us to settle all the disputed points. And it is interesting to note in this case the tactile anæsthesia (see Figs. 6 and 7) is now (November 1st, 1897) almost identical in its distribution with that in a case recorded by Professor Theodor Kocher, in which a lesion of the sacral plexus (first sacral segment) resulted from an operation for spina bifida.³

Let us now turn to the pathological diagnosis and consider the nature of the lesion. And in trying to determine the exact pathological character of the lesion of the spinal cord, we have to take into account the following points: The rapidity of the onset; the nature of the apparent cause; the progress of the case; the character of the symptoms; the exact distribution of the symptoms; the part of the transverse section of the cord which appears to be affected (whether the

lesion is a "system" or an "indiscriminate" lesion); and the constitutional peculiarities and tissue tendencies of the individual patient.

Figs. 6 and 7.—Area of distribution of the tactile anæsthesia at the date of the patient's discharge, in the case of G. A. described in the text.

By the observation of these points an experienced observer who is acquainted with the different forms of lesion which occur in the spinal cord, with the symptoms to which they give rise, and with the course which such lesions and such symptoms pursue, has usually no difficulty in making a pathological diagnosis.

Pathological Diagnosis.—Up to the time of the accident the patient was healthy but alcoholic. He then received the injury which I have described. This injury was slight, nevertheless it was attended by the production of immediate symptoms, namely, weakness and some pain in the right ankle, a "twittering" sensation in the right ankle, and a sensation of numbness and coldness in the right foot and lower part of the right leg. There was, you will observe, no evidence of local injury to the ankle-joint, although the pain is suggestive of this, and there was no evidence of any direct lesion to the back. The fact that immediately after the accident the patient complained of numbness and coldness in the right foot and lower part of the right leg seems to show that the weakness in the ankle was not merely the result of a local injury to the ankle and leg, but that it was due to a lesion of the spinal cord. The progressive course of the weakness (paralysis) and the gradual invasion of the opposite (left) leg are corroborative of this view. At the end of four months the left ankle became affected. In the course of a year the paralysis had become more extensive and very marked—almost as complete as it is at the present time—affecting the muscles of both legs below the knees and the glutei muscles. How far the alcoholic condition predisposed to the occurrence of the lesion it is impossible to say; it is not unlikely that it may in some degree have done so.

We may take it for granted, then, that the injury produced some alteration in the sacral portion of the spinal cord, which was the starting point of the lesion which is now present.

The lesion seems to involve both the grey and the white matter, but especially the grey matter; it is very localised in its vertical extent; it is, in short, an indeterminate and not a system lesion. It developed very slowly and gradually; in fact, it is essentially chronic in character. There are no symptoms suggestive of a new growth (tumour) within the cord; and there are no symptoms, as I have already pointed out, indicative of a "coarse" lesion on the surface of the cord or of disease of the spinal bones.

Taking all of these facts into account, the most likely supposition seems to me to be that at the time of the accident a minute capillary hæmorrhage took place into the grey matter of the right side of the cord in the segment corresponding to the right ankle, probably the first and second sacral segment; and that this minute capillary hæmorrhage was the starting-point of a sclerosis, or a chronic myelitis if you like, which gradually extended, first invading the opposite (left) side of the same (first or second sacral) segment, and then invading the adjacent segments immediately above and below the segment first affected.

Two days ago I had the opportunity of showing the patient to two distinguished American neurologists—Dr. Sachs and Dr. Joseph Collins of New York—and of discussing the case with them. Dr. Collins suggested that the lesion was perhaps a dissecting hæmorrhage which had extended down the cord and given rise to the formation of a cavity in the grey matter, and that a second hæmorrhage had probably occurred when the symptoms became aggravated as the result perhaps of a process of acute myelitis.

This may of course have been the case, but a sclerosis or very chronic myelitis seems to me much more probable. The slow and gradually progressive course is, I think, opposed to the view of hæmorrhage. There is nothing to show that an acute myelitis developed, or a renewal of the original hæmorrhage, which I am disposed to think was very minute (quite capillary in extent), ever took place.

Let us now briefly consider the prognosis.

Prognosis.—Speaking generally, the prognosis in cases of myelitis due to traumatic injury in absolutely healthy persons is more favourable than in cases of myelitis originating spontaneously as the result of disease. But you must observe that this patient was not absolutely healthy; his alcoholic habits must be taken into account. Further, in this case the course has been progressively from bad to worse. It is chiefly

in the traumatic cases in which the height of the lesion is rapidly reached, in which the symptoms are the result of a spinal hæmorrhage or of an acute meningitis or myelitis resulting from, or associated with, that hæmorrhage, that the prognosis is favourable. The extreme muscular atrophy, the reaction of degeneration, the trophic and vasomotor disturbances, and the marked and lasting paralysis of sensation are in this case all unfavourable points. I fear that in all probability the paralysis below the legs will persist as a permanent condition. If I am correct in thinking that the paralysis below the knees and of the glutei muscles is due to a sclerosis which has involved and destroyed the grey matter of the anterior horns of the first, second and third sacral segments, the paralysis in these parts (glutei muscles and muscles below the knees) will probably be permanent.

But I see no reason to suppose that the lesion will continue to extend and involve other segments; it may, of course, do so, but it is just as likely, perhaps more likely, to be arrested; and, provided that the bladder and rectum continue to improve (as they appear to be doing), that septic cystitis is not developed, and that the bedsores heal (as they probably will do) the prognosis as regards the duration of life is favourable.

Further, it is not improbable that in the course of time and under appropriate treatment the patient may completely regain the muscular power in the muscles of the thighs, for these muscles are only slightly paralysed; they are not markedly atrophied, and they react normally to the faradic current. Now, if this should be the case (if the patient should regain complete power over the muscles of the thighs which act on the knee-joints), we may reasonably hope that in the course of time he may be able to walk with, and perhaps even without, the help of sticks; for, provided that there is no paralysis of the muscles acting on the knee-joints, a patient who is completely paralysed below the knees can walk with the help of sticks and with the aid of thick boots which prevent the toes catching the ground, and give a rigid support to the "wobbly" ankle-joints.

TREATMENT.

With regard to treatment, this must be directed to getting the bedsores healed, paying attention to the bladder and rectum, and to endeavouring, if possible, to limit the further spread of the lesion.

In many cases of traumatic paraplegia in which the lesion is situated on the surface of the cord and is due to hæmorrhage and thickening and inflammation of the membranes, marked benefit results from the free application under chloroform of the actual cautery; in this case, in which the lesion appears to be situated within the spinal cord, I hardly think that counter-irritation over the spinal column is likely to be of much avail.

Rest in bed, iodide of potassium, arsenic, nitrate of silver, strychnine, and massage to the muscles of the thighs (for I have very little hope that any marked improvement will take place in the condition of the legs), appear to me to be the most appropriate remedies. Further, let me point out that great care must be taken to avoid irritation of the anæsthetic areas. In detailing the notes of the case, I have stated that on more than one occasion the skin was severely burned by the application of a hot bottle. The resistance of the skin in the anæsthetic areas is very markedly impaired. Ulcers and bedsores are very easily produced, and after they have been produced show little tendency to heal. This tendency to the production of bedsores is a point which should always be kept in view in the management of cases of spinal myelitis. I have already told you that the patient has been placed on a water bed, and that the nurses have been instructed to see that he is kept scrupulously clean and dry.

Before leaving the case, let me emphasise the fact that in this case, in which the lesion had its starting point in an injury—a jar—to the spinal cord and spinal column, there have been no symptoms suggestive of "railway spine." This is a very important point, for until recently it was very generally, but quite erroneously, supposed that the nervous symptoms which so frequently follow railway accidents and injuries were the result of concussion of the spinal cord. This mistaken idea is now completely exploded. Further, this case seems to show conclusively that a slight injury may be the starting point of serious organic disease of the spinal

cord, and that in such cases the disease is not attended with any of the nervous symptoms which follow railway accidents and injuries.

Note as to the Subsequent Progress of the Case.—The progress of the case has been very much what was predicted. The lesion has not extended; in fact the patient has slowly but steadily improved in several respects. The condition of the patient on November 1st, 1897, was as follows: The bedsores have been healed for several weeks; the paralysis of the bladder and rectum has almost entirely disappeared; the glutei muscles and the muscles below the knees remain absolutely paralysed; the paralysis of the thighs has entirely disappeared; the areas of anaesthesia, analgesia, and thermal anaesthesia are slightly smaller (see Figs. 6 and 7); the muscles of the thighs feel firm; the calves also feel distinctly firmer; the measurements are as follows: Right calf, thickest part = 12 in.; left calf, thickest part = 12½ in.; right thigh, 7½ in. above the patella = 19 in.; left thigh, 7½ in. above the patella = 19½ in. On comparing these measurements with those which were taken at the date of the patient's admission to hospital (May 26th, 1897), it will be seen that both the calves and thighs are slightly smaller, though the muscles of the thighs (and in some degree those of the calves) are distinctly firmer; the diminution is probably, I think, due to the disappearance of vasomotor oedema; the legs get less blue on exposure and less swollen when hung down than they did at the time of the patient's admission to hospital. The general health is very good, and the patient can now not only stand but walk. He is able to walk a few steps unsupported and without sticks, and he can walk fairly well in his boots with the help of two sticks. He can walk barefooted with the aid of sticks, but with much greater difficulty, owing to the marked foot-drop and the "wobbly" condition of the ankles.

Before concluding this lecture I wish to show you another case of paralysis due to spinal injury which, curiously enough, happens to be in the ward at the present time, for it presents some remarkable contrasts with the case which we have just considered, and it illustrates some of the general statements which I have made in commenting on the first case.

The following is a brief abstract of the more important points of the clinical history:

CASE II. Complete Motor and Sensory Paralysis of the Upper Extremities and Temporary Motor Paralysis of the Lower Extremities due to Dislocation or Fracture of the Fifth Cervical Vertebra: Gradual Recovery from the Paralysis: permanent Stiffness of the Neck remaining.—F. B., aged 48, a carter, was admitted to Ward 30, Edinburgh Royal Infirmary, on June 14th, 1897, suffering from paralysis of the arms. The patient, who is a robust healthy-looking man, states that he was quite well until eight months ago, when, on October 7th, 1896, he sustained a fall which was the cause of the present trouble. He was getting into his cart, having one foot on the wheel, when he fell on to his back on the hard macadamised road. He was not rendered insensible by the fall, but immediately became paralysed. Immediately after the accident he experienced pain in the back of the neck and between the shoulder blades. He lay helpless on his back, unable to move either his arms or his legs, but was able to call out for assistance. A gentleman who was passing raised his arms above his head, but he did not know that they were being moved. He was then placed on a stretcher and carried home. There was a small superficial cut on the back of the head, and some swelling of the lower part of the neck, but, so far as he knows, no other appearance of injury. For a day or two after the accident he felt little or nothing wrong with the neck; it then became painful. For several weeks the pain in the neck was agonising. He states that for three weeks he "was fevered with the pain." He was confined to bed for three months after the accident. He states that for three weeks after the accident he was unable to feel when the arms were touched, moved, pinched, etc.; the sensation then gradually returned. There was never any loss of feeling in the legs. The paralysis of the arms remained absolute for two months, and involved the upper arms, forearms, and hands. At the end of two months he began to move the fingers, wrists, and elbows. He was totally unable to move the shoulder-joints for three months. The paralysed muscles were, he states, more or less rigid, and frequently affected with twitches and spasms. The paralysis of the legs seems to have been incomplete and of short duration. He states that during the three months that he was confined to bed he could push himself up by putting his feet against the foot of the bed. There was never any affection of the bladder or rectum. During the three months that he remained at home in bed he had to be fed. On December 30th, 1896, he was admitted to the Edinburgh Royal Infirmary under the care of Professor Annandale. He remained in the infirmary for six weeks. During this period he improved considerably (under iodide of potassium, strychnine, blisters to the back of the neck, and electricity), and since his discharge he has continued to improve steadily.

Condition on Admission (June 14th, 1897).—The patient is a robust, healthy-looking man. His head is slightly bent forwards. A well-marked projection is present in the lower cervical region; it corresponds to the position of the fifth cervical vertebra. The head is stiff, the movements being impaired in all directions—forwards, backwards, to the right and to the left. There is no pain or tenderness in the neck, and forcible rotation does not produce any complaint of suffering. There is no paralysis of the lower extremities; the patient walks well and firmly; the knee-jerks are, however, markedly exaggerated. He states that when he attempts to run he feels a "throbbing sensation in the spine." There are no "objective" disturbances of sensation, either to touch, pain, heat, or cold, but he states that the arms and hands are very sensitive to cold. The functions of the bladder and rectum are perfectly normal and have always been so. There is marked paralysis and atrophy of the muscles of both upper extremities. The paralysis and atrophy chiefly affect the deltoid, the biceps, the brachialis anticus, the triceps and the supinator longus in each arm, and the supraspinati and infraspinati muscles; the deltoids, supraspinati and infraspinati, and the supinator longus are in particular wasted. The muscles of the right arm are more affected than those of the left. Fibrillary twitches can occasionally be seen in the biceps and triceps. The deep reflexes in the upper extremities are exaggerated. The

muscles of the forearms are slightly affected, weak, and small, but not markedly flabby or wasted; the small muscles of the hands are normal; the grasping power of the right hand as measured by the dynamometer = 40, and that of the left = 70. The pupils are equal and of small size; their contractility both to light and accommodation is normal.

DIAGNOSIS.

Time does not permit me to discuss the diagnosis in this case in the detailed way in which we have considered it in the first case. Nor is much discussion necessary, for the nature of the case is self evident.

The cervical spinal column at the level of the fifth cervical vertebra was severely injured (fractured or dislocated) at the time of the accident. The evidence of this is still present in the form of a projection at the level of the fifth cervical spine and in the stiffness and impaired mobility of the neck.

The injury was followed by immediate paralysis in all four limbs, loss of sensation in the arms, no paralysis of the bladder and rectum. The paralysis of the legs seems to have quickly passed off; the anaesthesia of the upper extremities disappeared in the course of three weeks; the paralysis of the arms remained absolute for two months, and was then slowly and gradually recovered from; the muscles of the upper arms and shoulder girdles became extremely atrophied, and were at the same time the seat of rigidity and spasms.

The lesion was evidently on the surface and not in the substance of the cord; the rapid and complete recovery of the legs, and the marked improvement which has taken place in the arms, and the absence of any paralysis of the bladder and rectum, are proofs of this. The exaggeration of the knee-jerks (the only evidence of any nervous derangement in the legs which still remains) is easily explained by the pressure of inflammatory thickening or of the displaced bone upon the cord.

The lesion evidently affected the nerve roots connected with the fifth and sixth cervical segments rather than the cord itself. This is shown by the rapid and complete recovery which has taken place in the legs, the absence of any paralysis of the bladder and rectum, and the very marked improvement which has taken place and is still taking place in the arms.

The anaesthesia, which was at the commencement of the case complete in the upper extremities, has entirely disappeared. The paralysis of the forearms and hands has almost entirely passed away, and the muscles of the upper arm and shoulder girdle are steadily improving. This improvement will, I believe, continue; in fact, I venture to predict that the patient will in the course of time get quite well, and that the only permanent effect of the lesion will be the stiffness and rigidity of the neck; that, depending as it does upon injury and displacement of the bones, will of course always remain.

The second case is thus in striking contrast to the first. Both were the result of a comparatively trifling fall. In the first case, there was no direct injury to the back, though there was, I believe, a minute hæmorrhage into the grey matter of the cord. In the second case, the vertebral column was severely injured and the nerve roots at the point of injury very severely contused—perhaps some of them lacerated. There may have been some slight crushing (contusion) of the cord, but it is obvious, I think, that the cord itself was not severely damaged; and considering the very marked character of the bone injury, this is a remarkable and very fortunate result for the patient.

In the first case the injury was not attended or followed by any local pain in the back; in the second case the patient suffered for several weeks from severe (agonising) pain in the neck at the seat of the local injury.

In the first case the initial symptoms were slight, the paralysis was of very gradual development, but it slowly and steadily increased, and its maximum degree of intensity was only reached after several months had elapsed. In the second case the maximum degree of paralysis was instantaneously produced, and after the first effects of the injury passed off the course has been one of steady and progressive improvement.

In the first case, the injury was at the bottom (sacral region), in the second case near the top (cervical region) of the spinal cord.

In both cases paralysis and marked muscular atrophy have resulted from the injury; but in the first case these condi-

tions were (probably) due to a lesion of the grey matter; in the second to a lesion of the motor nerve roots. Consequently in the first case the prognosis as regards recovery from the paralysis is very bad, in the second case very good.

In the first case the paralysis, which was, I believe, due to a lesion of the grey matter, has been throughout its course a "flaccid" paralysis; in the second case, in which the paralysis was, I believe, due to an injury of the motor nerve roots, there had been marked symptoms of motor irritation (rigidity, twitchings, and spasms).

In the first case the sensory disturbances which have gradually developed have persisted; in the second case they were completely recovered from in the course of a short time (three weeks).

In the first case there has been some affection (paralysis) of the bladder and rectum and marked trophic disturbances; in the second case these symptoms have been entirely absent.

The first patient had for years been a hard drinker; the second patient has always been a steady man, never given to alcoholic excess.

Note as to the Treatment and Subsequent Progress of the Case.—The patient was treated with electricity, massage, and hypodermic injections of strychnine. He rapidly improved, and was discharged on July 31st. The grasping power of the hands at this date was as follows:—Right = 75, left = 95. The movements at the shoulder-joint were much more freely performed than at the date of his admission, and the paralysed muscles had gained considerably in bulk. When last seen (November 13th, 1897) he stated that he had been working for a week; the movements of the shoulder are much more free, and the muscular power and nutrition much improved; the neck is still stiff, but the immobility is rather less than it was.

NOTES AND REFERENCES.

¹ It must be remembered that in some cases of alcoholic peripheral neuritis with paraplegia, shooting pains are complained of, and hyperæsthesia of the sole and muscular tenderness (on pinching the calf muscles) are very marked. ² As I will presently point out, different observers are not agreed as to the exact sensory distribution of the spinal nerves connected with the lumbar and sacral segments of the cord. ³ Die Läsionen des Rückenmarks bei Verletzungen der Wirbelsäule, Figs. 86 and 87, *Mitteilungen aus den Grenzgebieten der Medizin und Chirurgie*, erster Band, viertes Heft, p. 655.

TWO CASES OF OÖPHORECTOMY FOR INOPERABLE BREAST CANCER.*

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THE very remarkable success which attended Dr. Beatson's first case of oöphorectomy for inoperable cancer of the breast has led me to perform the operation in two cases, and, as it is of importance that any cases in which this operation has been done should be reported, with the view of ascertaining what value, if any, attaches to it, I need not apologise for reporting the two cases in which I have performed it.

CASE I.—Mrs. S., aged 34, admitted to King's College Hospital on October 23rd, 1896. The history of the case was that the patient was well until about three years previously, when she noticed a swelling in her right breast, which rapidly increased in size. The breast was removed at a country hospital, and she was told that it was a cancerous tumour. A year later she went back to the same hospital and some enlarged glands were removed from the axilla. Three weeks before admission she felt pain along the old scar, noticed some discharge, and found that there was an ulcer in the mid-axillary line.

On admission, the patient seemed in fairly good condition, but complained of pain in the region of the right breast and between the axillary folds. On examination, a scar was seen running in the space between the fifth and sixth ribs, and curving upwards towards the base of the axilla and a little to the inner side of the angle of the fifth rib, there was a red and slightly ulcerated and thickened part in the scar. Between the axillary folds in the scar itself were two small nodules, and on the left side of the scar towards the axilla was an ulcer about the size of a shilling, with considerable induration of the skin around and redness of the skin; in the axilla there was a hard tender mass, occupying the greater part of the space, somewhat flattened and firmly adherent to the side of the chest, so that it could not be moved in any direction; it filled up practically the whole of the axilla. There were numerous glands in the posterior triangle of the neck, some of which were large, especially one towards the outer border of the edge of the sternomastoid muscle. There was no evidence of internal deposits.

The case was clearly one where no good could result from an attempt to remove the disease; not only was it very extensive but it was also very adherent, and, judging from the large size of the glands in the lower part of the posterior triangle of the neck, it was almost certain that other enlarged glands would be found further in which could not be taken away. The question of oöphorectomy as an alternative

procedure was therefore put before her, and, having been thoroughly explained to her, she consented and desired to have the operation performed. Accordingly, on October 28th, both ovaries and tubes were removed, and at the same time a small portion of the ulcerated patch was cut away for microscopical examination.

There is nothing whatever to note about the progress of the oöphorectomy; the patient went on perfectly well. She was discharged from the hospital on December 23rd; at that time there seemed to be distinct improvement in the cancerous growths; the ulcer had undoubtedly cicatrised to a considerable extent; the mass in the axilla felt softer and not quite so adherent; the glands in the neck were noticeably smaller and the patient was in excellent health.

On March 16th, about four months and a half after the operation, she showed herself, and the following is the note taken:—A great deal of the skin infiltration has disappeared, but there still remains a small patch of ulceration about the size of a threepenny bit at the posterior part of the original mass, and there is a small scab on it; the mass in the axilla is distinctly smaller and softer, and is now freely movable; the glands in the neck are very much fewer; they are only about the size of split peas, and, indeed, the large ones at the lower part have entirely disappeared. The patient is very well with the exception that there is a little friction to be heard at the lower part of the left pleura, which she herself can feel on exertion, but there is no pain or other symptom associated with it. It should have been said that thyroid tabloids were also given while she was in the hospital, and were continued nearly up to the middle of March, but the administration was irregular once she left the hospital.

Improvement still continued for a considerable time, but towards the end of May she did not feel so well, and when seen on June 4th the following is the note:—The growth has now again distinctly increased; the ulceration has extended, and is nearly as large as it was originally; the mass in the axilla is larger than on the last occasion and becoming more adherent, but still it is not quite so extensive nor so adherent as at the time of the operation. As regards the neck increased growth is very apparent; the glands are quite noticeable and the large glands have again reappeared; indeed, the condition in the neck seems worse than it was before the operation; the pleuritic friction still continues and the patient feels weakly, but there are no special signs of internal deposit.

She had to give up her situation shortly after this on account of increasing weakness and pain, and I have not seen her since, but Dr. Bennett, of Staplehurst, sent me an account of her condition at the beginning of March. At that time the ulcer below the axilla had increased greatly in extent, reaching from the anterior to the posterior fold of the axilla; it was about an inch and a half broad. A nodule in the pectoral muscle had appeared and increased in size. There was a large mass in the axilla and glands in the neck, one of them the size of a walnut. The patient suffered great pain, and had to have frequent doses of morphine.

CASE II.—Mrs. F., aged 33, admitted to King's College Hospital on May 23rd, 1897. The patient said that about nine months ago she found the outer side of the left breast tender, and about five months ago she noticed a swelling there; from that time this swelling has steadily increased in size, and for the last two months she has had shooting pains down the arm and in the side. About two months ago she noticed a small swelling on the right side, and also swellings under her arm. On examination a large nodular tumour was found in the left breast, chiefly towards the outer side, and also extending inwards beyond the nipple; the tumour was hard, adherent to the skin; the skin at one part was red and about to give way; there were a number of nodules in the skin round about the breast, and a nodule on the right side towards the upper edge of the breast and apparently superficial to it; the axilla was full of glands, which were matted together and of considerable size, and evidently adherent to the tissues around; there was also a mass of glands above the clavicle; small, hard glands could also be felt in the right axilla; there was distinct enlargement of the second costal cartilage on the left side; slight discharge from both nipples. The patient was extremely weak; she had never been subjected to an operation. This was clearly a case in which no radical operation could be performed with any chance of success. The question of oöphorectomy was therefore explained to her, and she consented to undergo the operation. Accordingly, on May 26th, both ovaries and tubes were removed. The wound healed well, and the patient was discharged on June 10th. At that time it was thought that there was a slight improvement, but not to any marked extent; the tumours seemed to feel softer and flatter, and not to have progressed at all; in fact, some of them seemed rather smaller. She was seen from time to time during the course of the next few months, but was found to be gradually getting weaker and thinner, and no real improvement could be made out. Thyroid tabloids were given in the first instance. Her condition steadily got

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