tures of the nervous system, between which no difference in aspect can be discerned, chemical agents have affinities for some and not for others. No difference can be detected, even in minute aspect, but these structures differ in their function, and those that so differ, differ also in susceptibility to chemical substances. The presence of atoms of one substance, or the arrangement of the atoms of another in molecules, entails a difference in the influence on the living structure. The effect of this is, first, to derange function, and then to alter nutrition; at last, such molecular change may result as to amount to structural alteration, and to produce what is called degeneration. This, following structures of like functions, is termed "systemic."

TOXINS.

If a small dose of atropine enters the blood it passes, diluted to an almost inconceivable degree, to every part of the nervous system, and yet acts alone on the structures within the eye. Curare also, reaching all parts, acts only on the terminations of the motor nerves. Alcohol, by its presence in the blood, affects the peripheral nerve endings, sometimes those of the muscles of the limbs, sometimes those of sensation. The same fact is true of arsenic, unlike alcohol as it is. But many of these toxic agents not only may act chiefly on the sensory nerve endings, but on certain of these sensory nerve endings. Those which are the most susceptible are the terminations of the nerves within the muscles—those that convey impulses to the centres—impulses produced by muscular action. These nerves may suffer chiefly or alone. Their impulses guide muscular co-ordination; loss of them causes ataxy, and thus from both alcohol and arsenic we may have a peculiar "pseudo-tabes," which resembles in a remarkable degree locomotor ataxy. The revelation is carried further by the fact that the same condition of pseudo-tabes may occur as a form of the paralysis that follows diphtheria. Here we have some definite ground to go upon, which gives us a fresh, and almost startling, light on this series of phenomena. Diphtheritic paralysis has been proved to be the result of a chemical substance, a modification of albumin, generated by the action of a ferment, which passes into the blood from the organisms in the throat. These facts, proved beyond question by Martin, show how slight a change in chemical composition will convert a nutritive material into a poison and has a wide significance.

Many other acute diseases besides diphtheria may be followed by similar changes in the nerves, and we cannot doubt that these are due to similar toxins, similar poisons, due, directly or indirectly, to the organisms of the disease. Alcohol itself is but a product of the growth of organisms. The organisms of syphilis have yet, perhaps, to be discovered, yet the lessons of post-syphilitic tabes are too clear to be ignored. We must regard the diseases as due to toxins, produced by a slight modification of otherwise harmless substances. These toxins act on the nerve structures, and thus they are revealed. They constitute an important chapter in pathology, inasmuch as their influence is bilateral and is symmetrical. These effects are thus distinguished from other morbid processes, and are in contrast to the effects of other blood states, such as rheumatic and gouty poisons, which affect the connective tissues first, the nerve elements only secondarily, and whose effects are generally one-sided and random in distribution. The evidence thus afforded as to both cause and effect is of the utmost practical importance. We meet with similar symmetry and similar limitation to function in many other states, both when a poison may have been taken in from without and when there are abnormal chemical processes in the body, such as may give rise to toxic agents, of which we at present know little or nothing. No abnormal chemical process can take place producing one substance without other substances being produced at the same time. That which is most conspicuous may be least influential. The material that causes tetanus is only one of several toxins, generated in unequal quantity, but equally toxic. That which is so potent a cause of the neuritis in diabetes bears no relation to the amount of sugar in the urine, but is, as it were, a by-product, not related in quantity to the sugar. So we have the characteristic diabetic neuritis when there is only a trifling amount of sugar, and it may be absent when there is much. So it is with other substances. The poison we can

trace may only be slight evidence of the more active poison we cannot trace.

The excess of uric acid in gout must be accompanied with an excess of other substances, and probably with the formation of some that are quite abnormal, which vary in amount in different individuals, and vary also in toxic power. It is common to meet with such evidence of toxic action in the gouty, sometimes grave, and often manifested by the subjects of the inherited disease. Some cases of chronic Bright's disease present symptoms of this character which can only be explained by the presence in the blood of abnormal toxic agents, different from the causes of uræmia. Many facts also more than suggest that the effects of cold on some individuals may induce not only the toxic agent to which acute rheumatism is due, but also poisons acting symmetrically on the nerves. A most intense case of universal peripheral neuritis was lately in the hospital, excited one wet night, in an alcoholic woman, through a leaky roof.

No branch of medicine is of more urgent importance to the practitioner in his daily work. But it is through the nervous system that the influence of such agents is discerned, and familiarity with them is essential for such discernment. For nearly half a century no vista has been opened up of equal practical importance. Nor is it an accident. It is because the nervous system is, and must ever be, that which acts and is acted on, and the special study of its morbid states must transcend any other branch of medicine in importance both theoretical and practical.

JUDGMENT AS TO OPERATIONS.

After referring to the opportunity of studying the latest development of the surgery of the nervous system, the lecturer pointed out the high importance of the opportunities afforded for the study of the indications for and against an operation and the forecast of the ultimate result. The questions for and against an operation must present themselves even to those who might not be called on to perform an operation itself. The experience gained at the hospital might give them more ability to do this than the fullest life-work could do alone. Moreover, in the isolation that would be the lot of some, the experience of the surgery of brain and spine might prove invaluable in the ability to relieve by operations, on which otherwise they would not venture.

In conclusion Dr. Gowers said if that which had been said was commonplace—"I aspire to no higher standard—so, too, is life; so, too, is death; but neither, on that account, has less keen interest for us, and the fact that it is commonplace should not hinder us from efforts to preserve the one and to postpone the other. That which is common in place is altered in effect when the place is changed. Forces that are uniform are ever altered in effect by conditions that are changing, and the old in this world is ever new."

A CASE IN WHICH THE SPINAL CORD OF A RABBIT WAS SUCCESSFULLY USED AS A GRAFT IN THE MEDIAN NERVE OF A MAN.

By MAYO ROBSON, F.R.C.S.,

Senior Surgeon to the General Infirmary at Leeds; Professor of Surgery in the Yorkshire College of the Victoria University; and Hunterian Professor, Royal College of Surgeons of England.

THE following case, which I have hitherto not reported, but which I intended to describe at the International Medical Congress in Berlin, will, I think, be found to present several points of interest; and the delay in reporting it will, I trust, have enhanced the value of the present paper, since I am able to give a description of the case after an interval of six years.

In February, 1889, I read a paper before the Clinical Society of London on a case of nerve grafting, which was, I believe, the first case in which the operation had been carried out in the human subject. Although it was difficult to explain the rapid return of function in the arm after the operation, there could be no question as to the result, which, from a report received three years afterwards, had become perfect. In July,

1890, my colleague, Mr. Atkinson, read an extremely interesting paper on the subject at the annual meeting of the British Medical Association in Birmingham, in which he described two cases of his own, and at the same time mentioned two cases of mine and one of Mr. Ward's, all of which were at the time of being reported progressing satisfactorily towards complete recovery.

The case I have to describe is as follows: W. R., aged 29, a gardener, was admitted to the Leeds Infirmary under my care on January 18th, 1890, having been sent to me by Dr. Mackay, of Hornby. He gave the history of having seven months ago fallen on a scythe, which had produced a deep incision on the lower and inner part of the upper arm, the brachial artery being divided. At the time of injury a surgeon was sent for; the artery was ligatured, and the two ends of a divided nerve were sutured. The wound healed slowly by granulation. On admission to the infirmary, the patient was in robust health. There was a scar on the inner aspect of the right arm, extending from a point 2 inches above and to the inner side of the olecranon process, obliquely upwards and forwards for about 3 inches to the inner side of the prominence of the biceps. The circumference of the right forearm was two-thirds of an inch less than that of the left, that of the wrist half an inch less. The hypothenar eminence was absent, the thenar eminence was much atrophied, and the interossei muscles were very much wasted. He had entirely lost the power of grasping, though he could flex the metacarpophalangeal articulations to a right angle. Extension of the wrist was possible, apparently with considerable exertion, but flexion of the wrist was impossible against gravity. The thumb could not be adducted nor the fingers separated or approximated. All the muscles acting on the wrist and hand which had their nerve supply from the median and ulnar nerves were paralysed, while those supplied by the musculo-spiral were capable of acting.

Sensation was absent along a narrow line extending over the inner and anterior aspect of the ulnar border of the forearm from the elbow to the wrist. In the palm sensation was absent except over the thenar eminence and part of the proximal phalanx of the thumb. On the back of the hand it was absent, internal to a line drawn backward from the cleft of the middle and ring fingers, also over the whole of the back of the little and ring fingers, as well as over the distal one and a half phalanges of the index and middle fingers.

ELECTRICAL REACTION.

The extensors reacted to faradism; the flexors showed no reaction. To a current of 10 M.A.P., the C.C.C. was greater than the A.C.C., both in the flexors and extensors. It was manifest that there had been a complete division of the median, ulnar, and internal cutaneous nerves, and it was clearly useless to attempt anything short of operative interference.

On January 30th, 1890, the limb having been previously aseptically ether was administered, and an incision made along the line of the cicatrix, it being prolonged some distance upwards and downwards, and supplemented by a transverse incision about an inch above the elbow. The ulnar nerve was soon exposed above the internal condyle, it being firmly fixed in fibrous tissue. The lower end of the upper segment, which was bulbous, was connected by fibrous tissue with the upper end of the lower segment. A long search then took place for the median nerve, as the large cicatrix had altered the normal anatomy of the parts. A small nerve was discovered at the upper part of the wound, which proved to be the internal cutaneous. The lower end of this nerve was discovered later, and united to the upper by a catgut suture. The internal intermuscular septum was divided $1\frac{1}{2}$ inch above the internal condyle, and the atrophied remains of the brachial artery defined. At last, about the middle of the upper arm, the bulbous lower end of the upper segment of the median nerve was discovered well under and concealed by the belly of the biceps. Later the upper end of the lower segment was found just above the bend of the elbow. This extremity was expanded and sent ramifications into the cicatrix. The fibrous tissue between the ends of the ulnar nerve was excised, and the two healthy portions were united by grafting strands of the sciatic nerve of a rabbit so as to fill up the gap and produce continuity. It was quite impossible to bring the

divided ends of the median nerve nearer than $2\frac{1}{2}$ inches. All the nerve tissue at my disposal having been exhausted in uniting the ulnar nerve, Mr. Littlewood, who was assisting me, dissected out the spinal cord of a rabbit just killed, and this was used as a graft to connect the ends of the median nerve, the inserted cord lying loose and quite free from tension when finally placed in position. Fine catgut sutures were used throughout. The edges of the wound were brought together and the usual dressings applied, the arm being fixed on a rectangular splint. Healing occurred by first intention, and there was an entire absence of fever or pain.

On February 10th the patient could feel the scratch of a pin on the flexor aspect of the first phalanx of the thumb, as well as at the root of the index finger. He could tell when the hairs on the back of the first phalanges of the ring and little fingers were pulled, but could not feel the scratch of a pin in that position.

On February 17th sensation had returned over the whole of the palmar surface of the thumb and the proximate phalanx of the index finger.

On March 4th sensation seemed to be creeping slowly along the first finger, and to be present over the whole of the palmar area supplied by the median nerve, and extending as far down as the web of the fingers, and a short distance along the middle finger. As yet there was no marked improvement in the ulnar distribution.

On March 6th electrical reaction to faradism was absent in the muscles. C.C. 15 M.A.P.; C.C.C. equal to A.C.C. in flexors; C.C.C. greater than A.C.C. in extensors.

The muscles were gradually developing, and the general nutrition of the hand showed improvement. There was a slight power of grasp and some power of flexion of the wrist, as well as slight power of adduction of the thumb and flexion of the fingers. Sensation was felt all over the thumb and index finger, in the second finger up to the first phalanx on the palmar aspect, also in the third finger, though less distinct. No sensation could be elicited over the distribution of the ulnar nerve.

On March 30th he began to have sharp shooting pains along the distribution of the ulnar nerve.

On April 1st the flexors of the forearm began to react visibly to C.C.C., though the muscles of the thenar eminence did not, and there was no faradic reaction.

On April 30th sensation was returning at the back of the ring finger, and the flexors now reacted to A.C.C. of 5 M.A.P.

On June 13th the nutrition of the hand was much improved, and there was a greater feeling of warmth in it. He could pick up small objects, and although the grasp was not powerful, it was much improved. The powers of flexion of the wrist and adduction of the thumb were considerably increased, but there was no sensation as yet over the ulnar distribution.

Being interested in the case I made inquiries from time to time after he left Leeds, but I never saw him again until February, 1896, six years after the operation, when I asked him if he would let me demonstrate his case at the Leeds and West Riding Medico-Chirurgical Society, where my colleagues and other members of the Society had the opportunity of seeing him. Dr. Mackay had applied galvanism to the muscles of the forearm and hand from time to time, from the time of his leaving Leeds until the middle of November of the same year, when all treatment was stopped. He did not resume work till March, 1891, not because he was unable to undertake light work, but as the patient put it, "he wanted to give the arm a fair chance of complete recovery." Since March, 1891, he had not missed a single day's employment, and was able to do all his duties completely, from wheeling a well-laden barrow to using a scythe.

Condition of the Patient when seen in February, 1896.—There was a firm round scar along the inside of the arm. The circumference of the right forearm was 11 in.; left forearm, 11 in.; right wrist, 7 in.; left wrist, 7 in.

From these measurements it will be seen that the muscles had almost completely returned to their former volume, and in the hand all the muscles except the abductor of the thumb were as well developed as in the left, this being quite as well marked in the interossei as in the other muscles. The movements of the arm were completely restored, and almost as

perfect as in the left. Flexion of the fingers and the grasp had completely returned, and the only weak muscle was the abductor of the thumb, which had no perceptible power. Sensation was completely restored, as was easily demonstrated by touching the different portions of the arm and hand with a pin.

Electrical Reaction.—All the muscles of the arm and hand reacted to faradism except the abductor of the thumb.

REMARKS.—It will thus be seen that though the recovery had been tardy, it was complete in almost every respect, the only exception being that of the abductor pollicis which for some unexplained reason did not recover its function. The case is very encouraging, since it clearly demonstrates the possibility of restoring continuity of nerves by grafting. Whether the spinal cord in this case took up the functions of a nerve, or whether it simply served as a basis on which the nerve tissue was built up, I am quite unable to say. But that it did answer its purpose is clearly shown in the report of the case. Why restoration of function in the ulnar nerve should have been longer than in the median, I am unable to say, as the ends of the nerve were not separated more than $\frac{3}{4}$ of an inch, whereas the ends of the median nerve were between 2 and 3 in. apart. Could it be that the spinal cord offered a better medium for establishing continuity?

When in February, 1889, I related before the Clinical Society a fact (about which there could be no doubt), that after grafting a portion of the posterior tibial nerve of a man into a gap in the median nerve of a girl, sensation had returned in the fingers supplied by the median nerve within thirty-six hours after the operation, I could see that the statement was received with some incredulity. The observation, however, was made in a public institution, and there confirmed by others who had no interest in the case, so that I am able to vouch for its accuracy. The same remarks apply with regard to the observations in the present case, and I think it will be granted that both cases give much food for thought.

I feel sure that we have still much to learn concerning the repair of nerve lesions, and I am not at all certain that the conclusion of physiologists is correct when they affirm that the peripheral portion of a divided nerve always undergoes atrophy.

A CASE OF DEXIO-CARDIA WITHOUT DISPLACEMENT OF OTHER VISCERA.

By WILLIAM MACLENNAN, M.B., C.M.,

University Assistant to the Chair of Materia Medica and Therapeutics,
Glasgow University; Dispensary Physician, Western Infirmary,
Glasgow; Visiting Physician, Glasgow Training Home
for Nurses; etc.

NUMEROUS cases of displacement of the heart arising from some obvious chest disease have been recorded by various observers, but few instances have been noted of dexio-cardia without a history of thoracic disease, past or present, and unaccompanied by displacement or transposition of the other viscera.

Byrom Bramwell records a case of congenital displacement of the heart to the right side, where the liver also remained on the right side.¹

Malformations and monstrosities which are irremediable may not be of great value to the practical physician, but they are of great interest to the anatomist and physiologist.

The following case which came under my notice recently at the dispensary of the Western Infirmary, Glasgow, seems worth recording, as it is apparently one of those rare cases of cardiac displacement, without coincident displacement or transposition of any other organ, and without a history of chest disease.

M. S., aged 15, was brought to the dispensary by an older sister "to get a bottle for a cold" of a few days' duration. When the usual examination of the chest was made inspection revealed a pulsation in the right mammary region which had all the appearance of the cardiac beat. Further examination demonstrated this to be the case.

The chest is generally well developed and presents no

formation which points to past or present disease. The movements are free and apparently equal on both sides. The right is perhaps slightly flatter than the left intracavicular region. The left clavicle, as ascertained by measurement, is fully 1 inch higher than the right clavicle from the nipple, so that the upper border of the right clavicle is on a level with the lower border of the left clavicle. Professor Cleland, to whom I showed the case, pointed this fact out to me. As a result, the left shoulder is correspondingly higher than the right. With the exception of these slight, and to the eye not very obvious, differences, the two sides are practically alike. Careful inspection of the right mammary region shows the rhythmical pulsation of the heart, which is obviously lying in its whole extent quite superficially and not overlapped by any pulmonary tissue. The vermicular form of cardiac contraction is easily made out—first, the auricular and then the ventricular systole.

The measurements of the chest are as follows:

Circumference is at—Axillary line, 26 inches; mammary line, 25½ inches.

Right chest—axillary level, 12½ inches; mammary level, 12½ inches.

Left chest—axillary level, 12½ inches; mammary level, 12½ inches.

During forced inspiration (mammary level)—right side, 13½ inches; left side, 13½ inches.

During forced expiration (mammary level)—right side, 12½ inches; left side, 12½ inches.

It will be seen from a study of these figures, that although the difference between forced inspiration and expiration is not so great as it might be, the movements are pretty equal on both sides. The percussion note over the entire left lung is clear and resonant—if anything rather exaggerated—while that over the right lung is slightly dull. Over the left mammary region the note is clear and cardiac dullness entirely absent. The respiratory murmur over the left lung is full and strong and entirely free from *râle*; that over the right lung is weaker, though equally pure. In the usual cardiac area no heart sounds are heard at all, but over the right mammary region the heart sounds are clear and sharp and very distinctly heard. The area of cardiac pulsation, which is represented in the illustration by the continuous curved line in the right mammary region, is absolutely dull, and merges below with the usual area of hepatic dullness. The dotted line encloses a space which represents visible cardiac pulsation, while just over the right nipple, at the *x*, is the apex

beat. Measured transversely the cardiac dullness is 2½ inches, and perpendicularly 3½ inches. The heart is obviously lying in close contact with the chest wall.

The liver is normal in position and size, and there is no

¹ *Edinburgh Medical Journal*, 1881-2, vol. xxvii, 743.