common septic bacteria cannot live in the circulating blood of a healthy animal. Why is this? Various explanations have been given of it. It has been attributed to the alkalinity of the blood, to the want of oxygen, to the excess of oxygen, to the struggle for existence between the blood-corpuscles and the bacteria. The suggestion that it is due to the excess of oxygen is groundless; for in the circulating blood the quantity of free oxygen present is not more than a quarter of the quantity that can be pumped out of this same volume of water freely exposed to the air.* Nor is it dependent on defect of oxygen; for recent experiments have shown that bacteria continue to vegetate, though slowly, in the entire absence of oxygen. As regards the third suggestion, that bacteria are destroyed in the struggle for existence, it is difficult to criticise it till we know what is meant. I confess I do not understand the analogy which is implied in the expression.†

In connection with the fact that germs are met with in the liver and other abdominal organs, I would remind you of another which clearly stands in relation with it: the observation which has been referred to by Dr. Bastian in his published writings (and was adverted to by him in his observations at the Pathological Society last evening), that, in peritoneal and pleural inflammations in rodents, however produced, it invariably happens that the exudation-liquids contain swarms of bacteria.‡

There are two cases in which this result presents itself: the first, in which in the course of a general infection, which may happen to be of a specific kind, the serous membranes become secondarily inflamed; the other, in which a traumatic inflammation is produced by the introduction of a drop or two of an irritating liquid. If this liquid be, as in the original experiment, itself a germicide, it is clear that no germs can come from outside with it. Obviously, here you have virtually an occluded wound, in which a traumatic inflammation is set up of an infective character. I do not doubt that the germs in this case come in from the intestine; but it is no less certain that they would be utterly harmless, unless the substratum for their development existed in the development of the inflammatory process.

I will conclude by drawing your attention once more to an experimental fact, to which, if I mistake not, I adverted to in my Lectures of 1873. I refer to an experiment made by my friend, Professor Chauveau§ for the purpose of illustrating the influence of blood-contamination—in short, of the septicæmic state—as the progress of traumatic inflammation. It is well known that, among the many operations which are daily inflicted on animals for the purpose of adapting them to the requirements of human luxury, there is one known as *bistournage*, which is largely employed in certain countries. This consists in twisting the spermatic cord, without making any external wound, in such a way that the circulation in the organ is permanently stopped. Of the thousands of operations of this sort which are daily performed, none are ever followed by infective consequences. The organ becomes encapsuled, and eventually shrivels. But if, previously to the operation, a dose of septic matter have been introduced into blood-stream, what happens then? The textures around the organ become the seat of acute diffuse inflammation, which soon extends to adjoining parts, and may threaten life. What is the meaning of this? In the thousands of animals that undergo *bistournage*, without suffering from it, the result is but a counterpart of what happens in a wound when entirely protected from contamination. In the single case, which is infected, a poison present in the blood-stream determines in the injured part an infective inflammation. The experiment affords a striking instance of

the co-operation of two agencies in one pathological process; both of which agencies, although not affecting the result with equal directness, were alike essential. The immediate cause of the septic inflammation of the testicle was evidently the injury to which it had been subjected; but no infective process would have developed itself—nay more, no inflammation whatever would have occurred—had it not been that masses of septic matter were at the time of the injury circulating in the blood-stream, some of which were conveyed to the injured part, and then became centres of infective action.

On the other hand, the constitutional effects which were produced by the injection of the septic liquid into the blood would have passed off without endangering the life of the animal, if there had been no injured organ to afford the necessary conditions for the development of a septic focus. Two causes, therefore, were concerned: the injury and the septic particles which were brought to the injured part by the blood-stream; and of either it could be stated, with equal truth, that it would not have been efficient without the other. In this respect, the *bistournage* experiment admits of the same explanation as the one previously mentioned, in which a septic peritonitis was induced by the injection of a drop or two of solution of iodine into the peritoneal cavity; for, in the one case as in the other, the injury which was the immediate cause of the pathological process would have had no infectious results, unless infective particles had been present. But here the parallelism ceases; for, by a further experiment, Chauveau showed that, if the septic liquid were carefully filtered before injection, so as to deprive it of its visible particles, *bistournage* could be performed without unfavourable result. The filtrate, though obviously still contaminating, was quite innocuous. It appeared to be essential to the morbid fruitfulness of the seed sown that it should be enclosed in particles of sufficient size to lodge in the capillaries of the injured part.

[To be continued.]

LOCALISATION IN SPINAL DISEASE:

ILLUSTRATED BY (1) A CASE OF "ATROPHIC PARALYSIS" IN AN ADULT; (2) A CASE OF CENTRAL MYELITIS; (3) A CASE OF ALCOHOLIC PARAPLEGIA.

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WE are indebted to the labours of Lockhart Clarke, of Duchenne (de Boulogne), of Charcot and his pupils, and other observers, for the knowledge that the spinal cord, though so narrow in its lateral dimensions, yet presents a special localisation in different districts, under the influence of disease, almost, if not quite, as distinct as has been observed in diseases of the brain. Several districts in the cord can be mapped out by the phenomena of disease, some of them equally distinct in their functional endowments, and some in the different periods in which they undergo development during foetal existence. Among these districts, particular interest attaches to the central grey matter, and especially to its anterior and posterior cornua; these cornua presenting a remarkable distinctness in the diseases to which they are subject, as much so as in the functions to which they are respectively subservient.

A large and important group of maladies originates in morbid changes taking place in the anterior cornua, and belongs in essentials to these cornua, the implication of neighbouring tissues constituting a secondary and subordinate process. This group has been classed by M. Charcot under the title of "myopathies spinales". In the maladies by which it is constituted, whether acute or chronic, the distinguishing characteristic is, that the transmission of sensitive impressions is not modified at all, or only in a secondary and subordinate manner. The entire stress of the disease falls upon the motor function and the nutrition of the muscles. Voluntary motion is more or less enfeebled; but what localises the paralyzing influence in the anterior horns is the muscular atrophy by which it is attended. As is well known, the atrophy in some of the diseases reaches the extent of entire destruction of the muscle affected.

My first case belongs to the acute variety of this group. It is intimately related to a well-known malady, "atrophic paralysis of infancy": a disease in which the morbid changes commence in the anterior horns of the spinal grey matter, and, according to M. Charcot, are usually restricted to one or two of the circumscribed oval groups of large ganglionic motor cells characterising those horns. These cells form the starting-point and centre of the morbid process, and it is only in the utmost stage of alteration and in certain regions that the horn is invaded through its entire extent. (*Leçons*, 2me série, p. 181.)

* The quantity of free oxygen in common water exposed to the atmosphere is about 0.6 per cent. per volume at ordinary temperature, that of oxygen in the blood about 0.15. The extreme smallness of the quantity of free oxygen in circulating blood is due to the presence of a body (hæmoglobin) which seizes upon the oxygen with great avidity. On the other hand, there can be no doubt that the oxygen present in the blood is sufficient for the maintenance of bacterial life; for in the experiments recently conducted under Professor Donders' supervision at Utrecht, it was found that although oxygen, as is well known, promotes the vital activity of bacteria, these organisms can live in its absence—a fact explained by supposing that they have the power of tearing it from other combinations. See Grossmann and Mayerhausen, "Ueber das Leben der Bacterien in Gasen"; *Pflüger's Archiv*, vol. xv, p. 245.

† Since delivering this lecture, I have become acquainted with a paper by P. Granitz ("Experimentelle Untersuch. über die durch Parasiten bedingten Krankheiten"; *Virchow's Archiv*, vol. lxx, p. 546), in which the author adduces several striking facts in support of the conclusion that, just as the vegetative processes of the fungi are checked whenever they are brought into competition with those of more vigorously growing organisms, so the growth of ferment organisms is restrained in presence of actively growing cells—e.g., pus-corpuscles.

‡ On the same occasion, Dr. Bastian referred to another fact of a similar nature—namely, that when by the injection of irritant liquids under the skin an inflammation of the subcutaneous tissue is produced in rabbits, the exudation liquids are found to swarm with bacteria. The explanation is, that the skin at the injured part being infiltrated with exudation, is no longer protective. Its external contaminated surface is thereby brought into relation with the subcutaneous tissues.

§ Chauveau, "Etude expérimentale sur les phénomènes de mortification et de putréfaction qui se passent dans l'organisme animal vivant"; *Bull. de l'Acad. de Médecine*, 1873, p. 540.

There is, however, a matter of interest of a different character attaching to my case; viz., that the subject of it is an adult. The malady, as its name implies, is one which has been known as belonging chiefly to early childhood. It is most frequent (Charcot) between the first and third years, is rare after the fifth year, and is quite exceptional after the tenth year. It appears, however, from a paper on the subject in *Le Progrès Médical*, 1874, No. 7, that in 1866 M. Kussmaul had formed a suspicion, correctly based on two cases of his own, that the disease may also occur at a later period of life. Afterwards M. Duchenne took up the subject. In his work *De l'Electrisation Localisée*, third edition, he has a chapter (iii, p. 437) plainly provisional, "Paralysies Spinales de l'Adulte"; and the first article, entitled "Paralysie Spinale Antérieure Aiguë de l'Adulte", is devoted to the consideration of the cases at present in question, three instances being given in illustration. Dr. Moritz Meyer, in his work on *Electricity in its Relations to Practical Medicine*, translated by Dr. Hammond, 1872, p. 229, adds to his article on "Infantile Paralysis" the remark, that a similar paralysis of the lower extremities occurs in rare cases among adults also, occasioned, he believes, either by the influence of some exanthematic action or by some other unknown cause. He proceeds to notice some particulars in which the malady, as affecting adults, differs from the ordinary phenomena presented by children. These particulars depend chiefly on the circumstances that the development of the limbs has been completed, and that the nervous functions have attained a condition of greater stability. Hence temperature is not lowered in the affected limbs as it is in those of children, and the disabling effects of the paralysis are less developed: a statement which receives illustration from the case of my patient. Dr. Meyer details two cases which occurred simultaneously in twins, in each after an attack of measles.

M. Charcot, in his second series of lectures, enlarges on the same topic, and expresses a suspicion, plainly well justified, "that cases of this kind are not unfrequently misunderstood, and that in reality they are not absolutely rare" (p. 171). He details the particulars of two cases. In an article in *Le Progrès Médical*, to which I have already referred (No. 7 and succeeding numbers, 1874), other cases are added by the authors, MM. Bourneville and Teinturier.

Among the various cases to which I have thus alluded, there are particulars of only one *post mortem* examination. This occurred in the practice of MM. Charcot and Gombault, in a female who died of cancer at the age of sixty-seven, having been attacked seven years before by this peculiar form of paralysis. In this case, reported in *Le Progrès Médical*, the morbid changes in the proper tissue of the cord were limited to the large motor cells of the anterior horns. The changes in these cells extended through the entire length of the cord, and were especially advanced in the lower part of the cervical region. The only other change in the cord was diminution in the size of the horizontal bundles of fibres passing from the anterior horns to the corresponding nerve-root. Certain points are remarked as distinguishing the changes in this case from the changes usual in childhood, especially that the affected horns were not lessened in size, that the white columns were not secondarily affected, and that there was no disappearance of an entire group of cells, with increase of interstitial tissue.

The general characters presented by the disease in the adult have been a close copy of those observed in childhood. Most of the cases set in with severe fever; but in one case general paralysis attacked the patient so suddenly as to be complete in half an hour, the patient thenceforward lying absolutely without power of voluntary movement for two years. In two others, also, fever seems to have been absent. Generally there appears to have been complete immunity from any interference with the cerebral functions, except that in one instance the initiatory fever was attended with delirium, and in another is described as having presented the character of an invasion of typhoid "d'une haute gravité". In two cases only was the paralysis confined to the lower extremities. In my own case, it will be seen that a still greater limitation was observed. The paralysis was attended with the usual loss of faradic contractility, and with flaccidity and atrophy of the muscles. Functional power was retained in the sphincters, and there was entire absence of any tendency to the formation of sloughs; all being characters belonging to those forms of spinal disease in which the changes are restricted to the anterior grey matter of the cord. Sensation was not impaired in any instance; but there appears to have been one particular in which the symptoms differed from those occurring in childhood; the presence, viz., in certain instances, of pain, especially seated in the vertebral region and loins, frequently radiating down the limbs. Particular mention must also be made of one case, in which a double herpes zona appeared upon the chest during the initiatory fever. This latter symptom, as well as the pains, appear to indicate a tendency in the disease of adults to transgress the limits

generally observed at an earlier period of life: a supposition favoured also by certain subjective sensations referred to the limbs, indicating irritation in the posterior cornua, with which there is every reason to associate the transmission of sensitive impressions. Finally, recovery was complete in one case only.

The ages of the patients varied between fifteen and sixty-two years. As respects the subject of causation, M. Duchenne refers to the impression of cold, especially when made whilst the subject was perspiring; and it is to be noted that this influence is prominent among the cases which I have quoted. In a case by M. Bernhardt, the element of cold was especially distinct. The patient went into the courtyard of his house without his shoes and in his night-dress, whilst in a state of profuse perspiration. On regaining his chamber and washing his hands, he found a difficulty in handling the soap. On the next evening, he had trouble in counting out money to pay for a *fiacre*; on the next day but one, he could not hold his cup, and was obliged to be fed; and, the day after, all his limbs were paralysed. He had no fever. Intense mental emotion appears also to have had some share in causing the illness in one or two instances.

CASE I.—W. B., aged 15, was a fine healthy-looking young man, free from any family history of serious disease or of rheumatism, and had enjoyed very good health. He had been subjected to a considerable amount of muscular exertion, noticed by M. Duchenne as predisposing to the disease, in having to walk a great deal. The legs of his trousers were wet through on Thursday, and were allowed to dry on him; on Friday, he complained of being cold, and on Saturday shivered and became feverish, and went to bed. At that time, he suffered from pain across the loins and down the right lower extremity. The attack lasted for two days, when he got up, but found his right leg give way. Three or four days afterwards, the pain returned, and he again went to bed; but there was no return of fever. On again getting up two or three days afterwards, the power of his right lower extremity was greatly enfeebled. The pain in the back and stiffness lasted for a fortnight longer. Seventeen weeks later, he was admitted into the Birmingham General Hospital. At his admission, the disease was found to be completely limited to the right lower extremity; all the other limbs were muscular and well developed. The patient had a light complexion, with dilated pupils. He had all the appearance of being in excellent health. The sounds of his heart were quite normal. His urine was free from albumen. Though the segments of the right lower extremity could not be employed separately, yet, by using the extremity as a whole in the manner of a crutch, the young man was able to accomplish a walk of more than three miles, though not without some muscular aching. The walk was, of course, marred by a very decided limp; the swing of the body being called in to assist the advance of the leg at each step forward. The right buttock was somewhat flattened. The right thigh was greatly atrophied; but, in the leg, the recovery of the calf-muscles occasioned the difference in girth between the two limbs to be small. During the first six weeks of residence, the right thigh lost about half an inch; the difference between the thighs on each side increasing from two inches and a half to three inches, the relative dimensions remaining afterwards unchanged. The difference between the girth of the legs increased from one-quarter to half an inch. The flexors of the thigh upon the trunk, the adductors, and the extensor muscles of the knee, though just able to effect movement in the limb, offered not the least resistance to passive motion. Extension of the thigh and flexion of the knee were both performed with considerable force. The calf-muscles possessed nearly, if not quite, their normal force, and had retained their normal nutrition; the diminution in the girth of the leg probably depending on wasting of the anterior muscles. Flexion of the toes also was performed energetically; but flexion of the foot and extension of the toes could hardly be effected at all. The muscles of the sole of the foot retained their natural amount of power and degree of nutrition. The function of sensation in all its forms was in a natural condition. There was no increase of reflex irritability. Faradic contractility was very low in both lower extremities; but there was a decided difference in favour of the left side, excepting in the muscles of the right calf, in which the contraction on each side was nearly alike. Contractility to the interrupted galvanic current was no greater than to faradism. The comparative temperature was taken twice. On one occasion, the right (diseased) limb was .6 deg. the warmer; on the second, the temperature was alike on each side. The toe-nails were unchanged.

The patient remained under observation for six months. During that period, very full trial was made of electricity by galvanism and by faradism; of shampooing the muscles; of counterirritation to the spine by means of blisters, and afterwards of the hot iron. He took iodide of potassium and tonics; but he left the hospital without having under-

gone any perceptible improvement, and not having acquired a talipes equinus, to which the preponderating action of the calf-muscles appeared to dispose him.

[To be continued.]

ON STRICTURES OF THE INTESTINE: WITH REMARKS UPON STATISTICS AS A GUIDE TO DIAGNOSIS AND TREATMENT.*

By SIDNEY COUPLAND, M.D., Assistant-Physician, and HENRY MORRIS, M.A., F.R.C.S., Senior Assistant-Surgeon to the Middlesex Hospital.

THE subject of intestinal obstruction has been so exhaustively treated from all sides, that it may be thought almost unnecessary to add anything to what has been already written on the question. But, during the past few years, our attention has been several times directed to the subject, owing to the comparatively large number of cases, either in the care of our colleagues or under our personal supervision, that have fallen under our observation at the Middlesex Hospital. The study of these cases has led us to carefully collate a large amount of evidence with respect to the causes and effects of that class of obstructions included under the term of "stricture" of the bowel; and the conclusions at which we have arrived seem to us worthy of some consideration, as indicating more precisely than has yet been attempted the particular lines of treatment to be adopted in such cases, so distressing in their symptoms and so fatal in their results. We wish also to call attention to the methods of diagnosis employed for detecting the seat of a stricture, when once it has been ascertained that the patient is suffering from this form of obstruction.

I. *Situation of Strictures.*—With regard to this, indeed, we have nothing novel to propound; for the ground has been already fully gone over by writers, such as Dr. Hilton Fagge in his article in *Guy's Hospital Reports* (vol. xiv, 1868)—an article which has justly become the standard of reference for all writers since it was published; Dr. Brinton, in his posthumous essay on Intestinal Obstruction, and others. We have, however, deemed it worth while to seek for fresh facts in this direction; and the result of our search has been, that in all respects we have been able to adduce strong confirmation of the general truth of the statements made by those authors. Our sources of inquiry have been the *post mortem* records of the Middlesex Hospital from the year 1844 to the present time (with the exception of the year 1852 and the greater part of 1851); and the *Transactions of the Pathological Society* since its formation in the year 1846. From the former source, we have collected thirty-one, and from the latter, thirty-two cases of stricture of the intestine. It is justly remarked by Dr. Fagge that the *Transactions of a Society* do not afford a correct basis for statistical inference, seeing that they include only selected cases, interesting from their rarity or some peculiarity incident to the case. This is doubtless true; but with respect to the subject under consideration, the *Transactions of the Pathological Society* are of especial value. For here, if anywhere, we should find recorded instances of stricture in unusual and rare situations, and a certain safeguard would be found against drawing too hard and fast a line in one's conclusions. It is interesting to note, therefore, that whereas the number of cases of rectal stricture to be found in these volumes is comparatively small and is below the average drawn from other sources, yet, on the other hand, only one case has been brought before that Society in which the disease giving rise to the obstruction was seated above the cæcum. Bearing in mind Dr. Fagge's reservation, we think we may fairly quote the *Pathological Transactions* in our statistical deductions. We must also add that none of the cases have been quoted twice, care having been taken to exclude from the list culled from the Society any case that had been first entered in the Middlesex Hospital records. We find, then, that out of a total of thirty-one cases of stricture of the intestines examined after death at the Middlesex Hospital, in no fewer than twenty-seven was the disease situated in the large intestine. Of the remaining four cases, in one it involved the ileo-cæcal valve; in another, the ileum at its lower end; in a third, the upper part of the ileum; and in the fourth, the jejunum. No cases of stricture of the small intestine are recorded by Dr. Brinton, by Dr. Fagge, nor by M. Duchaussoy, whose figures are quoted by Dr. Fagge; so that we may hold that instances of stricture of the ileum or above the ileum are of extreme rarity. Out of the thirty-two cases recorded in the *Pathological Transactions*, thirty-one involved the large bowel alone, and one the lower end of the ileum and the cæcum.

The case of jejunal stricture referred to occurred at the Middlesex Hospital in 1867, and is recorded as being due to cicatrisation of an ulcer. The patient was a man aged 58, who died from peritonitis consequent upon perforation above the stricture. Of the cases of ileal disease, one was that of a male aged 65, also in 1867, in whom cancer of the lower end of the ileum had determined invagination of the gut into the cæcum, and death in this case also was due to peritonitis from perforation above the stricture. The other instance occurred in 1859; it was in a female aged 42, and was a cancerous stricture of the ileum at its upper extremity, secondary to cancer of the breast. A somewhat parallel case has come under the notice of one of us in the *post mortem* room of the Middlesex Hospital during the present year. It was a case of primary epithelial cancer of the uterus, with an unusual dissemination of secondary growths, one of which had involved the lower end of the jejunum in all its coats, so as to produce an annular constriction half an inch in width. It had given rise to no symptoms during life, although the stricture was so small as to admit only of the passage of a No. 7 catheter. A mesenteric gland in connection with the affected bowel was also infiltrated. We may also refer to the two cases, out of the total number of sixty-three, in which the disease, in both cases cancer, attacked the cæcum as well as the ileum at its lower extremity. One of these was admitted into the Middlesex Hospital last October. She was only twenty-eight years of age; had been losing flesh for six months, and for three months had suffered from abdominal pain, constipation, and vomiting, the last three weeks being marked by continued enlargement of the abdomen. The lower bowel contained feces, and daily the patient passed a small quantity. There were constant attacks of severe pain, during which the coils of small intestines could be seen on the surface. Acupuncture afforded but slight relief; and death soon followed from peritonitis due to perforation of the cæcum, which, at its valve, was the seat of a luxuriant growth of epithelial cancer. The other case is recorded in the *Pathological Transactions*, vol. xii, p. 117, by Mr. G. Lawson. The patient was a woman fifty-six years of age, in whom complete obstruction had lasted for only about a week before death. The site of the ileo-cæcal valve was occupied by a dense scirrhous mass, which infiltrated also the wall of the cæcum. A similar case to the first of these is to be found in Dr. Fagge's paper (*loc. cit.*, case No. 33).

In the remaining cases, *i.e.*, in fifty-eight out of sixty-three, the seat of stricture was in the large intestine. Of the twenty-seven cases in the Middlesex Hospital, we find that in twenty-four the stricture was situated in the sigmoid flexure and rectum, there being twelve instances in each of these sites; two were in the middle portion of the transverse colon, and one was in the descending colon. It may be observed that in no case was the cæcum (alone) attacked, nor the ascending colon, nor either of the flexures of the transverse colon, the latter being generally regarded as more frequent seats of stricture than is the centre of the arch. The figures obtained from the *Pathological Transactions* accord better with generally accepted views, for there we find one case of disease of the cæcum recorded, three of the hepatic, two of the splenic flexure, and two of the middle part of the transverse colon, two of the descending colon, thirteen of the sigmoid flexure, and eight of the rectum. Thus, in round numbers, nearly three-fourths of the cases of stricture involve the lower end of the intestine, the number met with in the sigmoid flexure and in the rectum being practically equal; whilst of the remaining one-fourth, the ascending colon is the rarest, and the cæcum the next rarest seat, the remainder being equally shared by the three regions of the transverse colon and the descending colon. In all but an insignificant minority of cases, the disease is seated below the cæcum; and this broad general conclusion approximates tolerably closely with the statements of the writers above named. We could point out, however, that Dr. Brinton's figures appear to us to give rather too high a range for affections of the cæcum and ascending colon.

II. *Nature of the Strictures.*—In general terms, it may be said that the majority of the strictures are malignant, and this notwithstanding the fact that few are associated with secondary infection of remote viscera. This may be explained by reason of the new growths mostly belonging to the class of epitheliomata, which are notoriously the most local of all forms of cancer, and also possibly because they lead to fatal results before the system comes to be infected. In a case under our care last year of epithelioma of the sigmoid flexure, an annular ulcer with thickened infiltrated margins, and a depressed and ulcerating base, which gave to the gut externally the appearance of having been constricted by a tight cord, the epithelial new growth infiltrated the coats of the bowel for about half an inch above and below the constriction; but there was absolutely no secondary infection in any part. A case precisely similar as to the form of local disease in the sigmoid flexure, which was in the Hospital in 1875, was asso-

* Read in the Section of Surgery at the Annual Meeting of the British Medical Association in Manchester, August 1877.