sional large draughts of warm water when the sickness seemed greatest, he recovered from that attack. The gall-stones, no doubt, passed successfully, which, from the presence of severe jaundice, is more probable than that they receded and returned into the bladder.

In the following year, he had another and more severe attack. It is probable that in this attack the false passage was formed from the gall-bladder to the duodenum, which I discovered at the *post mortem* examination, and the cystic termination of which enclosed an impacted calculus. The attack terminated with the discharge of gall-stones, brown biliary matter, and subsequent bilious diarrhœa.

From that time he began to take the celebrated mixture of turpentine and ether, and with so much apparent benefit, that during the subsequent four years the old gentleman allowed few days to pass without taking from half a drachm to a drachm of the mixture.

At the beginning of last winter his general health began to fail. A settled pain in the region of the gall bladder indicated chronic inflammation there. Notwithstanding all suitable treatment, he sank and died, very nearly eighty years old.

The *post mortem* examination revealed a gall-bladder full of calculi as the primary disease. Exudative plastic inflammation pervaded all neighbouring tissues.

The gall-stones were pulpy outside, and seemed to be made up of soft brown colouring matters; in the centre they were made up of crystallised cholesterine. I shew the dried bladder, containing one hard stone enclosed in the false passage. The others are removed. By this softness the theoretical value of the ether and turpentine mixture assumes a sort of empirical confirmation; although, on strict scrutiny, the direct solvent action of these substances cannot well be understood.

In the *symptomatic treatment of the passage of gall-stones* we have to rely mainly upon opium, which is sometimes better borne in the form of pills than that of tincture. We must carefully guard the patient from an overdose of this drug, which he is even more apt to take on his own account, from the torturing pain he is suffering, than the practitioner is likely to prescribe it. Nevertheless, severe narcotism sometimes follows large doses of opium—when the pain which caused them to be given suddenly ceases, from local causes. Such a case happened in Ireland some years ago, and was the subject of a painful legal inquiry. Happily, the life of the patient, who was a member of Parliament and a large estate proprietor, ended fatally only a few days after the severe narcotic symptoms had been successfully combated, so that the death and the narcotism stood in no immediate connection with each other. Whatever be our opinion, this case suggests caution.

Persons afflicted with dormant gall-stones should regulate their living in the most careful way possible, avoid all and every description of spirituous liquors, and let fruit and cereals, and light vegetables, enter largely upon their dietary.

In decided cases of gall-stones in the bladder, where continuous symptoms or repeated passages of concretions are observed, the surgeons should consider the propriety of planning and performing an operation for the extraction of these foreign bodies, either in a direct manner, or by forming a biliary fistula, and adopting a lithotriptic proceeding.

The operation is much slighter than lithotomy. Compared to such operations upon the abdominal organs as extirpation of ovarian tumours, it sinks into insignificance. If, for example, an incision was made a little above the lower edge of the liver, just large enough to admit the forefinger into the peritoneal cavity, the gall-bladder might be explored, and the presence or absence of calculi determined with the greatest certainty and the least danger. If calculi are present, the gall-bladder is seized with a small hook, pulled into the abdominal wound, and fixed there without being opened. In six days a good and passable fistula will be established, which, after a fortnight or three weeks, will be sufficiently consolidated to admit of the introduction of an instrument, by which such soft calculi may easily be crushed. The calculi once removed, I make no manner of doubt that the fistula would heal up by itself. I am certain that, with proper care and dexterity, surgeons might make a number of these operations successful, and have few failures; considering always that cases suitable for the operation would perhaps be half as common as cases for lithotomy.

Before knowing the cause and origin of gall-stones a little better, prevention is out of the question. But general hygiene will here do as much as in other diseases.

The above remarks may, perhaps, appear insignificant to gentlemen of longer experience, and the results of my researches small to those possessing more extensive opportunities than

myself. I hope that such of my hearers as enjoy either will make up my deficiencies. If, in full consciousness of these latter, I have nevertheless come forward, I have done so upon the principle that, however small our light, we ought not to put it under the bushel, but let it shine before the people. Should it be very dull, then I hope that my friends, in the discussion, will give it the benefit of a suitable trimming.

PATHOLOGICAL AND THERAPEUTICAL CONSIDERATIONS RELATIVE TO INFLAMMATION AND FEVER.

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In the following pages I shall attempt to give a *rationale* of the principal phenomena observed in inflammation and fever, with particular reference to recent neuro-pathological researches.

1. It is well known that the arteries of the abdominal and pelvic viscera, of the thoracic, and of the encephalon, are surrounded with nervous plexuses derived from the sympathetic system. The filaments of these nerves accompany the vessels to their finer ramifications, if not to their ultimate; and are distributed to their coats in no inconsiderable measure. In the limbs the arteries are accompanied by no such distinct sympathetic plexuses; the cerebro-spinal cords appear to take their place. By microscopic examination I have found that nerve filaments, in all respects similar to those of the visceral sympathetic, are given off from the finer ramifications of the cerebro-spinal nerves. They are in all probability distributed much in the same manner as the visceral nerves above mentioned. As branches from the ganglia of the sympathetic join the spinal nerves, it is no more than might have been expected that they would appear again at the peripheral expansions of the latter. The external carotid artery is surrounded by a plexus which accompanies each of its divisions. These are, therefore, similarly circumstanced to the visceral arteries of the three great cavities, which might have been anticipated considering their distribution.

In structure, the sympathetic nerves are found to consist of two kinds:—white tubular fibres, evidently identical with cerebro-spinal; and nucleated nerve bands, peculiar to the ganglionic nerves. The latter are known as fibres of Remak, and their nervous character is denied by several authorities. Bidder and Volkmann describe another variety of fibres which may be distinguished as the “fine tubular,” and which they regard as peculiar to the sympathetic system. These have not the double contour, and are but half the size of the ordinary cerebro-spinal. I agree with Todd and Bowman, in adopting Remak's view. However this be, it seems unquestionable that there are fibres in the sympathetic derived from the cerebro-spinal system, as well as others which arise in the various ganglia belonging to it. Anatomically, therefore, the sympathetic is a compound nerve, partly independent, and partly an offset of the nervous system of animal life.

2. Physiological observation accords with the above data, and extends them. The connection of the ganglionic nerves with the tissues of the part to which they proceed is proved by the influence of stimuli acting upon these nerves, or their centres, to excite muscular contractions or glandular secretion; and by the occurrence of pain, or reflex movements, when irritation is set up in the mucous surfaces, or other parts. The movements of the intestines and heart are unquestionably capable of being influenced by stimuli applied to their sympathetic nerves, or the related ganglia. The flow of gastric juice, of bile, and of pancreatic fluid, is produced by the stimulation of the mucous surface of the stomach and duodenum by the food. This stimulation is reflected through their nerves upon the several glandular organs. An irritant purgative causes griping pain and increased peristaltic motion. Muscular contractions can be influenced, in parts supplied with ganglionic nerves, by impulses originating in the brain or spinal cord: and conversely, the states of organs supplied with ganglionic nerves make themselves felt in the cerebral and spinal nervous centres. The effect of emotions upon the heart and the intestines is notorious, as well as the influence of intestinal disorder in producing headache, amaurosis, or tinnitus aurium, and of worms in causing convulsions.

The control exercised by the sympathetic nerves upon the vessels they accompany is very apparent in blushing, and in many pathological phenomena which will be hereafter alluded

to. The most striking evidence of this is, however, afforded by the experiments of Bernard. It is well known that in paralysis from disease of the brain or spinal cord, the temperature of the paralysed parts, as a rule, is lowered. This was found to occur when the anterior or posterior roots of the spinal nerves, or the root of the fifth pair, or that of the facial, were divided. The loss was not very considerable, varying from about 3° to 7° of Fah. When the sympathetic nerve in the neck was divided, or the superior cervical ganglion extirpated, the following phenomena were observed. The temperature of the operated side increased rapidly, and in a quarter of an hour after the operation had risen 11° Fah. The arteries and small vessels dilated, and became much more full of blood than those of the opposite side; the pupil contracted, as well as the palpebral opening, while the globe of the eye appeared depressed in the orbit. The hyperæmia which is the immediate result of the operation subsides considerably in a day or two; but the elevation of temperature is much more persistent, lasting, in rabbits, sixteen to eighteen days; in dogs, six weeks to two months. Not only the superficial parts, but the deep seated, and even the blood returning by the jugular vein, can be shown to be hotter than the corresponding parts of the healthy side, or than they themselves were previously. It is an important circumstance, observed by Bernard and Brown-Séquard, that the temperature on the sound side falls below its previous figure; the difference in one experiment amounting to $5\frac{1}{2}^{\circ}$ Fah. The phenomena now described are more prominently marked in healthy and vigorous animals than in those that are weakly, and in those that are digesting food than in those that are fasting. When an animal whose cervical sympathetic has been divided on one side is exposed to a temperature above that of its own body, the side where the nerve is entire gains heat, while the other remains almost unchanged, and before long no difference can be detected by the thermometer between the two. On the other hand, when an animal similarly circumstanced is placed in a medium considerably colder than its own body, the difference between the normal and the operated side becomes more prominently marked. The former loses heat much faster than the latter, and the thermometer shows that it may become as much as 21° Fah. colder than its fellow. If the upper end of the divided sympathetic is galvanised, all the effects produced by the previous operation disappear, and are replaced by their converse. The pupil dilates, as well as the palpebral opening, and the eyeball projects from the orbit. Instead of being active, the circulation becomes weak; the conjunctiva, nostrils, and ears, which were red, become pale. The temperature falls below the normal figure, while, curiously enough, that of the opposite side increases notably. According to Brown-Séquard, the effects produced by a transverse lateral section of half the spinal cord, in the dorsal region, on the posterior limb of the corresponding side, are exactly similar to those we have been considering. The condition, also, of the opposite sides in both cases is quite similar: "both receive less blood than usual, their temperature diminishes, their nutrition is less active, and their vital properties also diminish." Bernard remarks, that although he has watched, for a length of time, animals who had undergone division of the cervical sympathetic, he has never seen any œdema or inflammatory action supervene in the abnormally hot parts so long as the animal continued in good health. But if they fell sick, either spontaneously, or from the effect of other operations, the mucous membranes of the eye and nose, on the operated side *only*, became very red, swelled, and poured out purulent matter abundantly. If the animal's health improved, these inflammatory phenomena ceased. This highly important observation I can quite confirm from my own experience. A cat, on which I operated, had severe purulent ophthalmia of the left eye for five or six days, after which it spontaneously declined. Sixteen days after the operation the left ear was 15° Fah. hotter than the right. She had been debilitated by an unsuccessful attempt to divide the renal nerves on one side.

The cause of the elevated temperature of the parts lying in the range of the divided sympathetic is attributed by Brown-Séquard and Walter to the increased afflux of blood, to the hyperæmia. Bernard, however, opposes this view, because the temperature does not vary when the hyperæmia declines; because hyperæmia occurs when the fifth nerve is divided, but is attended with diminished temperature; because ligature of the veins of each ear, and consequent gorging of the vessels with blood, lowers the temperature of the parts, which again rises on the side on which the sympathetic is subsequently divided. It is true that if the carotid is tied, and the sympathetic afterwards divided on the same side, no calorification takes place;

but if the sympathetic be first divided, and calorification have come on, ligature of the carotid does not lower the temperature to that of the sound side.

Another argument which may be used in support of Bernard's opinion, is, that the temperature in the paralysed parts exceeds by 2° or 3° in some cases, the normal temperature of internal parts, as of the rectum. On the whole, it seems to me decidedly most probable that the increase of heat is not due solely to hyperæmic afflux, but that accelerated tissue-change also plays a considerable part in its causation.

Bernard doubts that the effect of dividing the sympathetic is to paralyse the arteries, and so cause their dilatation; he states, on the contrary, that the first perceived effect is the contraction of the carotid, and he looks on the subsequent dilatation of the vessels as the result of an afflux of blood to the part*. However, the contraction of the pupil, which is doubtless occasioned by the loss of the antagonist action of the radiating fibres of the iris, seems to indicate that the withdrawal of the influence of the sympathetic does tend to paralyse contractile tissues, and the very positive result of galvanising the divided nerve supports the same idea. There is nothing anomalous, as Bernard seems to think, in arterial paralysis promoting more active circulation. On the contrary, it is perfectly evident that the only result of arterial action must be to diminish the afflux of blood to the part. This is well seen when the arteries in the frog's web are made to contract by the application of cold; whole tracts of capillaries appear empty and deprived of blood. On warming the web, the arteries immediately dilate, and pour in blood abundantly. When a nervous trunk is divided, for instance, the sciatic, containing motor, sensory, and sympathetic fibres, all the changes are produced which naturally result from the suspension of the influence of these several fibres. However, the calorification in this case is somewhat diminished by the refrigerating tendency of the paralysis of the motor and sensory fibres.

Analogous experiments made by other observers are strongly corroborative of Bernard's statements. Jaschowitz shows that section of the sympathetic plexus of the spleen causes congestion of blood, softening, and tension of the capsule. If part only of the plexus is divided, the corresponding part of the spleen only is affected. Samuel, in experiments upon rabbits, dogs, and cats, found that the hyperæmia of the intestinal mucous membrane, produced by extirpation of the celiac plexus, was so great, that it exceeded all pathological hyperæmias hitherto known. The secretion of the mucous membrane is increased by the operation, but not to the same degree as in violent diarrhœa. Wharton Jones finds that after removal of the lower part of the spinal cord, and the roots of the nerves, the arteries of the webs in a frog retain all their contractility, or are even more than usually disposed to be constricted. If now the ischiatic nerve be divided on one side, "the result is that the skin of the extremity subjected to the experiment becomes, even to the naked eye, redder from vascular congestion than that of the opposite extremity, and on examination of the web under the microscope, the arteries are found considerably dilated. In the web of the opposite extremity, on the contrary, the arteries are seen still much constricted, some even to closure."

Practical conclusion. Paralysis of the vaso-motor nerves of any organ may throw that organ into a condition of hurried and disordered nutrition, attended with hyperæmic afflux; and, if the part be predisposed, actual severe inflammation may result.

3. Attention has lately been directed by Pfliiger and Lister to certain nerve phenomena, which the former terms inhibitory (*hemmungs*), and supposes to belong to a certain set or system of nerve fibres, whose sole function is to arrest or diminish action. Lister, on the contrary, concludes from his inquiries (*Proceedings of the Royal Society*, No. 32, page 367), "that one and the same afferent nerve may, according as it is operating mildly or energetically, either exalt or depress the functions of the nervous centre on which it acts. It is, I believe (he says), upon this that all inhibitory influence depends, and I suspect that the principle will be found to admit of a very general application in physiology." The following are instances of inhibitory action. The poles of a galvanic apparatus being fixed to the spinous processes of the ninth and twelfth dorsal vertebra of a rabbit, currents were passed through the spine (of course affecting the cord), with the effect of inducing "complete relaxation and quiescence of

* Plus tard cette artère et ses divisions deviennent plus grosses et sont en quelque sorte distendues par un afflux de sang qui se fait dans les parties correspondantes; mais cet effet, loin de ressembler à une paralysie, amène une circulation plus active. (P. 509.)

the small intestines, which had been previously in considerable movement, while the muscles of the limbs were thrown into spasmodic action, but on the discontinuance of the galvanism, the previous intestinal motion returned." Weaker currents were then passed, and "markedly increased the action of the intestines in every instance during the first twenty-five minutes." In the next half hour the increase of action from the galvanism, though still distinct, was less strongly marked, and "at the end of that period" with stronger currents, "the inhibiting influence was also found to be much less complete than before, indicating that the parts of the nervous apparatus concerned were in a less active condition, no doubt in consequence of exhaustion." Increased movements of the intestines were produced by direct irritation of the cord with a fine needle. It was very worthy of remark, that violent struggling of the rabbit, "when the intestines were in pretty free movement, was followed by absolute and universal quiescence of those organs for several seconds." This showed that an inhibitory action was capable of being produced naturally as well as artificially.

The slowing or arrest of the action of the heart by irritation of the vagus, seems to be due to an action of this kind, *Vide* Bernard's experiments (*Leçons sur le Système Nerveux*, tome ii, page 392.)

In a paper on inhibitory influence published in the *BRITISH MEDICAL JOURNAL*, February 5th, 1859, I have endeavoured to show that pathological phenomena are not unfrequent, which seem to be of this character. I modify, however, the statement of Mr. Lister, so far as to believe that it is not the energetic operation of an afferent nerve that causes inhibitory action, but its being injuriously affected by some impression made upon it. The enfeebled state of the nerve itself, or of the centre to which it proceeds, or the severity of the impression may give rise to the peculiar effect. Instances are quoted further on (p. 106), of inhibitory paralysis resulting from cold, and the following is a good instance of the same occurrence from another cause.

O. J., male, aged 37, got a whitlow on last phalanx of left thumb, the lymphatics were inflamed, and the axillary glands swelled, the whole arm was very painful. While the limb was in this state, one morning he found that he saw double, and had a squint in the left eye. At the Ophthalmic Hospital, it was found that the external rectus muscle was completely paralysed, and he had severe circumorbital pain. It was supposed that there was periosteal inflammation about the orbit, and iodide of potassium was given; the whitlow was poulticed, and the arm fomented. After a month of this treatment, there was no improvement of the eyes, but the arm inflammation had quite subsided. A piece of dead bone was now removed from the seat of the whitlow; soon after which the squint disappeared, as well as the pain in the arm, and about the orbit. The external rectus had quite recovered its power. (*Medical Times and Gazette*, January 29th, 1859.)

Dr. Watson refers to the production of amaurosis without visible change in the eye, in consequence apparently of the dental irritation, the blindness ceasing after the extraction of some teeth which had grown irregularly. He quotes from Mr. Lawrence an interesting case in which the extraction of a carious tooth with a splinter of wood projecting from one of its fangs procured the restoration of the sight of the eye of the same side which had been lost entirely for thirteen months. In such cases, the paralysis of the retina on the optic tubercles may fairly be designated inhibitory. Two cases of amaurosis, and one of ptosis, are recorded by Mr. Hancock (*Lancet*, January 22nd, 1859), as cured by the removal of decayed or overcrowded teeth. The pathology of these is no doubt the same. In the same communication, a case of lockjaw, and of extreme wry neck, are mentioned, as having yielded to the same measure. This shows that it depends very much on the condition of the nervous centre which is affected, what the result of an irritation shall be, whether paralyzing, or exciting. So, in some persons, opium causes powerlessness (a degree of paralysis), in others, it tones and prevents fatigue.

Practical conclusion. The nervous centre connected with a motor, vaso-motor, special sensory, and probably with a common sensory nerve, may be incapacitated from its function in consequence of an irritation transmitted from some distant part. Such paralysis may be termed *inhibitory*.

4. The phenomena of fully developed inflammation, as seen by the naked eye, are notorious, and do not require description here. The heat, redness, pain, and swelling, are accounted for by the hyperæmia and the exudation; some part, however, of the excess of heat being probably due to increased metamor-

phic processes taking place in the inflamed area. The phenomena observed by the aid of the microscope are as follows. After the application of the irritant (I used dilute liquor ammoniæ or its vapour), the blood is seen to traverse the capillaries more and more slowly, to oscillate, and at last to stop, the corpuscles becoming all compacted together into a red mass. It is abundantly evident that the arrest is not caused by the sticking of red or white corpuscles to the capillary walls, but by the interruption of those conditions which in health make the transit of the blood-globules easy; or, perhaps, by the setting up of a morbid attraction. It is equally manifest that neither contraction nor dilatation of the arteries or veins has anything to do with the production of stasis, at least of inflammatory stasis. The starting point of this is clearly from the capillaries. The stasis of blood may affect at first only a few capillaries, gradually it spreads and becomes very extensive. If a strong irritant is freely applied at once, stasis takes place almost immediately; too quickly to observe its mode of production. All around the stasis the circulation goes on very actively. The blood in the seat of stagnation is of a darker red than natural. During complete and universal stasis, the blood is seen sometimes flowing backwards in the veins, as if attracted towards the inflamed part, while at the same moment the arteries are pouring in fresh streams. At other times the current in the veins is only more or less retarded. The arteries may be seen in various states, either normal or slightly contracted, or empty and contracted, to one half or less of their diameter, or they are filled up with stagnant red globules, or they exhibit red corpuscles moving to and fro, driven forward by the heart's impulse, and again receding. The two latter states are often consecutive, the first being observed in complete repletion and stasis. When resolution takes place in a part, the blood which was stagnant and filled up the capillaries, begins at first to move very slightly, presenting a feeble oscillation. It has lost its adhesion to the walls of the vessels, but the corpuscles still adhere to each other. The oscillation increases, the obstructing mass is pushed onward, and projects into some vessel which is traversed by moving blood. The corpuscles separate from each other, sometimes one or two are swept away in the current at a time, sometimes a small clot containing several. At last all are dispersed, except perhaps some red corpuscles, which still adhere to the side of the vessel by their flat surface, or as I once saw, by one extremity. Adhesion of some red corpuscles to the capillary walls may be seen where the stream is slackening in commencing stasis, but it is most evident that the cause of the stasis is not mere adhesiveness or mechanical obstruction. The epithelium of the inflamed web becomes manifestly more opaque and granular, and often separates. Mr. Lister has observed that the pigment in the frog undergoes a remarkable change in an inflamed area, becoming diffused into the radiating processes of the containing cells, while in healthy parts it is concentrated around the nucleus. The same effect is produced by division of the sciatic nerve, so that the change seems to indicate a loss of power in the cell comparable to the paralysis of a muscle. Additional evidence is thus furnished of the loss of functional power resulting from inflammation.

It is probable that in all inflammations, of whatever character, or however caused, the visible phenomena are such as above described. Only it must be remembered, that in inflammations, such as we ordinarily meet with in warm-blooded creatures, there is not the same amount of stasis as is seen in the frog's web. This is an extreme result tending in the direction of gangrene. The vitality of the inflamed tissues is lowered, they are more or less incapacitated for functional operation, their nutrition is arrested, and in consequence, their cohesive power is impaired, and they become soft or brittle. It is quite certain that during inflammation the afflux of blood to the part is vastly increased, as proved by Lawrence's well-known experiment. The throbbing of the arteries so often spoken of as increased action is really, as far as regards themselves, a proof of debility; a sign that they yield more than they would in health to the increased impulse of the heart. In many inflammations, notably in the subcutaneous phlegmons, large or small, the tendency to suppuration is very marked, and when once the inflammation is fairly set up, extremely difficult to withstand. Until suppuration has occurred, it is found impossible to arrest the hyperæmic afflux, but when this has taken place, and the pus has escaped, it subsides spontaneously. It really seems as if a morbid development of force took place in the inflamed part, which did not subside until it had spent itself in cell production.

[To be continued.]