condition of the os and cervix uteri would do when uncomplicated with any other diseased condition. The menorrhagia and leucorrhœa induced by the above condition were both cured by local applications, the chief of which was nitric acid. The surface of the cervix healed in most cases, with about three or four applications of the strong acid, at intervals varying from a week or ten days, or a fortnight; and as soon as the surfaces were healed, the menstruation became normal.

10. *Stenosis, or Narrowing of the Cervix and Os Uteri.*—I have to allude now to a class of cases where, although pain is an important symptom, yet hæmorrhage is one that must be taken into account also; and it was mainly on account of the latter symptom that the six cases forming this class applied for relief. This condition, by not allowing a free exit for the menstrual fluid, allows a portion of it to coagulate *in utero*, and this acts as an irritant and causes a chronic congestion to be kept up, which, of course, greatly increases the amount lost at the period. An examination with the sound reveals the cause. The treatment is simple: divide the os uteri externum to make it larger, and, if necessary, cut slightly the sides of the cervical canal; then pass a sound twice a week for a month or two; and, in most cases, the relief, both from hæmorrhage and from pain, will be permanent. It has been so in four of my cases; the other two I have not been so fortunate as to entirely cure, although they are relieved to a great extent from menorrhagia.

11. *Anæmia.*—The last condition to which I intend alluding, as a cause of uterine hæmorrhage, is a general one, and that is anæmia. Although, of course, it is often the consequence of excessive hæmorrhages, yet it is occasionally the cause of excessive menstruation. I have had four cases, of which the following is a typical example. A thin pale girl, aged 17, began to menstruate at fifteen, and has done so about every two or three weeks profusely. No uterine disease could be detected; in fact, the hæmorrhage was more like a constant oozing of blood, and not with much colour. The cases were cured by directing attention to the general state of anæmia, and insisting upon the recumbent position, with the hips raised during the continuance of the menstrual period.

In conclusion, I must ask you to excuse the very short account given of most of the conditions mentioned in my paper; but all I wished to do was to place before you an analysis, as it were, of some of the causes of uterine hæmorrhage, so that it might be of the same assistance to you as it is to me.

ON THE MORBID HISTOLOGY OF THE SPINAL CORD IN FIVE CASES OF INSANITY.*

By RINGROSE ATKINS, M.A., M.D.,

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In the following communication, I record the appearances observed in the spinal cords taken from the bodies of five persons dying insane; and, though I feel that the recital of histological changes cannot but be wearisome, yet the few references to the condition of this centre contained in the pathological records of insanity, in this country at least, has induced me to trespass on your indulgence; and I can, therefore, only trust that the description which I am about to read of the appearances presented by the specimens, and depicted in the drawings exhibited for your inspection, may not be wholly devoid of interest, as forming a slight contribution to this field of inquiry. In each case, I shall shortly mention the state of the brain also, so as to afford a comparison with that of the spinal cord.

CASE I.—J. G., male, aged 29, single, was admitted into the District Lunatic Asylum, Cork, on April 9th, 1873. The patient, for nine days previous to his admission, had been labouring under great mental excitement, with paroxysms of violence, during which he had committed several unprovoked assaults, and was strange in his manner and behaviour. The mental derangement was attributed to a previous injury to his head. When he came under my observation towards the close of 1873, his mental condition was that of settled melancholy; he was depressed and silent, difficult to draw into conversation, and rarely answered directly any questions put to him, frequently requesting that he might be killed. His expression was gloomy, with a haggard anxious look; he was very restless and uneasy, constantly watching an opportunity to make his escape from the asylum. Physically, he was a weakly constituted young man, with a strong tendency to chest-disease, and used to suffer from repeated attacks of diarrhœa. Since then, the depression and gloom became more fixed, and the desire that he might be killed was constantly present. He progressively emaciated, and

the tendency to lung-disease increased. He had but little cough or expectoration, and no active symptoms; he suffered, however, from recurrences of diarrhœa. He was generally clean in his habits and person. Physical weakness and general emaciation gradually increased, and he died on January 20th, 1877. There were never any morbid disturbances or other indications of *coarse* disease in the brain or spinal cord.

Necropsy forty-eight hours after death.—The body was much emaciated; rigor mortis was little marked. The remains of commencing bed-sores were present over the lower portion of the sacrum and the trochanteric prominences. The scalp was normal, the left lateral surface of the frontal bone somewhat flattened, the calvarium in other respects being normal. The dura mater was healthy, no adhesions or thickening existing. The brain was large; the vessels at the base unaffected; the pia mater bridging the Sylvian fissure was adherent to the cortex; the latter, at the apices of both temporo-sphenoidal convolutions, was diminished in consistence. Over the superior surface of the organ, the pia mater was a little thickened, especially along the sides of the vertical cleft and over the right postero-parietal lobule, where it was white and opaque; the membrane generally was difficult to strip from the convolutions without injury to the cortex. Dissection revealed no gross lesion in the brain-substance or ganglia.

Microscopical Examination.—(a). *Pia Mater.* A portion of the membrane carefully stripped from the summit of a convolution, and immediately immersed in a weak solution of bichromate of potash, as recommended by Dr. Charlton Bastian, while the vessels were still naturally injected with blood-corpuscles, showed the muscular coats to be thickened and dotted with fine granules. [This method of examination affords, I believe, more reliable results than the inspection of stained specimens of the tissue, as, if cautiously manipulated, the real condition of the coats of the arterioles can be much more readily distinguished while the vessels are filled with blood-corpuscles than when the latter are washed out in the preparation of the specimen, the vessels then being empty and transparent, it often becomes difficult to determine the exact boundary-line of their walls.] (b) *The Brain.* Fresh teased preparations, stained with aniline blue-black and examined in glycerine, exhibited the larger pyramidal nerve-cells from the frontal and parietal regions in a more or less granular condition; where the granules were abundant, the basal extremities of the bodies had become rounded and eroded; when, however, they contained but few granules, the angles and processes were generally preserved, and could be traced for a considerable distance; in many cases, to their subdivisions. In no case had the nucleus disappeared or been concealed by the granules. The surfaces of the smaller vessels were dotted with rounded and elongated nuclei. A prepared carminised section of the tissue from the left superior frontal convolution, hardened in iodised spirit and bichromate of potash, showed the coats of the vessels to be fused, and, in some instances, surrounded with an overgrowth of connective tissue; in others, the lumen was filled with an organised plug; they were surrounded by the commonly observed clear spaces (perivascular canals?), which contained, clinging to the walls of the vessels, particles of hæmatoidin and minute granules.

Many of the larger nerve-cells had lost their normal outline, and were shrivelled and yellow, and destitute of their branching processes. Their nuclei were large and slightly coloured by the carmine; the smaller angular and pyramidal cells were generally unaffected. The neuroglia was granular, and contained numerous nuclei and clear spaces left by the disappearance of the disintegrated nerve-cells.

(c) *The Spinal Cord.* The spinal dura mater was normal; on slitting it up, two almond-shaped protuberances were seen on the left postero-lateral aspect of the cord; the upper one, three-quarters of an inch in length, occupied the origin of the fifth dorsal nerve; the lower, more pyramidal in shape, with its base joining the upper elevation, lay between the fifth and sixth dorsal nerves, the latter issuing below it. These eminences on the cord were covered by the pia mater, and were of a greyish-white colour, soft, and apparently composed of nerve-matter. The cord externally presented no further morbid appearances to the naked eye. It was cut into segments and hardened in Hamilton's chromic acid solutions which rendered the tissue very friable and difficult to cut sections from, that part around the central canal being especially so. At the junction of the cervical and dorsal regions, transverse sections coloured with carmine showed the following appearances. 1. The investing sheath of pia mater was considerably thickened, and composed of fine broad and deeply coloured bands of fibroid tissue containing numerous vessels. The septula passing from it into the substance of the cord were, in like manner, thickened from overgrowth of tissue. 2. The vessels following the same direction were also similarly affected, their coats being fused and composed of fine longitudinally running parallel fibres, the muscular layer being apparently obliterated.

* Read in the Section of Psychology at the Annual Meeting of the British Medical Association in Manchester, August 1877. Drawings of the appearances described were exhibited.

The open mouths of the vertically running vessels in the grey matter were shrivelled and irregular in outline, and, in some instances, so puckered and contracted as to resemble fibroid knots. 3. The right posterior grey cornu was, to the naked eye, atrophied to such an extent that the bulbous enlargement (*substantia gelatinosa*) had quite disappeared, its place being taken by a fine felt-like structure containing scattered in it numbers of minute nuclei and small amyloid bodies. The left posterior cornu was normal in configuration. The ganglion-cells of the anterior cornua were diminished in number, being swollen and clouded, so as to render the nuclei indistinct. The condition of the central canal and commissures was difficult to ascertain, the tissues being so friable that these parts were invariably injured in this region in the cutting of the sections. The connective tissue of the external layers of the white columns throughout the entire circumference of the sections was coarse and overgrown, the meshes which it formed for the nerve-fibres being wide and irregular, and, in some instances, broken into each other. At the points of coalescence of the septa forming the meshwork, stellate corpuscles appeared, the stellæ passing away into the septa; in the deeper layers around the grey matter, the supporting structure was closer and more compact, the cut extremities of fine fibres being very numerous in it, together with minute nuclei and small amyloid bodies. In the external layer of the white columns, the nerve-fibres had, in very many instances, entirely disappeared, the tissue presenting a loose and irregular appearance, contrasting strongly with that in the normal condition. Where present, the medullary sheath had lost, more or less, its circular outline, and the axis-cylinder was dislocated and frequently swollen and granular. On dividing the cord transversely through the middle of the upper tumour-like protuberance already mentioned, the substance of the latter was seen to be continuous with that of the cord itself, and, to the naked eye, no difference in structure could be perceived; the sheath of pia mater was prolonged over it and was thickened, especially at the angles where it was reflected from the surface of the cord. The centre of the section was occupied by a pyriform mass quite distinct from the surrounding tissue; this was set obliquely, the base pointing outwards and backwards in the direction of the enlargement on the surface, which appeared as if formed by the pushing outwards of the left postero-lateral column by the pressure of the central growth. The grey cornua were attenuated, especially the posterior crura, which were widely separated and curved round this mass. A section through the lower protuberance showed similar gross appearances, the central layer being larger and more rounded, the posterior grey cornua reduced to mere bands almost completely encircling it. Under the microscope ($\times 300$), the central structure presented a close molecular arrangement, with numerous small amyloid bodies scattered through it; it contained no trace of nerve-fibres or connective tissue reticulum. The external layer of the white matter presented the same coarse and disorganised appearance already described, and was, to a very considerable extent, destitute of nerve-fibres. At the points of coalescence of the fibres forming the irregular meshwork were stellate corpuscles, the stellæ passing into and joining with the fibres in the formation of the loculi. In that portion forming the surface-enlargements, these loculi were elongated, and the tissue generally was more compact and fibroid, the fibres following a left postero-lateral direction. Below the fifth dorsal nerve, where the two protuberances joined each other, the central growth was small and ovoid. In the lower dorsal and lumbar regions, the configuration of the structures was normal to the naked eye. Under the microscope, the vessels were seen to be thickened, the white columns affected, as before mentioned, and, in a section taken about the third lumbar nerve, many of the multipolar cells of the anterior cornua had disappeared, especially from that of the left side, several clear spaces being left where they had been situated; others were shapeless and granular, with loss of protoplasm and partially surrounded by clear spaces, indicative of the atrophic condition. In the lower lumbar region, the same changes, though to a less extent, were observed. In the sacral region, the cord was widened transversely, and, on being cut across about the origin of the second nerve, a central mass somewhat similar in outline, and identical in structure, to that in the dorsal region was seen; its long axis was set transversely, and consequently had displaced the surrounding structures laterally, causing the widening; the grey cornua were distorted and pushed outwards. The ganglion-cells in some places were granular and eroded; in others preserving their normal appearance. The vessels, nerve-fibres, and neuroglia were affected similarly to those in the upper regions of the cord.

Summary.—The changes throughout, summarised, are: moderate fibrosis of vessels, overgrowth of connective tissue matrix, atrophy, and partial disappearance of nerve-fibres in the external laminae of the

white matter generally, with a selective degeneration of the multipolar ganglion-cells, and, as a special condition, a central sclerosis in the upper dorsal and sacral regions.

CASE II.—J. C., male, aged 75, was admitted from the Cork Union Workhouse on December 16th, 1876, with little or no history, his relatives being unknown. There was a vague history of injury to the hip, and consequent disorder of motility; but no trace of such injury could be detected. The man was feeble and demented, with some slight excitement for a short time after his admission. He was kept for a few days in bed and then got up, when he was found to walk with a tottering unsteady gait, rendering him extremely liable to fall, if not closely watched, the limbs appearing to give way suddenly beneath him. There was no parietic dragging or ataxy; he had no control over the sphincters, the urine almost constantly dribbling away. He became gradually more and more enfeebled, both bodily and mentally, and died on February 14th, 1877.

Necropsy twenty-four hours after death.—Body wasted; rigor mortis slightly marked. The integument over the sacrum was infiltrated and dotted with minute sores (he had been confined to bed only one day previous to his death). The spinal column was curved laterally to the left on a level with the spine of the scapulae, and anteriorly (lordosis) in the lower dorsal region. The calvarium was soft and easily cut through. The dura mater was intimately adherent to the bone, coming away with the skull-cap; the diploë had disappeared, the entire thickness of the bone being more or less porous. The dura mater was somewhat thickened and of a yellowish colour; the sinuses contained dark fluid blood, and a considerable quantity of sanguineous serum escaped during the removal of the brain. The entire arterial system at the base of the organ was extensively diseased; both vertebrals were thickened, the left being more so, larger than the right, and slightly tortuous before its junction in the basilar. The basilar appeared as a firm tube, its walls being considerably thickened, and in parts of a dirty greenish colour; at its posterior termination in the posterior cerebrals, it was pouched and irregular; the latter vessels, as well as the cerebellar arteries, were also affected, the left posterior inferior cerebellar being cord-like. The internal carotids were rigid and of a dirty yellow colour; the coats of the left artery, just at the commencement of the middle cerebral, were pushed out into a distinct sacculatation. Both middle cerebrals were affected, the left especially so, being varicose and beaded, with patches of a dirty yellowish-green colour; the divisions in both Sylvian fissures were similarly diseased. The anterior cerebrals were also morbid, but to a less extent than were the other vessels. The various parts at the base of the brain presented nothing abnormal. The pia mater was not adherent to the cortex; the convolutions were wasted, the sulci being broad and shallow; the brain-substance generally was flabby. Dissection of the organ showed the corpora striata and optic thalami to be flattened and atrophied, and of dirty grey colour; the choroid plexuses were congested; the venæ Galeni filled with blood. The spinal cord was removed, from the lower cervical region to the terminal extremity. The muscles and intermuscular septa in the lower dorsal and lumbar regions were infiltrated with dark fluid blood, and the membranes of the cord were congested. On slitting up the theca, the cord, from the first to the eighth dorsal nerves, was found to be abnormally firm and resistant; from the eighth dorsal, for a distance of an inch and a half, the substance of the cord posteriorly was softened almost to diffidence, the dura mater being here intimately adherent to the nervous substance, which was of a reddish hue. The softening had not extended into the anterior region of the cord; the diffident portion was rather sharply separated from the firm rigid cord above and below it.

Microscopical Examination.—(a) *Pia Mater.* The vessels were injected; the muscular coat markedly thickened and granular. (b) *Brain.* Fresh preparations showed the ganglion-cells to contain masses of granules, many being broken down and others of a rounded or bulbous outline, the nucleus being in every instance distinguishable. A prepared section from the vertex of the right superior frontal convolution showed the coats of the vessels to be throughout homogeneous; the walls of those running on the surface and dipping between the convolutions were considerably thickened and fibroid, many being filled with the remains of blood-corpuscles; the medium-sized arterioles in the superficial layers of the cortex were similarly thickened, regular in outline, and surrounded by dilated perivascular spaces (?), which were generally quite empty, containing but little granular or other debris. Many of the minute vessels contained masses of bright yellow material, derived from altered blood-corpuscles. The ganglion-cells were very generally affected, the larger ones being markedly so; the great majority had lost their normal pyramidal shape, and were diminished in size; their outlines were eroded and irregular, the protoplasm containing finely granular yellow pigment. The nuclei appeared swollen, often occupying almost

the entire body of the corpuscle, and containing minute dark-coloured granules. The nucleoli were not easily distinguishable, and many of the cells were surrounded entirely with clear spaces, indicating atrophic as well as degenerative changes. The superficial layers of the neuroglia appeared loose and granular; the deeper layers closer and of a finer consistence, scattered through it irregularly, sometimes singly, sometimes in groups, were numerous minute nuclei (leucocytes?). (c) *Spinal Cord.* A section through the middle of the decussation of the anterior pyramids of the medulla showed the investing sheath of pia mater and its entering septula to be in parts thickened and fibroid, the vessels ramifying in it being similarly affected, more so than those running in the membrane covering the convolutions. At one spot in the lateral column, close to the periphery of the section, was a vessel with its coats entirely replaced by layers of minute cells placed concentrically and encroaching on the lumen of the vessel. This vessel appeared in several sections, and was the only one seen thus affected, the coats of the remainder being formed of wavy fibroid tissue, the vessels surrounding the position of the central canal being similarly affected; the latter had disappeared, its place being taken by an aggregated mass of nuclei extending for some distance around. The normal outline of the grey matter was preserved, and no gross changes had here occurred. The ganglion-cells of the posterior cornua were selectively affected, many being covered with brown granules, while others contained yellow pigment; many, again, were quite unaffected. In the upper dorsal region, several vessels were seen widely dilated and filled with blood-corpuscles, and in one section a minute hæmorrhage had occurred at the entrance to the anterior fissure. The vascular tissue was not so thickened or fibroid as in the medulla. The ganglion-cells of the anterior cornua were pigmented and granular, some of them being broken down and atrophied. Those of the posterior cornua were diminished in number, and the intercellular structure generally was coarse and granular. In the middle dorsal regions, the cord was friable and difficult to cut. Around the central canal, the tissue was loose and broken down; the latter was replaced by a collection of nuclei; the vessels surrounding it were shrunken, irregular, and surrounded by dilated perivascular spaces (?). The ganglion-cells of the anterior cornua and of the columns of Clarke were all more or less affected with pigment-atrophy; the white columns had lost their normal appearance, the connective matrix being coarse and overgrown, while the contained nerves were atrophied or had entirely disappeared; the cut extremities of minute fibres could be seen projecting from the surface of the section; large numbers of amyloid bodies were scattered irregularly and along the vessels and septula, being collected in greatest numbers in the posterior (columns of Goll) and postero-lateral columns, and this condition prevailed throughout the entire length of the cord to its termination. From the eighth dorsal nerve, for an inch and a half downwards, as previously mentioned, the posterior half of the cord was softened and adherent to the dura mater; the softened tissue showed, in the fresh state, the nerve-fibres to be converted into large droplets constantly changing shape, together with numerous amyloid bodies (reacting with iodine) and granular corpuscles. The posterior half was firm, and a section presented the changes already mentioned. Below the tenth dorsal, the central canal was dilated and tubular, the grey matter around being coarse and loosely arranged, the ganglion-cells being here more affected than in the higher regions. In the lumbar, sacral, and coccygeal divisions, the central canal was again obliterated by proliferated nuclei; the vessels and white columns were altered as above, the ganglion-cells, though somewhat yellow, retaining their normal outline and processes. Transverse sections of the spinal nerves presented the normal honeycomb appearance, the meshwork being slightly overgrown. The axis-cylinder of the nerve-fibres had very generally lost its central position, being situated at the edge of its containing circle, as if from the loss of support of its medullary sheath.

Summary.—The changes in this case are throughout very similar in kind to those observed in the first; viz., primary vascularity and subsequent fibrosis of vessels, overgrowth of connective tissue, atrophy of nerve-fibres, pigment-atrophy of ganglion-cells, and the formation of amyloid bodies with nuclear proliferation, the vessels being here more fibrotic, and the cells in a more advanced stage of degeneration, than in the case of J. G.

CASE III.—R. D., male, aged 24, admitted on May 30th, 1874, an assistant National School teacher, and unmarried, suffering from dementia, with periods of excitement and a suicidal tendency. The patient was now in the asylum for the third time, having become first mentally deranged seven years ago, while acting as subpostmaster at Eyeries, a village in the west of the County Cork. The supposed cause of his insanity was mental anxiety and fear, resulting from the finding by the inspector of a money-letter opened while in his posses-

sion. He was then under treatment for twelve months, and, recovering, was sent home, where he continued, supporting himself for several years; but, again becoming insane, he was once more placed in the asylum, and, again recovering, returned home for the second time. Since then, however, he had never been entirely well, being odd and queer, inclined to be idle, and very slow at any work set him to do. His present symptoms were attributed partly to a fall he had while lifting a basketful of turf, and partly to mental irritability brought about by his father's unkind conduct towards him. Since his first illness, it was stated that he had been generally silent and depressed. His habits were always regular and temperate. The present attack commenced seventeen weeks ago, and he had since then attempted to drown himself, and become so restless and unmanageable as to necessitate his removal to the asylum. The only bodily ailment complained of was constipation. Of late, he had slept badly. There was no hereditary history of insanity in any near relative; a first cousin, however, was stated to be insane. On admission, the patient was in a condition of deep dementia: his expression was blank, with a wandering unmeaning gaze; his features being occasionally crossed by a weak facile smile when anything interested him; he rarely spoke, and appeared to have little or no perception of what was said to him. The existence of any delusions could not be ascertained. Physically, he was thin, weak, and anæmic.

During his final residence in the asylum, he never showed any signs of amendment, gradually deteriorating mentally and physically until the psychical functions appeared to be almost completely destroyed, the mental deterioration being accompanied by progressive emaciation and general feebleness; he could only move slowly with a crouching shuffling gait, and he did not appear to be affected by either heat or cold, or painful sensations, sinking for the last six months of his life into the lowest depths of dementia. Urine and feces were passed apparently without his being aware that he did so. Finally, symptoms of lung-disease, with cough and expectoration supervened, and he died from a general decay of all the organic functions.

Necropsy, February 20th, 1877.—The body was much emaciated; the skin dry and rough. On the inner aspect of one knee was a small sore covered with a black eschar. The integument over the sacrum and buttocks laterally was reddened; there was no appearance of bed-sores. The calvarium was normal; the dura mater was healthy, not adherent to bone or arachnoid. The brain was of natural size; but little fluid escaped during removal. The basal vessels were collapsed, small, and delicate-looking, nowhere atheromatous; the crura cerebri were diminished in consistence. The vessels of the pia mater and arachnoid, posteriorly, were filled with dark-coloured blood. The pia mater was with difficulty separated from the cortex, leaving the latter rough and eroded. Microscopically, its vessels were hypertrophically thickened, with collections of granules and particles of hæmatoidin scattered on them and through the membrane. The brain-substance was normally firm; in spots the cortex was of a slaty-blue colour. The contour of the convolutions presented nothing abnormal, and, on dissection, the central ganglia were found plump and well formed. The dura mater surrounding the cord was normal. On slitting it up, the vessels ramifying in the sheath of pia mater, especially over the posterior aspect of the cord, were seen intensely injected with bright red blood, and were tortuous and twisted. The cord itself, as far as the middle of the dorsal region, was normal in form and consistence. At the origin of the eighth nerve, it began to narrow considerably; and, three-quarters of an inch below this, was constricted to five-sixteenths of an inch; above the constricted portion, which was surrounded by thickened membrane, was a layer of milk-white appearance two inches and one-eighth long, the cord being here at its broadest part nine-sixteenths of an inch in width. The injected vessels ramifying above this dipped beneath it, again appearing where the layer terminated.

Microscopical Examination.—(a) *Pia Mater.* The vessels showed hypertrophic thickening of coats, with granules and particles of hæmatoidin scattered on them and through the membrane. (b) *Brain.* Fresh preparations showed the ganglion-cells to contain dark granules, the processes being broken off from many and their basal angles rounded. Sections through the right superior frontal and left anterior central convolutions showed the vessels not markedly affected either as regards their course or the condition of their walls. The ganglion-cells were in parts in the earlier stages of pigmentary degeneration, but had generally retained their pyramidal outline. The nuclei were normal in appearance, taking carmine well. The neuroglia was close and with difficulty coloured by carmine. Over the surface of the sections were scattered irregular-shaped masses of highly coloured finely aggregated granules. (c) *Spinal Cord.* A section through the upper part of the decussation of the anterior pyramids of the medulla revealed

nothing abnormal in the vessels or grey matter; the peripheral layer of white matter was scarcely tinted; there was overgrowth of connective tissue and atrophy of nerve-fibres. Below this, the grey cornua had lost their symmetry; in one section, the right posterior cornu was atrophied, while in several others, again, below this, the left anterior horn was shortened, and a portion of the central grey mass was encroached upon by a tract of lighter coloured tissue distinguishable to the naked eye, passing obliquely backwards. The central canal was replaced by proliferated nuclei, and appeared as if pushed towards the left. The vessels in its vicinity were irregular and shrunken, the perivascular spaces around them being dilated. The ganglion-cells were normal, while the white columns presented the same appearances above noted. In the upper cervical region, the sheath of pia mater was fibroid; the vessels were somewhat thickened; those running into the anterior fissure were surrounded by loose connective tissue and widely dilated and filled with blood-corpuscles; the central canal was obliterated; the vessels around it were thickened and shrunken, appearing in the grey cornua like fibroid nodules. The ganglion-cells of the anterior cornua were but little affected; the nervous strands of the posterior cornua were indistinct and atrophied. In the dorsal region, the same general changes were observed: the ganglion-cells of the anterior cornua were here more affected, being in some sections diminished in number, rounded, and finely granular, though deeply and evenly coloured by carmine. The nervous reticulum of the posterior cornua was indistinct and atrophied. Similar changes prevailed in the lumbar and sacral regions, the ganglion-cells being here relatively less affected than in the dorsal portion of the cord. The central canal throughout the entire column was replaced by proliferated nuclei, which formed a large ovoid mass transversely, and were scattered, sometimes widely so, in the grey commissure. The atrophic and degenerative changes in the white columns was equally diffused in the different regions, and sections of the spinal nerves running in the sheath surrounding the cord presented the same coarse and altered appearance.

Summary.—Moderate fibrosis of vessels, overgrowth of connective tissue, atrophy of nerve-fibres, partial degeneration of ganglion-cells of the anterior cornua, and of nervous reticulum of the posterior cornua, with obliteration of central canal and dilatation (especially in the cervical region) of perivascular spaces.

[To be continued.]

THE CHEMICAL THEORY OF CONTAGIUM COMPARED WITH THE CORPUSCULAR THEORY, WITH SPECIAL REFERENCE TO THE ACTION OF DISINFECTANTS.*

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THE subject which I have the honour to bring before you is one full of deep interest, involving as it does some of the most subtle and controverted questions of our day; and while I claim for it an importance second to none in the long roll of subjects connected with sanitary science, I beg your indulgence for a short time, while I bring some points perhaps hitherto untouched to your notice; and, with your assistance, I hope I shall be enabled to throw some light—however faint the glimmer may be—on our present knowledge of this most abstruse subject.

We shall regard *contagia* as substances which must come into actual contact with the organism, if they are to affect it. By *infection* will be understood the power of being propagated through the inhalation of air tainted by the perspiration or breath of the affected person; and by the term *disinfectant* is meant a destructive agent, that is, a substance which will prevent infectious diseases from spreading by destroying their specific poisons. I propose, then, firstly, to give a short *résumé* of the views held in relation to the spore-theory of disease; and, secondly, to see how far these theories bear close investigation, and the conclusions drawn from them.

Dr. Beale, in the year 1870, promulgated his views of the intimate nature of contagia, and submitted that the actual properties in vaccine lymph lay in transparent particles of extreme minuteness, which he termed bioplasm, born in and only growing in the body. These particles are living, but do not assume any special form; they are not microzymes or any vegetable life. "I am justified," he says, "in advancing the doctrine that the germs originate in man's organism, and

that they are descended from the normal bioplasm of the body. They consist of a peculiar kind of living matter, the smallest particles of which, when supplied with proper pabulum, will grow and multiply. They can, in fact, be only identified by their effects. The contagious virus is, then, living and growing matter, the particles not being directly descended but having resulted from the multiplication of particles from without, which are capable of growing and multiplying in the blood, while it is not improbable that a few of the contagious disease-germs actually acquire their virulent properties after they have left the organism in which they have become developed, and while they remain immersed in media containing the proper elements of their nutrition and further development. They are extremely minute, and can exist under many different conditions. In connection with this latter statement, it is worthy of remark that Dr. Beale asserts that, when once living matter has actually become ice, its life is for ever destroyed and it is incapable of being revived or revitalised. Now, lymph was frozen by means of solid carbonic acid and submitted to a temperature of 116 deg. below zero of Fahrenheit, and after this intense cold it was found to be unaffected. Under what conditions, then, can it retain its vitality?

The theory of Hallier, utilising the laws of alternate generation and of digenesis in the reproduction of certain cryptogamic vegetations, is an endeavour to establish the dictum that "all virulent agents are nothing more than an allotropic condition of various mucedines or moulds, which only arrive at their complete development without the body, though in it they multiply in the form of exceedingly fine granules designated micrococci". Every virulent malady has been, according to this idea, set down as depending upon the presence of a fungus, each epidemic owing its origin to a different fungus. His theory is plainly dependent on metamorphosis; otherwise it would not stand argument, and until further investigation throws more light upon the fungoid nature of contagium, I think we may fairly dismiss it without discussion. With reference to this, I may say in passing, that in no subject is there more diversity of opinion than exists among mycologists; and those are not few who deny all alternation of generation among fungi, on which alone Hallier's theory is founded.

Closely allied to Hallier's is the bacterioid origin of disease; and whether we regard these minute forms as mere particles of protoplasm, or as a series of steps in the autogenesis of a specific form; or agree with Cohn, who is inclined, from their resemblance to *alga crenothrix*, or class them with oscillatorians; or with Lister, who believes that he has demonstrated the origin of bacteria from a fungus, a species of *dematiu*; their presence is sufficient to urge us to persevere in further investigations, and to endeavour to learn something definite of the character and growth of these minute organisms. A modification of this theory is, that bacteria naturally harmless in themselves derive poisonous properties by feeding on morbid food, and thus become the carriers of specific contagium. The history of these minute forms has been studied with much care, and the observations of Pasteur are worthy of notice in passing. He is of opinion that some of the infusorial ferments, among which are the *bacteridia*, develop only in oxygen; while another class, namely, *vibrios*, undergo their transformations when the gas is absent. Different changes are brought about by different germs; the butyric acid fermentation is due to a vibrio, the alcoholic to a *torula*, etc.

The results of the most recent experiments on this subject that I am aware of are those recorded by Messrs. Downes and Blunt, on "The Influence of Light on the Development of Bacteria", that, in fact, it is inimical to their production, and that under favourable conditions it may prevent their development; while under less favourable conditions it may not prevent, but only retard. They further state that those conditions which tend to neutralise the action of light are the same which are known to favour processes of fermentation and putrefaction.

Passing on to more recent investigations, we gain fresh information from that distinguished veterinarian of the Lyons School, Dr. Chauveau, whose researches have been confirmed by Dr. Burdon Sanderson, and with extreme care have again been submitted to trial by Drs. Braidwood and Vacher. Dr. Chauveau tells us—and a study of his experiments will well repay perusal—that so far as vaccine lymph is concerned, the contagium consists of minute particles, suspended in the contagium liquid; in short, that it is the particles and not the soluble constituents of vaccine on which its activity depends. By dilution of the lymph, Dr. Chauveau was enabled to separate by subsidence minute particles called leucocytes, and he ascertained that the serum without them was just as virulent as when loaded with them. Thus he eliminated the presence of leucocytes as being the active germs, and after most painstaking investigations, he demonstrated that the elementary granules of the pure serum never subsided and passed

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