persons who have not been brought into immediate contact with the sick, as it does the attendants themselves. It may, I think, be laid down as absolutely certain, that an epidemic of typhoid is never caused by the disease spreading by direct contagion, as epidemics of small-pox, scarlatina, and typhus are. On the other hand, it is argued that sometimes, in hospital practice, typhoid does spread to the attendants on the sick or the other patients; and, not at all uncommonly, persons suffering from typhoid, when removed to a distance, do communicate the disease to those brought into contact with them. Thus, in the hospital at Basle, 1,900 cases were admitted in six years; and during this period forty-five residents in the hospital became infected, and a large number in addition suffered from a non-febrile intestinal catarrh, which in all probability was due to the typhoid poison. But of these forty-five cases, many had never been brought into contact with the patients, and of the nurses it was found that those were especially liable to be attacked who occupied a particular room, where they were exposed to the emanations from a leaky choked soil-pipe. Probably there is no city in Europe, not even Munich, and no hospital, so saturated with the poison of typhoid as Basle and its hospital; and, moreover, the hospital drains are or were in a very unsatisfactory condition; and thus there is every reason for believing that the contagion in all these forty-five cases was indirect.

The same argument applies to the spread of the disease in private houses. In the great majority of instances where the fever is imported from a distance it does not spread; where it does, some defect in the sanitary conditions favouring indirect contagion can generally be detected; and it is therefore almost certain that the same is the case in the other instances; otherwise, we should have to admit that typhoid fever is sometimes contagious and sometimes not—nay, that during the same epidemic, the disease is contagious in one house or institution, and not contagious in another house or institution, though they may be situated close together.

I have seen many instances of supposed direct contagion, but have generally succeeded in tracing them to an indirect source. A boy was admitted to the Middlesex Hospital under my care, on March 27th of last year, suffering from a very severe attack of typhoid. For several days he lay in an unconscious condition, and during this time he had very profuse diarrhoea—twelve to twenty liquid motions daily, which were for the most part passed in the bed. In the next bed was a boy aged six, who had been admitted on April 16th, with acute renal dropsy and bloody urine. He was kept strictly confined to bed, and never got up to go to the water-closet down which the motions of the typhoid case were thrown. On May 11th, when he was convalescing, the dropsy having disappeared and the albumen much diminished, he was seized by typhoid fever, and passed through a moderately severe attack, with a well marked rash and characteristic symptoms. This at first sight appeared to be a case of direct contagion, but I have no doubt that the true explanation is this. The bedding of the first patient was constantly kept saturated by his liquid motions, and, though every care was taken to change the linen frequently, it was obvious, from a distinctly faecal smell which was always present, that the bedding or mattress remained contaminated, and thus time was given for the poison to develop its infectious properties. Another patient in the same ward, admitted for acute rheumatism, was also attacked by the fever. He occupied a bed on the opposite side, and never came near the first case, but, being convalescent, he used the water-closet down which the motions of the typhoid case were thrown; and it so happened that at this time the closet was out of order, the contents were retained, and an offensive smell was constantly present. Hence, I think, there can be no doubt but that he was infected by the emanations from the evacuations of the first case.

The first case affords an example of a very common mode of infection; and many of the cases attributed to direct contagion are really produced in this way, especially among the lower orders or where skilled nurses are not employed. The bed-linen or mattress, or the patient's own person, become soiled by the liquid alvine discharges. These soon dry, and are left undisturbed, and in a short time the poison develops its infectious properties. Soiled linen is well known to possess very active contagious powers, and to retain them for a long time.

If these views are correct, it becomes an important subject of inquiry as to how soon the stools acquire contagious properties. I am not aware of any observations which would enable us to decide this point with certainty, but the time is probably a very short one. The frequency with which washerwomen have been infected by soiled linen points to a very short duration, as such linen is seldom retained for any length of time. Some facts which have come under my own observation, though not conclusive, are also in favour of the period being very short.

At the Middlesex Hospital, it was formerly the custom to preserve the stools of cases of typhoid, which the physician wished to inspect, in pans which were placed in the water-closets of the wards. Now the time during which such stools would be so kept would hardly ever exceed twelve hours; nevertheless, several instances have occurred in which other patients using these closets have become infected. Supposing the cause of the infection to have been these reserved stools, we should have a period of not longer than twelve hours for the contagious properties to become developed. The experience of the London Fever Hospital pretty conclusively proves that the fresh stools are innocuous.

The practical conclusion to be drawn is, I think, this: that we have in all cases a few hours during which it lies in our power to render the poison innocuous, and to prevent the spread of the disease by direct infection.

[To be continued.]

THE GULSTONIAN LECTURES ON EPILEPSY.

Delivered before the Royal College of Physicians of London.

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LECTURE II.

MR. PRESIDENT AND GENTLEMEN,—The symptoms of the cases of convulsive disease which form the subject of these lectures, the forms of attack, their variations in severity and frequency, the mental and physical condition of the sufferers, and the mutual relation of these and other pathological elements, constitute subjects of much interest. It is useless to attempt in this lecture to traverse the whole of this extensive field, and our survey must be confined to a few points.

One subject which seems worthy of a passing notice, is the relative frequency with which fits occur by day or by night, using the terms as synonymous with the sleeping and the waking states. The investigation of this point in 840 cases has yielded the following conclusions. The attacks occurred only, or almost only, at night in one-fifth (21 per cent.); only, or almost only, by day in rather more than two-fifths (43 per cent.). They occurred by both day and night in rather less than two-fifths (37 per cent.). Fits occurred in the night, partially or only, in rather more than half the cases (57 per cent.); by day, partially or only, in four-fifths of the cases (80 per cent.). In 1 per cent., the attacks occurred only while going to sleep; in one-half per cent. only on waking up out of sleep. In 5 per cent. the attacks occurred only in the early morning. A much larger number had their first attack in the early morning; and many of these patients were in the habit of early rising, a habit which, it thus appears, should be practised with caution by those predisposed to epilepsy. Between the cases of epilepsy and those with hystero-epileptic symptoms, there was no difference in the frequency with which the attacks occurred in the day or in the night. The proportion, for instance, in which the attacks occurred exclusively, or almost exclusively, by night was, of epileptics, 21 per cent., and of cases with hystero-epileptic attacks, 20 per cent. In epileptics, it is somewhat more common for the first fit to occur in the day than in the night—rather more than half commenced in the former, rather less than half in the latter. In hystero-epileptics, it is much more common for the first fit to occur in the day than in the night. Two-thirds commenced in the day, one-third in the night. Nevertheless, in more than half these cases (56 per cent.) some fits subsequently occurred during the night—that is, during sleep. When the first fit occurred in the day, the subsequent fits occurred only in the day in half the cases, only in the night in one-seventh; by both night and day in one-third. When the first fit occurred during the night, the subsequent fits occurred only at night in about two-fifths of the cases; by day and night also in about two-fifths; and by day only in one-sixth. If we may apply to these proportions the doctrine of probabilities, we may say that if a patient who has his first fit in the day has subsequent fits, the probability is as six to one that some of his attacks will occur in the day; the probabilities are equal that his attacks will, or will not, be confined to the day; and they are equal that he will, or will not, have some attacks in the night; while the probability that he will have attacks only in the night is but one in seven. If a patient who has his first fit in the night has subsequent attacks, the probabilities are equal

that these also will occur only by night, and that they will occur both by night and by day, being in each case two in five. The probability is as five to one that they will not be confined to the day—that is, in favour of some fits occurring in the night.

Frequently, fits which have recurred for a time in one condition, during sleep, waking, or both, change their time. The conclusions deducible regarding these are as follows. 1. When fits which have occurred only by night commence to occur by day, they commonly continue also during the night. 2. When fits which have occurred only during the day occur during the night, they commonly cease by day. 3. Attacks which have occurred by day and night often cease to occur in the day and continue at night, but very rarely cease by night and continue by day.

The relation of attacks in women to menstruation is a subject on which various opinions have been expressed. The facts I have to offer are small in extent, the point having been investigated in sufficient detail in only 82 cases. In one-twelfth (7 cases), no attacks occurred at the time of menstruation; in one-third (29 cases), there was no difference at these times; in more than half (46 cases), the attacks were worse at the monthly periods; most frequently they were worse before the period (17 cases); next in frequency they were worse during the period (15 cases), and much less frequently after the period (4 cases). In 10 cases, the exacerbation was variable, either before, during, or after; in 2 cases, the attacks were worse at the menstruation soon after the patient became subject to fits, but not after the disease had existed for some years. In 2 cases, fits never occurred at the periods when menstruation was regular, but they did when it was irregular.

I pass now to the phenomena of the attacks. The fits in idiopathic epilepsy are so rapid in their evolution, and so similar in most cases in their developed characters, the opportunities for watching them are so rare, that mere observation of attacks proved for a long time unproductive of much addition to our knowledge. A new era in the study of epilepsy may be said to have commenced with the investigation, by Dr. Hughlings Jackson, of the modes of onset of attacks which begin deliberately, combined with that of the subjective sensations by which attacks commence that are less deliberate in their onset. This subject—the study of the modes of onset—is still full of promise to further investigation, and there is perhaps no point in the symptoms of a consecutive series of cases to which our attention may be more usefully directed.

I need scarcely remind you that the aura of an attack was formerly regarded as a change in the nerves of the part to which it was referred, exciting the fit, and that it is now known to be merely the impression made upon the consciousness by the commencing action in the brain or by the effect of this on the periphery. The fact that an aura commencing in a limb may be arrested by a ligature around the limb, above the part to which the sensation is referred, was once thought to constitute evidence that the process of the convulsion originated at the periphery. It is now well known that the ligature will arrest a fit which is due to a cerebral tumour as effectually, and more frequently, than one of any other kind, and of this I have seen many striking instances. The fact that the aura is the result of the commencing change in the brain renders its study of even greater importance than if it originated at the periphery. By its means we gain information, to be obtained in no other way, of the brain function first deranged, that is, of the functional region in which the process of fit begins. In some cases, at least, this may be regarded as the seat of the disease. We learn also something of the form of normal cerebral action, which disease modifies rather than subverts.

The aura of an attack, using the term in its widest meaning, as signifying the subjective commencement, may consist in a consciousness of motion, or of sensation, or in a mental state. It has been long and often maintained by Dr. Hughlings Jackson, in extension of the older view of Laycock, that the whole brain is made up of structures which subserve sensori-motor processes, and that into such processes all its functions may be resolved. It is unnecessary now to consider this view as a whole, but that every structure of the brain concerned with sensation proper is connected, directly or indirectly, with a part concerned with motion may be regarded as a proposition scarcely needing proof. A discharge, such as occurs in an epileptic fit, taking place in either of these related structures may lead to a discharge in the other. The two may act so simultaneously that the resulting motion and sensation may occur together. The patient may feel a tingling in his hand at the same moment as the fingers begin to twitch; or the discharge in one may lead the way, and be followed by the other at an interval. The twitching or the tingling may come first. I think that it is of importance to determine, in any given case, with which the attack commences—the motion or the sensation—*i.e.*, whether the motor or the sensory centre leads in the discharge. By so doing, we are able to understand better the association of auras and their progress. It is necessary, however, carefully to discriminate the form of the sensation, because, as

Dr. Jackson has also pointed out, the consciousness may be affected directly by the action of a motor centre, although no movement results. There are motor sensations as well as sensory sensations, and, as we shall see, a fit may begin by a sense of motion before any actual movement occurs. The word “sensation”, however, will here be used, when unqualified, to signify a sensation proper, such as numbness, tingling, and the like.

In what proportion of cases is consciousness lost so early that the commencement of the fit is unfelt? Of 1,000 cases, in which the presence or absence of a warning was noted, it was always absent in 495, while some aura existed, at least occasionally, in 505. Thus, roughly speaking, loss of consciousness precedes, or accompanies, the first symptoms in half the cases; in the other half, the patient is aware of the commencement of the attack. We may consider what facts regarding the modes of onset these 505 cases supply.

The sensation or motion with which the attacks commence may be referred to almost any part of the body, limbs, head, trunk, organs of special sense, and to many viscera. We must therefore infer that the process of the fit may commence in any part of the brain in which these various parts are represented. We may, for the present purpose, classify most of the auras or modes of onset into seven groups. 1. The unilateral aura, a motion or sensation in one side of the tongue, face, trunk, or in one arm or one leg. 2. Certain general aura; bilateral sensations in the limbs, tremors, starts, malaise, faintness, etc. 3. Aura referred to certain organs, mainly to those to which the pneumogastric nerve is distributed, and to this group belong most of the visceral warnings. The most common is the well known epigastric sensation, and others are a feeling of choking, dyspnoea, nausea, and cardiac sensations. 4. Vertigo and other allied sensations. 5. Certain sensations in the head, pain, etc. 6. Psychical aura, the consciousness of an emotion or an idea. 7. Special sense warnings; some of these are strictly unilateral, but it is convenient to consider them together. This classification is clinical, and as such is adopted as affording facilities for the determination of facts apart from theories.

We may take first the unilateral peripheral aura, present in 86 cases, or 17 per cent. of those with warnings. Of these, the commencement was in the arm in more than half (45 cases); in the leg and face in smaller and nearly equal numbers (15 and 17 cases); in the tongue in 5; and in the side of the trunk in only 2 cases. Such unilateral commencement is common in seizures due to organic brain-disease, and the organic disease causing them is usually at the surface of the brain, in the region stimulation of which causes movements in the parts first affected in the fit. Such stimulation, indeed, as Ferrier has shown, may cause convulsions beginning in the part. But, from the series of cases now under consideration, all those presenting symptoms suggestive of organic brain-disease were excluded.

In 5 cases only the aura was referred first to the tongue; in 2 others the tongue was affected secondarily. In 1 the commencement was by a movement, in 1 by a beating, in the rest there was merely a sensation; in 3 tingling, and in 1 a sensation of something crawling on the tongue. In each case the convulsion was right-sided, and, in each case in which the side of the tongue affected was noted, this was also the right side. Hence it seems probable that the sensori-motor processes for the tongue predominate on the left side of the brain, a fact also suggested by the great impairment of the movements of the tongue frequently noticed in right hemiplegia with aphasia. The association of movement of the tongue is twofold: one in its use for speech; one in its use in mastication and deglutition. We may trace this double association in the combinations of the aura. Tingling in the tongue was associated in one case with twitching in the lips; in another with a lateral movement, or sense of movement, in the jaw. The sensation of something crawling on the tongue in one case was followed by a feeling of sickness, then of something rising in the throat, and then by palpitation of the heart.

The seizure commenced in the face in 16 cases, and on one side as frequently as on the other, but much more frequently by a motion than by a sensation. In 8 cases the mouth was drawn to one side, no doubt by the zygomatic muscles. Commencement in the lips was rare. In only 2 cases was there an initial contraction in the orbicularis of the eyelids, and both were associated with a sensation in the hand, and were right-sided.

The cases in which the attacks commenced in the arm were 40 in number. In about three-quarters of the cases, the commencement was in the hand. Of those beginning by spasm, twitching, etc., the first motion was, in most instances, either in the hand as a whole (10 cases) or in the arm as a whole (8 cases). In only one case was there initial movement of the fingers, and this was clonic spasm in the common flexors. In 14 cases, the attack began by a sensation—“numbness”, “tingling”, “pins and needles”, etc.; and in these the commencement was in most in a definite part of the hand—the forefinger in three cases,

never in the thumb; twice in all the fingers, once in the middle finger, once in the palm, twice in the back of the hand, three times in the hand as a whole, and twice at the wrist. It never began higher up the arm. In five other cases, the sensation with which the fits began was less simple, and in several was certainly a motor sensation. One patient always felt "as if his arm were drawing up", and would beg that it might be held down, although there was no motion in it. The feeling was accompanied by severe pain, "as if the arm would break". In another case, there was a somewhat similar pain, "as if the arm were withering up". In a third, there was a feeling of stiffness; and in a fourth, a feeling of twitching in the first three fingers, apparently without movement; and in a fifth, there was a sensation in the back of the arm, "as if the nerves were being drawn". The attacks, commencing with motion, or with the sensations last described, probably motor, began in the right and left hands in an equal number of cases; but those commencing with a simple sensation began in the left hand twice as frequently as in the right. In three-quarters of the cases, consciousness was lost before the seizure had extended beyond the arm. But in 9 cases, after ascending the arm, the aura passed to the head, and in 4 to the mouth. In 2 cases, after passing up the arm to the shoulder, the aura passed down the side to the leg, and down to the foot. In no case, after passing to the head or mouth, did the sensation afterwards pass down the side to the leg; but in 2 cases, in which it passed to the mouth, it afterwards commenced again in the foot, and passed up the leg.

The seizure commenced in the leg in 14 cases, and in 10 of these in the foot. In only 5 did it distinctly begin as a movement, and this began in the toes once only, in the foot as a whole twice. In one case, the movement, twitching, began in the hip, and passed down the leg. In 5 cases, the commencement was by a simple sensation, once in the great toe, once in the sole, once in the dorsum, once in the foot as a whole, and once in the leg as a whole. A motor sensation, without movement, was described in one case: the patient suddenly felt as if the leg were bent up under the other, and that he must stretch it out. Of the cases in which the commencement was in the foot, consciousness was lost before the aura had extended beyond the foot in 2 cases; in 6 the aura extended up the leg and thigh; in 3 of these it passed on up the side to the head. In 2 cases, after passing up the side, instead of going to the head it passed down the arm to the hand, and then consciousness was lost. In no case in which it passed up to the head did it afterwards deliberately pass down the arm—just as in the cases in which the aura commenced in the arm if it ascended to the head, it never afterwards passed down the side. The passage of the discharge to the region in which the head is represented appears to be closely connected with loss of consciousness.* In 2 cases, the sensation, commencing in the foot, passed up the side, and when it had got to the level of the hand it recommenced there, and then passed up the arm. There are thus two modes in which the arm is involved secondarily to the leg, just as there are two modes in which the leg is involved secondarily to the arm—one extension by continuity, passing from the one limb to the other by the trunk, and passing down the limb secondarily involved; and the other by separate commencement in the extremity of the second limb, and the passage of the aura up both. It seems probable that, in the cases in which it passes from one to the other by continuity through the trunk, the discharge in the sensory centre takes the lead, and determines the course of the aura, although it may be closely, even instantly, followed by the motor discharge. The representation in the brain of the cutaneous nerves must be as continuous as the skin in which they are distributed. The passage of the aura by continuity up the arm, down the trunk, and down the leg, or *vice versa*, is intelligible on this theory, but scarcely on the theory that the discharge in these cases begins in the motor centres. This view is supported by a case lately seen, in which the seizures began with a sensation in the foot, without motion. The sensation passed, as such, up the leg and side, and down the arm to the hand, and not until it reached the hand was spasm added; the hand began to twitch, and the movement passed up the arm, and then consciousness was lost.

In several cases in which the seizure began in the mouth and face, the aura passed afterwards down the arm first and down the leg afterwards. No aura *beginning* in the tongue, face, or leg was associated with one in the special senses. In three cases of attacks commencing in the arm, there was a subsequent special sense aura; but in each of these the seizure in the arm began by a sensation proper, not by a motion. This seems to indicate that, as might be expected, the special sense-centres are connected with the sensory limb-centres, rather than with the motor limb-centres. The only case in which a special sense aura was in

any way associated with the lower extremity was one in which the seizures began with a pain in the back of the hand, and this pain passed up the arm and down the leg. When it reached, still as pain, the middle of the thigh, a flash of light appeared before the eyes. The pain went on down the leg, and, when it reached the foot, consciousness was lost.

In only two cases did the attack commence in the side of the trunk, and in one the sensation was described as "burning". In two cases, a left-sided aura was associated with palpitation of the heart. In one patient, a girl, a singular relation existed. The fits began with a feeling of numbness and beating in the right great toe, which passed up the leg, and, when it reached the groin, the patient felt a need to micturate. If she could do so, the aura ceased. If she could not, she suddenly felt as if turning over and over; then a peculiar psychical condition occurred; she lost consciousness, and passed into a severe epileptic fit. I have met with another case in which micturition sometimes arrested a commencing fit. I have also seen a case in which the act of micturition sometimes brought on a fit. The shiver, which in many children and some adults normally attends the act, indicates the associated affection of higher motor centres; and these facts suggest that the passage of urine during epileptic fits is not merely the result of loss of consciousness, but is really part of the convulsive action.

The mutual relation of the motor and special sense centres in the surface of the brain, ascertained by Hitzig and Ferrier, enables us to understand something of the progress of seizures. They do this whether we regard epilepsy as a cortical disease or not, because, from Burdon Sanderson's researches, the relation is similar in the lower centres. For instance, a fit beginning in the face or tongue, if it involve the limbs, takes the arm before the leg; and we find that the arm-centres intervene between those for the face and tongue, near the fissure of Sylvius, and those for the leg in the upper part of the hemisphere. Again, in a fit beginning with twitching of the angle of the mouth, rotation of the head commonly succeeds; and the centre for rotation of the head is situated in front of, and contiguous to, the centre for the action of the zygomatic muscles. But in other cases it is difficult to understand the progress of the aura from the experimental facts. For this there are probably three reasons. First, we know little of the degree of structural association or separation of the centres—the cerebral sulci, of course, affording no information on the matter; secondly, the centres represent, in many cases, complex movements, and fits begin usually with simple movements; thirdly, we are entirely ignorant of the mutual relations of the sensory centres of the limbs, which Ferrier's experiments locate on the inner aspect of the temporo-sphenoidal lobe. The facts of many auras make it probable that these rather than the motor centres lead in the discharge, and determine the course of the commencing fit; and I think that thus the progress and association of many auras may be explained.

A rare but curious condition sometimes attends the onset of a fit which begins unilaterally—what may be termed the alternation of the aura. In some right-sided convulsions, from left meningeal hæmorrhage, which I once watched, the rotation of the head to the right which accompanied the fit was preceded by a rotation to the left; and this itself was preceded by a slight initial rotation to the right—a double alternation. I have obtained very few indications of this phenomenon in idiopathic epilepsy. In one case, a left-sided fit was preceded by shaking and trembling of the limbs of the right side; in another case, the attacks began with a sensation in some left cranial nerve, followed by a sensation around the right wrist. The great majority of fits which begin unilaterally are epileptic. Of seventy-six in which the character of the fit could be ascertained, only nine (or 12 per cent.) presented hystero-epileptic or co-ordinated symptoms.

[To be continued.]

SWAMMERDAM THE NATURALIST.—On February 17th, a public meeting was held in Amsterdam, on the occasion of the two hundredth anniversary of the death of the celebrated Dutch naturalist Jan Swammerdam. A brief account of his life and works was given by Professor Stokvis, who said that, although the labours of Swammerdam were directed principally to the investigation of the structure of insects, and he seldom concerned himself with human anatomy, almost every step he took in the latter direction was marked by progress. His experiments on the muscles and on respiration might be regarded as models of strictly scientific investigation. The assembly afterwards visited the house where Swammerdam was born, in which a stone was placed bearing a Dutch inscription, of which the following is a translation: "John Swammerdam. His investigation of nature remains a model for all times. 1637-1680. 17th February, 1880." The Amsterdam Society for the Promotion of Natural and Medical Science has instituted a medal in honour of Swammerdam, to be awarded every tenth year.

* In this statement, it must be remembered, cases of idiopathic disease are spoken of. In convulsion from organic disease, usually more deliberate, I have known a sensory aura pass up the arm to the side of the face, and afterwards pass down the side of the trunk to the leg.