DR. STEWART.—I think we owe a debt of gratitude to Dr. Baker, because we want to have put before us the whole ground of the foundation of our reasons and thoughts in reference to the importance of epilepsy in connection with crime. I was very much interested in his reference to the influence of alcohol upon the brain. I was very glad to find that the reader of this paper was in accord with myself in regard to the exaggeration—I can use no milder term,—the exaggeration of alcohol as a psychological factor. I do not say that there are not a great many cases of insanity which may be traced to alcohol as the productive agent, but I do say that there are more cases of alcoholism as a result of insanity than of insanity as a result of alcohol. I think it is the mixing up of the two things which we have to contend against. So it is with regard to epilepsy and crime. We find men in the law courts who accept opinions which are not founded upon absolutely reliable data. I have on one or two cases been obliged to ask the judge to defend me from the barrister of my own side, or rather on the side of him who has summoned me; and I think it is too bad when one finds in courts of law one's self confronted with statements, held to be incontrovertible statements, which men like yourself have frequently doubted as being absolutely correct.

The thanks of the meeting were conveyed to Dr. Baker for his paper.

Unilateral Hallucinations; their Relative Frequency, Associations, and Pathology.

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BOTH in physiology and pathology the study of simple, incomplete, and degenerate forms usually sheds a light, sometimes very clear, on more complex and perfect types. For example, such works as those of Spencer, Maudsley, Laycock, and Carpenter show how much the relation of mind to organisation is elucidated by careful observations of the nervous system in the lower orders of the animal kingdom, and of its condition in the abortive and morbid specimens of the human species. In pathology, more particularly, it is not usually where disease has attained full maturity or has advanced to its last stages that we may expect to find its point of origin, mode of progress, or essential nature; rather it is where pathological change is only beginning, in tissue that deviates but little from the healthy standard, or in function that is but slightly disturbed: so in the special pathology of the nervous system much may be learned regarding the more serious diseases by minutely examining and considering the features of the slighter and less striking disorders.

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In this connection the group of phenomena that form the subject of the following paper are of considerable interest; so also is the relation in which they stand to each other, and to similar events in other parts of the nervous system, such as the motor, sensory, and even nutritional spheres; how far they may be considered as simply analogous conditions without causative connection, and to what extent, in certain cases, they may be correlated. Besides, as merely important incidents in the disorders of which they are symptoms they merit close observation. Attention will first be directed to one-sided hallucinations of the different senses.

It has long been known that hallucinations, instead of being apparently derived from the double organs which minister to the sense or senses involved, may seem to arise from only one of these organs,—may, in short, be unilateral. Thus Brierre de Boismont, in his book on hallucinations, refers to Calmeil's observations on phenomena of this kind, and more particularly to those of M. Michéa, who named them "d'hallucination dédoublée." He quotes from the latter a striking case in illustration, and also states that such hallucinations occur in the senses of touch, sight, and hearing. Gall relates the case of a Minister of State in Vienna, who was constantly hearing insulting expressions on the left side, so that he was very often turning his eyes in that direction to see where they came from, although, Gall adds, perfectly convinced on the right side of his head that they were delusions of the left side. Griesinger states that a patient was under his care in whom the hallucinations of hearing were confined to the left side throughout the whole duration of his insanity. Van der Kolk narrates the case of a female patient who was continually plagued by the devil talking in her left ear, and remarks, "This is, moreover, the only case with which I am acquainted where the hallucinations were confined to one ear."

These references will suffice to show that the older Continental physicians were familiar with the occurrence of this class of psycho-sensory disorders. When my own attention was directed to the subject in 1874 by a case of mental disease in which left-sided hallucinations of hearing were present, I could find no reference to this group of symptoms in English medical literature. With the view of ascertaining the frequency of their occurrence, as well as from the interest I felt

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in them by their apparent parallelism to the unilateral disorders of motion and sensation, I made a careful examination of 250 insane patients, these being, with a few accidental exceptions, all the cases in the asylum under my charge during that year. The results of my observations were embodied in a paper read at the Edinburgh meeting of the British Medical Association in 1875.(1) In the present communication I shall first submit an abstract of that paper, and afterwards supplement it by some details of similar cases that have since come under my observation. This will yield a basis for general considerations respecting the relations and pathology of these phenomena.

Amongst the 250 patients 34 were found to entertain clear and well-defined illusions or hallucinations of one or more of the senses. These 34 were by no means all who were so afflicted. There were many more in whom the sensorial disorders were so combined with delusions proper, or whose intellect was so enfeebled, or who were so obstinate or reticent, that reliable information could not be obtained from them. My observations, therefore, have reference only to these 34 patients.

No fewer than 31 heard imaginary voices, besides, in some cases, other unreal sounds; only 3 were free from auditory troubles of this kind. Twenty-nine were either seeing imaginary forms at or about the time of my examination of them, or adhered to the belief that they had seen them at some previous time since their illness began. Two suffered from illusions or hallucinations of taste, and 1 from similar disorders of smell; both sight and hearing were unaffected in each of these cases. In 1 the hallucinations were confined to taste; smell, sight, and hearing being normal. Fourteen complained of various alterations of general sensibility, such as stinging pains in arms or legs, feeling of numbness, localised in some, but varying in its site in others, and various other sensations, some of which were probably real.

Of the 31 cases in which hearing was involved, in 5 the voices were heard only in the left ear, and in 5 others in the left more than in the right; in 1 they were audible in the right ear alone, and in 2 they were stated to be more distinct in that ear than in the left.

The disorders of all the other senses were bilateral; at all events, they could not be determined to be unilateral, except

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to some extent in one patient who saw the hallucinatory objects much more distinctly with the right than the left eye. The objects seen in this case were of different colours—black, blue, and red being particularly mentioned. There was no apparent difference in the ordinary visual power of the two eyes when they were subjected to examination.

With respect to the causation of the unilateral cases, in 3 the mental disorder was clearly and immediately due to alcohol; and in 2 of the other 3 the patients had been previously of drunken habits.

These 6 cases are recorded in detail in the paper referred to, but as they have been already published, I shall merely mention that their features correspond to those in cases that have since come under my care, some of which will now be described, though mostly in more condensed form.

CASE 1.—J. W—, æt. 36. This man was an inmate of the Town's Hospital. He told me on admission, which was in 1877, that about eight years previously, while undergoing a sentence of imprisonment for theft, after about a year's solitary confinement he began to hear "voices," though alone in the cell. They varied greatly, were sometimes loud, at other times like a whisper, and seemed to him to resemble the voices both of men and women whom he had known. They have troubled him to a greater or less extent since that time. They have always been in the *right* ear, and patient is sure that he has never heard them in the left one. He mentioned of his own accord, and without any suggestive questions, that he had been in the habit of putting cotton into the right ear, which he believed had occasionally put them away altogether, although it had often little or no effect in modifying their intensity. At times he was disposed to think these voices real, though very generally, as when he was conversing with me, he knew them to be imaginary. The actual hearing power of both ears was ascertained to be equal and unimpaired.

He had also visual hallucinations. "I imagine," to use his own words, "I see both men and women, particularly with the *right* eye, and sometimes almost fancy them to be real." He said that they were of different colours, and appeared most frequently at dusk, adding that he saw them when the eyes were shut as well as when open.

CASE 2.—J. M—, æt. 48. This man was found guilty of having murdered his wife, and was sentenced to death. Grave doubt, however, having been felt as to his complete soundness of mind, an after inquiry was instituted, as a result of which his sentence was commuted to imprisonment in the Scottish Criminal Lunatic Asylum at Perth. He suffered from a form of alcoholic insanity, and Dr. (now Professor) Wm. Macewen directed my attention to the fact that the imaginary voices which troubled him and prompted the criminal act were said by the prisoner always to be in the left ear. Beyond confirming this fact I am unable to give further details of the case.

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CASE 3.—M. R—, æt. 65. This woman stated when about to be dismissed in sound mind, after about four months' residence in the asylum, that for a long time before her insanity commenced she heard a noise like the sound of a water-wheel, always on the *right* side of her head, which, though at first limited to that side, had become general, not being latterly associated with the one ear more than the other.

CASE 4.—J. M—, æt. 25. This man's illness was due to recent excesses in alcohol. He had hallucinations, both of hearing and sight. He stated after his recovery, as well as while his disorder lasted, that the voice which he heard was like that of a deceased sweetheart, and that it was always in his left ear only. "I turn," he said, "instinctively to the left." It was otherwise, however, with the visual disorder, as the imaginary objects were seen with both eyes equally.

CASE 5.—J. C—, æt. 32. This also was a case of acute alcoholic insanity. With the exception of the hallucinations of hearing this patient's mind was remarkably clear and calm, and none of the other senses were involved. He spontaneously remarked that the voices were all on the *left* side of the head; they seemed to him to repeat his thoughts. Thus, when he thought of going home to his wife the voice said, "Go home and see the wife."

CASE 6.—R. M—, æt. 50. Patient states that he has been drinking to excess for a week. With the exception of hallucinations of vision and hearing mind is apparently correct, though he is a little excited. He imagines he is receiving telephonic messages. While I was speaking to him he turned towards the *left*, saying, "Wait till I get this message from America." Though he says that the messages always go in at the left ear, he adds that they go out at the right one.

CASE 7.—F. R—, æt. 47, is a very intelligent man, and mind on admission was only slightly affected. He stated frankly that he had been much addicted to the drinking of whisky for some years, and that for the last two days he had been fancying that women and children were crying after him; but he remarked, "It was just the notions from drink." On asking him if he heard the voices in the one ear more than the other, he replied, without hesitation, that he heard them only in the *left* one. On this point he further said, "So satisfied I was that the voices were on the left, while being brought here, I turned to that side and looked out of the cab window to try and see the people who were crying after me." After a sound sleep he said to me, "I don't for a moment think that the voices were real, but I heard them as distinctly as I hear yours now." Again he mentioned that they were all on the left side.

CASE 8.—I am indebted to the late Dr. P. Cassels, an aural surgeon of Glasgow, for the account of the following case:—A. B—, æt. 26, consulted him occasionally for some years on account of tinnitus and the sound of a voice in one ear, but Dr. Cassels was not certain whether it was the right or left. These troubles dated from an accident that befell this gentleman while "canoeing" on the Tay, the boat having been upset, and himself nearly drowned. Directly afterwards he began to hear the voice in one ear always repeating, "Come this way, come this way." Dr. Cassels considered that this was the cry of the persons on the bank when the accident happened, which, as

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might be expected, had produced a profound impression on the patient. He was quite aware of the unreality of the voice which continued to trouble him, and there was no ground for supposing him to be insane.

CASE 9.—This case I have seen on several occasions during the last two years. It is that of a lady who had been long subjected to the intermittent toxic action of lead through contamination of the water-supply of her home before the source of the poisoning was discovered. Among other troubles to which it had given rise was multiple neuritis and mental disorder with hallucinations. While confined to bed she was afflicted with voices, which always seemed to come from the *right*-hand corner of the ceiling of her bedroom. Concurrently with the administration of treatment for the elimination of lead from the system the voices ceased, but the general mental disorder has not improved.

CASE 10.—A woman æt. 70, inmate of the Glasgow Aged Men and Women's Home, has for about two years complained of voices in the *left* ear, and also frequently of singing noises on the same side; the latter, she says, preceded the voices. About a year since, when she first spoke to me about them, she appeared to have no doubt that they were imaginary, and even now says they are so, though sometimes with hesitation. Latterly at night she has been troublesome to those near her by speaking aloud, apparently answering the voices which are probably then real to her. Her sanity at first could not be called in question, but latterly her mind as a whole has been somewhat disturbed, and I fear the development of positive mental disease. The imaginary words she hears have not varied much during later months, and have been "very good, hail" most commonly. She is positive that both sounds and voices have been in the left ear only.

In the early part of this year (1900) Dr. J. Kerr Love, aural surgeon to the Royal Infirmary, was good enough to make an examination of the state of this woman's hearing, and of her ears generally. I need not now submit his careful report in detail, and will only refer to his conclusion, which is to the effect that while her right ear is practically normal, both aural and bony conduction on the left side is very defective. He says, "I think there is damage to the auditory nerve, or its expansion in the internal ear of the left side."

Personal experiences.—The two following experiences of the writer are here recorded in further illustration of the subject under consideration. Strictly, only the first was one-sided; the second, though of a general character, has a bearing on the extension of hallucinations of all kinds.

At the outset of my professional career I happened to have a smart attack of catarrhal conjunctivitis. My professional colleague in the institution where we were both assistants put two or three drops of what was considered to be a four grains to the ounce solution of silver nitrate into the affected eye. Immediately there was a free flow of tears with spasmodic closure of the lids, and flashes of light in that eye. A few seconds later, in addition to the above phenomena, there set in rapidly recurring booming sounds, as of the discharge of artillery in the

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ear of the same side. Soon—not more than half a minute afterwards—a feeling of general intense strain with excitement set in, giving rise by its acuteness to the impression that if it did not abate quickly something would give way in the brain. In two or three minutes more it did subside considerably, and all special symptoms passed off within an hour from the time of the application of the caustic solution.

My next experience was of a different kind. It occurred in the year 1881. I had then severe colitis, with localised peritonitis. To relieve the intense pain much morphia was given me, both subcutaneously and *per rectum*. This it did, but at the same time vivid hallucinations arose. At first, and for some hours, they were restricted to the sense of sight. The earliest to appear were dissecting-room figures. Very disturbing was the side of a child's face, which presented itself entire at first, remained in view for a few seconds, then disappeared, but after a brief absence returned, the lowest portion of the face having been removed. This was repeated two or three times, another bit of the face, always from below, having been cut off during each absence.

The scene which has impressed itself most deeply on my mind was one which appeared when my bodily suffering was considerably alleviated. In the foreground, chiefly but not exclusively to the left, looking down from above were a number of faces of aged and venerable-looking men. The expression on all was calm, serious, and reverent. In front, beyond these faces, at what may be described as the middle distance, was a light in the form of a star, but of much greater magnitude than any star in our horizon. Its colour was of the deepest crimson, and its penetrating power was intense, yet the area which it illuminated was not a wide one. Beyond, all around, was profound darkness, a darkness which, strange to say, I could see into, and observe that it extended to a seemingly interminable distance. While intently surveying the scene before me, and more especially the star-like light in its centre, a voice, which seemed to come from behind and above, said in clear and distinct tones, "The dawn of the eternal day." I heard no other voice in this connection.

On several succeeding days I almost constantly saw visions. I was then gradually recovering from my illness, and the effects of the morphia were slowly passing away. They were for the most part more or less exact reproductions of scenes in many lands that I had visited. Perhaps the most perfect was one in Canada West, near where I stayed for about three weeks. Another was of the Lake of Lucerne, considerably modified. These visionary scenes were projected on to the wall opposite me as I lay in bed. I could see the wall distinctly through them, just as stars are visible through the train of a comet. When my bodily trouble had clearly subsided, the visual hallucinations assumed more pleasing forms than they had in its acute stage. But after two or three days they became wearisome, and their persistence began to worry and alarm me. However, they slowly grew fainter, and after lasting about a week in all, disappeared entirely.

It is to be observed that these hallucinations of sight and hearing were present when I was fully awake. Those of sight were visible in the more severe stage of my illness, even when my eyes were closed, but when recovering they were most distinct when the eyes were open.

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Though as real to me at the moment of observance as any genuine object, yet even at the worst period of the trouble, when I thought about them, I fully appreciated their unreality, and spoke of them to my relatives and medical attendants as of opium origin, comparing them to those of De Quincey, though falling far short of his visions in the fulness and richness of their imagery.

In all, I have notes of fifteen definite cases of unilateral hallucinations. During the last ten years my opportunities of observation have been more restricted, otherwise I would probably have been able to record a larger number. In reviewing these cases it will be observed that the sense of hearing was always involved, and that in twelve of them they were on the left side. No pure cases of one-sided visual hallucinations were found, though in two the imaginary objects were seen more with the one eye than with the other. No clear case of unilateral affection of the sense of taste or smell was noticed, though such cases are on record. It will be observed that in Case 10, singing noises preceded the voices in the affected ear, but in it there was clear disease of the auditory nerve. In this case it is interesting to note the presence of one-sided auditory hallucinations without insanity; while in another case of alcoholic origin they remained for some hours after the patient realised that they were imaginary—after he was of sound mind. Although the number of patients in whom the hallucinations were one-sided was not great, it is to be borne in mind that several others heard the imaginary voices more distinctly in one ear than the other. In one of them they were heard occasionally in the left, and at other times in the right ear, generally the former; but never in both at the same time.

General Relations of One-sided Hallucinations.

The phenomena we have been considering are limited to the sphere of the special senses. The question arises, Are analogous conditions present in the other great departments of the nervous system? The following case, quoted from my paper published in 1875, illustrates a somewhat similar event in the realm of general sensation:

J. B—, æt. 52, hears imaginary voices, and the voices are most distinct in the right ear. The insanity is of several years' standing, and is stated to be due to the intemperate use of alcohol. About thirteen

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years ago his right leg was amputated immediately below the knee, on account of an injury received in a railway accident. Since his admission into the asylum he has frequently complained of starting or burning feelings in the stump, which seems quite healthy. These are described occasionally as like a flame of fire, and are said to extend upwards to the body. He further states that "the blessed Virgin, angels, and men" go in at the stump, but sometimes the visitors are devils. They usually tell their names when they enter. They go up to the throat, and generally make their exit there, but now and again they return and leave the body through the stump. This occurs both day and night, but most frequently during the day. There is no peculiar sensation or more defined delusional idea associated with general sensibility in any other part of his body.

In this case there was generalised insanity; but the one-sided character of the hallucinations (illusions?), and their association with the stump, indicated that the mutilated limb, possibly the condition of its nerves, had at least exercised a modifying influence on these hallucinations.

Further, in the great department of sensation, and sometimes strictly limited to it, we meet with disorder and occasionally complete obliteration of function. This may be of organic origin, and due to lesion of the posterior part of the internal capsule. But the purest cases, which are also better analogues of one-sided hallucinations, are met with in hysteria. Patients have been under my care in whom there was complete abeyance of sensation in its various forms—touch, pain, heat, cold, muscular sense; inclusive also of the special senses of sight, hearing, smell, and taste—defects which were confined to one side of the body. Cases of this kind are by no means uncommon, and it is unnecessary to submit their histories in detail.

The question arises, is there, in disorders of general sensation, any degree of parallelism to the extension of hallucinations from one sense to another, on the same side, or from the one side to the other side, such as occurred in some of the cases recorded in this paper? In simpler form there appears to be a correspondence in the irradiation of morbid sensation from one nerve to another. Thus a decayed tooth occasionally gives rise to a severe supra-orbital neuralgia, and a diseased hip-joint may disclose itself chiefly by pain in the knee. In these cases the extension is on the same side, but it may be to the other side. In illustration may be mentioned that the smart pinch of an anæsthetic limb has

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been known to appear to the mind as a painful sensation in the corresponding part of the sound limb; or the converse may happen, as is well shown by a case of Dr. Bastian's, in which the application of a cold spoon to an anæsthetic arm produced a pricking sensation, followed by convulsive movements of the whole limb, which phenomena, after they had subsided, were revived by the application of the same spoon to the corresponding part of the sound limb.

In the motor region of the nervous system there are very similar events. They occur chiefly in three groups, the convulsive, the choreic, and the paralytic. All of them may be unilateral. Unless they are of an hysteric (neurotic) character, it is not often that they are of functional origin; usually there is an appreciable organic lesion of the one side, though that may be very minute. As will be evident in considering the pathology of these conditions, though due to definite lesion, they do not thereby cease to be analogous to one-sided hallucinations.

Spasmodic or convulsive action not infrequently begins in the muscles concerned in the production of a single movement. This is illustrated by the case of a lady who is at present under my care, and who formerly suffered from a severe form of epilepsy. All throughout her illness the seizures began in the flexors of the great toe, inducing painful cramp, and thereafter there was upward extension to the trunk, involving gradually all the muscles of the limb. The seizure might stop there or become generalised, and be associated with unconsciousness; or, as now for many years, it might never go beyond this foot. But, as I have seen in other patients, the morbid action may begin in a thumb or forefinger, or hand as a whole, or the side of the face, from each of which there was systematised extension, implicating fresh combinations of muscles and resulting movements as it progressed.

Choreic twitchings are more irregular in the order of their development. Sometimes, however, for a short time they are confined to one arm, or leg, or one half of face, all of the same side. But much more frequently, though the spasmodic movements may be very pronounced on the one side, and apparently limited to it, careful examination will show that they occur occasionally on the other side also.

Unilateral paralytic conditions, either partial or complete, of

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a functional character are by no means rare. Ordinarily the paralysis is hemiplegic in its form, but it may be limited to one arm or one leg. Much more rarely the loss of power may be restricted to a solitary muscle. Thus one of my patients, a girl twenty-three years of age, who was admitted into the Royal Infirmary on account of spasmodic paralytic and mental disorder of an hysterical character, prior to the setting in of these definite symptoms suffered from complete ptosis of one eye. For this she consulted an oculist, who excised a portion of the upper lid, with the result that when the muscle recovered its power, which it did as abruptly as she appears to have lost it, she was unable afterwards to completely close that eye.

There is no doubt that disorder of the vaso-motor system may also be altogether unilateral; usually the altered calibre of the blood-vessels so arising is associated with defects in the motor and sensory spheres, and is perhaps, in some instances, causative of them. This combination of symptoms is often seen in hysterical cases, where with abeyance of motion and sensation, hemiplegic or paraplegic, or both, as in a case recently under my care, the circulation of blood through the small vessels of the parts implicated is profoundly affected,—as a rule, retarded. For example, when one thrusts a needle into a leg or arm in this condition, as I have sometimes done, the flow of blood from the puncture is much more sluggish than usual, and may be all but absent.

Reviewing these phenomena of the sensory, motor, and vaso-motor systems, it will, I think, be obvious that each group in its own sphere and of its own kind bears considerable resemblance to the unilateral psycho-sensory manifestations which form the chief subject of this paper. It is where the disturbances of these great systems are of a neurotic character that the analogy is most complete. Thus the unilateral hallucination of hearing in a man of sound mind (Case 8), in which there was a reproduction of real voices heard at a time of supreme peril, imploring him to "come this way," these being the only words reproduced, has its homologue in the motor sphere in the case where the only definite loss of function was in a solitary muscle.

Further, the order of succession and variety in form in the hallucinations of sight and hearing of my own opium experiences appear to have their counterparts in the extension of

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one-sided convulsions, beginning, for example, in the big toe or the thumb, and implicating, as they spread, a progressively increasing range of muscular combinations.

The analogy between the sensori-psychical and somatic phenomena is still further maintained when the purely mental condition of the patients in the two classes is considered. Reverting to the cases with hallucinations narrated in the earlier part of this article, it will be seen that the patients were mostly insane, or were just recovering from mental unsoundness. One woman (Case 10) is slowly passing into generalised insanity. Turning now to the sensory and motor disorders, it will be observed that in the most typical and characteristic cases the patients were neurotic. In many of them the mental state was very unstable. Three had well-marked attacks of mania, of whom one died insane. Others were of a wayward, impressionable, emotional mental constitution, between which and positive insanity the distance is not great.

Pathology.—The pathology of unilateral hallucinations will now be considered. The question suggests itself, in such cases was there disease of the nerves on the affected side, which by extension upwards to the highest region of the brain would explain the one-sided feature of the phenomenon? A short study of ordinary hallucinations will help to elucidate this point. "In (2) a number of cases of bilateral hallucinations on record the nerves of the special sense or senses involved were found atrophied or otherwise diseased after death. Thus, in some instances of illusions or hallucinations of vision, the optic nerve and tract are stated to have been in a morbid condition. The most important case of this kind that has been recently published is one by Dr. Clouston, in which disease of the nervous system, beginning by blindness, afterwards developed into general paralysis with insanity. On examination after death by the microscope, that gentleman was able to trace degeneration along the optic nerves and tracts as far as the *corpora quadrigemina*. Dr. Batty Tuke has published cases of hallucinations of smell and hearing in which the olfactory bulbs were much degenerated in one patient, and disease existed in the neighbourhood of the *portio mollis* in another. What has been observed where the phenomena are bilateral doubtless occurs occasionally where they are only unilateral, although I

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have not observed that any cases of this kind have been recorded. I myself had a patient under me with blindness of one eye in whom, after death, the optic nerve was seen to be greatly atrophied ; but he was not insane."

In Case 10 of the present paper disturbances of hearing preceded the hallucinations of the same side. The aural surgeon found that disease exists in the nerve of that ear. It seems, therefore, not unlikely that there may have been an upward march of morbid action from the peripheral distribution of the nerve to the related auditory centre in the back part of the upper *temporo-sphenoidal* convolution ; but I need scarcely say that there is no feeling of assurance on this point.

"The probability of such extension in some cases from the sense-organ to the highest cerebral ganglia appears to be supported by the facts ascertained regarding general paralysis. Both clinical examination of the course of this disease and microscopical examination of the morbid parts show that it occasionally commences in the cord and gradually creeps upwards to the brain. Cases have occurred in my own experience where the progress of the symptoms led me to that conclusion regarding its origin."

"But though impressions received by the organs of the senses whose nerves are in a morbid condition may in some instances, when conveyed to the sensorium, be transmuted into forms most unlike the objects they represent, and further be accepted by the mind of the individual as real, should he be insane, it is probably not often that either illusions or hallucinations arise in this way. They are in all likelihood much more frequently due to disease in the sensorium itself or in the 'perceptive centres,' which, there is reason to think, exist in the hemispherical ganglia. An excitation of the visual sensorial centre, for instance, by a pathological process within itself would, in accordance with well-known laws of nervous action, produce images of objects external to the individual, though no such objects were really there. Or if a perfectly healthy impression coming from without were made on the centre while in that condition, the images presented to the mind would probably be altered as much as, or probably more than, if the transformation had occurred in the organ of sense itself or at any point before the impression reached the morbid centre."([8])

The possibility of modification of structure in afferent nerves

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and their peripheral distribution in sense-organs by extension downwards of morbid action from the cortical perceptive areas, when in a state of disease, is worthy of consideration. Obviously this problematical route is against the direction of the normal current in sensory nerves. But this objection loses much of its force when it is remembered that lately we have been constrained to alter, to some extent, our views respecting the lines of Wallerian degeneration. We now know that in disuse, and particularly in severe lesions of nerves, such as those experimentally inflicted on the lower animals by von Gudden,(4) damage to the neurons results, both inwards and outwards from the seat of lesions; and it has also been shown that degeneration occurs in the case of an *efferent* nerve, such as the hypoglossal, in the cells of the nucleus from which it takes origin.

It is very conceivable, therefore, that in a case of insanity in which hallucinations of one or more of the senses are very prominent and persistent, and in which the related portions of the cortex have presumably undergone profound though not necessarily gross structural change, their associated nerve-fibres throughout their entire length, even though interrupted by intervening ganglia, may likewise be more or less altered in their essential constitution. In such cases both cerebral centre and sense-organ might together take part in the presentment of hallucinations to the mind, whether they be unilateral or bilateral; at all events, the morbid creation arising and fully developed at the surface of the brain may be intensified, rendered more vivid, if pathological change similar to that in the highest centre exist in the neuron of the sense-organ.

Cases of mental disease with hallucinations of vision or hearing have occurred in my experience in which the mental disorder preceded the deafness or blindness of the patients; but even though there may have been causal connection between them, it is very doubtful if the gross nerve lesion commonly present in cases of that kind is akin to the delicate alteration of tissue usually associated with hallucinations. No doubt cases of very pronounced lesions of the cortical centres of hearing and sight, more especially but not exclusively in general paralysis, have been recorded by Mickle and others; but in many, probably in most instances of ordinary insanity,

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where hallucinations were prominent at the time of the patient's death, little *apparent* change has been found in these centres, or, at all events, it was not more marked in them than in neighbouring parts of the cortex.

"But passing from this inquiry, we proceed to another question, which is more immediately connected with our subject, namely, how does it happen that the centre for one side is sometimes implicated while the other is free? It seems to me that much light is thrown on this as well as on other points in cerebro-mental disorders by a study of Sir James Paget's views on general pathology. He very clearly shows, what might indeed *a priori* have been anticipated, that when a part is congenitally weaker than it should be, or has been weakened by disease, though it may have been restored to an apparently healthy state, it is apt to be affected first and to suffer most when a general morbid action arises in the system. An interesting case illustrating this disposition occurred in my practice several years since. A child in one of the wards of the hospital suffering from a trifling erythema of the upper lip became feverish, and at the same time the red surface extended over the side of the face and deepened in colour, assuming an angry aspect. The next day and the day following, the affected side of the face was swollen and had become purplish in hue, and the general symptoms were aggravated; but on the fourth day a copious eruption of measles fully explained the constitutional disturbance. We had here, then, a surface slightly enfeebled by disease participating in a new and general morbid action, both earlier and more severely than the neighbouring sound integument.

"Now, to apply this principle, we may consider that in unilateral hallucinations the special centre involved is weaker on one side than the other, through some cause either congenital or acquired, and that such an agent as alcohol in the blood acts with special virulence on the affected part. Assuming that it is abnormally weak, may not this be the point in some cases from which the morbid action spreads over the mind centres? just as in Ferrier's experiments the repeated irritation of a small portion of the cortical substance sometimes resulted in general convulsions."

This view of the pathological condition in unilateral hallucinations, published in 1875, fairly expresses my present

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opinion. Indeed, it is explanatory of the diverse symptoms produced by all toxic agents in different persons, most striking in disorders of the nervous system. Alcohol may be taken as the most familiar type of these agents. In the majority of people its toxic action does not differ greatly; it gives rise to a combination of mental, motor, and special sense disturbances pretty uniform in their features. In some, however, its morbid influence is much more marked on the centres related to the mind than on those specially associated with motion; hence the mental predominates over the motor disorder. Thus one meets with cases of delirium tremens in which there is great disorder of the mind, where the hand is steady and there is no apparent disposition to spasmodic movement. On the other hand, it is not unusual to observe pronounced tremor, most obvious in the hands; while, though there be mental agitation, there is no hallucination or other evidence of definite unsoundness of mind. Again, in exceptional cases that have come before me there was unusual implication of the cutaneous, sensory, and vaso-motor systems of nerves. Making due allowance for possible differences in the liquor taken, these diverse phenomena point to some peculiarity in the constitution of the nervous system of those in whom they are present.

Recent observations on the nerve-cell and its nucleus, and on the action of degenerative change in modifying the chemical constitution of these structures, show how unstable is the combination of the elements which enter into their composition, and how readily they may undergo profound alteration by the action of poisons, either autogenetic or of extrinsic origin.(5) It seems no great stretch of the imagination to suppose that in the building up of a dual organ like the brain, with elements whose chemical affinities are weak, there may occasionally be a slight difference between the corresponding parts of the hemispheres, so that a toxin in the blood may induce and maintain morbid action more readily on the one side rather than on the other.

In closing this paper it occurs to me that the inquiry may suggest itself to some minds if the further differentiation of psycho-sensory phenomena which unilateral hallucination constitutes, together with the related morbid cerebral

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state, in all probability limited at first to one hemisphere, brings us any nearer, however slightly, to the understanding of the *nexus* between mind and matter. To this the reply must still be emphatically in the negative. However minute our analysis of these and other revived sensory impressions may be, and however accurate our localisation of them in definite cerebral areas, we do but show how absolutely mental manifestations are associated with the brain and nervous system, equally in the reception of impressions, in the exercise of the highest mental faculties, and in the execution of the mandates of the will.

Notwithstanding all the advances in our knowledge of the physiology and pathology of the entire nervous system during the generation which is now drawing to a close, the essential nature of mind remains an undiscovered problem; and, however great the progress of these sciences may be in the future, no solution of it seems even conceivable.

(1) Published in the *Glasgow Medical Journal* for that year. Another paper by the writer on the same subject was read at the London meeting of the International Medical Congress (1881), of which there is a short abstract in the *Transactions*, vol. iii, p. 632.—(2) Quotation from paper published in 1875.—(3) Quotation from paper of 1875.—(4) See Mott's Croonian Lectures on "Degeneration of the Neurons," *British Medical Journal*, June 30th, 1900.—(5) Mott's lecture already referred to.

The Present State of Mental Science. The First of a Series of Papers on the Localisation of Mental Functions in the Brain. By BERNARD HOLLANDER, M.D.Freiburg-i.-B., M.R.C.S.Eng., L.R.C.P.Lond.

The Brain as the Organ of the Mind.

THOUGH medical science has made great advances during the nineteenth century, our knowledge of the *mental* functions of the brain is comparatively still obscure. Even as regards the elementary principles of mental science there is still a diversity of opinion. Thus when we state the first fundamental principle, that *the brain is the organ of the mind*, on which we are all agreed, we in reality differ widely according to the interpretation we give to the word "mind."

There are those who hold mind to be equivalent with in-

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