LECTURE I.
Delivered on April 1st, 1897.

Mr. President and Gentlemen.—The modern interest, and development of knowledge concerning, aphasia and other speech defects dates from the publication of certain memoirs by Broca, some six or thirty years since, when he attempted to localise what he termed the "faculty of articulate language" in a limited convolutional region of the left cerebral hemisphere. The publication of his cases and conclusions formed the starting point for a whole new series of investigations, whose result has been a remarkable development in our knowledge of the localisation of functions in the cerebral cortex, while the discussions to which these investigations have given rise have materially helped to lead to a better understanding of the working of the complex cerebral mechanisms needed for the carrying on of speech and thought. We are thus at the present day capable of dealing with the subject of speech defects from a much broader basis of discovered facts, as well as with a greater critical insight than was at all possible at, or even long after, the time when Broca wrote his famous memoir. Very much, however, remains to be discovered before the many differences of opinion that exist concerning obscure and complicated points in connexion with the nature and exact mode of production of speech defects are likely to be set at rest.

The special tendency of aphasia and other forms of speech defect to be associated with disease of the left rather than of the right hemisphere is now a well-recognised fact. This holds good for right-handed but not as a rule for left-handed persons. In these latter aphasic defects are produced by disease in similar parts of the right cerebral hemisphere. It is believed, therefore, that motor incitations for acts of speech are accustomed to pass off in the main from one cerebral hemisphere, and that whether this shall be from the left or from the right hemisphere becomes determined principally by the increased dominance, or slightly earlier development, of one of them, brought about more or less remotely in association with right- or with left-handedness.

Although we shall here deal with what are known as "acquired defects of speech"—that is, such defects as may have supervened after the power of speaking has been attained—still, it seems desirable that a very brief reference should be made as a preliminary to defects of speech resulting either from congenital disease or from diseases occurring at some date prior to the manifestation of articulate speech. The most important of these congenital speech defects is deafness, which of itself entails mutism, the individuals thus afflicted being known as "deaf mutes." It must be remembered that untaught acts of speech would, however, be possible except on the supposition that speech has now become a truly automatic act for human beings, and that if children do not speak at birth this is the main cause of their cerebral systems are still too immature. No such untaught acts of speech would, however, be possible unless development had been taken place in a normal manner and unless the auditory sense and intelligence had been unaffected. The occurrence of some emotion may in such a case afford a strong stimulus, under the influence of which the duly organised speech mechanisms become called into action.

Some curious cases of congenital speech defect were described by Hadden to which the term "idioglossia" has been applied. These children have to a certain extent a language of their own, so that when asked to repeat phrases they make use of definite sounds of their own instead of those proper to the words that should be employed. The sounds which they substitute are, however, the same for the same words. Some of these patients seem to have been capable of writing correctly from dictation, and they have also shown a fair amount of general intelligence.

The Various Kinds of Word Memory.

According to Sir William Hamilton, "Memory strictly so denominated is the power of retaining knowledge in the mind, but outside of consciousness. I say, retaining knowledge in the mind but out of consciousness is the power of bringing out of memory into consciousness the function of a totally different faculty (recollection). . . . It is not enough that we possess the faculty of acquiring knowledge and of retaining it in the mind; there is a further need of endowing it with a power of recalling it out of consciousness into consciousness—in short, a reproductive power (recollection). This reproductive power is governed by the laws which govern the succession of our thoughts—the laws as they are called, of mental association." This definition of memory implies the notion of an organic change taking place in definite nerve elements on the occurrence of events or individual psychic processes. It thus excludes entirely mental modification of some kind, plus the possibility of its renewal in more complete form from time to time.

We may therefore suppose that on fitting occasions, by the intervention of associational activity, there will be revival in more complete form of some thing like the original molecular
activity in the nervous elements concerned with the primary processes of the word-centres. It is not essential that the memorial revival of the sensory impression or of the intellectual process should after multifarious repetitions be associated with any distinct conscious phasis. What Sir William Hamilton termed the retentum may be described as a link in a perceptive process or in a chain of action—a link in a perceptive process or in a chain of thought represented merely (as John Stuart Mill put it) by "certain organic states of the nerves." This latter conception of the memorial revival of the sensory impression as a link in a perceptive process is one of the most important conclusions to be drawn from the study of the importance of the revival of the sensory impressions for the guidance of movements, seeing that their revival may be unattended by any distinct conscious phasis; and much the same thing may often be said concerning that memorial revival in the auditory centre which immediately precedes speech.

From what has already been said it is evident that "loss of recollection" by no means implies nor is it to be taken as synonymous with "loss of memory." For instance, a patient may be unable to recollect words—that is, spontaneously revive them—for ordinary speech when his memory for such words, nevertheless, exists unimpaired, as may be shown by the fact that the patient is able at once to repeat the words in question when he hears them pronounced or when they are written. His defect, therefore, may consist in a more lowered activity of the auditory word-centre, in which words are primarily revived during thought. "Loss of recollection," therefore, is a compound of two very different states: either (a) upon some diminished functional activity—that is, diminished readiness to be roused—in the central nerve mechanisms in which the retentum is, so to speak, stored or rendered possible of revival; or else (b) upon some defect in the corresponding cerebral fibres, whether the word is simply a sensory impression corresponding with different words. 3

In the case of words there are three distinct kinds or physiological types of memory to be considered—one of them existing in two forms, so as to make four varieties in all. These varieties of verbal memory are as follows:—1. Auditory memory: the memory of the sounds of words—which, of course, includes the memory of the inarticulate impression of words. 2. Visual memory: the memory of the visual impressions corresponding with different words. 3. Kinaesthetic memory: the memory of the visceral impressions resulting from the mere movements of the vocal organs during the utterance of words (impressions from muscles, mucous membranes, and skin)—that is, of the kinaesthetic impressions corresponding with the articulation of different words, which for the sake of brevity I shall call "kinesio-kinaesthetic" impressions; and (d) the memory of the different groups of sensory impressions emanating from muscles, joints, and skin, during the act of writing individual letters and words—that is of the kinaesthetic impressions corresponding with the groups of sensory impressions resulting from the mere movements of the vocal organs during the utterance of words (impressions from muscles, mucous membranes, and skin)—that is, of the kinaesthetic impressions corresponding with

2 These forms of word-memory were first definitely stated by me to be purely sensory in papers on the Physiology of Thinking (Fortnightly Review, 1869) and on the Sensory Sense (Brit. Med. Journ., April, 1869), and the name "kinaesthetic" was subsequently (The Brain as an Organ of Mind, 1880, p. 543) applied to the complex groups of impressions resulting from movements of the kinaesthetic sense.

3 Other French writers, as well as Ballet, attribute to Charcot the doctrine that "le mot n'est pas une unite, mais un complex" (Le Cerveau et la Parole, p. 53) because of some passages in his papers. He described four different kinds of word-memory. Charcot's lectures on Aphasia were delivered in 1883, but M. Ballet will find a full description of these four varieties of word-memory in his four articles, "De la localisation des differentes fonctions de l'organe de la parole" (Pensée, tome ii., p. 222), published in 1882.

THE LOCALISATION OF THE DIFFERENT WORD-CENTRES.

Although I am not a believer in the complete topographical dualism of the cerebral hemispheres, I consider it clear that there must be certain sets of structurally related cell and fibre mechanisms in the cortex, whose activity is associated with one or with another of the several kinds of sensory endowment. Such diffuse sensory centres may be considered as a sort of hybrid between the organ of the common sensation of touch and the organ of vision, while the particular parts of the general auditory and visual centres which are in relation with word-impressions may be more or less distinctly defined, and known as the analogous parts of the general kinaesthetic centre that are in relation with speech movements. It is probable that there are various varieties of amnesia in which the part of the visual centre in relation with words seems to be specially at fault (as in "word-blindness"), but there are other cases in which the whole of the auditory centre in relation with words is either wholly or partially inactive (as where we have to do with different degrees of "word-dullness")—in each case without defect in other parts of the brain. Similarly there must be what I have termed kinaesthetic word-centres of two kinds (the one in relation with speech-movements, and the other with writing-movements) holding a like all-important relation to the expression of thought in speech and writing. It is probable that the particular parts of the general auditory and visual centres which are in relation with word-impressions may be more or less distinctly defined, like the analogous parts of the general kineesthetic centre that are in relation with speech movements. It is probable that there are various word-centres which are not wholly inactive, as evidenced by the fact that the persons so affected can still quite well see and recognise ordinary objects, or hear and recognise the nature of ordinary sounds.

In regard to the visual centre as a whole, it is important to be established that it is more or less diffused through the convolutions of the occipital lobe and probably even more widely throughout this lobe. The particular part of the visual centre which is most concerned with the visual expression of thought is the region corresponding with the part of the visual centre in relation with words. In other words, the destruction of that part of the visual lobe which is most concerned with the visual expression of thought is most likely to result in word-blindness. It is probable that the region corresponding with
angular gyrus either alone or in association with part of the supramarginal lobule—and therefore that it is situated just beyond the confines of the occipital lobe, and in the region originally assigned by Ferrier, upon the basis of his experiments with monkeys, as the centre for vision as a whole.

In regard to the localization of the general auditory centre considerable doubt now exists, since the researches of Schafer and Sanger-Brown do not support Ferrier's allotment of this endowment to the upper temporal convolution. Curiously enough, however, it again happens that the localization of the part of the general auditory centre most concerned with the appreciation of words (as based upon clinico-pathological evidence in man) must be regarded as being in the posterior half or two-thirds of the upper temporal convolution. The above-mentioned results of Schafer and Sanger-Brown as to the localisation in monkeys of the general sense of hearing were of a negative character, and cannot be said to afford any definite evidence against this presumption as to the site of the auditory word-centre in man.

The situation of one of the two kinesthetic word-centres can be rather more certainly localised. Having elsewhere stated very fully my reasons for believing that the so-called "motor centres" of Ferrier and others are really sensory centres of kinesthetic type by means of which movements are guided, I shall not now attempt to set forth the evidence in favour of this opinion, but shall merely state my belief that Broca's region—namely, the posterior part or foot of the third frontal and the inferior part of the ascending frontal gyri—and, further, the parietal lobe are situated as above stated: that the auditory word-centre is situated in the angular and part of the supramarginal convolutions. It must be remembered that the auditory and motor word-centres are connected by a system of fibres which is known as the "glosso-kinesthetic" centre. The situation of the "chiro-kinesthetic" centre cannot be localised with nearly as much confidence. The tendency for some years has been to follow Exner, who believes it to be situated in the posterior part of the second frontal gyrus, though, as we shall see later, the evidence in favour of this localization is at present extremely scanty. All that can be said on this point, therefore, is that we know approximately where to look for the chiro-kinesthetic centre.

Diagram showing the approximate sites of the four word-centres and their commissures.

The chiro-kinesthetic centre for the production of writing movements connected with one another: (c) in the internuncial fibres connecting the two kinesthetic word-centres with the related motor-centres, in the bulb and in the cervical region of the spinal cord; and (d) in the motor-centres themselves which are concerned with the actual production of speech. In writing a word before dealing with the problems in detail a few other aspects of the questions relating to word-memory, as well as the modes of activity of the brain in perceptive and speech processes require to be considered.

The Primary Site of Revival of Words in Silent Thought.

It seems clear that words are the symbols with which our thoughts are inextricably interwoven, and that the revived feelings, ideas, or "images" of words may enter into thought processes by a more or less simultaneous renewal of activity in different regions of the cerebral cortex. There may be a revival of sound movements as well as visual movements; there may be a revival of visual impressions of words as we have seen them in written or printed characters; and, lastly, there may be a revival of the feelings of muscular contractions concerned in the pronunciation of words. Of these modes of "ideal" recall of words the two former are distinctly and easily recoverable, while the latter is vague and difficult of conscious realisation. Let anyone contrast his idea of the sound of the word "London," or his idea of the pronunciation of the word "London," with his idea of the muscular and other feelings associated with the articulation of the same word, and the inferiority in definiteness and recoverability of the latter will at once be come clear.

It is, however, a matter of extreme importance for the due understanding of the different kinds of speech defects and for the success of our endeavours to refer them to defective activity in this or that physiological region of the hemispheres that we should definitely know in what sensory region of the cortex words are principally recalled to mind during ordinary thought-processes. Two distinct views radically opposed to one another have been advocated on this subject.

There is the view (1) that words are revived as "motor processes"—that is, as faint excitations of the processes occurring in motor centres during the articulation of words; and (2) there is the view that words are revived in ordinary thought in the main as auditory ideas or images. The former view has for a long period been promulgated by Hughlings Jackson, and has more recently received the strong support of Stricker, both of them regarding Broca's region as a motor rather than as a sensory centre. The latter view is that which the writer has now for many years advocated. The fundamental nature of my opposition to the former view may be gathered from the fact that I have for many years opposed the opinion that motor centres, wherever they may be situated, are those whose action is dependent upon consciousness from subjective concomitants. No "ideal" reproductions seem ever to take place in such centres; they are raised into activity by outgoing currents, and, so far as we have any evidence, their production is the result of motion which immediately afterwards issue through cranial and spinal motor nerves to muscles, like those which they engender, simply physical phenomena. It is true that the altered condition of the muscles and of contiguous parts induced by the outgoing stirring-the concomitants of ingoing impressions, the terminus for which is the kinesthetic centre. This latter is therefore a true sensory centre, and in it images of movements or "ideal movements" may be revived in a more or less vague manner as already indicated.

But, even if we adopt what appears to me to be the more legitimate view that articulatory movements as well as movements in general are represented in the cerebral cortex only by sensory centres, there is still another good reason for rejecting the notion that the "material of our recollection" in the use of words during silent thought is primarily revived as glosso-kinesthetic impressions in Broca's centre. The principal reason opposed to this view seems to me to be as follows. In the first place it must be evident from the mode in which speech is acquired by the child that during the few months in which words enter into the simple trains of thought, before he has acquired the power to articulate them for himself, they must be revived as

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auditory impressions. Secondly, there is, as we have seen, a much greater definiteness of impression and readiness of recall for auditory than for articulatory feelings; and so far, therefore, there is a greater fitness in the former for serving as the material for recollection of words in ordinary thought processes. Thirdly, there is reason to believe that revived auditory feelings continue after the acquisition of speech by the child to have the same relation to his thought-processes as they must have had before his acquirement of the power of speaking, and this is impossible to understand if total deafness supervening in a child in full possession of speech as late as the fifth, sixth, or even the seventh year, will certainly entail dumberness and idiocy. Consequently the difference in the case of persons of their primary incitement to acts of speech be gradually transferred from the auditory to the visual centres. Fourthly, because, as we shall subsequently find, there is much evidence against this view to be derived from the study of speech defects, and not all auditory fatalism is necessarily indefeasible in the future.

It seems to me to be an error to attempt to settle such a question by endeavouring to ascertain which form of word-memory reveals itself most in consciousness; and I venture to think that the recent principal advocate of the view that words are primarily revived during silent thought as "motor processes," relies too much upon what is in reality an untrustworthy method—that of introspection. By concentrating his attention upon the genesis of his own speech, Professor Stricker inevitably brings its expressive side into undue prominence. As Taine says: "Plus on imagine nettement et fortement une action, plus on est sur le point de la faire... quand l'image devient très lumineuse elle se change en réalité.

The primary revival of words during thought takes place, I submit, in the great majority of persons by a subconscious process in the auditory centre, and tends to be immediately followed by correlated revivals in the glotto-kinaesthetic centre, and these again by inventive or creative activities in the bulbar motor centres. It may be perfectly true that kinaesthetic memories vary in intensity in different individuals, as do auditory and visual memories; and it might have been expected that the most high-bred (though I mean his view in a more discriminating manner) were to be counted as persons in whom the former kind of memory is highly developed, but for the fact that Ballast expressly states his inability voluntarily to recall kinaesthetic impressions. He believes, moreover, for reasons given, that the same holds good for Stricker. Thus they cannot voluntarily recall the kinaesthetic impressions associated with the act of writing a word, but they say they can recall the "mechanical" movements with which the articulation of the same word, even although the movements in the latter case are much more of an automatic type. These apparently contradictory results are easily explicable in accordance with my views, when one considers how the thought-processes of a higher order of thought-processes are referred to in the first three types may be met with in recorded cases of speech defect lend support to these views, and that this, in fact, is the real practical outcome of all that has been said by Charcot and his followers as to the division of persons in reference to the interpretation of speech defects.

Thus he took steps to test the power of what he calls the "auditive" memory of a person, by making a vivid mental picture of words, and using it as a leader in the memorial recall of words, as bright as in the actual scene. One of those who had the highest power of visual recall answers: "Thinking of the breakfast table this morning, all the objects in my mental picture are as bright as in the actual scene." One of those who had the lowest power answers: "No individual objects, only a general idea of a very uncertain kind."

Galton adds: "There are a few persons in whom the visualising faculty is very low that bring to mind's eye some object, anything else; and again there are a few in whom it is so high as to give rise to hallucinations." In this general sense persons may well be classed as "visuels" and "auditives" respectively; and we may thus indicate for this new motor of that person which is the more potent sensory endowment.

Supposing, however, that a person is a "visual" in this general sense, it should not, in my opinion, be taken as necessarily implying that visual memories of words are for the first time to be revived in silent thought. If we suppose that we should expect to find speech greatly interfered with in many cases of simple word-blindness; but this seems comparatively rarely to be met with, the contrast in this respect between visual memory and auditory memory is very striking. If all that has been said by Charcot and his followers as to the division of persons into "visual" and "auditive" is correct, we should expect to find speech greatly interfered with in a person in whom the auditory word-centre is damaged in such a person its action, as a leader in the memorial recall of words, might to a certain extent be taken on by the visual word-centre; while in a person who is not a "visual" but a "motor" or "auditive" kind of person, the weakness would be in the auditory word-centre. Thus the clinical effects in the form of speech disturbance would be different and altogether more marked in the latter case. It will be found that many recorded cases of speech defect lend support to the views, that this, in fact, is the real practical outcome of all that has been said by Charcot and his followers as to the division of persons in reference to the interpretation of speech defects.

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In different persons, as we have seen, there is also a good reason to believe that in a small minority of persons the primary revivals of words during silent thought are not so limited as to the silent thought may take place therein, just as it does in the act of reading. Thus Galton says: "Some few persons see mentally in print every word that is uttered; they attend to the visual equivalent and not to the sound of the words, and they read them as clearly as people do in dreams long after they have ceased to be impressed. It is possible, of course, that a person possessed of this high visualising power, whilst he may be thus aided in the delivery of a speech previously written, may nevertheless, in a process of silent thought, fall back to the rule and read the words voluntarily in his auditory centre. But it may be otherwise with some few persons, so that, as Ribot supposes, they may habitually think and represent objects "by visual typing, substitution, and representation."

Something of this kind we are bound to suppose must occur in a word-deaf person whose auditory word-centre is destroyed and who is yet able to speak—a rare conjunction that has occasionally been met with; just as we are bound to suppose that when a congenitally deaf and dumb child is taught to speak by the lip-reading process he brings about this by means of a primary revival of visual images, which act directly upon the glosso-kinesthetic centre and thence upon the motor centres in the bulb.

But, in the case of a congenitally deaf and dumb child, the visual images act with the help of a material symbol. A patient of a friend of mine who, by means of raised letters and words, excitation of the centres for touch and movement, was enabled to supply to himself the place of the auditory word-centre of a patient of whose case I have elsewhere said 20: "I can by means of the page with its lines and its letters, and he recited by heart passages of the Bible, which he had committed to memory, and he could repeat them in order from one another, and the intervals between each word written in black appear to me also. I see them in white. All my reproductions of words are visual." The same author mentions an orator, Hérault de Séchelles, who was accustomed, as it were, as a patient of his, to read his speeches; and cites an epigram of Charms, also a "visual," who, speaking of the class to which he belongs, said, "Nous pensons notre discours, comme nous écrivons notre pensée."

Undoubtedly, then, it would seem that there are certain exceptional persons who, as it were, read rather than hear their thoughts; and in whom, as in the patient whose case is told above, the visual image forms the most potent representations of words, whilst visual images form the most potent representations of ordinary external objects.

The Revival of Words for Speech is a Complex Process

The views just expressed, as I have said, to the seat of the primary revivals of words in memory, because there is a strong reason for believing that the activity when once initiated does not limit itself to a single centre. It must be borne in mind that the structural relations existing between the different seats of word-memory and the modes in which these are functionally related is in accordance with what occurs in ordinary processes of perception. In regard to such a process I have elsewhere said 20: "When any one constituent of a natural cluster of sensations comes within the range of the corresponding sense organs of an animal the other possible impressions composing the cluster (and representing the organism’s knowledge of the external object) become simultaneously nascent in memory, so that the object is perceived or recognised. If in a dark room my hand comes upon an orange or a book, either of these sensations of touch will immediately fuse with nascent ideas of other possible sensations from the same object (whichever it may be), so that this object is perceived as a present external reality. Thus it happens that an object is recognised immediately or intuitively, not so much by the mere single or double impression present, as by the blending of this with more or less fully revived memories of other impressions which have at various times been associated with the same object. Truly enough, as Bain says, "When we see, hear, touch or move, what comes before us is really more contributed by the mind itself than by the present object." It is therefore by the simultaneous consciousness and fusion, as it were, of the subjective side of various new and old impressions that a present object is perceived and recognised. It could only be by the previous establishment of structural communications between the severally related sensory cells (in different centres) that the excitation of those of any one order would suffice to revive more or less strongly in other groups just such molecular changes as like objects had on previous occasions excited. And it may be easily understood that the molecular movements initiated by any one or two sense impressions may start from such groups of cells and thence flow over into all corresponding articulating cells between them and the cells of other related groups."

In a similar manner it may be supposed that the revival of activity in the auditory centre during the voluntary recall of words does not remain limited to that centre, but gives rise, as I have already said, to molecular movements in two directions—that is, forwards to related portions of the kinesthetic centre and backwards and upwards to related portions of the visual centre—though with different degrees of intensity in different persons.

It is of importance to remember that for ordinary persons (that is, for those who are neither congenitally blind nor congenitally deaf) the four memories of words seem to be mainly recalled into play in definite couples—namely, the auditory and the glosso-kinesthetic revivals taking place during articulate speech, and the visual and choro-kinesthetic revivals taking place during oral reading. By this I mean that in expressing one’s self in spoken words memories of such words are first principally revived in the auditory centre, and that the nervous units thus called into activity immediately are transmitted to the motor centres through commissural fibres (see Fig. 2, c).

The glosso-kinesthetic revivals. A diagram illustrating the relative positions of the different word-centres and the mode in which they are connected by commissures. The connections indicated by dotted lines indicate possible but less habitual routes for the passage of impulses.

In different persons, as we have seen, there is also a good reason to believe that in a small minority of persons the primary revivals of words during silent thought are not so limited as to the silent thought may take place therein, just as it does in the act of reading. Thus Galton says: "Some few persons see mentally in print every word that is uttered; they attend to the visual equivalent and not to the sound of the words, and they read them as clearly as people do in dreams long after they have ceased to be impressed. It is possible, of course, that a person possessed of this high visualising power, whilst he may be thus aided in the delivery of a speech previously written, may nevertheless, in a process of silent thought, fall back to the rule and read the words voluntarily in his auditory centre. But it may be otherwise with some few persons, so that, as Ribot supposes, they may habitually think and represent objects "by visual typing, substitution, and representation."

Something of this kind we are bound to suppose must occur in a word-deaf person whose auditory word-centre is destroyed and who is yet able to speak—a rare conjunction that has occasionally been met with; just as we are bound to suppose that when a congenitally deaf and dumb child is taught to speak by the lip-reading process he brings about this by means of a primary revival of visual images, which act directly upon the glosso-kinesthetic centre and thence upon the motor centres in the bulb.

But, in the case of a congenitally deaf and dumb child, the visual images act with the help of a material symbol. A patient of mine who, by means of raised letters and words, excitation of the centres for touch and movement, was enabled to supply to himself the place of the auditory word-centre of a patient of whose case I have elsewhere said: "I can by means of the page with its lines and its letters, and he recited by heart passages of the Bible, which he had committed to memory, and he could repeat them in order from one another, and the intervals between each word written in black appear to me also. I see them in white. All my reproductions of words are visual." The same author mentions an orator, Hérault de Séchelles, who was accustomed, as it were, as a patient of his, to read his speeches; and cites an epigram of Charms, also a "visual," who, speaking of the class to which he belongs, said, "Nous pensons notre discours, comme nous écrivons notre pensée."

Undoubtedly, then, it would seem that there are certain exceptional persons who, as it were, read rather than hear their thoughts; and in whom, as in the patient whose case is told above, the visual image forms the most potent representations of words, whilst visual images form the most potent representations of ordinary external objects.

The Revival of Words for Speech is a Complex Process

The views just expressed, as I have said, to the seat of the primary revivals of words in memory, because there is a strong reason for believing that the activity when once initiated does not limit itself to a single centre. It must be borne in mind that the structural relations existing between the different seats of word-memory and the modes in which these are functionally related is in accordance with what occurs in ordinary processes of perception. In regard to such a process I have elsewhere said: "When any one constituent of a natural cluster of sensations comes within the range of the corresponding sense organs of an animal the other possible impressions composing the cluster (and representing the organism’s knowledge of the external object) become simultaneously nascent in memory, so that the object is perceived or recognised. If in a dark room my hand comes upon an orange or a book, either of these sensations of touch will immediately fuse with nascent ideas of other possible sensations from the same object (whichever it may be), so that this object is perceived as a present external reality. Thus it happens that an object is recognised immediately or intuitively, not so much by the mere single or double impression present, as by the blending of this with more or less fully revived memories of other impressions which have at various times been associated with the same object. Truly enough, as Bain says, "When we see, hear, touch or move, what comes before us is really more contributed by the mind itself than by the present object." It is therefore by the simultaneous consciousness and fusion, as it were, of the subjective side of various new and old impressions that a present object is perceived and recognised. It could only be by the previous establishment of structural communications between the severally related sensory cells (in different centres) that the excitation of those of any one order would suffice to revive more or less strongly in other groups just such molecular changes as like objects had on previous occasions excited. And it may be easily understood that the molecular movements initiated by any one or two sense impressions may start from such groups of cells and thence flow over into all corresponding articulating cells between them and the cells of other related groups."

In a similar manner it may be supposed that the revival of activity in the auditory centre during the voluntary recall of words does not remain limited to that centre, but gives rise, as I have already said, to molecular movements in two directions—that is, forwards to related portions of the kinesthetic centre and backwards and upwards to related portions of the visual centre—though with different degrees of intensity in different persons.

It is of importance to remember that for ordinary persons (that is, for those who are neither congenitally blind nor congenitally deaf) the four memories of words seem to be mainly recalled into play in definite couples—namely, the auditory and the glosso-kinesthetic revivals during articulate speech, and the visual and choro-kinesthetic revivals during oral reading. By this I mean that in expressing one’s self in spoken words memories of such words are first principally revived in the auditory centre, and that the nervous units thus called into activity immediately are transmitted to the motor centres through commissural fibres (see Fig. 2, c).

The glosso-kinesthetic revivals.

A diagram illustrating the relative positions of the different word-centres and the mode in which they are connected by commissures. The connections indicated by dotted lines indicate possible but less habitual routes for the passage of impulses.
of the visual word-centre, and from this region stimuli can be effected through the instrumentality of motor centres in the cervical and upper dorsal regions of the spinal cord.

There can be no doubt, in fact, that the functional association of the auditory and the visual word-centres themselves. These latter are interrelated as also the kinesthetic word-centres, as well as that between the visual and the chiro-kinesthetic centres, is of the closest kind. No less intimate, however, is the bond of association between the activity of the auditory and the visual word-centres themselves. These latter can be aroused and incited through the instrumentality of motor centres of the visual word-centre, and from this region stimuli reach the auditory word-centre, and the activity thus aroused, part which ordinarily calls the glosso-kinesthetic centre into activity, whence properly coördinated incitations issue from the cortex, in order to call into play the motor centres in the bulb.

In other cases expecially it seems that the organic functional connection of the auditory with the glosso-kinesthetic and of the visual with the chiro-kinesthetic word-centres is not adhered to. Thus the chiro-kinesthetic centre may be excited to activity in the main by visual symbols (either of hand or of lip movements), and is from the organic seats of these that incitations pass to related parts of the glosso-kinesthetic centre (c, e). A similar stimulation of these centres direct from the visual word-centre seemingly occasions in persons who are not deaf-mutes. We have already assumed it to be possible for some few "visuals," and subsequently for the interpretation of certain cases of disease in which the auditory word-centre has been damaged we shall find ourselves obliged to have recourse to such a supposition.

Again, in those children who have been born blind, but who nevertheless ultimately learned to write, a direct association must become established between the auditory and the chiro-kinesthetic word-centres. The same kind of associated activity between these two centres must exist in certain other persons not born blind, seeing that some patients suffering from word-blindness owing to destruction of the visual word-centre are able, nevertheless, to write, although incapable of reading aloud and writing from dictation.

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On the Different Modes of Excitation of the Word-centres, and on the Reason of their Functional Predominance in the Left Hemisphere.

It is important to recollect that word-centres are naturally called into activity in states of health in three modes, but that failure in the possibility of their excitation by one or other of these modes occurs in various morbid conditions, leading to this or that kind of speech defect. The three modes of excitation are these: (1) By means of "sensory" impressions coming from without; (2) by "association"—that is, by impulses communicated from another centre to which association processes are connected; and (3) by "voluntary" recall of past impressions, as in an act of recollection. It is convenient for practical purposes to separate these second and third modes of calling into activity the respective centres; still the second is probably closely related to our manner and is apt to be forgotten, much the brain acts as a whole even in operations that seem comparatively simple, and many of those who have written on aphasia have, as I venture to think, not sufficiently taken into account the fact that the name constitutes an integral element of the percept or of the concept.

The excitability of the centres—that is, the molecular mobility of their nervous elements—may vary with age, state of health, or the existence of different morbid conditions. Their excitability may be so much lowered that they are only capable of responding to powerful stimuli; so that those additional to the voluntary recollection within the limits of their province, such centres may still be capable of acting in "association" with others—that is, in an automatic manner during an ordinary process of thought—or at least under the sensory control. At other times the excitability of the perceptive centres may be unduly excited, so as to lead to hallucinations, illusions, and a wholly different class of defects such as are often met with among the insane.
follow that the predominant use of the right hand or of the left hand is, as it were, an associated effect, the leading activity in the production of speech by the left or the right hemisphere respectively; and that we must consequently push our question further back, and inquire as to the causes that have led to this predominant use of the right or the left hand.

This problem has been considered by Pye-Smith, but in a more exhaustive manner by William Ogle, but can only be briefly alluded to here. It has been thought to depend upon tribal customs, upon the greater number of cells and fibres forming part of the corpus callosum. Thus it may, in brief, be said that this preponderating complexity was on the right rather than on the left anterior lobe. There still remains the question why one cerebral hemisphere only should be efficiently educated for the perception of speech and for the production of speech movements, when, seeing that the bulbar motor centres are bilateral, it might be supposed that both these centres would be activated by the same stimulis from both hemispheres. In partial reply to this question Moxon, in a very able paper, long ago suggested that the call upon attention was so great for the production of the speech movements that the necessary concentration of attention would be much facilitated if this process of education were limited to one hemisphere. Whatever may be thought of this ingenious suggestion, there is no doubt that the left hemisphere rather than the right in the production of speech must be understood with certain reservations. It must not be supposed that the right hemisphere remains entirely uneducated, either in regard to the comprehension or to the production of speech. Little is said by writers generally on this subject, and what has been said has reference principally to the third frontal convolution. A hypothesis as to the functions of this part of the brain has been enunciated by Hughlings Jackson, and another view, as to what is figuratively termed the "overflow of education into the opposite hemisphere," has been expressed by Wylie. But neither of these hypotheses appears to me to be in accord with existing knowledge of the organic basis of right-handedness and making general this predominant use of the right hand.

But whatever may have been the original cause of this now very wide and very variable place of the right or left hand, and the difficulties of the problem with which we are concerned lie here—it would easily follow that with its continuance in process of time the left hemisphere should become (as it has been found to be) slightly heavier than the right, and that the left carotid might become (as it is said to be) very slightly larger than the right carotid. It is practically certain that the great preponderance of right-hand movements in ordinary individuals must tend to produce a more complex organisation of the right hemisphere. The most important points to be borne in mind in reference to this subject would seem to be these. All the movements concerned in speech are movements produced by symmetrical cerebral centres. Thus the relative weight of the brain is just as much reason, therefore, for the registration of kinesthetic impressions resulting from speech movements in the right as in the left third frontal convolution. Again, it cannot be supposed that auditory impressions from spoken words do not come from each ear to similar auditory centres in the opposite cerebral hemisphere; and our present knowledge makes it equally improbable that the visual impressions of words are not registered in a visual word-centre in each hemisphere. Of course impressions, therefore, there is, as I believe, no question of an "overflow" from one to the opposite hemisphere; on the contrary, each hemisphere receives its own proper share of ingoing impressions, and doubtless registers them in a more or less similar fashion. That this should be so seems an obvious truth, though it is one that hitherto appears to have been very imperfectly realised. Again, it may be taken as established, for reasons which will subsequently appear, that no preparatory processes connected with the incoming impressions. Whatever may be thought of this ingenious hypothesis, therefore, it would seem to be in accord with existing knowledge of the organic basis of right-handedness and making general this predominant use of the right hand.

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Thus it may, in brief, be said that this preponderating activity of the left hemisphere in regard to tactile and kinesthetic impressions (about which there is no room for doubt, and which indeed we have been treating with), and the left hemisphere is the more potent and seems to take the lead in some thought processes, as well as in giving rise to the voluntary excitations which determine the acts involved in speech. A greater convolutional complexity of the lower part of the brain rather than the right in the production of speech must be understood with certain reservations. It must not be supposed that the right hemisphere remains entirely uneducated, either in regard to the comprehension or to the production of speech. Little is said by writers generally on this subject, and what has been said has reference principally to the third frontal convolution. A hypothesis as to the functions of this part of the brain has been enunciated by Hughlings Jackson, and another view, as to what is figuratively termed the "overflow of education into the opposite hemisphere," has been expressed by Wylie. But neither of these hypotheses appears to me to be in accord with existing knowledge of the organic basis of right-handedness and making general this predominant use of the right hand.

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211 Hughlings Jackson, Transactions of the Royal Medical and Chirurgical Society, 1871.
213 Transactions of the Royal Medical and Chirurgical Society, 1871.
214 Guy's Hospital Reports, vol. xvi., 1871.
215 Journal of Mental Science, pp. 28, 32.
217 Moxon's paper is, indeed, in other respects remarkable, looking to the date at which it was written. This work, which was represented in Broca's region by "educated associations of movements"; and the meaning that he attaches to this phrase is rendered evident further on when he dwells upon the "inconceivable pitch of education" which is given to those supra-motorly departments of the brain which are trained in Broca's region. It is a pitch which should ready for "unusual words," or still better where he says, "The situation of the ideas of associated sensations which form the faculty of speech is supra-motorly, whilst the situation of the ideas of associated sensations which form the faculty of language comprehension is infra-sensory."
the outgoing channels of communication between these sensory centres and the corresponding associational and outgoing channels in the opposite hemisphere, however, being but little used, may remain comparatively undeveloped.

The particular degree of activity of the two cerebral hemispheres during speech would tend to become more and more accentuated in future years, and would in all probability lead to a much higher grade of functional activity, even on the receptive side, in the three kinds of word-centres: namely, general auditory, visual, and kinassthetic centres.

Views of this kind as to the partial education of the word-centres of the opposite hemisphere will be found to be of considerable importance when we come to speak of the modes in which destruction of one or other of the word-centres in the leading hemisphere may be compensated—or, in other words, of the way in which a cure may be brought about in this or that form of speech defect.

**Does Conception Take Place in a Centre Altogether Apart from Perception?**

The first authoritative writer on defects of speech who started the notion of the existence of an altogether separate centre for conception or ideation was Broca. This he did in a very important memoir, "On the Cerebral Mechanism of Speech and Thought," published in 1872.63 Whilst there are adopting some views which I had previously published on the subject of the cerebral processes that occur in perception,64 he made a departure from them in the direction above indicated. The functions that I spoke of as being carried on in the perceptive centres he divided into two stages. He said: "There is a primary or rudimentary perceptive act in which the external cause of a given set of sensations is recognised as such, and in which the simple attributes, as of form, colour, hardness, &c., are perceived. And there is a higher degree of elaboration in which, by the combination or fusion of perceptions derived from the various organs of sense, a conception or idea of an object as a whole is obtained. This is a new and distinct process, and is usually accompanied by the affixing of a name to the object. To the 'perceptive centres' I relegate simply the coarse primary perceptions, and to the 'ideational centres' the higher elaboration, the fusion of various perceptions together, and the evolution of an idea out of them, will be accomplished not by radiation from one perceptive centre to all the others, but by convergence of impressions from the several perceptive centres upon a central ideational cell area, in which a process analogous to the translation of an impression into a sensation and of a sensation into a perceptive act will take place. This central ideational cell area will form a part of the supreme perceptive centre, and will constitute the superadded convolutions which receive no radiating fibres."

In a subsequent communication some years later these views were still further developed by Broca.65 The centre for conception was then termed the "naming centre," whilst a related higher motor centre was postulated as a "propositionising centre," in which words, of the way in which a cure may be brought about in this or that form of speech defect.

With variations in detail, views similar to those of Broca as to the existence of a special centre for conception were subsequently published by Kussmaul66 and Charcot,67 whilst the views of the latter were adopted and further promulgated by Bernard68 and Bullet.69 The existence of a separate centre for ideas was also postulated by Grasset.70 The view that the senses of smell, hearing, taste, touch, sight, and compulsion which it is unnecessary to describe. A more simple and easily to be comprehended diagram was also produced by Charcot (and is to be found in the work of Grasset), which is based upon the same principles as the scheme issued by Broca, with the exception that he omits the "propositionising centre" and also adopts my view as to the existence of separate word-centres. He, however, makes the several sensory impressions converge to an "ideational centre" in order that their meaning should be realised, and indicates that the speech centre (that of Broca) and the centre for writing movements (both of them as "motor" centres) are called into activity directly from this ideational centre, as well as from the auditory and the visual centres reciprocally.

Some diagrams that have attracted much attention were also published by Lichtheim in illustration of his well-known paper on aphasia.71 They likewise show a centre for conception altogether apart from the sensory centres, and in his endeavours to explain the different kinds of speech defect he refers two of his types to a destruction of supposed afferent and efferent fibres proceeding to and from this conceptual centre. While, therefore, his diagrams and his language in many parts of his paper would make one think that he adopted in full the view as to the existence of a wholly separate centre for concepts, he says towards the end of his paper that "this has been done for simplicity's sake," and that his diagrams do not correspond in any way with the real spot of the brain, but rather to result from the combined action of the whole sensory sphere." This statement, though it is quite in accordance with my own view, seems to me to invalidate much of his exposition and to make it almost impossible for him to lend his legitimate support to, as does that, two of his types of speech defect are to be explained by the supposition of the existence of a lesion involving either the afferent or the efferent fibres pertaining to such a widely distributed centre. In addition to this gross error,40 his diagrams are at variance with his views on this important subject.72

My dissent from these particular views of Broca, whose work has been of such great influence both in France and England, though I do not contest the existence of a centre for the various forms of speech defect, has been supported by a large number of patients who have been submitted to examination at my instigation.41 I shall later state what I believe to be the interpretation of his seven types of speech defect, when it will be seen that they may be explained without any necessity for supposing the existence of lesions in any such parts.

**From this it is evident that there can in reality be only one perceptive centre, although its different parts may have been differently by myself (as well as by Broca) spoken of as "perceptive centres" because their activities were confined to a certain function, and different parts are derivative not from a perceptive act. I recognize now that it would have been better not to have used this term at all for these parts, for they are, in fact, more appropriately spoken of as sensory centres,**

64 Loc. cit., p. 477.
65 De l'Aphasie, 1885, p. 45. 66 Le Langage Intérieur, 1885.
66 De l'Aphasie, 1885, p. 46. 67 Le Langage Intérieur, 1885.
67 Le Cerveau Sensible, 1885. 68 Le Cerveau Sensible, 1885.
68 Le Cerveau Sensible, 1885. 69 Loc. cit., p. 477.
69 Le Cerveau Sensible, 1885. 70 Loc. cit., p. 477.
70 Loc. cit., p. 477.
was expressed in 1880, and again more strongly against them as well as against the allied views of Kussmaul, Charcot, and Lichtheim, in 1887. I am glad to say that this dissent from these doctrines has been followed by that of A. de Watteville, Ross, Allen Starr, and Wyllie, all of whom have likewise decided against the propriety of postulating the existence of a separate centre for ideas or concepts.

The postulation of a separate "centre for concepts" was based originally upon psychological considerations. It seemed to me wholly unnecessary and at variance with what appeared to be the real nature of the process of perception. I am again, I am unable to find any clear evidence from clinical data tending to prove the existence of a separate "centre for concepts"—or, in other words, any existing forms of speech defect that can only be explained by supposing the existence of a lesion in such a centre or in the course of its afferent or efferent fibres. I am convinced that the supposed necessity for assuming the existence of a "centre for concepts," when seeking to interpret different forms of speech defect, may in many cases be obviated by a fuller recognition of the different degrees of functional excitability that may obtain in the auditory and the visual word-centres respectively. We shall see that their molecular mobility may be so much lowered that they are only capable of responding to powerful stimuli. I am not without a hope that the matter may be approached in a manner less methodical, viz., to call or recollection may be impossible within their province, they may still be capable of acting in association with other centres—as when reading may be fluent though voluntary speech is greatly impaired; and still more easily under a direct sensory stimulus—as when a word is repeated which a direct sensory stimulus to which I have previously referred, I have been referred to as the association areas. These regions seem, therefore, to correspond with what I have referred to above as "associations of the perceptive centres."

Still, as it would be quite easy to show, perceptive processes vary greatly in complexity and emerge from insensible gradations into processes of conception. It seems therefore legitimate, therefore, to suppose that these latter regions are more specialised modes of mental activity, whilst having their roots in perceptive processes, must be completed in our growths therefrom—that is, in parts of the brain which are in close relation structurally and functionally with the several sensory centres. I have commonly spoken of such regions as "associations of the perceptive centres.

Of late Flechsig has called special attention to four areas of the cortex that differ from the sensory areas, since they are neither in relation with afferent nor with efferent fibres. He assumes that these regions subserve higher mental functions than those of the sensory centres, and tentatively he calls them "association areas." These regions seem, therefore, to correspond with what I have referred to above as "associations of the perceptive centres." They occupy a large proportion of the cerebral cortex, and are thus situated in the frontal, the parietal, and the occipital regions. They are probably almost inseparable in their localisation, and their anatomical substantia must be supposed to occupy a very considerable extent of the cortex of both hemispheres. A final question now remains for consideration related to these other which we have already been considering. It is this: When we look for the word-centres in the cerebral cortex? It may be said that this question has already been answered. And so it has tentatively and in a general sense. We have laid stress upon the existence of four different kinds of memorial registration of words and the probable sites of such word-centres in the hemisphere. I have indicated also that the gloseo- and the cheiro-kinesis centres constitute definite parts of the general kinesthetic centres, and that the auditory and the visual word-centres are special annexes of the sensory centres, to which I have previously referred. It may be said that these annexes and the several word-centres must be in most intimate relation both with the sensory centres and with their annexes.

In the views above expressed, it would be equally valid, but much better, to base our explanation of any of the different kinds of speech defect upon the supposed existence of some one separate centre for "idea," "conception," "conceptualisation," "name," "word," "words and the probable sites of such word-centres in the hemisphere. I have indicated also that the gloseo- and the cheiro-kinesis centres constitute definite parts of the general kinesthetic centres, and that the auditory and the visual word-centres are special annexes of the sensory centres, to which I have previously referred. It may be said that these annexes and the several word-centres must be in most intimate relation both with the sensory centres and with their annexes.

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Flechsig points out, in the first place, that these regions remain immature and completely devoid of myeline for several months after birth, though the sensorial centres have arrived at a certain degree of activity more or less simultaneously. Thus the processes of perception and conception, together with revival of linguistic symbols, are probably almost as inseparable in their localisation as they are in their nature and modes of occurrence, and their probable sites in the cerebral cortex.
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[April 3, 1897]

Late Dr. James Ross. Thus, in his work "On Aphasia," he gave expression to the following views (page 125): "And in passing from thinking by percepts to thinking by concepts, and from that to thinking by abstracts, there are no new centres introduced, but only a complication upon complication of the one perceptive centre. All that can be said is that the correlative of perceptive thinking is excitation of portion of the cortex which is directly connected with the sensory inlets; of conceptive thinking, excitation of portions which are remotely connected with them. It must, however, be remembered that the lesion is situated in or near to the sensory inlets; and even the intermediate portions of the cortex in which conceptive thought is carried on might be seriously damaged without giving rise to a special speech disorder, inasmuch as the impairment of speech which might be present would only be regarded as a part of a general decay of the reasoning faculties. When, however, the lesion is situated in or near to the sensory inlets a disorder of language results which is out of all proportion to the general impairment of the reasoning faculties." All that has been set forth above is thoroughly in harmony with the dictum of Max Müller, who says: "Though sensations, perceptions, and concepts may be distinguished, they are within our mind one and indivisible. We can never know sensations except as percepts, we can never know of percepts except as insipient concepts."

The Goulstonian Lectures

ON THE CHEMISTRY AND PATHOLOGY OF GOUT.

Delivered before the Royal College of Physicians of London,

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LECTURE I.*

Delivered on March 25th.

THE SOURCES AND FORMATION OF URIC ACID IN PATHOLOGICAL CONDITIONS OTHER THAN GOUT IN WHICH IT APPEARS IN THE BLOOD.

Mr. President and Gentlemen,—Although I hold the opinion that in health uric acid is only formed in the kidneys, and that the uric acid found in the blood is absorbed from the kidneys after formation in those organs, yet it must be borne in mind that there are other diseases besides gout in which uric acid appears in the blood, and in connection with which it has most probably not been absorbed from the kidneys, but has been formed elsewhere in the system. I will therefore briefly consider what these pathological conditions are and what are the probable sources of the uric acid in such conditions. The investigations of von Jaksch, Klemperer, and others have conclusively established that the presence of uric acid in the blood is not a pathognomonic sign of gout, and that uric acid may appear in quantities in the blood and be eliminated without causing gout. Blood disorders accompanied by the presence of uric acid in the blood.—Von Jaksch found uric acid in the blood in cases of both primary and secondary anemia, pernicious anemia, and splenic tumour. He also found it in the blood in conditions inducing dyspnoea—notably in heart disease, pleurisy with effusion, pulmonary catastrophe, pneumonia, and emphysema. Klemperer has recently confirmed the results of von Jaksch and others as to the presence of uric acid in the blood in leucorrhoea, and many observations have been made of the increased excretion of uric acid that accompanies this disease. Lauche found a daily excretion of 36 grammes (nearly six times the average normal amount) in a patient suffering from leucorrhoea. Let us now attend to Remotely connected with them. It must, however, be remembered that the effect is working on the portions of the cortex which are remotely connected with the sensory inlets will in a great measure depend upon the integrity of those that are in direct relation with them. ... On this, in a direct relation with them. Let us now attend to the effects of dissolution of this structure. A destructive lesion of the portions of the cortex which are most remotely connected with the sensory inlets would destroy the capacity of the patient for highly abstract reasoning, and would no doubt inflict considerable damage on the language in which abstract thought is embodied, but this condition would not be recognised as an aphasia; and even the intermediate portions of the cortex in which conceptive thought is carried on might be seriously damaged without giving rise to a special speech disorder, inasmuch as the impairment of speech which might be present would only be regarded as a part of a general decay of the reasoning faculties. When, however, the lesion is situated in or near to the sensory inlets a disorder of language results which is out of all proportion to the general impairment of the reasoning faculties. All that has been set forth above is thoroughly in harmony with the dictum of Max Müller, who says: "Though sensations, perceptions, and concepts may be distinguished, they are within our mind one and indivisible. We can never know sensations except as percepts, we can never know of percepts except as insipient concepts."

1. Lecture I. was published in The Lancet of March 21st, 1897.
2. Deutsche Medicinische Wochenchrift, 1890, xxxvii., p. 741.
3. Ibid., 1895, xxvi., p. 655.
8. Über die Klinische Bedeutung von Harmsäure und Xanthinbasen in der Blut, 1890.
10. Loc. cit.