

THE LUMLEIAN LECTURES  
ON  
SOME PROBLEMS IN CONNECTION WITH APHASIA  
AND OTHER SPEECH DEFECTS.

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[ABSTRACT.]  
LECTURE I.

MR. PRESIDENT AND GENTLEMEN,—The modern interest in, and development of knowledge concerning, aphasia and other speech defects dates from the publication of certain memoirs by Broca, some six and thirty years since, when he attempted to localise what he termed the "faculty of articulate language" in a limited convoluted region of the left cerebral hemisphere.

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 deal here 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 defects is deafness, which of itself entails mutism, the individuals thus afflicted being known as "deaf mutes." It must be borne in mind, however, that this mutism or dumbness may also be brought about by absolute deafness occurring from any cause after birth, but before the child has begun to talk, or even after it has learned to talk, up to the fifth or the seventh year. In addition to this class of cases there are also those of congenital idiocy without deafness, in which the child never learns to talk. There are also other cases, allied to the last, in which, owing to some intracranial lesion occurring either before, during, or soon after birth, the brain becomes so damaged as to arrest the development of the child's mental as well as of its motor powers. In other cases the occurrence of epileptic fits seems to be the retarding cause.

One of the most remarkable cases known to me of deferred speech in connection with the occurrence of epileptic attacks happened in one of my own patients. In the year 1877 I was consulted concerning the health of a boy, the son of a leading barrister, who was then 12 years old, and had been subject to epileptic fits at intervals. The first of these fits occurred in infancy, when the patient was about 9 months old. Towards the end of the second year the fits seemed to have ceased, the hearing was (as it had been) good, and the child appeared to be of average intelligence—to be well, in fact, in all respects except that he did not talk. When nearly 5 years old the little fellow still had not spoken a single word, and about this time two eminent physicians were consulted in regard to his "dumbness." But before the expiration of another twelve months, as both his mother and father assured me, on the occasion of an accident happening to one of his favourite toys, he suddenly exclaimed, "What a pity," though he had never previously spoken a single word. The same words could not be repeated, nor were others spoken, notwithstanding all entreaties, for a period of two weeks. Thereafter the boy progressed rapidly, and speedily became most talkative. When seen by me he spoke in an ordinary manner without the least sign of impediment or defect.

Such a sudden beginning to speak for the first time without previous prolonged trials and failures is a matter vastly transcending in importance the sudden resumption of speech when it has been for a time suspended in consequence of brain disease. No explanation of such a fact seems 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 in the main due to the circumstance that their nervous systems are still too immature.

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 said to be always 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.

Sir William Hamilton's definition of memory implies the notion of an organic change taking place in definite nerve elements on the occurrence of each sensory or intellectual process, that is, the notion of a permanent nervous 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 something like the original molecular activity in the nervous elements concerned with the primary perceptual or intellectual process of this or that kind. It is not essential that the memorial revival of the sensory impression or of the intellectual process should, after multitudinous repetitions, be associated with any distinct conscious phasis. What Hamilton termed the *retentum* may, indeed, be revived as a mere unconscious nerve 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 consideration is especially worthy of note from the point of view of the importance of revived kinæsthetic 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 recall of words in the auditory centre which immediately precedes speech.

Clinically, however, amnesia includes both these conditions, and ought, from an anatomical or localising point of view, to be divided into two generic groups: (a) Cases in which there is centric defect (either structural or of marked functional type), with which there will often be loss of memory of words as well as loss of recollection; and (b) cases in which there is merely commissural defect (mostly structural), with which there may be loss of recollection of words, but no necessary loss of word memory. It will be one of my objects in the present lectures to dwell upon the fact (which I pointed out some ten years ago) that it is often in the case of speech defects extremely difficult, if not impossible, from clinical evidence alone to decide whether the underlying lesion or default leading to a particular kind of amnesia be centric or commissural in seat. And yet from the point of view of the localisation of the lesion such a decision may be a matter of much importance, seeing that if the lesion were centric we should look for it in one part of the brain, while if it were commissural it might be found in a region comparatively remote therefrom.

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 sound of words—that is, of the auditory impressions representative of different words: 2. Visual memory: the memory of the visual appearances (printed or written) of words—that is, of the visual impressions corresponding with different words. 3. Kinæsthetic memory: (a) The memory of the different 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 kinæsthetic impressions corresponding with the articulation of different words, which for the sake of brevity I have proposed to speak of as "glosso-kinæsthetic" impressions; and (b) 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 kinæ-

esthetic impressions corresponding with the writing of different letters and words, which I have for similar reasons proposed to speak of as "cheiro-kinæsthetic" impressions.<sup>3</sup> The organic seat of each of these different kinds of word memory is in relation with its own set of afferent fibres; and the several centres must also be closely connected with one another by commissural or associational fibres, so that the memory of a word or the recollection of a word in one or other of these modes doubtless involves some amount of simultaneously-revived activity in one or two of the other word centres. In the majority of persons, as I pointed out in 1869, the revival of words in the auditory centre is the most potent process, and that which occurs first in order of time, but this is subject to individual variations. This seems to be now very generally admitted.

#### THE LOCALISATION OF THE DIFFERENT WORD CENTRES.

Although I am not a believer in the complete topographical distinctness of the several sensory centres in the cerebral hemisphere, 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 but functionally unified nervous networks may differ altogether from the common conception of a neatly-defined "centre," and yet for the sake of brevity it is convenient to retain this word and refer to such networks as so many "centres." Looking to the extremely important part that words, either spoken or written, play in our intellectual life, and to the manner in which they are interwoven with all our thought processes, it becomes highly probable that most important sections of the auditory and the visual sensory centres must be devoted to the reception, and consequently to the revival in thought, of impressions of words; these may be called auditory and visual "word centres" respectively. Similarly, there must be what I have termed kinæsthetic 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 our thought by speech and writing.

The visual centre as a whole is more or less diffused through the occipital lobe, the region whose destruction gives rise to word blindness corresponds with the angular gyrus. Clinico-pathological evidence seems to locate the auditory word centres in the posterior half or two-thirds of the upper temporal convolution.

The situation of one of the two kinæsthetic 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 kinæsthetic type by means of which movements are guided,<sup>3</sup> 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 convolution, is in reality the part of the brain to which I have been alluding as the "glosso-kinæsthetic" centre. The situation of the "cheiro-kinæsthetic" 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.

For the purpose of our discussion, then, it may for the present be assumed that the two kinæsthetic word centres are situated as above stated; that the auditory word centre is situated in the posterior half or two-thirds of the upper temporal convolution; and the visual word centre in the angular and part of the supra-marginal convolutions. It must also be assumed, upon grounds subsequently to be set forth, that the last-named word centres are connected together by a double set of commissural fibres. We must likewise suppose that two other important sets of commissural fibres exist between the different word centres—namely, one set through which the auditory word centre acts upon the glosso-kinæsthetic centre for the production of speech movements, and another by means of which the visual word centre acts upon the cheiro-kinæsthetic centre for the production of writing movements. In the study of speech defects it is, therefore, necessary to consider the effects of lesions in the following

situations: (a) In the different kinds of word centres; (b) in the different commissures by means of which these centres are connected with one another; (c) in the internuncial fibres

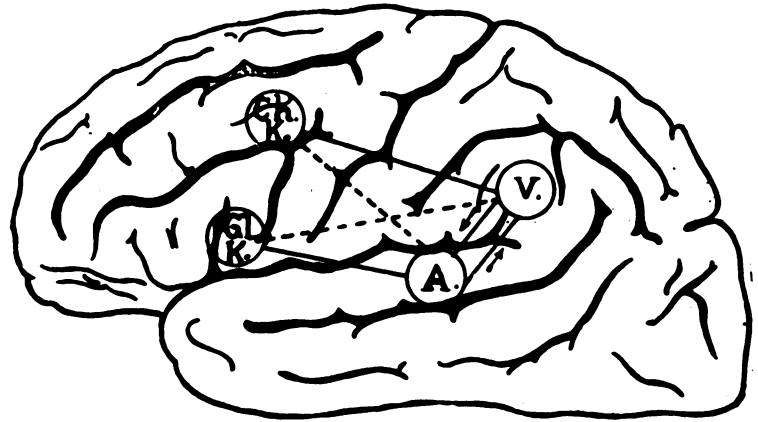


Fig. 1.—Diagram showing the approximate sites of the four word centres with their commissures.

connecting the two kinæsthetic word centres with their related motor centres, in the bulb and in the cervical region of the spinal cord; and (d) in these motor centres themselves which are concerned with the actual production of speech and writing. But before dealing with any of these 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 sounds of words as we hear them in ordinary speech; 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 distinct and easily recoverable, while the latter is vague and difficult of conscious realisation. It is, however, a matter of extreme importance for the due understanding of the different kinds of speech defect 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, holding that motor centres, wherever they may be situated, are parts whose activity appears to be wholly free from subjective concomitants. No "ideal" reproductions seem ever to take place in such centres; they are roused into activity by outgoing currents, and, so far as we have any evidence, the induction in them of molecular movements which immediately afterwards issue through cranial and spinal motor nerves to muscles are, like those which they engender, simply physical phenomena.<sup>4</sup> It is true that the altered condition of the muscles and of contiguous parts induced by these outgoing stimuli together engender a body of ingoing impressions, the terminus for which is the kinæsthetic 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 move-

ments in general are represented in the cerebral cortex only by sensory centres, there are still, I think, good reasons for rejecting the notion that the "material of our recollection" in the use of words during silent thought is primarily revived as glosso-kinæsthetic impressions in Broca's centre. 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 simple trains of thought, before he has acquired the power of articulating them for himself, they must be revived as 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 of our recollection" of words in ordinary thought processes. Thirdly, there is reason to believe that revived auditory feelings continue after the acquirement 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. If this were not so, it would be impossible to understand why 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 dumbness unless the child be drilled in lip reading, that is, unless the primary incitation 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 none that I am aware of telling unmistakably in its favour.

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, in so doing, Stricker and Ballet<sup>5</sup> rely too much upon what is in reality an untrustworthy method—that of introspection—which inevitably brings the expressive side of speech into undue prominence.

The real linguistic counters for thought are then, in my opinion, auditory and visual memories of words. And, in regard to these two, I believe that in the very large majority of persons it is the auditory word memory which is first revived in silent thought. This view is now very generally adopted, as may be seen by reference to the works of Ross<sup>6</sup> and Bernard.<sup>7</sup> It appears also to be the view of Herbert Spencer.<sup>8</sup> Although, however, the first stage in the revival of words seems to occur in the auditory centre, the molecular disturbance thus initiated is immediately transmitted to a varying extent in two directions. It is transmitted to the visual word centre on the one side and to the glosso-kinæsthetic centre on the other—to the latter strongly where the thought is to issue in speech, and to the former strongly where it is to issue in writing.

There can be no doubt that in some persons the visual centres as a whole are more highly developed and organised than the auditory centres, and *vice versa*. The existence of such differences has been thoroughly shown by Francis Galton,<sup>9</sup> who says: "There are a few persons in whom the visualising faculty is so low that they can mentally see neither numerals nor 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 "visuals" or "auditives" respectively; and we may thus indicate for this or that person which is the more potent sensory endowment.<sup>10</sup>

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 him the first to be revived in silent thought. If it were so 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 being most striking between destruction of the visual and destruction of the auditory word centres respectively. It seems that in either case the primary revival of words occurs in the auditory centre, but that in a "visual" the visual centre has acquired some power of compensating defects in the auditory word-centre which is absent in "auditive."

It will be found that very many 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) into four categories—"auditives," "visuals," "motors," and "indifferents"—a doctrine which has been fully set forth by Ballet. I contend that this doctrine must not be taken to mean anything more than that the different kinds of word memory referred to in the first three types may be met with in different degrees of excellence, and that in the fourth type there is no one kind of memory which is developed to a preponderating extent. In the latter class there would be no ground for supposing that the ordinary rule as to the primary revival of words taking place in the auditory centre is ever altered. As to the existence of persons representative of the third class I have already expressed my doubts—that is to say, I can find no good reasons or evidence to show that words ever arise in silent thought primarily in the kinæsthetic centres. I doubt whether these memories are capable of separate voluntary recall, and do not believe there is any evidence to show, as Bernard says,<sup>11</sup> that "the motor centre for speech may become independent of the sensorial centre which had presided over its education."

The case is altogether different in regard to individuals of the second class—the "visuals"—because not only does the power of memorial recall in the visual centre vary immensely in different persons, as we have seen, but there is also good reason to believe that in a small minority of persons the primary revival of words during a process of silent thought may take place therein, just as it does in the act of reading. 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 this about, by means of a primary revival of visual images, which act directly upon the glosso-kinæsthetic centre, and thence upon the motor centres in the bulb.<sup>12</sup> Undoubtedly, too, it would seem that there are certain exceptional persons, who, as it were, read rather than hear their thoughts; in whom, as Ballet says, the visual images of words acquire such an importance that they alone constitute the medium of their internal speech. Still, in spite of these exceptions, the general rule is that auditory images constitute 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 refer, as I have said, to the seat of the primary revival of words in memory, because there is 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.<sup>13</sup>

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 called into play in definite couples, namely, the auditory and the glosso-kinæsthetic revivals taking place during articulate speech, and the visual and cheiro-kinæsthetic revivals taking place during ordinary writing. By this I mean that in expressing oneself in spoken words memories of such words are first principally revived in the auditory centre, and that the nerve units thus called into activity immediately rouse through commissural fibres (see Fig. 2, c) the corresponding glosso-kinæsthetic elements before the pronunciation of the word can be effected through the aid of the motor centres in the bulb. Probably in a healthy brain there is some amount of concurrent activity during speech in related portions of the visual word centre. Again, when expressing our thoughts by writing, though the memories of the words are probably first revived in the auditory word centre, corresponding memories are almost simultaneously revived (through the intervention of the audito-visual commissure *b*) in related parts of the visual word centre, and from this region stimuli pass by another commissure (*d*) to corresponding cheiro-kinæsthetic elements before the actual writing of the words

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 existing between the auditory and the glosso-kinæsthetic centres, as well as that between the visual and the cheiro-kinæsthetic centre, 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 centres are often necessarily called into associated activity in immediately successive units of time. This happens, for instance, in two such common processes as reading aloud and writing from dictation.

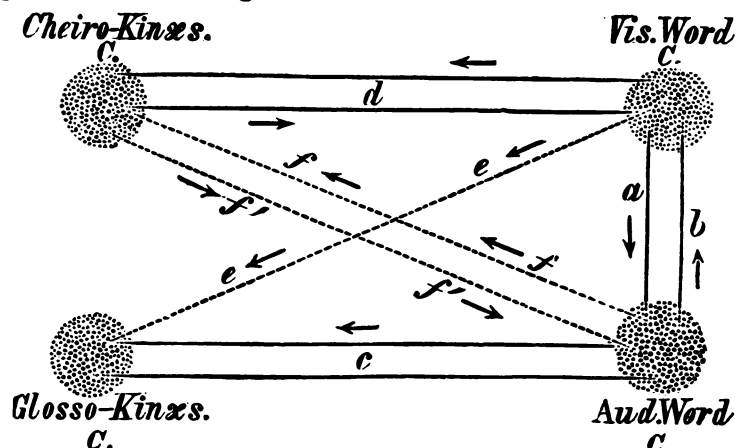


Fig. 2.—A diagram illustrating the relative positions of the different word centres and the mode in which they are connected by commissures. The connections indicated by dotted lines indicate possible but less habitual routes for the passage of stimuli.

In-reading aloud the primarily excited visual word centre must arouse, through (a) the visuo-auditory commissure, related parts of the auditory word centre, since this is the part which ordinarily calls the glosso-kinæsthetic centre into activity, whence properly co-ordinated incitations issue from the cortex, in order to call into play the motor centres in the bulb. Again, in writing from dictation the sounds of the words reach the auditory word centre, and the activity thus aroused becomes transmitted through (b) the audito-visual commissure to related parts of the visual word centre, this being the part that usually rouses the cheiro-kinæsthetic centre into activity, whence properly co-ordinated incitations issue from the cortex in order to call into play the motor centres in the cord concerned with the act of writing. In certain exceptional cases it seems that the ordinary functional coupling of the auditory with the glosso-kinæsthetic and of the visual with the cheiro-kinæsthetic word centres is not adhered to. Thus the deaf-mute thinks in the main with revived visual symbols (either of hand or of lip movements), and it is from the organic seats of these that incitations pass to related parts of the glosso-kinæsthetic centres (e, e). A similar stimulation of these centres direct from the visual word centre seems occasionally to obtain 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 resort to such a supposition. Again, in those who have been born blind, but have nevertheless learned to write, a direct association must become established between the auditory and the cheiro-kinæsthetic word centres (f, f). 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 either spontaneously or from dictation.

This functional unification of the word centres of which I have been speaking does not, however, remain in a state of isolation. As the functions of hearing, speaking, and writing develop the various impressions reinforce each other as well as that of sight.

#### 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—sensory, associational, and voluntary—failures in any of which lead to various kind of speech defects.

As to the causes which have determined the greater or almost exclusive influence of the left hemisphere in inciting speech movements only conjectures can be offered. It is, however, now pretty generally agreed that the immediate or proximate cause is to be found in the fact of the predominant use of the right hand, and this is shown by the great majority of cases of aphasia from lesions affecting the right hemisphere occurring in left-handed people.<sup>14</sup>

This problem has been considered by Pye-Smith,<sup>15</sup> and also in a more exhaustive manner by William Ogle,<sup>16</sup> but can only be briefly alluded to here. It has been thought to depend largely upon tribal or social customs and early tuition of young children by their mothers, though doubt has been thrown upon these views as giving any adequate explanation of the problem. William Ogle looks rather to certain peculiarities in the mode of origin of the left and right carotids respectively as calculated to favour a slightly freer blood supply to the left cerebral hemisphere. 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 left than of the right hemisphere.

Many years ago I ascertained a fact which at the time seemed very difficult to understand—namely, that the specific gravity of the cortical grey matter of the brain in the left frontal, parietal, and occipital regions is often distinctly, though slightly, higher than that from corresponding regions of the right hemisphere. Full details as to this will be found in a paper On the Specific Gravity of the Human Brain, published in 1866.<sup>17</sup> Now such an increase in specific gravity might easily be produced by the greater number of cells and associational fibres which the extra sensory and derivative functions above referred to would necessarily entail.

A greater convolitional complexity of the lower part of the left frontal lobe, as compared with the right, has been found to exist, and is thought to be a result of the preponderant activity of the left hemisphere in the production of articulate speech. Some evidence in favour of this view is to be found in the fact that Broadbent, in his examination of two brains taken from left-handed persons that were submitted to him by William Ogle, found in them the reverse condition—that is, that the greater convolitional complexity was in the right rather than in the left anterior lobe.<sup>18</sup>

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 seem that such centres would be likely to receive their stimuli from both hemispheres. In partial reply to this question Moxon, in a very able paper, long ago suggested<sup>19</sup> that the call upon attention was so great for the production of the extremely elaborate movements concerned in speech 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, nothing better has hitherto been forthcoming.<sup>20</sup>

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 symmetrically placed muscles on the two sides of the body; there is just as much reason, therefore, for the registration of kinæsthetic 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 pass from each ear to similar regions 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. For each of these three sets of afferent 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.

Again, it may be taken as established, for reasons which will subsequently appear, that the separate centres composing each of these pairs are brought into functional union by means of

commissural fibres forming part of the corpus callosum. So far, therefore, we seem bound to admit that each hemisphere has the chance of being equally educated, so far as the mere reception of speech impressions is concerned. It is, however, when we come to the executive side of speech functions that the difference begins to appear between the relative activity of the two sides of the brain. For reasons which we have previously been dimly endeavouring to indicate, the executive speech functions become relegated to one hemisphere, and this leading hemisphere—generally the left—becomes for this and for the other reasons which we have adduced more highly organised. The fact that the volitional impulses for the incitation of speech pass off from this hemisphere leads of necessity to the gradual perfecting of the associational channels between the auditory and the glosso-kinæsthetic centres, as well as between the auditory and the visual word centres of the left hemisphere, and also to the perfecting of the outgoing channels of communication between these sensory centres and the true motor centres in the bulb. The corresponding associational and outgoing channels in the opposite hemisphere, however, being but little used, may remain comparatively undeveloped. This difference in the degree of activity of the two hemispheres 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 pertaining to the leading hemisphere.

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 Broadbent. This he did in very important memoir, *On the Cerebral Mechanism of Speech and Thought*, published in 1872.<sup>21</sup> Whilst there adopting some views which I had previously published on the subject of the cerebral processes that occur in perception,<sup>22</sup> 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—perceptive and conceptive, dependent upon different centres. In a subsequent communication these views were still further developed by Broadbent.<sup>23</sup> The centre for concepts was then termed the “naming centre,” whilst a related higher motor centre was postulated as a “propositionising centre,” in which words other than nouns were supposed to be registered, and where sentences were formulated preparatory to their utterance through the instrumentality of Broca’s centre.

This supposed convergence of impressions from the various perceptive centres into a new region in which “conception” and “naming” take place is a view totally different from my own, which I put forward nearly thirty years ago.<sup>24</sup> The work which Broadbent supposes to be done in his “naming” or “concept centre” is, according to my view, carried out by the simultaneous activity of the different perceptive centres, and certain annexes which are derivative developments therefrom, of which I shall subsequently speak. And, again, I have postulated, instead of a single separate “naming centre,” the existence of four “word centres” as important and intimately correlated parts of the more general auditory, visual, and kinæsthetic centres. Consequently I never seek to explain certain cases of speech defect, as he and others whom I am about to mention not infrequently do, by supposing the existence of lesions in a localised centre for “concepts,” or of lesions involving the commissural fibres proceeding to or issuing from such a centre.

With variations in detail, views similar to those of Broadbent as to the existence of a special centre for concepts were subsequently published by Kussmaul<sup>25</sup> and Charcot,<sup>26</sup> whilst the views of the latter were adopted and further promulgated

by Bernard<sup>27</sup> and Ballet.<sup>28</sup> The existence of a separate centre for concepts is also postulated by Grasset.<sup>29</sup> Diagrams that have attracted much attention were also published by Lichtheim in illustration of his well-known paper on aphasia.<sup>30</sup> They likewise show a centre for concepts 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<sup>31</sup>: “this has been done for simplicity’s sake,” and that he does not “consider the function to be localised in one 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 legitimately to suppose, as he 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 diffused centre. In addition, there is the serious defect that his diagrams are at variance with his views on this important subject.<sup>32</sup>

My dissent from these particular views of Broadbent was expressed in 1880,<sup>33</sup> and again more strongly against them as well as against the allied views of Kussmaul, Charcot, and Lichtheim, in 1887.<sup>34</sup> I am glad to say that this dissent from these doctrines has been followed by that of A. de Watteville,<sup>35</sup> Ross,<sup>36</sup> Allen Starr,<sup>37</sup> and Wyllie,<sup>38</sup> all of whom have likewise decided against the propriety of postulating the existence of a separate centre for ideas or concepts. My opposition to this 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.

Then, 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.<sup>39</sup>

Again, as it would be quite easy to show, perceptive processes vary greatly in complexity, and merge by insensible gradations into processes of conception. It seems thoroughly legitimate, therefore, to suppose that these latter more specialised modes of mental activity, whilst having their roots in perceptive centres, must be completed in out-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 “annexes” of the perceptive centres. Of late Flechsig has called special attention to four areas of the cortex that differ from the sensory areas, inasmuch as they are neither in relation with afferent nor with efferent fibres. He assumes<sup>40</sup> that these regions subserve higher mental functions than those carried on in the sensory or perceptive areas, and terms such regions “association areas.” These regions seem, therefore, to correspond with what I have referred to above as “annexes of the perceptive centres.” They occupy a large proportion of the cerebral cortex, and are thus located by Flechsig: (1) in parts of the prefrontal lobes; (2) a large portion of the temporal lobes; (3) a considerable area in the posterior parietal region; and (4) the island of Reil. These four fairly well-defined areas are, as above stated, not directly connected with afferent or with efferent fibres; and in addition to this, two other reasons are given for supposing them to be concerned with the carrying on of higher functions. 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 comparative maturity; and, secondly, that these association

centres are the parts which are especially developed in the brain of man as compared with that of the lower animals.<sup>11</sup>

It is only fair to Broadbent to point out that more than twenty years previously he had cited almost exactly these regions of the cerebral cortex as parts that were neither in direct relation with peduncular fibres nor with those of the corpus callosum, and that he had attributed to these regions just the same functions as those now assigned to them by Flechsig.<sup>12</sup>

It is, I think, perfectly legitimate to suppose that the annexes to which I have previously referred tend to be developed in the directions above indicated by Broadbent and Flechsig, though how much of these territories they occupy must remain altogether uncertain. It seems also probable there is no sharp line of demarcation between these annexes and the several sensory areas, and that the combined sensory areas together with the annexes are accustomed to be thrown into functional 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 anatomical substrata must be supposed to occupy a very considerable extent of the cortex of both hemispheres.

A final question now remains for consideration related to this other which we have just been considering. It is this: Where are we to look for the registration and revival of words in the cerebral cortex? Something additional may now be said concerning the sites of the word centres which could not well have been said at an earlier period, and that is, that each of them is probably to be found partly on the confines of its percept centre and partly on that of its related annexe. This supposition is made because some words (especially names of things, persons, and places) are in closest relation with sensory centres; whilst others, such as verbs, adjectives, prepositions, and other parts of speech constituting the framework of language, are in closer relation with conceptual processes. These two modes of functional activity are, as I have said, absolutely inseparable from one another, and therefore the several word centres must be in most intimate relation both with the sensory centres and with their annexes.

If the views above expressed be anything like an approximation to the truth, it may be judged how vain it would be to attempt to base our explanation of any of the different kinds of speech defect upon the supposed existence of some one separate centre for "ideation," "conception," or "naming" which is connected by means of commissures (long enough and separate enough to permit of isolated damage) with sensory centres on the one side and with motor centres on the other. I am pleased to find that the views at which I have arrived on this important subject—while they differ so much from those held by some of the most authoritative writers on speech defects, are nevertheless in very close accord with those formed by one very distinguished writer and thinker on these subjects—namely, the late Dr. James Ross. All that has been set forth above is thoroughly in harmony with the dictum of Max Müller, who says: "Though sensations, percepts, 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 incipient concepts."

## REFERENCES.

<sup>1</sup>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 Muscular Sense (*BRITISH MEDICAL JOURNAL*, April, 1869); and the name "kinæsthetic" was subsequently (*The Brain as an Organ of Mind*, 1880, p. 543) applied to the complex groups of impressions resulting from movements of this or that part of the body. <sup>2</sup>Other French writers as well as Ballet attribute to Charcot the doctrine that "le mot n'est pas une unité, mais une complexus" (*Le Langage Intérieur*, 1886, p. 13) because he also dwelt upon these 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 different kinds of word memory in my book *The Brain as an Organ of Mind*, 1880, p. 696, or in the French translation (*Le Cerveau et la Pensée*, tome ii, p. 222), published in 1882. <sup>3</sup>*Brain*, April, 1887, and April, 1892. <sup>4</sup>*The Brain as an Organ of Mind*, 1880, p. 599. <sup>5</sup>*Le Langage Intérieur*, 1886, p. 55. <sup>6</sup>*On Aphasia*, 1887, p. 114. <sup>7</sup>*De l'Aphasie*, 1885, p. 49. <sup>8</sup>*Principles of Psychology*, vol. i, 1870, p. 187. <sup>9</sup>*Inquiries into Human Faculty*, 1883, p. 83. <sup>10</sup>On this subject many interesting details have been given by Ballet, *loc. cit.*, pp. 17-45. <sup>11</sup>*Loc. cit.*, p. 48. <sup>12</sup>In the case of a deaf and dumb child taught to speak and understand others by means of hand and finger movements their thought

would be combined visual and kinæsthetic impressions, or in the case of one who had been taught to read much from early life they might be "visual typographic images." On the other hand, in the case of a congenitally blind person who has been taught to read aloud by means of raised letters and words excitation of the centres for touch and kinæsthesia would constitute the initial processes in the act of reading aloud, although revived auditory impressions might constitute, as in ordinary persons, their habitual thought counters. A patient of the former class, whose history has been reported by E. Fournier (*Essai de Psychologie*, Part II, chap. v), says: "Je sens quand je pense que mes doigts agissent, bien qu'ils soient immobiles. Je vois intérieurement l'image que produit le mouvement de mes doigts." <sup>13</sup>*The Brain as an Organ of Mind*, p. 176. <sup>14</sup>According to Seguin, out of 266 cases of aphasia, he found 243 with right and 17 with left hemiplegia; that is, somewhere about 6 per cent. W. Ogle, on the other hand, from inquiries among 2,000 hospital patients, found that 85 of them were left-handed; that is, about 4 per cent. Left-handedness, curiously enough, was found to be "twice as common in men as in women." He shows, too, how very frequently there is hereditary transmission of this peculiarity. <sup>15</sup>*Guy's Hospital Reports*, xvi, 1871. <sup>16</sup>*Med. Chir. Trans.*, 1871. <sup>17</sup>*Journal of Mental Science*, pp. 28, 32. <sup>18</sup>*Med. Chir. Trans.*, 1871, p. 294. <sup>19</sup>*British and Foreign Medico-Chirurgical Review*, 1886, p. 481. <sup>20</sup>Moxon's paper is, indeed, in other respects remarkable, looking to the date at which it was written. Thus, he speaks of spoken words as 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 these supramotory departments, if I may so call them, of the brain, which hold ready for use the memorial forms of outgoing words," or still better where he says, "the situation of the ideas of associated motions which forms the faculty of speech is supramotory, whilst the situation of the ideas of associated sensations, which form the faculty of language comprehension, is suprasensory." <sup>21</sup>*Med.-Chir. Trans.*, 1872, pp. 180, 181, and 191. <sup>22</sup>On the Muscular Sense and the Physiology of Thinking, *BRITISH MEDICAL JOURNAL*, May, 1869. <sup>23</sup>*Brain*, i, 1878. <sup>24</sup>*BRITISH MEDICAL JOURNAL*, May, 1869. <sup>25</sup>*Ziemssen's Cyclopaedia*, vol. xiv, p. 779. <sup>26</sup>*Le Progrès Médical*, 1883. <sup>27</sup>*De l'Aphasie*, 1885, p. 45. <sup>28</sup>*Le Langage Intérieur*, 1886. <sup>29</sup>*Leçons de Clinique Médicale*, 1896 (Montpellier). <sup>30</sup>*Brain*, 1885. The reader will find several of the diagrams previously referred to in an article on the Sensory Side of Aphasia, by E. A. Shaw, in *Brain*, 1893, p. 492. <sup>31</sup>*Loc. cit.*, p. 477. <sup>32</sup>I shall later on 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. <sup>33</sup>*The Brain as an Organ of Mind*, p. 636. <sup>34</sup>*BRITISH MEDICAL JOURNAL*, November, 1887. <sup>35</sup>*Le Progrès Médical*, March 21st, 1885. <sup>36</sup>*On Aphasia*, 1887, p. 123. <sup>37</sup>*Brain*, 1889, p. 97, where Starr says: "The results of pathological observation fail to give any support to the hypothesis of an 'ideational centre,' which Broadbent and Kussmaul have introduced into the diagrams." <sup>38</sup>*The Disorders of Speech*, 1894, pp. 230 and 235. Wyllie, however, I think, tends to convey an erroneous impression by representing in a diagram on p. 276 of his work the seats of word revival in a lower plane and of percept revival in a higher plane, and assuming that the stimulation of Broca's centre takes place from the seat of percept revival rather than from the auditory word centre. This seems to be also the position of Lichtheim, judging from his Fig. 7, and what he says in reference thereto, *loc. cit.*, p. 477. <sup>39</sup>Examples will be given later, when speaking of the defects due to disabilities in the auditory word centre. <sup>40</sup>*Neurol. Cent.*, 1894, pp. 674 and 809; and *Gehirn und Seele*, Leipzig, 1895. <sup>41</sup>Since the above was written I have received from Déjerine the reprint of a communication made by him to the Société de Biologie, on February 21st, 1897, in which he contests these views of Flechsig. <sup>42</sup>*Med.-Chir. Trans.*, 1872, p. 178.

## THE GOULSTONIAN LECTURES

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## CHEMISTRY AND PATHOLOGY OF GOUT.

*Delivered before the Royal College of Physicians, March, 1897.*

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[ABSTRACT.]

LECTURE II.

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

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 in gout 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.

*Blood Disorders accompanied by the Presence of Uric Acid in the Blood.*—Von Jaksch<sup>1</sup> found uric acid in the blood of cases of primary and secondary anæmia, of pernicious anæmia and of splenic tumour, also in conditions inducing dyspnoea such as heart disease, pleurisy with effusion, pulmonary catarrh, pneumonia, and emphysema. Klemperer has confirmed this, and Laache,<sup>2</sup> Bartels, and others have shown that the