A M N E S I A V E R B A L I S

and

Other Disorders of Memory

A Thesis presented to the University of Edinburgh for the degree of Doctor of Medicine

by

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R E F E R E N C E S

Those works to which an asterisk is prefixed have not been consulted in the original.

AMIDON.....On the Pathological Anatomy of Sensory Aphasia: New York Medical Journal, 1885, p.113 & p.181.

BAIN.....The Senses and the Intellect, 4th Edit. 1894.

BALLET.....Le Langage Intérieure et les diverse formes de l'Aphasie, 2nd Edit., Paris, 1888.

* BANTI.....Afasia e sue forme: Lo Sperimentale, 1886.

BASTIAN.....Aphasia and other Speech Defects, 1898.

.....The Brain as an Organ of Mind, 4th Edit., 1890.

.....The Muscular Sense; its nature and Cortical Localisation: Brain, April, 1887.

.....On the various forms of Loss of Speech in Cerebral disease: British and Foreign Medical and Chirurgical Review, 1869, Vol. XLIII, p.209 and p. 470.

BATEMAN.....Aphasia and the Localisation of the Faculty of Language, 2nd Edit., 1890.

BERLIN.....Eine Besondere Art der Wortblindheit (Dyslexie) Wiesbaden, 1887.

BERNARD.....De l'Aphasie et de ses diverses formes, 2nd Ed. Paris, 1889.

* de BONALD.....Recherches Philosophiques. 1818.

BOUILLAUD.....Traité Clinique et Physiologique de l'Encéphalite, 1823.

BRAMWELL.....Illustrative cases of Aphasia, Lancet, 1897, Vol. 1, p. 796.

.....Morrison Lectures on Aphasia: Reprint from Edinburgh Medical Journal, 1897.

BROADBENT.....On the Cerebral Mechanism of Speech and Thought; Transactions of the Royal Medical and Chirurgical Society of London, 1872, p. 145.

.....A case of peculiar affection of speech, with commentary: Brain, 1878, Vol. I, p. 484.

BROCA.....Remarques sur le siége de la faculté du langage articulé, suivies d'une observation d'aphemie (perte de la parole): Bulletins de la Société Anatomique de Paris, Aug., 1861, T.VI. p.330.

Nouvelles observations d'aphemie produite par une lésion de la moitié posterieure des deuxième et troisième circonvolutions frontales: Bulletins de la Société Anatomique de Paris, 1861, T. VI, p. 398.

* de CARDAILLAC.....Études élémentaires de Philosophie, 2Vols.1830.

CHARCOT.....Clinical Lectures on Diseases of the Nervous System, translated by Savill: New Sydenham Society, 1889, Vol.III.

CREMEN.....A case of Amnesic Aphasia: British Medical Journal, 1886, Vol. I, p.14.

DAX, M. .....Lésions de la moitié gauche de l'encéphale coïncidant avec l'oubli des signes de la pensée: Gazette Hebdomadaire de Médecine et de Chirurgie, No.17, 28th April, 1865, p.259.

DAX, G. .....On the same subject. Loc.cit., p. 260.

DÉJERINE.....Contribution à l'étude anatomo-pathologique et cliniques des Différentes Variétés de Cécité Verbale: Mémoires de la Société de Biologie, 1892, Feb. 27.

.....Aphasie et hémiplégie droite: Bulletins de la Société Anatomique, 1879, p. 16.

.....Sur un cas de Cécité Verbale avec agraphie, suivi d'autopsie: Comptes Rendus de la Société de Biologie, 21st March, 1891, p.197.

DÉJERINE and MIRALLIÉ.....Sur les altérations de la lecture mentale chez les aphasiques moteurs corticaux: Comptes Rendus de la Société de Biologie, 1895, July 6.

DÉJERINE and SERIEUX.....Un cas de Surdité Verbale pure terminée par Aphasie Sensorielle, suivi d'autopsie: Comptes Rendus de la Société de Biologie, 18th Dec., 1897, p. 1074.

* EBBINGHAUS.....Ueber das Gedächtniss: Untersuchungen zur experimentellen Psychologie, 1885.

EDGREN.....Amusie: Deutsche Zeitschrift für Nervenheilkunde, Vol VI, 1895, p. 1.

EGGER.....La Parole Intérieure, 2nd Edit., Paris, 1904.

ELDER.....Aphasia and the Cerebral Speech Mechanism.1897.

.....Notes on Aphasia, with special reference to a subdivision of Broca's convolution: Edinburgh Hospital Reports, Vol.III, 1895,p.463

ESKRIDGE.....Cyst of the Brain in the foot of the left second frontal convolution: Medical News, Aug. 1896, Vol. XLIX, p. 122.

FÉRÉ.....Editorial footnotes in 2nd edition of Bernard's "de l'Aphasie", Paris. 1889.

.....Le langage reflexe: Revue Philosophique, January, 1896.

FERRAND.....Le Langage, la Parole, et les Aphasies. Paris, 1894.

FERRIER.....The Functions of the Brain. 2nd edit., 1886.

FISCHER.....Du rappel de la Parole chez les Aphasiques. (Thèse de doctorat) Bordeaux, 1887.

FLECHSIG.....Gehirn und Seele. Leipzig, 1895.

FLOURENS.....Examen de la Phrenologie. 1842 - 1845.

FREUD.....Zur Auffasung der Aphasien. Leipzig, 1891.

GAIRDNER.....On the Function of Articulate Speech, and on its connection with the mind and the bodily organs: Proceedings of the Glasgow Philosophical Society. 1865 - 1868, p. 87.

GALL.....Anatomie et la Physiologie du Système Nerveux. Paris, 4 vols., 1810 - 1819.

GALTON.....Inquiries into Human Faculty. 1883.

GORDINIER.....Arguments in favour of the existence of a separate centre for writing: American Journal of the Medical Sciences, Sept..1903, p. 490.

.....A case of brain tumour at the base of the second left frontal convolution: American Journal of the Medical Sciences, May. 1899, p. 526.

GOWERS.....Lectures on the Diagnosis of Diseases of the Brain. 2nd edition, 1887.

HAMILTON.....Lectures on Metaphysics and Logic. 4vols., 1858 - 1860.

HINSHELWOOD.....Letter- word- and mind-blindness. 1900.

.....A case of word-blindness with right homonymous hemianopsia: British Medical Journal, Nov., 1904, p. 1304.

HOLLAND.....Chapters on Mental Physiology. 2nd edit. 1858.

HUGHES BENNETT.....Clinical Lectures on Diseases of the Nervous System: British Medical Journal. Vol.I, 1888, p. 340.

HUGHLINGS JACKSON...Croonian Lectures on Evolution and Dissolution of the Nervous System: British Medical Journal. Vol.I, 1884, p. 591.

...On Affections of Speech from Disease of the Brain: Brain, 1878, Vol.I, p. 304; 1879, Vol. II, p. 203, and p. 321.

JAËLL.....La Musique et la Psycho-physiologie. Paris, 1896.

JAMES.....The Principles of Psychology. 1901.

KELLER, HELEN.....The Story of My Life. 1903.

KNOBLAUCH.....On disorders of the Musical Capacity from cerebral disease: Brain, 1890, p. 317.

KRAUSS.....Traumatic haemorrhage over the third anterior frontal convolution: American Journal of the Medical Sciences. Sept.. 1904, p. 393.

KUSSMAUL.....Disturbances of Speech: Ziemssen's Cyclopaedia of Practice of Medicine, 1877, Vol. XIV. 1878.

LEMAITRE.....Le Langage Intérieure chez les enfants. Lausanne, 1902.

LICHTHEIM.....On Aphasia: Brain, Jan. 1885, p.433.

LLOYD MORGAN.....Introduction to Comparative Psychology. 1894.

* LORDAT.....Analyse de la Parole. Montpellier, 1843.

McCONNELL.....A case of tumour of the left first and second frontal convolutions, with motor agraphia as its chief localising symptom: University of Pennsylvania Medical Bulletin, July - August, 1905, p. 156.

MACEY.....Editorial notes in Helen Keller's "Story of My Life", 1903.

* MAINE de BIRAN.....L'examen critique des opinions de M. de Bonald.

MILLS.....Aphasia and the Cerebral Speech zone: American Journal of the Medical Sciences, Sept. 1904, p. 375.

MILLS.....Cerebral Localisation: in a Textbook on Nervous Diseases by American authors, edited by Dercum. 1895.

MIRALLIÉ.....De l'Aphasie Sensorielle. Paris. 1896.

MOXON.....On the connexion between Loss of Speech and Paralysis of the Right side: British and Foreign Medical and Chirurgical Review, April 1866, Vol. XXXVII, p. 481.

MÜLLER, MAX.....The Science of Thought. 1887.

OSBORNE.....On the Loss of the Faculty of Speech, depending on forgetfulness of the Art of using the Vocal Organs: The Dublin Journal of Medical and Chemical Science, Nov. 1833, Vol. IV, p. 157.

OSLER.....A case of Sensory Aphasia - word-blindness with hemianopsia: American Journal of the Medical Sciences, March. 1891. Vol. CI. p.219.

PITRES.....L'Aphasie Amnésique et ses variétés cliniques. Paris. 1898.

.....Considérations sur l'agraphie, a propos d'une observation nouvelle d'agraphie motrice pure: Revue de Médecine, 1884, p. 855.

.....Étude sur l'Aphasie chez les polyglottes: Revue de Médecine, 1895.

.....Étude sur les Paraphasies: Reprint from Revue de Médicine. 1899.

* PORT-ROYAL Logique. 1683.

PROUST.....De l'Aphasie: Archives Générales de Médecine. 1872, p. 165.

RIBOT.....Diseases of Memory. 4th edit. Eng.trans.1898.

* RIVAROL.....De l'universalité de la langue française. Paris, 1797.

ROMANES.....Mental Evolution in Man. 1888.

ROSENSTEIN.....Diffuse Nephritis. Uramische Anfälle, von Temperaturerhöhung begleitet. Aphasie als Terminalerscheinung: Berliner Klinische Wochenschrift. April 27, 1868, p. 182.

ROSS.....A Treatise on the Diseases of the Nervous System. 2nd edition, 1883.

.....On Aphasia. 1887.

SAINT-PAUL.....Le Langage Intérieure et les Paraphasies. Paris, 1904.

SERIEUX.....Note sur un cas de cécité verbale avec agraphie: suivi d'autopsie: Mémoires de la Société de Biologie. 1892, p. 15.

.....Sur un cas de surdité verbale pure: Revue de Médecine, 1893, p. 733.

SKWORTZOFF.....De la Cécité et de la Surdité des mots dans l'Aphasie. Paris, 1881.

SOLLIER.....Les Troubles de la Mémoire. 2nd edit. Paris, 1901.

STARR.....The Pathology of Sensory Aphasia, with an analysis of fifty cases in which Broca's centre was not diseased: Brain, 1889, p.82.

STEWART, GRAINGER...Introduction to the Study of the Diseases of the Nervous System.1884.

STRICKER.....Du Langage et de la Musique. Paris, 1885.

THOMAS and ROUX.....Troubles latents de la lecture mentale chez les Aphasiques moteurs corticaux: Comptes Rendus de la Société de Biologie. 1895, p.531.

.....Du défaut d'évocation spontanée des images auditives verbales chez les Aphasiques moteurs corticaux: Comptes Rendus de la Société de Biologie, 1895, p. 731.

TROUSSEAU.....Lectures on Clinical Medecine. Translated by Bazire:New Sydenham Society. 1868.

VILLA.....Contemporary Psychology. London, 1903.

WARD.....Psychology: Encyclopaedia Britannica, 10th ed. Vol. XXXII, p. 54.

WERNICKE.....Der Aphasische Symptomen-complex. Breslau,1874.

.....Die neuren Arbeiten über Aphasie: Fortschritte der Medecin, 1886, p. 463.

WINSLOW.....Obscure Diseases of the Brain. 1860.

WUNDT.....The Principles of Physiological Psychology, 5th edit. London, 1904, translated by Titchener

WYLLIE.....The Disorders of Speech. Edinburgh, 1894.

Chap. i.

MEMORY AND ITS PHYSICAL SUBSTRATE.

In the Theory of the Faculties, which dominated psychological speculations towards the end of the eighteenth century, the various provinces of mind revealed by introspection were designated as so many mental faculties. These were supposed to be ultimate properties of the soul, which the psychologist could classify and describe, but which admitted of no further analysis. The Faculty of Cognition was opposed to the Faculty of Desire, and each of these was subdivided into a higher and a lower part. Memory was classed along with Imagination and the Poetic Gift as one of the lower Cognitive Faculties.

This division of consciousness into distinct and disconnected faculties is no longer held; and psychologists have arrived at a conception of the psychic life which is profoundly different from that of the old psychology. The application of scientific methods to the study of mental phenomena has succeeded in showing

that consciousness is composed of elements which in the last analysis may be reduced to two - sensations and simple feelings. From the former are evolved the intellectual processes; from the latter the emotions and the will. By sensation is meant that part of the conscious reaction to peripheral stimuli which has some objective counterpart; the "tone of feeling" accompanying sensation is entirely subjective and has nothing corresponding to it in the external world. In dealing with disorders of word-memory we are mainly concerned with disturbances of intellectual processes, and the many difficulties which surround the psychology of the feelings may be disregarded.

The analysis of mental functions effected by the English Associationist school which reduced the whole of conscious life to "sensations" and "ideas", although undoubtedly imperfect, is peculiarly adapted for purposes of exposition of disorders of memory. By ideas is meant, in this connection, all forms of memory-images aroused in the mind in the absence of their appropriate sensory stimuli from the periphery of the body. We have sensations and memory-images of sensations - ideas. These are the psychical elements with which we have to deal, and we must now examine some of the opinions which have been put forward in regard to their physical substrate.

Discussions of the relation subsisting between mind and body have always had a markedly philosophic character; and the attempts which have been made, from the earliest times, to form-

-ulate their connexion continue in the present day.

Disregarding all the vexed questions as to the causal efficacy of mind, the possibility of interaction between mind and body, and the alleged incompleteness of psycho-physical parallelism in certain domains of consciousness, we may note that practically all authorities admit that, so far, at least, as the cognitive elements of consciousness are concerned, there is a complete parallelism between mental and cerebral events. This psycho-physical parallelism is to be considered as "merely an empirical statement that certain physical and physiological conditions correspond to mental processes; and that the content of a sensation, and ultimately of an act of thinking has always a physical side; and that feelings and acts of willing, while referring indirectly to perceptive processes are accompanied by more or less accentuated physiological phenomena".*

If we accept this view it is evident that endeavours to correlate more definitely cerebral and mental functions must be directed to localising in the brain the neural elements which form the physical substrate of the psychic elements. This is the only form of cerebral localisation which we can expect to find; for just as the more complex states of consciousness may be analysed into their component sensations and ideas, so the more complex brain processes may be analysed into the functioning of determinate neural elements.

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* Villa:- Contemporary Psychology. (Eng Tr.) Lond. 1903. p. 126

When the "Faculty Theory" held sway among psychologists the anatomy and physiology of the brain were still in their infancy, and the favourite subject of research was the endeavour to locate in the brain the seat of the soul. The first serious attempt to find some anatomical basis for the psychological doctrines of the times was made by Gall.* who formulated the hypothesis that the aptitudes and dispositions of an individual may be determined by the shape of the skull, and especially by the amount of development thereon of certain bumps or protuberances, each of which corresponds to some special faculty of the mind.

Gall made many converts and his opinions had a great vogue for a time; but they fell into disrepute when Flourens†, as a result of extensive experimental research on living animals, showed that there was no such localisation of the faculties of the mind as Gall had asserted. Trusting mainly to ablation experiments on the lower vertebrates, and influenced probably by the Cartesian doctrine of the indivisibility of psychic functions, Flourens came to the conclusion that any part of the cerebrum can act vicariously for any other part, and that if one part of the brain be removed there is a weakening of the intelligence as a whole, proportional to the amount of brain removed, not a loss of any particular faculty or mental process.

The views of Flourens, founded as they were on careful experimental work, were widely accepted by scientific men, and

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* Gall:- Anatomie et la physiologie du système nerveux. Paris. 4 vol. 1810-1818.

† Flourens:- Examen de la Phrenologie &c. 1842-1845 (from Wundt's Principles of Physiological Psychology. 5th Edition translated by Titchener. Lond. 1904). Vol I p. 297.)

held almost undisputed sway down to the middle of the nineteenth century. Some investigators, however, still adhered to the doctrines of Gall, and insisted upon a certain amount of localisation of the cerebral functions. The steadily increasing knowledge of the complexity of cerebral structure, and the accumulation of pathological records of lesions which had been accompanied by loss of particular sensory or motor endowments, gradually led up to the complete overthrow of the Flourentian doctrines. Bouillaud* brought forward much evidence to show that loss of speech is a result of lesion of the frontal lobes. Marc Dax,† and after him his son, maintained that the lesion in such cases is generally confined to the left hemisphere. Finally in 1861. Broca‡ recorded two cases which definitely proved that loss of speech results from lesion limited to the foot of the third frontal convolution of the left cerebral hemisphere.

Although Broca's discovery led to the final abandonment of the views of Flourens, the conception of cerebral localisation now generally entertained may be said to date from the day that Fritsch and Hitzig tried the effect of electrical stimulation of the cortex instead of ablation which up till then had formed the only experimental method. The new method of investigation was taken up and improved on by Professor Ferrier in this country; and his researches, backed up as they have been by a host of workers in every part of the civilized world, have resulted in a mapping out of the cerebral cortex, which, if it still leaves

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* Bouillaud:- Traité clinique et Physiologique de l'encéphalite (1823)

† Dax. M. :- Lésions de la moitié gauche de l'encephale &c. (1836) [Republished in Gaz. Hebdom. 1865: April p259.]

‡ Broca:- Bul. de la Soc. Anatom. anj 1861, p330 and p398.

much to be desired, has had a profound effect on psychology and on the science of medicine.

It was soon discovered that the central convolutions on both sides of the Fissure of Rolando were directly related to the production of purposive movements, and that separate areas presided over the movements of the different regions of the body. The Rolandic area therefore came to be known as the motor region of the cortex. It was at this time the commonly accepted doctrine in psychology, supported in this country by the authority of Bain, and in Germany by that of Wundt, that feelings of innervation or of effort were concomitants of the outgoing stream of nervous energy and were not, as is now generally believed, dependent on ingoing impressions derived from the moving parts. On that view motor elements were a necessary part of the neural substrate of mental life. The view put forward by Bastian* that these so-called regions of the cortex are really sensory centres in which impressions of movements are received and registered is at last gradually gaining recognition, especially among psychologists. It is the view adopted in the following pages.

The early and precise localisation of the centres in the Rolandic cortex was due mainly to the fact that their stimulation results in objective phenomena which are easily observed. It is otherwise with those sensory areas which are in no immediate relation to bodily movement. Consequently we find that there has been, and still is, much diversity of opinion among physiologists

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* Bastian :- The muscular Sense: its nature and cortical localisation. Brain Apr. 1887.

as to the cortical areas whose functioning is correlated with acts of sight, of hearing, of touch, of taste, and of smell. And although much has been done in this field of research by experiments on anthropoid apes, we shall probably have to wait for the final settlement of these questions until we have accumulated sufficient clinical evidence of the subjective phenomena resulting from lesion of the various sensory areas in man, who alone is able to tell us the nature and amount of disturbance thereby produced.

It would seem that one source of the contentions which have arisen in regard to these sensory areas is the tendency to regard the cerebral mechanism subserving perceptive processes as being much more simple than it really is. Physiologists seem unwilling to abandon the pre-psychological concepts of the Phrenologists, and are still wont to look for a sharply defined localisation of mental processes which must be correlated with the functioning of widely separate regions of the brain. An examination of what is implied by an act of perception will render this clear.

As we have seen, the Theory of the Faculties by which consciousness was divided and subdivided into compartments, each performing its own function independently, suffered discredit on its physiological side with the refutation of Gall's doctrines. Among psychologists its earliest and most strenuous opponent was Herbart who showed that instead of so many distinct sources

of mental processes there was but one source - presentation. Modern psychology has shown that presentations are compounded of still simpler elements, namely, sensations. We have sensations and memories of sensations. When we see an apple we have a visual sensation; when we eat it we have sensations of taste; its odour gives rise to sensations of smell; and when we handle it we have sensations of touch and of resistance. If we see the apple again we can "remember" its smell and its taste, its "feel" and its weight. The various sensations which we had previously experienced are revived in consciousness as memory-images; and their revival, on seeing the apple again, constitutes the essence of the act of perception. These revived memory-images of sensations are not only the foundation of all processes of memory whatsoever, but they are also a necessary element in every act of perception.

Professor James has contrasted the difference between sensation and perception by saying that sensation is mere acquaintance with, while perception implies knowledge about, an object.* Now when an object is presented through one of the senses, it always occasions in the healthy adult some knowledge about it; and this knowledge about it depends on the revival of memory-images which have been, or may be, derived from the object through the other senses. We are incapable of receiving a simple sensation without at the same time perceiving its object.

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* James:- The Principles of Psychology. London 1901. Vol II p.2.

It is manifest, therefore, that in trying to localise the site of the different kinds of sensation, care must be taken to discriminate between disturbances of the sensory processes as such, and disturbances of perception.

It is also important to determine if the revival of memory-images is dependent on the functioning of the same neural elements as are concerned in sensation. Some psychologists hold the opinion that there are "sensation cells" directly concerned in sensory processes, and "memory cells" in which the memory-images are "deposited". According to some of these writers the two kinds of cells exist side by side in every sensory area; according to others they are topographically separate. There can be little doubt that such an hypothesis is psychologically untenable; and there is no physiological or pathological evidence which, if rightly interpreted, gives justification for such a supposition. This error has appeared again and again in connexion with experimental work and in the interpretation of clinical and pathological records; and it would seem to be due in the main to the assumption that the cortical areas in immediate relation to sensory nerves are the final terminations of the sensory pathways, and that it is with the functioning of such areas only that sensations are immediately correlated.

There is, however, some evidence to show that a distinction must be drawn between the parts of the cortex concerned in the primary reception of sensory impressions and the parts which may

be active when these impressions are revived in idea. This, however, does not imply that there are sensory centres and memory centres spatially separate in the cortex. It merely points to the fact that the primary receptive areas are not necessarily the only areas on which sensation ultimately depends. It points above all to a manifold representation of sensory impressions in the cerebral cortex. And since the intellectual value of a sense-impression depends on the kinds of memory-images which it calls up in its train, we may believe that at ascending levels of representation it may become associated with ideational complexes of a higher and higher order.

Such a view is to be clearly distinguished from the hypothesis of association centres expounded by Flechsig.* It has long been known that certain areas of the cortex are in direct connexion with afferent and efferent nerves whilst others are only indirectly so connected.† Flechsig, by his studies on myelination, has mapped out three great areas which he maintains have no projection neurones, and which, on the supposition that they subserve the higher psychic functions, he has named "association centres". The sensory areas are supposed to serve merely as a means whereby peripheral impressions may be projected upon determinate cerebral surfaces; the real psychic functions of brain being effected through the association centres which serve to bring the various sensory centres into mutual connexion.

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* Flechsig:- Gehirn und Seele, Leipzig, 1895.

† Broadbent:- Transactions of the Royal Med. & Chirurg. Soc. 1872. p178.

Such a restriction of the psychic functions to limited cortical areas is not warranted by pathological evidence; and the supposition that the sensory projection areas serve merely as a means of reduplicating in the brain impressions in the order in which they affect the peripheral organs of sense, is one of the cardinal errors of modern views on cerebral localisation. If there is one general principle which can be deduced from the mass of materials which has accumulated in connexion with the investigation of the cerebral substrate of psychic life, it is the importance of the functional interaction of the different parts of the brain in even the simplest acts of consciousness. The projection areas are true centres in the sense that they colligate sensory impressions spatially separate at the periphery; and they perform also functions of an associative kind in that they contain neurones which mediate associations between various widely separated cortical areas. Association, understood either psychologically or anatomically, is not confined to any restricted part of the brain: there is but one psychic centre, and that is the brain as a whole.

There can be little doubt that the truth lies with those psychologists who maintain that the same elements must be concerned in ideation as are affected in sensation. But just as we are incapable of knowing sensations apart from perceptions so we can know our revived sensations only as they enter into revived perceptions. And the knowledge about an object, which

perception implies, is dependent on the revival of sense-images many of which may have their physical substrate in spatially separate cortical areas.

It is consequently misleading to use the term "perceptive centre" for any isolated sensory area. A "visual perception" is merely a perception in which the "sign" given is a visual sensation: the other elements in the perception are dependent on revivals of other sense-images.

Now the "consciousness of particular things present to sense"* which constitutes perception, may be more or less complete. It may be of the thing's essential attributes, such as shape, size, mass, or of its more remote relations, such as its uses or its meaning. In a healthy adult the nervous impulse which initiates the perception tends to irradiate into all the nervous channels whereby are mediated the associations necessary for the revival of all the attributes of the object. But in certain morbid conditions of the brain it is found that ideas of the more fundamental attributes may be revived while those of the more remote are not. Thus in the condition known as object blindness(mental or psychic blindness), the visual presentation of an object may arouse ideas of all its tangible qualities, such as size and form - depending on revivals in tactile and kinaesthetic elements - whilst it suggests none of its more remote relations, such as its uses or its name.

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* James:- Principles of Psychology. Vol II. p.76

In this condition all the sensory elements in the visual cortex cannot be destroyed, or the person would be blind to all impressions: and some at least of the association fibres passing to remote parts of the brain must be uninjured, or the tangible attributes of the object could not be revived. The condition might be explained by interruption of association fibres to some other parts of the brain. This is the view held by Prof. James, who says* that mental blindness is due to the momentary loss of our non-optical images. That the absence of non-optical images may be a cause of object blindness cannot be denied; and, if there is no further representation of visual sensation than that which exists in the occipital cortex in the neighbourhood of the calcarine fissure, this must be the only cause of object blindness; and further, destruction of both occipital visual centres must prevent all visual ideation as well as all vision. But this is not so. The evidence is difficult to get in connexio with object blindness, but in the form of mental blindness known as word-blindness we find that lesion may produce an inability to know the meaning of printed words, although the words may be seen perfectly as to size, shape, and position, and although words may be ideally revived and written with a full knowledge of their meaning. Now in this case the cutting off of the visual centres in the occipital lobe from the centres through which written words derive their meaning might account for the word-blindness: but the lesion which cuts off the associations in one direction would

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* James:- Principles of Psychology. Vol I. p.50.

be very likely to cut off those in the other, so that the revival of the visual word-images from within would be as impossible as the revival of the non-visual images from without.

On the other hand we know that lesion which produces word-blindness sometimes prevents the ideal revival of written words and, consequently, agraphia. In this case it is evident that it is not the absence of non-optical images which causes the mental blindness but the absence of optical images having definite associations of a special kind. This is the strongest evidence we have in favour of the belief in "memory centres" which are distinct from sensory centres. We know that with destruction of the left angular gyrus visual word-images are actually blotted out, and that in the word-blindness in which the angular gyrus is not destroyed visual word-images may be revived from within: but since we cannot conceive of any means by which the memory-images of words can be "deposited" in special memory cells except by actual sensory impression, there would seem to be no explanation of the facts so simple as that which the principle of manifold representation entitles us to give. Written words are registered in the occipital lobes as mere visual impressions having such associations with other sense-representations as may be mediated by connexions between the occipital cortex and the sensory centres subserving the memories of the more essential attributes of graphic forms. They are registered again in the angular gyrus where they are associated directly or indirectly with the higher

ideational complexes which give to them meaning and significance.

Thus we may believe that every sensation which can be ideally revived has "impressed" the cortical elements, not at one point only, but, it may be, at many points; and its revival as a component of a particular revived perception will depend on the associations it has formed at each level of representation.

Such a conception is opposed to a belief in any sharply defined areas of sensory localisation. And the whole trend of the best modern work on this subject points to a similar conclusion: at most we can speak of only a relative localisation of cerebral functions.

Although it is unwarrantable to speak of memory centres as opposed to sensory centres, there is no objection to the use of the term memory-centre as a descriptive name for any group of nerve elements whose functioning is correlated with the revival of particular sense-images. This is allowable on any hypothesis. Whether it is held that sensory elements are identical with ideational elements or not, the elements concerned in sense-representation are, qua representation, "memory" elements; and in so far as a group of such elements subserves the memories of sense-impressions derived from particular sense-organs, or of such groups of particular sense-impressions as may have associates of a like order, we are justified in referring to such a group of elements as a memory-centre, quite irrespective of our knowledge as to its exact topographical localisation.

And in dealing with the word-memories pertaining to different sensory channels it will be convenient to speak of primary receptive areas and memory centres, since if we may judge by analogy from the conditions prevailing in regard to visual word-memories, the primary receptive areas are, or may be, spatially separate from the centres of word-memory properly so called.

The memory centres about whose localisation we have most definite knowledge are those in which are registered the memories of sensations derived from movements of the various parts of the body. This knowledge has been attained mainly by experiments on anthropoid apes, and it has been rendered possible by that peculiarity of the constitution of the nervous system which necessitates that purposive action must be preceded by the functioning of such sensory centres. As Professor James says: "Voluntary acts are, in fact, nothing but acts whose motor centres are so constituted that they can be roused by these sensorial centres whose excitement was originally their effect."*

Curiously enough, however, the true nature of these cortical centres whose experimental stimulation leads to purposive bodily movement has not been generally recognised. Even the distinguished observer to whose labours most of our knowledge of cerebral localisation is due, has persistently failed to realize the psychological importance of his own discoveries.† I cannot enter here into any detailed discussion of the controversy which has taken place about the true nature of these so called motor

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* James:- Quoted by Bastian. Brain. 1887. p 63.

† Ferrier:- The functions of the Brain. 2nd Edt. 1886

centres of the cortex. I need only say that I accept the view put forward with so much ability by Dr. Charlton Bastian,* and regard the whole Rolandic area as a great sensory centre - a kinaesthetic memory centre - in which are registered the memories of sensations of movements.

The only other sense-memories that enter largely into intellectual life are those of vision and of hearing. Unfortunately the predominantly subjective nature of the effects produced by stimulation or destruction of visual and auditory centres prevents us from deriving from experiments on the lower animals much conclusive evidence in regard to the localisation of visual and auditory memory centres. Nor are clinical and pathological records as yet sufficiently complete to give us any certain data. We know something, it is true, about the primary receptive areas of the cortex related to sensations of sight and of hearing. We know that the region of the occipital lobe in the neighbourhood of the calcarine fissure is an important station on the way in for visual impressions; and that part of the temporal lobes is equally important in relation to auditory impressions. But we know little of the regions where such impressions enter into association with other sense-representations in complex ideational processes - the visual and auditory memory-centres.

Although we know little about the memory-centres for sight and hearing in general, our knowledge is more definite in regard to those related to certain special forms of visual and auditory sensation. It was in connexion with disorders of speech that

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* Bastian :- Brain, ab. 1887.

our earliest knowledge of cerebral localisation was obtained, and it is to the continued investigation of this subject that we owe the most accurate information we possess at the present time in regard to visual and auditory memories.

Before going on to deal with the various forms of word-memory it is necessary to say something further on the nature of memory in general and the conditions on which its evolution and dissolution depend.

The word memory is commonly used as signifying the power we have of storing up sensory impressions, of recalling them at will, and of localising them in the past. Most psychologists maintain that localisation in the past is an indispensable feature of the memory-process strictly so called, and that the mere revival of sense-images should be described as imagination. It is convenient, however, for our purpose, to use the term in its widest sense and to refer to all forms of sense-representation as memories.

According to the old psychologists memory properly so called is the power of retaining knowledge in the mind but out of consciousness, while the power of calling this knowledge into consciousness is the function of a totally different faculty - recollection. This important distinction must still be maintained although it may be differently expressed. All that the modern psychologist understands by the words "in the mind but out of consciousness" is, that certain modifications of neural tissues

have been produced, in virtue of which the occurrence of certain conscious states is rendered possible. We know nothing empirically about mental states apart from consciousness. When the stimulus causing a sensation is removed, some material change is left behind in the molecular constitution of certain cortical elements, so that when, from any source, these elements are again excited by a nervous impulse, a memory-image of the sensation arises in the mind. We do not know what may be the nature of the change in the nervous tissues which remains as a result of a sensory impression, and leads to the possibility of the revival of a sensation as an idea. We can only vaguely conceive of it as some molecular alteration which remains as a more or less permanent residuum.

Since one idea has the power of calling up related ideas there must be "pathways" of communication between the various sites of idea registration. The old histology, which regarded the brain as a closed system of nerve cells and nerve fibres, adapted itself readily to the descriptive requirements of associationist psychologists; and so simply and naturally does the correlation of nerve cells with ideas and nerve fibres with associations fit in with the facts, that notwithstanding the different interpretation which must be put upon these terms in view of the modern conception of the neurone as the neural element, we may justifiably retain them for descriptive purposes.

The order in which ideas are revived in the mind is governed by certain laws of association. The first idea which is

associated with the introductory sensation is determined by its complete likeness, or, more frequently, its similarity, to the latter; and each idea revives as its successor either an idea which is similar to it in content, or an idea with which it has often appeared simultaneously. Underlying these laws of association, however, there is a profounder fact than mere similarity and contiguity. One idea calls up another because the pathways between the two sites of idea registration are well organised and very permeable to the nervous discharge. As Professor James says, "there is no other elementary causal law of association than the law of neural habit. All the materials of our thought are due to the way in which one elementary process of the cerebral hemispheres tends to excite whatever other elementary process it may have excited at some former time." *

The importance of the organisation of the neural tissues underlying conscious states makes it necessary to recognize an organic memory as well as a conscious memory. Indeed these two forms of memory are to a certain extent antagonistic. The more perfect the organic memory is, the more deeply organized the nerve elements are, the less tendency is there for their functioning to be accompanied by any distinct mental concomitant. The oftener a voluntary act is performed the more automatic does it tend to become. "Secondary automatic" acts are not due to the formation of new nervous pathways, but to such a rapid functioning of the old paths that the mental concomitant does not rise above the threshold of consciousness. As Ribot says, "every state of

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* James:- Principles of Psychology. Vol I p.566

consciousness necessarily occupies a certain duration.and.....an essential condition of consciousness is wanting when the duration of the nervous process falls below this minimum." *

We might in the same way consider the neural dispositions which control true automatic and reflex actions as instances of organic memory; but since it is only in the course of phylogenetic development that such nervous arrangements become organized, and since their functioning has not at any time in the individual life any conscious accompaniment, this is perhaps an unnecessary straining of the use of a word which is so commonly employed exclusively in regard to a mental phenomenon. Nevertheless, we must recognize that, as Ribot says, "Memory is per se a biological fact - by accident a psychological fact;" † it is not a faculty of the mind but a disposition of neural tissues.

The permanence of the residua of sensory impressions depends chiefly on the intensity of the impressions, their recency, the amount of attention bestowed on their reception, and the frequency of their repetition. Experimental psychology has shown that much depends on the time intervals which elapse between the repetitions. A number of repetitions spread over several days is found to be more efficacious than if they are all taken together at one time. Ebbinghaus ‡ was the pioneer in experimental work on this subject, and the method he employed was to test the effects of repetition in the learning of words by heart. In order to

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* Ribot:- Diseases of memory. Eng. Tr. 4th Edt. 1898. p.35.

† Ibid. p.10.

‡ Ebbinghaus:- Ueber das Gedachtniss. 1885 (from Professor Woods article on Psychology. Encyclopaedia Britannica. 10th Edt. Vol 32. p.61)

exclude the assistance given by the use of familiar words with all their ready made associations, he devised the system of using closed monosyllables which are not themselves words. Bam, fis, lup.tol, are examples of these senseless syllables. They are strung together into lines of various lengths, and the power of learning and retaining them in the memory is tested. It is found that most people can,with a little attention,remember four or five of these after a single reading or hearing. With more concentration they may retain six or seven, but beyond seven it is found that some repetition is necessary before they can be learnt. This maximum is called the "span of prehension" and it varies in different individuals.

It is found that if several repetitions are taken in succession the first gives the best results, each succeeding repetition being less and less efficacious. If, however, the repetitions are spread over several days there is an increase in efficiency in proportion to the number of days over which the repetitions are distributed. Thus two repetitions on twelve days are more efficient than four on six days, and four repetitions on six days more efficient than eight on three days. The age of the associations seems to be important, and each fresh repetition apparently does more for an old association than for a new one. Ribot has taught* that the stability of a new nervous arrangement is to a great extent dependent on nutrition; and it may be that only by distributing the repetitions over a sufficient time to

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* Ribot:- Diseases of memory. pp.193-197.

allow the "fixing" of the effects of the several impressions can the full benefits of repetition be obtained. In this connexion it may be recalled that the period of life at which retentiveness is most marked is that at which the processes of nutrition are most efficiently performed.

Thus we may say that the chief factors concerned in the formation of memories are (1) the intensity of the impressions, (2)their recency, (3) the attention bestowed on their reception, (4) the frequency of their repetition, (5) the time intervals over which the repetitions are distributed, and (6) the plasticity of the nervous structures involved.

Chap. ii.

WORD - MEMORIES AND SPEECH.

Words are symbols of thought. They are the means by which we convey to our fellow-men the thoughts that arise in our minds. True, we can do this, to some extent, by means of appropriate gestures; and this most primitive form of language is used, more or less, by everyone. It may even be, as in uneducated deaf-mutes or in those stricken with aphasia, the only form of language available. But it is with the words of articulate speech that we are here concerned, and the various forms of word-memory that we acquire must be considered separately.

Words are primarily sounds, or to be more accurate, sound - sequences. This is a fundamental fact which must never be forgotten; it is the key to all our knowledge of speech defects. The natural language of gesture contains no words; the rude pictorial writings of primitive man symbolise not words but things. Only when muscular action results in articulate sounds having some definite meaning, and when written characters symbolise not things but sounds, can words be said to exist.

A child when learning his native language hears a sound made while his attention is directed to some object. By frequent repetition of this lesson he in time comes to associate this particular sound with the object, so that on hearing the sound, which may now be considered one of the attributes of the object, all its other known attributes are revived in his mind.

This association implies the formation of nervous pathways from the site of registration of the auditory word-memory to the various memory centres in relation to those sensory channels through which the child's knowledge of the object has been obtained. In the course of time the converse mode of association becomes established, so that when the idea of the object arises in the child's mind, the memory of its sound attribute - its name - is also revived. The establishment of this association necessarily precedes intelligent voluntary speech. But the "reflex" production of speech, the imitation of words heard, may be carried on without the formation of either kind of association, and so the training of the kinaesthetic centres and the formation of a kinaesthetic memory of the movements of articulation may be initiated. This is brought about through the connection of the auditory centre with the kinaesthetic centres. When a child is learning to say his first word a new combination of muscular movements is being attempted for the first time. Movements of some kind, however, of all the muscles to be employed have already been registered in their related kinaesthetic centres.

and it can only be by some combination of these represented movements that an attempt at the new movement is made. The end to be attained being the production of a sound, such auditory memory of sounds as the child possesses, or the auditory impressions conveyed by the voice of the teacher, must ~~form~~ be the main source of the kinaesthetic incitations, and the guides which control the action of the kinaesthetic centres. To some extent the sense of sight may also help, and the visual impressions of lip movements may act as a sort of "coarse adjustment" in the selection of the appropriate muscles to be employed. But the success of the attempt is judged by attending to the sound produced. This is compared with the sound remembered or again repeated by the teacher, and a fresh attempt, involving new combinations of the various muscles, is made, until at last the correct grouping is arrived at and the correct sound is uttered. By repetition the representation of this muscular grouping becomes more and more organised in the kinaesthetic centres, and the connecting path from auditory to kinaesthetic centres becomes more and more permeable, so that, when the sound of the word stimulates the auditory centre, its correct utterance follows immediately like an echo.

In this way is built up a kinaesthetic memory-centre for words, always ready to respond to stimulation from the auditory centres and becoming more and more organised by each repetition.

When, at a later stage in the child's development, words are produced spontaneously, when the associations between ideas of

things and their names have become firmly established, the pathway to the kinaesthetic centre is still by way of the auditory centre, although now the primary incitations may be said to be derived from the "ideational centres" instead of from the peripheral terminations of the auditory nerves. The sight of an object, or the idea of an object aroused through associational channels, revives at the same time its designating sound representation; through the auditory centre the appropriate elements in the kinaesthetic centre are stimulated; efferent impulses from the kinaesthetic centre stimulate the motor centres in the bulb, and the name of the object is uttered.

At a later period in the child's education, when he has already accumulated a considerable number of auditory and kinaesthetic word-memories, he may proceed to acquire another form of word-memory - a visual word-memory - which, as a factor in his further mental development, is of the greatest importance. He learns that the various words, with which he is already familiar as sounds, may be symbolised by graphic signs variously arranged.

The process of learning to interpret these signs, and of associating their various combinations with the sounds he already knows, is long and tedious. He has first to learn the various letters of the alphabet, associating their forms with their arbitrary sound designations, and these with the articulatory movements necessary for their production. He thus acquires an entirely new series of memories, - a visual letter-memory, an auditory letter-memory, and a kinaesthetic letter-memory.

The visual letter-memory is a memory of certain signs which are symbols of certain sounds. The sight of the written sign calls up its equivalent sound-memory in the auditory centre, which, in its turn, excites the appropriate elements in the kinaesthetic centre, thus leading to the utterance of the letter-sound.

Up till now the child's education in reading has been confined to the recognition of certain meaningless signs and their association with certain meaningless sounds; but he soon learns that combinations of these signs may serve to symbolise sounds with whose meaning he is already familiar. He begins with short monosyllables, spelling the words aloud letter by letter, and then pronouncing the word as a whole. It might be supposed that his previously acquired knowledge of the sound equivalents of the various letters would enable him speedily to effect the pronunciation of these small words; in reality it is not so. Teachers of children have told me that the recognition of the letters of a word is no guide to the majority of children as to the pronunciation of the word. I have heard a child trying to read the word "cat" call it "man". It would appear that the sound of every monosyllable has to be learnt as a whole, quite apart from a knowledge of its component letters. M a n is pronounced "man" by the child, not because of any relation between the sounds of the various letters to the sound of the word "man", but just because he is told that m a n is "man" and not "cat" or any other sound. No doubt at a later period the

child brings his reasoning power to bear on the relation between letter-sounds and word-sounds, and children vary greatly in their rate of development in this respect; but probably all children, to begin with, learn to read many monosyllabic words simply as word-sounds, without being guided, in any way, by the known sounds of the component letters.

In learning to read, associations are formed between the visual symbols and the auditory representations which they symbolise, so that the sight of the written word calls up the memory of its sound equivalent. At the same time, or a little later, the converse form of association has to be established, so that the sound of a word may call up the visual memory of the written or printed word. This is a necessary preliminary to the full attainment of the fourth form of word-memory which is acquired when the child has learnt to write.

In learning to write, the child, to begin with, has to copy letters and words from a model placed before him. A special set of coordinated movements is necessary, and it is only after much practice that anything like facility is obtained.

Guided at first by direct visual impressions, and later by visual memories, the kinaesthetic centre for writing movements in time becomes so deeply organised that in educated people these movements become almost automatic. Yet it is important to note that these well organised kinaesthetic centres can be aroused to activity only through the centres, and through the individual elements of the centres, which presided over the

education of the kinaesthetic centres in the process of learning to write. In the absence of visual letter- and word-memories the most skilful penman is unable to write a single letter or syllable spontaneously; and, in attempting to copy, his attempts are on a level with those of a child who has not got beyond the stage of pot-hooks.

In order to write spontaneously, the auditory representations of the sounds of words must call up the visual memories of their written appearance in the visual word-centre, which tells them off, letter by letter, to the kinaesthetic centre concerned in writing. In writing to dictation the writing path is the same; whilst in copying, the visual word-centre is stimulated by direct sensory impressions.

It is now generally admitted that, in educated people, there are these four forms of word-memory. These word-memories are the memory-images of the sensations through which we acquire a knowledge of words. We hear words and we have an auditory word-memory; we see words written and we have a visual word-memory; we utter words and we have memories of the movements necessary for speech; we write words and we have memories of writing movements.

It is also generally believed that each of these forms of word-memory has a separate and more or less definite localisation in the cortex of the brain. That this localisation should be confined to one hemisphere came to be regarded as a matter of course as soon as the first surprise at the possibility of

such an arrangement had been overcome. The more we know of speech defects, however, the more importance are we inclined to ascribe to the related centres in the opposite hemisphere. Nevertheless, there is no getting away from the fact that in the great majority of people the left hemisphere takes a vastly predominant part in speech processes. Many attempts to explain this peculiarity of our nervous constitution have been made, and none of them are very satisfactory.

At a comparatively early period in the investigation of speech defects it was discovered that the predominance of the left hemisphere in speech processes is associated with right-handedness, and that in individuals who are left-handed the right hemisphere has a corresponding pre-eminence. All efforts to account for this relegation of the speech centres to one or other side of the brain by anatomical peculiarities, such as differences in the size of the carotids or the greater development of one side of the cerebrum, are quite inadequate. The only suggestion of any real value on this subject was made by Moxon in 1866.* He showed how much easier it is for delicate or complex movements to be performed if the attention is confined to those originating in one hemisphere of the brain instead of being divided between those emanating from both hemispheres. Now, the movements necessary for speech are delicate and complex, and if they could be brought about by the action of centres on one side of the brain there would be a great saving of labour and an increase in efficiency.

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* Moxon :- British and Foreign Med. Chir. Review, 1866, p 481.

This possibility, in reference to speech movements, is now recognised as a fact. According to Broadbent's law, muscles which act uniformly with their fellows of the opposite side may be innervated from either hemisphere; and clinical and pathological records show that when the kinaesthetic centres for speech are destroyed on one side, those of the other side may be trained to take up their functions. This hypothesis may help to explain why speech movements have their origin in one hemisphere, but it does not explain why this should be the left rather than the right or why the side should vary according to whether a person is right- or left-handed.

The word-centre whose localisation has been known longest, and about which we have most definite information, is that in which are registered the memories of the movements concerned in the production of spoken words. This was the area originally asserted by Broca to be the seat of the faculty of speech as a whole. Since Broca's time it has generally been known as the "motor speech centre", but those of us who regard this region of the brain as being sensory in character must adopt the designation suggested by Bastian* and refer to it as the glosso-kinaesthetic centre for speech. Most clinicians are at one in believing that this centre is limited to the foot of the third left frontal convolution; but, as we shall see later, there is not entire unanimity upon this point.

Although there is still some doubt about the localisation of the auditory centre as a whole, the evidence is supposed to

* Bastian :- Aphasia p13.

be very complete in regard to that of the auditory word-centre. The posterior half or two-thirds of the left superior temporal convolution and, probably, the posterior part of the middle temporal convolution, are considered to be the site of the registration of auditory word-memories.

The centre subserving the visual memory of words has been shown by numerous cases of loss of visual word-memory to be located in the left angular gyrus and ~~the~~ supra-marginal gyrus; and there is some evidence which points to the conclusion that the visual memories of words, letters, numerals, and musical notes, have each a more or less separate localisation in this neighbourhood.

The localisation of a special centre for the memories of the movements employed in writing - a cheiro-kinaesthetic centre, as Bastian has termed it - has not yet received ~~any~~ much pathological confirmation. It has been customary to follow Exner who ascribed to it a position in the posterior part of the second left frontal convolution, in close relation to the centres for the other movements of the right hand and arm.

Having considered the various forms of word-memory as memories of symbols, dependent on the activity of certain word-centres, it is necessary to examine in more detail the relation which the different forms of word-memory have to one another and to the thoughts which the words symbolize. Before doing so it will be well to say something about the movements employed in speech.

The production of any form of language, whether it be the natural language of gesture or acquired language, spoken or written, depends on a series of movements coordinated to a certain end. The nature of this coordination, its importance, and how it is effected, may be best studied in connection with the production of articulate speech.

In the utterance of words there are three separate muscular mechanisms concerned: (1) there is the respiratory mechanism, the action of which is necessary to supply the blast of air through the larynx and the oral cavity; (2) there is the laryngeal mechanism on which the voice sounds depend; (3) there is the oral mechanism by which the sounds produced in the larynx are modified in tone, or quality, and by which new sounds, originating in the mouth, may be added to the vocal sounds.

A spoken word, even a short monosyllabic word, is not the simple single sound which it may appear to be, but is made up of a series of sound-units following each other in rapid succession; and a word of three or four syllables is not a succession of three or four sounds, but a succession of three or four series of sound-units. These sound-units are not identical with the sounds of the letters of which the written word is composed; but, for purposes of analysis, various Physiological Alphabets have been prepared which include all, and only, the sound-units of speech. One of the best and simplest in relation to the English language is that given by Professor Wyllie* in his great work "The Disorders of Speech".

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* Wyllie:- Disorders of Speech. p. 6, and Frontispiece.

WYLLIE'S PHYSIOLOGICAL ALPHABET. (Disorders of Speech. facing title-page.)

I. - VOWELS

y - i e a o u - w

These should be pronounced in the Latin manner, as ee, eh, ah, oh, oo. As explained by Professor Wyllie in his text, y and w, although consonants, have very close relationships to the vowels, initial y being very closely related to i, and initial w to u.

II. - CONSONANTS

	Voiceless Oral Consonants.	Voiced Oral Consonants.	Voiced Nasal Resonants.
Labials.	P	B	M
(1st Stop Position)	(W)	W	
Labio-Dentals.	F	V	
Linguo-Dentals	Th	Th	
	S	Z	
Anterior	Sh	Zh	
Linguo Palatals.	T	D	N
	(L)	L	
(2nd Stop Position)		R	
Posterior	K	G	Ng
Linguo-Palatals	H or Ch	Y	
(3rd Stop Position)		(R)	

On examining the Physiological Alphabet it will be seen that the unit sounds of speech may be divided into those in which there is a vocal element,- the long and short vowels, the voiced oral consonants, and the nasal resonants; and those in which there is no element of voice,- the voiceless oral consonants. In the production of the latter only two of the muscular mechanisms are employed - the respiratory and the oral. Disregarding, for a moment, the respiratory mechanism, we may say that the production of voiceless oral consonants depends on the co-ordination of the various muscles of the oral mechanism so that they all perform their respective parts in the act at the same time. It is a co-ordination in simultaneity of the various elements of one mechanism within itself - a co-ordination of muscular actions. When we remember the part played by the respiratory mechanism it is apparent that there is also a co-ordination in simultaneity of one mechanism with another - a co-ordination of movements. This is still more evident if we consider the mode of production of the voiced units. Besides the co-ordination in simultaneity of the various muscles of each mechanism within itself, whereby each mechanism performs properly its share in the act of speech, there must be a similar co-ordination of all three mechanisms so that they all come into action at the same moment. If they do not, if one mechanism lags behind, there will be some defect of speech, as in stammering. In this form of speech-defect the action of the mechanism for the production of voice is delayed, the co-ordination in simultaneity is at fault, and the

act as a whole is marred in its performance.

There is another form of coordination of movement which is even more important in speech production than coordination in simultaneity. Speech consists of successions of sound-units grouped together into syllables; the syllables are joined together to form words; the words are arranged in successive phrases and sentences. This is coordination in succession. Unless the initial sound-unit is followed by its proper successors, unless one syllable is followed by its appropriate syllable, unless one word is followed by another in due sequence, speech is rendered unintelligible. Speech, as an intelligent action, depends on a succession of movements coordinated to a certain end. If the coordination in succession is faulty to any extent, to that extent the end is not attained.

What, then, is the nervous mechanism underlying this coordination in succession? Is it due to any fixed arrangement, and if so, how was such an arrangement evolved?

A child learning to say his first word is trying to effect a new adjustment between his organism and his environment, and the method of acquisition is the method of trial and failure. The necessary physiological apparatus does not exist in a perfect state; it has to be organised by repetition. A succession of sounds falling upon the auditory word-centre leads to excitation in the glosso-kinaesthetic centre of certain elements in which are represented movements which have given rise to the production of similar sounds in the past. An exactly similar sound-sequence

has never been produced before, so it is unlikely that the correct movements will be elicited at the first attempt. The error is appreciated by the ear, a fresh attempt is made, and so on, until the correct sounds are produced. Each sound-unit represented in the auditory centre becomes associated with its appropriate movement represented in the glosso-kinaesthetic centre; and since the sound-units are received by the auditory centre in succession, they may be revived in succession, and thus lead to successive excitations of the related elements in the glosso-kinaesthetic centre. Further, an associative connection becomes established between the elements of the glosso-kinaesthetic centre through afferent impressions derived from the moving parts, so that the sensations arising from one movement may act as a reinforcement to the stimuli, emanating from the auditory centre, which lead to the initiation of the succeeding movement.

It may be said, then, that for the production of a word consisting of a short series of sound-units the mechanism which governs the co-ordination in succession of the necessary movements is located in the auditory centres and is reinforced by kinaesthetic impressions derived from the moving parts.

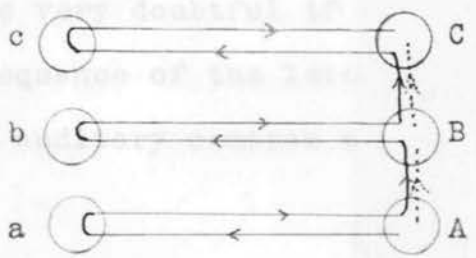
And this association by contiguity of sound-sequence representation might, conceivably, be the only source of the co-ordination in succession of speech movements. But when we consider that during the period of education the auditory memory of words is greatly helped by practice in pronouncing the words

it is evident that the associative process in the auditory centre is reinforced in some way by glosso-kinaesthetic action.

In teaching a child a word of more than one syllable he is made to pronounce one syllable and then another, and, finally, the word as a whole. Now, the association in the child 's mind between the first and second syllable is not merely an association between two syllable-sounds, but an association between a syllable sound, a movement made, and a second syllable-sound. The kinaesthetic impressions resulting from the utterance of the first syllable form a bond of association between the two syllables; and so, when the auditory memory of the word arises in the child's mind, kinaesthetic representations may be an important factor in determining the sound-sequence remembered. The process may be illustrated by means of a diagram.

A B C are the memories of the syllable-sounds of a word, and a b c the memories of the movements necessary for their utterance. The association path utilised in the recall of A B C is not A····B····C but, according to the order in which the assosciations were formed when the word was first learnt, A — a — B — b — C.

The dotted line shows association by contiguity of sound-sequence, the continuous line, association through reinforcement by kinaesthetic representations.



In this way the co-ordination in succession of the movements necessary for the production of words is dependent on the revival in proper sequence of the auditory representations of the sounds to be produced; and this revival of the auditory representations in due sequence is controlled and guided, in part at least, by asso$ciation with the kinaesthetic impressions, presented or represented, which result from the movements made in the production of the words.

This participation of the kinaesthetic centres in the recall of auditory word-memories may, at first, be accompanied by a mental image, more or less distinct, of the speech movements; but as the word-memory becomes more perfect and the production of words becomes automatic, the conscious element disappears, and the kinaesthetic centres form, in the chain of asso$ciation, merely an organic link whose functioning has little or no conscious mental concommitant.

Just as the co-ordination in succession of syllables to form words may depend on asso$ciative paths in the nervous tissues, organised by repetition, so, a succession of words learnt by heart may be similarly linked together. The memory of the alphabetical sequence is, probably, almost entirely dependent on the participation of the kinaesthetic centres in the process of learning the alphabet. It is very doubtful if any ordinary person could ever learn the sequence of the letters of the alphabet by means of the visual or auditory centres alone. It would appear to be

the ingoing impressions resulting from the movements used in the production of one letter-sound which leads to the revival of the memory of the next letter. This dependence of the memory of sequences, learnt primarily through the visual or auditory centres, on kinaesthetic impressions, is more strikingly shown when the child comes to learn the multiplication table. Long after he is able to repeat it correctly from twice one to twelve times twelve, he may be unable to answer any question such as what is four times seven, without mentally repeating the whole column from four times one to four times seven.

The same thing is true of all ~~sequences of~~ word-sequences learnt by heart; but when we consider the co-ordination in succession of words used in spontaneous speech, it is at once apparent that something more than such a fixed arrangement of nervous structures is involved. Here an entirely new element is introduced. Hitherto we have been dealing with words as series of sound-sequences, and series of movements, without any regard to their meaning, or, at least, without any thought of their adaptation to the special circumstances of the individual. We may have auditory and kinaesthetic memories of words without attaching to them any meaning, as when we learn to pronounce, without understanding, a sentence in a foreign language.

The co-ordination in succession of words thus learnt by rote is controlled by fixed nervous arrangements organised in the process of learning. But, for the purpose of spontaneous speech,

every word and phrase must have some definite meaning attached to it, and their coordination in succession depends entirely on the circumstances in which we are placed. It is a question of the adjustment of the organism to its environment; its explanation is the subject-matter of objective psychology and does not concern us here.

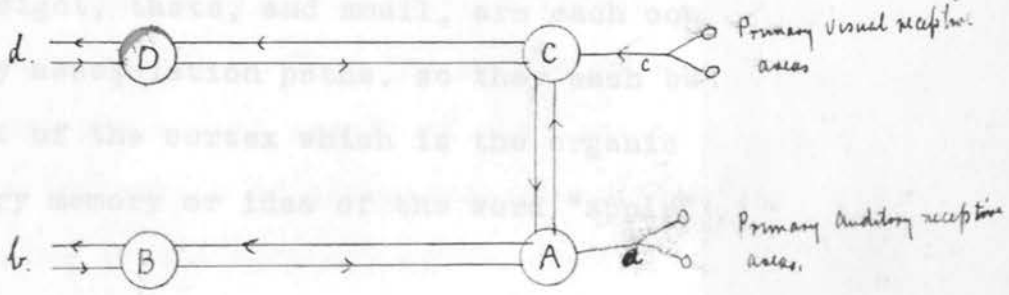
The attachment of words to their meanings is a matter which we shall have to consider, but before doing so it will be well to examine the relations which the visual word-centre and the cheiro-kinaesthetic centre have to one another and to the other word-centres.

There is abundant clinical evidence to show that the visual word-centre has a relation to the cheiro-kinaesthetic centre similar to that which I have described as existing between the auditory and the glosso-kinaesthetic centre. The movements of the hand in writing are coordinated in succession by visual memories of the successive letters to be written, and the coordination so effected is reinforced by kinaesthetic impressions derived from the moving parts. The revival of words in the visual centre may be helped by stimuli derived from the cheiro-kinaesthetic centre, although, here, this is not so important as in the case of the revival of auditory word-memories. For the succession of the letters and syllables of a written word is not a succession in time but in space. and, up to a certain point, the extended picture of the written word may be revived in the

visual word-centre as a single memory not requiring any associat--ive process to bind its component parts together. Nevertheless. the existence of a backward connection between the cheiro-kinaesthetic centre and the visual word-centre is shown by the possibility of reading by cheiro-kinaesthetic impressions so long as the visual word-centre is intact, whilst, if the visual word-centre is destroyed, this is impossible.

These two word-centres, then, are joined together by two sets of commissures just as the auditory word-centre and the glosso-kinaesthetic centre are. This may be indicated in a diagram.

A, B, C, and D are the four word centres. A is the auditory-word-centre, connected with the glosso-kinaesthetic centre by two pathways A-B and B-A. The visual word-centre C is similarly connected with D, the cheiro-kinaesthetic centre, by C-D, and D-C. A and B become connected when we learn to speak. C and D when we learn to write. Before we learn to write we are taught to read, so that C becomes joined to A by a commissure C-A; and when we are taught to spell and to write spontaneously, when the sound of a word is able to call up its written equivalent, A becomes connected with C by the commissure A-C.



These are the connections between the various word-centres which, from a consideration of the ordinary course of education, we should expect to exist; we shall see in the course of our examination of the dissolutions of word-memories how far such connections may be deduced from clinical and pathological evidence; and, further, the question will arise as to whether it may be necessary to postulate any other connections between the different word-centres.

In the meantime, however, there remains to be considered the most important connection of all, namely, the organic basis of the relation between words and their meanings, between language and thought.

We have already seen the nature of the process involved in our cognition of an apple as an object having a certain appearance, taste, smell,&c. We have memories of sight, taste, smell, which together form our complex idea of the apple. We may now carry the process a step farther. We are told that the object is an apple. Immediately,this sound designation becomes an attribute of the apple just as much as any of its qualities; and just as the various parts of the cortex subserving the ideas of sight, taste, and smell, are each connected with one another by association paths, so they each become connected with that part of the cortex which is the organic substratum of the auditory memory or idea of the word "apple".

We pronounce the word "apple" and we have sensations of the movements necessary for its utterance. In most people these sensations are vague and indistinct and the memory of them still more so. Yet, if these kinaesthetic memories are realisable in consciousness at all, they may become associated with the other ideas which we have of the apple. But such association, if it is ever formed, will have little intellectual value, and its physical basis will never become organised.

Owing to the indistinctness and want of intensity of the kinaesthetic impressions, the attention, on which the determination of association so greatly depends, is never brought to bear on the relation between the meaning of a word and the sensations of movement accompanying its utterance. When we are learning to pronounce a word the attention is confined to the relation between the sound which we are attempting to produce and the movements necessary for its production. We are forming an association between an auditory idea and a kinaesthetic idea. On the other hand, when we are learning the name of a thing the attention is brought to bear on the relation between the name and the ideas which we already have of the object.

The converse form of association - that between the idea of the thing and its name - is, I believe, effected also through the auditory word-centre. When the memory of an object leads us to utter its name, the mental recall of the name is an auditory revival, and the incitation of the glosso-kinaesthetic is secondary to the functioning of the auditory word-centre. In all normal

individuals the path through the auditory centre is the one necessarily employed in learning a language. We must have an idea of the sound before we can produce it; and when we have acquired a wide vocabulary and become proficient in its use, the same route must be followed as was necessary during its acquisition. It is merely travelled more quickly, so that we are barely conscious of any intermediate process between the inception of the thought and its utterance.

Thus psychological considerations alone would lead us to the conclusion, so far, at least, as the auditory and glosso-kinaesthetic representations are concerned, that words are associated with their content, and things with the words that designate them, mainly, if not entirely, through the auditory word-memory.

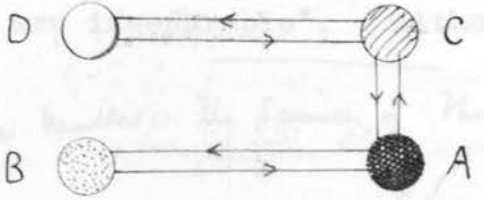
When we learn to read, we know that the written word "apple" stands as a symbol for the sound "apple", of which we already know the meaning. It is a symbol of a symbol, and there would appear to be no need for the establishment of any direct association between the written symbol and the meaning of the word. But the visual sensation of the written word has distinctness and intensity, and these are factors which are of importance in determining association. If the attention were directed to the relation of the written word to the object which it stands for, a direct association might become established between the written word and its meaning.

But since the asso$ciative path first opened up is that which tends to be most used, and therefore to become the most organised, it is not surprising that in the great majority of people, if not in all, the meaning is attached chiefly to the auditory symbol which is the first form of word-memory to be acquired.

The cheiro-kinaesthetic memory of words would seem to have even less relation to the meaning of words than the glosso-kin--aesthetic memory. In the absence of visual word-memories it is doubtful if any information can ever be gained by arousing ~~th~~ the cheiro-kinaesthetic centre through impressions derived from the hand in tracing over the letters of a word. Nor can the idea of a thing lead directly to the revival of the cheiro-kinaesthetic centre so as to lead to the writing of the word, except through the intermediation of the auditory and visual word-centre**s**.

Thus we may come to the conclusion that in thought and speech the meanings of words are brought into relation with verbal symbols mainly, and in most people, through the auditory word--centre; partly, and sometimes, through the visual word-centre; very little, or not at all, and seldom, if ever, through the glosso-kinaesthetic centre; and, never, to any extent, through the cheiro-kinaesthetic centre.

These views on the relation of thought to the various forms of word-memory may be indicated by the depth of shading of the different centres in the diagram already given.



Hitherto we have confined our examination of the relations between thought and language to that subsisting between our ideas of a concrete object and the name by which it is designated.

In passing from the realm of immediate sense-experience to that of conceptual thought we are at once confronted by our ignorance in regard to the physical correlate of thought processes in general.

It may, perhaps, be said that the more general a concept is the greater is the area of the cortex involved and the more dependent the concept for its very existence on the word, which alone is able to bind together the component ideas which take part in its formation. The appearance of the concept "fruit" in consciousness is accompanied by excitation of the cortical elements subserving the various ideas involved in the concepts apple, pear, plum,&c., and the idea of the word "fruit".

In such concrete conceptions the component ideas refer directly to sensations; but simple ideas derived from sensation may be grouped in new combinations which have never been presented to the senses. By generalisation these reflective or imaginative ideas give rise to abstract conceptions, which are even more dependent on the words which we use to designate them than the most general concrete conceptions are.

The more abstract thought becomes, the greater is the necessity for liguistic symbols; and the recognition of this fact has led to the controversy as to whether thought is possible at all without words. Max Muller maintained that it is not: that "thought and language are inseparable"*. Although all may agree that this

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* Max Muller: The Science of Thought, 1887, p. 56

is true of thought in its highest forms, most authorities are now at one in holding that thinking on a lower plane, thinking by "percepts" or by "recepts"* may be carried on without the help or knowledge of words, as in uneducated deaf-mutes and the lower animals. But there can be no doubt about the importance of words in all higher forms of thought. In fact it is very generally recognised that mental evolution in man has been coincident with, and to a great extent dependent on, the development of language.

The part played by words in the intellectual progress of the individual has been long recognised by philosophers. Sir William Hamilton said: "Words are fortresses of thought; they enable us to realise our dominion over what we have already run in thought; to make every intellectual conquest the basis for others still beyond.....unless thought be accompanied at each point of its evolution by a corresponding evolution of language, its further development is arrested".†

This opening up of the mind to wider and wider intellectual possibilities as a result of the acquisition of language has received a most striking exemplification in recent years. The increased intelligence of deaf-mutes after they have been taught the use of words has been long known, and when Dr. Howe succeeded in teaching Laura Bridgman, who was both deaf and blind, the importance of words in this respect became still more evident. At the present day, however, we are in possession of evidence

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* Romanes G. J.:- Mental Evolution in Man, 1888, p. 36.

† Hamilton, Sir W.:- Lectures Vol III. pp. 138-140.

much more conclusive and striking. One of the most remarkable records in the history of education is the life of Helen Keller,* written by herself. Deaf and blind from the age of nineteen months, she has learnt everything that is included in a modern education and has passed through a full curriculum at Radcliffe College. The story of Miss Keller's life and education affords abundant evidence of the value of words as a stimulus to thought, and throws an illuminating light on many problems in Psychology and Pedagogy.

Some writers, whilst admitting the importance of words as a means whereby fresh ideas may be acquired, have held the belief that these ideas, as soon as they are formed, possess an independence of words. The choice which we appear to exercise in the use of words, even in the case of abstract thought, would seem to give some support to this belief. But, when a thought becomes nascent in the mind, it may arouse associations with several words, each having as its content some of the component ideas or groups of ideas involved in the concept. The more clearly the thought is realised the easier does the revival of the appropriate word become. The struggle for supremacy among the different words depends on the unequal strength of their associations with the groups of ideas forming the concept, and the victory of one leads to the feeling that a choice has been exercised. It may, indeed, be doubted if an abstract thought is ever clearly defined in consciousness unless it is accompanied

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* Helen Keller:- The Story of my Life. London 1903.

by its appropriate verbal symbol. "The ordinary man will never get rid of the fallacy that words obey thought, that one thinks first and phrases afterwards. There must first, it is true, be the intention, the desire to utter something, but the idea does not often become specific, does not take shape until it is phrased; certainly an idea is a different thing by virtue of being phrased. Words often make the thought, and the master of words will say things greater than are in him".*

A question which has been much discussed by writers on Aphasia may be referred to here. Does ideation or conception, it has been asked, take place in a centre apart from the centres of sense-representation?

The description given in the previous pages of the nature and localisation of the nervous structures concerned in the formation of ideas represents, I believe, the opinion of most modern psychologists, and is distinctly opposed to any such possibility; yet it is not really at variance with the views put forward by some writers who have been severely criticised for postulating a separate centre for concepts.

It seems to me that the diagraphic indication of the connection which exists between a word and its meaning has been a source of much misunderstanding in this matter.

The first important contribution to this subject was made by Sir William Broadbent in his memoir "On the Cerebral mechanism of Speech and Thought".† In this paper he put forward views

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* John about Macey in the Story of my Life by Helen Keller, p. 419.

† Broadbent:- Transactions of the Royal Med. and Chirurg. Soc. 1872. p145

which, although at one time widely accepted, are adhered to by only a few writers at the present day. He said: " To the 'perceptive centres' I relegate simply the translation of sensations into rudimentary or primary perceptions.....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 various perceptive centres upon a common intermediate cell area".* Since this process is usually accompanied by the affixing of a name to the object Broadbent, in a later communication, termed this area the "naming centre".†

Now, so far, at least, as concrete conceptions are concerned we believe that this view is erroneous and that their evolution from the combinations of various sense-memories is accompanied by "radiation from one perceptive centre to all the others". But the more abstract the conception is, the more truth there will be seen to be in Broadbent's words; and if we substitute the auditory word-centre for his naming centre his description agrees to a great extent with what I have said on the relations subsisting between the auditory word-memory and abstract thought.

Other writers, such as Kussmaul, Lichtheim, and Charcot, have been credited by their critics with an adoption of Broadbent's views, but it seems clear that when these writers put a "centre for concepts" in their diagrams and referred to it in their ~~texts~~ texts, they by no means held the same views as Broadbent, nor did

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* Broadbent Trans. Royal Med Chir Soc. 1872. p 188
† Broadbent Brain Vol i. 1878. p. 494.

their "concept centre" correspond to his "naming centre".

What most of these writers mean when they depict a centre for concepts is, I think, well expressed by Kussmaul in his explanation of this centre in his own diagram. He says: " The centre (M) designates the ideational centre or centre of conception, in other words all that portion of the cellular network of the cortex in which ideas are produced as a result of impressions of the most varied description made on the senses, object and word images." *

In like manner Lichtheim expresses his dissent from the view, which his diagrams might imply, that there is a centre for conceptions confined to any one area of the brain. "Though in the diagram" he says, "(M) is represented as a sort of centre for the elaboration of concepts, this has been done for simplicity's sake; with most writers I do not consider the function to be localised in one spot of the brain but rather to result from the combined action of the whole sensorial sphere". †

In view of such disclaimers it seems unjust to ascribe to these writers the opinion that there is a special centre for concepts. The scattered areas which make up their "concept centre" evidently corresponds to Broadbent's "perceptive centres", but joined together "by radiation from one perceptive centre to all the others"; and the "common intermediate cell area" to which they converge is one or more of what are now termed word-centres.

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* Kussmaul :- Disturbances of Speech. Zeumssen Cyclop. Vol 14. p. 780.

† Lichtheim :- On aphasia. Brain Jan. 1885. p 477.

The close connection between conception and naming led Broadbent to believe that both processes are consummated in a common centre. These other writers, while believing that ideas may be evolved by intercommunication between their component sensory representations, acknowledge that, for the purpose of naming, convergence to a common centre - a word-centre - is necessary.

Lichtheim, in his diagram 7,* shows clearly that he does not consider the centre for concepts to be limited to one spot in the brain but that it is formed by a combination of the various perceptive centres. He does not, however, indicate how these centres are joined together by commissures. These radiations between the various perceptive centres were added to Lichtheim's diagram by Wernicke, and the diagram so modified has been accepted by Wyllie† as a useful means of illustrating the constitution of "word-percepts" and "object-percepts" and their relation one to another.

There seems to be very little difference between the views of these writers and those of their critics. Bastian‡ indeed admits that the words of Lichtheim quoted above are quite in accordance with his own view although he thinks that they are at variance with the diagrams and with the language in many parts of Lichtheim's paper.

Now, it must be admitted that some other parts of the brain besides the word-centres, are involved during ideation and that

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* Lichtheim: on aphasia. Brain 1885. Jan. p 478

† Wyllie: Disorders of Speech. p 276

‡ Bastian: Aphasia p. 45

if the idea is assosciated with a name - if it has a word as one of its attributes - there must be some communicating channel between these other parts of the brain and the word-centres. If so much is conceded it is surely perfectly legitimate to indicate such a connection diagraphically. On the other hand, such a distinction between words and ideas or concepts cannot be defended as being strictly accurate; for the word-representation is just as much a component of the idea as the other sense-representations which form its content; and the word-centres should thus be included in the "ideational" or "concept" centre.

The view insisted on by Wyllie*, which makes the various forms of word-memory a partial, or separate, idea which, united with the partial or separate idea of an object formed by the fusion of its other sensory representations, makes up our total idea of the object, gets over the difficulty, and justifies the splitting up of the "centre for ideation" into two parts, - one represented by the various word-centres, and one as a "centre" which includes the whole of the rest of the cortex concerned.

Whilst, on such an understanding, it may be legitimate enough to depict such a centre for concepts, it is a very different matter to say that such a scheme is necessary for the explanation of any known or possible defect of speech; but for the purpose of discussing the relations between thought and words, it serves to illustrate, in a very simple and definite manner, the views of the different writers who have dealt with this subject.

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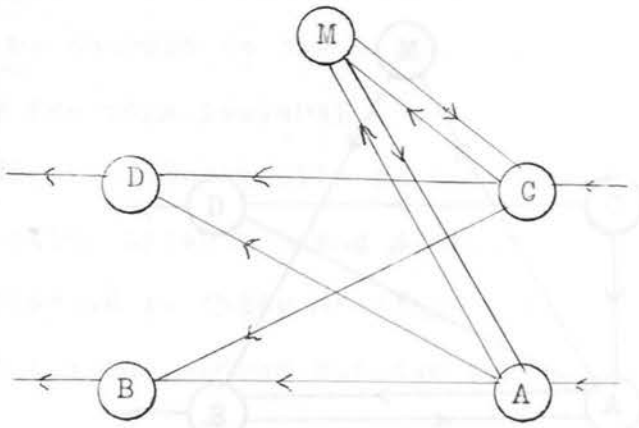
* Wyllie:. Disorders of Speech. p.234



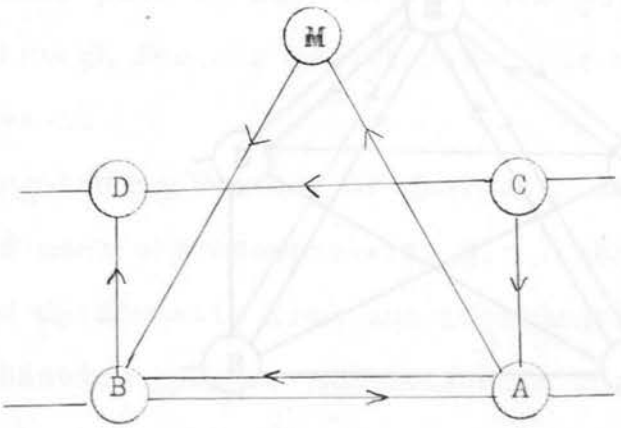
Kussmaul's diagram (modified). Ziemssen's Encyclop. V.xiv p.779.

Understanding of spoken language, A-M.

Understanding of written language, C-M.

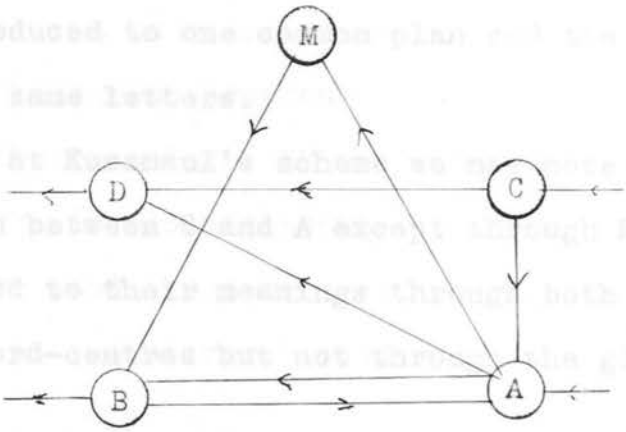
Voluntary speech, M-A-B.

Voluntary writing, M-C-D.



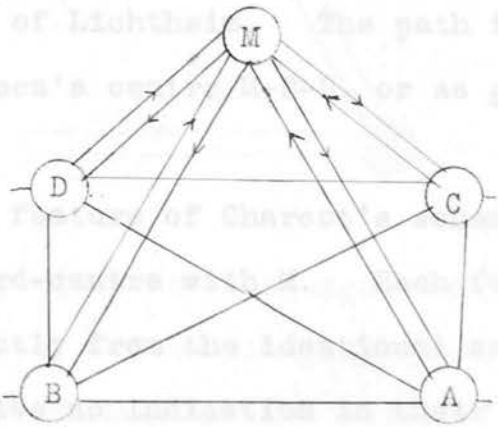
Lichtheim's first diagram (modified). Brain, Jan.1885,p.437.

Understanding of spoken language. A-M
Understanding of written language. C-A-M.
Voluntary speech. M-B.
Voluntary writing. M-B-D.



Lichtheim's second diagram.(modified). Brain, Jan.1885, p.443.

Voluntary writing. M-B-A-D.



Charcot's diagram (modified) after Bernard, de l'Aphasie,p.37.

Understanding of spoken language. A-M.

Understanding of written language. C-M.

Voluntary speech. M-B.

Voluntary writing. M-D.

For the purpose of comparison some of the diagrams of these writers may be reduced to one common plan and the various centres indicated by the same letters.

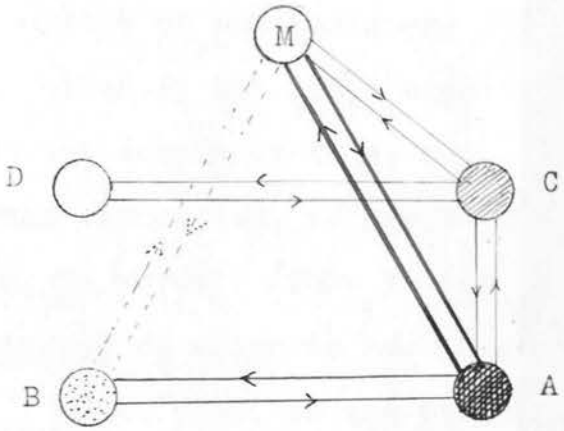
Looking first at Kussmaul's scheme we may note the absence of any connection between C and A except through M. For Kussmaul words are attached to their meanings through both the auditory and the visual word-centres but not through the glosso-kinaesthetic centre.

In Lichtheim's scheme C is not connected directly with M but by the path C-A-M. A and M are united directly by a single commissure A-M and M is connected with B by M-B. That is to say that when the meaning of a word heard is understood the path A-M is used, but that when a thought arises in the mind it becomes united with its linguistic symbol only through the path M-B, the "voluntary speech path" of Lichtheim. The path for voluntary writing is through Broca's centre M-B-D, or as given in his second diagram, M-B-A-D.

The distinguishing feature of Charcot's scheme is the direct connection of each word-centre with M. Each form of word-memory may be called up directly from the ideational centre.

Ross and Bastian give no indication in their diagrams of their opinion in regard to the relation of words to thought. In their texts, however, they both strongly teach that the auditory word-memory is that which is primarily revived in voluntary speech processes and that auditory word-memories form our real counters of thought.

The views which I have put forward in the previous pages may be indicated by a diagram constructed on the lines of those here described. To the scheme previously given a "concept centre" may be added. The importance of the different word-centres, in relation to thought, is already indicated by the depthe of shading of the word-centres, and the same relation may also be shown by the thickness of the commissural connections.



Understanding of spoken language. A-M.

Understanding of written language. C-A-M.

Voluntary speech. M-A-B.

Voluntary writing. M-A-C-D.

Chap.iii.

THE INNER SPEECH.

We are now in a position to consider a question which has given rise to much controversy, and which has led to great variety and conflict of opinion among different authorities.

When we are silently thinking, especially if our thoughts are of an abstract nature, or if we are arranging them in our minds for formal expression, we may be distinctly aware that we are "thinking in words". This is the "inner speech", "le langage intérieure" on which so much has been written in recent years. What, then, is the nature of this silent speech? How do our thoughts become linked with words, and what form of word-memory is primarily evoked in the process?

Much that has been said in the previous pages has of necessity prejudged this matter, but the questions involved are of such vital importance in regard to the dissolutions of word-memory met with in disease that it is necessary to examine the various opinions that have been put forward by different authors, and to endeavour, as far as possible, to account for.

and it may be to reconcile the differences of opinion which have been expressed.

As we have seen there are four distinct forms of word-memory, and some writers think that any one of these may be the source of the primary revival of words in thought. We may, to begin with, leave out of account the visual and the cheiro-kinaesthetic word-memory, since many people who can "think in words" are unable to read or write. The problem is thus reduced to the question whether the auditory word-centre or the glosso-kinaesthetic centre is the primary source of the word-representations employed in silent thought.

The history of the investigation of this subject has been well detailed by Victor Egger* in a work of much philosophic acumen and of rare literary grace. He points out that the ancient philosophers, whilst often closely approaching the subject of the inner speech, persistently failed to apprehend its real nature and its great importance in mental life.

Not until the seventeenth century do we find any adequate description of the inner speech distinctly dissociated from the phenomena which accompany or resemble it. Egger attributes this greater clear-sightedness of modern philosophers to two circumstances. One was certain usages of the Christian religion and the other was the nominalist theory so prevalent in the philosophy of the times.

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* Egger, La Parole intérieure, 2nd Edit. Paris 1904.

The formal distinction made by the Church between the Oratio vocalis and the Oratio mentalis, and the tendency for mental prayer to become the habitual state of profoundly religious souls, easily led up to the belief that an "internal speech" was a most ordinary condition of the human mind.

Bossuet was the first writer to distinguish clearly the psychological phenomenon of an internal language which was implicit in the Nominalism of the Middle Ages.[‡]

The earliest work in which we find any clear realisation of the relation of words to ideas is the Logic of Port Royal, and the description of this relationship there given contains the essence of the best beliefs of the present day...."l'idée de la chose excite l'idée du son, et l'idée du son celle de la chose".[*] A similar knowledge of the inner speech was shown by Locke in his Essay on the Human Understanding and by Leibnitz, but it is not until the end of the eighteenth century that we meet with anything like a clear description of this phenomenon. In his work "De l'universalité de la langue française" published in Paris in 1797, Rivarol clearly describes the true nature of the inner speech in the following words:[†] "L'idée simple a d'abord nécessité le signe, et bientôt le signe a fécondé l'idée; chaque mot a fixé la sienne, et telle est leur association, que, si la parole est une pensée qui se manifeste, il faut que la pensée soit une parole

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‡ Bossuet. La Logique. (from Egger. Op. cit. p.16-p17.).

* Port Royal: Logique (1683) II, p1. (from Egger. Op. cit. p. 17).

† Rivarol: De l'universalité de la langue française (from Egger. Op. cit. p21-p22)

intérieure et cachée; l'homme qui parle est donc l'homme qui pense tout haut.....Que dans la retraite et dans le silence le plus absolu un homme entre en méditation sur les sujets les plus dégagés de la matière, il entendra toujours au fond de sa poitrine une voix secrète qui nommera les objets à mesure qu'ils passeront en revue".

An almost exactly similar opinion was expressed by de Bonald*, whose works were, however, marred by insistance on the error, which has reappeared in recent years in the writings of Max Muller, that thought is impossible without words.

Up to this time all the writers who had dealt with the relation of language to ideas had considered the mental recall of words as a memory of word sounds. In a critical examination of the opinions of de Bonald, Maine de Biran† suggested the the idea, which subsequently became very popular, that language is a sort of muscular echo by which the vocal organs are instantaneously brought into relation with the impressions which the ear receives from the voice of another person. Only thus, he thought, does language become for each of us a personal possession, only thus does it become a vehicle for the expression of ideas. It is not a succession of sounds but a willed muscular movement.

These opposing views were to some extent combined by de Cardaillac in the most complete study of the inner speech which had yet been published.

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* de Bonald, Recherches Philosophiques (1818). (from Egger. Op. cit. p. 22).

† Maine de Biran, L'examen critique des opinions de M. de Bonald. (from Egger. Op. cit. p. 39).

While distinctly realising that we hear the words of our thoughts and that the inner speech is but the memory of sensations produced by the "outer speech", de Cardaillac* is at a loss to understand why the inner speech is relatively more distinct than our memories of other sensations.

Just as we cannot control our sensations so we have no power over our memories of sensations. On the other hand, "we exercise absolute empire over our motor organs", especially the organs of phonation. Since the inner speech is as much at our disposal as the outer speech, it would appear to follow the law of the outer speech instead of that of other memories of sensations. It is, therefore, chiefly a motor process, and the mental audition which accompanies it is a secondary phenomenon. In the active state, at least, in which we direct the course of our thoughts, we mentally hear ourselves speak because we first speak mentally. Thus speech, even the inner speech, is controlled by the laws which preside over muscular movements, because it is the habitual result of a movement.

The three theories which can be traced in the works of these early philosophers have each been defended in more recent times.

The conclusion of the earliest writers, that the sounds of words are our real counters of thought, has been reiterated and expanded by Charlton Bastian in England, and by Victor Egger

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* de Cardaillac, Études élémentaires de philosophie 2 vol., 1830 t II p 189-391. (from Egger Op. Cit. p 43).

in France. The view suggested by Maine de Biran has been brought into great prominence, and become very popular, by the writings of Alexander Bain and of Stricker of Vienna. The nature of the inner speech described by de Cardaillac has been upheld quite lately by G. St-Paul, of Tours, as being the most common of all "endophasic formulae".

The whole question of the inner speech received a new impetus from the teaching of Charcot, in France, which speedily led to a profound modification of the views previously entertained. It has long been known, and it was a prominent feature in Charcot's teaching, that in regard to the memory of sensations in general, great differences are to be found in different individuals as to the sense-memory which is best developed and on which they mainly rely. In some the visual memory is greatly predominant; in others some of the other senses is most highly developed. In some memory power of any kind is weak, in others it is strong. Charcot held that the same is true for word-memories and he classified all individuals into auditifs, visuels, and moteurs, according to the predominance in them of any particular form of word-memory.

These views had a great influence on writers of the French school. They were accepted by Désiré Bernard,† who, in his work on Aphasia, follows Charcot in believing that the majority of people are auditives, but that in a certain number of cases

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† Bernard, de l'aphasie, 2ème Edit., Paris, 1889, p. 41.

it is the visual word-memory, or the memory of articulatory movements, which is first revived in conciousness in thought and speech processes.

A full exposition and elaboration of Charcot's views has been made by Gilbert Ballet in his work "Le Langage intérieure", and, as these opinions have been very generally accepted by writers on Aphasia as giving the best explanation of some of the peculiarities and irregularities met with in cases of speech disturbance, it will be necessary to examine in some detail the evidence upon which Ballet relies for the proof of his thesis.

An important contribution to this subject has been made quite recently by G. St-Paul.* He adopts Charcot's classification of individuals into auditifs, visuels, and moteurs and has further differentiated many additional composite types.

In this country the importance ascribed to motor memories as a result of Bain's teaching, and his expressed views on their paramount importance in regard to word-memories in particular, have led to a widespread belief that words as we are conscious of them in thought are revived motor images. "A suppressed articulation", Bain says,† "is in fact the material of our recollection, the intellectual manifestation, the idea of speech."

All writers who have accepted Bain's views on the nature

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* G. St-Paul, Le Langage intérieure et les paraphasies. Paris 1904.

† Bain, The Senses and the Intellect, 4th Edit. 1894, p357.

of memories of movement in general have followed him in believing that words are primarily revived in thought as incipient motor processes; and among clinicians who have paid special attention to this subject no one has so ably applied the doctrines of Bain to the study of speech defects as Dr. Hughlings Jackson.

Stricker* of Vienna has also given his support in the strongest manner to this view, and his work stands alone as a defence of it based upon prolonged auto-observation. Stricker says: "When tranquilly seated, I close my eyes and lips, and come to evoke in my memory some well known word, it seems to me, if I fix my attention on my organs of articulation, that I speak inwardly.....I pronounce the words of which I think".* He asserts most emphatically that when he thinks in words, he has no consciousness whatever of any auditory word-image. His word-memory that enters into immediate relation with his thought consists, as Bain said, of a "suppressed articulation".

The opposite view - that words are primarily revived in thought as auditory memories - we owe to Charlton Bastian. The fact that Bastian does not admit the psychical importance of motor centres would of itself account for his total opposition to the views of Bain and Stricker; but even if it is admitted that motor representations are of sensory origin and

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* Stricker, Du Langage et de la musique, [redacted]. Paris 1885. p. 1.

are registered in sensory centres. there are still. he thinks. "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-kinaesthetic impressions in Broca's centre."* In his latest reference to this subject he gives the following reasons for his opposition to this view.* "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 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

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* H. Charlton Bastian, Aphasia and other Speech Defects, 1898, p. 21.

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 unmistakeably in its favour".

Egger* has arrived at the same conclusion on purely psychological grounds. The inner speech is an imitation or echo of the outer speech. We notice it as a sound, as an imitation of spoken language, and the voice which we hear is our own voice. "Ma parole intérieure est l'imitation de ma voix.... ...la parole intérieure est <u>comme</u> une parole, et ma parole intérieure est <u>comme</u> ma parole".* Whilst in the outer speech we feel very distinctly the movements of the tongue and lips in addition to the sounds of our own voice, the inner speech is "une image simple, une image purement sonore".† In our ordinary speech the attention is directed almost entirely to the sounds produced. So, in the inner speech, although being but an imitation of the outer speech, it has a double origin like its model, the kinaesthetic element(<u>l'image tactile</u>) in time disappears from consciousness in proportion to the absence of attention directed towards it. Egger admits that the vividness of the sense of movement may vary in different individuals and thinks that in those who chiefly use the inner speech as a preliminary to effective outward expression

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* Egger, La Parole intérieure, 1904. p. 67. † Ibid. p 75.

- actors, advocates, and certain professors - l'image tactile may be better conserved than in those whose thought is more purely contemplative.

The attempted reconciliation of these conflicting views by the Charcot school may be best studied in the work of Ballet and its more modern developments in that of G. St-Paul.

In "le Langage interieure" Ballet*, after some preliminary observations on the formation and development of language, in which he shows that our memory of words is a complex memory composed of four different kinds of images, states his belief that during reflection these images are present in our minds, and that the form of word-memory which is most vivid depends on our individual tendencies or aptitudes. "Nous entendons mentalement, nous voyons, nous parlons, ou même dans des cas exceptionnels, nous écrivons notre pensée." (bis)

In addition to these four types, auditifs, visuels, oral and graphic moteurs, Ballet describes another type which he believes to be the most common of all. In such individuals one form of word-memory shows no marked predominance over any other, and all forms may be used indifferently for the primary recall of words in thought and speech. To this class Ballet applies the name of "les indifférents".

In dealing with l'audition mentale Ballet shows that he recognises very clearly the importance of auditory word representations in thought processes. "We hear," he says, "the words

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* Gilbert Ballet:- Le Langage interieure et les diverses formes de l'Aphasie. 2-Ed. Paris

which express our thought, as if an internal voice spoke delicately in our ear".[p18] He admits that, since the voice which we hear most frequently is our own voice, the inner speech reveals ordinarily the characters of our own voice, its timbre, and its rythm; but he does not think, with Egger, that this is always so. As proof of this he points out that we can often recall the words or phrases spoken by others, not in our own voice but in theirs. Now, this may be at once admitted, but it seems to me to have very little bearing on the nature of the inner speech. The power of remembering the tones of another person's voice and associating them with words which he may have spoken, is closely allied to the memory for musical sounds and no doubt varies in different individuals. A more important point to be noted is this: the calling up, in the mind, of the words of another person, with, or without, association with the peculiarities of his voice, is of the nature of a memory of something learnt; and the mental process involved is of quite a different kind from that which obtains in spontaneous thought. The importance of this distinction will be more evident when we come to consider the visual recall of words; but, since this sort of evidence is constantly being put forward as a proof of this or that form of the primary recall of words in thought, it cannot be too often repeated or too strongly insisted upon, that the mode of recall of a series of words learnt in any particular way

has no direct bearing upon the question as to what form of word-memory is primarily evoked during our own proper thought processes.

Ballet concludes his examination of auditory word representations by saying that they are certainly the most important of all forms of word-memory in relation to the inner speech. He does not think there is any one (except those who are born deaf) in whom they are completely absent. We are all auditifs to a certain degree in the sense that we all have at our disposal a certain number of auditory word-images of which we constantly make use. Yet he thinks that in exceptional cases this form of word-memory is of secondary importance and that in some people, depending on hereditary predisposition or the nature of their education, visual or motor word representations acquire a marked predominance.

In discussing "la vision mentale" Ballet devotes his attention to an elaboration of the well known differences which are found in different individuals in regard to their powers of visual representation in general. He points out that while the auditory memory is chiefly a memory of signs -words,- the visual memory is essentially a memory of things and only exceptionally a memory of words. Nevertheless he thinks that in educated people the visual images of words hold a place, little or great, among psychic phenomena, and that in certain individuals the images of words are always visual.

visual. "Ces personnes n'entendent pas leur pensée, elles la lisent". (p41)

There is not much evidence brought forward in support of this proposition. The fact that mathematicians have to rely on the visual memory in regard to their language of signs does not help us in connection with the mental recall of words. As Ballet himself says, mathematical language has no "réalité auditive", and our knowledge of its signs is a knowledge derived from visual presentation whilst our knowledge of words is primarily and above all knowledge derived from auditory presentation. And just as visual representation is the usual mode of primary recall for mathematical signs so the usual mode of primary recall for the signs of ordinary language is auditory representation. As evidence of the possibility of the substitution of one form of word-memory for another as our counters of thought, it would be more to the point if a mathematician could be found who, instead of utilising his visual memory, relied on his auditory memory for the mental recall of mathematical signs.

A patient observed by Charcot, whose case has been recorded by Bernard is mentioned by Ballet as a very remarkable type of visuel. Here again, however, the evidence given is chiefly devoted to showing that this patient had recourse to his visual memory in the recollection of words learnt by heart, and does not necessarily prove that, in spontaneous thought,

the primary recall of words was not, in this patient, the same as in other people. "If he recited a lesson whilst at college or a passage from a favourite author at a later date, two or three readings sufficed to fix in his memory the page with its lines and its letters, and he recited by mentally reading the desired passage which, at the first summons, presented itself with the greatest distinctness." *

There can be no doubt that this patient had a remarkable capacity for the visual recall of words, but there seems to me to be nothing in the record incompatible with the belief, that, in ordinary thought processes, his recall of words may have been effected in the usual way. His visual memory being so strong he naturally utilised it for the recall of words seen. In learning a passage from a book he had no need, as most people have, to translate the written symbols into their auditory and glosso-kinaesthetic equivalents before they could be committed to memory. But the great power of the visual word-memory in this patient does not imply that, in order to apprehend the meaning of what he read, there was no need for the stimulation of his auditory word centre. It does not imply that the visual symbols were sufficient by themselves to evoke in his mind the ideas which they signified. If, in order to understand the meaning of what he read, it was necessary that the auditory word-memories should be aroused, then it would seem likely that, in order to think in words, his auditory word-images should be

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* Ballet. Le Langage intérieure p. 43.

first evoked, even if they had to be translated into their visual equivalents before they could be distinctly realised in consciousness. The ready manner in which people with a power of vivid visual representation can do this is shown by those instances, recorded by Galton,* of individuals who "see mentally in print every word that is uttered". In these cases the auditory word-memories are necessarily those which are first aroused, and although "they attend to the visual equivalent and not to the sound of the words" this may be merely an accidental phenomenon depending on the vivid nature of their visual word representations and not a necessary condition for the understanding of words heard. In every one there is probably more or less excitation of the visual word-centre in all speech processes, receptive or productive, and in individuals in whom the visual representation of words attains a marked degree of vividness it is quite likely that the visual equivalents of the words so aroused will most strikingly arrest the attention and become the "focus of consciousness". Yet prior to, or simultaneously with, the stimulation of the visual word-centre, the meaning of the words spoken is apprehended through the auditory word-centre. So, in spontaneous thought or speech, the primary connection between ideas and words may take place through auditory word representations, although, on introspection, it may be the visual equivalents which are most prominent in consciousness.

* Francis Galton,- Inquiries into Human Faculty. 1883. p 96.

This argument would apply also to the best piece of evidence adduced by Ballet in support of the belief that some people "read their thoughts". This is the case of the Geneva librarian who said: "When I think of a word or a phrase I see very distinctly this word or this phrase printed in ordinary characters, or written in my own writing or that of another person; the letters of a word are distinct from one another, and the intervals between each word written in black appear to me also. I see them in white. All my representations of words are visual." (p.44)

In his chapter on "Indifferents" Ballet says that a person with a visual memory so highly developed as this would, in the case of its loss, be in the position of a man who, having put all his money in one bank, becomes ruined on the day on which that bank fails. (p.60) And so he would if Ballet's views on the relation of the visual memory to thought and speech in these cases are correct. Such a man would then be aphasic and would suffer from great mental degradation; all abstract thought would be impossible and he might be word-deaf.

The possibility, however, of words being attached to their meanings, in such cases, through the visual word-memory only cannot be seriously entertained, unless the individual was born deaf, in which case he comes into a different category altogether. For in everyone with normal hearing the first knowledge of words is necessarily acquired through the auditory

centre, and there is no evidence which to my mind proves that this initial importance of the auditory word-memory is ever abrogated or diminished.

There is no question raised as to the possibility of words becoming directly attached to their meanings through the visual word-centre or of this centre taking the lead in thought. We have already seen that the necessary associations might readily be formed if the attention were brought to bear on them in the process of education. What seems doubtful is that in anyone in whom the sense of hearing is intact such a departure from the ordinary method of acquiring language ever takes place. The educated deaf-mute who can speak by calling up the visual memory of lip movements shows that the auditory centres have no special prerogative in the initiation of speech movements. So, in a normal individual the glosso-kinaesthetic centre might no doubt be stimulated in the same way if only the necessary associations were formed: but I cannot conceive the conditions under which the formation of such associations would be necessary, and without the necessity I do not think they would be formed.

In his fourth chapter Ballet deals with "l'articulation et l'ecriture mentales" and enters upon much more debatable ground than in the case of the visual memory of words.

He recognises that "motor word-images" are the memories of sensations derived from the moving parts during articulation

and writing, and has no doubt that these motor images exist in everyone; but he points out that authors are not in agreement upon the importance which should be attributed to them in relation to the inner language. He finds the explanation of the contradictory conclusions come to, as a result of introspection, by Stricker and Egger, "deux auteurs egalement recommandables," in the fact that Stricker is "moteur" whilst Egger is "auditif". He thinks they have both erred in generalising from their own cases. The different conclusions arrived at by these observers are, he thinks, sufficient proof that motor representations of articulation have not the same vivacity or the same importance in all individuals.

In support of his contention for the existence of moteurs he quotes Plato, Montaigne, Maine de Biran, and Bain: but the evidence on which he mainly relies is taken from Stricker's work "Du langage et de la Musique".* That Stricker is a pure moteur is shown, Ballet says, by the extract from his work which I have already quoted. But in Stricker's own words we have, in part at least, an explanation of his conclusions.

"If I fix my attention on my articulatory organs", it is certain that an undue prominence will be given to representations of movement which under ordinary conditions may be of quite subsidiary importance. That the glosso-kinaesthetic centre undergoes constant stimulation during thought processes

* Stricker. - Du langage et de la Musique. Paris. 1885. (2e Edit).

I most firmly believe. What I have already said as to the importance of this centre in reinforcing the auditory memory of syllable-sequences and in controlling the coordination in succession of words, necessitates the belief, that under all ordinary conditions, thinking in words is accompanied by constant stimulation of the glosso-kinaesthetic centre. But this belief by no means implies that these excitations of the glosso-kinaesthetic centre have any distinct mental correlative. It is, of course, possible that the power of recalling kinaesthetic impressions may vary in different individuals; but even if there were as much variety to be found in this respect as occurs in regard to the visual sense, it would be no proof that kinaesthetic revivals are ever the primary source of word-memories in speech and thought.

By fixing my attention on my organs of articulation when I think of a word, I can almost persuade myself that I am moteur: if I attend to the sound of the words of which I am thinking I am certain that I am auditif. If I try to discover what I am most distinctly conscious of, without any predilection one way or the other, I have no hesitation in saying that it is the sound of the word, as if uttered in my own voice, which obtrudes itself on my mind. My representations of speech movements, even when the attention is directed to them, are of the vaguest description. True, I have the feeling that the words are "on the tip of the tongue", on the verge of

utterance; but what the appropriate movements are, in what position the tongue should be, or what form the oral cavity should take, I have scarcely a notion. I have never found anyone who could tell off-hand the positions taken up or the movements made by the organs of articulation in the utterance of any given word; yet, if glosso-kinaesthetic representations are so vivid as to form a word memory useful for purposes of thought, such knowledge should surely be possible.

It is commonly admitted that speech movements belong to the class to which Hartley gave the name of "secondary automatic", and there are grave psychological objections to the belief that kinaesthetic representations of such movements are ever distinctly realisable in consciousness.

Whilst I believe that the incipient functioning of the glosso-kinaesthetic centre which goes on during thought may give rise to the feeling that we are speaking inwardly, I do not think that glosso-kinaesthetic representations can ever be so vivid or so distinct as to give us any information of <u>what</u> we are saying - that is, of the words we are using. They do so only by their backward action on the auditory word-centre, just as visual representations of words may be aroused by stimulation of the cheiro-kinaesthetic centre. If we close our eyes, and someone communicates to our hand the movements of writing a word, we are at once conscious of the word so written - we mentally see it. So, if it were possible

to communicate passive movements to the organs of articulation, we should mentally hear the word. That this is the relationship existing between the kinaesthetic centres and our memory of words in thought processes is shown by an examination of the possibility, seriously discussed by Ballet, that "graphic motor representations" may, unaided, suffice for the inner speech.

Much of Ballet's argument on this point has been nullified by the discovery of the true mechanism of "pure" word-blindness.

The fact that some patients suffering from word-blindness are enabled to read by passing over the letters the tip of the index finger, or a pencil held as in the act of writing, has been known for many years; but it was not until 1892 that the true explanation of this phenomenon was ascertained. The work of Déjerine* has conclusively shown that in these cases the visual word centre is not destroyed but merely isolated from its connection with the primary receptive areas in the occipital lobes: consequently stimulation of the visual word-centre through the cheiro-kinaesthetic centre is still possible. Thus the evidence which was supposed to support the notion that cheiro-kinaesthetic presentation of words leads directly to a consciousness of the meaning of words is now seen to have an entirely opposite signification, and emphasises in the strongest manner the helplessness of kinaesthetic centres, unaided, to give us any such information.

* Déjerine, - Différentes Variétés de Cécité Verbale. Mémoires de la Société de Biologie. Fev. 27. 1892. p 61-90

Ballet concludes his examination of the inner speech by a short description of "les indifferents ou mixtes". In these cases no particular form of word-memory shows any marked predominance over any other and any of them may be made use of indifferently for the primary recall of words in thought. This, Ballet believes to be the most common type of all.

The notion that anyone during a train of thought should be constantly changing his "thought counters", at one moment recalling words as sounds, at another as visual signs: or that one day or for one subject he is auditif and another day or for another subject visuel, seems to me both grotesque and absurd. The evidence adduced in support of such a possibility is of the most inconclusive description. The memory of things learnt at school is here, as usual, brought forward as evidence; but as I have already said the form which memory of such things may take has no bearing on the question of the inner speech in its relation to spontaneous thought.

Ballet finds that in recalling the first page of the AEneid and the first words of the Iliad, he sees the former while he hears and mentally speaks the latter. He concludes that if he became affected with word blindness the AEneid would become for him a dead letter. And so it might be. But if he were accustomed to think and speak in Latin, none of the words in the first page of the AEneid would be lost to him and he would still be able to use them in speech. if his auditory word-memory remained unimpaired.

The latest important contribution of the French school to the subject of the inner speech is the work of G. St.-Paul.*

The importance of St.-Paul's work consists in the extensive series of observations which he has recorded rather than in the conclusions which he has drawn from them. These observations, which take the form of answers to a series of questions sent to prominent men in various countries, may be considered as the last word that can be said on the nature of the inner speech in so far as it can be determined by introspection.

The distinction which St.-Paul makes, in his list of questions, between the memories of sensations in general and the various forms of word-memory is of the utmost importance, and he very rightly emphasises this distinction in his text. An individual who has the power of vivid visual representation of objects is a visual proper; but if he has also the tendency to visualize his word-memories he is at the same time a verbo-visuel. St. Paul also lays stress on the difference, to which I have already alluded, between the representation of words in spontaneous thought and that of words learnt by heart. But I think his clear realisation of this distinction has led him into error when he supposes that different kinds of centres are involved in the two processes. He imagines that a special "endophasic" centre is concerned in the production of the true inner speech, while the memory of words heard or seen is subserved by one or other

* G. St.-Paul, - Le Langage intérieure et les Paraphasies. Paris 1904.

of the word-memory centres. His "conclusion is that every normal individual possesses, besides the four centres of word-memory, more or less unequally developed: (visual word-memory, auditory word-memory, motor word-memory(oral) and motor graphic word-memory,) a centre of the inner language of the same name as one of the first three(visual endophasic centre, auditory endophasic centre, motor(oral)endophasic centre), a centre which is in close relation with the psychic centres in which are effected the highest intellectual operations, and in unison with which it functions." (p.56).

The whole psychological hypothesis on which St. Paul bases his doctrine of the inner speech is open to the gravest objections. Following Flechsig he believes in the demarcation of the cerebral cortex into projection areas in immediate relation with the projection systems of neurones, and association areas having connections one with another and with the projection areas. These association areas St. Paul believes to be special psychic zones while the projection areas are infra-psychic. The peripheral parts of the association areas are intermediate territories between the sensory projection areas on the one hand and between the association areas and the infra-cortical motor centres on the other. The so called motor areas of the cortex he looks upon as being not truly motor, but rather incito-motor or"ideo-motor", the true motor centres being in the bulb.

While regarding the Rolandic area as a sensory region he makes a distinction between a true sensory centre like Broca's convolution and the incito-motor centres in the same region. He is doubtful whether a similar differentiation obtains between centres of motor memory and incito-motor centres for each of the cortical "motor" centres, and he thinks that the occurrence of a true akinamnesia would be proof of such an arrangement.

St. Paul recognises the fact that thought - the observation of the psychic act itself- escapes us both on introspection and on extrospection. The phenomena of consciousness are due he thinks, to the projection on the psychic cortex of sensory impressions impinging on the infra-psychic areas. In silent thought these infra-psychic areas are stimulated by the direct action of the psychic centres, and introspection reveals to us the action of the psychic cortex, not directly, but by a reflection from the infra-psychic neurones whose activity is aroused by the psychic centres themselves. "The psychic territory receives then, in some way, the reflection of its own activity, thanks to the infra-psychic territories which act as a mirror". (p.16)

This "mirror function" is characteristic of the human race and does not exist in the lower animals. It is by means of it that self-consciousness, the distinction of the ego from the non-ego, and comparison and judgement are rendered possible.

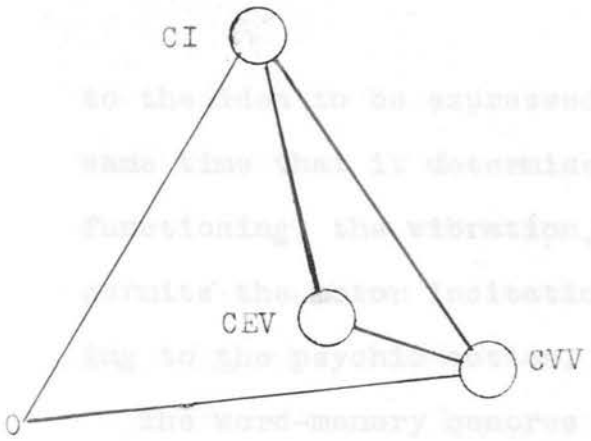
The word-images of which we are conscious during introspection

are the result of the reflection on the psychic centres of an activity in the endophasic centre which is initiated by the psychic centres themselves - "forms of activity of the psychic centres transmitted to an infra-psychic territory, and sent back, thanks to this territory, to its point of departure". (p. 21)

The territories of projection transmit impressions - visual or auditory - to the psychic centres through the intermediation of special centres -"centres transmetteurs" - which are interposed between the word-memory centres and the psychic centres. These transmitter centres are neither sensory nor motor but intermediary between the psychic centres and the territories of projection and of reaction and are probably to be looked for in the peripheral parts of the assosciation areas. On the efferent side they are incito-motor centres in close relation to the projection areas of the speech organs.

These views of St.-Paul may be more readily understood by reference to his diagrams. (Sch. 1, 2, & 3. p.57)

In the normal state the reception and interpretation of language, written or spoken, supposes modifications in the psychic centres produced by the functioning of the transmitter centres and, at the same time, the rousing of the word-memory centre which permits the individualisation, the signification, of the modifications produced. Similarly in that which concerns phonation, the motor incitation which results from the action of the psychic centres leads to the emission of a word adequate



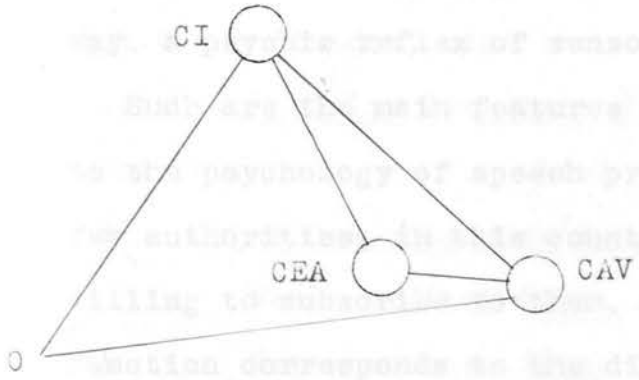
Scheme 1. (verbo-visuels)

CI. - "Psychic centres".

CVV. - Visual word-memory centre

CEV.- Visual endophasic centre.

O. - Transmitter centre.



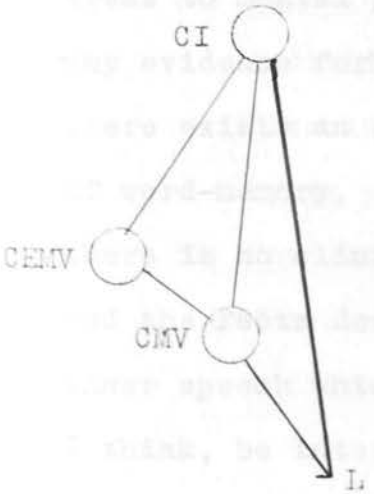
Scheme 2. (verbo-auditifs).

CI.- Psychic centres.

CAV.-Auditory word-memory centre

CEA.-Auditory endophasic centre.

O. - Transmitter centre.



Scheme 3. (verbo-moteurs).

CI. - Psychic centres.

CMV.- Motor word-memory centre.

CEMV.- Motor endophasic centre.

L. - Transmitter centres and incito-motor centres.

Saint-Paul's schemes. Op. cit. p. 57.

to the idea to be expressed only if the psychic centre/, at the same time that it determines a motor incitation, provokes the functioning, the vibration, of the centres of motor memory which permits the motor incitations to be effected in a form corresponding to the psychic action. (p.28)

The word-memory centres themselves are neither sensory nor motor; their existence is due to the "repercussion" on the infra-psychic territory of psychic modifications determined in the psychic territory by sensations emanating from the infra-psychic spheres of projection. Verbal images are then, in a way, a psychic reflex of sensory activity. (p.29)

Such are the main features of St.-Paul's theories in regard to the psychology of speech processes, and I think there are few authorities, in this country at all events, who will be willing to subscribe to them. That some differentiation of function corresponds to the division of the cortex into projection and association areas may be recognised, but the data on which to found a theory of the relation of such cortical areas to mental processes are still to seek. Nor is there any evidence forhcoming to necessitate the hypothesis that there exists an endophasic centre separate from the centres of word-memory. St.-Paul admits that up to the present time there is no clinical evidence in favour of such a distinction; and the facts derived from introspection in relation to the inner speech which led him to postulate its existence may, I think, be interpreted in quite a different way.

In his classification of endophasic types St. Paul has added to the threefold division of Charcot many new composite varieties, and he records observations which correspond to the various forms which he describes. Besides the pure types (Types endophasiques monoeidiques) - verbo-auditifs, verbo-visuels and verbo-moteurs,-, he describes types (Types endophasiques dueidiques & trieidiques) in which two or more centres are concerned. These he divides into (1) those in which the action of one centre always precedes that of the other (Formules Suneidiques), and (2) those in which sometimes one centre sometimes another acts alone, or, rather, in which the individual conforms sometimes to one type and sometimes to another (Formules Parallaxeidiques).

The following are the chief types which he describes.

I. Types endophasiques monoeidiques

Verbo-auditif (type Egger)

Verbo-moteur (type Stricker)

Verbo-visuel (type Galton)

II. Types endophasiques dueidiques

(A) Formules suneidiques.

Auditivo-moteur (St.-Paul)

Visuelo-moteur

Types paradoxal

(B) Formules parallaxeidiques

Moteur-auditif

Auditivo-moteur-auditif

Auditif-moteur

Auditif-auditivo-moteur

Auditif paradoxal

Moteur-visuelo-moteur

Visuelo-moteur-visuel

III. Types endophasiques trieidiques.

Formules suneidiques - l'equilibre

Formules parallaxeidiques - l'indifferent(Type de Ballet)

To understand the classification it is necessary to know the exact meanings ascribed to the various terms used.

A verbo-auditif is an individual who, in silent thought, hears the words of his thoughts without any consciousness of mentally speaking or seeing them; a verbo-moteur one who mentally speaks the words without hearing or seeing them; and a verbo-visuel one who sees the words without mentally hearing or speaking them.

The auditivo-moteur is conscious of first mentally speaking the words and then hearing them. This is the type to which St.-Paul finds himself to belong and which he believes to be the most common type of all. According to St.-Paul, in the auditivo-moteur the audition is secondary to the articulation, and the converse con - dition in which the auditory image is first distinctly represented and leads secondarily to the mental articulation is referred to by him as a "type paradoxal" the existence of which he considers problematical.

The visuelo-moteur first mentally speaks and then sees the words

The corresponding paradoxal type first sees the words and then speaks them.

The moteur-auditif is generally moteur, sometimes auditif. The auditivo-moteur-auditif is generally auditivo-moteur, sometimes auditif. The auditif-auditivo-moteur is generally auditif, sometimes auditivo-moteur. The moteur-visuelo-moteur is generally moteur, sometimes visuelo-moteur. The visuelo-moteur-visuel is generally visuelo-moteur, sometimes visuel.

An exceptional type is the auditivo-visuel who both hears and sees the words.

St. Paul's examination of 240 observations, of which 38 were indefinite and undetermined, gave the following statistical results:

Auditivo-moteurs.....48%

Visuelo-moteurs.....20%

Verbo-auditifs.....15%

Verbo-moteurs.....7·4%

Verbo-visuels.....6·9%

Auditivo-visuels.....1·4%

These results, arrived at by St. Paul, may be regarded as being a fairly accurate indication of the relative frequency with which the various forms of word-memory are revealed by introspection in the endophasia of educated people. I dissent altogether, however, from St. Paul's interpretation of these results. The majority of writers, in recent years, while admitting the possibility of the existence of visuels and moteurs

as exceptional variations from the normal, have expressed the opinion that the auditif type is the most common, and that, as a rule, the auditory word-memory is that which is primarily assosciat-ed with thought processes and primarily evoked in silent thought.

In the endophasic type which he has called auditivo-moteur St.-Paul states that the path from the idea to the mental sounding of its verbal symbol is by way of Broca's convolution. "Chez l'auditivo-moteur l'idéation détermine le fonctionnement de CMV(Broca's centre) et celui-ci le fonctionnement du centre auditif CA. (Sch.4, p.208) Similarly, in visuelo-moteurs he says ideation determines the functioning of Broca's centre and the latter that of the visual word-centre. In pure verbo-moteurs Broca's centre is of course supposed to be stimulated directly from the "ideational centres." It therefore follows that in 75% of the cases he believes that innervation of Broca's centre is the initial endophasic process. Only in verbo-auditifs(15%) in verbo-visuels(6·9%), and in auditivo-visuels(1·4%), does he suppose the primary evocation of words to be effected without the intermediation of the glosso-kinaesthetic centre.

Such a view is completely at variance with all that I have said as to the relations which I believe to exist between the cortical elements subserving ideation and speech processes. It is a view which has been shown to be opposed to all that we know of the way in which language is acquired by the child, and the order in which the various centres are first brought into relation with each other

Although, at first sight, it may seem to accord well with much of the evidence derived from clinical and pathological investigation, it is a view which is psychologically unsound and cannot be entertained.

If, however, we consider the auditivo-moteur as an individual in whom the auditory word-memory is primarily evoked, it may be, subconsciously; if we believe that the glosso-kinaesthetic centre is stimulated secondarily by the auditory word-centre, and that, by a repercussion on the auditory word centre from the glosso-kinaesthetic centre, a reinforcement of the auditory word representations is thus brought about, we may, I think, understand how so many observers record the fact that they are first conscious of mentally speaking and then of mentally hearing the words of their thoughts. The initial incitation of the auditory word-centre subconsciously produced, concomitantly with, or in immediate succession to, the inception of the thought, leads to an incitation of the glosso-kinaesthetic centre which reveals to us the fact that we are speaking. The reinforcement of the auditory word representations which is produced by this incipient functioning of the glosso-kinaesthetic centre makes them prominent in consciousness so that we are distinctly aware that we mentally hear the words; and the mental hearing seems to succeed the mental speech.

The feeling that the words are mentally spoken is very often described, (e.g. in St. Paul's auto-observation, p. 146), not

as the consciousness of a form of word-memory but merely as the ideal representation of an act being performed. And this indeed seems to me to be almost all that can be said of kinaesthetic memories in general when they are dissociated from the memories of those sensations under whose guidance the movements were first learnt and through which the interpretation of intrinsic kinaesthetic impressions is mainly effected. Kinaesthetic memories unaided give us memories of the "feeling of effort" and little else When we mentally speak and hear ourselves speak we know that we are speaking; but we should be quite unable to determine what words we are using were it not for our auditory word-representations which are in part the source and in part the result of the glosso-kinaesthetic representations of which we are vaguely conscious. As St.-Paul says of himself: "mon parler mental n'est pas fait d'images; c'est un acte". (p.146)

We may believe then that in auditivo-moteurs the usual mode of the primary evocation of words is not departed from.

In regard to visuelo-moteurs the same considerations would be applicable as to the order in which the respective centres are stimulated if we believe that the visual centre is ever the site of the primary evocation of words in spontaneous thought.

In endeavouring to interpret the observations which have been brought forward in support of the opinion that there exists a certain number of individuals who are true verbo-visuels I consider of the greatest importance the distinction which St. Paul

insists upon, between (1) visual memory in general - visual memory of objects, (2) visual memory of texts learnt - "mémoire visuelle topographique des textes", and (3) the visual memory of words. As already indicated I cannot admit a differentiation between "mémoire visuelle verbale" and "endophasie visuelle verbale", but with this exception I think St.-Paul's classification of the different forms of visual memory is very necessary, and one which has been too much neglected by writers on the inner speech. As we have already seen, much of the evidence brought forward by Ballet and other writers in favour of the existence of verbo-visuels merely showed that the individuals in question were good visuals, that they had the power of vividly representing visual sensations in general. St.-Paul has clearly brought out, in the course of his enquiry, that "visualism" is a common accompaniment of different endophasic formulae. A person may be auditif in silent thought and yet have a good visual memory for objects or for texts learnt by heart; and however great this latter gift may be it does not justify us in saying that he is a verbo-visuel in the proper sense of the word.

The mass of evidence brought forward in St.-Paul's observations can leave no doubt in any unbiassed mind of the reality of the facts on which the division of all persons into classes of different endophasic type has been founded. What is open to question is the interpretation that should be put upon the facts.

That people do exist who in silent thought mentally see written or printed every word which comes up in their minds cannot be disputed in view of the many well authenticated cases brought forward by St.-Paul. But that the possession of such an endowment is a proof that in these cases the visual word-memory is the primary source of word recall is, I think, still open to doubt.

If we suppose that the auditory word-memory is that which is primarily evoked in every case it may nevertheless be admitted that there is always some consecutive stimulation of the visual word-centre and a tendency for this form of word-memory to become nascent in consciousness. Im most people, however, this incipient functioning of the visual word-centre is seldom, if ever, associated with any mental concomitant which rises above the threshold of consciousness. At least, on introspection, it does not, without conscious effort, occupy the "focus of consciousness". Yet by making an effort, many people can visualise the words of which they think. Now, in individuals possessing an exceptionally strong visual word-memory and in whom the visualisation of words requires no conscious effort, the minimal stimulation of the visual word-centre, consecutive to the functioning of the auditory word-centre in silent thought, may be sufficient so to "light up" the visual word-memories that, on introspection, these visual representations arrest the attention and become focal in consciousness.

The auditory representation of words may be, and generally is, in these cases, proportionately less vivid; and although the subconscious revival of words which is evoked simultaneously with,

or in immediate sucession to, the inception of the thought itself, has taken place in the auditory word-centre, the only form of word-memory apparent on introspection is that which has been secondarily aroused and which, from its greater vividness, arrests the attention.

This explanation might, I think, hold good even in the remarkable case of Dr. Henry de Gaulejac which has been recorded by St.-Paul. (Obs. 37, p.128-129.)

Dr. de Gaulejac says that for him the visual image is, in all circumstances, not only the necessary substratum of his thought but also the first condition of his verbal expression. He never speaks with ease nor can he readily find his words unless their visual representation is very distinct. When he was a boy he was very subject to ophthalmic migraine and while the attacks lasted he saw only very imperfectly objects situated to his left. These appeared to him in a thick fog or vacillating in a continuous upward and downward movement synchronous with the pulsations of his arteries. As the attack developed his face became congested, slight vertigo supervened, and at last he could see almost nothing of his surroundings. Objects lost for him, at that moment, all significance. In order to name them he sought to evoke their visual word-images. By a great effort of will or of attention he sometimes succeeded in doing so, but the image was feeble, and more frequently, he was only able to represent the last letters of the word; the first

letters, more to the left, remained in the fog or vacillated like the objects. Not being able to read his verbal image, he says, he was unable to give expression to the word; he said one word for another. Thus if he saw "une fourchette"and tried to recall its name, he only succeeded in visualising the terminal letters "ette". On trying to name it he would call it "assiette". "manchette" or any other word having the same termination.

The explanation which he gives of his inability to pronounce the proper word is that it was because he could not see the first part of the word. But if, as he says, it was always necessary to see the word before he could give expression to it, it may be asked how he was able to pronounce the words "assiette" and "manchette". He makes no mention of what occurred in regard to his visualisation of the first letters of these words. If they also were lost in the fog to the left it would appear that the visual representation of a word was not, for him, a necessary condition of its utterance.

It seems to me that all the facts in this observation may be explained if we suppose that the cortical disturbance which caused the temporary hemianopsia at the same time produced a true amnesia verbalis of auditory origin. As we shall see later the conservation of the auditory memory of a general termination like "ette" while the more special parts of a word are difficult to recall, may be explained in accordance with the law of dissolution that the less organised memories disappear before the more organised.

Thus according to the view which I have expressed as to the part played by the visual word-memory in such cases, he could "see" only the part of the word of which he had an auditory recollection. On trying to recall the name of the object the only part of the word which he could remember was the termination "ette". That was all that his auditory word-centre could supply to his visual word-centre for visualisation and consequently that was all of the word that he could see. But it was not because he could not see the first part of the word that he could not utter it, but because his auditory centres could not supply the necessary stimulations to his glosso-kinaesthetic centre. If the inability to recall the first part of the word "fourchette" was due to the disturbance in the left half of the visual field the same thing ought to have happened in connection with the words "assiette" and "manchette", and he should have been no more able to pronounce these words than that which he sought.

But if, as I believe, the amnesia was of auditory origin and due to some functional disturbance of the auditory word-centre, both the inability to say the word and the inability to "see" it, may be easily explained. He could see and utter all that his auditory word-centre supplied and no more.

Such an explanation would seem to cover all the phenomena observed in verbo-visuels and in visuelo-moteurs. In visuelo-moteurs the glosso-kinaesthetic revivals, although less vivid than their visual equivalents, are more prominent in consciousness than the auditory representations to which both owe their

existence.

In pure verbo-auditifs it is not doubted by anyone that the auditory word-centre is the site of the primary revival of words in thought and speech; but it is necessary to enquire why the pure verbo-auditif seems to be generally unconscious of any glosso-kinaesthetic revival whatsoever.

That, as a rule, the glosso-kinaesthetic centre participates in all endophasic processes in which words are linked together in grammatical sequence, I firmly believe; and I have already suggest-ed some reasons why this should be so. It must therefore be supposed that in the pure verbo-auditif the auditory word-represent ations are relatively so vivid and the glosso-kinaesthetic revivals so feeble that in ordinary silent thought the latter do not rise above the threshold of consciousness, even to the extent of producing the feeling that an act is being performed.

A good instance of the unconscious nature of glosso-kinaesthetic functioning in these cases is afforded by an observation recorded by Lemaitre.* The subject was a healthy boy of thirteen years. He conformed to a rare endophasic type which Lemaitre calls auditivo-visuel verbal alternatif, or as St.-Paul would say auditif-visuel. That is to say he sometimes heard the words of his thought, sometimes saw them written. He was never conscious of any "motor" word-representations whatsoever; yet Lemaitre noticed that, in class, he sometimes articulated the words of his thoughts, "je ne dirai pas a demi-voix, mais a quart de voix et assez nettement pour qu'elle arrive a mes oreilles". Lemaitre thinks.

* aug. Lemaitre. — Le langage intérieur chez les enfants
Lausanne. 1902. Obs III p7.

therefore, that he was auditivo-moteur when he was not verbo-visuel.

Nothing could show more clearly how the glosso-kinaesthetic centre may participate in the endophasic process without its action being revealed on introspection; and I believe that in all cases in which departure from the usual auditivo-moteur type is observed a similar explanation will hold good.

Pure auditifs have generally no idea that they speak mentally: the words succeed each other in consciousness as if imposed upon it by some outside agent. But while the weak stimuli which excite the auditory word-centres in silent thought are insufficient to lead to glosso-kinaesthetic functioning which may be apparent on introspection, the stronger stimuli derived from the visual word-centre in silent reading may do so. Egger has noticed, in his own case, that l'image tactile appears to be more frequent when he reads than in simple meditation. Ordinarily he thinks it is absent and does not form a necessary element in the inner speech.*

A similar explanation will apply in the case of pure verbo-visuels in whom there is no consciousness of mentally speaking the words which they "see". The vivid visual word-memory, aroused by stimuli derived from the auditory word centre, occupies the focus of consciousness, and any glosso-kinaesthetic revival which may be present is, like the primary revivals of auditory origin, relegated to a sub-marginal or infra-marginal position.

* Egger - La parole intérieure 2e Edit. Paris 1904. p 90.

In all these cases then it would appear that the auditory word-memory may be the first to be evoked in silent thought although this may not be evident on introspection. Can the same explanation apply in the case of pure verbo-moteurs? It seems to me to be the only way of reconciling the observations of Stricker and of Bain with the clinical and pathological evidence derived from the study of aphasia. St.-Paul has pointed out that individuals of the auditif type have a difficulty in conceiving the possibility of such a form of endophasia as that which has been described with so much minuteness by Stricker as the result of his prolonged auto-observation; and he suggests that since he himself belongs to the auditivo-moteur type , he is in a better position to understand Stricker's form of endophasia than those who are, like Egger, purely auditif.

Although I am as distinctly auditivo-moteur as St.-Paul I confess to an insuperable difficulty in understanding how the glosso-kinaesthetic representations of words can by themselves form our counters of thought.

There are two main difficulties to be explained in Stricker's record. The first is that which I have just indicated - how memories of the position and movements of the articulatory organs can be so vivid and definite as to form the material of our recollection of words; and the second is how it is possible that so careful an observer should have failed to notice his mental sounding of words when his attention was specially

directed to this point. Stricker asserts most positively, again and again, that in thought and in silent reading his only representations of words are "motor" representations. "It seems to me that I speak inwardly (p.1) ..... I pronounce the word of which I think" (p.1) ..... "it seems to me that I speak when I think" (p.23) ..... "it is in vain that I look for a memory of the sounds" (p.25) ..... "when, then I think in words, I say that auditory images take, so far as I can see, no part therein." (p.25)

We must suppose that Stricker's inability to find any trace of the sound-memory of words in his inner speech indicates an abnormal lack of vividness in connection with the auditory representation of words. If, as I believe, the auditory word-memory in him as in all men is the first to be aroused, his auditory representations must be so feeble that they are not noticeable on introspection. It may be that the constant concentration of the attention on the organs of speech which his prolonged auto-observation entailed and encouraged, led to an unusual power of calling vividly into consciousness the memories of speech movements. It would seem however that in concluding that such representations of movements form the material of our recollection of words and are the first form of word-memory to be evoked he has been led into error by the vivid nature of what is at most but a secondary and superadded phenomenon.

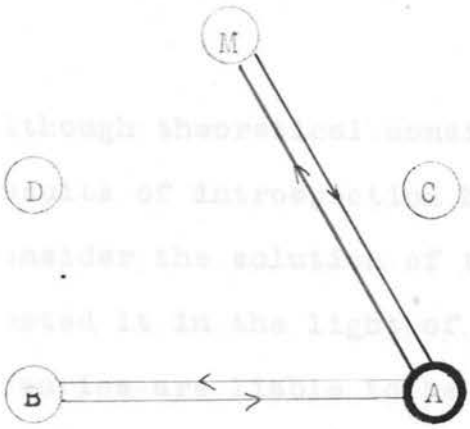
Stricker: Du Langage et de la Musique, Paris 1885.

The views which I have put forward in the previous pages as to the relations of the various word-centres one to another in the various endophasic types which have been described may be indicated in a series of simple diagrams founded on the diagram of the word-centres which I have given in the previous chapter.

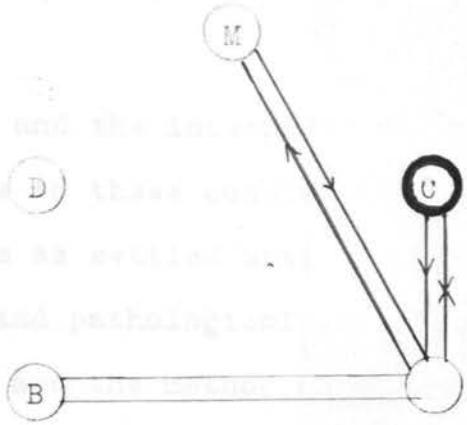
The centre M indicates the whole of the cortex subserving ideation with the exception of those parts which are occupied by the word-centres. The line M-A indicates that in every case the path from idea to speech is through the auditory word-centre.

The slight stimulation of the other word-centres, which follows immediately the auditory revival, may lead to a "lighting up" of the forms of word-memory subserved by these centres. These vivid representations arrest the attention on introspection while the less vivid representations correlated with the functioning of the other word centres remain marginal or infra-marginal.

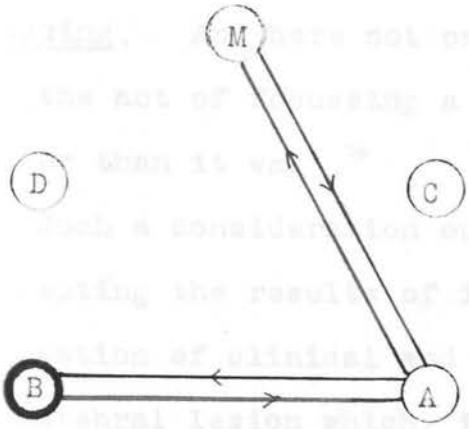
The thickness of the centres in the diagrams indicates the relative vividness of the different forms of word-memory in the various types.



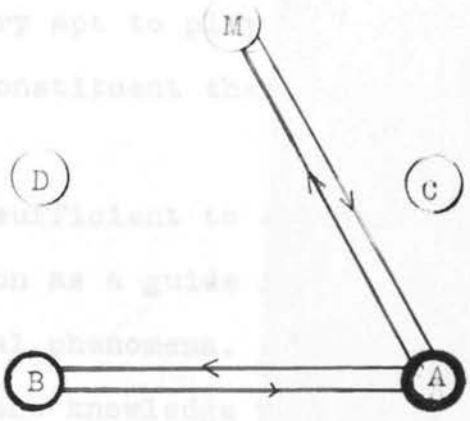
Verbo-auditif (type Egger).



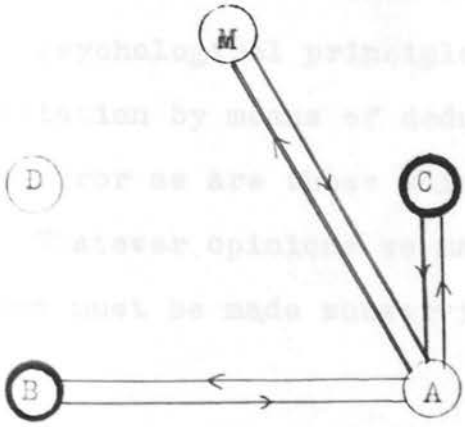
Verbo-visuel (Galton).



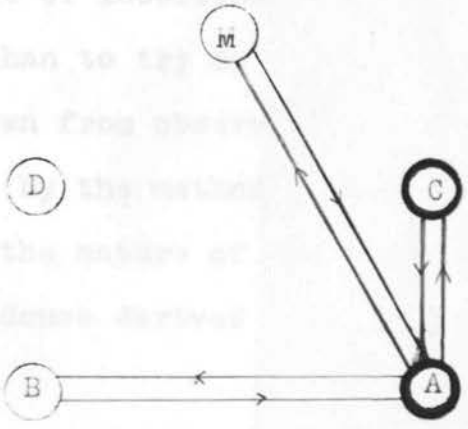
Verbo-moteur (Stricker).



Auditivo-moteur (Saint-Paul).



Visuelo-moteur.



Auditivo-visuel.

Although theoretical considerations and the interpretation of the results of introspection have led us to these conclusions we cannot consider the solution of the problem as settled until we have tested it in the light of clinical and pathological experience. Theories are liable to be erroneous and the method of introspection is notoriously untrustworthy. As Lloyd Morgan says, introspection is really retrospection because "we cannot examine the psychical wave as it passes; we can only endeavour to focus it, or its constituent parts, in the mental vision as it was when it was passing. And here not only is memory apt to play us tricks but... ...the act of focussing a marginal constituent thereby makes it other than it was".*

Such a consideration ought to be sufficient to deter us from accepting the results of introspection as a guide in the interpretation of clinical and pathological phenomena. When we find a cerebral lesion which, in view of the knowledge we possess of cerebral localisation, appears to be incompatible with the conservation of speech processes observed during life, it would perhaps be better to reconsider our knowledge of localisation in the light of psychological principles rather than to try to effect a reconciliation by means of deductions drawn from observations so liable to error as are those which are made by the method of introspection.

Whatever opinions we may hold on the nature of the inner speech ~~this~~ must be made subservient to evidence derived from clinical and

* C. Lloyd Morgan - Introduction to Comparative Psychology. 1894. p20.

pathological investigations. But since our knowledge of cortical localisation must be regarded as being still far from complete, speculations which are founded on the possibility that the areas of the cerebral cortex subserving certain mental functions have not yet been definitely and finally demarcated, may be legitimate enough, so long as they are not at variance with such knowledge as may be considered as being beyond dispute.

Chap. iv.

DISSOLUTIONS OF MEMORY.

When the doctrine of Evolution came to be generally accepted by scientific men, it was soon realised that the phenomena of disease might be regarded as dissolutions, or reversals of evolution. This view was elaborated with great ability by James Ross* and Hughlings Jackson† in regard to diseases of the nervous system, and other writers have applied the same conception to disease in general.

The fundamental laws of dissolution were clearly enunciated by Hughlings Jackson in his Croonian Lectures in 1884. Just as evolution is a passage from the most to the least organised, from the least to the most complex, and from the least to the most voluntary, so, in the gradual onset of disease, those parts of the nervous system which are the least organised, the most complex, and the most voluntary, are the first to suffer.

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* Ross:- Diseases of the Nervous System. Vol II. p 373 - Vol I p. 71. (2nd Ed. 1883).

† Hughlings Jackson:- Croonian Lectures. Brit. med. Journal. 1884. p. 591. Vol I.

In considering disorders of memory as dissolutions we must recognise that we are dealing with psychic phenomena and cannot always follow the correlated dissolutions of nervous structure; yet we may be sure that every morbid mental change has as its physical concommitant, some morbid change in the intimate structure of the brain.

The conditions which may lead to such morbid change in the memory-centres are many, but they may all be described, in virtue of their action, as forms of stress. Any influence, which acts upon the memory centres, so as to lead to their functional degradation or actual destruction, is a stress. Whether it be some poison circulating in the blood, or a localised haemorrhage in the brain, it is equally a form of stress. In the one case the stress may fall evenly upon the memory centres as a whole; in the other it falls unevenly and may affect only some particular group of neurones.

The extent of the cerebral area affected - the number of memory centres involved - has been made the basis of a classific-ation of disorders of memory. Thus, Ribot* has divided disorders of memory into "general" and "partial". When the loss of memory is general it affects memories of all forms more or less indifferently, so that, for example, all memories of sensations experienced during a certain period of time may be obliterated. The most important partial disorders of memory are those related to our memory of words and it is with these that we are here chiefly concerned.

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* Ribot:- Diseases of memory. p.70-71. (Eng. Trans. 4th Ed. 1896).

The severity of the stress has also been used as a basis for classification. Sollier* has proposed to divide all disorders of memory into organic and functional according to whether the memory centres are destroyed or only functionally deranged.

Without entering further into the question of classification we may note that the particular memory centres affected will determine the particular forms of memory which may be implicated; the severity of the stress will determine the amount of dissolution produced.

Dissolution is most plainly exhibited when the stress is gradual in its onset and general in its incidence. If it is slight to begin with, and gradually increases in severity, the loss of the least organised memories is followed by the loss of more and more deeply organised memories. In many cases, however, the onset of the stress is not gradual but sudden, and we must distinguish between a sudden stress which is slight and one which is severe. When mere functional degradation of the memory centres is produced we may say that the stress is slight; when actual destruction of the centres results the stress is severe. Manifestly there may be all gradations between a stress so slight that its effects may not be observable, and a stress so severe that it produces complete disintegration of nervous substance, with total obliteration of the correlated memories.

The importance of recognising variations in the severity of

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* Sollier :- Les Troubles de la Mémoire 2ème Edit. Paris 1901. p. 89-92.

the stress is due to the fact that the reaction of a centre to stimuli of different intensities depends on the amount of functional degradation present. When this is slight, the failure of the least organised elements to respond to stimulation will appear first as a want of response to the weakest forms of stimuli. It is important, then, to consider what the different forms of stimuli may be to which memory centres may be subjected.

We have seen the double connections which every memory centre has, (1) with its sensory pathway and (2) with other memory centres. There are consequently two routes by which nervous impulses may reach a memory centre. Now, the direct sensory impression impinging on a memory centre in an act of perception, is a stronger form of stimulus than that which is derived from associational impulses in the course of ideation. Were it not so, every memory-image aroused in the process of thought would be so vivid that it might produce an hallucination; we might not be able to distinguish between the representation of an object and its presentation. It seems probable, further, that the stimuli derived from associated memory centres may be subdivided according to whether the associated memory centre has itself been aroused directly by sensory impressions, or only indirectly, from a third memory centre. In this way the strength of the impulse which arouses any memory centre varies directly with its relation to sensory impression.

If the functional degradation of a memory centre is so great

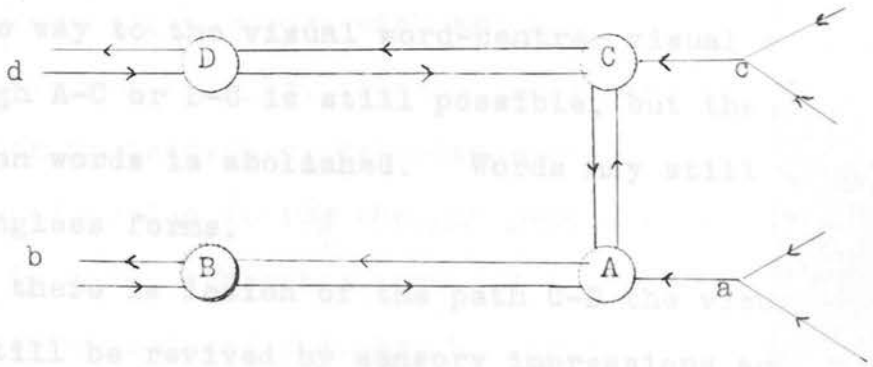
that the memory images cannot be revived by direct sensory impressions, so long as this depth of dissolution lasts, the memory is as completely blotted out of consciousness as if the memory centre were destroyed. There always remains, however, the possibility of recovery of function. When, on the other hand, actual structural disintegration of a memory centre supervenes, the memory correlated with that centre is permanently lost.

The stress which leads to disorder of memory may fall on the memory centres themselves or on their commissural connections with other centres. Lesion of the afferent or efferent pathways may also cause disturbances which, although not strictly speaking disorders of memory, yet closely resemble them, and may be mistaken for them.

We may use the scheme of the word-memory centres, already given, to illustrate these points.

Dissolutions of word-memories.

If the centre C is destroyed the visual word-memory is lost: the visual images, the mental pictures, of written words cannot be revived. They cannot be revived by sensory impressions, therefore the patient is word-blind and cannot copy writing placed before him: they cannot be revived by associational impulses from the auditory word-centre, therefore he cannot write spontaneously or to dictation.



A. Auditory word-centre
B. Glosso-kinaesthetic centre
C. Visual word-centre
D. Cheiro-kinaesthetic centre

If the path c-C is cut across,- if all sensory impressions from the primary receptive areas in both occipital lobes are blocked on the way to the visual word-centre,- visual revival of words through A-C or D-C is still possible, but the perception of written words is abolished. Words may still be seen but only as meaningless forms.

If there is lesion of the path C-D the visual word-memory can still be revived by sensory impressions and by assosciation, but the visual images so revived cannot be reproduced in writing; the production of written language in all its modes is impossible.

A similar relation holds good in regard to the kinaesthetic centres. If the centre B is destroyed the glosso-kinaesthetic images cannot be revived and speech is impossible. If the centre B is intact and the path B-b is destroyed, then the outer speech is impossible but the revival of glosso-kinaesthetic images in the inner speech is not interfered with.

If the path C-A is destroyed the interpretation of written words is interfered with, and if A-C is at fault spontaneous writing is impossible.

We must therefore bear in mind that there may be:

(1)

(a) Failure in the perception of words due to interruption of the afferent paths - the word-memory centres being intact.

(b) Failure in the production of words due to interruptions of the efferent path - the word-memory centres being intact.

(2) Failure in the perception and production of words, due to disorders of the word-centres themselves, or of the commissures connecting them, one with another.

In the former category (1) the inner language is left intact; there is no necessary disturbance of intelligence, and memory and recollection during thought processes are not interfered with.

It is quite otherwise when (2) the word centres or the commissures between them are at fault. There may then be great disturbance of the inner speech; both recollection and memory of words may be abolished, and the reception and production of words may be interfered with. The form which the disturbance of word memory may take will depend on the site and extent of the lesion,- on the area of incidence and the severity of the stress.

Terminology

All disorders of memory have been commonly described under the general term "amnesia". Whether there is loss of memory proper or loss of recollection, or loss of both memory and recollection, most authors have agreed to class all such disorders as amnesias.

In view of the many ambiguities surrounding the use of this term, Pitres* has classified all amnesias according to the factor which is at fault in the mnesic process. He points out that failure to revive an impression may be due to the fact that the impression has not been adequately "fixed" in the brain. This fault of fixation may arise from a defect of "penetration" or to

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* Pitres:- L'aphasie Amnésique et ses variétés cliniques, Paris 1898. p. 28-44.

a weakness of "retention". To these amnesias of fixation he applies the term "apexia".

Provided that the memory images are properly fixed, forgetfulness may be due to various causes. In Pitres' own words, there may be:

(1) Oubli par manque de la reviviscence.

(2) Oubli par défaut de l'évocation.

(3) Oubli par perte de la reconnaissance.

Manque de la reviviscence, according to Pitres, is due to organic alteration or functional inertia of the memory centres, whereby revival of the memory images, either by association or by sensory impressions, is rendered impossible.

The second form of amnesia, - par défaut de l'évocation - is characterised by the difficulty or impossibility of the voluntary recall of the memory images, while their recognition when they are aroused through sensory channels is conserved. Pitres supposes that all faults of evocation are due to interruption of the associative pathways, so that associational stimuli are prevented from arriving at memory centres which are themselves intact. As will be seen later this view is not supported by much evidence, and it appears better to regard the conditions which Pitres ascribes to "défaut de l'évocation" as being also due to some defect of "reviviscence". If the functional degradation of a memory centre is slight, voluntary recall may be impossible although the centre may still respond to sensory stimuli; if the

functional degradation is severe, or if the centre is destroyed, the memory images cannot be revived by association or by sensory impressions.

La reconnaissance, as used by Pitres, is the phenomenon by which the memory-image is recognised in consciousness as the equivalent of the sensation-image of which it is only the reproduction; when complete and precise it localises the memory in the past with the whole of the accessory circumstances which accompanied its fixation.* Thus, "perte de la reconnaissance" is chiefly a failure to localise memory-images in time and in space, and this may also be due to some defect of revivability of memory centres. There is loss of recollection of the associated images on which localisation in the past depends.

Sollier has maintained that it is only when there is organic destruction that amnesia is real; and that when there is merely functional degradation the amnesia is only apparent.†

Such a contention is unfortunate, especially in view of the fact that, in regard to word-memories, the term "amnesia verbalis" has been generally adopted to indicate a condition which, whatever may be its true pathogeny, is not necessarily associated with destruction of any of the word-memory centres.

It is very important that this term "amnesia verbalis" should be defined as clearly as possible; for the different meanings which have been ascribed to it by different authors have been a source of much confusion in the past.

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* Pitres:- L'Aphasie amnésique. p.31-32.

† Sollier:- Les troubles de la mémoire. p. 89.

I think the term amnesia verbalis should be used to indicate the failure, from whatever cause, to call up spontaneously in the mind, words, as they are wanted in thought and speech. It cannot be defined better than in the words of Professor Wyllie who uses it solely "as signifying a failure to call up in the mind the appropriate word-images for ideas that are seeking embodiment in words, whether for purposes of silent thought or for those of audible speech".*

What this may imply as to the particular form of word-memory which may be at fault is not now in question. The failure in amnesia verbalis is essentially a failure in the inner speech, and our opinions as to what form of word-memory is at fault will depend on the views which we hold as to what the form of word-memory may be which we utilise as the "material of our recollection" in the use of words. According to the views put forward in a former chapter amnesia verbalis is always a failure of auditory recollection. For those who believe, with Bain and Stricker, that the memories of the movements of articulation form the material of our recollection of words, amnesia verbalis must be a failure of recollection of articulatory movements.

Charcot and his disciples maintain that there can be no such thing as an amnesia of words because there is no such thing as a memory of words.† Our memory of words, they say, is a four-fold memory, and for amnesia of words there must be a four-fold loss of recollection. There may be an auditory amnesia or a visual

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* Wyllie :- Disorders of Speech. p267.

† Bernard :- De l'aphasie p. 3-6

amnesia, or amnesia of the movements of speaking or of writing, but unless there is amnesia of all four forms of word-memory we cannot truly say there is an amnesia verbalis.

Nothing could show more plainly than this doctrine the pernicious effect of Charcot's teaching. It is a doctrine which is based solely on the indefensible belief in the autonomous character of the different word-centres. It is a doctrine which has not a particle of clinical evidence to support it, and which is in the main at variance with the evidence derived from introspection.

We may concede, however, that if a patient is able voluntarily to call up in his mind any form of memory of the word appropriate to the idea, he cannot be said to have amnesia verbalis. That inability to do so necessarily implies failure of auditory revival is a separate question; but even if this is denied, the definition of amnesia verbalis as a failure to call up spontaneously in the mind, words as they are wanted for thought or speech, is not thereby invalidated.

While restricting, in this way, the use of the term amnesia verbalis, it is legitimate to speak of amnesias of the separate forms of word-memory. We may believe that inability to speak may be due to a glosso-kinaesthetic amnesia - to a loss of recollection of the movements of articulation, - as well as to a failure of auditory recollection. So, inability to write may

be due to a cheiro-kinaesthetic amnesia as well as to a visual amnesia. Whenever a word-centre is destroyed there is amnesia of the correlated form of word-memory; but there is also something more. There is an agnosia. When the auditory word-centre is destroyed, the auditory recollection of words is impossible, but there is also a deafness to words, - the auditory word-memory cannot be revived by direct sensory impressions. So when the visual word-centre is destroyed there is word-blindness as well as the inability to revive spontaneously the visual memories of words.

The terms "word-deafness" and "word-blindness" are used by clinicians not merely as denoting particular symptoms, but as class names which connote particular series of ~~associated~~ associated symptoms. Since these symptoms generally include some defect of uttered speech, or, perhaps, because word-deafness and word-blindness are disorders of the "faculty of speech" as a whole, it has been customary to refer to them as forms of aphasia.

The fact that the auditory and visual word-centres are sensory centres, while the kinaesthetic centres for speech and for writing have been generally considered to be motor centres, has given rise to the distinction commonly made between "sensory" and "motor" aphasia.

The use of the word "aphasia" itself has been a source of considerable confusion. In the following pages I shall use it as indicating faults in the production of spoken language due to lesion in or near the centres of word-memory. Its origin may be

indicated when necessary by prefixing the words 'auditory' or 'glosso-kinaesthetic'. Those who regard Broca's centre as being a sensory centre cannot admit the division of aphasias into sensory and motor; and, as the use of the term glosso-kinaesthetic aphasia may be repudiated by those who believe Broca's centre to be a motor centre, it will be convenient to refer to this form of speech disturbance as "Broca's aphasia.

Bastian* has suggested that the term "aphasia" should be reserved for the speech defects resulting from affections of the glosso-kinaesthetic centre, and that the word "aphemia" should be used to indicate the loss of speech which may be produced by destruction of the internuncial fibres between the third left frontal convolution and the motor centres in the bulb.

Such a use of the word aphemia is apt to be confusing seeing that this term has been so frequently employed in the sense in which Bastian now proposes to use the word aphasia.

Bastian further proposes to confine the use of the word amnesia to the defects which may arise from lesion at the posterior end of the Sylvian fissure. This restriction of the use of the word amnesia to auditory and visual defects implies, as Bastian himself admits, some inconsistency. As has often been pointed out all forms of aphasia are really amnesias: there is loss of recollection of some form of word-memory.

The defects produced by interruption of the tracts leading from the primary receptive areas to the word-memory centres and those from the kinaesthetic centres to the motor centres in the bulb

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* Bastian :- aphasia. p. 140-141.

and spinal cord have received different names from different authors.

Defects due to destruction of the word-centres have been referred to as "cortical", while those due to interruption of the afferent or efferent paths have been described as "sub-cortical". Even the term "trans-cortical" has been used.

Wyllie* has proposed the terms "pictorial", "infra-pictorial", and "supra-pictorial" to indicate the relation of the lesion to the individual word-centres.

Seeing that in the sub-cortical or infra-pictorial types of word-deafness and word-blindness there is not necessarily any defect of word-memory or interference with the inner speech, the solitary defect produced has been commonly referred to as "pure" word-deafness or "pure" word-blindness. This is perhaps the most convenient term, and there is no reason why the same word should not be used to describe the loss of speech produced by sub-cortical lesion in the region of the third left frontal convolution. It is a "pure" aphasia.

For amnesia verbalis. Pitres† has reintroduced an old term, used long ago in the same sense: he calls it "amnesic aphasia".

There is no need for this, if the words amnesia verbalis are clearly understood as indicating a failure to call up words in the mind: and unless this special meaning is attached before-hand to the word "amnesic", the term "amnesic aphasia" is open to the old objection that every form of aphasia is amnesic.

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* Wyllie :- Disorders of Speech. p. 364.

† Pitres :- L'aphasie amnésique. p. 7 - 8.

I think it would be well to use the words "amnesic" and "amnesia" for loss of recollection whether or not accompanied by loss of memory proper, whilst "amnesia verbalis" should be used only as indicating a loss of recollection of that particular form of word-memory, whatever it may be, which forms the material of our recollection of words in the inner speech.

"Aphasia" should, I think, be used only in reference to some defect of uttered speech, due to disorder of one or more of the word-centres, or of their commissures, or of the afferent and efferent tracts in the neighbourhood of the word-centres.

"Agraphia" may be used in a corresponding sense with regard to defects of writing.

"Word-blindness" and "word-deafness" should not be held to connote more than is indicated by these words, and any farther description of the nature of the defects should be supplied by explanatory words or phrases.

Chap.v.

DISSOLUTIONS OF AUDITORY WORD-MEMORIES.

A word-centre may be considered to be intact when its least organised elements respond adequately to the weakest stimuli to which they are accustomed to respond in health. In the case of the auditory word-centre these stimuli are the assosciational impulses which, in voluntary thought processes, are derived from the centres of sense-representation in general.

Under ordinary circumstances the proof that these voluntary incitations are effective is manifested by ability to produce, in due order, words appropriate to the ideas which arise in the mind. If the auditory revival is at fault speech will be correspondingly defective. The converse proposition does not, of course, hold good. If speech is defective the fault is not necessarily in the auditory word-centre.

What I wish to emphasise is that the proof of the integrity of the auditory word-centre must be looked for in ability to

produce words voluntarily, not in evidence of response to sensory impressions. The fact that a patient can hear and understand every word spoken to him is often taken as a proof that his auditory word-centre is intact; nothing is more likely to lead to error.

I have said that the functional integrity of a word-centre is shown by the response, to the weakest stimuli, of the least organised elements of the centre. According to the law of dissolution it is the response of the least organised elements that will be the first to fail when stress falls upon the centre.

We may say, then, that the first sign of functional degrad--ation of the auditory word-centre is a failure in the voluntary recall of the least organised auditory word-memories, and that this failure of auditory recall is manifested by the absence of such words from speech. Since we must regard auditory word-representations as the material of our recollection in the use of words, this condition is the slightest form of that defect which I have defined as Amnesia Verbalis properly so-called.

The proof that some word-memories are more liable to dissolution than others is afforded by the study of morbid conditions. It is found that the least stable of all word-memories are those of foreign languages learnt late in life. Our mother tongue, acquired when the nervous system is most plastic, is much more firmly imprinted in the memory and is not so readily lost in disease.

There are many recorded cases which show the slight hold we have on our memory of foreign languages and how readily its dissolution may be brought about.

Sir Henry Holland* relates an experience which shows well the temporary loss of a foreign language which may be brought about by simple fatigue. He had descended a mine in the Harz mountains and had talked in German to the inspector who accompanied him. After some time he began to feel exhausted and felt the utter impossibility of carrying on the conversation. He could not recall the words necessary for the expression of his thoughts. Every German word and phrase deserted his recollection, and it was not until he had taken food and wine and had some time at rest that he regained them.

The late Professor Grainger Stewart† has recorded the case of a Scottish student, familiar with German, who, walking into the country with a companion, spoke German at the begining of the walk with ease and accuracy but became unable to express himself at all in that language when exhausted at the end of his excursion.

A good example of the gradual dissolution of the memory of foreign languages due to persistent and gradually increasing stress is afforded by the well known case of Dr. Scandella who died in New York, in 1789, of yellow fever. During his illness he spoke at first only English, then only French, and on the day of his death only Italian.‡

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* Sir Henry Holland:- Mental Physiology, p 167. footnote

† Grainger Stewart:- Introduction to the Study of the Diseases of the Nerv. System p 169

‡ Kussmaul:- Disturbances of Speech, Zeimssen's Cyclop. Vol XIV. p 621.

If in such cases the stress, after lasting for some time, abates or is removed, recovery of the lost languages may be observed; and the order of recovery is the reverse of that in which they disappeared from the patient's speech. Or, if the original stress is severe and dissolution takes place so suddenly that its various stages cannot be distinguished, when recovery takes place, the most deeply organised memories are the first to appear, and the others emerge in an order the reverse of that in which they would have been lost could their dissolution have been observed. A good example of this was recorded by Gairdner many years ago.*

"A youth about sixteen years of age was admitted,..... with well marked symptoms of concussion of the brain..... He remained in a state of complete insensibility for nearly 48 hours after admission when he began to speak in a language which could not be interpreted till he was visited by one of his shipmates who told us it was Welsh. He talked incessantly, and we were told that his words were not incoherent, but rather a narative of past events - recollections in short. He continued in this state for between two and three days, when he began to speak most unmistakeable English, but every word nearly was an oath; and most horrible imprecations he uttered. During three or four days longer he may be said to have spoken Welsh and sworn English. As consciousness gradually returned, he ceased to speak Welsh and to swear English; and when he recovered completely, after an illness of about twenty days, he spoke English and ceased to swear."

Welsh was the native language of this youth, and its use was possible at a level of dissolution at which the use of the more lately acquired English was impossible.

The reappearance of English oaths before English speech points to the fact that in any particular language all classes

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* Gairdner:- Proceedings of the Glasgow Philosoph. Society 1865-68. p. 102-104.

of words have not the same depth of imprintation.

It has been known for many years that in different degrees of amnesia, varying with the severity of the stress, there is a progressive loss of words from the most special parts of speech, such as names of people, of places, and of things, to the more general, such as verbs, adjectives, pronouns, &c.

In the defect, as it is most frequently observed, the loss of recollection is usually confined to proper nouns and noun substantives. And since the names of concrete things are of little importance in thought, there is little mental impairment in uncomplicated amnesia verbalis. It is only when the thoughts are to be expressed in words that the loss of the recollection of names is made manifest.

A patient suffering from this form of amnesia may speak whole sentences fluently until pulled up by some name which he cannot remember. To get over the difficulty he will often use some periphrase, such as "what I buy with" for "purse", or he will substitute some more general term, such as "thing", for any such part of speech. Sometimes he will use a wrong noun, with, or without, appreciation of his error. This is the slightest manifestation of the defect, known as paraphasia, which is met with in all stages of severity, from the occasional misuse of a word, to the most profound disturbance of speech in which the words used are mere gibberish.

Sometimes, instead of total forgetfulness of a word, there is only a partial forgetfulness. The patient has a general

idea of the word to be produced but its exact sound cannot be revived in the mind. The auditory revival being faulty, the proper stimulus to the glosso-kinaesthetic centre is also defective, and the word is faultily produced. This defect Wyllie has proposed to term Articulative Amnesia.* The only objection to this designation is that it might imply that the amnesia is of kinaesthetic origin; that there is an amnesia of the necessary movements instead of a failure of auditory representation. For the corresponding defect due to disturbance in Broca's convolution, Wyllie uses the term Articulative Ataxia.** The phenomena observed in the two forms are no doubt distinct in their causation, but their clinical differentiation is not always possible; for as Kussmaul says,† "an ataxic impress can be stamped on the utterance of a word by the disjointed acoustic combination of the same".

The amnesia of nouns is generally tested by asking the patient to name objects which are shown to him; and it is a most common experience to find that, while the object is recognised and its uses well understood, there is a total inability to recall its name. Lichtheim has pointed out‡ that evidences of amnesia are "more easy to demonstrate when the patient is made to name objects than when he is engaged in ordinary talk; names which occur without effort in fluent speaking arrest him when he has to find them for objects or persons shown to him".

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* Wyllie:- Disorders of Speech, p 269. ** Ibid p.270

† Kussmaul:- Disturbances of Speech. p.763.

‡ Lichtheim:- on aphasia, Brain. Jan. 1885, p. 473.

It might have been supposed that the stimulus afforded by the visual presentation of an object would be more powerful to call up the memory of its name than the weaker nervous discharge assosciated with the idea of the object. And so it would be always, were it not for the powerful assosciations which are formed between series of words as they are employed in our ordinary conversation. The utterance by amnesic patients in ordinary conversation, of nouns which they cannot recall when the object which the noun signifies is shown to them, is often found to occur in the midst of phrases which have been frequently used by the patient. The memories of word-sequences are not so much interfered with as the memories of individual words, because the glosso-kinaesthetic centre, on whose functioning memories of word-sequences so greatly depend, is intact. As has been already said, stimuli derived from the functioning of the glosso-kinaesthetic centre, passing backwards to the auditory word-centre, are powerful instigators of auditory revival. If the degradation of function in the auditory word-centre is slight, these backward currents may suffice for the correct auditory recall, and the correct utterance, of words occurring in conventional or frequently used phrases, while these same words cannot be recalled or uttered individually when desired. As Ross says:* "It seems clear.....that the patient is aided in his utterance of such words by their assosciation with others, and it is

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* Ross:- On aphasia. p. 119.

probable that it is this assosciation which revives them in the memory, and not any external impression".

It has often been asserted that in everyday conversation we have not to think of our words before we speak them, and, consequently, that no auditory recall of them is necessary in these circumstances. And this is to some extent true. In ordinary conversation our thoughts seem to become attached to set phrases and we do not pick and choose our words; but this does not do away with the necessity for the auditory revival of all the words used. Such auditory revival may be, and no doubt generally is, subconscious; but that the auditory elements enter into the chain of cerebral action cannot, I think, be doubted.

Lichtheim supposes that in "fluent talking the innervation of the auditory word-centre is not necessary"*, and this is also the opinion of Pitres who says, "in fluent conversation we are all, or almost all, moteurs..... In the majority of men the thought calls up directly the motor images which are necessary for its expression".†

I have already expressed my dissent from this doctrine and it need not be again referred to; yet it has constantly to be borne in mind, for on it depends the explanations given by its advocates, of many of the phenomena observed in cases of speech disturbance.

In naming objects at sight, some patients become, as Cairdner

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* Lichtheim:- on aphasia. p. 473.

† Pitres:- Etude sur les paraphasies. Revue de Med. 1899 mai. p 337.

said, "intoxicated" with some word which obtrudes itself in consciousness all too readily, and which, by its very persistency, interferes with the recall of the word sought. This symptom simulates the true "recurring utterances" which we shall have to consider in dealing with dissolutions of glosso-kinaesthetic word-memories, but the clinical differentiation of the two forms is generally easy.

The failure of word memory in amnesic patients is often more pronounced in their voluntary writing than in their spoken language. Even in very slight cases, reduplication of syllables, repetition of words, and the use of wrong words (paragraphia), are commonly found.

Although amnesia verbalis leads to defects in voluntary speech and writing, it does not, in uncomplicated cases, interfere with the power of understanding and repeating words heard, or of understanding, reading aloud, writing to dictation and copying words seen. There is no word-deafness and no alexia. This is, in itself, evidence that the auditory word-memories are not blotted out, that their neural basis is not destroyed. There is a defect of recollect-ion, not of memory proper; and while particular word-memories cannot be revived spontaneously, they can be easily revived by the auditory or the visual presentation of the words.

As a rule, it is not necessary to supply the amnesic patient with the whole word sought. If the first syllable is whispered or written, he, almost always, immediately recollects the rest of the word.

The auditory revivals effected by hearing the words spoken, or seeing them written, are sufficient, not only for the understanding of the words, but for their production. One of the most striking features of some severe cases of amnesia verbalis is the fact that patients, whose voluntary speech may be almost nil, may yet be able to read aloud with considerable fluency.

Different degrees of amnesia verbalis may be recognised at all levels of dissolution, according to the severity of the stress. It is possible to trace the various stages from the temporary forgetfulness of names which everyone occasionally experiences, to the most profound amnesia, in which scarcely a word can be recollected, and in which, consequently, spontaneous speech is almost impossible.

There are many morbid conditions in which amnesia verbalis may be observed. In general enfeeblement, in old age, and as a result of fatigue, forgetfulness of names is often noticed. It is also found in some forms of insanity, in the course of the infective fevers, and in toxaemic conditions generally. It may be brought about by concussion of the brain and by localised or general pressure from effusion of blood in the cranial cavity. It may be present in various functional disturbances and in evanescent organic affections of the brain, and it may also be one of the results of the severe forms of stress due to organic lesion in the cerebral substance, such as tumour, softening, abscess, and haemorrhage. Such lesions are, however, very apt

to produce structural damage of the auditory word-centre and so lead to some amount of word-deafness, or to implicate more than one of the word-centres. In these cases it is seldom that amnesia verbalis is present without other symptoms, varying with the site and extent of the lesion.

It is not very often that an opportunity arises of making a post-mortem examination of a case of uncomplicated amnesia verbalis due to gross lesion, and as has been said already, there is some difference of opinion among authors as to whether this condition is necessarily the result of a defect in the auditory word-centre or not.

The following case, which was followed by an autopsy, showed amnesia verbalis uncomplicated by any other disturbance of speech or memory.

W.T... aged 70, suffering from Bright's disease, was seized, one night in April 1903, with an attack of giddiness and became unconscious for a short time. He was indisposed for a few days, and, on getting about again, he found that he had lost, as he thought, the sight of his right eye. This was his only defect for three months. He then had another attack very similar to the first. This time, however, his speech became very paraphasic for a few days and his friends had considerable difficulty in understanding him when he spoke. His speech soon improved very much, and when I first saw him, in August, 1903, his only defects were right homonymous hemianopsia and amnesia verbalis.

The following are the principal facts elicited on examination. He was a fairly well educated man, right-handed, and showing no trace of paralysis of the limbs. He was not deaf and not word-deaf; he understood perfectly everything that was said to him. In spontaneous speech he showed complete amnesia of names of people and of places, considerable amnesia of noun substantives, some amnesia of verbs, slight paraphasia and articulative amnesia. He could name the months of the year, days of the week, letters of the alphabet and numerals. He could repeat anything said to him. He could recognise tunes heard and could sing spontaneously.

He had right homonymous hemianopsia, and Wernicke's hemiopic pupillary reaction was present. There was no word-blindness. He understood what he read and could recognise letters and numerals if the print was not too small. In reading he often thought he had got to the end of a line before he had really done so. This was due to the hemianopsia. His visual acuity was defective, but if the print or writing was large enough he could read aloud fluently. In voluntary writing he sometimes used wrong words, repeated words or phrases, and made some mistakes in spelling. He could copy written words and numerals and could do "transfer" copying,-could copy printed words, transposing the printed characters into their written forms.

In spontaneous speech the amnesia was chiefly confined to proper nouns and noun substantives. Sometimes he could not

remember verbs. When trying to tell me that he used to sing in a church choir, he said, "I used to - I used to - I used to - but he could not recollect the verb "sing". He never could recollect the names of places or of people.

He could read aloud slowly, sometimes omitting words, and could name at sight words, letters, and numerals. He recognised all common objects, knew their uses, and could name most of them at sight.

He could write to dictation, but not freely, and made slight mistakes in spelling: individual letters and numerals were written to dictation freely and correctly.

He was musical and his powers in this respect seemed little impaired. He could sing the words of a hymn better than he could repeat them. He could not read musical score very well and could not recollect the names of the signs for "flats" and "naturals" when these signs were pointed to on a piece of music. His musical knowledge had never been very great.

The following is a letter which he wrote to me a few days after I first saw him.

> Dear Sir
>
> I am writing you a few lines in order that you may see that I have made some improvemen in my improvement in my general health. I wish I could say my speech was improved but it much the same.
>
> I am busy with the list of names, but I cannot get on with list as I should like to, my memory is very defective and at present shows no improvem but my ~~imp~~ sleeping is certainly better. I was in the Country on the Glorious on the first, from the number of reports I shd there were a fair number of reports. I am getting ~~verg~~ tired and thank you so much which is indeed kind of you.
>
> yours most truly
>
> W.T.

The list of names, referred to in this letter, was a list, printed in large letters, of names of certain people and places. The patient was engaged in a law-suit connected with some property, and his legal advisers assured him that he would win his case if he could stand cross-examination in the witness box. This was impossible, as he could not spontaneously recall the names of the people against whom he had brought the action or the name of the place where the property was. I tried to impress these names on his memory through his visual word-centre, either by stimulating, through it, his auditory word-centre so as to lead to the possibility of the spontaneous recall of the auditory memory of the names, or by forming a visual memory of them, which he might learn to associate with the persons and places which they signified. The attempt was a failure and there was no amelioration of the amnesia up to the time of his death in December 1903.

At the necropsy nothing abnormal was detected on a superficial examination of the brain, except that the arteries at the base were very atheromatous. On making transverse sections, begining at the tip of the occipital lobe, a patch of softening was found in the white substance of the left hemisphere, just at the level of the calcarine fissure. The grey matter of this sulcus and also that of the contiguous sulci of the external surface were much atrophied. On continuing the sections the softening was traced forward as far as the posterior ends of the first and second temporal convolutions in the grey matter of which it terminated.

In this case the amnesia was comparatively slight, and there are many cases on record in which it was much more severe. As a rule, however, these are cases in which there are graver defects of the auditory word-memory than mere amnesia verbalis, or in which some of the other word-centres are implicated. As Pitres says*: "Pure amnesic aphasia is rare. In the great majority of cases the faulty memory of verbal recall, which determines and characterises it, is combined with the partial or total loss of the activity of some of the centres specialised for the reception or emission of language, and then exhibits itself in mixed and complicated forms, the diagnosis of which is sometimes surrounded by very great difficulties".

In the case which I have just recorded, all the word-centres, as these are generally located, were structurally intact. The slight implication of the temporal convolutions was posterior to the region generally assigned to the auditory word-centre. This proximity to the first temporal convolution is a common, if not constant, feature in the post-mortem records of simple amnesia verbalis. The lesion always seems to be just on the outskirts of the auditory word-centre. Sometimes it is in the inferior parietal lobule, sometimes in the second or third temporal convolutions, and sometimes in the posterior part of the temporo-sphenoidal lobe.

The production of the same symptom by lesion of any one of these different regions seems to be opposed to our ideas of cerebral localisation, and many explanations have been given

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* Pitres:- L'aphasie Amnésique p74-75.

to account for this peculiarity. Some of these must now be considered in detail.

Pathogeny of Amnesia Verbalis

Amnesia verbalis is manifested above all by a loss of recollection of names of people and of things. That a person should be unable to recall the names of the most familiar objects, used to be regarded as evidence of a profound disorder of memory; and it was thought very remarkable that, in such a case, the name of an object may suggest the idea of the object as formerly, although the sight of the object no longer suggests the name.

Many attempts have been made to account for this peculiar susceptibility to stress of the memory of names. Forbes Winslow writing on this subject nearly fifty years ago said:* "Metaphysicians agree in the opinion, that qualities of objects and events, are more easily retained in the mind than dates and names; in other words, that the intellect takes a more tenacious grasp of adjectives, than of substantives". The metaphysicians had evidently noted the results of dissolution of auditory word-memories and endeavoured to give a metaphysical explanation of them.

Another opinion, which carries us little further, was given by Kussmaul.† He said that since we can think of persons and

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* Winslow:- Obscure diseases of the Brain. Lond. 1860. p. 359.

† Kussmaul:- Disturbances of Speech, p. 759.

of things without thinking of their names, "the conceptions of persons and things are more loosely connected with their names than the abstraction of their circumstances, relations, and properties are". This explanation has been widely accepted as being sufficient to explain the loss of recollection of names while that of other parts of speech remains unimpaired.

A far more important suggestion, made by Osborne* as far back as 1833, seems to have been lost sight of until a few years ago when it was again put forward by Professor Wyllie. This view cannot be expressed better than in the words of the latter writer. He says:† .."as every thing and every class of things, has its name, nouns are almost infinitely numerous; and yet if we examine a few sentences of written or spoken speech, we find that only the abstract nouns and the general terms occur individually with any considerable frequency in ordinary speech, and that the specific names of concrete things do so only at long intervals. Nouns of the latter class, therefore, being seldom repeated, can make no very deep impression on the speech centres. On the other hand, if we look at adjectives, prepositions, verbs, &c we find that while they are comparatively few in number, they are individually more frequently used, being often repeated."

Here we have a real reason why the memory of nouns is so liable to dissolution. It is an explanation which agrees with all that we know about the permanence of memories in general.

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* Osborne:- On the loss of the Faculty of Speech, Dub. Jour of Med. Science Nov 1833, p158.

† Wyllie:- Disorders of Speech, p261-262.

Of Kussmaul's explanation that the amnesia of nouns is due to the fact that we can think of things without recalling their names, Wyllie says, "this, of course, is only another way of saying that we do not always mentally repeat the names of such objects when we think of them".

This mental repetition of words in the inner speech is, as I have already said, essentially a mental sounding of words, and it seems perfectly clear that it is one of the chief factors in determining the permanence of auditory word-memories. We have already seen the importance of repetition of sensory impressions in the organisation of memory centres, and there is abundant evidence to show that a similar effect is produced by revivals of the original impressions as ideas. Why recollection should fail before memory proper, has been pointed out in a former chapter, and now that we see how nouns are less deeply imprinted on the memory than other parts of speech, the law of dissolution at once explains their early loss in amnesia verbalis.

It was recognised by the older writers that the loss of nouns in speech is of the nature of what we now know as a true dissolution of memory; it was, for them, a loss of certain endowments, with retention of others of which "the intellect takes a more tenacious hold". Even after the question of localisation of cerebral functions had been definitely settled it seemed clear to most observers that amnesia verbalis was not due to destruction of any special centre of noun-memory.

Nevertheless, some modern writers have been led to believe that there may exist a special centre for the registration of nouns, and that the phenomena of amnesia verbalis are due to destruction of this"noun" or "naming" centre. The latter term was introduced by Broadbent as a descriptive name for his "concept centre", and it has been used by some later writers in a somewhat similar sense

C.K.Mills, writing on cerebral localisation, says.* "A careful study of the entire subject of speech disturbances, including an analysis of cases already reported, will be convincing as to the necessity of a higher area for thought and speech, intermediate between the sensory or receptive centres. and the motor or emissive". Mills seems to base his belief in the existence of a naming centre on a case of amnesia verbalis in which, after death, a tumour was found in the third temporal convolution on the left side. In this region, therefore, he locates the "naming centre".

He accepts, in their entirety, Broadbent's views on the connection between conception and naming, and on the consummation of these two processes in a common centre. "The destruction of this centre" he says,"would cause loss of the memory of names or nouns". Mills does not draw any distinction between memory proper and recollection, but it must be supposed that, if a naming centre exists, its destruction will be followed by loss of memory of names as well as by loss of recollection.

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* Mills:- Nervous Diseases by American Authors edited by Dercum, 1895, p. 427.

It is evident that Mills believed that the naming centre was destroyed in the case which he recorded. Yet in his examination of the patient the following facts were elicited. "She could not name objects either from sight or touch..... ...when such objects were named to her she would promptly, and with evidences of satisfaction, indicate that the names were correct; and she could also, as a rule, repeat the names spoken before her".*

Now, in Mills' scheme, the naming centre is the only bond of association between the word-centres and the "perceptive" centres, and it is difficult to understand how, if this bond was destroyed, the patient could have known whether names spoken before her were correct or not. The word-sound could have no meaning unless brought into association with the sensory representations which form the content of the words, and according to Mills, this association is brought about by, and in, the naming centre. Indeed, if this "naming centre" is a true "concept centre" as this was described by Broadbent, if there is "no radiation of an impression from one perceptive centre to all the others", then this patient should not merely have suffered from loss of memory of names, but should have been unable to form concrete conceptions at all.
The presentation of an object through any, or all, of the senses should have resulted in no recognition of the object, or its name, or its uses.

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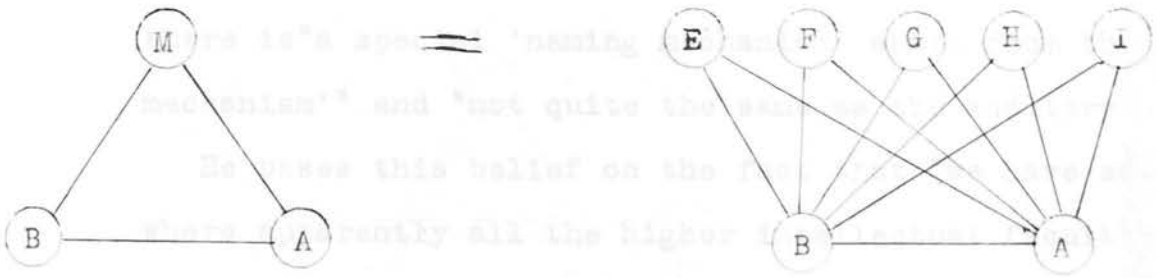
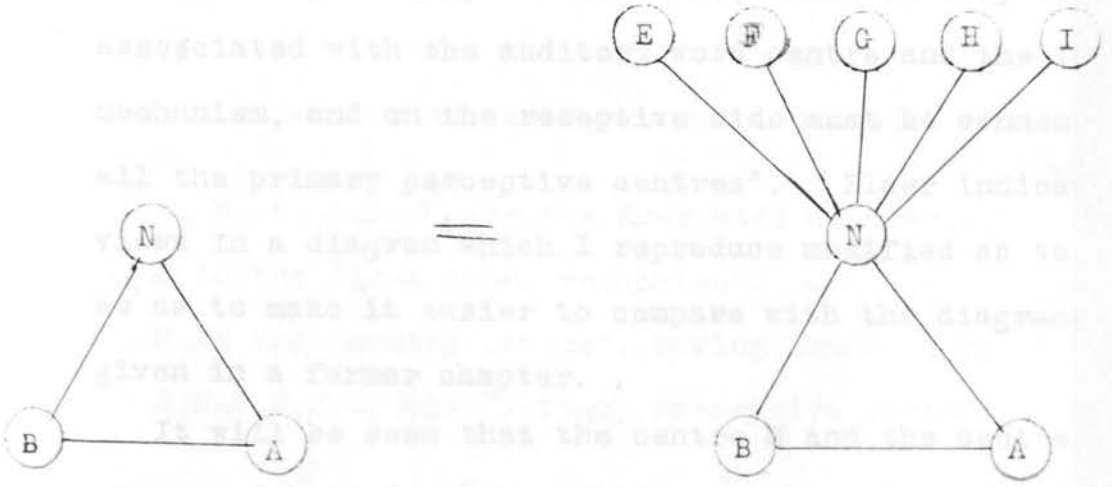
* Mills:- Loc. cit. p. 428.

Opponents of the hypothesis of a localised centre for concepts have often maintained that no record of lesion of such a centre has ever been made. They did not anticipate that the only defect produced by destruction of a concept centre should be a more or less pronounced loss of recollection of words - the amnesia verbalis of clinicians.

Mills has given a slight modification of Lichtheim's diagram as indicating his own views on the connections of the word-centres. The "naming centre" is substituted for Lichtheim's "concept" centre and is evidently regarded by Mills as being identical with it. I think, however, that if the writings of Lichtheim and of Mills are compared, it will be evident that this is by no means the case. Lichtheim expressly dissents from the view that there is a centre for conceptions confined to any one area of the brain, while Mills, accepting Broadbent's hypothesis, distinctly says there is. The difference which really exists between the views of Lichtheim and of Mills may be shown by the following diagram. In Lichtheim's scheme, M stands for all the perceptive centres joined directly to the word-centres. In the scheme of Mills, N is the "naming" centre interposed between the perceptive centres and the word-centres.



Lichtheim's scheme, in which M stands for all the perceptive centres.E,F,G,H.I. connected directly with the word centres A & B.



Mills' scheme, in which N is the "naming centre" interposed between the perceptive centres E,F,G,H,I. and the word-centres A and B.

Views somewhat similar to those of Mills have been put forward by Elder in his work on Aphasia.* He endeavours to show that there is"a special 'naming mechanism' apart from the 'ideational mechanism'" and "not quite the same as the auditory word-centre"×.

He bases this belief on the fact that "we have some cases where apparently all the higher intellectual faculties are intact. where the patient can think and act rationally, can form ideas of objects, recalling their form, appearance, and other characteristics. but on speaking cannot recall their names.....And again, the fact that we have cases with no affection of the auditory word centre and no affection of the higher intellectual centres, but very distinct amnesia of nouns, shows that the mechanism concerned in the recalling of names is not quite the same as the auditory word centre".†

Such a mechanism, he concludes, "must be very closely associated with the auditory word centre and the ideational mechanism, and on the receptive side must be connected with all the primary perceptive centres". Elder indicates these views in a diagram‡ which I reproduce modified as to lettering,&c. so as to make it easier to compare with the diagrams already given in a former chapter.

It will be seen that the centre M and the centre A are each connected by a double commissure with a special naming centre N. To the centre N is further indicated a convergence of impressions from all the perceptive centres and from the visual word centre.

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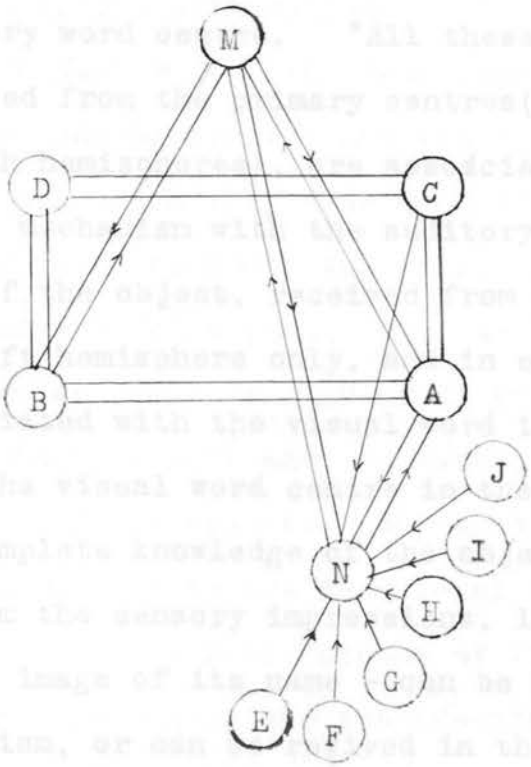
* Elder:- Aphasia and the Cerebral Speech Mechanism. London. 1897.

× p. 122. † p 122. ‡ p. 124 - p125.



Elder's scheme of the word-centres and naming centre. (modified).
(Aphasia &c. pp. 124-125).

A, B, C, and D. are the four word centres.

M is the "ideational mechanism".

N is the "naming centre", having connections with M, A, C, and E, F, G, H, I, J, the "primary perceptive centres".

Elder describes the relation which he believes to exist between our knowledge of an object derived from sensory impressions of sight, touch, taste, &c. and the word-sound received by the auditory word centre. "All these impressions", he says, "are received from the primary centres(which it is to be noted are in both hemispheres), are associated in what I have called the naming mechanism with the auditory word image, or sound of the name of the object, received from the auditory word centre, in the left hemisphere only, and in educated persons probably also associated with the visual word image of the name, received from the visual word centre in the left hemisphere only; and the complete knowledge of the object - that is, all we know of it from the sensory impressions, including its name and the visual image of its name - can be transmitted to the ideational mechanism, or can be revived in the memory by the ideational mechanism".*

It will be seen that this description of the naming centre corresponds very closely to that given by Broadbent. Elder's naming centre would seem to be the "common intermediate cell area which by "convergence of impressions from the various perceptive centres" formed the naming centre of Broadbent. But the naming centre of Broadbent was a concept centre. What, then, is the meaning of the centre M in Elder's diagram ? If a "concept centre" or "ideational mechanism" is to have any meaning at all, it must signify that grouping together of all the "perceptive

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* Elder:- aphasia p. 126

centres", either directly one with another, or through a "common intermediate cell area", by which alone the formation of concrete ideas is rendered possible.

Again, the primary perceptive centres in Elder's scheme seem to perform all the functions which Lichtheim attributed to his concept centre, and the centre M in Elder's diagrams, which are ostensibly fashioned on that of Lichtheim, would appear to be entirely superfluous. When we have complete knowledge of an object, when we have memories of all its attributes,-"all we know of it from the sensory impressions including its name and the visual image of its name",-- we have an idea of the object. Why this idea, already complete, should be "transmitted to the ideational mechanism", it is difficult to conceive. The real outcome of Elder's teaching is to make us believe that there are two ideational mechanisms, - one for concrete ideas, his naming centre, and another whose functions can only be described in his own words, "the mechanism by which the intelligence is called into action or by which the concepts are elaborated".*

It is difficult to bring Elder's views into line with modern psychological beliefs, but, if the attempt is made, it will appear that his naming centre can, at most, be but a part of the auditory word-centre. It is not inconceivable that the parts of the auditory word-centre in which memories of names are registered may be more or less topographically distinct from the parts concerned with the memory of less specialised parts of speech.

* Elder:- aphasia p.60

The more intimate connection of names with impressions of sense, and of other parts of speech with the more abstract forms of thought, might indeed lead us to expect to find some amount of separate localisation of the areas subserving the memories of different classes of words. How far this may exist in the auditory centres is by no means clear from an examination of the recorded cases of lesion of this part of the brain; and Elder's contention, that the naming centre may be localised in the posterior half of the third and second temporo-sphenoidal convolutions, will require much more convincing evidence than he adduces before it can be accepted.

A view of localisation much less open to criticism than those of Mills and Elder has been put forward by Guido Banti.* He believes that Amnesia Verbalis is due to perturbation of the auditory word-centre and that this centre extends as far as the inferior parietal lobule. Depending on the extent of this centre destroyed, or on the particular parts of it affected, there will be either pure amnesia verbalis or pure word-deafness, or a combination of these two groups of symptoms. Pure word-deafness will occur if the centre is destroyed in its most active part,- in the part which most directly receives sensory impressions. Pure amnesia verbalis will be the result of alteration of the peripheral parts of the auditory word-centre, especially the inferior parietal lobule, - those parts by which it is brought into relation with the ideational centres.

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* Banti:- Afasia e sue forme, lo Sperimentale 1886. t. LVII.
(taken from Pitres L'aphasie amnesique p 25)

The most naive of all the explanations of amnesia verbalis is that which has been very generally adopted by writers of the French school. The idea of an object is complete save for the loss of recollection of its name; the auditory memory of the name is evidently not abolished since it can be revived by the word heard; the glosso-kinaesthetic centre is evidently intact since words heard can be repeated; consequently, the failure in spontaneous recall of the name is due to interruption of the pathways between the centres of sense-representations in general and the word-centres.

This is the view now adopted by Pitres, although at one time he thought that amnesia verbalis is due to functional defect in one or other of the word-centres.* In his more recent writings he relegates amnesic aphasia to a class of speech disturbances whose mode of production he believes to be quite different from that of ordinary aphasic conditions.†† He thinks that while "sensory" and "motor" aphasia are "manifestations symptomatic of loss of excitability, organic or functional, of the centres of the sensory or motor images of words, amnesic aphasia is the indication of rupture of communications between the intact psychic centres and the unaltered centres of word images".‡ He thinks it is quite natural that the lesions causing amnesia should be found in the immediate neighbourhood of the "sensory" word-image centres, but he thinks that they produce their effects, not by the destruction of any specialised centre

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* Pitres:- Revue Médicine 1895, p 898. (Étude sur l'aphasie chez les polyglottes).

† Pitres:- Revue de Médecine 1899, p.550. (Étude sur les paraphasies)

‡ Pitres: L'aphasie Amnésique p.49

exclusively concerned in word evocation, but by breaking a part of the commissural pathways which unite the different word - centres to the parts of the cortex in which the higher psychic acts are effected.*

Pitres recognises that a lesion destroying such commissures would be very likely to cause word-deafness as well as amnesia verbalis,-that the word heard could no more revive the idea of the object than the idea of the object could revive the word - image. The well known fact that this is not so, in pure amnesia verbalis, compels him to believe that the "psycho-sensory" path follows a different route from that of the "sensory-psychic". From the frequency with which the inferior parietal lobule is found to be affected in cases of amnesia verbalis, he supposes that the psycho-sensory path may be situated in this region of the cortex.†

A similar explanation of the mode of production of amnesia verbalis is given by St.-Paul.‡ He indicates his views by means of a diagram in which the "psychic centre" CP is united to the word-memory centre CM by two pathways - one conducting centripetal excitations v.c.p. by which projections on the psychic centre are effected(apport, reviviscence.); the other v.c.f. conducting centrifugal excitations, by means of which the psychic centre acts on the word memory centre(evocation), and determines the revival of images which are then projected on the psychic centre by the former pathway(fonction mirroir).

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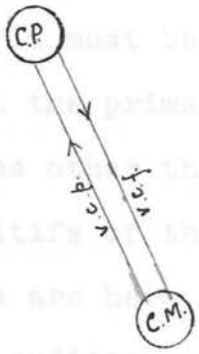
* Pitres:- L'aphasie amnesique. p. 72 †Ibid p 73

† St. Paul:- Le Langage Intérieur p. 277.



* St.-Paul:- Le Langage Intérieur. p. 278.

St.-Paul divides amnesia into centripetal amnesia and centrifugal amnesia, but it is with the latter, which he supposes to be due to destruction of the path v.c.f., that we are here concerned. It must be remembered that both Pitres and St.-Paul believe that the primary evocation of words may take place in word-centres other than the auditory; but the application to verbo-auditifs of their views, brings them into line with the question we are here considering, - the mode of production of amnesia of auditory word-memories.

That the impossibility of spontaneous recall of auditory word-memories, met with in simple amnesia verbalis, is not due to destruction of a localised centre for the registration of specialised parts of speech, such as nouns, is, I think, clearly shown by the fact that these memories can be aroused by the auditory presentation of the words in question: if the centre for such auditory memories were destroyed the patient would be word-deaf to these words.

The attempts at localisation made by Mills, Elder, and Banti, are all open to this objection. It is significant that each of these authors should have located the area for the registration of nouns in different regions of the cortex. Mills says it is in the third left temporal convolution. Elder places it at the posterior extremities of the second and third left temporal convolutions. Guido Banti, while indicating the inferior

parietal lobule as the site most frequently affected in amnesia verbalis. probably comes nearer to the truth when he says that this defect may be brought about by lesion of any part of the periphery of the auditory word-centre.

Such a conclusion is quite in accordance with the view which I have put forward in the previous pages; for any affection of the periphery of the auditory word-centre would probably lead to functional degradation of the auditory word-centre of such a nature, that the effects produced would be those of a stress falling evenly, and so conform to the law of dissolution.

The objections to the views of Pitres, St.-Paul, and other writers of the French school are very great. Whilst it cannot be doubted that the auditory elements subserving the memory of nouns must have structural connections with the parts of the cortex which are the sites of sense-representation in general, it seems impossible to believe that any gross lesion should ever be able to implicate such widespread commissures without at the same time interfering with other important structures.

The probabilities are great, that the centripetal and centrifugal connections between the auditory word centre and the various cortical regions concerned in the formation of concrete ideas, lie close together; and that consequently. a lesion of one would invariably be accompanied by functional manifestations indicating implication of both routes.

This objection was clearly appreciated by Pitres. but his

attempt to locate the "psycho-sensory" pathway in the region of the inferior parietal lobule is nullified by the occurrence of amnesia verbalis when the lesion is in some other part of the brain, such as, for example, the regions indicated by Mills and Elder as the site of their postulated "naming centre".

It is conceivable, however, that a functional disturbance of such centrifugal conducting ways might occur, having as its necessary concommitant a failure of word evocation. But since these centrifugal fibres are but the prolongations of neurones whose cell bodies are in the "psychic cortex", such functional degradation of these processes would probably always be accompanied by nutritional disorder of the related neurones as a whole, and the psychical correlate of such disorder would show graver mental defects than mere amnesia verbalis.

There would seem to be no good reason for believing that the explanations given by these writers are necessary for the interpretation of the phenomena of amnesia verbalis. As Bastian has long taught, all the facts can be most easily accounted for on the hypothesis that in simple amnesia verbalis there is a functional degradation of the auditory word-centre itself, whereby some of its elements are rendered irresponsive to "volitional" stimuli while retaining their excitability to sensory impressions. As we have seen, if such functional degradation is the result of a stress falling evenly, the morbid manifestations will follow the general law of dissolution: reaction to weaker stimuli will fail before reaction to stronger

stimuli, and the elements which first fail to respond will be those which are least deeply organised.

Lower levels of dissolution of auditory word-memories.

In the morbid conditions which we have been considering, the auditory word memory can always be aroused by direct sensory impressions; but if the stress be more severe, the functional degradation produced in the least organised elements may be so great that response to direct stimulation is lost.

There is then deafness to those words whose memories are least stable, as well as amnesia verbalis. But since the level of dissolution at which response to direct sensory impression fails, is lower than that which leads to loss of recollection, we should expect to find the amnesia much more profound than the word-deafness and, consequently, spontaneous speech much more seriously disturbed than the power of understanding words heard. The study of amnesia in individuals who are conversant with several languages well illustrates this condition.

The manifestations of this level of dissolution are seldom observed as the result of a gradually increasing stress. It is rather in the process of recovery from still lower levels that it most frequently occurs. We have already seen the order in which foreign languages are recovered - an order the reverse of that of dissolution, and we may now note, that in any particular language the understanding of words heard is recovered before such words can be used in speech.

As a result of an investigation of this subject* Pitres has come to the conclusion† that the following stages may be observed during the course of recovery from Aphasia due to stress which is sudden and severe, such as apoplexy.

(1) At the time of the initial stroke, which is sometimes severe, but which generally passes off without leaving persistent hemiplegia, the patient completely loses consciousness, and remains for a certain time, varying in different cases, incapable of all psychic manifestation.

(2) Having recovered consciousness he soon understands the language which was formerly most familiar to him, but is not able to speak it.

(3) A little later he is able to express himself in this language, without as yet being able to understand or speak the others.

(4) After a longer or shorter lapse of time he understands the other languages which he has known.

(5) Lastly, he recovers the power of speaking these languages.

Most of these stages are clearly shown in a case recorded by Pitres‡ of which I give here a short summary.

The patient was a man named Cast...., aged 55 years. Born at Dax, he was acquainted, from his earliest infancy, with the French language and with the patois of his district. At an age at which, as a rule, foreign languages are acquired with difficulty, he accepted an appointment at Las Navas, near Madrid, and very quickly learnt to understand and to speak Spanish.

In June 1895 he had an attack of apoplexy, with complete loss of consciousness. In five days he recovered consciousness

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* Pitres:- Etude sur l'aphasie chez les polyglottes - Rev. de Med. t XV. nov 1895. pp. 873-899.

† Pitres:- L'aphasie amnésique. p. 59-60. ‡ Ibid. p. 60-63

and then it was found that he could not speak. He understood what was said but was quite incapable of responding. Fifteen days later he wrote a letter to his daughter which was quite incomprehensible. He returned to France at the end of 1895. By this time he was able to make himself understood in French or in patois, but he was unable to pronounce a single word of Spanish. If a question were addressed to him in that language he understood it, but he always replied in French or in patois. If pressed to speak in Spanish he invariably replied"je ne peux plus; je ne sais plus; j'ai tout oublié".

Three months later, when he was first seen by Pitres, he had already made some progress. He could say almost all that he wished to in French or in patois, but he had the greatest difficulty in using any Spanish words. Even in French, although he had no difficulty in repeating the most difficult words, he was often at a loss for a word in the course of conversation and often employed a periphrase to express his meaning.

A gradual amelioration took place and when Pitres recorded his observation Cast... was able to speak French quite freely, only very seldom being at a loss for a word. At this time he understood all that was said to him in Spanish almost as well as in French, but was not yet able to express himself in that language. Familiar phrases and isolated words he could use spontaneously, but there was pronounced amnesia verbalis for Spanish. When asked the Spanish for "table",he was unable to recollect it. Pitres says:- "Je lui souffle: una me..., et il s'écrie radieux: 'Ah voilà! Una mesa, une table, c'est cela'. Je le prie de nous dire le mot espagnol qui signifie allumettes. Il recommence à chercher et ne trouve pas. J'écris au tableau fosf... et avant que j'aie terminé le mot, il s'écrie: 'Voilà! voilà! C'est fosforos'"

The record of this case before the patient came under Pitres' observation is not very exact, and it is not distinctly stated whether after recovering consciousness he understood Spanish when it was spoken before him, or whether the comprehension of what was said to him, which he exhibited before he could speak at all, refers to the French language. It seems probable that at this period he was word-deaf to Spanish. The different stages of dissolution in regard to this language were well shown, at a later date, by the existence of the ability to

understand it while he could not yet speak a word of it, and by the persistence of amnesia verbalis after he had attained some fluency in speaking it.

It seems very reasonable to suppose that a similar manifestation of different levels of dissolution of word-memory may be exhibited by amnesic patients who are acquainted with only one language - their mother tongue. A stress falling evenly on the auditory word-centre that had reached a certain intensity might produce a profound amnesia of all the more general parts of speech, and at the same time the functional degradation of the least deeply organised elements might be so great that a partial word-deafness would be present. There would be word-deafness to nouns though not to other parts of speech; and spontaneous speech would be very defective owing to the profound amnesia verbalis.

This condition, which may be called noun-deafness, might be very easily overlooked in the examination of a patient, because a deafness to the nouns in a sentence would generally interfere with the comprehension of the meaning: it might therefore be supposed that there was a much greater deafness to words than really existed. I think that if this defect were specially looked for it might be found in many cases of auditory aphasia, particularly when recovery is taking place.

It is difficult to find any clear recognition of noun-deafness in recorded cases, but it seems to have been observed in a

patient whose case has been reported by Nadine Skwortzoff *

" If a number of objects are placed in front of him, an inkstand, a cap, a pin, a watch, a pen,&c., and if he is asked to point to one of these objects, he does so at random; he gives the pin box for the watch, the key for the inkstand,&c. Sometimes he points correctly to the object which is mentioned but he makes a mistake the instant afterwards: at the same time he recognises these objects, indicates their uses, and makes use of them properly.

He understands verbs. If he is asked "Where do you work"? he shows the place. To the question "What do you do there"? he makes clear, by the aid of gestures, the nature of his work. He is not deaf; in fact he understands, and consequently, hears very well questions in which the name of any object does not happen to occur."

This patient's voluntary speech was very defective, being almost limited to "yes" and "no", and some oaths. This is what we should expect as a result of the profound amnesia verbalis which must accompany dissolution of the auditory word-memory to such a low level that noun-deafness is produced. In the absence of an autopsy, however, it is impossible to say that this was the only cause of the aphasia.

A similar deafness to nouns, with less disturbance of voluntary speech, was present in one of Wyllie's cases of pure word-blindness. †

" There was no marked degree of word-deafness but there was a slight degree of it, which was shown when the patient was tested with the names of concrete things. Thus when I asked him to touch, as I named each part, his nose, eyebrows, beard.&c. he often made mistakes in what he touched. There was marked amnesia of the names of persons and of concrete things".

There are some interesting conditions, met with occasionally, in connection with dissolutions of the auditory word-memory, which may be conveniently referred to here.

* S Kwortzoff:- De la cécité et de la surdité des mots dans l'aphasie. Obs. IV p106-108.

† Wyllie:- Disorders of speech. P.346.

Auditory Apexia.

Before complete noun-deafness is produced, or after it has, to some extent, been recovered from, we might expect to find a stage at which the recognition of nouns heard is only partly interfered with. The understanding of the word heard, in such cases, is not impossible, but there is retardation of the process by which the name heard calls up the mental image of the object. There may be no word-deafness in regard to any word taken individually, and yet the meaning of a sentence of ordinary conversation may be but imperfectly understood, because sufficient time is not given for the significance of some of the words used to be realised.

A defect of this kind was clearly indicated by Lordat in his analysis of his own speech defects. He said: "I was no longer in a condition to receive the ideas of others, because the amnesia which prevented my speaking rendered me incapable of understanding quite promptly the sounds which I heard so as to know their significance".* He felt that each word heard required a special effort of memory to recall its meaning and the rate at which conversation is usually conducted did not allow sufficient time for this.

The auditory word-images thus tardily aroused are often very evanescent, so that while the individual words of a phrase may be easily repeated by the patient, if taken one at a time, there may be a total inability to repeat a phrase of any length

* Lordat:- Analyse de la parole. p.347. (Quoted by Pitres, L'aphasie amnésique p.79.)

if taken as a whole. Thus a patient of Pitres' was able to repeat the words Bonjour....mon ami....comment....vous..... portez-vous, taken separately, but when asked to repeat the entire phrase, he could only remember "portez-vous."†

This is the condition to which Pitres has applied the term "apexie" or amnesia of fixation.* He supposes that the apparent anomaly of being able to understand individual words, although not their combination into sentences, may be explained by the fact that there is a too rapid fading of the memory of the words heard, so that by the time the end of the phrase has been spoken the patient has already forgotten the begining.

It is difficult to decide how much of the defects in these cases is due to a failure of retention and how much to a difficulty of"penetration". If a sentence spoken at the ordinary speed is not understood, there will be, of course, some difficulty in repeating it; just as any of us would have some difficulty in repeating a sentence in an unknown language. We know that the "span of prehension" for meaningless syllable-sounds is not very great even in health, and it is no doubt less in amnesic conditions. But when sentences are spoken slowly, so that the meaning of the individual words is understood we must conclude that the inability to understand the sentences as a whole and the inability to repeat them as a whole, are due to a true apexia - a want of fixation of sensory impressions.

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* Pitres:- L'aphasie amnésique. p.77. † Ibid. p.79-80

Echolalia.

The ability to repeat words heard is sometimes retained when there is, or appears to be, a considerable amount of word-deafnes present; and in a few rare cases the curious fact has been observed, that the act of repeating the words has enabled the patient to understand words, the meaning of which he was unable to apprehend by the ear alone. These cases are closely related to those of another class in which there is a true echolalia. In this condition words are repeated fluently without any understanding of their import, and not only is this possible, but there is generally a pronounced tendency to echo all words heard.

No satisfactory explanation of true echolalia has yet been given. It is well known that this symptom is often exhibited by patients suffering from dementia; and Wyllie suggests that since aphasic states are frequently accompanied by some amount of dementia, the echolalia in these cases may be due to the dementia rather than to the aphasia.* And it must be admitted that when the mimetic tendency is so pronounced that every word uttered before the patient is repeated by him in parrot-like fashion without any understanding of the words so produced, there must be grave disturbance of the intelligence.

And such disorder of the intellect is in these cases the psychical correlate of functional or organic alteration in parts of the cortex other than the centres of word-memory.

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* Wyllie - Disorders of Speech, p. 271.

The functional degradation of the auditory and glosso-kinaesthetic centres cannot be very great since they both respond under the stimulus of sensory impression, as is evidenced by the repetition of words heard. We may I think legitimately suppose that there is, in true echolalia, some affection of that widespread area which is included in the centre M, and that the logagnosia may be truly described as "supra-pictorial".

A good example of this type was seen by Bateman at the Salpêtrière.*

The patient was "a woman aged 56 who had right hemiplegia with aphasia and who, although she never spoke, repeated all that was said, - for instance, Dr. Voisin addressed her thus, "Voulez vous manger?" She said, instantly, "Voulez vous manger ?" I then said to her in English, "You are a bad woman." She instantly said, "You are a bad woman." I said, "Sprechen sie Deutsch ?" She retorted, "Sprechen sie Deutsch ?" In the words that she thus echoed, her articulation was distinct, although the foreign phrases were not repeated by her in quite so intelligible a manner as the French.

More interesting than echolalia assosciated with profound mental impairment, in which the words uttered by the patient or by another person are not understood, are those rare conditions in which the repetition of words, which are not understood when heard, leads to a knowledge of their meaning. A short note of a case recorded by Dr. Byrom Bramwell will illustrate this condition.†

A woman, aged 26 years, had a sudden cerebral attack, which was followed by absolute deafness to all sounds for sixteen days, as well as by temporary aphasia, word-blindness, and absolute word-deafness for four weeks. There was rapid recovery of speech, as well as partial recovery from the word-deafness.
At one period of her illness it was found that she could repeat correctly words and sentences which she could not understand when spoken; and could write from dictation long sentences which she was quite unable to understand by the ear. She could

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* Bateman:- ~~On~~ Aphasia. 2nd Edit. p. 213.

† Bramwell: Lancet. 1897. VII. p. 1256

repeat the words of a sentence spoken slowly by another person and could take up its meaning when finished. When asked a question she often echoed the last part of it, and then after repeating some of the words seemed to understand their meaning.

What possible explanation can be given of a case like this ? How is it, that a stimulation of the auditory word-centre which is sufficient to lead to the appropriate innervation of the glosso-kinaesthetic centre, is yet insufficient to revive in the mind the meaning of the words heard; while the mere act of uttering the words leads to an understanding of the meaning of of the words uttered.?

It cannot be held that the functioning of the glosso-kinaesthetic centre itself gives any help directly: glosso-kinaesthetich impressions receive their interpretation only by acting on the auditory word-centre through the commissure B-A. Must we suppose, then, that auditory impressions plus glosso-kinaesthetic impressions are more effective in rousing the auditory word-centre, so as to lead to a knowledge of the words, than the impressions derived from auditory presentation alone ?

I think this is highly probable. If it is so, it would accord well with the importance which I have ascribed to the backward action of the glosso-kinaesthetic centre on the auditory word-centre in the inner speech. Even in health, this help in understanding words by puting the glosso-kinaesthetic centre into action is often noticeable. When the meaning of a passage which we have just read, escapes us. we go over it again,

mentally speaking the words with more emphasis, or we may even read them aloud. It would seem that some people get assistance in the same way when listening to spoken words. But in any case it is not on the movements of the oral articulative mechanism that the attention is fixed, nor, when we repeat aloud the words seen or heard, is it on the sounds which we produce. It is on that inner voice which is brought into prominence by the functioning of the glosso-kinaesthetic centre. So, in disease, auditory revivals which may suffice for the repetition of words heard may not suffice for the calling up in the mind the meaning of the words heard, while the auditory revivals produced by the functioning of the glosso-kinaesthetic centre may be sufficient to do so.

There is, however, the possibility that in some of these cases of word-deafness, in which words can be repeated, the incitations of the glosso-kinaesthetic centre are not derived from the auditory word-centre in the left hemisphere at all. It has been supposed, that in some cases of destruction of the first left temporal convolution, ability to repeat words heard may be retained, and that the auditory word-centre on the right side is then the source of the glosso-kinaesthetic incitations. This is the explanation suggested by Bramwell in regard to the case which I have quoted. The very existence of such a word-centre is, of course, denied by some authors, but there are several considerations which might lead us to suppose that in this connection

it may not be necessary to invoke the aid of an auditory word-centre at all. When it is remembered that we can without much difficulty repeat words of a foreign language which we have never heard before, it cannot be maintained that a centre of auditory word-memory is necessarily concerned in the process. It is true that the sound-units of speech are very much alike in all languages, and it may be said that it is by new combinations of these sound units that the repetition of such words is rendered possible. We must then believe that the memories of the sound units of speech are efficiently stored in both hemispheres, even if the memories of their orderly combination into known words have their site in the left auditory word-centre only. Under the direct stimulation of words heard, these sound-unit memories, in the right temporal convolution, might suffice for the revival of appropriate glosso-kinaesthetic memories, so that the words might be more or less accurately produced. Such a mode of repetition would be comparable to the imitation of sounds other than words; and since it is well known that individuals vary much in their powers of imitation of such sounds, this method of repeating words would probably be much easier for those who are naturally gifted with such mimetic powers.than for those who are not.

If such a method of repetition of words heard, but not understood, is possible, it may be pointed out that in the event of the auditory logagnosia being of the"pure" or"infra-pictorial"

variety, the incitations derived from the glosso-kinaesthetic centre, in the act of repetition, would lead to a stimulation of the left auditory word centre, and so, to an understanding of the words uttered.

Such a condition would be parallel to that which is found in pure word-blindness: movements of copying, instigated by the general visual centres, lead to a revival of visual word-memories, and so, to a recognition of the words copied.

Lowest levels of dissolution of auditory word-memories.

If the dissolution of auditory word-memory is carried to its lowest level,- if the auditory word-memory centre is destroyed,- there would then be complete amnesia verbalis and total word-deafness. Auditory word-representations would be completely blotted out of consciousness; and if the views which I have put forward in regard to the importance of auditory word-memories in thought and speech are correct, a patient suffering from such complete dissolution of auditory word-memory would be aphasic, because words could not be revived spontaneously; he would be word-deaf, because the auditory word-memories could not be aroused by direct sensory impressions; he would not be able to read, because the visual symbols could not recall the auditory symbols through which the understanding of words is mainly effected; he would not be able to write, because in spontaneous writing the primary evocation of words takes place in the auditory word-centre; finally, he would suffer from profound mental degradation in which all abstract thought would be impossible.

An almost similar opinion was expressed by Bastian many years ago.* He said:-"The condition of Amnesia may merge by insensible gradations into one of Aphasia..... Suppose a person to be suffering from a defective activity of the Auditory Word-Centre, so that Names cannot be recalled 'voluntarily' or by 'assosciation'

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* Bastian:- Brain as an Organ of Mind. p 684-685. (4th Edt. 1890).

There would already be great hesitations and difficulties in the expression of Thoughts, both in Speech and in Writing. But suppose this mere defective activity to be replaced by actual destruction of the left Auditory Word-Centre, so that its functional activity became entirely lost: words could then, of course, neither be recalled 'voluntarily' nor by assosciation; and still further, they could not be perceived and consequently could not be imitated. An individual thus affected would ~~neith~~ neither be able to Speak nor to Write, that is, he would be completely aphasic - with the superadded peculiarity that he would not readily comprehend spoken and perhaps written Language."

Writing on the same subject in 1898, Bastian says*, in reference to this paragraph:-"It should be observed that these statements were made partly as a priori deductions and partly as a result of the observation of actual cases, though at this period there had only been too few of them. Still, it seemed to me then - and from several points of view it would still seem a legitimate conclusion - that loss of articulat speech should result from destruction of the auditory word-centre, just as agraphia results from destruction of the visual word-centre."

An investigation of the symptoms which result from destruction of the auditory word-centre introduces us to one of the most debated points in the history of aphasia; and there is at the present time a fundamental difference of opinion among writers in regard to this matter.

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* Bastian:- aphasia p. 154.

Although some of the older records reveal to us the existence of the condition now known as word-deafness, it was not until 1869 that its dependence on a lesion of the 'auditory perceptive centres' was clearly formulated. In that year, Bastian, in a remarkable paper, "On the various forms of loss of Speech in Cerebral Disease"*, clearly indicated the nature of the defect present in such cases. Nothing, however, was known as to the region of the cortex affected until 1874 when Wernicke published his monograph "Der Aphasische Symptomen-complex"†. In this paper Wernicke brought forward evidence to show that lesion of the posterior extremities of the upper and middle left temporal convolutions produced word-deafness and other disturbances in the reception and production of speech. He described this condition as "Sensory Aphasia" and enumerated as its symptoms, word-deafness, paraphasia, alexia, and agraphia.

At this time nothing was known of a visual word-centre; but some years later Kussmaul‡ pointed out that word-blindness is related to destruction of the angular gyrus and part of the supramarginal gyrus, and that word-deafness is the essential defect produced by lesion of the temporal convolutions.

The anatomical and physiological differentiation of the auditory and visual word-centres has been universally admitted, but there are still some authorities who adhere to the symptom-complex described by Wernicke as resulting from destruction of the first and second temporal convolutions.

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* Bastian :- British and Foreign Med. and Chirurg. Review, April 1869 pp 482-484.

† Wernicke :- Der Aphasische Symptomen-complex. Breslau 1874.

‡ Kussmaul :- Disturbances of Speech (Ziemssen's Cyclopaedia Vol XIV.). p. 783.

Déjerine and Mirallié* maintain that there is a true "Sensory Aphasia"as described by Wernicke, due to a lesion of the auditory word-centre and entailing word-deafness, paraphasia, alexia, and agraphia or paragraphia. Mirallié, whilst admitting the special relation of the angular gyrus to word-blindness, thinks that this defect is generally, if not always, assosciated with a certain amount of word-deafness. On the other hand he holds, that the sensory aphasia of Wernicke is synonymous with the word-deafness of Kussmaul, and is characterised by word-deafness and troubles of speech and writing. In all cases he thinks that, at the begining, both word-deafness and word-blindness are present, but that, in time, some recovery from one or the other takes place, depending on which word centre is least implicated in the lesion. Although he admits that the true type of sensory aphasia is exhibited by those cases in which both the auditory and the visual word-centres are destroyed, yet he is of opinion that "to say that a patient presents the variety of aphasia called 'word-deafness' is to say that he is at the same time alexic, paraphasic, and paragraphic". Word-deafness as here used is cortical word-deafness, the pictorial auditory aphasia of Wyllie, and does not include pure word-deafness due to interruption of the afferent tracts.

It is almost universally believed that the word-deafness produced by lesion of the first, and part of the second, temporal convolutions is a result of destruction of the tissue elements

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* Mirallié:- De l'aphasie sensorielle. p31-32.

subserving the auditory memories of words, and it is necessary to bear this in mind when considering the symptoms described by different authors as being the necessary accompaniment of cortical word-deafness.

As indicated in the symptom-complex of Wernicke there are four questions involved: (1) the effect on the hearing and understanding of words, (2) the effects on speech production. (3) the effects on reading, and (4) the effects on writing.

In regard to the first question there is unanimity of opinion, founded on irrefutable evidence, that destruction of the posterior two-thirds of the first and part of the adjacent second temporal convolution, results almost always, in complete word-deafness. The words are heard by the patient as sounds, but they have for him no significance.

In regard to the form and amount of speech disturbance produced there is much variety of opinion. As already said, Wernicke, Déjerine, and Mirallié say that paraphasia is the necessary consequence of destruction of the auditory word-centre. Lichtheim* also agrees with Wernicke on this point, and Wyllie has given expression to the opinion that "in general, the destruction of the auditory word-centre leaves the patient in possession of considerable powers of expression".†

Considering the importance attributed by Wernicke to auditory word-representations as the source of correct speech, it seems strange that he should have thought that destruction of the

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* Lichtheim:- on aphasia. Brain Ja. 1885: p. 440.

† Wyllie:- Disorders of Speech, p 289.

auditory word-centre, or its connections with Broca's convolution, should result in paraphasia. As Freud* pointed out, if the normal ways of conduction are interrupted or are not able to be supplemented by others, speech ought to be abolished. This is the logical position taken up by Bastian, who has long contended that destruction of the auditory word-centre should entail aphasia, not paraphasia. Believing as he does that the glosso-kinaesthetic centre is never the site of the primary revival of words and that unaided it is totally inadequate for the production of intelligent speech, the only alternative he admits is, that in some rare cases the visual word-centres may be the primary site of word evocation and may be able to act directly on Broca's convolution so as to suffice for the production of paraphasic, and, it may be, even of correct speech.

It might have been supposed, that an examination of the clinical records of cases in which post-mortem examination has shown destruction limited to the first and second temporal convolutions, would easily settle the point in dispute. This, however, is far from being so. Such cases, for one reason or another, reveal surprising differences in the nature of the symptoms observed during life.

Several lists of recorded cases with necropsies, in which the lesion was more or less strictly confined to the region of the auditory and visual word-centres have been compiled, - one

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* Freud:- Zur auffassung der aphasien Leipzig 1891. p.17.

by Seppilli in 1884,* one by Amidon in 1885,† one by Allen Starr in 1889,‡ and one by Mirallié in 1896.§

In many of these cases the lesions were widespread and involved more than one of the word-centres, and so do not help us in the elucidation of the symptoms which result from destruction of the auditory word-centre alone. In many of them, moreover, the clinical details are of the slenderest description. Yet if we examine the cases in which the lesion was limited to the first and second temporal convolutions, and in which the clinical record is fairly complete, we find that there is a great want of uniformity in the symptoms observed during life. In some there has been aphasia, in some there has been more or less pronounced paraphasia, and in some there seems to have been but little disturbance of speech.

Mirallié's case 12 is a good example of the abolition of speech from destruction of the auditory word-centre. The patient is described as having had "aphasie motrice", agraphia, alexia, and word-deafness; and the only lesion of the left hemisphere found after death was destruction of the first temporal convolution.

The great majority of the cases have had paraphasia, generally very pronounced, and in some it has been of the kind known as "jargon" or "gibberish" aphasia. In many of the cases in which the paraphasia was not very severe it was observed that the word-deafness was not complete: in these there can be no question of

* Seppilli:- Rivista Sperimentale. 1884. (quoted by Bastian, Aphasia, p. 142).
† Amidon:- New York Medical Journal, 1885. p113. p.181.
‡ Allen Starr:- Brain 1889. p.82.
§ Mirallié:- de l'aphasie Sensorielle 1896. p135

total destruction of the auditory word-centre. An example of this condition is afforded by Amidon's case 7, in which there was found meningeal adhesion with softening along the whole of the first and part of the second left temporal convolutions. This patient, when shown an object, might call it by an absurd name, "but on being told the right one, perceived her error and pronounced the correct name over and over". Her speech was paraphasic but "she expressed some ideas spontaneously with perfect accuracy".*

Jargon-aphasia was exhibited in Mirallié's case 21. - Jargon aphasia in spontaneous speech, total agraphia, word-deafness, word-blindness without letter-blindness. Autopsy:- Lesion of the left temporal lobe and in particular of the first temporal convolution.

The few recorded cases in which speech has not been much interfered with are not very conclusive. One in which it is stated to have been correct, is quoted by Amidon, from Sepilli, but the details are meagre. A man, aged 60, understood nothing said to him. He answered always wrongly while he spoke correctly His intellect was weakened. His hearing was good. A softening was found involving the left first temporal convolution except its anterior third. (Amidon's case 17).

A very remarkable case of good spontaneous speech, with widespread lesion of the auditory and visual areas, is reported by Amidon. (case 1).† This patient understood nothing said to her

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* Amidon:- New York Medical Journal, 1885. p. 181.

† Ibid; p. 113.

unless it was emphasised by explanatory gestures. When induced to read aloud, she spun out a perfectly senseless jargon of words, yet she voluntarily described her illness to Amidon in correct language. At the autopsy there was found in the left hemisphere destruction of the inferior parietal lobule, the entire angular gyrus, the posterior three-fourths of the first temporal, the upper and posterior half of the second temporal convolution and a part of the second occipital convolution.

It is manifest that such variety in the nature and amount of the disturbance of voluntary speech, produced by lesion more or less limited to the same cortical area, must depend on individual differences in the functional or structural relations of the left temporal cortex. After making all allowances for the possibility of faulty or imperfect observation, there can be no doubt that in some individuals destruction of the first temporal convolution may produce complete aphasia, whilst in others there may result but comparatively slight disturbance of speech.

There are, however, several possibilities which have to be borne in mind in examining this question. We are not always told the interval which elapsed between the time at which the clinical facts recorded were observed and the date of the autopsy. It may be that sometimes the extent of the lesion found after death was greater than that which existed when the clinical observations were made. There is also a noticeable

want of uniformity in the use of descriptive terms by different writers in indicating the nature and amount of speech disturbance present. Thus four of Mirallié's cases and two of Amidon's are described as having "motor aphasia", in only one of which, was there any lesion of the third frontal convolution.

Again, Amidon describes a patient as having spontaneous speech "very good", while reference to the original* shows that there was very considerable paraphasia. (Case 15).

Another source of uncertainty in estimating the value of many of the earlier observations is the want of exactness in the description of the site and extent of the lesion. Many of these cases were recorded as instances of aphasic disturbance in which the results of necropsy were opposed to the doctrines of Broca, and the recorders often considered it quite sufficient to show that there was no lesion of the third left frontal convolution.

But, even if we take all these facts into consideration, there is still sufficient well attested evidence to show, that destruction of the cortical area known as the auditory word-centre does not always, or indeed generally, cause the total abolition of intelligent speech which should result from the blotting out of all auditory memories of words.

The explanations of the varying amount of speech disturbance met with, which have been given by writers who have devoted special attention to this subject, are many and contradictory.

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* Wernicke :- Der aphasische Symptomen complex. p. 43.

The simplest way out of the difficulty is to accept the beliefs of the Charcot school. When destruction of the first left temporal convolution leads to complete aphasia, it is necessary to suppose that the patient is auditif. On the other hand, if only slight paraphasia results, it is readily explained by the supposition that he is moteur. We have, however, good reasons for repudiating the doctrine that the kinaesthetic centres are ever the primary site of word revival. We are compelled to look for the source of the glosso-kinaesthetic incitations to the sensory centres through which our first knowledge of words is acquired.

Here again, then, a possibility, which we have already considered in dealing with the inner speech, comes to the front. Is the the visual word-centre ever the site of the primary evocation of words in thought, and does it ever act directly on Broca's convolution so as to lead to speech.? We have seen that there is no evidence derived from introspection which compels us to believe that this may be so, and we must now enquire if any clinico-pathological evidence is more conclusive.

If the visual word-centre ever usurps the function of the auditory word-centre as the source of primary word-evocation in thought and speech, we might expect to find in some cases of destruction of the auditory word centre but little interference with the inner speech. In such a condition, even if speech were impossible, if the visual word-centre could not

act directly on the glosso-kinaesthetic centre, there should be no difficulty in expressing the thoughts in writing.

An examination of recorded cases shows that such a condition has never been observed. In every instance in which destruction of the temporal convolutions has abolished speech, spontaneous writing has been impossible. We might also expect to find that destruction limited to the visual word-centre should sometimes entail aphasia. I can find no record of any such pronounced disturbance of speech due to lesion of the visual word-centre alone. Again, if in destruction of the auditory word-centre the production of speech more or less paraphasic is brought about by the agency of the visual word-centre, we should expect to find speech abolished in every case in which there has been destruction of both the auditory and the visual word-centre in the left hemisphere. This is not so. An examination of cases in which the double lesion has been found reveals the same variety in the amount of speech disturbance as was found in cases in which the auditory word-centre alone was affected. In some there has been aphasia(e.g. Mirallie's case 8); in some there has been jargon aphasia(e.g. Mirallie's case 29); in some paraphasia(e.g. Mirallie's case 48); and in some but little disturbance of speech(e.g. Amidon's case 1).

So far, then, there is no support given to the view that the visual word-centre is ever the source of the speech which may be possible when the first temporal convolution is destroyed.

It seems to me very difficult to believe that the visual word-centre can possibly act on the glosso-kinaesthetic centre so as to lead to intelligent speech. That such a possibility is commonly believed in I am well aware. Those who support this belief constantly compare the mode of speech production postulated to the way in which speech is effected by deaf-mutes who have been taught to speak. There is really, however, no legitimate comparison between the two. The action of the glosso-kinaesthetic centre in educated deaf-mutes is initiated and guided by the visual memories of lip movements - a means of initiation and guidance strictly comparable with that which obtains in regard to specialised limb-movements in ordinary people. A movement seen is imitated. The visual representation of the movement calls up the related kinaesthetic memory and the movement is made - the word is uttered. But a written word can never form a guide for movements of articulation, any more than the oral articulative mechanism can produce a written word. The only possible bond between a written word and the movements necessary for its oral production is the memory of the sensations which first acted as guides in learning to produce the sounds of the word. Under ordinary conditions the guiding memory is an auditory word representation: in deaf-mutes it is a visual memory of lip-movements. In the deaf-mute who can read aloud, the sight of the written word must first revive the memory of the appropriate lip-movements, just as in ordinary people it must first call up the memory of its sound equivalent.

If, then, we cannot look to the visual word-centre for any help in the initiation and guidance of speech movements, and if we are bound, as I think we are, to look to the nervous elements subserving the auditory memory of words for the incitations which act upon the glosso-kinaesthetic centre, it is evident that there are but two possible explanations of the retention of speech when the first temporal convolution is destroyed. Either (1) the right auditory word-centre is much more highly developed than is generally supposed, so that when the left auditory word-centre is destroyed the corresponding centre on the right side may act on the left glosso-kinaesthetic centre, or (2) the cortical area subserving auditory word-memories on the left side of the brain has not been finally determined.

If we believed with Déjerine and Mirallié that the word-centres are confined to the left hemisphere - that "the right brain has nothing to do with the function of language" * - then we would seem bound to think that in most cases of cortical word-deafness the whole of the auditory word-centre is not destroyed.

There are probably not very many writers at the present day who are prepared to deny the existence of word-centres in the right hemisphere, however little importance may be ascribed to them; and it is perfectly legitimate to suppose that if they exist at all, they may, when the left auditory word-centre is destroyed, suffice for the production of paraphasic speech.

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* Mirallié :- de L'aphasie Sensorielle, p. 93.

This opinion has been put forward and strongly supported by Bastian and it is also the view entertained by Byrom Bramwell.‡ We know well that when the foot of the third left frontal convolution is destroyed the right side of the brain is not sufficient for speech production; so that if the right auditory word-centre is the source of the paraphasic speech in the cases which we have been considering, it must act on Broca's convolution by means of fibres passing obliquely through the corpus callosum. Bastian quotes Sherrington's histological investigations in support of this contention and gives an extract from a private communication from this observer, in which he says "I saw nothing at all incompatible with what you urge, but anatomically everything in favour of it".*

If, then, speech production, when the left auditory word-centre is destroyed, depends on the right auditory word-centre, we should expect to find complete aphasia produced in every instance by destruction of both auditory word-centres. Unfortunately cases of this double lesion are extremely rare: Bastian was able to collect only four examples. In three of these speech was abolished, while in the fourth case it was not interfered with. This remarkable case, recorded by Pick,† has never been adequately explained.

A day labourer, aged 24, was completely word-deaf and behaved like a deaf person. His speech was perfectly correct. He spoke fluently and only occasionally hesitated about the right word. Writing was executed slowly, but quite correctly, though he could not write from dictation. He read aloud easily and quite correctly and he understood both print and writing perfectly.

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* Bastian :- aphasia, p. 173.

‡ Bramwell, Harveian lectures, 1897.

† Pick :- Archiv. für Psychologie 1892, p. 909. (Marcallie's case 55, p 171)

At the necropsy the upper parts of both temporal lobes were found to be shrunken, soft, and of a yellow colour. On the left side the posterior half of the upper temporal convolution and the supramarginal gyrus were the parts that were softened. The island of Reil was intact. On the right side there was softening of the upper temporal convolution and a great part of the second temporal as well as of the island of Reil, together with some small foci in the lower part of the ascending frontal, and in the third frontal convolution.

Bastian thinks there is no way of explaining this case except"by supposing that the left visual word-centre was capable of acting directly on Broca's convolution.....so effectively that the patient was capable of reading aloud and of speaking, even without making mistakes in words".*

Mirallié, notwithstanding the description of cortical softening in the left temporal lobe, has cited this case as an example of pure word-deafness† - a condition which is generally looked upon as being necessarily due to a subcortical lesion.

So far as the clinical record is concerned he was quite justified in doing so: every detail of the case pointed to such a conclusion. And it is not inconceivable that the posterior part of the first temporal convolution may be but a station on the way in, whose destruction may produce word-deafness while still leaving at least part of the area of auditory word-memory relatively intact. If such be the case it may depend on the nature of the lesion and on variations in the vascular supply of the adjoining parts as to how much functional disturbance may occur in the site of the remaining auditory word-memories. The aphasia or paraphasia would then be due to such functional degradation rather than to actual

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* Bastian:- aphasia, p. 166.

† Mirallié:- de l'aphasie Sensorielle p. 171.

destruction of the elements subserving auditory word-representation.

This is the alternative possibility to which I have referred and to which I think due consideration has not always been given: the area of the auditory word-centre on the left side may not yet be really known. On this point Bastian says:- The evidence in favour of the posterior half of the upper, with perhaps the posterior part of the middle temporal convolutions being the chief, if not the exclusive, seat of the auditory word-centre must be regarded as very conclusive. The differences in voluntary speech power presented by the cases above referred to cannot therefore be explained by the supposition that the auditory word-centre has not yet been properly localised".*

If word-deafness be taken as a criterion of the abolition of auditory word memories, such a conclusion is legitimate enough. If the afferent path be unbroken and the auditory word-memory cannot be aroused by direct sensory impressions, then we know that the auditory word-centre must, practically, be destroyed. We have seen reason, however, to believe that the site of memories of sensations may be elsewhere than in that region of the cortex which is first acted upon by sensory impressions; that there is a synthetic process by which the components of mixed sensations become grouped together; and that the ultimate nervous arrangements which form the physical basis of their memories may be looked for elsewhere than in the

* Bastian:- Aphasia, p. 164.

primary receptive areas of the cortex. When a perceptive act is interfered with in consequence of a lesion destroying some cortical area, we are not bound to believe that such interference is necessarily due to destruction of the nervous structures underlying representation. We have seen something of the complex elements concerned in the formation of a visual memory of an object and the synthesis of component sense-memories necessary in effecting it. I contend that the formation of an auditory word-memory may be at least as complex and that there is no reason to suppose that its final consummation takes place in that cortical area whose destruction causes word-deafness.

The fact that intelligent speech has been abolished in all cases (with the exception of Pick's case) in which both temporal lobes have been affected, is highly suggestive of some assistance being derived from the right side when destruction of the first left temporal convolution has been accompanied by some amount of retention of speech. Yet there are some difficulties in accepting this view. Bastian is at a loss to understand why some amount of word-deafness does not result from lesion of the right temporal lobe, and it seems equally difficult to account for the total word-deafness generally produced by lesion of the left side alone. If there is a store of word-memories in the right auditory word-centre susceptible of spontaneous recall to such an extent as to lead to the production of even paraphasic speech, the possession of such word-memories ought to be still

more in evidence when aroused by sensory impressions; and word-deafness should not be complete when the left auditory word-centre alone is destroyed. Certainly this ought to be so if such word-memories are registered in the right auditory word-centre directly, without any co-operation of the left auditory word-centre. If, however, the formation of a right auditory word-centre be due to an "overflow of education" from the left side, as Wyllie has suggested,* the only way in to the right auditory word-centre might be through the destroyed left auditory word-centre while the way out to Broca's convolution would not be interfered with.

If we must look to the left auditory word-centre for the source of the speech which is found in cortical word-deafness, and if we suppose that the area of auditory representation in the left hemisphere is of greater extent than is generally held, where, it may be asked, are we to fix the limits of this centre of auditory word-memory. In the present state of our knowledge it is impossible to answer this question; but everything points to the parts immediately surrounding the posterior half of the first temporal convolution, such as, for example, the regions put forward by Mills, Elder, and Guido Banti as the most likely sites of the lesion causing amnesia of nouns, as being specially worthy of consideration in this connection.

However this may be, I think we are bound to believe, that the retention of anything like intelligent voluntary speech necessitates a belief in the persistence of some amount of

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* Wyllie :- Disorders of Speech. p.263 - p.264.

auditory word-memory whose neural basis is to be looked for in the temporo-sphenoidal region of the cortex, it may be on the left side, it may be on the right.

If we conclude that the retention of speech in cortical word-deafness indicates a persistence of some amount of auditory word-memory, it will be found that such a hypothesis may help us to reconcile the conflicting views which have been put forward by different authors in regard to the absence or presence of alexia in these cases.

Déjerine, Mirallié, and others, maintain that destruction of the auditory word-centre entails alexia, while Bastian thinks that this is by no means necessarily so. From an examination of sixteen cases in the lists of Mirallié and of Amidon, in which the lesion was pretty closely limited to the hinder part of the first and more or less of the second temporal convolutions, Bastian finds* that in only five of them is there any mention of the existence of some amount of word-blindness. These sixteen cases are Nos.1,3,4,6,7,10,12,14,19,21,25, and 32. in Mirallié's list, and 7,14,17, and 18, in Amidon's list.

It has to be noted that in some of these cases no record at all is given of the patients' powers of reading. Thus in case 1, and in case 7, in Mirallié's list, and in all four cases in Amidon's list, no mention is made of the presence or absence of ability to read. In the cases in which it is referred to it is important to note that the ability to read bears a constant

* Bastian :- aphasia p 144.

relation to the amount of disturbance of spontaneous speech. Of the five cases exhibiting alexia, two had "aphasie motrice" (nos.12 & 25), one showed some "motor aphasia" and paraphasia (no.14), one had jargon aphasia and word-blindness without letter-blindness, (no.21). In one the word-deafness was only partial and speech was paraphasic, although alexia and agraphia were total (no.19). Of the cases in which ability to read was more or less retained, in one there was paraphasia and the patient read slowly (no.3); in no.4 speech was altered and reading was difficult; in no.32 there was paraphasia and no word-blindness; in no.10 there was a lesion in the third frontal, so it cannot be appealed to one way or the other; in no. 6 speech is reported good and there was no word-blindness.

It is thus seen that the amount of speech disturbance and the amount of word-blindness are almost always strictly parallel. When these patients cannot speak, they cannot read: when speech is paraphasic, reading is laboured and written language badly understood: when speech is but little interfered with, there is no alexia. If, as I have supposed, the integrity of the auditory word-memory is necessary both for the production of correct speech and for the full understanding of words read, the parallelism of the two defects in these cases would readily be explained.

The same explanation would apply to the defects of writing in the few cases in which any record of the patient's powers

in this respect has been made. If, as I have suggested, the paraphasic speech in cortical word-deafness is due to a profound amnesia resulting from deep functional degradation rather than to a true destruction of the auditory word-centre, we should expect to find that the understanding of words read(sensory stimulation) might be better preserved than spontaneous speech (assosciative recall): on the other hand,voluntary writing would be rather worse than spontaneous speech,as in cases of ordinary amnesia verbalis.

In conclusion. I think it may be said that an examination of recorded cases of "sensory aphasia" points even more strongly than is generally admitted to the importance of the auditory word-memory in speech production, in reading, and in writing; but,whatever theory we may adopt as to the relative importance of the various word-centres, and of their relations one with another, we are bound to admit that there are on record many cases which, on any hypothesis, leave a considerable residuum of unexplained phenomena.

Chap. vi.

DISSOLUTIONS OF GLOSSO-KINAESTHETIC MEMORIES.

In examining the dissolutions of memory which may result from stress falling upon the glosso-kinaesthetic centre, I propose to consider first the effects of complete destruction of Broca's convolution. As yet we know but little as to the consequences of slight stress falling upon this word-centre, and any speculations which may be made concerning them necessitates an understanding, in so far as may be possible, of all that is entailed by a complete blotting out of glosso-kinaesthetic memories.

For on this subject there is by no means unanimity of opinion. Although the defects of speech which result from destruction of the foot of the left third frontal convolution have been the subject of constant study by eminent neurologists since the day when Broca recorded his first case; and although the clinical features of the condition are consequently well known,

there is still much difference of opinion as to the true explanation of many of the phenomena observed in connection with the reception and production of language in this type of aphasia, and especially as to what disturbance, if any, of the inner speech may result from lesion limited to this part of the cerebral cortex.

Almost the only point on which all observers are at one is, that destruction of Broca's convolution is followed by practically complete loss of oral speech. Words cannot be spoken voluntarily, and repetition and reading aloud are also impossible. The patient may have at his disposal one or two common expressions, such as "yes" and "no", which he uses on all occasions, it may be appositely, it may be not; or he may use some meaningless expression in reply to all questions. Sometimes an intelligible word or short phrase is used habitually - the"recurring utterance" of aphasia: commonly also these patients may retain the use of some customary oath.

The explanation generally given of the retention of such expressions in Broca's aphasia is, that their articulation is effected through the uneducated centre in the right hemisphere; and it is important to note that most of the words produced are such as, from frequent repetition, must have their neural basis deeply organised. No satisfactory explanation has ever been given of those recurring utterances in which a phrase, such as "list complete", or "I want protection", is used.

The suggestion put forward by Hughlings Jackson,* that those were the last words uttered, or about to be uttered, before the seizure, is probably true; but it does not help us much as to the mechanism through which their utterance becomes possible when the left glosso-kinaesthetic centre is destroyed.

So far, as regards the effects on spoken language, there is universal agreement; but when we enquire as to the ability of these patients to express their thoughts in writing, we at once enter on debatable ground. Even from the earliest days in the history of aphasia there has been diversity of opinion on this question.

Broca, himself, did not consider the agraphia which was present in his first case as being due to anything more than the paralysis of the arm which existed. He said that these patients understand articulated and written language perfectly and can put their ideas on paper distinctly. "What they have lost" he said, "is not then the faculty of language, not the memory of words, nor yet the action of the nerves and muscles of phonation and articulation; it is something else, it is a faculty considered by M.Bouillaud as the faculty of coordinating the movements peculiar to articulate language, or more simply as the faculty of articulate language, without ~~it~~ no articulation is possible".†

When more cases had been observed, it was seen that this explanation was insufficient, since, in some patients, agraphia was present without any paralysis of the arm.

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* Hughlings Jackson:- Brain 1879. Vol II. p. 215 & p.326

† Broca:- Bulletin de la Société Anatomique 1861 t.VI. p.353

Trousseau came to the conclusion that the disturbance of the faculty of language was greater than Broca had supposed, and that amnesia verbalis was the real cause of the agraphia in these cases. He said:* "In general an aphasic individual is not more apt to express his thoughts in writing than in speaking; and although he has retained the power of moving his hands as nimbly as before, he is yet as unable to compose a word with his pen as he is to articulate it. Now, in such a case, it is impossible to admit a defect of co-ordination, whereas loss of memory explains everything..... There is not inco-ordination only, but verbal amnesia also; for the patient has lost the memory of the words." This view was upheld in this country by Gairdner and Hughlings Jackson. Gairdner said:†-"the aphasic writes as badly as he speaks; and when he speaks not at all, he writes not at all". Hughlings Jackson was still more emphatic - "If a patient does not talk because his brain is diseased, he cannot write....I submit that the facts that the patients do not talk, and do write, and do swallow, are enough to show that there is no disease at all".‡

When the existence of a special centre for writing came to be entertained, it was supposed that the agraphia in motor aphasia might be due to implication of this centre in the lesion. Such a belief was especially necessary for those who accepted the teaching of Charcot as to the autonomous activity of this centre. Thus we find Ballet describes motor aphasia in its purest form as consisting in "the loss of articulate speech....with conservation of the faculty of hearing, of reading, and of writing words."§

* Trousseau:- Lectures (translated by Bazire). Vol I. p. 268. p. 271.
† Gairdner:- Proceedings of Glasgow Philosophical Society 1865-68. p 104
‡ Hughlings Jackson:- Brain Vol I. 1878. p. 320 — p 324.
§ Ballet:- Le Langage Intérieure p 117

A similar variety of opinion is to be found in the works of more recent writers. Déjerine and his pupils have specially investigated this subject and have come to the conclusion that the opinion expressed by Trousseau is that which is most in agreement with the data derived from clinical experience. Denying, as they do, the very existence of a "writing centre" they are bound to believe that the agraphia in Broca's aphasia is due to the amnesia verbalis which they think is entailed by the blotting out of glosso-kinaesthetic memories. Thus Mirallié says: "All destruction of the centre of the motor images of articulation entails destruction of the notion of the word and consequently agraphia.....the patient is incapable of evoking the complete notion of the word in his inner speech(langage intérieure) and agraphia is the consequence."*

Wyllie, writing in 1894, agrees with Déjerine on this matter, and says, "it may be remarked that opinion is coming round to the older view of Trousseau and Gairdner, according to which this disablement of the power of writing is one of the common, almost constant, results of motor aphasia".†

A few years after these words were written, a view directly opposed to the conclusion of Trousseau and Gairdner was upheld by two observers to whose opinions the weightiest consideration is due. Bastian,‡ in his Lumleian Lectures, argued very strongly against the belief that destruction of Broca's centre alone

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* Mirallié :- L'aphasie Sensorielle. p78

† Wyllie :- Disorders of Speech. p. 316

‡ Bastian :- aphasia, p 93-94-103

entails agraphia; and Byrom Bramwell*, about the same time, had independently arrived at the same conclusion.

The common occurrence of agraphia in Broca's aphasia is, of course, admitted by both these writers: it is in their explanation of the mode of its production that they differ from the orthodox view. Those who follow Trousseau assert that the agraphia is the result of amnesia verbalis entailed by a blotting out of the memories of the movements of articulation: Bastian declares that no amnesia verbalis need result from such a loss of memory, and that the agraphia is due to functional or structural disturbance of the cheiro-kinaesthetic centre.

The problem thus resolves itself into a part of a larger and more important question: Does destruction of Broca's convolution entail amnesia verbalis ?

Notwithstanding the ambiguity which has so often surrounded the use of the term amnesia verbalis in the descriptions of aphasic conditions, there has been general agreement as to the meaning to be attached to it in regard to this question. When Trousseau said, "they have forgotten the words", he meant that there was a loss of recollection, an inability to call up in the mind words necessary for the expression of ideas.

In examining some of the different opinions put forward as to the presence of this defect in assosciation with destruction

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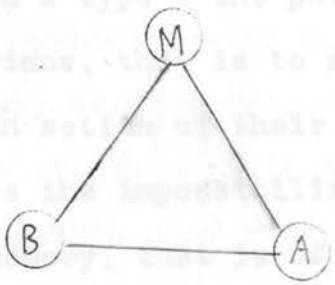
* Byrom Bramwell:- Morrison Lectures on aphasia (reprint from Ed. Med. Jour.) p118.

of the glosso-kinaesthetic centre, it will be convenient to make use of a diagram such as that which Lichtheim used in the exposition of his views on aphasia. By so doing, we can readily compare the three most important suppositions which have been put forward as to the course of the voluntary speech tract and the site of the primary evocation of words in thought and speech.

A and B are the auditory and glosso-kinaesthetic word-centres. M is used to indicate the whole or any part of the "psychic cortex", other than the four word-centres.



For those who, like Lichtheim, believe that, in voluntary speech, B is stimulated directly from M, destruction of B must necessarily imply a total inability to call up in the mind the auditory representations of words. It was indeed the belief, forced upon him by his clinical observations, that the auditory representations of words cannot be spontaneously evoked when Broca's convolution is destroyed, which led Lichtheim to conclude that the voluntary speech tract indicated in his schema "may be considered as accurate".*

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* Lichtheim:- Brain 1885 p.441.

Although Lichtheim believed that stimulation of Broca's convolution is the initial process in the recall of words, he did not consider the memories of the movements of articulation to be the material of our recollection in the use of words. He clearly held that what is lost in amnesia verbalis is the auditory representation of words. But since, according to his view, the only path from M to A is through B, destruction of B necessarily interferes with auditory revival. He says:- "I think that in most motor aphasias - in those, among others, of the true Broca's type - the patient has lost the auditory word-representations, that is to say, cannot awake them voluntarily by an action of their higher centres"*....."that there is, besides the impossibility of expressing any words, a loss of word-memory, that is of the power of sound-revivifications."**

Wyllie has, to some extent, followed Lichtheim in believing that B is stimulated directly from M. He says:-"there can be no doubt that the main direction of current is that of a reflex arc" from A to M and from M down to B. Yet he thinks "it is certain, in the case of A at least, that the currents may also flow in the opposite direction. Thus, in motor aphasia, in which B is destroyed, the auditory images of words may, to some extent at least, be revived at A, by descending currents from the sense-image centres, so that the patient may be able to call up words in the mind, although unable to utter them."†

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* Lichtheim:- Brain. 1885. p. 472. ** Ibid. p. 473.

† Wyllie:- Disorders of Speech. p. 277 - p. 278.

Wyllie holds the belief, which is practically also that of Déjerine and Mirallié, "that in health the two word-images are habitually revived together as a 'Word-Percept'. When one of them is destroyed, the word-percept is mutilated and incomplete, and cannot be so easily revived".* As a consequence of these opinions, Wyllie thinks that the amnesia verbalis produced by destruction of Broca's convolution may not be complete, as Lichtheim maintained, but that, to some extent, a direct revival of auditory word-images may be possible. "But there is reason to believe", he adds, "that in every case of severe motor aphasia that is due to the destruction of the motor images, Amnesia Verbalis is extremely well marked, - even more so, perhaps, than it is in cases of severe auditory aphasia".**

Bastian† is disposed to deny that amnesia verbalis is a common or necessary consequence of destruction of the glosso-kinaesthetic centre alone. He bases his opinion on the evidence which he has brought forward to show that words are primarily revived in the auditory word-centre rather than in the glosso-kinaesthetic centre. He also relies on the evidence afforded by some cases of destruction of Broca's convolution in which ability to write spontaneously was retained and in which no evidence of even a partial amnesia verbalis was shown in spontaneous writing. Nevertheless, Bastian is quite prepared to admit that exceptions to this rule may occasionally be met with, and that in some cases, owing to the close functional relations existing between the

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* Wyllie :- Disorders of Speech. p. 268. ** Ibid :- p. 312.

† Bastian :- Aphasia - pp. 94 - 95

different word-centres, destruction of one centre may greatly alter the functional readiness of the others.

All these authors, it is to be observed, regard the amnesia verbalis which may be present in Broca's aphasia as a failure to revive spontaneously the auditory word-images. For those, however, who consider that the memories of the movements of articulation form the very material of our recollection of words, destruction of Broca's convolution must necessarily imply complete amnesia verbalis. So, with regard to the views of the Charcot school, the amount of amnesia verbalis produced by destruction of Broca's convolution will depend on the "intellectual formula" (Ballet), the "endophasic type" (Saint-Paul) of the individual. If the subject is moteur, amnesia verbalis will be profound; if auditif or visuel, the inner speech will be but little interfered with.

I have already expressed my adherence to the views of Bastian in regard to the site of the primary evocation of words in thought and speech, and in regard to the form of word-memory employed as the material of our recollection of words; but the considerations which I have put forward as to the part played by the glosso-kinaesthetic centre in the auditory revival of words, compel me to think that destruction of Broca's convolution may entail amnesia verbalis to a greater extent and in a greater number of cases than Bastian is prepared to admit. At the same time I do not think that Broca's centre is ever stimulated

directly from M, so as to lead to intelligent speech; nor do I ascribe any importance whatever to the loss of the memories of articulation in so far as such memories are regarded as being capable of revealing in consciousness the significance of the words we seek or find. It is, indeed, doubtful if we are justified in speaking of memories of articulation at all. Glosso-kinaesthetic memories are important as organic memories, not as psychical phenomena; and if the participation of the glosso-kinaesthetic centre in the process of auditory word revivification is such as I have described, then, the amnesia verbalis which results from destruction of Broca's convolution is not due to the blotting out of a form of word-memory, but to a break in one of the links of the organic chain through which the association of the sound-sequences of words is effected.

Saint-Paul has shown that the majority of mankind conforms to the type which he has named auditivo-moteur; and it is in individuals of this endophasic type, that the assistance given by the glosso-kinaesthetic centre in the auditory recall of words, will be most necessary and most frequently utilised. In this type, destruction of the glosso-kinaesthetic centre may always produce more or less amnesia verbalis. In persons who are distinctly auditif, the intra-central assosciations in the auditory word-centre may suffice for a free and full auditory revival, although, even in them, the nervous current, in health, is constantly flowing backwards and forwards between the word-centres which Wyllie has so well named the "Primary Couple".

So it may happen, that in pronounced auditifs, destruction of Broca's convolution may entail little or no amnesia verbalis. This is, I think, the explanation of those cases of "motor aphasia" in which ability to write has been retained, and in which no amnesia verbalis has been found.

It might have been supposed that this question could be easily decided by an examination of cases of Broca's aphasia. The differences of opinion among clinicians of great experience is a proof that this is not so. And the reason is not far to seek. The amnesia of names which results from functional degradation of the auditory word-centre is made manifest by the absence of such words from the patient's speech; but when the glosso-kinaesthetic centre is destroyed, when the mechanism on whose functioning the expression of words is immediately dependent, is at fault, any inability to call up words in the mind is masked by the aphasic condition which is present. If the power of writing is retained, the presence of some amnesia verbalis may be revealed in the patient's spontaneous writing. but, in the majority of cases of Broca's aphasia, whatever be the reason, spontaneous writing is as impossible as speech. We have, therefore, to fall back on some other method, such as that adopted by Lichtheim,* of making the patient indicate by signs, the number of syllables in the word to which an object corresponds; and observers are not unanimous as to how much reliance may be put upon this test.

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* Lichtheim :- Brain, 1885 p. 441

In a research on this subject undertaken by Thomas and Roux,* the following method was adopted.

Some common object, the name of which contains several syllables, is shown to the patient; the objects chosen having only one designation. Many syllables are then pronounced successively, among which occur one of the syllables - the first or the last or an intermediate syllable - of the name which designates the object. When a syllable forming part of the name of the object is pronounced, the patient should make some affirmative sign indicating that he recognises this syllable.

Thomas and Roux found that healthy people always recognised all the syllables without hesitation. It was the same also in persons suffering from deprivation of speech but not aphasic. In seven cases of Broca's aphasia they found that the first syllable was very often recognised, but the last or the intermediate syllables were never recognised.

The results of Thomas and Roux's research seem to me to be suggestive in relation to the view which I have put forward as to the part played by the glosso-kinaesthetic centre in the auditory revival of syllable-sequences. It seems possible that an object may call up in the auditory word-centre the first syllable of its name more or less distinctly; but the glosso-kinaesthetic centre being destroyed, the usual association path, A-B-A, between the memories of the first and second syllables, is blocked: hence the difficulty in evoking in the

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* Thomas et Roux:- Comptes Rendus. Soc. de Biologie. 1895. p 731 (Séance du novembre 16).

mind the full name of the object, and the consequent difficulty in recognising the second and subsequent syllables as forming parts of the name, when they are pronounced separately and not in sequence.

We may now return to the question of agraphic defects in Broca's aphasia. Bearing in mind the two principal views put forward in explanation of the loss of spontaneous writing: (1) that it is due to amnesia verbalis, (2) that it is the result of functional or structural change in the cheiro-kinaesthetic centre produced by the lesion which causes the loss of speech, we may now enquire how these explanations accord with what is observed in regard to the other modes of writing - writing to dictation, copying, and writing with separate block letters or on a typewriter.

The defects in writing to dictation are admitted to be very much the same as in writing spontaneously. Lichtheim* says it is lost: Déjerine and Mirallié† say it is either lost or very defective, and from an example which Wyllie‡ gives of this mode of writing in one of his own cases he no doubt agrees with the opinion of these observers. Bastian supposes it is retained in all cases in which the lesion is strictly confined to the glosso-kinaesthetic centre.

Now, on the supposition that the agraphia in spontaneous writing is due to amnesia verbalis, it seems at first sight

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* Lichtheim:- Brain, 1885. p.438

† Mirallié:- L'aphasie sensorielle. p.87

‡ Wyllie:- Disorders of Speech. p.321.

difficult to understand why the auditory revival produced on hearing the words pronounced should not suffice for the visual and cheiro-kinaesthetic revivals necessary for writing. The contention of Déjerine and Mirallié that auditory revival alone does not lead to a correct "notion of the word" cannot be upheld. If the words heard are understood, as they almost always are in Broca's aphasia, it must be conceded that the notion of the word has been sufficiently good. When it is remembered, however, that in writing to dictation the words heard are as a rule, if not necessarily, first translated into the inner speech before they are written, it will be seen that any endophasic disturbance may lead to corresponding defect in this mode of writing.

On the view which I have put forward the difficulty should be especially prominent when words of more than one syllable are concerned. There are very few words of this description which we write "as a whole", that is, without first subdividing them mentally into their constituent syllables. If this process is, as I have suggested, essentially a function of the interaction of the auditory and glosso-kinaesthetic centres, it is obvious that a break in the association path A-B-A will lead to a difficulty in the endophasic revival of the syllables in proper succession. In this way the difficulty in writing to dictation is brought into line with that which occurs in spontaneous writing.

Such an explanation is not required by those who think, with Lichtheim, that the path for writing spontaneously or to

dictation passes through Broca's centre directly to the cheiro-kinaesthetic centre. If this were so it would be unnecessary to invoke amnesia verbalis as a cause of the agraphia: the difficulty in both modes of writing would be accounted for by the interruption of the direct tracts M-B-D or A-B-D. Although some writers still adhere to this view of the writing paths, the objections to it seem to me to be so great that the question of its accuracy scarcely merits discussion. It was obviously suggested as a simple way of explaining the agraphia so commonly met with in Broca's aphasia, but it has no possible physiological or psychological foundation.

It is commonly admitted that in Broca's aphasia ability to copy is, as a rule, retained and that transfer copying is possible This is the opinion of Lichtheim,* Déjerine and Mirallié,† Wyllie§ and others. Elder‡ has asserted that copying is servile and that transfer copying is not possible. Bastian, of course, holds that no form of agraphia is produced by lesion limited to the foot of the third left frontal convolution.

Comparatively few observations have been recorded as to the ability of these patients to write with separate block letters. Mirallié†† investigated this matter in ten patients at the Salpêtrière and he found that in every case the ability to write in this way was strictly parallel to the ability to write in the ordinary way. It may be observed that this form of writing.

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* Lichtheim:- Brain 1885. p. 438

† Mirallie:- L'aphasie Sensorielle p. 85 †† Ibid. pp 87-88

§ Wyllie:- Disorders of Speech, p. 321

‡ Elder:- Aphasia and the Cerebral Speech Mechanism. p. 83.

so long as the letters used are recognised, is mainly a test of the power of spelling, and these results have a bearing on the question as to whether the glosso-kinaesthetic centre takes normally any part in this process.

There can be no doubt that in the condition met with clinically as the result of lesion in the neighbourhood of Broca's convolution, agraphia is generally a prominent symptom: and I think both the suggestions which have been put forward to account for it may be of value. In some cases it would seem that there has been co-existing damage of the cheiro-kinaesthetic centre due to its proximity to the third frontal convolution, or that there has been a second lesion implicating some part of the writing path A-C-D. When the power of copying has been interfered with it is certain that this must have been so. On the other hand there are a considerable number of cases on record which support the view that the agraphia may be due to amnesia verbalis entailed by destruction of Broca's convolution alone. Those cases in which the loss of speech has not been complete and in which the defects of speech and the defects of writing have been strictly parallel are especially suggestive in this connection.

To complete this part of the subject I give a very short summary of two cases bearing on the question of agraphia in this form of aphasia.

The first is a case recorded by Rosenstein which has often been adduced as a good example of agraphia produced by lesion confined to the foot of the left third frontal convolution.

A woman aged 22. recovering from an intermittent fever with nephritis and uraemia was suddenly seized with severe cerebral symptoms. She understood what was said to her and tried to answer but could only say "yes. yes". She had formerly been able to write well but now when requested to do so she only made all sorts of scrawls but no letters. She lived sixteen days longer without the aphasia disappearing and died from a thoracic complication. At the necropsy a clot the size of a hazel-nut was found in the third frontal convolution, surrounded by a limited area of secondary softening. The precise site of the clot is not stated. *

The next case is one recorded by Guido Banti in which writing was not interfered with. Bastian lays great stress on the evidence afforded by this case in favour of his view that destruction of the foot of the third frontal convolution does not necessarily entail either amnesia verbalis or agraphia.

A right handed man, aged 36. had a sudden apopleptic attack in 1887 which caused a right hemiplegia which was temporary and aphasia which persisted. He could not articulate a single word not even isolated syllables. He wrote without hesitation the history of his illness. He wrote correctly the names of objects shown to him. He understood written instructions. He always wrote very rapidly and did not seem to hesitate to choose his words and made no mistakes in syntax or orthography. Writing to dictation and copying were perfect. He could understand equally well ordinary writing and print and at once grasped the meaning of spoken language.

His condition gradually ameliorated and in three years he had practically recovered his speech. He died in 1882 and at the autopsy a patch of yellow softening was found situated in the posterior part of the foot of the third left frontal convolution and extending for some millimetres only into the white substance. †

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* Rosenstein :- Berliner Klinische Wochenschrift 1868. p. 182.

† Banti :- Lo Sperimentale 1866. LVII. obs. II p. 270. (from Bastian's aphasia p. 88.)

We must now enquire what disturbance, if any, in the understanding of words heard and seen, may be present in uncomplicated cases of Broca's aphasia.

There is pretty general agreement that these patients have little or no difficulty in understanding words heard; but some observers believe that there is always some defect, although slight, in this connection. Déjerine and Mirallié* think there is some latent word-deafness which may be detected if specially looked for, and Wyllie is of the same opinion. Wyllie says:-"To put the matter to proof, patients with motor aphasia should be tested with the words which we know to be the least deeply imprinted, viz., the names of concrete things. My own method is to ask the aphasic patient to touch, in succession, as I name each part, his nose, his ear, his chin &c.; and my belief is that in a large proportion of cases of motor aphasia the patient fails to interpret some of these names, or has a difficulty in interpreting them, which he shows by hesitating and considering before he touches the part".†

It is known that some people when listening to a speech or any story that interests them, unconsciously perform movements of articulation as if they were mentally speaking the words which they hear. Bain thought that there was a tendency in everyone to do this. He said:-"While intently listening to a speech, we are liable to follow the speaker with a suppressed articulation of our own, whereby we take the train of

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* Mirallié :- L'aphasie Sensorielle. p. 100.

† Wyllie :- Disorders of Speech. pp. 318-319.

words into a vocal embrace, as well as receive it passively on the sense of hearing."*

Ch. Féré has noted, in some cases of mental disorders, that ~~the~~ audition of words is accompanied by movements of the tongue and that any obstacle to these movements may suppress an hallucination of words. But, he adds, "these movements of articulation which accompany audition of words do not occur in pathological states only: Dr. Shephard of New York, to whom I related my experiments in this matter, has informed me that his relations have often drawn his attention to the fact that when he listens attentively to a story which interests him, his lips perform the movements of articulation which correspond to the words heard."†

This appears to be but an exaggerated use of a method employed sometimes by everyone, when, from lack of attention or owing to the inherent complexity of the thought expressed, it is found necessary to translate the words heard into our own inner speech, or it may be even to utter them aloud, before we clearly apprehend their meaning. It is perhaps possible that individuals who have accustomed themselves always to listen in this way may experience some difficulty in understanding words heard when owing to lesion of the glosso-kinaesthetic centre, the inner speech is interfered with. Even if this be so, it is very unlikely that such a method of listening to words is at all common; but the possibility of such a peculiarity must be borne in mind when any appreciable word-deafness

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* Bain: The Senses and the Intellect. 4th Ed. p. 371

† Ch. Féré:- Footnote in Bernard: "De l'aphasie" 2nd Ed. 1889. p. 187.

is observed in Broca's aphasia.

In regard to the majority of individuals the experience of clinicians is on the whole in accordance with what we should expect: word-deafness is not a consequence of destruction of Broca's convolution.

Opinions vary as to the amount of disturbance in the interpretation of written words which may be caused by destruction of Broca's convolution. Broca himself did not think there need be any alexia; but Trousseau* pointed out that many aphasic patients who say that they can read and who occupy themselves with books and papers, are yet found, upon careful examination, to be quite unable to understand what they pretend to have read. For many years Trousseau's opinion was accepted very generally and it has been supported within recent times by Déjerine and his pupils and by Wyllie.

The following methods were adopted by Déjerine and Mirallié† in the investigation of this subject.

(1) A number of written or printed words designating certain objects is shown to the patient and he is asked to point to the corresponding object.

(2) When the patient has at his disposal some words which he can use intelligently, he may be asked to describe with the aid of gestures the meaning of some simple passage which is given to him to read.

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* Trousseau:- Lectures p.260

† Déjerine + Mirallié:- Comptes Rendus de la Société de Biologie. 1895. p.523 - p.527. (Séance du 6 Juillet).

(3) Simple questions are put to the patient in writing, such as, "Are you married?" "Have you any children?"

Care has to be taken that the meaning of the question is not simply guessed at owing to the recognition of one of the leading words. To make sure that the phrase as a whole is really understood these words should be incorporated in other phrases having a different meaning.

(4) The patient is asked to point out certain words in a printed page.

(5) A certain word is pointed to and he is asked if it is not this or that other word.

(6) He may be asked to read aloud, if possible, and to explain what he has read.

Déjerine and Mirallié examined in this way fifteen patients, and they found that in all the cases of true cortical motor aphasia, word-blindness, manifest or latent, was present. One patient recognised only some isolated letters and was incapable of recognising a word. The greater number recognised isolated words, in particular the most usual words, but were quite unable to understand a whole phrase. One of them read the isolated words but forgot immediately the words which he had just read.

This last condition is that which Pitres has termed apexia, and it seems probable, as Pitres suggests, that the defects of reading in many of these patients may be due to some extent to to this "amnesia of fixation."

The latent disturbances of the power of reading in Broca's aphasia have been investigated by Thomas and Roux.* They have shown that even in patients who have recovered the power of reading fluently, certain modifications, varying in different cases, may be present which only require certain tests to bring them into prominence. The tests employed by Thomas and Roux were chiefly directed to altering the usual appearance of a word.

They examined the ability of seventeen patients to read:-

(1) The word written vertically.

(2) The word written horizontally in separate syllables.

(3) The word written horizontally in separate letters.

(4) The last test was to give the patient the separate letters of a word and to get him to form the word with them.

From their investigation Thomas and Roux came to the following conclusions.

(1) The difficulty in reading, which is constant in cortical motor aphasics, disappears slowly but leaves for a long time traces which may be discovered by special tests.

(2) These patients recover successively:

(a) The appearance of the word as a whole.

(b) The association of the syllables which form the word.

(c) The association of the letters which form the word.

"In a word they recover the power of reading in a chronological order absolutely the inverse of that in which a child learns to read."

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* Thomas + Roux:- Comptes Rendus de la Soc. de Biologie. 1895. pp. 531-534.

The investigations of Déjerine and Mirallié and of Thomas and Roux are important: they show that destruction of Broca's convolution may be associated with some disturbance of the power of understanding written and printed language.

Wyllie has arrived at a similar conclusion. He says that in motor aphasia "the reception and interpretation of speech that is written or printed are interfered with, as a rule, in a marked degree".*

This, however, is not the opinion of all observers. Lichtheim thought that in uncomplicated cases the power of understanding words is not lost. He says: "a break in the motor tract can never in itself produce a disturbance in the intelligence of writing".† Bastian is also of opinion that alexia is not a necessary feature of destruction of Broca's convolution. He believes "that in reading, as a rule, a proper comprehension of the meaning of the text requires a conjoint revival of the words in the visual and the auditory word-centres, but that for this mere comprehension it is not necessary for the stimulus to pass on also to the glosso-kinaesthetic centre, as it must do in reading aloud".‡

It is admitted that some amount of alexia is commonly found associated with Broca's aphasia: the differences of opinion refer to the interpretation of this phenomenon in such cases. Is it a consequence of the blotting out of the articulatory images or is it a result of some co-existing affection of the

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* Wyllie:- Disorders of Speech. p. 319.

† Lichtheim:- Brain 1885. p. 467.

‡ Bastian:- Aphasia p. 95

visual word-centre ? Déjerine and Mirallié think that it is due to an interference with the "notion of the word" entailed by the loss of the memories of the movements of articulation. Wyllie's view is practically the same. Lichtheim says* that all cases of alexia co-existing with motor aphasia are examples of "total aphasia"(due to affection of both the auditory word-centre and of Broca's convolution) in which the word-deafness has already been recovered from. Bastian gives a somewhat similar explanation. He says:† "What we have to ask ourselves when in the presence of such cases is whether there is any evidence to show that the case is not one of simple aphasia, and whether a lesion exists also in the region of the posterior extremity of the Sylvian fissure. We may enquire, therefore, for the previous existence of word-deafness, as Lichtheim suggests, and also examine the patient carefully for the present existence of some amount of hemianaesthesia. The finding of the latter would show two things: first that the lesion was not limited to the third frontal convolution and secondly that either it or a second lesion also existed not far away from the visual word-centre, which consequently may have been also involved.

After recording two cases in which he observed this conditior he adds: "The possibility is therefore that in the cases of assosciated aphasia and alexia recorded by Trousseau and others the latter defect is not to be regarded as a consequence of the lesion in Broca's region but rather as a result of some co-existing damage to the visual word-centre".††

Lichtheim:- Brain 1885. p. 468.

Bastian:- Aphasia. p. 98 †† Ibid. p. 100.

There is now a considerable amount of evidence to show that alexia is not always a necessary consequence of destruction of Broca's convolution, and there can be little doubt that in some of the cases in which it has been present there has been some co-existing damage to the visual word-centre. Yet we have on the other hand good grounds for believing that some amount of alexia may be commonly met with as a result of lesion confined to the foot of the third frontal convolution.

How then can such a defect be explained ? Why does not the sight of the written word revive its appropriate sound-representation even although the glosso-kinaesthetic centre is destroyed ? Here again it would seem to be the interference with the inner speech which is the cause of the difficulty. In most people words silently read are mentally spoken and it is on the auditory representations as they are reinforced by stimuli derived from the functioning of the glosso-kinaesthetic centre that the attention is fixed, not on the subconscious auditory revivals which follow immediately upon the sight of the written words. When the glosso-kinaesthetic centre is destroyed this absorption of the words into the inner speech may be interfered with, because, as we have seen, the inner speech is, in the great majority of men, accompanied by a constant interaction between the auditory and the glosso-kinaesthetic centres.

It may also be pointed out that written words of more than

one syllable are sequences of letters in space which may not readily call up the proper sequences of syllable sounds in time unless helped by the mental division of the words into syllables which is effected through the auditory and glosso-kinaesthetic centres. Unless the sight of the written word calls up the meaning directly this revival of syllable sounds in proper succession is absolutely necessary. In many people, especially in those who are imperfectly educated, interference with the usual method of mentally sounding each syllable as it is read might seriously militate against a proper understanding of the text.

The conclusion of Thomas and Roux, that in the process of recovery from the alexia of Broca's aphasia the recognition of the word as a whole precedes its recognition when separated into syllables, seems at first sight very surprising. They say that recovery takes place in the inverse order to that in which the child learns to read. But that is the universal order of dissolution, not of recovery. Recovery is a re-evolution in which the most complex and most special processes are the last to be reacquired. As a matter of fact the separation of the syllables of the word adopted by Thomas and Roux in their tests was not a mere indication of the division of the word into syllables, but a distortion of the word which required some power of synthesis to recombine the widely separated groups of letters. This power, like the power of spelling a word, is a later acquisition than the recognition of the word as a whole

and is consequently later to reappear when recovery sets in. In reading, the one thing needful is that the written word should arouse its auditory memory, and I contend that when the glosso-kinaesthetic centre is destroyed, the revival of the syllable sound-sequences should be easier if the division of the written word into syllables is indicated.

If we conclude that destruction of the glosso-kinaesthetic centre may entail some amnesia verbalis, agraphia, and alexia, we must I think believe that these defects are the result of some interference with the ordinary course of auditory revivals. True amnesia verbalis is always an auditory logamnesia but it may be produced by interruption of any part of the nervous arc A-B-A. Writing spontaneously or to dictation is a graphic expression of the inner speech and will have all the imperfection of the inner speech: the agraphia may be but the objective manifestation of the amnesia verbalis. To read silently with understanding is to assimilate into the inner speech the words read: if this is not possible the words may be imperfectly understood owing to incoordinate syllable revival; and even if isolated words are understood their grouping into phrases is interfered with and the sense of the text badly interpreted. One result of the inability to take entire phrases into the mental grasp is an apexia which still further precludes a proper understanding of the words read.

Partial dissolutions of Glosso-kinaesthetic memory.

Having dealt with the phenomena which may be observed in association with complete destruction of the glosso-kinaesthetic centre, we may now proceed to examine the nature of the speech defects which may be produced by partial injury or mere functional degradation of this region of the cortex.

Hitherto I have used the term Broca's convolution in its usual acceptation as designating that part of the brain in which are stored the memories of the movements of articulation, and which is generally considered to be confined to the foot of the left third frontal convolution. Some writers have included in Broca's area the adjacent parts of the ascending frontal and the ascending parietal convolutions. Ferrier,* probably because he found the centres for movements of the lips and tongue in anthropoid apes to be situated in these parts, has included in the motor centre for speech the feet of these central gyri. Wyllie,† adopting Ferrier's description of the extent of Broca's area, suggests that the foot of the third frontal is the centre for the storage of the "psycho-motor" pictures or memories of speech, and that the feet of the ascending frontal and parietal gyri are the seat of the executive motor cells which are called into action by the psycho-motor

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* Ferrier:- Functions of the Brain. 2nd Edit. pp. 478. and 481.

† Wyllie:- Disorders of Speech. p. 302.

centres in the production of speech.

Although Wyllie is the first author who has attempted to localise these separate divisions of the "motor" speech area, it must be noted that some such differentiation of function in this part of the cortex is implied in the teaching of many writers on aphasia. All those writers who have looked upon the Rolandic area as a motor region and at the same time have believed that memories of the movements of articulation are the mental residua of afferent impressions derived from the moving parts, have necessarily believed in the co-existence in the "motor speech region" of both sensory and motor elements. Indeed there is no little inconsistency in these writers referring to the foot of the third frontal convolution as the motor centre for speech; for it is in this very region that they locate those memories of articulation which they admit to be of sensory origin. This was the position of Charcot and his followers* and the later writers of this school have insisted still more that Broca's convolution is a sensory centre although all the other areas mapped out by the physiologists in this neighbourhood are to be regarded as motor in function. Saint-Paul† considers it a very remarkable thing that sensory centres should be found in the pre-Rolandic region. He says we must distinguish carefully between the centre of Broca - the centre of "la mémoire motrice" and the "adjoining motor centres such as the cortical

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* E.g. Ballet:- Le Langage Intérieure. p. 48. * Bernard:- de l'Aphasie p. 38.

† Saint-Paul:- Le Langage Intérieure. pp 219. 220.

centres of the facial."

Unfortunately Saint-Paul supports his opinion by putting forward the old fallacy that the"criterion of the motor function of a centre is the existence of a paralysis consecutive to the destruction of the region considered as centre". "Aphasia", he says,"is not a paralysis. If the aphasic does not speak it is because he has forgotten the movements necessary for speech. The centres of Broca and of Exner-Charcot appear to be, clinically speaking, the only two centres known in the Rolandic region lesion of which does not entail paralysis".*

The difficulty which so many writers seem to have in realising that destruction of a kinaesthetic centre necessarily entails paralysis seems to be at the root of the confusion which prevails in regard to the relation of the Rolandic cortex to ingoing impressions. If this were understood the necessity for postulating motor centres in the cerebral cortex would not be felt; and it would be recognised that there is no functional difference between the glosso-kinaesthetic centre and the other areas of the "motor" region except in the degree of the specialisation of the movements concerned and in the apparent restriction of their representation to one hemisphere while the more general movements of the organs of speech are represented in both hemispheres.

Aphasia is just as much a paralysis of oral articulative movements as cortical brachial monoplegia is a paralysis of all

* Saint-Paul :- loc. cit. pp 219-220

the movements of the arm. In the one case a special set of movements is affected while in the other all movements, even the most general, are abolished.

The paralysis of speech movements with retention of the more general movements of the speech organs may be accounted for either by the fact that the ordinary movements of the tongue, lips, &c. may be brought about by innervation from either hemisphere while speech movements are innervated from the left hemisphere only; or it may be simply because the kinaesthetic centre for speech movements is topographically distinct from those of the more general movements of the muscles concerned in articulation and so may be separately destroyed. We do not really know whether there is any such distinct separation of these kinaesthetic centres in the left hemisphere or whether those of the ordinary movements of the tongue, lips, &c. may not be mixed up inextricably with those of the more specialised movements of speech. Wyllie believes, from a consideration of the results of experiments on animals, that the motor centres for the tongue lips and vocal cords are situated in man in the same region as they are found to occupy in the anthropoid apes. Yet he is bound to acknowledge that the foot of the third frontal convolution is more important in relation to speech than those other centres which he has included in Broca's convolution.

Wyllie, therefore, like Saint-Paul, thinks a distinction can

be made between the centre in which are registered the memories of articulatory movements and the adjacent "motor" centres through which such movements are directly effected.

Bastian* strongly opposes Wyllie's hypothesis and insists that even if the localisation of the centres for the tongue, lips and vocal cords are in man confined to the region in which they have been found in anthropoid apes and not farther forward it is only what we should expect. The special movements of speech may very likely be registered in a different area from that of the more general movements such as those of mastication, but the real motor centres in both cases are the centres in the medulla oblongata.

The clinical and pathological evidence in favour of Wyllie's hypothesis is at present of the slenderest description. One of Broadbent's† cases of aphasia in which the loss of speech was very nearly complete although intelligence was scarcely at all affected, had a cyst in the lower end of the ascending frontal gyrus but "a very small part of the adjacent posterior end of the third or inferior frontal" was also involved. Mills‡ has recorded a case of oro-lingual paralysis with defects of articulation in which there was softening of the lower extremities of both central convolutions. This region, he, therefore, proposes to call the "utterance centre" and thinks it is innervated in speech production from the foot of the third frontal convolution.

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* Bastian:- Aphasia. p 138
† Broadbent:- Royal Med. Chir. Soc. Transactions 1872. p 146
‡ Mills:- Dercum's System of Nervous Diseases. p. 409.

Elder has recorded a very similar case which he thinks goes a long way to confirm the hypothesis of Wyllie.

The patient was a man whose speech became suddenly affected. It was indistinct and blurred and saliva trickled from his mouth. There was paresis of the right side of the face, more marked in the lower part. He knew what was being said, he knew what he was going to say, tried to say it, and always succeeded in saying it, but the words were blurred and indistinct. He had difficult in swallowing even liquids. His voice was unimpaired. He

He lived six days and after death "a blood clot of about a dessert spoonful in quantity was found at the level of the lower part of the ascending frontal and ascending parietal convolutions It had destroyed almost entirely the cortical substance of the lower end of these convolutions...It did not quite involve the whole of the lower end of the ascending frontal as it did not quite reach the precentral sulcus, there remaining intact a strip of cortex adjoining the foot of the third frontal. The foot of the third frontal also remained intact. The island of Reil was also not involved."†

Elder thinks that in this case, while the "psycho-motor" centre was intact, the main efferent path was cut across by the cortical lesion in the foot of the ascending frontal convolution. He further supposes that if the direct way out from the left side is blocked, the left psycho-motor speech centre can at once act through its callosal commissures, on its fellow of the opposite side so as to lead to the production of speech which is only more or less dysarthric. This belief is no doubt based on the fact that lesion of the geniculate fasciculus at or below the level of the internal capsule on the left side is so often associated with dysarthric defects of speech rather than with infrapictorial aphasia. This result of lesion of the pyramidal fibres on the left side, combined with the fact that some temporary dysarthria

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† Elder:- Edinburgh Hospital Reports. Vol III. 1895. pp 466-475.
and. Aphasia and the Cerebral Speech Mechanism p. 31.

is produced by similar lesion on the right side, led Lichtheim* to suppose that the speech tract passing from Broca's convolution bifurcates high up and that a small proportion of its fibres pass downwards in the right internal capsule. At the present day, however, it is generally believed that the impulses which pass down through the right hemisphere are derived from the right third frontal convolution the innervation of which is effected, through fibres in the corpus callosum, by the glosso-kinaesthetic centre on the left side.

The complete loss of speech which results from sub-cortical lesion situated not very far from the cortex - the infrapictorial type of Broca's aphasia - is supposed to result from the implication in the lesion of the callosal fibres as well as those of the left geniculat fasciculus. But it has often been observed that these cases of complete or nearly complete infra-pictorial aphasia recover much more rapidly than do those in which aphasia is due to cortical disease, and it was suggested by Broadbent that recovery is facilitated by the establishment of a "new way out" for the motor stimuli by way of the corpus callosum.

Now if the callosal fibres are destroyed by the lesion which causes the loss of speech, such a mode of recovery would be impossible, as Broadbent pointed out. On the other hand if the callosal fibres are not destroyed the defect of speech should not be greater, if we accept Elder's view, than was exhibited in his case. But we know that some cases of infra-pictorial aphasia

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* Lichtheim :- Brain 1885. p. 480

in which speech has been almost quite abolished do recover much more rapidly than when the aphasia is of the pictorial type. A good example of this has been recorded by Dejerine.*

A woman aged 23 was admitted into the Hotel Dieu on Dec.10th 1878. Three years previously she lost her speech and became paralysed on the right side. Aphasia was complete: to all questions she replied "papa","papa" and she continued in this state for nine months. She then gradually recovered her speech until at the time she was seen by Dejerine she spoke so well that he says it was difficult to believe that one had to do with an old aphasic. She died on Dec.29th. 1878.

At the necropsy an old focus of softening was found completely cutting across the fibres from the third frontal convolution, destroying also a part of the lenticular nucleus as well as the anterior part of the internal capsule.

In this case then, speech was practically lost at first although in a comparatively short time complete recovery took place. We seem bound to believe, therefore, that the callosal fibres could not have been destroyed and that the aphasic condition was due to the destruction of the left geniculat fasciculus only.

We know practically nothing as to the exact site of the callosal fibres or as to how far they may run in close proximity to the pyramidal speech tract. Wyllie says:"There seems every reason to believe that between Broca's convolution and the upper part of the left internal capsule, the two parts of the double speech tract - the direct for the left hemisphere,and the callosal for the right - lie close together or very near each other."† But if this be so,the rapid recovery in those cases in which the lesion is fairly high,although not too close to the cortex,

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* Déjerine:- Bulletin de la Soc. anatomique. Jan 1879. p.16

† Wyllie:- Disorders of Speech. p.423.

cannot be explained as being due to the opening up of a new way out through the callosal fibres. On the other hand there are cases in which the lesion is immediately beneath the cortex, although not implicating it, and in which recovery does not take place, or takes place as slowly and imperfectly as in pictorial aphasia. There seem therefore some grounds for believing that the callosal fibres diverge from the fibres of the geniculate fasciculus high up, and that destruction of the direct speech tract alone may produce, for a time at least, a true infra-pictorial aphasia the severity of which will depend on the completeness of the destruction of the pyramidal fibres.

If this be so, and if we believe that the foot of the ascending frontal convolution is part of the direct speech tract, Elder's case ought to have conformed to the type of infra-pictorial aphasia rather than to that of a simple dysarthria.

It would appear that Wyllie, when he formulated his hypothesis of the subdivision of Broca's area, anticipated that destruction of the feet of the central gyri would entail infra-pictorial aphasia rather than dysarthria. For we find that in a case which he has recorded(case of Patrick Keaney), and which he admits presents all the features of the infra-pictorial type, he is inclined to think "that the motor images or pictures presumably stored... in the foot of the third frontal, were intact, but could not be exteriorised or executed on account of the destruction of the executive cells..." *

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* Wyllie:- Disorders of Speech, p.328.

It would appear, then, that this case of Elder's, instead of lending support to Wyllie's hypothesis, is rather opposed to it; and further, there there would appear to be no necessity to invoke this hypothesis in order to explain the clinical facts. From the pathological report of the extent of the blood-clot, and from the diagram of its horizontal section given in Elder's original paper, we are bound to believe that some pressure or partial destruction of fibres passing downwards from the foot of the third frontal convolution must have occurred; and the results of such a disturbance of the efferent impulses would be just the sort of dysarthric defects which this patient exhibited.

We must conclude that up to the present time we have no pathological evidence in support of the hypothesis that the centres for general movements of the oral articulative and vocal mechanisms are topographically separate from those of the more special movements of speech, and that there are no good grounds for including the feet of the central convolutions in Broca's convolution. The condition which we have been considering is, therefore, not a result of partial destruction of the glosso-kinaesthetic centre. If we search the records of aphasia for cases of partial destruction of the foot of the third left frontal convolution we find merely varying degrees of speechlessness according to the severity of the lesion. In many cases the clinical record is very imperfect, and it

seems impossible to lay down any rule as to the nature and amount of the speech disturbance assosciated with partial destruction of this word-centre.

We have already seen the difficulties to be encountered in estimating the amount of disturbance of the inner speech which may be consequent upon total destruction of the glosso-kinaesthetic centre; and the interpretation of the slighter defects of speech met with as a result of partial destruction or functional degradation of this word-centre, is constantly hampered by doubts as to how much may be due to "loss of the memories of articulation" and how much may be the direct effect of endophasic disorder.

In considering the partial dissolutions of word-memory which may result from a slight stress falling evenly upon the glosso-kinaesthetic centre we should clearly distinguish between two questions: (1) Does lesion of the glosso-kinaesthetic centre entail a true amnesia verbalis, and (2) Does a stress falling evenly upon the glosso-kinaesthetic centre lead to a loss of the memories of the movements of articulation, which affects first, in accordance with the law of dissolution, such of those memories as may be most special and least deeply organised ? We have already considered in some detail the relation of destruction of Broca's convolution to amnesia verbalis and we may now examine the second question.

Does a stress falling evenly upon the glosso-kinaesthetic centre lead to a loss of the memories of the movements of articulation, which affects first, in accordance with the law of dissolution, such of these memories as may be most special and least deeply organised ?

Such a defect may be termed glosso-kinaesthetic amnesia or amnesia of articulation, but it must not be confounded with the articulative amnesia of Wyllie which is of auditory origin.

In the early days of the history of aphasia, when the "faculty of speech" as a whole was localised in Broca's convolution, it was natural that every defect in speech production should have been referred to functional or organic disturbance in this part of the brain. But it is not so easy to see why this should have been so after the importance of the temporal region of the cortex in relation to speech processes had been recognised. Although at the present day a patient's inability to use names or nouns in spontaneous speech is almost universally admitted to be due to a loss of recollection of their auditory representations, we find, in many works written long after the publication of Wernicke's monograph, such cases included under the descriptions of motor aphasia or aphemia. We find, for example, in Bernard's valuable chapter on Aphemia(Broca's aphasia) many cases referred to as examples of partial loss of speech due to lesion of Broca's convolution, which are now

regarded as typical examples of amnesia verbalis of auditory origin. He says that of all the parts of speech the substantive is that which is most frequently and for the longest time at fault in aphemics.and he gives as one instance the case of the naturalist Broussonnet who substituted periphrases and accumulations of adjectives for all substantives and especially for proper nouns.*

In Ballet's chapter on"l'Aphasie motrice"we find the same order of phenomena referred to. These patients, he says, are good examples of the law which regulates the dissolution of memory. In them we may note "that the progress of l'amnesie motrice, like that of every amnesia, is from the particular to the general".†† That the defect of speech which Ballet has in mind is the same as that which I have dealt with under dissolutions of auditory word-memories seems evident from what he says on page 123 of his work: - "The aphasic who is incapable of evoking spontaneously the motor images may succeed in doing so when the centre in which these images are registered is stimulated by another sensory centre.....Many aphasics repeat words pronounced before them, although they are quite incapable, when left to themselves, of finding the motor images of these words."†

We have good grounds for believing that in the great majority of patients, if not in all, to whom this description applies it is the auditory images which cannot be revived spontaneously. This is indeed the test on which we mainly rely in the diagnosis

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* Bernard :- Or L'aphasie. p.170 (2me Edit).

† Ballet :- Le Langage Intérieure. p.123. †† Ibid. p.120

of ordinary amnesia verbalis.

Examples could be multiplied from other authors showing the prevalence of the view that defects of speech, which are far more satisfactorily explained on the supposition that they are due to functional degradation of the auditory word-centre, may be the result of lesion of Broca's convolution. There can be little doubt that the confusion on this subject which is to be found in works on Aphasia is due to the fact that the true relation of auditory word-memories to speech production was not realised.

So long as it was believed that the revival of the memories of the movements of articulation is the initial process in word evocation; so long as the auditory word-centre was looked upon as merely a regulator for securing the use of appropriate words instead of as the source of all intelligent speech whatsoever; so long as loss of speech was regarded as proof of the destruction of Broca's convolution; so long was it necessary to believe that the loss of the use of names and nouns in voluntary speech may be due to lesion of the foot of the third frontal convolution.

Another reason which led clinical observers in more recent times to relegate such defects of speech to the category of motor aphasia was the conclusion, too hastily arrived at, that since these patients are not word-deaf, the auditory word-centre is necessarily intact. Not until Bastian pointed it out did it seem to occur to clinicians that memory images which cannot be voluntarily aroused may be easily revived by direct sensory impressions. But even if this belief had been entertained

it would have had little effect on the conclusions arrived at on this subject so long as it was not realised that auditory revival precedes glosso-kinaesthetic revival in all speech production both "outer" and "inner".

It may be well to ask, however, if we may not err in concluding that every instance of the loss of nouns in speech must be a result of functional degradation of the auditory word-centre. Is it possible that functional degradation of the glosso-kinaesthetic centre may lead to a loss of spontaneous utterance of the more special parts of speech while the production of such words when they are heard or seen is still possible ? The stronger incitations derived from the auditory word-centre when it is strongly aroused by hearing the word spoken or by seeing it written may be sufficient to overcome a functional inertia of the glosso-kinaesthetic centre while the weaker spontaneous auditory revivals are not. If the stress were more severe, there might be almost complete muteness in voluntary speech, and the production of the more complex movements, or those which from lack of frequent repetition are least deeply imprinted on the glosso-kinaesthetic centre, might be difficult even in repetition of words heard or in reading aloud.

Such a condition would be exactly parallel to what is observed in some rare cases of hemianaesthesia in which movements of limbs cannot be performed when the eyes are closed although they can be readily effected under the stimulation and guidance of the visual sense. If such a mode of interference with speech

production ever occurs it is no doubt as rare as the form of paralysis observed in those cases* of hemianaesthesia recorded by Duchenne, Briquet, and Bazire, and a case which came under my own observation. (Case of A.P... p.299.)

In looking for evidences of true dissolutions of glosso-kinaesthetic memories we must first consider the factors on which organisation of these memories depends, and so endeavour to determine what particular movements of articulation will be the first to be lost when a stress falls evenly on this word-centre. The formation of glosso-kinaesthetic memories takes place, as we have seen, under the guidance of auditory word-memories and not in any direct relation to the ideas which form the content of words. Direct associations are formed only between the memories of series of sound-units and the memories of the movements necessary for the production of such series of sound-units. The grouping of these kinaesthetic memories in sequence so as to give rise to kinaesthetic memories of words is in the first place controlled by the auditory word-centre, and their subsequent revival for the production of intelligent speech is always initiated in the same way. In the process of education, however, when these memories are being organised in the glosso-kinaesthetic centre, their constant repetition in certain unvarying combinations gives rise to intra-central associations in the glosso-kinaesthetic centre whereby their revival in orderly succession becomes to some extent automatic.

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* Quoted by Bastian:- Brain 1887. April "On muscular Sense".

The initial movement once started, the whole series of movements which go to the production of the word, tend to follow each other in due succession, with but little stimulation or guidance from the auditory word-centre.

The coordination of words into sentences adequate for the expression of spontaneous thought is, as has been already said, not dependent on any fixed nervous arrangements in the word-centres. The order of the words employed depends primarily on the order in which ideas follow one another in the mind; but their arrangement in grammatical sequence is, in a sense, controlled by fixed associations in the word-centres. The framework of language - the connecting parts of speech - is composed of groups of words which are associated in the word-centres as sequences learnt, and are evoked as such in thought and speech. The frequent repetition of these word-sequences gives rise to a glosso-kinaesthetic memory of the succession of necessary movements, so that the utterance of such word-sequences is, like that of individual words, to some extent automatic.

These "memories of sequences learnt" considered as a function of the glosso-kinaesthetic-centre reach their highest exemplification in the memories of texts learnt by heart. When the same sequence of words has been repeated very frequently at intervals extending over a long period of time, the kinaesthetic memory of sequence becomes perfect, and the series of words once started may be correctly produced in the absence of any constant guidance from the auditory word-centre.

This is, I think, the explanation of those cases to which I shall presently refer, in which prayers or well known poems may be correctly repeated by patients whose speech is otherwise very paraphasic.

We may thus include in our conception of the glosso-kinaesthetic centre as a centre in which are registered the memories of the movements necessary for the production of sound-units, syllables and words, a function of subsidiary importance, whereby certain series of such movements are linked together so that the revival of one part of the series tends to arouse the succeeding parts to some extent independently of the incitations derived from the auditory word-centre. We should therefore expect that a stress falling upon the glosso-kinaesthetic centre and leading to disturbance of speech short of complete aphasia would manifest itself by (1) defects in the production of individual sound-units, or (2) defects in the production of sound-units coordinated in succession into syllables, words, and phrases.

(1) Defects in the production of individual sound-units.

In trying to discover what sound-units and what sequences of sound-units have their kinaesthetic memory most deeply organised we must recognise that here, as in all other cases of memory-images, repetition is the most important factor. But in regard to the production of sound-units, at least, there are other factors of considerable importance. The most complex movements

and the last to be acquired are notoriously the least stable, and it is well known that some of the sound-units of speech present much more difficulty than others to the child when he is first learning to speak; and these difficulties are not always the same for all children. In the babbling which precedes the first attempts at voluntary speech the vowel-sounds and consonant-sounds seem to be produced with almost equal ease; but in voluntary speech there appears to be an order of difficulty which varies somewhat in different children. Of the vowels, a, e, o are the easiest: i(ee) and u(oo) are those which are most difficult. Of the consonants, those produced at the first and second stop positions, p, b, m, and t, d, n are those which are first employed: k, g, and ng seem to present more difficulties and are later in appearing: r and l and sometimes sh and s and y present varying amounts of difficulty. Owing to individual peculiarities we cannot be sure in any given case as to what sound-unit movements would be least deeply organised on account of difficulty of acquisition.

So far as I know, the frequency with which the different sound-units of speech occur in ordinary spoken language has not been investigated. The order of frequency of the letter-units in written language are well-known. This order is generally given as follows, begining with the most frequently used letter:
e t, a o n i, r s h, o l c w n m, f y g p b, v k, x q j z.

I have examined many examples of English prose to see

what the order of frequency of the sound-units may be and I believe that the following arrangement is approximately correct for the English language. Of course the vowel-sounds occur much more frequently than any individual consonants. The long and short e sound and the a sounds are by far the most common: i(ee) occupies an intermediate position, and o and u(oo) are relatively very infrequent. Among consonants t, n, r, come first, and then in decreasing frequency, s d l, k z th(voiced), b w, sh p m v f ng zh y th(voiceless), g h.

Comparing the order of frequency in which the consonant-sounds occur in speech with the ease and priority of their acquisition by the child, we should conclude that the glosso-kinaesthetic memories of t, d, n, should be deeply organised being early and easily acquired and frquently revived: those of sh, y, g, and ng should be less so, being comparatively infrequent in speech and later in being acquired: those of h, g, th, zh, ng, f, should be poorly organised from lack of repetition, and those of r, l, sh, s, should be in the same position from the complexity of the movements and the delay in their acquisition.

Some clinical confirmation of these theoretical indications may be obtained, but it is to be regreted that records of the slighter disorders of speech are both scanty and imperfect.

It is well known that children, before they have learnt to speak correctly, pass through a stage in which the pronunciation is scamped or slurred. This condition is known as lalling and it may occur on one or more consonants. In the great majority

of children it disappears at an early stage of their education but in some individuals a difficulty with some particular consonant remains as a permanent defect of speech.

There is some evidence that a dissolution of glosso-kinaesthetic memory may cause the production of certain consonants to revert to the lalling method of childhood; but to be sure that this result is a true dissolution we should have to know the nature of the difficulties the individual had when first learning to speak. Winslow quotes a case, recorded by Grüner of Jena, of a man who after recovery from an acute fever always substituted tz for f. "One of the first things he desired to have was coffee(Kaffee), but instead of pronouncing the letters ff he substituted in their place a t and z and therefore asked for a cat(Katze). In every word which had an f he committed a similar mistake substituting a z for f." *

This was a lalling upon a single consonant, produced by disease, and the substituted sound was always the same. In a case which I record in detail in a subsequent chapter(Case of A.P... p.299.) there was produced a lalling upon several consonants which lasted for many months. P, b, k, f and at first some other sounds were given as s; w, l, and r as y. Here the lalling was on many consonants and the substituted sound was not the same in all cases although always the same for each group. Thus p was never given as y nor r as s.

A similar condition is sometimes observed in the course of

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* Winslow:- Obscure Diseases of the Brain. p. 508.

recovery from Broca's aphasia. Wyllie says: "One of my patients lalled distinctly - always, for example, using T, an easy letter, for a number of others. He said tage for cage, take for sake. He also used L for W, saying lee for we; and he scamped his words like a child, saying 'rison for prison".*

Sometimes sound-units which cannot be uttered voluntarily may be uttered automatically; and a few rare cases are on record in which, in addition to the faulty production of some sound-units, this automatic production of others has been so in-coordinate that speech has been rendered wholly unintelligible. A remarkable case which may, I think, be best explained in this way, was recorded by Osborne and is well known.†

A scholar of Trinity College, Dublin, after an apoplectic fit, spoke only an unintelligible jargon. His general mental powers seemed unimpaired. He understood spoken and written language perfectly and could express himself fairly well in writing. "When he failed it appeared to arise merely from confusion, and not from inability, the words being orthographically correct, but sometimes not in their proper places".

His power of repeating words after another person was almost confined to monosyllables; and in repeating the letters of the alphabet he could never pronounce k, q, u, v, w, x, and z, although he often uttered these sounds in attempting to pronounce the other letters. The letter i, also, he was very seldom able to pronounce.

He was asked to read the following sentence:- "It shall be in the power of the College to examine or not to examine any Licentiate previous to his admission to a Fellowship, as they shall think fit". This is what he read:- "An the be what in the temother of the trothotodoo to majorum or that emidrate eni enikrastrai mestreit to ketra to trombreidei to ra fromtreido as that kekritest". A few days afterwards he read the same passage as follows:-"Be mather be in the kondreit

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* Wyllie :- Disorders of Speech. p. 315

† Osborne :- Dublin Journ. of med. and chem. Science. Vol IV. p 160. (Nov. 1833).

of the compestret to samtreis amtreit emtreido andt emtreido mestreiterso to his eftreido tum bried rederiso of deid daf drit des trest."

He generally knew that he spoke incorrectly, although he was quite unable to remedy the defect.

(2) Defects in the production of sound-units coordinated in succession into syllables, words, and phrases.

This is the question we are specially examining. May there be an amnesia of articulation of words which, in speech production, simulates a true amnesia verbalis ? May the loss of a foreign language, while the native language is retained, be due to stress falling upon the glosso-kinaesthetic centre ?

Those who believe that affections of Broca's convolution may cause amnesia verbalis have often asserted that this may be so. Even writers who are disposed to deny that destruction of the left third frontal convolution entails amnesia verbalis have confessed to having observed this loss of a foreign language with conservation of the mother tongue, or the recovery of the latter before the former, in cases of Broca's aphasia. Thus Bastian says: "Another interesting peculiarity is also often seen when resident foreigners become aphasic. During recovery it is found that they are at first only able to express them - selves in that language in which they are most thoroughly versed - namely, in their own native language. I have seen this in several patients. Two were Germans who had been long resident

in this country; yet after an attack of right hemiplegia and aphasia each of them was for a long time unable to utter a word of English. When they began to speak they used German words only; and after they had further recovered, if occasionally in want of a word while speaking English, it was always a German equivalent that first presented itself." *

I have already dealt with this peculiarity of speech as a result of dissolution of auditory word-memory; but in these cases the lesion was in the glosso-kinaesthetic centre. Such a lesion, according to Bastian, need entail no amnesia verbalis. When, then, these patients were "in want of a word" are we to suppose that the auditory representation of the English word was present in the mind and that what was lost was merely "the memories of the movements" necessary for its articulation ? Was it primarily an amnesia of articulation with or without amnesia verbalis ? Or was it a true amnesia verbalis and nothing else ?

The same problem is presented by some of those cases in which, after almost complete recovery of the native language, there remains a difficulty in regard to proper nouns and substantives.

Baron Larrey recorded, many years ago, the case of a soldier who was wounded at the battle of Waterloo. A ball had entered the left frontal region, about six or eight milimetres from the eyebrow at a point corresponding to the temporal ridge. There was right hemiplegia which gradually disappeared. As far as his intellectual faculties were concerned there was

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* Bastian :- aphasia . pp. 82 - 83.

no derangement, except that he was unable to employ substantives or proper names in his conversation. He lived for twelve years and eventually died of phthisis.

At the autopsy the ball was found embedded in the substance of the frontal bone, with signs of fracture of the innernal table; the dura mater was strongly adherent to the whole of the left anterior cranial fossa. A spheroidal excavation of about seven or eight centimetres in depth, and five centimetres in its horizontal diameter, was discovered at the summit, on the temporal side, of the left anterior lobe of the brain. The subjacent cerebral substance was healthy, as well as the rest of the brain. *

Here is an example of what would have passed for a case of true amnesia verbalis of auditory origin evidently caused by lesion limited to the anterior lobe. Was it, then, simply an amnesia of articulation ? Or was it an amnesia verbalis consequent upon glosso-kinaesthetic damage ?

Ballet's auto-observation on derangements of speech produced by nicotine poisoning points to the possibility of a glosso-kinaesthetic amnesia while the auditory representation of the word to be pronounced is more or less distinctly present in the mind. He says† it has sometimes happened that he has produced in himself, by means of tobacco, true attacks of transitory aphasia. When in this condition, he has only a very small number of words at his command. On trying to pronounce the names of objects which he sees around him, he only utters incoherent monosyllables. His notion of the word is quite distinct, and he can evoke, with a certain facility, the visual and auditory image of the word, but he is quite incapable of pronouncing it. On trying to utter the word

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* Quoted by Bateman:- ~~on~~ aphasia pp. 186-187.

† Ballet:- Le Langage Intérieure pp 118-119

"parapluie", he says, "I try to coordinate the syllables which constitute it; and, whilst I articulate very well "parapet", "obélisque", my tongue makes a fruitless appeal to my "mémoire motrice". Then, suddenly, as I keep my eyes fixed on the mental visual image of the word, the word bursts forth, so to speak, and comes out with a rush: the visual image has revived the motor image momentarily effaced".

In all such conditions it seems likely that the strong stimulation afforded by hearing the word pronounced would suffice for its production; but, sometimes, the functional degradation of the glosso-kinaesthetic centre seems to be so great, that, although speech is not abolished, there is inability or much difficulty in pronouncing certain words which are heard, even when there is no word-deafness. Bateman quotes a case, recorded by Crichton, of a lady who substituted one word for another, "but who exhibited the singular peculiarity that when the proper expression of her thought was mentioned to her, she was unable to pronounce it."*

What I take to be a good case of glosso-kinaesthetic amnesia exhibited chiefly in naming objects at sight, has been recorded by Nadine Skwortzoff.† On being asked to read, this patient was unable to pronounce the names of the letters which he recognised. For V he said, "c'est reut, teux, tipe, non c'est un petit bien haut". When asked to read the words "les petites nouvelles", he read "retipe tafé". The words being pronounced

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* Bateman:- Aphasia. p. 192.

† Skwortzoff:- De la cécité et de la surdité des mots dans l'aphasie. pp. 113-117. (obs viii).

before him, he repeats "fereux tapin". Yet he understood all that he read and all that was said to him. On being asked to name at sight a "crayon", he said, "c'est pour écrire vieffe, créfon, crémon, créon, crayon." Once he found the right word he could pronounce it many times in sucession if one pronounced it before him; but, while he was still seeking the correct pronunciation, it seemed to help him little to hear the word uttered, unless he had already nearly arrived at the correct pronunciation spontaneously. It was always possible to recognise the resemblance between the word which he wished to pronounce and that which he did pronounce.

The search for the right pronunciation in such cases seems characteristic of glosso-kinaesthetic amnesia. When the difficulty in naming is due to true amnesia verbalis, these tentative utterances are not made as a rule: so far as the particular word is concerned, the patient is mute. I think it is possible to distinguish between these cases of amnesia of articulation and cases of "articulative amnesia" of auditory origin.

Agrammatismus

There is another form of speech defect which may probably result from a degradation of glosso-kinaesthetic function. The disturbance of coordination, instead of affecting the series of movements which are necessary for the production of individual

words, falls only or chiefly upon those word assosciations which form the connecting framework of speech. The defect, when fully developed, has received the name of Agrammatismus. We are, perhaps, not justified in supposing that all cases of this kind are the result of functional degradation of the glosso-kinaesthet-ic centre, but it would seem likely that many of them are.

In these cases the speech of the patient is almost confined to the words absolutely necessary for the indication rather than the expression of their thought, and the grammatical forms which give to words definiteness and exactness of signification are lost. Pronouns are sometimes omitted and all verbs may be used in the infinitive, and the lower the dissolution of glosso-kinaesthetic memory the more general are the grammatical forms in which words are used. One of the earliest observations of this condition was recorded by Deleuze in his work on Animal Magnetism. In speaking this patient employed only the infinitive of verbs and she never made use of a pronoun. Instead of saying "Je vous souhaite le bonjour, restez, mon mari va venir", she said, "Souhaiter bonjour rester, mari venir"*. She could not count beyond 3.**

This is the type of agrammatismus which seems to be most probably assosciated with glosso-kinaesthetic defects. In other cases it may possibly be occasioned by amnesia of auditory origin but I think that the disappearance from speech of the connecting

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* Quoted by Pitres:- L'aphasie amnesique. footnote. p.56
and by ~~Anton: Lepidosiagnosie~~.

** Wyndow:- obscure Diseases of the Brain. p.392.

words and phrases whilst a considerable number of substantives are retained, is presumptive of some disorder in that centre on whose integrity the auditory revival of the framework of speech is so greatly dependent.

There is another class of cases in which it seems probable that the functional defect is in Broca's convolution, but in which, while the emission of words or syllables is not abolished, there would seem to be some break in the backward flow of the current from B to A which normally takes place during thought and speech processes. The result of this is a break in the continuity of auditory revival and consequently of speech. The first syllable of a word may be produced correctly, but the severance of the important association path B-A leads to failure in the prompt auditory revival of the next syllable which, consequently, cannot be spontaneously produced.

The defect may not be very noticeable in the conversation of the patient which is generally very paraphasic: very often he attempts to produce only words which he feels he can pronounce. But when he is asked to repeat words, he succeeds in producing only the first, or, it may be, the last syllable. He hears the word and understands it quite well but he is unable to translate it as a whole into his inner speech and consequently cannot produce it. The following summary of one of Pitres' cases of paraphasia gives a good illustration of this condition, and all the facts seem to point to the glosso-kinaesthetic centre as

being the chief site of the lesion causing the paraphasia.

Jean Hard.... a man 35 years of age. When 30 years of age he had an attack of right hemiplegia and transitory aphasia. When 32 he had a second attack and when 34 a third attack which was followed by right hemiparesis and persistent paraphasia.

Examined on 12th January 1898 he was found to be a man of athletic build in full possession of his intellectual faculties. There was some concentric restriction of the field of vision on both sides, left hemi-hyperaesthesia and slight paresis on the right side.

Speech paraphasic - uses one word for another. No word-deafness Speech difficulty varies from day to day.

Naming:- Many names given correctly - sometimes not. Sometimes makes several false attempts before arriving at the right word. Thus when shown a "plume" he said: "Prum, Prune". Then suddenly and with a triumphant air he said "Plume, voila, c'est ça". So for "crayon" he said at first "caron", then, "cazon" and lastly "crayon".

Repetition:- Isolated letters, vowels or consonants, are repeated well. This is also the case with simple syllables and monosyllabic words. But the repetition of words composed of two or more syllables is either very difficult or completely impossible. This is still more evident if he is asked to repeat short phrases even if they are very simple and of common usage. He can, however, repeat all these words if they are divided for him into their constituent syllables. He can repeat rhu-ma-tis-me although he cannot say "rhumatisme".

Proust-Lichtheim test:- When Hard... is unable to pronounce the name of a common object which is presented to him he has nevertheless generally a precise notion of the word corresponding to the name of this object. He always knows how many syllables are in the word which he cannot say.

Reading aloud:- Possible - but often faults of articulation. The sight of a written word enables him to pronounce words which he cannot utter spontaneously or repeat on hearing them spoken.

Silent reading with understanding retained.

Spontaneous writing almost impossible.

Writing to dictation:- Much the same difficulties as in repeating He cannot complete the words although he begins them correctly. For the word "hopital" he writes "hopi" and only after some reflection is he able to add the end of the word.

Copying:- He copies easily and does transfer copying.

Writing of letters and figures:- Better than that of words. He can do simple addition sums but fails at subtraction and multiplication. He knows his multiplication table very badly.*

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* Pitres:- Etudes sur les paraphasies. Rev. de med 1899. T. XIX. (Reprint) pp 453-460

Paraphasia.

All defects of speech, whatever be their origin, which lead to incoordinate production of sound-units, syllables, words and phrases, may be looked upon as forms of paraphasia. These defects may be divided into four groups.

(1). Occasionally there is failure of coordination in succession affecting the sound-units of syllables, whereby these sound-units instead of following each other in proper order, are transposed. Such are those errors which are hardly pathological, the "spoonerisms" which are occasionally committed by everyone. "Cus porcuscles" for pus corpuscles, "biting a rook" for writing a book, are examples. This condition is also met with in disease. Lordat says that when he was recovering he said "sairin" for "raisin" and for "Musulman" he felt inclined to say "Smulman".

(2). The recognised type of true paraphasia is that in which the patient uses wrong words instead of those that he means to employ. This is really not a failure of coordination in succession at all, and it can be best accounted for by considering it as a result of faulty auditory revival.

(3). When the patient uses actual words but collocates them in such a disorderly manner that no sense can be made of them, it is generally supposed to be only a severe form of the previous defect. There is, however, a considerable difference which points to a different source of the defect in the two forms.

In this group(3), so far as the actual words are concerned, auditory revival may be correct enough; and it is the incoordination in succession which accounts chiefly for the paraphasia. In most cases, no doubt, this is complicated by the former defect(2)- wrong words are used. This use of wrong words is almost always assosciated with amnesia verbalis, and if we admit that amnesia verbalis may result from glosso-kinaesthetic damage, this form of paraphasia would be best explained by supposing that the whole condition - the use of wrong words and their disorderly arrangement - is due to functional degradation of Broca's convolution.

(4). The most severe form of paraphasia is that type of disordered speech known as jargon or gibberish aphasia. In this condition words are not used at all: there is merely an incoordinate succession of the sound units of speech broken up into groups which simulate words. This form of speech defect has been found to be assosciated with destruction of the temporal convolutions in both hemispheres or with extensive destruction of the auditory centre in the left hemisphere affecting also the visual word-centre.

Such a case as that recorded by Osborne would seem to show that an analogous condition may be produced while the auditory and visual word-centres are capable of acting in a perfectly normal manner. It is necessary to suppose that in such cases

the disordered speech is due to some affection of the glosso-kinaesthetic centre or of the commissures connecting it with the auditory word-centre.

The explanation of the causation of paraphasia which has been most widely accepted is that which was put forward by Wernicke and Lichtheim.* According to these writers paraphasia is the necessary consequence of destruction of the auditory word-centre or of the connecting paths between A and B. That lesion in these situations may produce paraphasia is admitted by almost everyone; but, as has been already pointed out, the blotting out of all auditory word-representations or the complete severance of the glosso-kinaesthetic centre from the whole of the auditory word-centre, entails aphasia rather than paraphasia.

Kussmaul† ascribed paraphasic defects to failure of attention and in the slighter forms, such as those included in group (1), there is no doubt that this may be an important factor; but it is quite inadequate as an explanation of paraphasia in general.

Bastian is inclined to believe that most paraphasic defects may be due to disordered function in the auditory word-centre; and in describing paraphasia as an incoordinate amnesia he practically agrees with the opinion expressed long ago by Lordat that paraphasia is really a paramnesia.‡ The inadequacy of this explanation in all cases is felt by Bastian himself, and he thinks the question as to "how far defects in the action of

* Lichtheim:- on aphasia. Brain. 1885. p. 439. p. 442.

† Kussmaul:- Disturbances of Speech: Ziemssen Cyclopaedia. vol XIV. p. 784.

‡ Lordat:- see quotation by Lichtheim loc. cit pp. 465 - 466

the glosso-kinaesthetic centre itself may be a cause of par-aphasia" is worthy of consideration.*

Pitres, in an important series of papers, has maintained that the Paraphasias are not due to defects in the word-centres at all, but result from partial destruction of the "ways of communication" between the ideational centres and the "motor" speech centre. He says that paraphasia cannot be the result of an amnesia of words because there is no such thing as an amnesia of words. He follows Charcot in maintaining that there are four forms of word-memory each of which is independently assosciated with the ideas of things. For Pitres, then, paraphasia is the result of partial destruction of the path M-B, and paragraphia is due to a similar condition of the path M-D. The phenomena commonly assosciated with paraphasia, such as alteration or loss of the power of repeating or of reading aloud, he looks upon as accessory symptoms due to interruption of the paths A-B and C-B.†

Apart from the fatal objection that the paths M-B and M-D in all probability do not exist, it would, on Pitres' hypothesis, be necessary, in many cases of paraphasia, to postulate an inordinate number of lesions to account for all the symptoms. While there can be little doubt that Pitres is right in saying that the same centre cannot be concerned in all cases of par-aphasia, there are more difficulties to be explained on his

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* Bastian :- aphasia . pp. 221-223.

† Pitres :- Etudes sur les paraphasies. Rev. de med. 1899. T. XIX. pp. 543-564.

hypothesis than on that which would ascribe paraphasia to partial destruction or functional degradation of one or other of the word-centres. On the view which I have put forward, faulty co-ordination in succession may result from injury, short of complete destruction, to any part of the path A-B-A; and the use of wrong words or "words" which are not words may be due to faulty auditory revival or to unguided or inco-ordinate action of the glosso-kinaesthetic centre.

It must be admitted that there is not very much pathological evidence in favour of the view that paraphasia may be due to disorders of the glosso-kinaesthetic centre. The great majority of cases of well marked paraphasia which have been followed by necropsy have occurred in association with word-deafness, and the paraphasia has been due to the lesion at the posterior end of the Sylvian fissure. On the other hand, some of the most remarkable and best recorded cases of paraphasia have not been followed by necropsy and in some of these there are to be found evidences of peculiarities which point to a different origin from that of the paraphasia due to lesion of the temporal lobe.

If we admit that paraphasia may be due to defect in the glosso-kinaesthetic centre as well as to damage of the auditory word-centre or of the commissures between these two centres, it must be recognised that the clinical differentiation of the various forms is exceedingly difficult. Even with regard to

the imperfect articulation of words when Broca's convolution is damaged it may be, as Wyllie says, "practically impossible to know whether the patient's imperfect articulation of the word was due to the imperfect revival of it in his mind, or to the impossibility, owing to the motor asynergia, of articulating it when it is revived."*

In endeavouring to interpret any case of paraphasia and to determine whether the defect is of auditory or of glosso-kinaesthetic origin, we must be guided mainly by broad general principles founded on what we may consider as well established knowledge of the functions of the various word-centres. If ability to read silently with understanding is retained while reading aloud is imperfect; if the thoughts can be expressed correctly in writing while speech is paraphasic; if repetition of words heard is as imperfect or nearly as imperfect as spontaneous utterance although there is no word-deafness - the presumption is strong that the lesion which causes the paraphasia is situated in the neighbourhood of the glosso-kinaesthetic centre.

Several cases have been recorded in which paraphasic speech was not accompanied by any defect in expression of the thoughts in writing. Osborne's case already referred to belongs to this class. Forbes Winslow relates the case of a man whose conversation was a singular intermixture of words to which no meaning could be attached while he was able to write coherently.

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* Wyllie:- Disorders of Speech: p.314.

and with perfect lucidity, whatever he wished to communicate to others.* Bastian refers to a case, which he saw in consultation, of a man who was "unable to express himself intelligently uttering, in fact, only a mere jumble of words"; yet when asked to describe in writing how he got from his home to his office in the city, he wrote three or four lines to the point, and without any mistakes either in the collocation or the spelling of the words.†

While we seem bound to believe that in these cases the defect was in the glosso-kinaesthetic centre or in its connections with the auditory word-centre, the explanation of the ability to write correctly must be the same as in those cases of destruction of Broca's convolution without agraphia such as that recorded by Guido Banti. For we must believe that in an individual in whom destruction of Broca's convolution would produce amnesia verbalis and agraphia, some parallel defects would be produced by functional degradation of this centre to such a degree as to cause markedly paraphasic speech.

There is a feature sometimes exhibited by paraphasics which may, I think, be important in showing that the glosso-kinaesthetic centre is not at fault. It has often been observed that patients who are very paraphasic in spontaneous speech may yet recite accurately prayers or texts learnt by heart if only they can once get started. This I believe to be due in most cases, to a truly automatic functioning of the glosso-

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* Winslow:- Obscure diseases of the Brain. p. 521.

† Bastian:- Aphasia. p. 223.

kinaesthetic centre. The intra-central glosso-kinaesthetic associations have been so deeply organised by frequent repetition that if the nerve impulses are only started in the proper channel the action of the glosso-kinaesthetic mechanism goes on automatically, the kinaesthetic impressions from one movement being quite sufficient to initiate its successor without any help or with but little help from the auditory word-centre. When there is destruction of the auditory word-centre this phenomenon is not exhibited, because the initial stimulus from the auditory word-centre which starts the series of movements cannot be obtained. But if the paraphasia-producing lesion affects the auditory word-centre but slightly, or if the audito-kinaesthetic commissure is damaged but not destroyed, the hearing of the first words of a familiar prayer or verse may lead to their production by repetition, and the continuation of the passage may be effected in the way I have described.

Bateman quotes from Paul Janet the case of an old priest who was incapable of pronouncing distinctly two words having any sense; "if, however, an appeal was made to his verbal memory he could recite the fable of La Fontaine, 'Le Coche et la Mouche', or the celebrated exordium of Father Bridaine, and this he would do with the most perfect distinctness of articulation, although he was evidently incapable of understanding a single word of what he said".*

Féré has recorded a somewhat similar case.† A man suffering

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* Bateman:- Aphasia. p. 193

† Féré:- Le Langage Reflexe. Revue Philosophique Jan 1896. (Quoted by Peters. L'Aphasie amnésique. p. 85-86.

from dementia and hemiplegia used habitually only some rare monosyllables. Hearing someone utter before him the words "Monsieur, je vous salue", the patient started saying the prayer "Je vous salue, Marie, pleine de grâces". Féré also refers to the case of the surgeon Malaval who died in 1758 and who, to the end of his life, exhibited the same peculiarity. He was suffering from dementia and spoke very little; but when certain words fell upon his ear in a conversation in which he was incapable of taking any part, he often began reciting verses or entire pages of prose which he had previously learnt and the memory of which was recalled to him by the words which he happened to hear.

An account of the same peculiarity occurring in an aphasic has been reported by Fischer.* This patient knew the ordinary prayers of the Catholic Church. If asked to repeat one of them he tried in vain to remember it. But if one started him by whispering "Notre père qui êtes aux cieux" or "Je vous salue, Marie, pleine de grâces" he continued to the end without making any mistakes or omissions.

The importance of glosso-kinaesthetic memories of sequence as a help to auditory revival is shown in some cases of amnesia verbalis. Pitres relates† that one of his patients, on being asked the date of her birth, said, first of all, eighteen hundred. Then she counted aloud ten, twenty, thirty &c, and stopped at fifty. Then she counted again one, two, three, &c. and stopped at nine. "It was in 1859 then that you were born"? She

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* Fischer:- Du Rappel de la parole chez les aphasiques. Bordeaux. 1887. (quoted by Pitres. L'aphasie amnésique p. 88)

† Pitres:- L'aphasie amnésique. p. 88.

replied very clearly," in eighteen hundred and fifty-nine." "In what month"? She murmured January, February, March, &c. and stopped at July. "What date"? She reflected a moment and then counted ten, twenty, thirty and stopped. On being asked to repeat "the thirtieth of July 1859" she did so with a very distinct articulation.

Pitres considers this experience difficult to interpret in a satisfactory fashion. He thinks that the patient had certainly, after hearing the question, a precise notion of the reply which she ought to make. "She knew that she was born on July 30th 1859. Why then did she not reply at once, seeing that she was quite capable of articulating the words necessary for the emission of the response ?" I cannot but think that Pitres is wrong when he says that this patient had a precise notion of the reply which she ought to have made. True, this knowledge was present "in the mind" but it was "out of consciousness". The memory proper was intact but recollection was at fault. She was in the ordinary amnesic condition of knowing the right word when she heard it. Now the words which she wanted having been previously well learnt as parts of certain sequences, and consequently having their intra-central glosso-kinaesthetic associations well organised, she was enabled, by trusting to the memory of the movements in sequence, to arrive at the utterance of the word she wanted. On hearing the word, she recognised it as the word sought.

If we consider retention of the power of reciting "sequences of words learnt" as evidence of the integrity of the glosso-kinaesthetic centre, it will be found that the majority of paraphasics have retained this power to a greater or less extent, and that, consequently, paraphasia is as a rule the result of lesion of the auditory word-centre or of its connections with the glosso-kinaesthetic centre. This agrees with the evidence derived from the pathology of paraphasia so far as we know it.

When a gradually increasing stress falls evenly upon the glosso-kinaesthetic centre, a stage of dissolution may be observed at which, while the first few words of a sentence are correctly spoken, the remaining words may be a mere unintelligible jumble. This condition may be compared with the defect of the visual word-centre, known as dyslexia, in which only the first few words of a sentence can be read correctly.

This level of dissolution of glosso-kinaesthetic memory was noticed in a patient suffering from traumatic haemorrhage over the third left frontal convolution; and since it has a bearing on several disputed points in regard to affections of Broca's convolution, I give here a short summary of this case which was recorded by Krauss.

On Monday evening, August 10th, 1903, a man, aged 62, fell heavily on the pavement, injuring his head over the region of the right eye. He complained of great pain over the occiput during the night; but next day there did not seem to be much the matter with him except the discoloration of the eye.

On Wednesday morning at six o'clock, his wife approached his bed and asked if there was anything he wanted; to which he made an unintelligible reply. Thinking he was jesting, his wife asked, "What language are you talking, Italian or Polish?" He evidently did not recognize her, but kept on jabbering in an unintelligible and incoherent manner. To his sister, who visited him this morning, he said, "Hello Clara!" very plainly, then jabbered for some seconds. Later in the day his son called, and in reply to the question how he felt, the patient replied quite distinctly, "All right". On attempting further conversation with his father the son noticed that the first two or three words of a sentence would be distinctly spoken and the remaining words would be an unintelligible, as if spoken in a strange language.

As time went on the distinctly spoken words became less and less and conversation was stopped. During the next day or two he seems to have become completely aphasic, only uttering at times a cry like "mum, mum, mum". At a consultation on Saturday morning it was decided to remove him to hospital for the purpose of operating. The conversation in the sick-room was overheard by the patient, and on seeing the ambulance at the door, he said, very distinctly, "No hospital for me". A carriage was thereupon ordered and it was thought he might be induced to enter under the guise of going for a drive; but he waved his hand and said again, very distinctly, but pitifully, so that all in his vicinity could hear him, "You can't fool me".

At the operation. "a small localised haemorrhage of the brain membranes....immediately over the cap of Broca" was found.

On September 12th he was dismissed cured. On being examined on September 15th it was noted that "a mental peculiarity still present is his inability to remember names. He forgets name of nurse, of the firms with whom he transacts business, and of old acquaintances".

In this case it is interesting to note the gradual onset of the symptoms - dysphasia - paraphasia - aphasia, the distinct utterance of words under emotional excitement after being aphasic for several days, and the existence of amnesia verbalis after recovery. We seem, here, to have good evidence in support of the view that both amnesia verbalis and paraphasia may be due to dissolutions of glosso-kinaesthetic memories.

Hysterical Mutism

Although functional defects of the glosso-kinaesthetic centre have been considered in some detail, nothing has been said of a condition which, by common consent, is considered to be pre-eminently a functional defect of this region of the brain. Hysterical paralysis, in its various forms, has been known for a long time; and because of our intimate knowledge of its clinical features, we are apt to forget that in regard to the real nature of the condition we are almost in as much ignorance as were our predecessors in the days of daemonology and witch-craft. We have no physiological explanation to give of the manifold phenomena classed as "hysterical", or still more misleadingly as "functional"; and it has been left to thinkers whose researches have not yet found much favour among scientific men to formulate the only psychological hypothesis which gives any promise of being ultimately of value.

Clinically, the defect of language in hysterical mutism conforms to the type of infra-pictorial aphasia; but any attempt to localise the functional defect will depend on the views held in regard to the functions of Broca's centre in the inner speech. For those who deny the existence of any defect of the inner speech when Broca's convolution alone is destroyed, hysterical mutism may well depend on some affection of the glosso-kinaesthetic centres.

But if we believe that in many people abrogation of the functioning of this centre entails more or less amnesia verbalis, the complete command of written language exhibited by hysterical mutes, points rather to some defect in the pyramidal tract.

Since we are here dealing with a condition whose nature we do not know, and whose site it seems very unlikely will ever be revealed to us by after-death examination, it is evident that speculations concerning the particular cerebral elements affected must depend on our views in regard to the functions of the speech-centres as revealed to us by necropsy in cases of gross lesion. And the differences of opinion which we have seen to exist on this more simple problem reappear, in connection with hysterical mutism, in the writings of those authors who have dealt with the pathogenesis of this morbid state.

Chap. vii.

DISSOLUTIONS OF VISUAL WORD-MEMORIES.

The integrity of a word-centre is established when its least organised elements are found to react adequately to the weakest stimuli to which they are accustomed to respond in health. In the case of the visual word-centre these stimuli are derived from the auditory word-centre in the act of writing spontaneously. As we have already seen, the spontaneous recall of the visual memory of words is not, as a rule, effected directly from the general centres of sense-representation, but indirectly through the auditory word-centre; and we are perhaps justified in believing that incitations derived from another word-centre actively aroused are more powerful than those derived from the "ideational" centres. On this ground alone we may suppose that an amount of functional degradation which, if it affected the auditory word-centre, would give rise to some amnesia verbalis, may, when affecting the visual word-centre,

pass unobserved. There seem no grounds for believing that the relative depths of organisation of the different classes of words in the visual word-centre are ever made manifest by dissolution in the way that obtains in regard to the auditory word-centre. If the auditory word-centre is intact, it is doubtful if there is ever a visual amnesia of nouns alone, or of foreign languages alone. If auditory recall takes place, the visual memory of such special parts of speech can be aroused, unless the functional degradation of the visual word-centre is so great as to prevent all spontaneous recall.

The evidence most suggestive of a selective dissolution of visual word-memories is found in connection with the loss of the different classes of graphic signs. We have already seen that the memories of letters and of words are acquired separately, and there is abundant clinical evidence to show that they may be lost separately. The same is true of numerals, algebraic signs, the written characters peculiar to certain foreign languages, and, even, of the different kinds of letter forms in our own language, such as small and capital letters. From an early period in the investigation of word-blindness it has frequently been noted that ability to read letters has been preserved while there has been complete blindness to words; and this has generally been looked upon as an instance of dissolution affecting first the more complex and more specialised elements of the visual word-centre. More extensive observations

have, however, shown that the order in which these memories are lost is not always the same. There are several cases on record in which blindness to letters has existed without word-blindness, and, even, one or two in which blindness to numerals has been present as an isolated symptom. The occurrence of such cases seems to preclude the view that word- without letter-blindness is an instance of true dissolution resulting from a stress falling evenly on the visual word-centre. We seem forced to believe that words and letters and other graphic signs are registered in topographically separate areas which may be separately affected by localised lesions. Even if this be so, however, a true dissolution may occur if a stress falls evenly on the whole group of centres.

Whatever the explanation may be, we know as yet hardly anything about the symptoms which may be produced by slight functional degradation of the visual word-centre. With a gradually increasing stress we should expect to find loss of spontaneous visual revival - manifested by inability to write spontaneously - before loss of reaction to sensory impressions. The patient would become agraphic before he became word-blind; and it is probable that an intermediate stage might be observed during which he could write to dictation better than he could write spontaneously, and during which the visual word-memory could be aroused from the cheiro-kinaesthetic centre in the act of tracing over the letters of a word, better than by voluntary

recall. The lowest stage of dissolution is reached when the centre fails to react to direct sensory impressions. There is then, necessarily, agraphia for every mode of writing - spontaneous, to dictation, and copying - as well as word-blindness.

An examination of recorded cases of disturbances of the visual word-memory shows that in many instances little attention has been paid to defects in the various modes of writing; and when defects of writing have been observed, ability to read has been taken as evidence of an unimpaired visual word-centre. But just as the absence of word-deafness is no proof that the auditory word-centre is intact, so the absence of word-blindness is no proof that there may not be some functional degradation of the visual word-centre. Examples of the slightest dissolutions of the visual word-memory must, therefore, be looked for among cases in which agraphia has not been accompanied by alexia.

Although no examples can be found which exhibit a visual amnesia of the more special parts of speech comparable to the amnesias of auditory origin, there are some recorded cases suggestive of a condition which, if we adopt the views of some writers as to the part played by the visual word-memory in the act of spelling, may be regarded as analagous to the failure of auditory recall which is manifested in articulative amnesia and in some forms of paraphasia. Bastian has contended that spelling is essentially a function of the visual word-centre.

He says:* "It seems to me perfectly clear that in writing, the spelling of words(that is, the order of the letters) is first revived in the visual word-centre, and that this activity calls up a related activity, letter by letter, in the cheiro-kinaesthetic centre. The auditory word-centre cannot be concerned with this process, as in ordinary writing we spell by arbitrarily arranged letters and not phonetically or by sounds".

If we accept this view, a case recorded by Eskridge† may be looked upon as an example of functional degradation of the visual word-centre, manifesting itself by an inability to spell correctly.

A man aged 34 had a difficulty in writing which consisted in transposing the letters of words. The following are some of the facts elicited by Eskridge on examining him.

"He writes his name perfectly and copies script, and printing into script, with scarcely a mistake. In writing voluntarily he transposes the letters of a word, adds and omits letters, so that what he writes makes very little sense unless one knows what he is trying to say. On requesting him to spell words, it is found that he spells the words just as he writes them. It seems to matter very little how he spells a word, he usually pronounces it correctly. He reads aloud writing and printing quite readily but not unfrequently omits and miscalls words. He says that he has no difficulty in understanding what he reads." Six months later his condition was found not to have varied much. Thus Eskridge says: In writing simple words such as "dog","cow","hog" at dictation, he frequently transposes some of the letters, and is as long in writing a single letter as a child is when it is first learning to write. He can write voluntarily, but it requires about two hours for him to write five or six lines. He can read much of what he has written, but miscalls words, inserts some, and leaves out others. When he makes a mistake in writing he sometimes recognises it and will try to correct it, but in trying to correct one he frequently makes a greater mistake. At other times he is either indifferent to his mistakes or does not perceive them. The effort of writing is very exhausting to him. He can copy fairly well, transcribing both printing and writing into script."

He was operated on and a cyst was found in what was thought to be the foot of the second left frontal convolution.

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* Bastian:- Aphasia. p.233 foot-note.

† Eskridge:- Medical News. Aug 1896. Vol XLIX. p 122.

It will be seen that in this case, as Eskridge says, "the agraphia is secondary and the fault in spelling the primary symptom". The presence of a cyst in what was supposed to be the neighbourhood of the cheiro-kinaesthetic centre might lead us to suppose that the difficulty in spelling was of kinaesthetic origin. And it is possible that, during the act of writing, some assistance may be given by the cheiro-kinaesthetic centre, which may be compared to the reinforcement of the auditory word-memory by glosso-kinaesthetic functioning in thought and speech. But it is extremely doubtful if such an interaction takes place, as a rule, between the visual word-centre and the cheiro-kinaesthetic centre during the process of spelling a word aloud. Since this patient, when asked to spell a word aloud, spelt it wrongly, it seems, perhaps, more probable that the defect in spelling was due to some functional disturbance in the visual word-centre. If the fault in writing had been due to damage to the cheiro-kinaesthetic centre, I think the patient would have been able to spell words aloud correctly while he would have written them wrongly, as in a case recorded by Cremen.*

Although I admit that such a defect as was shown by Eskridge's patient may be due to disorder of the visual word-centre, I demur to Bastian's statement that the auditory centre cannot be concern in the process of spelling. A good visual may rely almost entirely upon his visual word-memory for the mental recall of the order of the letters of a word; but I think the majority of us

* See page 333.

spell, as a rule, by appealing to our audito-kinaesthetic memories of sound-sequences. Few people on being asked to spell a word aloud, are conscious of visualising the word and then reading off, as it were, the letters seen. If the word has several syllables, it is first broken up, in the inner speech, into its constituent syllables, and then the different syllables are further divided into their component letters. In auditivo-moteurs the first part of this process is undoubtedly a function of the auditory and glosso-kinaesthetic centres, and I think that in many instances the letter sequence may be arrived at through the unaided action of the same centres. Nevertheless there can be no doubt as to the assistance which may be rendered by the visual word-memory in securing the correct succession. When in doubt, our final appeal is to the visual word-memory - we write the word to see "how it looks". Here again, however, the best results are often obtained by trusting to kinaesthetic memories of movements coordinated in succession. Some people, when in doubt about the spelling of a word, say, "Let me see how I should write it", - not how it looks when written in this or that way. They trust to the combined action of the visual and cheiro-kinaesthetic centres to bring about the proper spelling.

The act of spelling seems indeed to be the most highly specialised of all the functions of the word-centres, and would seem to depend for its highest perfection on the co-operation of all four word-centres. This may, perhaps, account

for the apparently anomalous result of Thomas and Roux's investigation of the latent defects of reading in Broca's aphasia. The recognition of a word when the individual letters are widely separated is a recognition of how the word is spelt, and, being the last and most specialised acquisition in regard to this word, it is the last to be recovered. (See page 213)

It is doubtful if any recorded case can be pointed to as evidence of the existence of a further stage of functional degradation of the visual word-centre; that is to say, a condition in which the reaction of the visual word-centre to voluntary stimuli is impossible, while it may be still brought about by direct visual impressions, or even, to some extent, by hearing words pronounced. A case which seems suggestive in this connection is one of two cases recorded by Pitres as examples of agraphia from destruction of the writing centre in the second frontal convolution.*

M. X.... a Russian officer, could speak Russian, French and German with facility. Six months after a slight threatening of cerebral disease he found to his great surprise, at an evening assembly, that when addressed in French or German he could not reply in either of these languages; though he understood perfectly what was said to him in them and could still express himself in Russian with his usual facility. Little by little he improved, regaining the power of speaking French, though that of speaking German still remained lost. Wishing one day to write, he found that it was impossible for him to trace a single word, though his hand and arm were not at all paralysed. This led him to consult M. Charcot who found him in the following condition:- His intelligence was well preserved. He spoke French freely, replying to questions exactly, and related with precision the various phases of his malady. He had a little

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* Pitres:- Revue de médecine. 1884. p.864.

difficulty in the movements of the fingers of the right hand, together with slight cutaneous anaesthesia and incomplete loss of the sense of position of the fingers. He could read aloud in either Russian, French or German; but he could not write in any of these languages - not even in Russian. M.Charcot asked him to name and then write his address at Paris. He replied immediately: "Je demeure hotel de Bade, boulevard des Italiens", but when he tried to write these same words, he could scarcely trace "Je dem.." From dictation he could, however, succeed in writing the rest. He could copy writing placed before him. Asked to write M.Charcot's name in Russian, French or German, he could write it without any great difficulty in Russian; he had more difficulty in writing it in French; whilst it was impossible for him to write it in German. A few days after this examinatio M.X...died suddenly, and there was no necropsy.

The fact that this patient, who could read and was not aphasic, could copy and write to dictation, although not spontaneously, points to the visual word-centre as the region which was most probably at fault. The strong stimuli afforded by the written or printed words sufficed to arouse the visual word-centre so as to enable the patient to copy and to read, while the weak voluntary incitations from the auditory word-centre failed to do so. The somewhat stronger incitations derived from the auditory word-centre, when the words were dictated, enabled him to write words which he could not write spontaneously.

Bastian supposes that in this case there was some damage to the audito-visual commissure*, while Pitres concluded that the cheiro-kinaesthetic centre was at fault. It seems clear that a destructive lesion in either of these situations is incompatible with the symptoms. For if the cheiro-kinaesthetic centre was destroyed the patient could not have copied or written to dictation, and if the audito-visual commissure was destroyed, writing

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* Bastian :- aphasia. p. 251.

to dictation should have been, as Bastian admits, impossible. It is conceivable, however, that the defects may have been due to functional degradation in either of these situations; and although the explanation I have given seems to me the most probable, it must be acknowledged that the case belongs to that large group of speech defects in which anything like a positive regional diagnosis is impossible.

Visual Apexia.

Functional degradation of the visual word-centre may sometimes exhibit itself as an apexia. Pitres thinks that since apexia may be associated with all varieties of aphasia it has no topographic significance*; yet it seems probable that when the evidence points to defect of one particular word-centre, and there are no signs of any disturbance of the other word-centres, we may be justified in concluding that any indications of apexia which may be present are the result of the affection of the particular word-centre in question. At the same time it must be admitted that if the apexia verbalis is the only symptom of disordered word-memory present, it is very difficult to say which of the word-centres may be at fault.

Pitres has pointed out that loss of ability to read silently may be due to apexia and not to word-blindness*. Each word is seen and understood individually, but immediately fades from the memory; so that when the patient is reading one word he has

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* Pitres:- L' aphasie amnésique. p 79.

already forgotten the word which preceded it. I think that in such cases the apexia is probably of visual origin, and may be due partly to a fault of penetration whereby the words are not readily recognised, and partly to a failure of retention caused, chiefly, by too speedy a fading of the visual impressions.

Apexia would seem indeed to be a defect of what has been termed "primary" or "elementary" memory, rather than a failure to revive true memory-images. What psychologists call the "specious present" may be represented as a "psychical wave with a summit or crest of clear consciousness, a short rising slope of dawning consciousness, and a longer falling slope of waning consciousness".* The fading of impressions which occupies the falling slope, the persistence in the margin of consciousness of elements which an instant before had occupied the focus of consciousness, is what is known as primary memory.

When we are reading a line of print or writing, each word in succession occupies the focus of consciousness; but in health our attention is not so closely confined to the word which is focal that we are not at the same time more or less conscious of the words immediately preceding and following. It is this marginal element in our consciousness of the printed words which enables us to read with rapidity and to apprehend at a glance the meaning of a phrase or sentence. If, however, owing to some disturbance of the visual word-centre, the time occupied in recognising each word is at all prolonged, the normal fading

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* Lloyd Morgan:- Introduction to Comparative Psychology. p 13.

of impressions would remove the immediately preceding words from the margin of consciousness; and this would still more be the case if the impressions faded with abnormal rapidity. As a consequence, word after word might be correctly read without the sense of the phrase or sentence being understood. That there is, in these cases, some amount of delay in "penetration", as well as a failure of "retention", is shown by the fact that when patients suffering from this form of visual disturbance read aloud, they do so more slowly than usual.

It is generally stated that these patients understand each word of a sentence taken by itself, although they are incapable of apprehending the meaning of a phrase or sentence as a whole. When, however, it is remembered what divergent associations every ordinary word has, it is evident that the significance of any particular word in a sentence depends greatly on the words which precede and follow it. It is the "setting" which gives meaning to such words; and, if the "setting" is not known, it is only by chance that the real value of the words is arrived at.

A case which I consider a good example of visual apexia has been recorded by Elder.*

A man, aged 67, after an attack of right hemiplegia with some dysarthric disturbance of speech, found that while he could understand perfectly what was read and spoken to him, he himself could not intelligently read a book. He said to his wife, one day, "It is very curious that, whilst I can understand what you read and can remember it well, I cannot understand what I read myself. I see everything quite well, and can see the words, and can pronounce the words aloud, but I cannot connect them into sentences."

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* Elder:- Aphasia and the Cerebral Speech Mechanism, p. 173. (case X).

On being tested it was found that practically his statement was correct. He could read letters, figures and words, although he spoke them a little more slowly than one usually reads. Occasionally with a long word he would make a mistake in a syllable, substituting some other syllable in the middle for the proper one; but he usually could correct himself.....In reading he heard what he himself said, and understood it. He could thus read slowly and understand what he read, but the under - standing of sentences was done entirely through his ears. He could spell words when asked to with the greatest ease, and when a word was spelt over to him, he could tell what it was at once.

The right hand was paralysed and when he was asked to write with the left hand he was found to be absolutely agraphic. He could not write a single letter of the alphabet. When asked to trace an A in the air with his left forefinger or hand, he could not do so. Similarly with other letters, apparently he could not recall their shapes.

Elder is "strongly of opinion that this was a case of supra-pictorial visual aphasia, lesion between C and A in diagram"(the visuo-auditory commissure)*. He admits, however, that this shoul have entailed inability to read aloud, and that the agraphia points to affection of the visual word-centre.

The complete agraphia in spontaneous writing or in writing to dictation might have resulted from low functional activity in the visual word-centre. The weak stimuli might have been unable to arouse the impaired visual word-centre, while the strong sensory stimuli of the printed words were just sufficient to do so. The slowness of utterance in reading aloud, and the inability to read silently with understanding are characteristic of visual apexia.

Pitres says that in practice it is not difficult to determine whether inability to understand written or printed matter is due

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* Elder:- Aphasia & p.175

to word-blindness or to apexia. In the former case, the patient, having lost the notion of the significance of graphic signs, is equally incapable of understanding the words and of reading aloud; in the latter he is able to read aloud, he even understands each word individually, but he does not know the meaning of phrases composed of several words.*

Some very remarkable cases have, however, been recorded in which the patient, although able to read aloud, appears quite incapable of understanding the meaning of any single word which he reads. And the want of understanding seems to be as great when the words are read aloud, as during silent reading. Yet these patients are not word-deaf. Why, then, do they not understand words read aloud by themselves as well as words spoken by others ?

A case recorded by Goix† shows this condition.

A young girl (24) was subject to periodic nervous attacks during which she was absolutely incapable of understanding print or writing. Yet she was able to read aloud correctly; that is to say, she was able to translate written into spoken words, but she no longer knew what the words which she read signified. Her reading could be understood by another person, although she herself did not understand what she read. "I do not know what I have read" she observed, "I only know that I have read. I can see but I cannot understand".

The impossibility of understanding existed even for single words, both written and printed. The words engelure and traitement having been pointed to with the finger, she read them aloud correctly but did not know what they meant. When the written word encrier was shown her, she read it aloud very well. On being asked what the word was that she had read, she replied "encrier". But she was unable to indicate the object which the word signified. Nevertheless, when the object was

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* Pitres:- L'aphasie amnésique, p.78

† Goix:- Journal des sciences médicales. 24. fev. 1893. (Lille) (quoted by Ferrand in Le Langage, la parole, et les aphasies. Paris 1894. p. 143.)

shown to her, she recognised it and called it by its name. The patient was able to copy, but without understanding what she copied. She could write to dictation and could express her thoughts in writing as well as by speech. But she was not able to understand what she had herself written and so could not correct her letters. There was restriction of the visual fields especially to the left, but no hemianopsia.

Ferrand* cites this case as an example of "l'amnésie verbale visuelle". Such a designation is, however, very misleading. So far as words are concerned there is no amnesia at all. There is rather a form of logagnosia in which the words as written symbols are recognised while their meanings are forgotten. If the condition is to be described as an amnesia, it is evidently rather a pragmatamnesia than a logamnesia. It is the converse of amnesia verbalis, in which the idea of an object, or its presentation, does not lead to the memory of its name. Here, the visual presentation of the name does not lead to a knowledge of the object which it stands for. Should we not then suppose that in these cases it is not the word-centres which are at fault, but the regions subserving sense-representation in general ? May it not be that the functional degradation affects some part of the cortex included in the "centre" M, so that although direct stimulation, as when an object is presented through any of the avenues of sense, is sufficient to arouse the memory of all its attributes, including its name, the less direct stimulation afforded by presentation of its written name is incapable of doing so.

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* Ferrand:- Le Langage, la parole, et les aphasies. Paris 1894, p.147.

It is a curious fact that in these cases words spoken by others seem to be readily understood, while the mental sounding of written words, or even the stronger auditory incitations produced by reading the words aloud, seem to give rise to no apprehension of their meaning. As we have seen, the meaning of written words is arrived at mainly, if not entirely, through the intermediation of the auditory word-centre; and it is doubtful if the auditory presentation of a word is a much stronger means of auditory revival than is its visual presentation. Why then should these patients understand words spoken to them, while they cannot understand words read silently; and why, if they can understand words spoken by others, can they not understand words read aloud by themselves ?

I think the explanation of these anomalies must be looked for in some perversion of "attention", and that the defects connected with the interpretation of written language may often be found associated with more or less disturbance of intelligence. Goix's case was undoubtedly purely "hysterical", and in some other cases of this description, evidences of more profound mental impairment may be found. In a very complex case, recorded by Pitres,* in which ability to read aloud without understanding was a prominent symptom, signs of mental alienation were present from the begining, and in the end the patient had to be placed in an asylum. I do not propose to enter into any detailed examination of this case of which a full and most excellent

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* Pitres:- Etudes sur les paraphasies. Rev. de Med. 1899. p.444 - p.453. (obs. V.)

record has been made by Pitres; but I should like to refer to some of the facts which point to the probability that a failure of attention may be a not unimportant factor in the causation of this rare form of disorder of memory.

Marie Duc.... aged 40, was hysterical from the age of puberty. After an apoplectiform attack in Jan.,1897, she did not understand what was said to her and did not recognise her friends. On admission to hospital,15 days afterwards, she spoke continuously in an unintelligible jargon. There was no paralysis of the face and no anaesthesia. She did not appear to be altogether devoid of intelligence, but she understood incompletely what was said to her, or took no notice of it. Towards the end of February she improved, recognised people about her, understood their questions, and replied, if not in correct language, at least in a way which showed intelligence. The visual fields could not be examined.

Spsech. Very loquacious - surprising volubility. Articulation good. Words pronounced rapidly but distinctly. Paraphasia. Did not appear to notice that she did not make herself understood and continued talking. Often indulged in interminable monologues No word-deafness now.

Naming of objects very defective - showed marked amnesia verbalis.

Repetition sometimes correct, more often defective. Repeats figures better than words.

Recitation very defective. Named the days of the week and the names of the months.

Music. Could accompany a melody but could not start one by herself

Reading aloud. Could read aloud with few mistakes in a slow monotone. More mistakes if fatigued. Read aloud sense and nonsense with equal conviction.

Silent reading. Did not seem to understand what she read. Did not obey written orders. Read aloud a list of names including her own "Marie", but could not pick out her own name. Yet if when she was trying to recollect the name of an object, its name was shown to her in writing, the written word was recognised at once as the word sought.

Spontaneous writing. Paragraphia. Could not express the simples thoughts; could not even write her own name correctly though she could "sign" it. Often wrote better with the eyes closed.

Writing to dictation. Succeeded sometimes with simple words. With phrases would sometimes repeat the same word againand again as if she had forgotten the rest of the phrase.

Copying defective.

Reading by cheiro-kinaesthetic impressions. Recognised words so written but did not know their meaning. Did not answer questions written thus, but recognised a word sought. as in the case where the written word was seen.

Writing with block letters defective.

Most of the defects in regard to language in this case may be explained by severe functional degradation of the auditory and visual word-centres. These centres were not destroyed, for they could be aroused to function by direct sensory impressions. After the initial word-deafness had disappeared she could understand words spoken and could read aloud. Yet here, as in less severe cases, she did not seem capable of grasping the meaning of words read aloud by herself. She could not even understand isolated words.

There is much evidence to show that this patient's power of attention was very defective. The complete disregard of the model when asked to copy a sentence was probably due to this. The fact that she often wrote better when her eyes were closed might be explained by there being then less probability of her attention being distracted by her surroundings. Above all, it is important to note, that when the attention was brought to bear on the relation between a written word and its meaning, she at once recognised and understood the written word. This was clearly shown in the examination of her ability to name objects at sight. If, when she could not remember the name, it was written before her, she at once recognised it as the word sought.

We know practically nothing of the physical basis of attention, and it helps us but little to invoke its disorders as an explanation of phenomena which must be correlated with structural or functional alterations in the nervous tissues. If the attention

cannot be brought to bear on the relation between a word and its meaning, it is probable that the parts of the cortex subserving the memories of words and the memories of their meanings are not simultaneously aroused to that extent which makes attention possible. In the case which we have been considering the fault of attention is probably not due to the condition of the word-centres, since they can all be made to function under the stimulation afforded by direct sensory impressions. We must evidently look for the disordered action in those parts of the cortex in which words receive their meaning,- the general centres of sense-representation, or in the association paths which connect the word-centres with these parts. If we suppose the general visual memory centres to be those which are affected in such cases, we should have a condition in which visual ideation would be interfered with in a manner resembling what takes place in object-blindness, with the important difference that in object-blindness there is a pragmat-agnosia as well as a pragmatamnesia; whilst in the cases which we are here considering, the affected centres can be aroused by direct sensory impressions, although not always by stimuli arriving through associational channels.

In Pitres' case when both the word-centres and the general memory centres are both strongly aroused by direct sensory impressions, as in the experiments with the written words in naming objects at sight, the attention may be brought to bear upon the relation between the word and its meaning, and lead to a recog-nition of this relation. And since understanding seems possible

when words are spoken aloud by other people, we must suppose that when the words read aloud by the patient herself are not understood, some other impressions received from without, or some mental process going on within, are more effective in absorbing the attention than the impressions derived from reading aloud.

Dyslexia.

What may probably be a more severe form of the functional defect which leads to visual apexia has been described by Berlin† under the name of dyslexia. In this condition it is not so much a rapid fading of the visual impressions which is shown, but, rather, a speedy exhaustion of the visual word-centre, so that after the reading of a few words, it is no longer capable of reacting to direct impressions at all. Berlin suggests that the defect may not be in the visual word-centre itself, but in the afferent tracts leading thereto, the conductive power of these becoming soon exhausted.

As a rule the only defect complained of by patients suffering from this condition is a difficulty in reading. The following short note of a case recorded by Hinshelwood* shows the nature of the difficulty.

"On attempting to read he read the first few words quite correctly and then suddenly came to a stop, saying he could not go on. After resting a little he would begin again with precisely the same result, always coming to a stop after reading a few words. On asking him how it was that he could not continue to read, he said that although he could see the letters quite distinctly, he became stupid - they seemed to lose all meaning for him. He particularly said, in answer to further inquiry, that there was no blurring of the letters and that they did not seem to run together....Visual acuity was unimpaired. The attempt to read seemed to cost him great mental effort...He experienced no pain but simply a sense of great mental fatigue".

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* Hinshelwood:- Letter-word- and mind blindness. 1900. p.37. P38.
† Berlin:- Eine Besondere Art der Wortblindheit (Dyslexie). Wiesbaden 1887.

Total dissolutions of Visual word-memories.

Our knowledge of the results which follow destruction of the visual word-centre is much more precise than is the case with regard to mere functional disturbances. From the time that the existence of a special centre for the visual memory of words was first suggested, it has always been recognised that its destruction should entail word-blindness; but it was by no means generally believed that agraphia is also a necessary consequence of such a lesion. It was not until after the publication of some observations by Déjerine and Serieux, in 1891-92,* that there was anything like a general acceptance of this view; although, if Bastian's teaching on the relations of the visual sense to kinaesthesis and to the initiation of voluntary movement had been accepted, such a conclusion might have been arrived at a priori.

In complete cortical word- and letter-blindness, writing is affected in all its modes. The patient can neither write spontaneously nor to dictation. More important still, he cannot copy. Theoretically, this is a symptom which should enable us to decide between an alexia of auditory origin and that which is due to destruction of the visual word-centre. In the former condition the path c-C-D-d being intact, there is nothing to prevent copying being executed with facility even if the meaning of what is copied is not understood. In practice, however, it

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*Comptes Rendus de la Société de Biologie. 1891-1892.

is doubtful if such a condition is ever met with; and the reason for this would seem to be, that a lesion, sufficiently extensive to blot out all auditory word-memories, necessarily inflicts such damage on the visual word-centre as would by itself cause alexia and total agraphia. It would seem that any retention of the functions of the visual word-centre is incompatible with destruction of the auditory word-centre to such an extent as to lead to aphasia, alexia and agraphia. As Bramwell says,* "so close is the connection between the auditory speech centre and the visual speech centre, that they may be almost regarded as parts of one centre". It is this close relation, both functional and topographic, which alone can justify the description by Wernicke, Déjerine and Mirallié of a "Sensory Aphasia" with its complex symptomatology; and we may legitimately utilise the most uncomplicated cases of cortical word-blindness which have been recorded, as a means of determining the symptoms which are produced by destruction of the visual word centre alone.

If the views which I have put forward in a former chapter on the nature of the inner speech are correct, destruction of the visual word-centre alone should produce little, if any, disturbance of the use of words in silent thought or in uttered speech. Déjerine and Mirallié teach that any lesion of the "zone of language" entails impairment of the inner speech. And it is true that in the examination of cases of cortical word-blindness there is often found some evidence of amnesia verbalis and paraphasia;

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* Byrom Bramwell:- Morrison Lectures on aphasia (Reprint) p. 529.

but it is much more probable that this is due to functional disturbance produced by the lesion in the contiguous auditory word-centre, than to the loss of the visual word-images. There is no such mysterious connection between the various centres in the zone of language as Déjerine and Mirallié suggest*; nor is revival of all three forms of word-images a necessary condition of the inner speech. The amount of amnesia verbalis present in cortical word-blindness is invariably proportionate to the amount of functional degradation produced in the auditory word-centre.

It has commonly been noted that at the onset of an attack of cortical word-blindness there may be very considerable paraphasia which in the course of a comparatively short time almost completely disappears, leaving, it may be, a trace of amnesia verbalis. But it cannot be contended that such disturbance of speech is the result of the loss of the visual memory of words, since the recovery of speech is not accompanied by any improvement of the word-blindness. Destruction of the visual word-centre does not, per se, necessarily lead to any disturbance of the inner speech in the sense in which I have used that term; although, of course, it does interfere with the visualisation and the ideal production of written words.

In the examination of cases of word-blindness, sufficient pains have not always been taken to distinguish clearly between the symptoms which may be found in those in which the blindness to graphic signs is complete, and in those in which it is more or

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* Mirallié: L'aphasie Sensorielle. p. 100.

less partial. The presence or absence of letter-blindness has, it is true, frequently been noted; but the effects of such conditions on the various modes of writing have seldom been observed.

We should suppose that the integrity of the visual letter-centre, and of its afferent and efferent tracts, would enable a patient, not only to read letters, but, also, to write them voluntarily or to dictation. Especially should we expect the ability to copy letters to be retained. I have examined the records of many cases of cortical word-blindness in which there was no letter-blindness or in which the letter-blindness was incomplete, but I have not been able to find any very distinct evidence that such a retention of ability to write as I have suggested has been noted. I cannot help thinking that this is partly due to the fact that the peculiar-ity in question has not been looked for. That a patient is not able to write words spontaneously or to dictation is often consider-ed sufficient evidence that he is completely agraphic; and in many cases no reference at all is made to copying.

Word- without letter-blindness.

Cases of cortical word-blindness in which there is no letter-blindness are rare, and it is questionable if some of the cases which have been recorded were really examples of cortical disease, and not of the type described by Déjerine as pure word-blindness. Hinshelwood has recorded a very interesting case of his own

observation,* and he has collected three others, one by Swan Burnett, one by Mierzejewski, and one by Schweigger.

On analysing the salient features of these four cases, Hinshelwood found that (1) "they could read fluently the individual letters, printed and written, but could not interpret words composed of these letters; (2) they could read figures both individually and when combined in the most complex manner; (3) they could write spontaneously and to dictation, but could not interpret the words which they themselves had written, although they could read the individual letters." †

If these cases were, as Hinshelwood supposes, cases of cortical word-blindness, they raise a very important question as to the effect on the ability to write caused by lesion of the visual word-centre. Déjerine and Serieux have shown conclusively that destruction of the visual word-centre causing both word- and letter-blindness, entails agraphia; but Hinshelwood supposes that if the visual memory of letters is preserved, writing, in all its modes, remains possible.

He observed in his own patient "that he wrote very slowly and spelt out each word as he wrote it. He could revive only the visual image of each letter and not the visual image of the whole word. Hence his slowness in writing and his necessity for spelling it out letter by letter." ‡

Now, according to Bastian's views, the fact that this patient could spell at all is presumptive evidence that his visual

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* Hinshelwood:- Letter- word- & mind-Blindness. London 1900. p. 52.

† Ibid: p. 68. ‡ Ibid. p. 65

word-centre was not destroyed. But if the four patients cited by Hinshelwood were all able to spell correctly without any assistance from their visual word-centres, then we must believe that the integrity of the auditory and glosso-kinaesthetic centres suffices in many cases for the accurate recall of the proper succession of the letter-units of words. So long as they are able to spell there seems no reason why such word-blind patients should not be able to write slowly, if the centres of visual letter-memory are not destroyed; but unless we are prepared to admit that spelling does not require the co-operation of the visual word-centre, all cases of word- without letter-blindness in which ability to write is retained must be looked upon as belonging to the group described by Déjerine as being due to an isolation of the visual word-centre from the primary receptive areas in the occipital lobe.

So far as we can judge from recorded cases of cortical word- and letter-blindness, followed by necropsy, the ability of such patients to spell has not often been investigated. Yet we find in one of the best examples of this condition - the case of Augustine Ver...., described by Serieux - an instance of agraphia from cortical word- and nearly complete letter-blindness, in which the patient could spell correctly the words which she tried in vain to write. On being asked to write her name and address, the patient wrote in characters often difficult to recognise, "Madame Aaddm Ao Msono umc." While writing, she spelt

quite correctly each syllable of the word that she wished to write: Bu...; Qu..i..n..c...a..m &c. Quincampoix. *

The evidence afforded by this case is in favour of the view that the visual word-centre is not necessarily concerned in the process of spelling; and it, consequently, favours the opinion of Hinshelwood that if there is neither letter-blindness nor agraphia so far as letters are concerned, ability to write spontaneously and to dictation may be retained. Copying slowly but not servilely, should also be possible, and there should be no difficulty in transcribing, letter by letter, print into script.

It was found by Hinshelwood that although his patient was quite unable to read words by sight, he "was able to read if he was allowed to spell out aloud each word letter by letter." † This method of reading has been noticed in some cases of pure word-blindness in which there has been no letter-blindness, and it raises the question whether the possibility of reading in such a fashion necessitates the integrity of the visual word-centre or whether, as Hinshelwood supposes, the appeal to the auditory word-memory is sufficient. If a word spelt aloud is able to be recognised without the co-operation of the visual word-memory, it implies an auditory or audito-kinaesthetic memory of the letter-sequences of words just as much as does the ability to spell under the same conditions.

Further observations may enable us to determine whether cases of word- without letter-blindness in which the power of

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* Serieux :- Mémoires de la Société de Biologie 1892. p. 15.
† Hinshelwood :- Letter- word- & mind- blindness. p. 5-6.

spontaneous writing is retained, and in which reading can be accomplished by spelling the words aloud, are ever of cortical origin, or whether they are not rather cases of pure word-blindness in which the afferent tracts to the word-centres are destroyed, while those to the letter-centres are intact.

Letter- without word-blindness.

The relation of the amount of word- or letter-blindness to the amount of agraphia is still better shown in a case of letter-without word-blindness recorded by Hinshelwood.* This patient was quite unable to write certain letters to dictation, although he wrote the same letters at once when they occurred in words dictated. Hinshelwood's case is an excellent example of uncomplicated letter- without word-blindness; and, as the condition has very seldom been noted, I give here a short summary of this important record. Unfortunately, no note seems to have been made with regard to the ability to copy.

A young man, aged 24 years, in the course of an illness which was suggestive of cerebro-spinal meningitis, developed paralysis of the right arm, leg, and the right side of the face, with aphasia and profound apathy from which, however, he could be roused. There was a gradual improvement in his speech and before his dismissal from the infirmary, he could converse with the other patients and nurses. There was no word-deafness and no object-blindness. On testing him with letters it was found that he could neither read nor write a single letter of the alphabet except "T" which he generally recognised and always named "Tom" which was his own name. Nor could he point out any named letter except "T". The inability to recognise them was the same with all sizes and forms of letters both written and printed. On testing him with

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* Hinshelwood:- Letter - word - & mind - blindness. p 69.

words, however, in a large number of trials it was quite evident that he could read almost every word presented to him, even words of three or more syllables and very unfamiliar ones, whilst at the same time he was quite unable to name or point out a single letter of the word he had just read. Substantives he could make out much better than verbs, and could read them with the greatest fluency. Slight intentional mistakes in spelling and even reversing letters were not oblerved by the patient, who read the words just as if no alteration had been made and did not seem conscious of anything peculiar about the word. Numerals he recognised and named as far as nine but not beyond that, and only the Arabic numerals and not the Roman. When he left the hospital about three months after admission he was able to recognise some letters but only occasionally and with many failures. He could write a few letters to dictation but he made many mistakes.

On attempting to write the alphabet he wrote as follows:- a,b,c,d,e,i,j,h,m,n,s,u,w,v,y,z, and the following letters being dictated he wrote as follows:-

Dictated b, wrote b.	Dictated c, wrote c.
" y, " l.	" f,(failed).
" p (failed).	" d, wrote a.
" r (failed).	" n (failed).

While he failed with many of the letters he wrote readily words begining with the same letters. In the above trial he failed to write"p", "r", or "n", but wrote quite readily "pot","Robert", " nail", and so on.

Word- and letter-blindness.

In cortical word-blindness with letter-blindness the conditions are less complicated and the symptoms are easily explained. There is total inability to read both words and letters either by sight or by kinaesthesis, and the agraphia is correspondingly complete. Copying is quite impossible, except by servilely following the model. The ability of these patients to spell aloud, or to recognise words spelt aloud, does not seem to have been investigated; but Serieux's case already referred to, points to the possibility that it may be retained.

A case recorded by Déjerine*, of which I give a short summary, shows well the defects produced by this form of dissolution of memory.

A man, aged 63 years, was admitted to the Bicetre on Feb.12th 1890. Seven years previously he had a slight attack of right hemiplegia not accompanied by speech troubles, which had almost completely disappeared. Soon after his admission he found one morning that he could not read his newspaper. On examination there was found to be no trace of word-deafness, but he was unable to understand either print or writing, and could not even name a single letter of the alphabet. He could recognise his name and could name all objects shown to him. Right lateral hemianopsia was believed to exist. There was paraphasia both in spontaneous speech and in his repetition of words. When asked to write he held the pen most awkwardly and could write nothing but his name, and that so badly as to be scarcely recognisable; and whether he attempted to write spontaneously, from dictation, or to copy, he wrote only his own name, "Séjalon", in an indistinct fashion.

On March 10th the initial paraphasia had almost completely disappeared. His writing was as bad as before, but he held the pen much better. He could not write a single word spontaneously or from dictation, nor could he copy, - he made mere meaningless strokes only. He could, however, write from dictation a numeral or a number composed of not more than two figures. There was complete alexia as before; he recognised his own name but nothing else. On Nov.5th, 1890, the letter-blindness was slightly less. He could then recognise c and g of the alphabet, but no other letters. He could not make out any word, but he recognised and pronounced numerals and numbers of not more than two figures. The agraphia was as complete as before for spontaneous writing, dictation and copying.

He died on Nov. 24th, 1890, and at the necropsy a focus of softening "having the diameter of a five franc piece" was found occupying the inferior three-fourths of the angular gyrus, all the rest of the cortex, including the foot of the third and also that of the second frontal convolution, being absolutely intact. Sections of the left hemisphere showed that the softening extended inwards in a wedge-shape as far as the posterior cornu, destroying the greater part of the optic radiation of Gratiolet. In the right hemisphere two small foci of softening of the size of a small nut were found - one in the putamen, the other in the anterior part of the thalamus, which destroyed by their union the genu of the internal capsule.

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*Déjerine:- Comptes Rendus de la Société de Biologie. 1891. p197.

In this case both word- and letter-blindness were produced by a cortical lesion, and consequently there was complete agraphia. The temporary nature of the paraphasia produced by a lesion strictly confined to the angular gyrus is noteworthy; and we are bound to believe that it was due to a temporary functional disturbance in the adjacent auditory word-centre, and not a consequence of the blotting out of the visual memories of words.

The observation made in this case, that a totaly word-blind patient is able to recognise his own name in print or in writing, has often been noted. Mirallié has laid stress on the rule that a patient's own name should never be used as a test, either for word-blindness or for agraphia, since it stands on quite a different footing from all other words.* The recognition of his own name by such a patient is explained on the supposition that it is recognised not as a word but as a design. In the same way, he is supposed to write it as he would draw some well known design, and not as a word made up of a number of letters.

Although, in Déjerine's case, the writing of the patient's own name was done very badly, it has sometimes been observed that the signature so written bears a close resemblance to that of the patient before he became agraphic. As I shall attempt to show later, this ability in an agraphic to sign his own name is a good instance of automatic action of the cheiro-kinaesthetic centre - the production of a "series of movements learnt", without any guidance from the visual word-centre. The poorness of the attempt

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* Mirallié: de l'aphasie Sensorielle. p 34

in Déjerine's case may be accounted for by the fact that the patient was a day-labourer who probably had little chance of developing a cheiro-kinaesthetic memory of his signature.

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Pure word-blindness.

It had long been observed that some patients suffering from word-blindness were also agraphic while some were not; but it was not until 1892 that anything like a satisfactory explanation of this was suggested. In that year Déjerine* published the record of a case of word-blindness in which there was no agraphia except during the last few days of the patient's life, and which at the necropsy showed that up till a few days before death there had been no destruction of the angular gyrus. Two years later Wyllie† recorded two cases of the same kind in which the angular gyrus was intact. In the same year another good example was published by Redlich‡; and in 1904 Hinshelwood§ recorded a case, with necropsy, which he had under observation for several years.

Wernicke†† had already in 1886 referred to the possibility of a subcortical word-blindness corresponding to the subcortical word-deafness of Lichtheim; but Déjerine's was the first record of an actual case corresponding both clinically and pathologically to Wernicke's theoretical indication.

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* Déjerine:- Mémoires de la Société de Biologie, 1892. Février 27. p.61-90
† Wyllie:- Disorders of Speech, p.340 & p.344.
‡ Redlich:- Jahrbuch für Psychiatrie, 1894. p.242 (Quoted by Bastian, Aphasia. p.195)
§ Hinshelwood:- British Medical Journal Nov 12. 1904. p.1304.
†† Wernicke:- Fortschritte der Medicin 1886. p.463.

The explanation which was put forward by Déjerine and which has been almost universally accepted is, that pure word-blindness is produced by a cutting off of the visual word-centre from the common visual centres in both occipital lobes. A lesion of the white substance capable of doing this will at the same time be very likely to destroy the optic radiations and so cause the homonymous hemianopsia which is generally present in these cases. Déjerine does not attribute any functional importance to the visual word-centre on the right side, and therefore does not think that the visual word-centre on the left side may be aroused by incitations passing through the corpus callosum from its fellow on the right side, which is in uninterrupted communication with the primary visual areas. Bastian, however, believing as he does, in the importance of the word-centres in the right hemisphere, thinks that the lesion in pure word-blindness of Déjerine's type must cut across not only the tracts connecting the left primary visual area to the left visual word-centre, but also those connecting the visual word-centres on both sides with each other.* Whichever explanation we accept, there can be no doubt that the essential feature of this form of word-blindness is an interruption of the afferent fibres between the primary receptive areas in the occipital lobes and the left visual word-centre.

The following is a short summary of Déjerine's case which shows well all the main features of pure word-blindness.

Bastian :- aphasia . p 200.

A man, aged 68 years, of more than ordinary culture, after a number of attacks of tingling in the right leg and arm, suddenly found that he could not read. Word-blindness was complete, both verbal and litteral. Blindness to musical notes was also complete There was preservation of ability to read figures and also to calculate. There was no trace of word-deafness, no trace of disturbance in articulate speech, and the inner speech was intact. There was no object blindness or optic aphasia; mimicry was perfect and very expressive. There was perfect preservation of spontaneous writing and of writing from dictation; and reading by kinaesthetic impressions was possible. Copying was very difficult and defective There was right lateral hemianopsia and hemiachromatopsia. There was integrity of motility, and of sensibility general and special, as well as of the muscular sense. The same symptoms persisted for four years.

Ten days before his death he became suddenly affected with with paraphasia and total agraphia, without any trace of word-deafness. He preserved his intelligence to the end.

At the necropsy recent lesions were found in the left hemisphere in the form of red softening in the inferior parietal lobule and in the angular gyrus. There were old lesions(plaques jaunes) in the lingual and fusiform lobules, in the cuneus, in the white substance of the occipital lobe, and in the posterior extremity of the corpus callosum. The optic radiations were markedly atrophied. The right hemisphere was intact. *

The word-blindness in these cases is not due to any defect of memory. The visual memory of words can be revived spontaneously, or by kinaesthetic impressions in tracing over the written letters. The visual word-centre and its connections with the auditory and cheiro-kinaesthetic centres being intact, there is no agraphia in spontaneous writing, or in writing to dictation. Copying, however, is impossible, if there is letter-blindness as well as word-blindness. The visual presentation of the written symbols not being able to arouse the elements of the visual word-centre, which, by their action on the cheiro-kinaesthetic centre, initiate the movements of writing, any attempt at copying which is made is

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* Dejerine: Mémoires de la Soc. de Biologie. 1892. Tome 27. p. 64.

effected through the co-operation of the general visual centres. The result is not copying in the proper sense of the word. It is what has been termed servile copying or copying as from a design, and the success with which it may be accomplished varies in different cases.

Authors are not all in agreement as to the ability to copy of patients suffering from pure word-blindness. Déjerine and Mirallié* are of opinion that copying is always servile in such cases. Elder† and Saint-Paul‡ express the same opinion. Bramwell§ says they can copy mechanically but cannot do transfer copying; yet he thinks they may be able to form words with block letters and to write on a typewriter. Bastian‖, on the other hand, says they can or may do transfer copying, and he, also, is of opinion that they ought to be able to form words with separate letters.

I think the explanation of this difference of opinion is to be found in the fact that attention has not been sufficiently directed to the question of the presence or absence of letter-blindness in the cases on which observers have founded their conclusions. It will I believe be found that in every instance in which a patient suffering from pure word-blindness is able to copy well, there is no letter-blindness. Unfortunately, in the only case followed by autopsy in which the absence of letter-blindness was noted (Wyllie's first case), there is no mention made of the patient's power of copying. In Déjerine's case and in that of Redlich, letter-blindness was present and copying was

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* Mirallié :- L'aphasie sensorielle. p. 57.
† Elder :- aphasia. p. 86 and p. 160
‡ Saint-Paul :- Le Langage Intérieur. p. 25-6
§ Bramwell :- Morrison Lectures (Reprint). p. 122.
‖ Bastian :- aphasia. p. 202. & p 294.

very defective or impossible.

What seems to me an excellent example of pure word-blindness without letter-blindness was reported, in 1888, by Hughes Bennett,* and the remarks made by this careful observer on the mode of copying present are well worthy of consideration.

"Although he names every letter without mistake he is unable to tell or understand a single word, no matter how short, unless he spells it out aloud like a child learning its first lesson... ....The patient although he cannot read a single word, can write a letter like any educated man, and his handwriting is excellent. ....When asked to copy writing or print he does so with perfect accuracy, but very slowly, letter by letter. Printed letters he transcribes into written characters. He does not understand what he is writing unless he spells the word out aloud. His writing to dictation is without fault."

Here we have an accurate description of the mode of copying possible when there is no letter-blindness. The words are copied letter by letter with perfect accuracy, and printed letters are transcribed into written characters. The visual letter-centre, its afferent tracts, and its commissural connections with the cheiro-kinaesthetic centre being intact, letters can be copied accurately; and their combination into words can be effected, through the general visual centres, by following the grouping of the letters in the model. This case seems to show that copying which can not be called servile is possible in word-blindness when there is no letter-blindness.

This is sometimes even more strikingly shown in those cases in which, in addition to pure word-blindness, there is a partial letter-blindness. On asking the patient to copy some printed

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* Hughes Bennett: British Medical Journal 1888, V. I. p. 340.

words, the letters which can be recognised may be written in script, while those which cannot be recognised may be copied in print. I had the opportunity of frequently testing this in a case of pure word-blindness and partial letter-blindness which, on account of its many complexities and peculiarities, I record in considerable detail.

Ada P....., aged 29 years, unmarried, of no occupation. Family history good. Had a slight illness at the age of 13, probably chorea. Excepting this, her health has always been good.

On Jan.17th, 1901, I was called in to see the patient who complained of indigestion and general malaise. At the end of a fortnight she had much improved. While taking a walk one cold day she was suddenly seized with a paroxysm of coughing. She went home, and, as the cough persisted, I was sent for. I found her temperature was 100° and sent her to bed. There were no physical signs to account for the cough which lasted for 24 hours without intermission and was of a very hysterical character.

Two days afterwards, on the 5th of February, while she was still in bed, a twitching of the left hand was noticed by her sister. I was called in at once and found the movements limited to a rythmic extension of the left wrist. This soon began to alternate with supination of the hand. If opposed, the movements became more violent and irregular. In the course of the evening the elbow joint became involved in the movements, and next day the whole of the left arm was affected by similar clonic contractions. The movements ceased during sleep. The deep reflexes of both legs were much exaggerated, especially those of the left leg. All day on the 6th Feb. the patient was dull and apathetic and complained of pain in the head. Next day, Feb.7, the left arm was still jerking vigorously and the left leg became affected in a similar manner. The leg movements began by clonic contractions of the muscles causing inversion of the foot. On testing the patellar reflex the whole limb became attacked by violent spasm. Ankle clonus could be elicited, but it was not easy to test, as the whole limb jerked violently in all directions. Next day the whole of the left leg was included in the movements and the left arm was still in the same condition.

On Feb.10th, the right foot began to be affected in the same way as the left had begun, that is, by rythmic inversion of the foot; and, on the 11th, the whole of the right leg was included in the movements and the right hand had begun to be alternately extended at the wrist and supinated. On Feb. 12th, the whole of the right arm was affected, while the movements of the left hand had somewhat abated. For a week the temperature had ranged from 99° to 101°

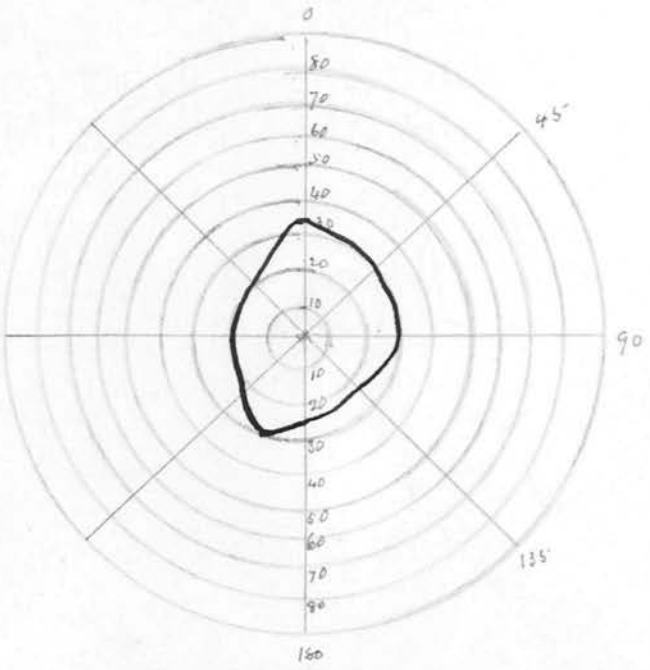
and the pain in the head had been considerable. Her speech became affected in a peculiar manner, and there was ptosis, with photophobia, of the left eye. Her speech defects were not investigated at this time as she was too ill, but the general impression produced was, that there was a great predominance of sibilants. She had no difficulty in saying what she wanted to, but merely a faulty pronunciation, such as "ses" for "yes" and "sad" for "bad".

From this date the movements began to abate, and in their disappearance they followed the exact order in which they had come on. First the left hand and arm became quiescent, then the left foot and leg, then the right foot and leg, and lastly the right hand and arm. The temperature went down and the pain in the head got better. The ptosis lasted only a few days and never recurred. By the fifth of March all clonic movements had ceased. The deep reflexes were still exaggerated, and testing them tended to bring on a return of the clonic contractions.

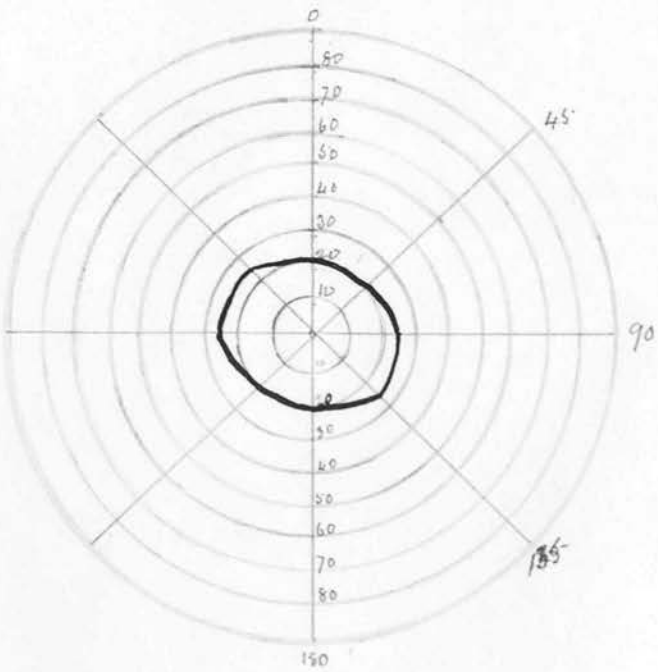
There was now found to be complete anaesthesia, with loss of the muscular sense, of the right arm, with the exception of the thumb and index finger. This had been preceded for some time by a loss of power in localising impressions. Soon after this she complained of pain with hyperaesthesia in the right hip. The pain varied in its position. At first it was complained of over the course of the sciatic nerve, but later it became localised in the groin and down the inner aspect of the thigh. It gradually disappeared from the thigh and became located in the knee. The abatement of the pain was accompanied by a spread of the anaesthesia of the right side, so that by June 11th the whole of the right side of the body had become completely anaesthetic with the exception of the thumb and index finger and an area of three square inches on the inner aspect of the knee, which latter was hyperaesthetic. At a later period this area was painful only on deep pressure.

When the clonic movements ceased in the limbs, motor paresis, which slowly improved, was found to be present. Although, at first, the left hand was more paralysed than the right, it recovered more quickly; but for several weeks the grasping power in both hands was very feeble.

At various times during her convalescence, most frequently at her menstrual periods, there was some return of the clonic spasms. As time went on the rythm of the movements tended to become quicker and approximated to that of a coarse tremor. Sometimes they lasted for days without intermission except during sleep. All her limbs were affected in this way at some period of her convalescence but in no definite order. Sometimes when sitting with one toe just touching the floor there would be a persistent rapid ankle clonus which might persist for hours. If the foot were lifted off the floor, the movements became more hurried and irregular, a rapid internal and external rotation at the ankle joint predominating. At various times there was a return of coarser movements in the limbs, but they had lost their rythmic character and were of a more choreic type. The left arm and shoulder were



Right Field of Vision.



Left Field of Vision.

The Fields of Vision in the case of Ada P.....

affected for a long time in this way, but by July 20th both the choreic movements and the coarse tremor had quite disappeared. There was, however, still great loss of power in the limbs, and she began to suffer from sickness after every meal. This lasted until the begining of August, when, her power of walking having sufficiently recovered, I sent her to Folkestone for a change. She remained away a fortnight and returned very much improved. The sickness had ceased and she could walk very much better. She afterwards made a more or less uninterrupted recovery and in the course of some months became practically well. She has, however, remained up to the present time completely hemianalgesic on the right side of the body. Sensibility to touch has returned although localisation is defective. Painful impressions are not felt as such.

Her condition with regard to motor power, sensation, kinaesthesis, and the reception and production of speech was tested many times during the course of her illness, and the following are some of the notes made at these times.

Motor power. On June 11th.- Grasp of left hand stronger than that of right. Very little power of movement of the fingers of the right hand, except in the index finger and thumb. Other movements of the right arm not paralysed, though feeble. The left hand and arm can be moved pretty well. Right leg can be moved slowly but in a very jerky manner. In walking, keeps the right knee rigid, and drags the foot along the floor without any "sickle movement". Left leg can be moved freely. Excitement causes increase of the clonic spasms which are frequently present in the right leg and foot, and may even cause the left foot to be affected in the same way. Knee jerks exaggerated, especially on the right side.

Sensation. June 11th. Complete anaesthesia over the whole of the right half of the body with exception of the thumb and index finger, an area of about three square inches on the inner aspect of the knee, and a small spot on the middle of the sole of the foot. Firm pressure over the inner aspect of the knee is attended by considerable pain. A firm pin prick on the middle of the sole of the foot is felt, but not as very painful. The conjunctiva of the right eye is quite insensitive, though the reflex is well marked. Right half of the tongue and soft palate quite anaesthetic. The superficial reflexes of the anaesthetic side are greatly exaggerated, especially the abdominal. There is pronounced concentric restriction of both visual fields and no hemianopsia.

Kinaesthesis. June 12th. If passive movements are made, the patient being blindfolded, she has no knowledge of the position of the right arm except when the forefinger and thumb come in contact with anything which she recognises, such as her dress or her hair. When blindfolded, voluntary movements are very imperfectly performed by the right arm. When asked to raise her

hand, from hanging by the side of her chair, on to her knees, she feels with her forefinger and thumb as she slowly slides her hand up along her dress. If the arm is kept away from her side she is unable to perform the action but keeps moving her forefinger and thumb as if trying to come in contact with something which she may recognise. I extended the arm at right angles to her body, and having told her that it was bent at the elbow, I asked her to extend it. The extensors were put into action, and while encouraging her to continue extending it, I gradually flexed it. The flexors then began to act, the patient still being under the impression that she was extending the arm. In the end she could not tell whether it was flexed or extended.

July, 21st. Choreic movements of the left shoulder, and coarse tremor in both legs, which had been present for some time, had ceased some days ago. Since then she has complained of languor and headache. She shows considerable enfeeblement of motor power generally and is less able to walk. She says the floor feels soft and spongy under her. She is still anaesthetic.

She was lying down on a sofa and I asked her which leg she could move best. Her answer was, "the right one, if I can see it". I asked her to flex her leg at the knee without looking at it. She said she could not, but on being urged to try, she made the limb move slightly and the foot slipped off the sofa on to the floor. On asking her where her foot was now, she said she did not know. I told her to look. She did so, and said it had slipped down. "Now", I said, "lift it up and lay it beside the other one". In order to do so she sat upright, so that she could see exactly where her foot was, and then quite easily and rapidly replaced it on the sofa.

Speech:- Production. The earliest indication of any disturbance of speech was the sibilant lalling which came on at the end of the first week of her illness. At that time the patient was so ill that the real nature and extent of the speech defect could not be investigated; but it was noted that there was a great predominance of "s" and "y" sounds. It may here be said that this condition lasted with very little alteration during the whole period of her illness.

On analysing these defects by means of the physiological alphabet of Wyllie, it was found that all the vowels were given their proper value when used in ordinary speech. If the vowels were pronounced by themselves they were always prefixed by a Y sound, thus, "yä", "yë", "yö", and so on. Of the voiceless oral consonants, P was always given as S, the voiceless W as Y. Of the voiced oral consonants, W, L, and R were always pronounced as Y. G was given as D in the earlier days of her illness and later as G. B was at first given as S, but later as B. Of the voiced nasal resonants, N was the only sound which occasionally gave some trouble. For example, she always referred to the letter M as "am M". With regard to the various stop positions it will be seen that the difficulties were confined to the labials and the linguo-palatals.

When the acute phase of her illness was over, it was found that she could not read. She could still write, however; but her writing reproduced all the peculiarities of her speech, the substitution of the letters Y and S for other letters corresponding to the substitution of Y and S sounds in her spoken language. She was unable to read what she wrote; so the peculiarities which rendered her writing rather difficult to decipher were not noticed by her. The handwriting was good when the tremor and paresis of the right arm had passed off. I have obtained many copies of letters written during her illness. The following is a good example. It was written to a cousin but was never sent, so I have the original.

My dea Hayy.

I was veyy seaseg to hea you ayyieg home safey.

You will be sussised to hea E... yode down on Sungay. O..& I went to meet him, & as usuay he dave us a yost joyney took the yond tunind & came though ---- he is yoocind ve y well & is comind adain nex Sattye week. Well I cant yite any mo e I am tyied Love f om eveyone

f om T.....

Ss. Do you yi e you Sotos.

The following is a translation: My dear Harry, I was very pleased to hear you arrived home safely. You will be surprised to hear E... rode down on Sunday. O...and I went to meet him, and as usual he gave us a lost journey - took the wrong turning and came through-----.He is looking very well and is coming again next Saturday week. Well I can't write any more.I am tired.

Love from everyone

Ps. Do you like your Photos? from T.....

It will be seen that the substitution of letters is very similar to that which was noticeable in her speech. There are, however, some differences. The terminal"d"in such a word as "pleased" was always pronounced, although written as "g", and the terminal "ing" was often pronounced correctly, although written "ind". The only constant similarity in her speech and writing was the use of "y" and "s" for other letters. Yet it will be noticed that the letter "r" is sometimes written "y" and sometimes omitted altogether. Again, the letter "l" is generally written "y" but in short words like "well" and "will" it is often written correctly. In her letters, the phrase "love to all" is sometimes written correctly, sometimes "yove to ayy".

In writing to dictation, the same mistakes were made as in spontaneous writing. Thus the phrase "Let us go out" was written "Yet us do out". One of her earliest efforts at writing to dictation was with the following sentences: "A lad was leading a lamb on the road. A bad man was caught with a dog in a bag". She wrote as follows: "A yag as yeagind a yamb on the yoag. A bag man as caut ith a god in a bad". The following four renderings of the sentence "Peter White made brown wax", written at different times, show how improvement gradually occurred.

(1) Sete yite mage boun yax.
(2) Pete yite made boun yax.
(3) Petey Yite made boun yax.
(4) Petey White made byown wax.

At first she could scarcely copy at all. As the letter-blindness improved she could copy the letters which she recognised. At first she could not do transfer copying at all, but she could copy print as print much better than she could copy writing as writing. Later she could, in copying from print, transfer the letters which she knew while copying in print those which she did not recognise. Up to the very end she had great difficulty in copying the letters K, L and R.

Reception and interpretation of speech. When it was discovered that the patient was not able to read, careful examination revealed the fact that there was a certain amount of general amnesia. For example, she did not remember that her second name was Gertrude. There also seemed to be present what, at first sight, looked like a slight degree of word-deafness. This was elicited by an endeavour to determine if there was present any letter-deafness, or, more accurately, a deafness to any of the sound-units of words. I found she was unable to understand the spoken words, peach, pad, late, lad, lard, that is to say, words which begin with letters which she did not use in writing and whose sounds she did not use in speech. The results were not uniform, and the defect, in so far as it may have existed, did not last long. On the whole it may be said that there was no word-deafness. She always understood what was said to her in ordinary conversation. There was no doubt a certain amount of mental deterioration during the first few months of her illness, but not to any appreciable degree. There was no amnesia verbalis: she was never, so far as could be made out, at a loss for a word, although its production might be so mangled as to make it difficult to understand what she meant.

For several months she was almost totally word-blind, and, to a great extent, letter-blind. On testing her with large printed capital letters, in a child's primer, on May 30th, the following condition was noted.

A - Always recognised. Pronounced "ya" as in Yale.
B - Generally recognised but with some hesitation. She is inclined to recall it to memory by its position in the alphabetical sequence. This is noticeable in connection with the first four or five letters and Z which is always referred to as "the last one" before being named.
C - Recognised sometimes. Cannot distinguish it from G
D - Always called "G" without any hesitation.
E - Recognised with difficulty or not at all when isolated from its position in the alphabet. Recognised most readily in small words like "the" "be" &c.
F - recognised and named correctly.
G - Not recognised at all, or mistaken for "C".
H - Recognised and named correctly.
I - Recognised. Pronounced "Yi".
J - Recognised. Pronounced "Zay".
K - Not recognised at all, or mistaken for "Y" and so named. (She pronounced "Y" in the same way as "I", but I have judged which she meant by comparing her writing with the results of this method of examination).
L - Never recognised as such. Always thought to be "Y".
M - Recognised and always referred to as "an M".
N - Recognised in the alphabetical sequence, but apparently only in association with M. If the other letters are covered and I ask "What comes after M ?" Answer: "N". Q. "Is that N ?" A. "Don't know".
O - Always recognised and named "yo".
P - Always mistaken without any hesitation for "S".
Q - Not recognised. Some other unrecognised letters sometimes mistaken for Q, when it is called "Kyo"
R - Always mistaken for "Y". She seems to realise dimly that L and R are not the same letter but she maintains that each of them is a "Y".
S - Recognised and named correctly. Cannot distinguish it from P.
T - Recognised and named correctly.
U - Recognised and named correctly.
V - Recognised and named correctly.
W - Always recognised as two Vs and named so.-"Double V".
X - Not recognised at all.
Y - Very seldom recognised. Sometimes called "Z".
Z - Recognised with difficulty. Named only when remembered as "the last one".

She had "lessons" every day, and at the end of ~~this~~ a month it was found that she could recognise most of the letters if given time. By the 30th of June she could make an attempt at repeating the alphabet from memory, which at first she was quite unable to do. Here is her repetition of the alphabet on that date: A B C G F H I J M N O S T X Y Z. She made a long pause after O and T as if she knew there was something she was missing.

From the fact that the letters remembered ran in sequences -ABC, HIJ, MNO, &c., I became suspicious that her improvement in reading the various letters from a printed alphabet might be due to memory of the sequence, and that she might not be able to read at sight all the letters which she could now name correctly when they were shown to her in their alphabetical order. I, therefore, got her some block letters, and it was at once evident that this was so. These letters, like those of the alphabet with which the other tests were made, were printed Roman capitals. It was found that she recognised very few letters at sight. If allowed a little time she named many of them correctly. When a letter which she did not recognise at sight was shown to her, she evidently began to say her alphabet mentally, at the same time tracing with her forefinger, on the table, the written form of each letter in succession. When, in her mental sounding, she came to the letter shown to her, she recognised that the written form of the letter corresponded with the printed letter, and she named it correctly. She failed when the letter shown to her was one of those of which she seems to have lost all memory.

It was found that although she could read scarcely a word of her own writing at sight, she could readily do so if allowed to trace the words over with a pencil or with her finger. This was true of any writing with regard to all the letters which she could write spontaneously; and if the words were short, or familiar, she could read them aloud and understand them.

There were, however, certain letters of which she seemed to have lost all knowledge. For many months the letters K, L, P and R, were not recognised by sight, by sound, or by kinaesthesis: they were not used in writing and their sounds were not used in speech. The letter W was not recognised by its sound: it was only when it was called "double V" that she knew what was meant. I gave her a box of block letters and asked her to sort out all the blocks which she thought did not represent letters of the alphabet. She removed all the Ks, Ls, Ps, and Rs.

One day, after much trouble, I taught her to pronounce the letter P and the P sound in words; and the curious fact was observed, that, from that day, she could use the P sound in speech, could recognise the letter P in print or in writing, and could use it in writing spontaneously or to dictation.

She could name numerals correctly up to 20, after which she said 30, 40, &c. She could also write numerals but was quite unable to read them after she had written. Even when allowed to trace over the figures with her pencil she rarely was able to name them correctly. She, however, found a way by which she could always name them. It was the same method which she adopted when trying to read capital letters. When shown a figure, she began to repeat the numerical sequence 1,2,3,&c., at the same time tracing with her forefinger each number as she named it or mentally sounded it. When she came to the figure shown, she at once named it correctly.

In consequence of her difficulty in reading numerals at sight, it was almost impossible for her to do the simplest addition sums on paper; yet she was very good at mental arithmetic. She was especially quick at the multiplication table, and never made a mistake.

The word-blindness was almost total for some months, but she was able to read with understanding long before she was able to recognise all the letters. She early recognised the word "the" because "it was a short one and began with a "t"."

Her power of reading, like her recognition of letters, came back gradually; and, so far as could be judged, re-education had very little to do with her recovery. This was especially noticeable in regard to those letters which she had most completely forgotten. Prolonged efforts to teach her to recognise the letters K, R, and L, having resulted in complete failure, the attempt was given up. Yet in the course of time these letters "came back" to her. One day she discovered that she could recognise K; some weeks later the same thing was observed with regard to L; and in the end she once more knew all the letters of the alphabet.

The most striking instance of a good result from trying to teach her was the effect of showing her how to pronounce the letter P, or rather to produce the P sound in words. Why regaining the power to pronounce the sound should have enabled her to recognise the letter may be difficult to explain, but there is no doubt as to the fact that the one followed the other almost immediately.

Since we may get word-blindness without letter-blindness and letter-blindness without word-blindness, it is probable that her recovery of the power of reading words was not dependent on the recovery of the power of recognising letters; but it was observed that improvement in both took place about the same rate. Concurrently there was improvement in her enunciation of words, and the recovery of ability to recognise a letter was generally accompanied by the reinstatement of its sound in her speech. Whether the one invariably preceded the other, and if so, which returned first, I cannot say, as, by the time such recovery took place, her general health had so much improved that I had ceased seeing her regularly. Eighteen months after the onset of her illness all defects of speech and of word-memory had quite disappeared.

Since this account was written she has had a relapse. In December 1904 she had, for three weeks, choreic movements of the mouth and tongue with great general malaise and a febrile temperature. She developed her old lalling speech and, at first, wrote in the old way. She showed many of her old symptoms, such as paralysis of the right leg, and developed many new ones of a markedly hysterical character. As her general health improved she became completely word- and letter-blind and totally agraphic. She remains so at the present time. (Oct. 1905). She still lalls when she speaks to me; but her sister says that she often speaks correctly, especially when talking to children or to strangers.

There are two circumstances in connection with this case which almost always make anything like a definite regional diagnosis impossible, and almost certainly entail a residuum of unexplained phenomena. These circumstances are (1) the fact that both hemispheres were involved, and (2) that there was a large admixture of functional with organic troubles. As to the latter point there is, I think, no room for doubt; but as to the nature of the organic trouble there is great uncertainty.

There can be little doubt that in its main features this case conforms to the type of pure word-blindness described by Déjerine; but it shows, in addition, evidences of disturbances of speech processes not commonly associated with this condition.

The various peculiarities in regard to the letter-blindness are both interesting and puzzling. Even in simpler cases it is often impossible to explain satisfactorily irregular troubles of this kind - they lie outside the range of what is at present possible in regard to diagnosis. While here it seems to me still more hopeless to attempt successfully to unravel all the difficulties by reason of the probability that in this case we have to do with multiple organic together with functional troubles.

The fact that this patient sometimes wrote voluntarily some of those letters of which she had lost all conscious memory points strongly, I think, to automatic functioning of the cheiro-kin-aesthetic centre. There is here a kinaesthetic memory of movements learnt in sequence; but this memory is a purely organic

memory and is not accompanied by any knowledge of the significance of the movements. The incitations which initiate the nervous discharge in the cheiro-kinaesthetic centre are derived from the ingoing impressions resulting from the formation of the letters immediately preceding, and not from the visual word-centre. This mode of writing may be truly described in the words which have been erroneously used with reference to the writing in simple cases of pure word-blindness, as being "performed automatically, without any exercise of the reflection or judgement".

Bastian's Type of Pure Word-blindness (Parietal Type).

Déjerine's explanation of the way in which pure word-blindness is produced has been accepted by most writers as sufficient to account for all cases in which word-blindness is not accompanied by agraphia. [illegible]. When a patient, who is completely word- and letter-blind, is yet able to read by kinaesth-etic impressions and to write spontaneously and to dictation, we seem bound to believe that he is not suffering from destruction of his visual word-centre. Yet Bastian has described a type of word-blindness in which, although the visual word-centre is destroyed, there is no agraphia.* This form he calls the "parietal type of pure word-blindness"; and he indicates certain symptoms which he thinks may be of importance in enabling us to discriminate clinically between this type and that described by Déjerine.

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* Bastian :- aphasia, p. 186.

Bastian confesses that he can bring forward only two cases with necropsies in illustration of this group, "and unfortunately they are not very well defined cases, being rather complicated, not only clinically, but also by reason of the lesions found at the necropsy".* One of these cases was recorded, many years ago, by Broadbent.†

A man, aged 59, after an illness which began with sickness, vomiting and pains in the head, was unable to read either print or writing though he could write quite well. Twelve months later he was no longer able to write voluntarily though he could still write correctly from dictation. Soon afterwards, when he came under observation, he was found to be unable to read. He could see the words, but could not understand them: he could not even recognise or name single letters; the only exception to this being that he recognised his own name, whether printed or written.

There was some amnesia verbalis in spontaneous speech. Naming objects at sight was very defective. He died after a severe apopleptic attack, nine years after the begining of his illness.

At the autopsy, besides the recent haemorrhage, there were found two old blood clots. "One about the size and shape of an almond was closely embeded in the infra-marginal gyrus between the deep parallel sulcus on the one side and the secondary small gyri on the lower wall of the fissure of Sylvius on the other, about opposite the junction of the upper third with the lower two thirds of the descending cornu. The other was farther back and on a higher level, almost exactly corresponding in situation with the posterior end of the fissure of Sylvius externally and with the junction of the descending cornu with the body of the ventricle internally; in fact it occupied the thickness of brain substance separating the extremity of the fissure from the ventricle".

Bastian says: "It seems pretty clear that the second of these blood-clots must have been situated in the angular gyrus, whilst the first of them was situated somewhere near the middle of the upper temporal convolution, and therefore that the patient's alexia was due to destruction of the visual word-centre".‡

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* Bastian:- aphasia p. 187.

† Broadbent:- Transactions of the Royal Med. and Chirurg. Soc. 1872. p. 162.

‡ Bastian:- aphasia. p. 189

The second case which Bastian thinks should find a place in this group was recorded by Osler in 1891.*

A man aged 72 , while at his supper on November 1st, 1888. suddenly found that he could not read his daily paper. On exam--ination there was found to be some amnesia verbalis and slight paraphasia, absolute word-, letter-, and figure-blindness, and right homonymous hemianopsia. "He could write his name but said that since his failure to see distinctly he did so with difficulty. He wrote as well with his eyes shut as when they were open, but did so with hesitation. He wrote the name of the Hospital, and the words "Philadelphia Record".....On one occasion he wrote the word "record" when told to, but after he had written it he spelled it "freedom". His general condition gradually got worse and he died in January 1889.

At the necropsy softening was found of the left supra-marginal lobule and of the white substance of the lower part of the angular gyrus; also of the white matter of the posterior parts of the first and second temporal convolutions. There was likewise complete softening of the white matter between these convolutions and the lateral ventricle(posterior horn); while another area of softening two inches in thickness and an inch in breadth was found in the white substance of the temporal lobe, which externally touched the grey matter of the third and the base of the second temporal convolutions.

In both these cases Bastian believes the visual word-centre to have been destroyed; and the only way that he can account for the absence of agraphia is by supposing that in people much accustomed to write, the auditory word-centre may be able to act directly on the cheiro-kinaesthetic centre by way of the commissure A-D. "It is well known", he says,† "that many voluntary movements during the period that they are being learned and sometimes for long afterwards, require for their execution the active co-operation of the visual centre, though at a later period the guidance of the kinaesthetic centres may suffice without any aid from the visual

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* Osler:- American Journal of Medical Sciences. March 1891. p. 219.

† Bastian:- Aphasia p 192.

centre". He thinks that it may happen in a person who is strongly auditive but a weak visual, "after the stage of learning to write has well passed, that the activity of the visual word-centre whilst writing may be reduced to a minimum".*

It is with the greatest diffidence that I venture to oppose the opinion of so great an authority, but I have already expressed my dissent from the doctrine that facility in performing any movement is dependent on the formation of new nervous connections. It is difficult to imagine how the presentation or the represent--ation of word-sounds can ever form guides for the performance of movements the results of which are not sounds but written signs; and if the necessary guidance is supposed to be afforded by the cheiro-kinaesthetic centres themselves, it seems equally difficult to believe that the guidance so given would ever suffice for the constantly varying combinations of movements concerned in the production of written words in the expression of spontan--eous thought. Kinaesthetic guidance seems to suffice only in the case of a series of movements the sequence of which has been firmly imprinted on the kinaesthetic centres by frequent repetition. It is commonly found in connection with the writing of one's own name - one's signature. Here the movements, coordinated in succession, have been learnt in a sequence which never varies. Once the act of writing is started the signature may be completed without any aid from the visual word-centre. It is an instance of a purely kinaesthetic memory and has the "unconscious" character of kinaesthetic memories in general when they are

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* Bastian:- aphasia p. 186.

dissociated from the sense-memories through which we interpret intrinsic kinaesthetic impressions.

Bastian quotes a third case as probably belonging to his parietal type of pure word-blindness. This is the case of M.H.P., reported by Bernard‡ in which, after an attack of right hemiplegia with some disturbance of speech, there remained right lateral hemianopsia, word- and partial letter-blindness, with no agraphia. He could read by kinaesthetic impressions, and Bastian supposes that this was rendered possible by auditory revivals produced by excitations from the cheiro-kinaesthetic centre passing backwards along the commissure D-A.

Most observers would consider this a good example of Déjerine's type of pure word-blindness; but Bastian thinks that the fact that a hemiplegic condition existed at first, that there was no hemi-anaesthesia or hemiachromatopsia, and that the clinical defects subsequently found were very limited in their nature, renders it "distinctly less probable that the patient's condition was due to lesion in the occipital region than to one further forward which also involved the visual word-centre itself".*

The considerations which Bastian thinks may afford some help in discriminating between the two types of pure word-blindness during life, are the following.†

Parietal Type	Occipital Type (Dejerine's)
1. Possibly some right-sided paresis.	1. Probably no right-sided paresis, but possibly some slight right hemianaesthesia.

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* Bastian:- aphasia. p. 191 - p 192
† Ibid:- p. 202.
‡ Bernard:- De l'aphasie. p. 69. obs. I.

Parietal Type.	Occipital Type(Dejerine's).
2. Cannot do "transfer copying".	2. May be able to do "transfer copying."
3. Speech often slightly paraphasic.	3. Speech not affected, or slightly amnesic only.
4. May be no hemianopsia or hemiachromatopsia.	4. Hemianopsia always, and when complete, probably also hemiachromatopsia.

Taking these points separately we may note that the applic-ation of the tests to the cases of pure word-blindness which have been verified by autopsy shows that a reliance on them as a means of differential diagnosis might have been misleading.

1. In Déjerine's case and in Wyllie's case there was no hemi-anaesthesia, and in Redlich's case there was some right-sided paresis.
2. Transfer copying is impossible in any case if there is letter-blindness as well as word-blindness.
3. The speech defect will depend on the amount of injury inflicted on the auditory word-centre; and considerable paraphasia may result from a lesion which also produces pure word-blindness of Déjerine's type.
4. Pure word-blindness of Déjerine's type, if not due to gross lesion, may occur without hemianopsia.

The imperfect and scanty nature of the evidence on which Bastian relies, in postulating his parietal type of pure word-blindness, entitles us to pause before accepting a doctrine which is subversive of the well-founded belief that agraphia is the

necessary consequence of destruction of the visual word-centre. In Broadbent's case the description of the lesion found at the autopsy does not convey any absolute certainty that the whole of angular gyrus was destroyed; and in Osler's case it is distinctly stated that it was the "white substance of the lower part of the angular gyrus" which was softened. It seems probable that both were cases partly of Déjerine's type, although accompanied by considerable damage to the visual word-centre itself. For, after all, the writing powers of both these patients were very limited. Broadbent's patient did not write at all spontaneously; and the writing of Osler's patient seems to have been confined to a very few words.

Chap. viii.

DISSOLUTIONS OF CHEIRO-KINAESTHETIC MEMORIES.

Cheiro-kinaesthetic centre is the term used by Bastian to indicate that portion of the cerebral cortex in which are registered the memories of the movements employed in writing. Most writers on Aphasia have referred to it as the motor centre for writing, the graphic motor centre, or, shortly, as the writing centre. Some of these writers admit that there must be some region of the cortex in which the kinaesthetic impressions derived from the act of writing are received and registered; yet they persist in calling the writing centre a motor centre even when they believe that the cortical area concerned is that in which these kinaesthetic impressions are registered. Some think that the foot of the second frontal convolution may be the site of the registration of such kinaesthetic impressions, and that the motor centres are to be found in the "motor" area for the hand and arm in the central convolutions. Others think that

there is a motor centre for writing which is distinct from the motor centre for general movements of the hand and arm, and which probably occupies part of the second frontal convolution. Dr. Byrom Bramwell is inclined to deny the existence of a separate motor area for writing apart from the general motor area of the hand and arm; but he feels bound to believe in the existence of a kinaesthetic centre for writing which he thinks may probably be situated in the neighbourhood of the angular gyrus. He is of opinion that destruction of the kinaesthetic writing centre "would probably produce incoordination of writing movements rather than complete agraphia".*

Those who hold Bastian's views on the nature and functions of kinaesthetic centres regard such a belief as an instance of the old fallacy which was put forward by several of the speakers in the debate at the Neurological Society when Bastian read his paper on "The Muscular Sense".† This fallacy has reappeared again and again in this and other countries; and it seems almost impossible to get clinical observers to realise that destruction of a kinaesthetic centre necessarily entails paralysis of the movements registered in that centre.

Although there is some confusion as to the nature of the centre which immediately presides over the act of writing, it has been customary to suppose that some such centre exists in the neighbourhood of the hand and arm area of the Rolandic cortex - probably in the foot of the second frontal convolution. There

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* Byrom Bramwell :- Morrison Lectures on aphasia (Reprint). p. 237.

† Bastian:. The Muscular Sense &c. Brain April 1887.

are, however, a number of writers whose opinions are worthy of the greatest consideration who deny the existence of any such centre. Wernicke, Déjerine, Mirallié, and others say that in writing we merely reproduce on paper the visual images of words registered in the visual word-centre, and that to do so no special writing centre is required.

To those who accept Bastian's teaching on the nature and functions of kinaesthetic centres the existence of a kinaesthetic centre for writing seems a self-evident truth: they have a difficulty in understanding how such an opinion as that of Déjerine and Mirallié can have arisen. It would seem that the denial of the existence of a writing centre must be due to (1) the meaning ascribed to the word "centre" in this connection, or (2) to the interpretation put upon the scarcity of pathological evidence in favour of the hypothesis that such a centre exists, or (3) to the views held as to the functions which such a centre would be called upon to perform.

(1). For many years it has been customary to use the term "centre" to indicate more or less defined groups of neural elements subserving certain sensory and motor endowments. The mapping out of part of the cortex into regions related to the movements of the limbs and trunk has given rise to a belief that such centres have always a compactness and a topographic limitation which is not warranted by the results of experiment or by pathological evidence. When the suggestion was put forward that a special writing centre

may exist, it seemed to carry with it the implication that such a centre must necessarily be distinct from the region presiding over the ordinary movements of the arm and hand. And so it happens that the question of the existence of a writing centre has been unjustifiably confounded with that of its topographic separation from the centres of arm and hand movements in general. This is however to restrict the use of the word "centre" in a way which is quite illegitimate. Although it may be denied that any special set of movements of a limb are localised in areas distinct from those of other special or general movements of the same limb, yet it must be admitted that the complex grouping of muscles, which is necessary for the facile performance of any skilled movement, must have a neural basis which is practically quite distinct from that of other skilled movements of the same limb; and it is convenient to include the whole of the neural network concerned in any series of skilled movements as the "centre" for that series of movements, however widespread its cortical extent may be, and however much it may coincide regionally with the centres for other special or general movements. There is a functional and a structural unity in such a neurone group for which it is convenient to have a name, and the use of the word "centre" for such a purpose is perfectly legitimate.

(2). It may thus be seen how too much importance may have been attributed to the scarcity of pathological evidence in favour of the hypothesis that a writing centre exists. Even if

we admit that no case of agraphia has been recorded which can be definitely asserted to have been due to destruction of the writing centre. this by no means entitles us to deny the existence of such a centre; although it may be of value as evidence in regard to the question of its separate topographic localisation. Within recent years, however, some evidence has been forthcoming which is regarded by many investigators as definitely proving that a writing centre exists in the foot of the second frontal convolution, as Exner originally maintained. Some of this evidence will be considered later.

(3). Although some differences of opinion have been expressed as to the separate localisation of the graphic centre, it is rather in respect to the functions which such a centre is called upon to perform that the real controversy about its existence has arisen. No one has dealt more fully with the arguments for and against the existence of a centre of "graphic motor images" than Mirallié, and he concludes, with Déjerine, that such a centre is quite unnecessary and does not exist. In this country the opposite view has been maintained by Bastian, Elder, and others.†

Now it seems to me that if all these writers agreed as to what was being attacked and what was being defended the whole controversy would lose its point. Mirallié states clearly at the begining of his argument that what he is prepared to contest is the existence of a graphic centre as this was understood by Charcot and his followers.* According to Charcot the graphic centre is an autonomous centre of motor images, which is in direct connection

* mirallié:. De l'aphasie Sensorielle. p. 65.

† Footnote. This view is strongly upheld in America by Mills and Gordinier. See. American Journal of med. Sciences Sept 1904. p 375. • Sept 1903. p 490

with the "ideational centres", and whose functioning in spontaneous writing is independent of the functioning of the other word-centres The idea of an object may revive directly the written word by the path M-D, and the sensory impressions derived from the movements of writing the word may call up directly the idea of the object by the path D-M. Agraphia is the result of destruction of the centre D, or of the path M-D.

This opinion is still held in a modified form by Pitres, Saint-Paul and others; but neither Bastian nor Elder nor any writer in this country is prepared to uphold it. When, then, these writers contend for the existence of a writing centre, it is manifest that they mean something different from the sort of writing centre whose existence Mirallié denies. So it happens that although Mirallié's arguments may be perfectly valid against the views of the Charcot school, they have little or no bearing on the views held by English authors.

If we believe that in spontaneous writing words are revived primarily in the auditory word-centre, and that the visual word-images are then aroused as a necessary preliminary to kinaesthetic revival, we must hold that agraphia following destruction of the visual word-centre does not in any way support the belief that there is no cheiro-kinaesthetic centre at all. For the stimuli which initiate the functioning of the cheiro-kinaesthetic centre are not forthcoming: they are stopped on the way. The path A-C-D is cut across, and agraphia results. So, when agraphia

is due to amnesia verbalis, the spontaneous recall of words being impossible the cheiro-kinaesthetic centre cannot receive the incitations necessary for the production of spontaneous writing. Copying, however, would still be possible, the path c.-C-D-d being intact. Yet Mirallié puts forward the retention of ability to copy while spontaneous writing is lost, noted in some cases of "motor"aphasia, as a proof that no centre of graphic images exists. Seeing that he believes the agraphia associated with destruction of Broca's convolution to be the result of amnesia verbalis, it is difficult to understand why he should deny the possible existence of an intact graphic centre which can be roused to function by the visual impressions of the words to be copied. His argument may be valid against the view that agraphia in Broca's aphasia is due to destruction of the graphic centre; but it has no bearing on the question of the existence of such a centre, unless this centre is the autonomous centre which Charcot supposed it to be.

The difficulty which Mirallié feels in admitting the existence of a special centre for the registration of memories of writing movements seems to be due to the evident want of relation between such memories and the meanings of words. He considers the memories of articulatory movements to be an important element in our "notion of the word". Not finding any such relation to the notion of the word in the memories of writing movements, he denies the existence of a centre in which such memories may be registered.

And indeed this is a difficulty which has never been explained by those authors who, whilst believing in a "writing centre" analogous to the "speech centre" of Broca, postulate a relation between memories of articulatory movements and meanings, yet deny such relation in the case of the memories of writing movements. Bastian on the other hand is perfectly consistent. The relation of the auditory word-centre to the glosso-kinaesth--etic centre is almost exactly analogous to that of the visual word-centre to the cheiro-kinaesthetic centre. In the one case as in the other the kinaesthetic centre is not in direct relation to the general centres of sense-representation, and cannot be utilised for the production of spontaneous thought except through the intermediation of the auditory and visual word-centres. Mirallié's difficulty disappears if we believe that the mental concomitant of glosso-kinaesthetic action has nothing to do with the "notion of the word", however important this action may be in assisting the auditory revivals which form the real material of our recollection in the use of words.

The incitations derived from the visual word-centre during spontaneous writing are the weakest stimuli which the cheiro-kinaesthetic centre receives; and they ought to be the first to become ineffective when dissolution of cheiro-kinaesthetic memory sets in. Writing from dictation may afford a slightly stronger stimulus; copying, a still stronger one; and the direct sensory impressions derived from the act of writing, or from writing

movements passively communicated, are the strongest stimuli possible.

We may conjecture that stages of dissolution corresponding to this order of excitability to stimuli may be met with; but in practice, the difficulty of assuring ourselves that the other word-centres and their commissures are intact, is, as a rule, insuperable. We may however examine some of the recorded cases which are most suggestive in this connection. And here, as in the case of the dissolutions of glosso-kinaesthetic memories, it will be convenient to begin with complete destruction of the centre and then to seek out evidences of less and less complete states of dissolution.

Up till a few years ago it is doubtful if any instance of agraphia could be pointed to as being indisputably due to destruction of the cheiro-kinaesthetic centre. In 1899, however, Gordinier recorded a case which seems to fulfil all the requirements, both clinical and pathological, of this condition. Not only does it seem to establish the possibility of an agraphia due to complete dissolution of cheiro-kinaesthetic memories, but, to many minds it will carry conviction as to the separate localisation of a special centre for writing.*

* A woman, aged 37, had symptoms of cerebral tumour accompanied by numbness in the right arm. On examination the grip of the right hand was found to be slightly weaker than that of the left. Dynamometer: outer scale, right 50; left, 75. No muscular atrophy. Both fine and coarse movements of right and left hands and arms normal. No sensory disturbances.

Gordinier:- American Journal of the Medical Sciences May 1899. pp. 526-535.

In regard to speech, "the only difficulty present is a total inability to write. Although she understands perfectly written language and can read to herself or aloud, she cannot write voluntarily nor form correctly a single letter, and cannot write from dictation or copy. She holds the pen in a perfect manner and performs movements with it as if to write, her writing consisting, however, of nothing more than a series of united curves. ....She was unable to write with her left hand as she was not ambi-dextrous. The fine and coarse movements of the right hand are executed in a perfect manner, and there exists no paralysis of the muscles of the hand, forearm, or arm.....This condition of complete agraphia continued throughout her illness, and was, with the exception of a slow cerebration and frontal ataxia(Bruns), the only localising symptom present". She died two days after operation. At the autopsy a glioma was found "occupying the foot of the second left frontal convolution, being distinctly separated from the arm area by the pre-central sulcus, which sulcus in this case was well developed.....On section the tumour was seen to extend downward and inward in the centrum semi-ovale as far as the roof of the anterior cornu of the lateral ventricle, and forward to near the apex of the frontal lobe, involving almost exclusively the white matter of the second frontal gyrus....."

It is important to note that in this case every mode of writing was abolished. Copying was as impossible as writing from dictation or spontaneously. Unfortunately no note is made of the power of reading by kinaesthetic impressions: most probably it was abolished. For those who believe that the "writing centre" is a kinaesthetic centre this is a most serious omission from any record of agraphia: it leaves us in doubt as to the reaction of the centre to direct sensory impressions.

Gordinier gives as the explanation why this patient could not write with the left hand that she was not ambi-dextrous; but many people who are not ambi-dextrous can write after a fashion with the left hand. And although we cannot draw any conclusions from the absence of this power in agraphic conditions, it seems

probable that its retention may be an important indication in regard to the site of the lesion causing the agraphia.

When a right-handed person writes with the left hand and forms his letters and words in the ordinary way, the writing path is probably from the left auditory word-centre to the left visual word-centre, then by way of the corpus callosum to the right visual word-centre and thence to the right cheiro-kinaesthetic centre. When, however, the writing produced by the left hand is "mirror-writing" it seems perfectly clear, as Elder has pointed out*, that the transference of the impulses to the right hemisphere takes place through the left cheiro-kinaesthetic centre. If, then, ability to write with the left hand is retained while there is agraphia of the right hand, we may conclude that the auditory and visual word-centres are not at fault: if mirror-writing be possible it points to an intact writing centre and a subcortical lesion. I do not think there is any means of distinguishing between lesion of the centre D and lesion of the commissure C-D. Destruction of the commissure C-D will simulate destruction of D itself, unless the commissure D-C escapes, which is very improbable. If the path D-C is cut across, stimulation of D by passive writing movements will arouse no recognition of the letters so formed: writing in all its modes will be abolished by destruction of the path C-D.

The importance of retention of ability to write with the left hand is shown by a case which was reported by Pitres as an instance of agraphia due to destruction of the centre D.

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* Elder:. Aphasia. pp. 214-218.

M. L. aged 31, had an apoplectic attack with right hemiplegia in 1882. He improved rapidly under anti-syphilitic treatment; and when Pitres examined him in 1884 there remained only some relatively slight but very interesting defects.

He complained of nothing except a slight stiffness of the right lower extremity and a complete inability to write with the right hand, although he could use this hand in almost all other ways. There was right-sided hemianopsia. When, his eyes being closed, the movements necessary for writing the word "Paris" were communicated to his arm, he readily recognised the word so written. There was no word-deafness or word-blindness and speech and intelligence were unimpaired. When asked to write the word "Bordeaux" he was unable to form a single letter with the right hand: with the left hand he wrote the word very plainly and without mistake. Then taking the pencil in his right hand he was able with difficulty, and by looking each instant at the letters he was about to trace, to reproduce them with the right hand. He could not do transfer copying with his right hand. He could draw with his right hand such things as a circle, a triangle, an octagon, or a human figure, without hesitation. ※

This case has given rise to much controversy. The fact that the patient recognised the word "Paris" by kinaesthetic impressions is clear proof that the cheiro-kinaesthetic centre was not destroyed. Nevertheless his great difficulty in copying points to a very low functional activity of this centre. The commissure D-C was evidently not destroyed since he could read by kinaesthetic impressions; and we may probably conclude that the commissure C-D had also escaped. The defect in copying could not have been due to functional degradation of the visual word-centre, since the visual presentation of the letters is a stronger stimulus to the visual word-centre than the indirect impressions derived from the cheiro-kinaesthetic centre; and this latter form of stimulus we know to have been effective in arousing the visual word-memory. His ability to write from

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※ Pitres:- Revue de médecine. 1884. p.870.

dictation with the left hand points to functional integrity of the auditory and visual word-centres. We seem bound then to ascribe the agraphia to low functional degradation of the cheiro-kinaesthetic centre - a degradation so severe that only through direct sensory impressions could its functional activity be aroused; or to a break in the path C-D while the path D-C was left intact.

Bastian supposes that the agraphia in this case may be explained by destruction of the audito-visual commissure A-C. He adduces the following reasons in support of this contention. (a)"Because the proved identification of writing movements made with the right hand in the air could only take place through an intact cheiro-kinaesthetic centre; (b) because of the patient's ability to copy with comparative ease words or letters with the right hand; (c) because the existence of a hemianopsia is more in accordance with the presence of a lesion in the neighbourhood of the visual word-centre than of one situated in the foot of the second frontal convolution or thereabouts; (d) because he was able to draw geometrical figures and even the outline of a man with the right hand when bidden, though he could not write letters or words".*

Of these four reasons I would say: (a) the reaction to direct sensory impressions is not a proof that a word-centre is intact; (b) copying was done with difficulty and not with "comparative ease"; (c) the patient was evidently syphilitic and so

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* Bastian :. aphasia p. 251

there may have been more than one lesion: a hemianopsia-producing lesion so far forward as to destroy the audito-visual commissure would probably also have led to pure word-blindness; (d) if the cheiro-kinaesthetic centre has a separate localisation it may be influenced by a stress which in no way affects other kinaesthetic centres.

It seems, therefore, that all the facts of this case point to a lesion in the neighbourhood of the left cheiro-kinaesthetic centre, either destroying the commissure C-D, or so lowering the activity of the centre itself that it responded only to direct sensory impressions.

When the stress falling upon the cheiro-kinaesthetic centre is not so severe as to abolish spontaneous writing, some interesting paragraphic defects have been observed. One of these is an inability to spell correctly when writing.

It seems reasonable to suppose that just as functional disturbance in the glosso-kinaesthetic centre may lead to a paraphasia which consists in an incoordination in succession of the sound-units of words spoken, so, functional disturbance in the cheiro-kinaesthetic centre may lead to a paragraphia which consists in an incoordination in succession of the letters of words written. I have suggested that an intact glosso-kinaesthetic centre may be important for the inner speech by reinforcing the subconscious auditory memories aroused in ideation and so making them vivid in consciousness; and it seems possible

that some such reinforcement of the visual word-memories may be effected by cheiro-kinaesthetic functioning during the act of mentally writing. I have also suggested that the revival in proper succession of auditory word-memories is facilitated by by incipient functioning of the glosso-kinaesthetic centre; and it seems possible that a similar influence may be exercised by the cheiro-kinaesthetic centre on the revival in proper succession of visual memories of the letter-units of written words. But neither in regard to reinforcement nor in regard to revival in succession is the cheiro-kinaesthetic centre as important as the glosso-kinaesthetic centre. We do not, as a rule, mentally write our thoughts, although we can do so; and it is a striking illustration of the influence of the kinaesthetic centres on the auditory and visual word-centres that just as when we speak mentally we "hear" our own voice, so, when we write mentally, we "see" our own writing.

The following case, recorded by McConnell*, shows how a stress falling gradually upon the cheiro-kinaesthetic centre leads at first to mistakes in spelling and other paragraphic defects, whilst later it produces almost complete agraphia.

A man aged 28, right handed, had an illness which was ushered in by general convulsions, at long intervals, with loss of consciousness. In the course of the next few years these convulsive attacks increased in frequency while they decreased in severity. On examination in May 1904 he showed no paresis or paralysis of any muscle or group of muscles of either the upper or lower extremities. He had neither static nor motor ataxia; all the movements of the arms and legs could be instantly and properly performed. There was some paresis and slight defect of sensation

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*McConnell:- University of Pennsylvania Medical Bulletin. Sep.-Aug. 1905. p.156

of the right face. Speech was very thick. The defect was "a paresis of the articulatory, enunciatory, and phonatory apparatuses rather than an aphasia due to lesion of Broca's region". He had no difficulty in reading print, writing, or numbers, or in recognising and correctly naming objects. He was asked to write, but the specimen was largely a series of meaningless strokes. The pencil was properly held and well managed, but efforts were fruitless. The result was the same on attempts at spontaneous writing or from dictation. Writing from copy was practically perfect.

A letter written two years before coming under observation showed omissions, faulty spelling and formation of words and letters in one part, which words were elsewhere spelled correctly or the letters properly formed. Specimens of later date showed an exaggeration of these conditions up to the point of complete inability to write.

On May 21st, 1904, he was operated upon and a tumour was found. "It lay across the foot of the second frontal convolution, encroaching somewhat on the lower half of the first, slightly upon the upper posterior portion of the third frontal convolution and the anterior edge of the precentral convolution."

The tumour was removed and a good recovery was made. Speech was immediately better, but the agraphia persisted for a time. On June 12th, 1904, "he wrote a letter of over a page, of good construction and almost perfect spelling."

This case, in its later stages, is a good example of low functional activity in the cheiro-kinaesthetic centre. That the centre was not destroyed was evident from the retention of ability to copy: and of course we know that after the operation recovery took place. Here, as in Gordinier's case, no mention is made of the power of reading by kinaesthetic impressions; but as "writing from copy was practically perfect", we seem bound to believe that reading by kinaesthetic impressions was also possible.

The interesting observation that the agraphia was preceded by a period during which his writing showed "omissions, faulty spelling and formation of words and letters...up to the point of complete inability to write" entitles us to ascribe to disorders

of the cheiro-kinaesthetic centre some other cases of paragraphia in which a failure to spell correctly is the only defect in connection with written language. Such a case is the following, which was recorded by Cremen.*

A man of intemperate habits, suffering from aortic and mitral disease, became aphasic without any paralysis of limbs. He improved very much during the next five months and was able to make himself understood fairly well, occasionally using one word for another. About eighteen months later he had another attack which again caused his speech to become very imperfect. His face was slightly drawn but there was no appreciable paralysis of limbs. Volitional speech was found upon examination to be much affected, evidently as a result of great amnesia verbalis. His understanding of spoken and written language was perfect. When given the first sentence of the Lord's Prayer, he repeated it through correctly. He could read aloud clearly and distinctly His spontaneous writing was absolutely unintelligible. The following is what he wrote as a history of his case: "Cork Molens.-- I noscent nountg ani ammbys gosisbyoyey imitwats yab I bet yas you me sent sml me good me much cocleped." He wrote his own name and residence accurately and could write numerals to any extent without dictation. When asked to write the word "just" he wrote "fugl", for "subject" "supfect," for "speak" "sery," for "found" "spunt." When asked to spell those words he did so accurately in every instance, and when asked why he did not write them he explained that he had forgotten how to make the letters.

The striking feature in this case is the retention of ability to spell aloud correctly words which were written wrongly; and there seems no way of accounting for the defect in writing words except by supposing it due to disorder of the cheiro-kinaesthetic centre. Indeed we should expect this retention of ability to spell aloud correctly to be exhibited by all paragraphic patients in whom the defect is due to disorder of the cheiro-kinaesthetic centre alone. Unfortunately no mention of this point is made in the records of Gordinier and McConnell.

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* Cremen:- Brit. Med. Journal. 1886 Jan 2. p. 14

In those cases of paragraphia in which words are spelt aloud in the way that they are written, as in Eskridge's case,† it seems more probable that the defect is in the visual word - centre. It is conceivable, however, that in some persons, at all events, visualisation of words is necessary for correct spelling aloud; that this visualisation of words is accompanied by incipient functioning of the cheiro-kinaesthetic centre; and that visual revival of the letters of a word in proper sequence depends on, or is assisted by, incitations derived from this centre. If such be the case functional degradation of the cheiro-kinaesthetic centre may lead to inability to spell aloud correctly, as well as inability to spell correctly when writing.

Such considerations may be of use in explaining some of those cases of paragraphia which takes the form of an intoxication with a letter or letters. A good example of this has been recorded by Bastian.*

The patient was a sailor who became a criminal lunatic in 1855. He was not hemiplegic, but there was a certain amount of dementia, together with some slight impairment of speech and an utter inability to express himself in writing. When his peculiarity of writing first manifested itself, he commenced the writing of each word correctly, and then in place of the remaining letters he wrote "ffg". Later there was a tendency to duplication of many of the consonants, together with an almost invariable termination with the letters "ndendd" or at least "endd".

His mode of reading agreed with his mode of speaking rather than with his peculiar style of writing; on the other hand he spelt a word in the way in which he would write it, and then pronounced it correctly immediately afterwards.

Bastian says that in this case "the act of spelling was

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*Bastian :- Aphasia, p. 227.

† Eskridge :- see page 267.

apparently modified by simultaneous revivals in the cheiro-kinaesthetic and in the visual word centres."*

At the begining of the paragraphic condition this patient "commenced the writing of each word correctly, and then in the place of the remaining letters he wrote 'ffg.'" This would appear to be analogous to the defect of speech noted in Krauss's patient who, before speech became quite unintelligible, could speak correctly the first two or three words of a sentence, whilst the remaining words were "an unintelligible jumble, as if spoken in a strange language".† The speech defect in this case we know to have been due to glosso-kinaesthetic damage; and it seems highly probable that the defect of writing in Bastian's case may have been due to some similar perversion of function in the cheiro-kinaesthetic centre.

But it must be admitted that the possible sources of paragraphic defects are many; and the more we keep our minds open to these possibilities the more difficult does it appear to be to feel sure of the site of the lesion in any particular case. If the path for spontaneous writing is A-C-D, or, perhaps more accurately (A-B-A) - (C-D-C) - D-d, it seems possible for disturbance of any part of this path to cause defects of writing, the source of which it may sometimes be impossible to determine with any certainty.

The same conclusion has been arrived at by Déjerine, Mirallié, and others, upon different grounds. They do not admit a writing

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* Bastian:- Aphasia. p 227. note 2.
† Krauss:- American Journ. of the Medical Sciences Sept 1904. p. 397

centre into the "zone of language"; but they recognise that defects of writing may result from destruction of any part of this zone. Writing being the last form of language to be acquired by the race and by the individual its dissolution will be the earliest feature of any disturbance of the faculty of speech as a whole; and in recovery from disorders of any part of the speech-zone the defects of writing will be the last to disappear.

This conception is of great importance even although we do not agree with these writers in denying the existence of a writing centre. It may be that the functional unity of all the word centres is such that a stress falling upon any one of them or on any of their connections one with another, acts not only locally but also as a stress falling upon word-memory in all its forms; and that, in accordance with the law of dissolution, the memories which are the first to disappear and the last to be recovered are those which have their neural substrate least deeply organised.

Chap. ix.

MUSIC-MEMORIES AND THEIR DISSOLUTIONS.

It is highly probable that the centres in the brain which subserve the memories of auditory, visual, and kinaesthetic impressions of music, have relations one to another which are closely analogous to those which subsist between the different word-centres. There is an auditory centre for tones and there is a kinaesthetic centre for the movements employed in the pro - duction of tones by the vocal mechanism: there is a visual centre for musical signs - notes - and there is a kinaesthetic centre for the movements employed in the writing of musical score. The evidence afforded by clinical observations tends to show that each of these four music-centres is topographically separate from, although in close juxtaposition to, the corresponding word-centre.

Memories of music, unlike word-memories, are not a common possession of the race. Music, having only an aesthetic value,

has been of little importance in the struggle for existence; and it is not surprising that we should find great individual differences in respect to this endowment. There are some people whose auditory centres are so constituted that they are absolutely incapable of distinguishing one tone from another. On the other hand, those who are naturally gifted with a "musical ear" can readily distinguish between tones of different pitch: they can remember them and they can produce them by the vocal mechanism or by means of a musical instrument. Again, just as many people who can speak cannot read or write, so many people who can sing are ignorant of musical notation. It is thus evident that in investigating a case of disorder of music-memories, a knowledge of the previous powers of the patient is even more important than in cases of speech disturbance.

There is one feature of music-memories which needs to be kept constantly in mind when comparing dissolutions of these memories with dissolutions of word-memories. We utilize our memory of words to give expression to our own original thought; but only a select few utilize their memories of tones to produce original melodies in the way that they utilize their memories of words in spontaneous speech.

A melody is a sequence of tones of varying pitch, grouped together with certain qualities of time or rythm; and the ability to appreciate and remember melodies may be said to be ultimately dependent on a "sense of pitch" and a "sense of time or rythm".

The latter is a far more common endowment than the sense of pitch. Intimately bound up, as it is, with the development of the sense of hearing, a sense of rythm is almost universal; and people who cannot distinguish one tone from another can appreciate, remember, and reproduce the rythm of a simple melody.

Memory of a melody is memory of a sequence of sounds learnt; and here, as in the case of sequences of words learnt, I would insist on the importance of kinaesthetic centres as links in the chain of association. Here, also, is found the importance of kinaesthetic functioning as a means of reinforcing auditory revivals. There would seem to be little room for doubt that memories of melodies are primarily evoked as sound-representations; although Stricker maintained that in his case memory images of music are almost entirely motor representations.

In the auditory representation of a melody incipient kinaesthetic functioning almost always necessarily occurs, as was shown to be the case in regard to auditory representations of word-sequences; and there is some evidence to show that such kinaesthetic functioning has considerable importance in regard to the revival of the tone-sequences in due order, and in regard to the greater vivacity of auditory representation thereby effected.

Marie Jäell relates some experiences which confirm this view. Having been in the habit of exercising the fingers by means of a mechanical contrivance - un accélérateur du toucher - she had, one day, at the end of the exercise, a distinct feeling of the

muscular movements employed in performing a scherzo of Mendelssohn which she had not thought of for many years and could not voluntar-ily recall. The impression lasted for half a second and was so vivid that she had the illusion of an instantaneous auditory perception of the musical work. This work became suddenly so present in her mind that she did not doubt but that she could play it by heart after this sudden revelation of the muscular movements necessary for its interpretation. She immediately sat down at the piano and played, at an extremely rapid pace from the begining to the end, this work which for years she had in vain tried to remember, which she had, as we say, forgotten.*

This writer finds the mental representation of a sequence of tones greatly facilitated if accompanied by kinaesthetic representations of the movements necessary for producing them on the piano, and even observes a distinct improvement in the timbre of the sounds mentally heard under these conditions.†

As in the case of word-memory, the co-ordination in succession of words in spontaneous speech or thought is but little affected by kinaesthetic revivals, so the co-ordination in succession of tones in musical composition is but little affected. But the auditory representations are rendered more vivid in the one case as in the other.

It is said‡ that Liszt, when composing, was accustomed to place his hand on the writing table with his fingers in the actual position of playing the notes which he wished to write. When so

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* Marie Jaëll:- La Musique et la psychophysiologie. Paris 1896. p 123

† Ibid: pp 125-127 ‡ Ibid: p 126

doing he seemed to make an effort of attention, as if he were listening, and then appeared to approve or disapprove of the musical combination thus examined. So, Marie Jaëll says of herself: "All musical thought manifests itself with more penetration when, to the harmonies and to the melodies thought, I join the sensations of the muscular functioning by which I would transmit them to the piano." *

Just as, in skilled musicians, the auditory representation of complex combinations of tones may be intensified by the reinforcement derived from the kinaesthetic centres concerned in the instrumental production of such combinations, so, in the ordinary person who has an ear for music and can sing simple melodies, the recall of any musical air is inseparably bound up with the kinaesthetic revivals which are necessary when the air is produced by the vocal mechanism. The clear auditory representation of a melody is impossible to most people if they do not mentally sing the melody; and mentally singing it implies incipient functioning of the kinaesthetic tone-centre.

Dissolutions of music-memories.

We are not yet in a position to describe with any certainty the disorders of memory which may result from destruction or from functional degradation of the auditory and kinaesthetic tone-centres and of the visual centre for notes. All that we can do is to examine some of the cases that have been recorded

* Marie Jaëll:- op. cit. p126

in which there has been some disturbance of the musical powers, and to endeavour to form some conjecture as to the nervous mechanism concerned.

Disorders of the memories of music have generally been found associated with defects of speech; and it is very commonly observed that when one of the word-centres is destroyed the corresponding music-centre is also affected. On the other hand some of the most interesting cases are those in which although there is some marked defect of speech. the musical powers are retained and the production of words in singing is better than in speech. These will be considered in some detail; but in the meantime I wish to look at some of the cases in which, with or without defect of speech, there has been some defect in the reception or production of music in persons previously musical.

At present we know nothing of the effects of functional degradation of the auditory tone-centre. If it ever occurs it ought to cause an amnesia of tones analogous to amnesia verbalis, and, consequently, defects in the voluntary production of tones. The repetition of tones heard and singing at sight might be retained. It is here, however, even more difficult than in amnesia verbalis to be sure that the defect may not be in the kinaesthetic centres.

When the auditory tone-centre is destroyed tone-deafness results: amusia* should also be produced. The following case of tone-deafness has been recorded by Edgren.

* used in the same sense as I have used the term aphasia: i.e. as a fault of production.

An intelligent and musical man, aged 34, developed tone-deafness eighteen days after an injury to his head. He told his wife that he had been unable to make out the tunes played at a place of public amusement. He had gone to several to test himself. He could hear only indistinct sounds, and was unable to make out any melody; he could not even distinguish between a march and a valse or polka. When his wife spoke to him he did not understand her. The word-deafness and other aphasic symptoms disappeared within a month, but his tone-deafness remained unchanged till his death from purpura three years after the accident.

At the autopsy the following changes were noted. In the left hemisphere the anterior two-thirds of the superior temporal gyrus and the anterior half of the middle temporal gyrus were destroyed. At the junction of the posterior and middle thirds of the superior temporal gyrus the surface was sclerotic and adherent to the thickened pia. Under this sclerotic patch and for about 1cm behind it in the first temporal gyrus the softening was continued in the grey matter, but with decreasing depth. In the right hemisphere a similar condition was found affecting the superior and external surface of the superior temporal gyrus in its posterior half and the lower edge of the supra-marginal gyrus for a similar distance. The destruction had spread to the white matter which was softened to a much greater extent than the grey.*

Relying chiefly on this case Edgren* locates the auditory tone-centre in the first and second temporal gyri immediately in front of the auditory word-centre.

It is noteworthy that in this case not only was there a total loss of the power of discriminating one tune from another, but the sense of time was also so defective that the patient could not distinguish between a march and a valse or a polka. The sense of musical time being more primordial than the sense of tune we may conjecture that in cases in which the dissolution of auditory memory is not so great the sense of tune may be lost while that of time may be retained.

In a case recorded by Bernard complete tone deafness was associated with aphasia; and at the autopsy the whole of the

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* Edgren:- British Medical Journal Dec 22. 1894. p 1442.
and. Amusie:- Deutsche Zeitschrift für Nervenheilkunde. Vol VI 1895.
p 41. Cont 2

left superior gyrus was found to be destroyed while the right hemisphere was healthy.* It seems probable then that the auditory tone-centre like the auditory word-centre is most important on the left side; but up to the present time there is but little independent evidence in favour of Edgren's localisation.

Tone-deafness has been found in conjunction with pure word-deafness. In such cases, if the tone-deafness be also "pure", the spontaneous production of tones should be possible. In all cases conforming clinically to the type of pure word-deafness which have been followed by autopsy. both temporal lobes have been affected. In Pick's case, in which the power of recognizing melodies appeared to be lost. the anterior part of the left superior temporal gyrus was unaffected, but the whole of the corresponding convolution on the right side was softened. In a case recorded by Serieux. which showed the symptoms of pure word-deafness the production as well as the recognition of melodies was abolished, and in this case the anterior portions of both temporal lobes were affected.†

When the spontaneous production of tones is faulty while there is no tone-deafness. it is possible that amnesia of auditory tone-memories may be the cause. It would seem likely, however, that the defect may sometimes be due to faulty kinaesthetic action rather than to faulty auditory revival. When, as in the following case, recorded by Kast. the attempt to repeat tones

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* Bernard:- de l'aphasie . p. 147.

† Serieux:- Comptes Rendus de la Soc de Biol. Dec 18. 1897. p 1074. and Revue de Med. 1893. p. 733

heard and appreciated is faulty, the probability of the disorder being in the kinaesthetic tone-centre is increased.

The patient, who was aphasic, was before his illness a prominent member of a musical society in his native place. Attempts to sing or to repeat simple melodies were very faulty. "He always showed that he could get the rythm of the correct melody and he also knew the value of every note, though he sang throughout false tones, and with false intervals, and that in spite of the fact that he was evidently conscious of his defective musical capacity, and consequently not easily induced to lend himself to further experiments. An attempt was now made to get him to repeat tones, and here too considerable disturbance was apparent, although he recognized the falseness of the tones which he produced and manifested considerable anger thereat. When, however, the patient was got to give me tones which I had to reproduce he remarked the smallest error, corrected me with a loud "Nein, Nein", and was only satisfied when the correct sound was given. He recognized all the melodies and songs which were sung to him, and expressed his dissatisfaction if songs he knew were sung incorrectly. *

The difficulty which this patient had in repeating tones heard and appreciated points to the lesion being in some part of the path between the auditory tone-centre and the motor tone-centre in the bulb. Knoblauch compares it with the paraphasia which, according to Lichtheim, may be produced by destruction of the commissure A-B. Bastian thinks such cases ought perhaps to be classed with incomplete aphemia due to lesion of the path B-b. My own impression is that the symptoms may be due to some functional degradation of the kinaesthetic tone-centre, just as corresponding paraphasic defects may be due to disorder of the glosso-kinaesthetic centre.

In a case of aphasia briefly referred to by Proust, the patient could read and write musical notes, could recognize

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Kast:- Münch. med. Wochensch., 1885. No 44. p 62

(Quoted by Knoblauch: Brain. 1890. p 333.)

melodies sung to her, and could even compose music; but she was unable to sing a melody which she herself had composed.* It is open to question if such a condition should not be classed with cases of infra-pictorial aphasia due to subcortical lesion, rather than with cases of Broca's aphasia. We must suppose that as a rule the mental singing implied in composing a melody necessitates the integrity of the kinaesthetic tone-centre. In a trained musician, however, the kinaesthetic centres concerned in the production of instrumental music may suffice to make vivid in consciousness the sequence of auditory representations.

We have not very many records of disturbances of the visual memory for notes; but there is some evidence to show that such disturbances may occur with or without word-blindness. Finkelburg† tells of a patient who was note-blind but could play from memory or could repeat music which he heard sung or played by another. Charcot‡ refers to the case of a colleague whose first symptom of aphasia was an inability to read music although he could play from memory quite well.

When note-blindness is due to destruction of the visual note-centre there must be agraphia for writing musical score; but a form corresponding to pure word-blindness may be met with. Proust has referred to an instance of this kind. The patient was able to compose and write musical notes but was quite unable to read them.§

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* Proust:- archiv. Général. de méd. t.xix. 1872, p.310. (De l'aphasie)

† Referred to by Bernard:- De l'aphasie p.108. ‡ Ibid., p.108

§ Proust:- archiv. Gén. de méd: 1866 (quoted by Bastian. Aphasia. p.295)

Although not strictly pertaining to dissolutions of music-memories, it is convenient here to examine those cases in which the musical powers are retained while speech is defective, and to consider the modifications of the aphasic state which may result from such retention. It has often been observed that patients who cannot speak are able to hum or to sing to some monosyllable well known airs. Bernard refers to three cases of aphasia in which this condition has been noted.* A patient of Behier was aphasic and could utter only the syllable "tan" but was able to sing the Marseillaise and the Parisienne repeating only this syllable instead of the words of these songs. One of Charcot's patients sang the melody of the Marsellaise with only one guttural sound, the only sound he could utter. Bouillaud tells of a patient who could hum very correctly a tune which he had composed and written during his illness.

Such cases may be explained by supposing that the aphasic condition is due to destruction of the glosso-kinaesthetic centre while the kinaesthetic tone-centre has been uninjured. If we depict the relations of the auditory and kinaesthetic centres for words and tones diagraphically, the auditory tone-centre α may be placed close to the auditory word-centre A; and the kinaesthetic tone-centre β close to the glosso-kinaesthetic centre B. Further, α must be joined to β by the commissure $\alpha - \beta$ just as A and B are joined by A-B. In Broca's aphasia the path $\alpha - \beta$ may be

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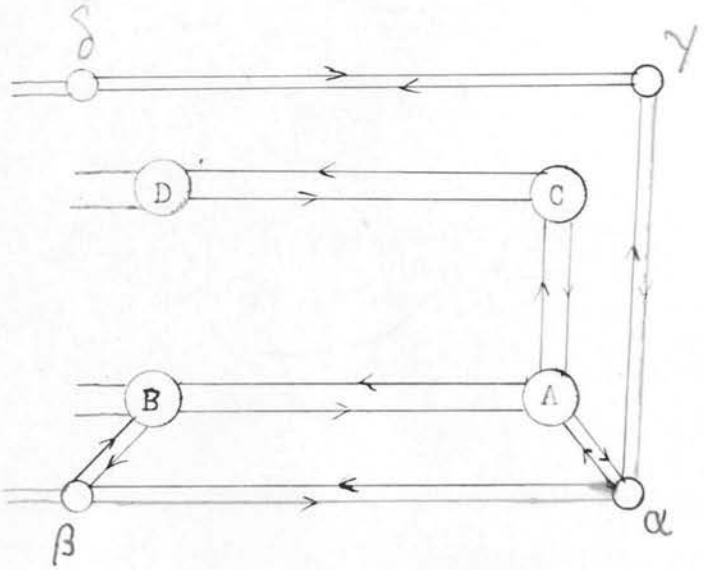
* Bernard:- De l'aphasie pp. 180-181.



Scheme of the music-centres.

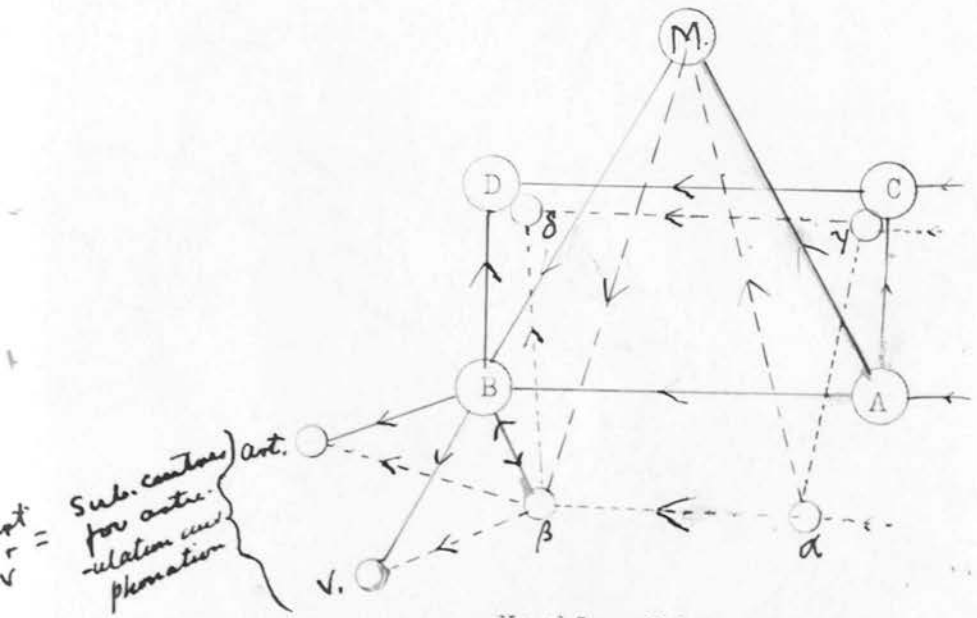
A, B, C, and D, are the four word-centres.

α . The auditory tone-centre

β . The kinaesthetic tone-centre.

γ . The Visual centre for notes.

δ . The kinaesthetic centre for writing music.



Knoblauch's scheme (modified). Brain 1890. p. 328 Fig 4. and p. 339. Fig 8.

intact and so the production of a melody without words rendered possible.

There is, however, a second group of cases in which the explanation is by no means so simple. In this group are found patients more or less completely aphasic for all forms of speech who are nevertheless able when singing to articulate correctly the words of some well known song. How such a condition is to be accounted for is not definitely known, and unfortunately, the rare instances in which a post-mortem examination has been made have not, in any way, illuminated the problem. One of these cases was recorded by Gowers.* A patient who, as the necropsy revealed, was suffering from destruction of Broca's convolution, and who was able to use only the words "yes" and "no", hearing, one day, another patient in the ward singing "I dreamt that I dwelt in marble halls", joined in and sang the second verse alone, articulating every word correctly. This case is very difficult to understand, and we seem bound to suppose, as Gowers suggests, that the glosso-kinaesthetic centre in the right hemisphere must have been the source of the articulated words.

Bernard has described a somewhat similar case in which the lesion found after death is still more difficult to reconcile with the symptoms observed during life.†

The patient was a teacher of music who became aphasic three years before she was seen by Bernard. By this time her speech had recovered considerably but she still had difficulty in expressing herself. There was marked amnesia verbalis and hesitation in

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* Gowers:- Diagnosis of diseases of the Brain. p 133. (2nd Ed. 1887.)

† Bernard:- De l'aphasie. p 108

speech. She was known in the ward as la Dame blanche, because she was fond of singing the celebrated song:-

"La dame blanche vous regarde
"La dame blanche vous entend".

The words of the song were distinct and the air exactly repeated. She showed no trace of word-deafness and she could repeat correctly any word that she heard. She was partially word-blind and completely note-blind.

At the necropsy a large "plaque jaune" was found on the external surface of the left hemisphere, involving the upper half of the insula, the middle and posterior portion of the three frontal convolutions and the lower fourth of the ascending frontal. A prolongation extended backwards to the posterior extremity of the Sylvian fissure. At the inferior angle of the superior parietal lobule another small plaque was found.

If we can believe that the pathological conditions found after death existed at the time when the clinical record was made, there seems no explanation of this case except by supposing that the articulation of words was effected by the right glosso-kinaesthetic centre. The aphasic symptoms recorded do not, however, correspond to those met with in Broca's aphasia, but point rather to functional degradation of the auditory word-centre. And this, indeed, has been the condition in almost all cases in which words have been articulated well in song while speech has been defective.

It has been very commonly believed that most of these cases have been aphasias of Broca's type; but this is probably due to the long-standing belief that loss of speech necessarily implies destruction of Broca's convolution. Now that we know more as to the speech defects which may be brought about by disorders of the auditory word-centre, it would seem that a different interpretation may be put upon those cases of aphasia in which words can

be used in singing.

Bastian supposes that in many of these cases the speech defect has been the result of functional degradation of the auditory word-centre;* and that under the strong associational stimuli derived from an undamaged auditory tone-centre, words could be recalled in singing which could not be aroused spontaneously in the absence of such stimuli. Acording to Bastian then the path for volitional singing is $\alpha \overset{A-B}{\frown} \beta$. The melody is effected through $\alpha - \beta$ while the use of the words is brought about through α -A-B.

Notwithstanding the evidence of cases like those of Gowers and Bernard, we are, I think, bound to believe that, in singing, the articulation of words is, as a rule, controlled by the glosso-kinaesthetic centre just as in ordinary speech or recitation; and that if Broca's convolution is destroyed, the singing of words is impossible. Knoblauch, who believes these cases to be examples of "motor aphasia" supposed that the "motor speech centre" is connected with the"motor tone-centre"and that each of these centres is connected with sub-centres for articulation and phonation. In the event of the tone centre escaping while the speech centre is destroyed, he thought that these sub-centres may be aroused through the tone-centre so as to lead to the correct production of words in singing.†

Although there seems no need to introduce these postulated sub-centres, there is nevertheless much to be said in favour of

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* Bastian:- Aphasia p. 287.

† Knoblauch:- On disorders of the musical Capacity from cerebral disease. Brain 1890. pp. 325-328.

Knoblauch's opinion that an association between the centres β and B is a most important bond of union between tones and words produced in singing. This is especially true of songs which have been often sung, and, consequently, have been well learnt. The kinaesthetic memory of the sequence of articulatory movements is deeply organised in the case of a well known song; and each kinaesthetic tone-memory is strongly associated with its corresponding kinaesthetic word-memory. If, then, the auditory word-centre is so much damaged that it is not able to respond to incitations coming from the auditory tone-centre, kinaesthetic tone representations aroused by an intact auditory tone-centre may suffice for kinaesthetic word-revival through the path α-β-B. This is the interpretation which I am inclined to give of such a case as that which Knoblauch recorded in his paper.*

A child, 6 years of age, suffering from scarlatinal nephritis, was seized with convulsions which were followed by right hemiplegia and aphasia. She could not speak at all at first. Later she said "Mamma", and apparently repeated a few words. She could sing the song "Weisst Du wie viel Sternlein stehen", but she could not recite the text of the song, or speak voluntarily single words of the same. On examination it was found that she could repeat a few words but very imperfectly. "If one commences the song "Weisst Du wie viel Sternlein stehen", she sings it with the right melody in an automatic way, being unable either to continue or to begin afresh when she once stops. All the words of the text which she is unable to pronounce spontaneously are, while she sings them, articulated perfectly. The comprehension of spoken language is quite normal".

This patient was first seen on Feb. 8th. On Feb. 21st she was able to repeat most words correctly, with considerable trouble it is true. She could count up to three if some one started her with "one". In the begining of March she was able to sing the song "Weiss Du wie viel Sternlein stehen" quite alone. On the 8th of March she was able to recite the text of the song without singing the melody. By the begining of April she had acquired a considerable vocabulary and even attempted to form small sentences.

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* Knoblauch:- Brain 1890. p 318.

Knoblauch believes this to be a case of motor aphasia; but as Bastian has pointed out,"no really aphasic patient attempts to repeat words and succeeds as this child did".* Bastian thinks it "may well have been a case of partial damage to the auditory word-centre, causing the centre to be unable to respond to voluntary incitations, and leading to imperfect utterance at first, unless the auditory word-centre was under stimulation from the auditory tone-centre."* But it may be questioned if an auditory word-centre so much damaged as to prevent the repetition of words heard could be stimulated to action by the auditory tone-centre. It seems more probable that the block in the speech path was too great to be overcome in this way; but if the path $\alpha - \beta$ was intact, the stimulation of the kinaesthetic tone-centre may have been quite sufficient to revive the kinaesthetic word elements which had become, by frequent repetition, well organised and intimately associated with their corresponding kinaesthetic tone elements.

Evidence that the glosso-kinaesthetic centre is not destroyed in such cases may sometimes be found in the retention of ability to recite sequences learnt, such as the alphabet, numerals up to twenty, or the days of the week, as has been pointed out when treating of paraphasic defects.

In a case recorded by Bastian† in which there was word-blindness and, for a time, word-deafness, voluntary speech was almost abolished although articulation of words when singing was good.

"The only words she uses voluntarily are "no", which she uses correctly, and "Bull",the name of the patient next to her. If the

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*Bastian:- aphasia p.289. †. Ibid. p.291.

alphabet be repeated slowly to her she joins in and will continue to repeat it alone correctly. Sometimes, however, she makes a mistake, shakes her head and says "no", and cannot continue until she is started afresh. When started by counting aloud, she can count up to twenty alone, with some defects of articulation, such as "en" for "ten".....She cannot repeat a single word after me... ....She can sing a tune to order. She commences humming and then joins in with the words, many of them perfectly articulated, some of them badly articulated, and in the place of others mere lalling." In a specimen given, the second line of the hymn "Hark, Hark, my soul" was rendered thus:

"O'er earth's green eas(seas), and ocean's nave mint ore" (wave beat shore).

She could recite the words of hymns if once started, but her articulation was not so good in recitation as in singing.

I think the evidence in this case afforded by the ability to repeat sequences of words which had been well learnt, is strongly in favour of the view that the glosso-kinaesthetic centre was not seriously damaged.

Faults of articulation in singing are of course very common in aphasic states, and, when excessive, are according to Mirallié,* indicative of "sensory aphasia". He says that while the motor aphasic articulates better in singing than in speaking, in sensory aphasia, on the contrary, the patient has paraphasia and jargon aphasia in singing as in speaking. As an example he refers to a patient who, on being made to sing the Marseillaise, used the following words:

"Il grand trafa en la fatrie
Il était tant son des roci." †

In another case of sensory aphasia, however, the words were fairly correctly given in singing while paraphasia was well marked in speech.‡

Mirallié:- De l'aphasie Sensorielle. p.44.
† Ibid. p.159. ‡ Ibid. p.188.

But there is no undoubted evidence to show that a patient suffering from Broca's aphasia can sing words better than he can speak them: on the contrary, it is probable that the retention of ability to sing words may be taken as a proof that the third left frontal convolution is not destroyed. The differences met with as to the perfection or imperfection of articulation of the words in singing may be explained in various ways. According to the view of the mechanism of song production in aphasic conditions which I have suggested, such differences will depend chiefly on the depth of imprintation of the kinaesthetic memory of the sequences of words and tones. If in the previous life of the patient a song has been sung so often that its production has become automatic, then its articulation should be good. If, on the contrary, the patient, although musical, has not been in the habit of singing frequently any particular song, the associations necessary for its correct automatic production will not have become organised and the words used may be as Mirallié says, "forgés de toutes pièces ou détournés de leur sens".

In the present state of our knowledge we have reason to believe that if the glosso-kinaesthetic centre is destroyed the articulation of words is as impossible in song as in speech. If it can be shown that words can still be articulated in singing when Broca's convolution is destroyed, we seem bound to believe that the articulation is then effected through the glosso-kinaesthetic centre in the right hemisphere.

Chap. x.

SUMMARY AND CONCLUSION.

In the preceding pages I have endeavoured to apply the Law of Dissolution to the various phenomena observed in disorders of word-memory. In doing so it has been necessary to enter into some detail concerning the evolution of speech processes in the individual, and to consider the relations of the different forms of word-memory one to another and to thought and speech.

The conclusions arrived at are based upon certain doctrines in regard to the nature of that inner speech which is the necessary accompaniment of all conceptual thought. And the opinion has been expressed that however dissimilar may be the results of introspection in particular instances, there is reason to believe that the neural processes underlying the use of words in spontaneous thought and speech are essentially alike in all normal persons; and that the varieties of endophasia made manifest by the method of introspection express differences of nervous

organisation which are more apparent than real.

Regarding auditory word-memories as forming the true material of our recollection in the use of words, and as being the first form of word-memory to be evoked in thought and speech, we seem bound to repudiate the commonly accepted doctrine that excitation of Broca's convolution is ever the primary endophasic process. Yet there are grounds for believing that auditory revival may be modified by kinaesthetic functioning; and I have suggested that memories of sound-sequences may be more readily and more accurately revived if they are reinforced at each instant by stimuli passing backwards from the kinaesthetic elements whose excitement they themselves have induced.

The main conclusions arrived at in regard to dissolutions of word-memory may be summed up in a few words.

(a) When a stress falls evenly upon the auditory word-centre amnesia verbalis is the earliest manifestation of dissolution. It affects first the memory of foreign languages; then, in succession, proper nouns, substantives, and the more general parts of speech, in the native language. If the stress becomes more severe a word-deafness to foreign languages precedes a deafness to nouns in the native language, and this leads on to complete word-deafness. In recovery the opposite order is observed.

Just as amnesia of nouns produces aphasia so far as nouns are concerned, so, complete amnesia of words produces complete

aphasia. And the fact that destruction of the first left temporal convolution does not always, or indeed generally, produce aphasia shows that the site of registration of auditory word-memories occupies a greater extent of the cortex than is generally believed.

(b) Destruction of the glosso-kinaesthetic centre causes practically complete loss of uttered speech. It may also account, in some cases, for the amnesia verbalis and the agraphia often found associated with Broca's aphasia.

There is not much evidence regarding the effects of slight stress falling upon the glosso-kinaesthetic centre. It is possible that some cases of amnesia verbalis may result in this way. Paraphasia may be produced by disorder in the auditory word-centre, or in the glosso-kinaesthetic centre, or in the commissures between these two centres. Failure in the production of particular sound-units of speech may be due to affections of Broca's convolution.

(c) The first effect of stress falling evenly upon the visual word-centre should be manifested by disturbance of spontaneous writing; but it is doubtful if any recorded case can be adduced in support of this contention. More severe stress interferes with the power of reading. The defect may take the form of an apexia which simulates true word-blindness.

Destruction of the visual word- and letter-centres entails

complete alexia and total agraphia: all modes of writing are impossible. Ability to spell may be retained.

Pure word-blindness interferes with the reading of words by sight, while reading by kinaesthetic impressions is retained, and spontaneous writing and writing from dictation are not affected. When there is no letter-blindness reading by spelling the words aloud may be possible. Copying and "writing" by means of separate block letters are possible only when there is no letter-blindness.

There is no sufficient evidence to lead us to believe in the existence of a type of pure word-blindness in which the visual word-centre is destroyed.

(d) A cheiro-kinaesthetic centre exists: most probably in the foot of the second frontal convolution. Its complete destruction entails complete agraphia and inability to read by kinaesthetic impressions. In low functional degradation of the centre ability to read by kinaesthetic impressions may be retained while copying is difficult and spontaneous writing impossible.

Slight stress falling upon the cheiro-kinaesthetic centre may produce an inability to spell correctly when writing: in some cases even ability to spell aloud correctly may be interfered with.

(e) The evidence in support of the law of dissolution when applied to loss of music memories is very scanty; but we may

believe in the possibility of different degrees of impairment of receptive and productive processes analogous to those that obtain in regard to word-memories.

Some interesting problems arise in connection with the retention by aphasics of ability to articulate words when singing; and the importance in this connection of glosso-kinaesthetic memories of word-sequences well learnt by frequent repetition has been pointed out.

The attempt to bring all forms of amnesic disorder under the one great law of dissolution necessitated some conjectures regarding possible stages of functional degradation which may never have been manifested by amnesic patients. And the reader may have felt that no good purpose can be served by indulging in speculations so remote from practical needs. Yet the application of the principle of continuity in the investigation of natural phenomena has rendered such good service in every domain of scientific labour, that we cannot doubt that its comparative barrenness in the realm of mental disorders has been due to our ignorance of the evolution of mental life and our imperfect methods of observation when dissolution of its physical substrate supervenes, rather than to any failure of the principle when applied to the phenomena of such morbid states. And any attempt, however faulty, to bridge over the gaps in our

knowledge by hypotheses based upon principles of such universal application may be of some ultimate value, although these hypotheses themselves be untenable in the light of further investigation; for, as Lichtheim says, "even erroneous assumptions may prove of advantage in the search for truth."*

* Lichtheim: on aphasia, Brain. 1885, p484.