Remarks

ON

SOME AFFECTIONS OF SPEECH.

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DR. THOMAS, Assistant Medical Officer (Education) of the London County Council, relates a number of interesting examples of speech defects met with in children.

In one series it is chiefly in reading that the difficulty occurs. An intelligent boy of 7 years old cannot remember how to make l, p, y, g, that is, cannot reproduce the written or printed characters representing the articulate sounds, and reads "It has three birds in it" as "To see best in to," that is, he cannot reproduce the articulate sounds represented by the printed words. On the one hand, he cannot translate auditory impressions or perceptions into visual representative characters, and, on the other, cannot translate visual symbols into the appropriate articulate sounds. He recognized words if they were spelt to him; he did difficult sums in mental arithmetic, and when 11,308 was written in numerals gave the number in words.

Another boy could not read the smallest words. Said "chair" spelt "sister"; made serious mistakes in writing from dictation; did not copy correctly. He, also, calculated correctly, and was said to "know all his letters," that is, I suppose, could name them, or perhaps could say the alphabet.

A third boy, of 11, good at arithmetic, smart, ready, and trustworthy, spells out "girl" as "vice"; cannot read "mouse," though he recognizes each letter; writes from dictation "a pen and ink" as "a gen and inck." It may be accidental that the two words which he bungles are nouns, while "and," which has the same number of letters, he writes correctly.

These, with a case which has come under my notice, afford an opportunity of discussing the terms "word-blindness" and "letter-blindness," and appear to me to be worthy of consideration as bearing upon the mechanism of speech and thought.

My case is as follows:

I was informed that a boy of 14, of superior intelligence, was kept in a lower class at school because he could not read aloud, and that his prospects in life were likely to be injured by his not reaching the proper standard.

I found him to be remarkably alert intellectually, fond of reading, particularly adventures and travels, full of information, ready and apt in conversation, and altogether a very interesting boy. He could not explain his difficulty in reading aloud. I gave him two long and rather complicated paragraphs from the *Times* to read, and asked him to tell me what they were about. This he did readily and clearly. I then asked him to read them aloud. His face at once took on an expression of anxious effort. He did not read even short words fluently, but uttered two or three with the slight hesitancy and uncertainty of a beginner, and was then brought to a standstill for a moment by some longer word, not because it was difficult or unfamiliar, but apparently as if he had to grasp its meaning and pass it through his mind for utterance. Sometimes it seemed as if he were on the point of substituting another word (Dr. Thomas's boy No. 1, when shown the word "buds," read it "branch," which looks like an intellectual substitution).

There was here clearly no word-blindness in the true sense of the term, since that is a purely sensory defect, and this was a motor failure, not a sensory defect. Words printed or written reached his mind with normal readiness, and were perfectly understood. There was no fault in the mechanism of speech or intellectual expression, to employ the excellent term introduced by Hughlings Jackson. The afferent and efferent paths, and the sensory and motor centres concerned in language as an intellectual process, were intact. It was utterance in one particular respect which was interfered with—the translation of visual characters into the articulate sounds which they represented.

This boy ultimately gained the faculty of reading aloud fairly well, but with great effort, and when he read aloud

the attention was so concentrated on the task that he did not understand what he read.

Now this is not an intellectual operation properly speaking. We can read aloud quite easily an unknown language—it is a mere matter of putting into corresponding spoken words certain combinations of letters. No ideas reach the mind. So, again, we can read aloud, often with appropriate inflection of the voice and emphasis, while thinking something else all the time, and not at all realizing mentally the meaning of what we are reading. The same convolutions are not engaged in translating printed words into articulate sounds as are concerned in the intellectual recognition of the meaning of the word and its employment in the mental operation which ultimately find expression in speech.

A case closely parallel to this came under my observation in 1878, and was related in *Brain*, vol. i, 1878 9. The patient read his newspaper with great interest, and related the substance of paragraphs to the Sister of the ward and to the class, but when asked to read aloud, the result was a jargon which had no recognizable relation whatever to the words he was reading.

The printed words reached his mind and conveyed their meaning, but the cell and fibre mechanism by which the association between visual word symbols and the articulatory motor centre is effected was damaged.

In another case an old woman in reading aloud a familiar verse, which she understood perfectly well, always read it wrong, but differently every time; there was, however, some correspondence in length and sound between the words as she read them and the words of the verse.

Another case seen in 1871, and related in a communication to the Royal Medical and Chirurgical Society on the Mechanism of Speech and Thought,¹ corresponded more closely with Dr. Thomas's cases, supposing, that is, that boy No. 1, while still failing to name letters and to read aloud, did not learn the meaning of the words.

The patient, a very intelligent man, could not read either printed or written characters, except his own name. He could write letters to his wife, or from dictation, and took elaborate notes of my instructions, but could not read even what he had himself written.

The conception which I entertain of the mechanism of speech and thought is based on the functional and structural arrangements of the spinal cord.

Throughout the nervous system there is an afferent or sensory and an efferent or motor side. The sensory is everywhere and always the dominant side. All movements are in orderly response to sensory impressions; the sensory impression guides and governs the movement which it calls into action. The structural representation of this physiological fact is that sensory cell-groups arrange and combine the motor cell-groups which put into execution the dictates of the sensory impressions. Such motor cell-groups may be said to represent the words. In the cord the sensory and motor cell-groups execute reflex actions which may be extensive and elaborately co-ordinated.

At the next higher level the sensory impressions and movements are re-represented, to employ Hughlings Jackson's useful term, and undergo an intellectual elaboration. Impressions are translated into sensations, and the sensations, tactile and other, derived from the skin, muscles, and viscera, are co-ordinated with visual sensations in such manner that visual and tactile form and size correspond. The tactual centre may be said to educate the visual centre. The movements of the limbs and of the body generally are at this level brought, in some degree, under the guidance of visual sensations.

The spinal motor centres have been educated by the corresponding spinal sensory centres, and large and complex cell-groups have been formed representing extensive co-ordinated purposive movements. These groups are placed at the service of the visual sense-centre which can call into action and combine for a given purpose, under the guidance of vision, movements of the entire body and limbs. It may almost be said that the spinal motor centres concern themselves with muscles, while the visual centre directs movements. The second level in which the primary intellectual elaboration—the translation of impressions into crude sensations, and the organization of movements under the guidance of vision—takes place is, in my judgement, constituted by the great central ganglia,

the thalamus (sensory) and corpus striatum (motor). It is interesting to see that these two great masses of grey substance, which have long been almost ignored by neurologists, are being reinstated in their important position.

Another step in intellectual elaboration is perception, the recognition in consciousness of the external object to which the sensory impression is due. This is done separately for each sensation, and we have a corresponding number of perceptive centres, tactual, visual, auditory, gustatory, olfactory—all of them in marginal convolutions which are reached by radiating fibres ascending from the central ganglia, bulb and cord—each of which directs and controls motor centres, also situate in marginal convolutions and in relation with radiating fibres, which, however, are efferent. The movements of the body and limbs are under the joint control of the tactual and visual centres, the tactual perceptive centre being concerned in what may be called individual movements, the visual with general combined movements.

The auditory perceptive centre while in relation with the motor system generally and automatically for protective purposes, as when we start at a noise, or turn aside, or assume certain attitudes, has a special educational relation with the muscles concerned in speech. Words, as articulate sounds, are acquired by imitation; they can, to a certain extent, be so acquired by a parrot or raven. Articulatory motor cell-groups are organized in the left third frontal convolution under the guidance of sensory cell-groups in the auditory perceptive centre, the superior temporal convolution. Words are thus primarily automatic—percipio-motor processes only, parrot-like reproductions of articulate sounds. Words of an unknown tongue listened to and uttered are nothing more. Their employment as intellectual symbols, as having a meaning, as vehicles and instruments of thought, although taking place as the child is learning to talk, is another matter altogether.

In learning to read, the process is at first, while relating only to letters, almost more distinctly concerned with perceptions, as distinguished from ideas, and is more independent of intellectual operations, properly speaking, than that of learning to talk. In learning to speak, a double process is going on, for while the utterance of a name is gradually accomplished by the organization of a communication between auditory and articulatory cell-groups, the person or thing designated is before the child's eyes, and is associated in the child's mind with the name. The name comes to represent a mental image, and is not merely an articulate sound. The letters that a child painfully learns to associate with the appropriate sound do not raise any idea whatever in the mind. The process is simply the association of an arbitrary visual character with a given auditory perception. There is no natural connexion between the two, but an association is established by an effort of attention. The letter has to be repeated aloud again and again. The association between the printed character and the sound which it represents—between the visual impression and its auditory equivalent—is reinforced by the articulatory rendering of the sound which brings into action the imitative motor process. There is no such thing as a separate centre for letters as such; a letter is learnt when such an association is formed between the visual and auditory centres that the character seen at once suggests the particular articulate sound. This connexion may be established with difficulty and imperfectly, or it may be deranged by some lesion, so that the individual cannot name the letters shown to him. This has been called "letter-blindness"; but it is not a sensory defect at all—it is the result of an imperfect sensori-motor mechanism. A word made up of these very letters may convey an idea to the mind.

The sensory centre for printed or written words is the same as that for individual letters, and the translation of words into the appropriate articulate sounds in reading an unknown language is exactly the same process as learning the individual letters. It is the establishment of an association between visual characters and an already organized articulatory motor centre. It is on a level with parrot-like speech. But before the child is taught to read, spoken words have become intellectual counters. The name of an object calls up a mental image formed by the convergence on a higher cortical centre of all the perceptions to which the object gives rise—a centre in which the name becomes the symbol of the com-

bined perceptions, or complete image or idea of the object. This, which is sensory in character, and constitutes the cortical summit of the afferent side of the nervous system, has a corresponding cortical motor centre for intellectual expression which it educates and employs, and this in turn makes use of the word groups ready organized by the auditory perceptive centre in the left third frontal convolution, the downward starting point for words, for articulate speech. These two centres I have called the naming centre and the propositionizing centre respectively. The word groups, then, are called into action by impulses along two different routes, a low level route from the auditory or visual perceptive centre, and a high level convolutional route, which, starting in the auditory or visual marginal perceptive centre, ascends to the centre for names or ideas, and is transmitted forwards to the centre for intellectual expression, which employs the word groups for utterance.

An interesting question here arises. When a printed or written letter or word is read aloud, does the visual perceptive centre reach the motor word group in the third frontal, organized by the auditory centre, by fibres passing directly to them, or does the word as seen call up the word as heard—that is, the corresponding sensory word group in the auditory perceptive centre, and make use of it to pass on the impulse which gives rise to the uttered word to the motor-word groups? The latter is the order of events which probably makes the difficulty in reading aloud to be due to imperfect association between the visual and auditory perceptive centres. It is not likely that fibres pass from the calcarine or occipital region to the third frontal, whereas the calcarine and angular convolutions are adjacent to each other. It is true, however, that a deep-seated mass of commissural fibres takes origin in the occipital lobe, and proceeds towards the frontal convolutions.

Sufficient has been said to explain the idea which I entertain of the particular imperfection in the mechanism of speech of which the cases related are examples.

The question of numbers in relation to aphasia of various kinds is one of very great interest. It was very early found that some patients whose vocabulary was limited to "yes" and "no" and a few interjectional exclamations could state distinctly the number of objects given them to count. Sometimes the numeral would drag the name of the object with it, as, for example, a man who could not say "shillings," when asked to repeat it, or when shown the coins, said "five shillings" after counting this number when the amount was placed before him. A patient who could not say any part of the alphabet could count up to 20, and, while unable to write a single letter, would make figures on the palm of his hand with his finger to show the number of spokes in a wheel.

These are instances of motor differences between words or letters, and figures. Even more remarkable is the sensory difference between letters and numerals. Dr. Thomas's boy, who could scarcely recognize letters, at once put into words "11,308." From such examples as this it has been inferred that there is a different cortical centre for letters and figures. But, suppose this had been a Roman boy, would he have failed to recognise "X" as signifying "decem"? He would have been unable to say "x," to translate a visual character into an articulate sound, but he would at once have interpreted it as signifying "ten," and said "decem." It is not that there is a separate centre for letters and numerals, but that they represent different cerebral processes. A number is not like a name or noun; it does not call up the image or idea of any particular object; it has nothing to do with the properties of objects, and it is not a motor part of speech. It represents, in a sense, an abstract conception, but not of a very high order. Dogs can probably count sheep, birds can count the eggs in their nests, and other instances of the faculty of enumeration by animals might be cited. A calculating boy need not be otherwise very clever. The auditory and visual perceptive centres receive and register spoken and written numerals, and the word cell-groups for the utterance of numbers must be organized in the articulatory centres; but addition and subtraction and other arithmetical operations are totally different processes from the intellectual apprehension and description of the properties of an object. It is as a result of this fundamental distinction, and not because there are separate centres

for letters and figures, that the remarkable difference is observed.

I have shown elsewhere that words as motor processes, which they are from one point of view, parrot-like reproductions of articulate sounds, must be organized bilaterally in the bulb and central ganglia, all the muscles concerned in speech being bilaterally associated, the word cell-groups being ready for employment by the higher centres, and, in my opinion, this bilateral organization extends as high as the third frontal convolutions. Word cell-groups exist in the right third frontal as well as in the left, and are habitually employed in speaking in association with the left third frontal, the two being connected by commissural fibres of the corpus callosum. It is through these word groups on the right side that aphasia is obviated in some cases of right hemiplegia with marked paralysis of the face and tongue, the lesion having taken place in the white fibres of the internal capsule sufficiently low down to leave intact the commissural fibres of the corpus callosum between the frontal convolutions of the two hemispheres.

In support of this view may be cited the remarkable phenomenon of mirror writing. Some people can write currently with the left hand, but the writing is not only backwards from right to left, but reversed, so that a mirror is required in order to interpret it, when it is found to resemble the ordinary handwriting. Here the graphic centres must be bilaterally associated, and the left must have educated the right.

I may be permitted here to recall the fact that before the identification of the sensory and motor cortical areas by Hilzig and Ferrier I had inferred that they would be found in the Sylvian, Rolandic, calcarine, and occipital convolutions, since radiating fibres from the bulb and central ganglia were distributed only to those convolutions, the intermediate superadded convolutions constituting much the largest area of cortex receiving no radiating fibres. This structural arrangement, made out by tracing the fibres, has been confirmed by Flechsig on developmental grounds. I have some right, therefore, to assume that other conclusions at which I arrived are valid. The most important of these was that the fibres of the corpus callosum and anterior commissure were distributed to exactly the same convolutions as the radiating fibres, and constituted a commissure between corresponding gyri in the two hemispheres. I found also a large longitudinal commissural system.

REFERENCE.

¹ *Transactions of the Royal Medical and Chirurgical Society*, vol. lv, 187.

Clinical Remarks

ON

A CASE OF

CEREBRO-SPINAL MENINGITIS OR SPOTTED FEVER TREATED BY LUMBAR PUNCTURE AND VACCINE INJECTIONS: WITH RECOVERY.

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THE following case of cerebro-spinal fever has several points of interest. It was the first case to be notified in London during the recent visitation of the disease in this country. Although it was a very severe type of the disease, at first suggesting the malignant form, it happily ended in recovery. No conclusions of any value can be drawn as to the effects of treatment in one case. With regard to lumbar puncture, which was repeatedly performed, I should like to say that, after an extended use of this method of treatment during a number of years, I consider it of great value in all forms of meningitis. It should be performed as soon as one diagnoses the nature of the case, and should be repeated at short intervals, especially where there are signs of intracranial pressure. The immediate improvement in the patient's condition after lumbar puncture is usually most striking, and I believe that several lives in my own practice have been saved by its means. I have always used the needle of an ordinary antitoxin syringe for this purpose. The fluid should be allowed to come away gradually drop by drop

as it usually does, and should be collected in a test tube. As a rule no suction should be employed.

In this case in nine punctures nearly 9 oz. of fluid were removed. In two punctures no fluid was obtained. The fluid obtained was at first very turbid, then was clear, again was very turbid on the fourth puncture, while afterwards it was either opalescent or clear. The cells contained in the fluid were throughout chiefly polymorphonuclears. The micro-organisms were intracellular, Gram-negative diplococci, and on one occasion the *Staphylococcus albus*. After the end of the fifth week the fluid was sterile.

The vaccine used was prepared and administered by Mr. Leonard Dudgeon, Superintendent of the Clinical Laboratory at St. Thomas's, to whom I am much indebted for the care and attention given to this case. It is obvious, however, that the value of such a vaccine as has been here used can only be determined by experience in a sufficient number of cases. It is impossible to say how far the recovery was due to the lumbar punctures and the vaccine injections respectively. I am convinced of the benefit to be derived from lumbar puncture. Of the effects of the vaccine we can speak with no certainty at present. For the following notes of the case I am indebted to Mr. W. O. Sankey, house-physician, and Mr. W. N. Child, clinical clerk.

Florence H., aged 6 years, was admitted to St. Thomas's Hospital under the care of Dr. Hector Mackenzie.

The only previous illness she had had was measles when 2 years old; otherwise she had been quite healthy.

On Thursday, January 24th, 1907, the child seemed perfectly well, but next morning, before breakfast, she shivered, and complained of pain in her left shoulder.

She took her usual breakfast, however, and went to school, but at eleven o'clock she said she felt ill, complained of headache, and was allowed to walk home.

The headache, which was frontal, continued, but the pain in the left shoulder was not mentioned again.

She vomited twice during the afternoon. Between 7 and 8 p.m. she became unconscious, her fingers were constantly twitching, and she kept looking round in a frightened manner. During the night she spoke incoherently of the pain in her head.

Next morning, Saturday, January 26th, at 10.30, the child, who was still unconscious, was brought up to St. Thomas's Hospital and admitted. She lay on her side with her legs drawn up and was in a comatose condition. The face was cyanosed and the respiration shallow. The radial pulse could only just be felt. Strychnine and ether were at once given hypodermically.

On inspection in the ward the child still lay on her side with the legs, thighs and trunk flexed; from time to time she straightened out her limbs and screamed loudly.

The head was retracted and the muscles of the neck were stiff. The knee-jerks were brisk on both sides; the plantar reflex was extensor and Kernig's sign was obtained. The skin had a bluish mottled appearance, and on the front of the chest, back and legs there was a scanty dark blue petechial rash; in one or two places the haemorrhages were as large as a three-penny-piece. The pupils reacted to light, and there seemed to be marked photophobia.

Nothing abnormal was detected in the chest.

The abdomen was flat and retracted, and nothing definite could be felt of the organs.

The tongue was dry and furred.

The temperature was 101.4°; pulse, 144 per minute; respirations, 32 per minute.

Lumbar puncture was performed two hours after admission, and about 5 drachms of very turbid fluid ran out through the needle; this contained a number of cells, in which a diplococcus be could seen. A subsequent examination revealed the presence of "a large number of cells, chiefly finely granular polymorphonuclear cells, and many intracellular Gram-negative diplococci."

The child was noisy and restless during the afternoon, but slept well after being given chloral, 5 grains.

The temperature rose to 102.8° during the night.

On the following day, Sunday, January 27th, some fresh spots were seen; the child was quieter, and recognised her mother; she took milk well. After admission there was no more vomiting. Lumbar puncture was performed again, but no fluid could be obtained, even by aspiration.

The temperature went down to 101.2° during the day.

Until Monday, January 28th, the condition steadily improved.

The child was able to talk intelligently and answer questions; she said she had no pain at all, and her eyes did not ache. There was still some retraction of the head and stiffness in the neck, and the tongue was still furred. The haemorrhagic spots were now brownish-yellow, and no fresh spots had appeared; some labial herpes was present.

The pulse was steady and regular at 126 per minute, and the temperature was 102.8°.