LOSS OF WRITTEN LANGUAGE DUE TO DISSOLUTION OF THE PHONETIC STRUCTURE OF THE WORD IN BRAIN ABSCESS.

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WRITTEN language is a complex function ; being built on the spoken word it has to draw on a variety of subsidiary functions which have to be unified in one particular skill. Moreover, the subsidiary functions are not the same for reading and writing ; in reading, visual-gnostic factors are of major importance, in writing, special skill of hand and finger is required.

The mechanism of disorder in written language is relatively simple when as in pure alexia the visual-gnostic is the predominant factor involved or when, as in isolated agraphia, the apractic-constructive factor is mainly operative. More frequently a number of factors is involved, resulting in a combination of agraphia and alexia which is difficult to analyse ; the difficulties are increased when, as so often, a disturbance of the spoken word is superadded.

The disorder of written language as presented in the following case is unusual because these interfering factors are absent ; for the same reason it presented most favourable conditions for analysis and for investigation of the underlying mechanism.

The patient, A. P—, labourer, a single man, aged 22, gave the following history of his illness : In December, 1948, he started to complain of intermittent blurring of vision, headache and vomiting, which lasted a few days. Further attacks occurred until April, 1949, when the condition became worse, the headache more frequent and intense, and he vomited more often ; he then found that he could neither read nor write ; he was unable to read the names of his co-workers in the factory, and unable to read his daily paper apart from the headline (*Daily Mirror*). He was unable to write the simplest word, or his own name. He was then sent by his doctor to hospital, where an X-ray of the skull showed an intracranial gas bubble with fluid level in the right frontal region. As there was some rise in temperature a brain abscess was suspected, and he was transferred on 21 June, 1949, to the Neuro-Surgical Unit, Bristol. There it was found that he had bilateral papilloedema with retinal haemorrhages, slight weakness of the left lower facial muscles and weakness of the left upper limb. It was also noted that he was unable to read or to write, though he could spell written words. On 29 June, 1949, excision of a well encapsuled brain abscess was carried out ; the abscess was about the size of a plum and was situated in the inferior gyrus of the right frontal lobe, extending from its middle to its posterior portion. He was discharged from the unit on 23 July, 1949, and followed up as an out-patient.

His condition remained at first satisfactory and he was able to return to work, but there was no change in the alexia and agraphia. At the end of October he complained of giddiness and had, for the first time, epileptiform fits. When he was examined later he gave the following description of these attacks, which from his first fit in October, 1949, recurred at approximately monthly intervals. He had been told that about the time of the fits he was given to swearing, attacking others and generally noisy behaviour, which lasted up to a week. He had little recollection of what happened during this period. He remembers seeing strange

things—a man, " fair haired and thick set " coming through the window and " frizzy writing " on the windows, also he remembers reading distinctly, " Blinking fool, hurry, come out and come home." He saw it quite plainly and could read it easily. In one of the fits he thought German soldiers were chasing him with fixed bayonets and he heard voices calling him and shouting at him.

His previous history showed the following data: He is one of twin brothers. He had measles and underwent tonsillectomy in early chlldhood, otherwise his development was normal. He describes himself prior to his illness as a happy, contented boy. He was bilingual, went to an English school, but at home spoke mainly French. He says that he was two standards retarded at school, was slow to learn, but picked up more on his own after leaving school. He learned reading fluently, wrote with spelling mistakes in more uncommon words, and made similar mistakes when spelling the spoken word. He had on tests usually 10–15 marks out of 20. After he left school he regularly read his daily paper and some weeklies. He occasionally wrote letters to his relatives and friends. When asked about his reading procedure he says that he used to guess the word from two or more letters, usually the first and the last, and from the length of the word. A report from his school teacher states that he was on the dull side, but had no special difficulties in reading, writing or spelling. He was taught by the phonetic method. After he left school he had jobs on a farm, was employed as a storesman for three years, then as a boiler man and builder's labourer. Prior to his operation he had a severe cold with running nose and cough, but he had no aural discharge. Physical examination showed an operation scar running from about the centre of the forehead posteriorly in a half circle across the right frontal region. Neurological examination showed slight weakness of the lower facial muscles, otherwise there was nothing abnormal.

The following are a representative selection of his reactions to numerous investigations:

Writing.—He writes all the letters of the alphabet correctly and without hesitation; only occasionally he has some difficulties with capital letters, when he writes small letters instead. He is unable to write even very common and short words to dictation; he can write his name, but this is the only word which he writes correctly with confidence and consistency. Otherwise he is unable to write even the most common and short words, and it is very rarely that he succeeds, and this only after many attempts. Here are a few examples:—Plum: " pem, pmo, puam." Stroll: "cng, sm." Window: " wdo, wp." Simple: " spe." Drag: " rde, red, cprug, drug." His writing is very slow and hesitant; he tries to get the succession of letters by speaking the word, and even when he correctly puts down the first letter (in this he is most often successful), he is not sure whether he is correct or not. He is equally unsuccessful in putting together words from printed letters. However, he copies words as well as letters without mistakes, copying letter by letter. He writes all the single numbers correctly, and composite numbers up to hundreds; from a thousand on he has difficulties with positioning.

Reading.—The reading of letters, printed or written, is perfect. The reading of words is as severely affected as is the writing; he correctly reads the letters singly, but is, as a rule, quite unable to combine them in the word. Examples:—Dark: there was no spontaneous attempt to read; only when prompted to say the nearest he can think of he produces DEAF, then DAFFA and finally DORMITORY. When asked how many letters the word DORMITORY has he says, " It sounds like a short word; it might have 3 letters." Fellow: after he has spelled it correctly he says, " Has it anything to do with LADY ?," then when this was not accepted by the examiner, " Would it not be PRIVATE ?." When reminded that the first letter he spelled was an F he says, " It would not be COFFEE ?, it sounds like an F," then, " CLOTH," adding, " It would not be with F; there is an H in it," and then he produces " PHOTO," but adds again " Photo would not be F," and finally he says, without much confidence, " FOOT."

His reading of words and sentences, in writing and in print, was tested on many occasions as was his reading procedure and the results were essentially always the same. As a rule he was not able to read even the simplest word " synthetically," by putting together the letters which he correctly spelled; nor was he able to recognize the visual character of a particular word. When he succeeded, which was very rarely and only after several unsuccessful attempts, he did so by getting the first sound of the word right, sometimes also the last, and making a more or less lucky

guess, but even then he was never quite certain whether his solution was the right one or not.

There was usually little correspondence between the letters spelled out correctly and the response he produced when trying to get at the word as a whole. Even if he knew that the word he had to read started with a particular sound, and even if he repeated it while trying to form the word, he did not necessarily produce a word with this initial sound; the sound might have been in any part of the word or altogether missing. It did not make any difference whether the words were presented to him in writing or in print. The results were the same, whether he had to read in English or in French, whether it was meaningful for him or not.

Spelling.—The same inability, the same complete disorganization of the word as to its parts became manifest as in his writing attempts. Examples:—WINDOW: H—E; does not know how to carry on. When asked what is the first letter he says S, but is not certain and spells then F—H. CAR: K—H—S—. CAR (repeated) R—H—H—S. FLOOR: F—O—R—N—. DISH: Repeated several times "dish," then D, again probing "dish" D—E—S—. CROWD: O—R. CROWD: S—O—R—. CROWD: S—O—F—O—; tries by saying "crowd;" S— then he starts again C—A—T. PEN: P—E; says "pen" and adds an N.

As with writing and reading, he scores most often in the initial letter. It is exceptional for him to spell a word without grave mistakes; there is usually not only a displacement of sounds, but insertion of letters not contained in the word, so that the word spelled by him has no resemblance to the spoken word. The number of sounds he spells usually does not agree with the number of sounds in the actual word.

He is also incapable of naming even the simplest word when it is spelled out for him.

Various Other Tests to Ascertain the Patient's Capacity to Differentiate the Written and the Spoken Word.

Partitioning of a word into its syllables: After he has been instructed he sometimes gives correct answers, but more often he fails. When two or more words are presented to him orally he is usually quite unable to say with any certainty which is the longer or which the shorter. Nor is he able to say of how many letters or sounds a particular word consists; only occasionally he may give the correct number. When given the same tests in writing his answers are correct.

When a number of written words is presented to him and he has to pick one particular named word he gives the correct answer in about 75 per cent. of trials; the results are poorer when the choice is between similar words than when between words of different lengths and sounds. He is usually guided by the first and last letter, and is more successful with some initials than with others; as further tests show, there are certain initial sounds which he is, as a rule, able to pick out correctly. Occasionally he makes his choice from other letters, as when he recognizes "traffic" from the double "f" in it. The scoring in these tests compared with that in other related tests is fairly high; this might be partly due to the fact that it was applied at a late stage of his examination when he had been subjected to a great number of similar tests connected with word structure; by that time his results had become generally somewhat better than at the beginning of the examination.

In the next test we wanted to find out whether certain initial or end-sounds of a word stand out more and are perceived with more accuracy than others. Five words of various lengths with each letter of the alphabet as initial and end sounds were presented to the patient orally in mixed order. The results were checked over a number of sessions. With the initials he was regularly and unhesitatingly correct only with the "k," "f," and "g" sounds. Next in order came the "d" and "t," "b" and "p," "n" and "m," "c" and "s" sounds, but he was usually unable to distinguish between the members of these pairs; he was also not so sure of the correctness of his answers, even when scoring. The last in order were the vowels, with which he was rarely successful; instead of the vowel he named a consonant which was not necessarily contained in the particular word presented. With successive testing his results showed some improvement. It made no difference if the words presented were English or French, or in a foreign language. For the same

sound the scoring was higher in short than in long words. As for the end-sounds, the same relation between the various sounds in scoring was found as with the initials; but the results were, as a whole, much poorer, and he was much more hesitant.

He failed in analysing two consonant sounds, for instance, " dr " or " pr " and sounds similarly composed. In spite of repeated explanation he failed to name words of a similar sound, or words which rhymed with one or more particular words presented; thus when asked to name a word similar in sound to the word " port " he produces: Jar—Bole—Putty—Potty—, or when asked to give a rhyme to the word " send " the following were his answers: Soil—Sound—Salt—, adding, " It sounds the same, but it does not rhyme." In these tests he often produces words of the same conceptual category instead of sound associations.

In a further test he was asked to form as many words as possible with a given initial. It took him a long time, and except for a few correct responses most of his answers were out of the way. His most common errors were to put the initial sound in any part of the word formed by him. Then, as in the previous test, the same deflection from sound to conceptual categories occurred frequently. Examples: —Letter L: " WELL—ALICE—HELL." S: " S—S—WATCH, —NO—WESTERN—MACHINE." I: " I AM GOING, I SEE—that is E." P: " PALER—WATCH—PENCIL—TEA— NO, it is not P—PORRIDGE—PEN—PAPER." T: " TAPERY—TEA—SUPPER—POINT— is P PRINT— is P—TEARING—STAIRS— it is S—GLASS." He is slightly more successful when he is asked to form from two initials. DA: " DANCE—BON— has a B—DUFFER—TOBACCO—DOOR—, that is G." DR: " DRIZZLING—DRILL—COMPRESSION—DRILLING MACHINE—AB/BORER MACHINE—DRILLING—DAZZLING—EXERCISE—TRYING—." MA: " MAMMA—MOTHER—MAMON—PAPA— it would not be any good." PL: " BELLL—PILLOW—PAL—PUZZLE— NO." LO: " LOWRY—LOADING—LOW—LOAF—LOW BUILDING—LOW VAN—LOW—GLOBE—GLOWING." RE: " REFLECT—RECEIVE—RECALLL—."

When asked to name the sounds contained in a particular word irrespective of their place in the word he was very uncertain and made many errors. Examples: DRAG: " Sound of an R—, sound of a D—, R is first. Is an H in it ?—I don't know." STROLL: " C—F—CR—AS—; is AS in it ? Is there a letter after the C ? F ?—C—S—R—G—."

Conversational speech.—His conversational speech was fluent and he expressed himself well. His comprehension was unimpaired; he could reproduce a small story with most of the details. The naming of concrete objects and of pictures of objects was prompt and without hesitation. His vocabulary was not very rich, but it corresponded to his general intellectual level, which was according to the Wechsler test in the dull normal category, with little difference between the vocabulary and the performance scores. His pronunciation was correct. He discovered grammatical errors, and corrected them when they were intentionally made to test him. This applied for the English language. Comprehension and conversation in French seemed to be unimpaired, though more detailed testing was not carried out.

He recognized popular tunes and could produce them correctly. He could easily and correctly tap out a variety of rhythms.

Apraxia was absent both with objects and with expressive movements. His body orientation was unimpaired. He had no constructive difficulties; drawing from memory and copying were both adequate. Neither were there any disorders in the optic-gnostic sphere; he recognized pictures of objects and situation in all details. He was efficient and accurate in jig-saw puzzles, and he was satisfactory in similar tasks when he had to draw or to construct a whole from parts. He was also within the normal range in the picture completion tests. In Weigl's grouping test he proved to be rigid, and could not shift from the colour to shape.

His arithmetic was very poor; in writing he could do additions well, subtractions with mistakes, but no multiplications or divisions; he was, however, very poor at arithmetic at school and had no practice since; it seems doubtful therefore if a loss attributable to his brain lesion had occurred. His memory for past events and for recent events was quite adequate, as was his immediate retention. On the Wechsler test he had an I.Q. of 86; comparing the Hold with the Don't-Hold there was a loss of 17.5 per cent.

During the period of two months in which intensive testing was carried out there was progressive slight improvement in his defects. Therefore, some tests which were first given at a later date showed somewhat better results than similar

tests given earlier, but the defects in spelling, reading and writing remained very severe during the two months after his discharge from hospital.

Electro-encephalograms were taken on several occasions. The first record showed :—Delta : Persistent focal activity of moderate to high potential at 2 cps in the right frontal region. Theta : Bursts of low-moderate potential at 4–5 cps originating in the right frontal region and spreading back to the right temporo-occipital region, appearing diffusely on the left. Alpha : Low moderate potential, symmetrical, not responsive to physical stimuli at 9–10 cps. Hyperpnoea increased the theta both in amount and in amplitude. Photic stimuli produced a normal response. In successive records the delta activity was less prominent and spread more over the whole of the right cortex.

During his stay in the hospital one major fit was observed ; it was reported that he curled up like a ball and turned over on the floor, sustaining an abrasion and some swelling of the nose. He had no recollection of the fit. There was no post-epileptic confusion of any duration.

He was, during the period of hospital observation, always mentally clear, but somewhat restless, and it was difficult to make him follow the rules.

Summary of the Case History.

The patient, a twenty-two-year-old, right-handed man, whose illness started with intermittent headache and vomiting, found four months later that he could neither read nor write. Before his illness he was a regular and fluent reader of journals and newspapers, but had no great practice in writing, which was rather laborious. A few months after the loss of written language a brain abscess the size of a plum was discovered in the middle and posterior portion of the right lower frontal lobe. The abscess was subsequently excised along with some neighbouring brain tissue. No improvement of his reading and writing capacity occurred after the operation. Three months afterwards he had his first epileptic fit, and since then seizures have occurred at irregular intervals during the period of observation. They were of psychomotor character ; during these attacks he had visual hallucinations, some of which consisted of written sentences. Throughout the course of his illness there was no indication of aphasia or visual-gnostic disorder. The disturbance in written language was still very severe more than a year after the operation. There was only very little tendency to restitution at the time the present investigations ended. His agraphia and alexia were purely verbal, and he had no difficulty in reading and writing letters. It was found on numerous tests that there was a complete disorganization of the phonetic structure of the word.

Comment.

The special subject of investigation in this case was the disorder of written language which occurred as an early symptom of a brain abscess. The entire complex of writing, reading and spelling was involved exclusively and with the same severity ; the spoken word was left intact. Our patient was able to write letters singly without mistake and hesitation and to copy words correctly letter by letter, but he was quite incapable of writing words spontaneously and to dictation ; when he tried, he usually produced a sequence of letters which had no relation to the word he was asked to write. The only exception was his name, which he invariably wrote correctly. Similarly he could read all the letters of the alphabet singly without mistake and spell out the written

word letter by letter correctly, but was at a complete loss when he tried to read the word as a whole or when he attempted to put the word together from the letters. Once more the only exception was his name. There was the same severe disorder in spelling as in reading and writing. Detailed examination showed that he was neither able to give the correct succession of the sounds of a word, nor could he say of what sound elements a particular word consisted. On many occasions he was unable to name the initial or the end sounds of a particular word. He could not say of how many syllables a word consisted, nor whether a word was long or short, or which of two words was longer and which shorter. He was unable to form words of similar sound or to rhyme, and he had great difficulty in forming words from an initial sound.

There was, therefore, a severe disturbance of the phonetic details of the word, and the spoken word was almost completely disorganized in its phonetic structure. The patient's inability to spell is a natural expression of this phonetic disorganization of the word and needs no further explanation. His verbal agraphia, characterized by failure to set the correct succession of letters into writing, is also a consequence of the phonetic defect if we assume that the patient was in the habit of spelling out the word when writing, and if we assume that he had not developed a purely visual picture of the word in writing; the latter seems improbable considering that he had always been a rather poor and laborious writer. The alexia, however, is not easily explained from the phonetic defect.

Our patient was taught reading by the spelling method; even so, it can be assumed that he had, with growing skill, developed a visual scheme (Piaget, 1948) of the written word and should therefore have recognized familiar words ideo-visually. Though reading may become largely a visual-gnostic function independent of the spoken word, it is as a rule not entirely independent of it. In some way speech articulation or phonetic elements participate and permeate the reading act. It is, therefore, not surprising that disorders of speech interfere as a rule with written language, including reading. This is so commonly the case, despite some exceptions, that the presence of alexia along with agraphia is considered to be one of the most valid signs of a disturbance in internal language. The visual word scheme is thus usually lost when the internal word, the kinaesthetic or the phonetic formula of the word, becomes unavailable. In our case there was, however, no aphasic disturbance, and the word, when spoken, was kinaesthetically and phonetically intact. Our patient's alexia seems to be, therefore, of an order different from that in aphasics.

So far as the alexia is concerned there is a great resemblance to pure word-blindness which is, as generally accepted, due mainly to an ideo-visual defect. There is the same inability to read the most simple words, and whilst the spelling out of the written word letter by letter may be undisturbed, the patients are, as in our case, quite incapable of putting the letters together to form the word and quite incapable of reading the word as a whole. In cases of pure word-blindness, spelling and writing are, if at all, only involved to a minor degree. One of the most outstanding features of our case, however, is that the same severe disturbance exists in all those functions which form part of written language. Moreover, the ideo-visual disturbance which frequently

accompanies word-blindness in some phase of its course is, in our case, completely absent.

In some respects our patient is comparable to an illiterate; but there is this difference: that those faculties which are essential for written language had been lost in our case, whilst they are potentially present in the illiterate. Much closer functionally is the relation between our patient's disturbance and congenital word-blindness. This condition occurs in children who, with well developed speech and often very good intelligence, are unable to read or have very great difficulties in learning to read. It was termed word-blindness, as it appeared to be the congenital replica of pure word-blindness which had been previously described in focal lesions of the brain in adults. Earlier descriptions of such cases suggested that the alexia was indeed the essential feature in the congenital as well as in the acquired form of word-blindness. However, detailed investigations carried out more recently have shown that the difficulties of these children are not confined to reading; in a great number of cases they were as marked in spelling and writing. This and more detailed analysis of the cases led to a revision of the opinion previously held. A review of most of the modern work on this subject has been given by Solms (1948). The approach and the results of different authors vary, and a generally accepted solution has not been found. Ombredané (1937), in considering mainly reading difficulties, distinguishes a phase of exploration and one of elaboration during the reading act; in congenital wordblindness both of these are, in the opinion of Ombredané, pathologically slowed down. Frank (1936), Rombach and Kern (1937) and Pflugfelder (1948) speak of the solidity of the optic structure of the word and weakness of analysing it. Ley (1929) thinks there is mainly a failure to synthetize, and Thiele (1938) emphasizes the inability to analyse and to synthetize the word. Orton (1937), who has a physiological approach, is of the opinion that it is interference by the minor hemisphere which causes the difficulties. Of special interest with regard to our own case are the observations of Bachman (1927) and Hermann and Voldby (1947), who speak of a confusion of letters in their series of children and a patient of Ley (1931), who declared that he did not hear the letters in the word and could, therefore, neither spell nor write.

The case descriptions as well as the differing opinions of the various authors suggest that the pattern of what is termed congenital word-blindness is not uniform, but there is a group of these children in whom the difficulties are almost identical with those of our patient. As in our case, no disorder in the optic-gnostic function can be found; spelling, reading and writing are equally severely involved; writing and reading of single letters is almost undisturbed; the spelling of the written word does not offer any difficulties, and letters which are phonetically akin are often mixed up in spelling and writing. The phonetic differentiation of the word, either written or spoken, seems to be lacking in the same way as we found it in our observation. There is, therefore, the same problem which faced us in our investigation, namely, the incapacity to read the word ideo-visually, though its phonetic structure does not seem to be directly involved in this procedure.

It appears that this problem cannot be solved as long as we measure ideo-

visual reading procedure by general gnostic rules; according to these the written word has its particular visual character, and the identification of this character is a skill which can be acquired provided the visual-gnostic function is intact. These visual-gnostic rules may be valid as long as the language is intact. In aphasia, as mentioned before, ideo-visual reading is not maintained and alexia is the rule. The way in which reading can be involved by a phonetic disorganization of the word without aphasia is indicated by the description which our patient volunteered. Though he was taught reading by spelling, later, according to his own information, he would, when reading, pick out one or two letters of the word and guess at the word. It is interesting to note that his description conforms with the perceptual procedure found in tachistoscopic exposure, where the perception of one or two letters and the length of the word ensures a correct reading. In such reading procedure the word formation takes place from details perceived by a non-perceptual process. The "closure" to the Gestalt might, under these circumstances, be a visual process identical with that which, under other conditions, occurs on non-verbal objects. Such process was not blocked in our patient by any lack of visual imagery, as his drawing shows. It is, however, not less likely that at this procedure a transposition into the phonetic sphere takes place, that the visual elements perceived evoke the corresponding sound elements and that the word is thus completed phonetically. This is what probably happened in our patient. There will be then no difficulty in explaining our patient's failure to read, because we have seen that he is unable to guess at the word from single sounds presented and unable to form a word from phonetic elements. It is, therefore, significant, and seems to confirm the observation in our case, that children with congenital word-blindness are, when reading, unable to by-pass spelling, and in systematic training the ideo-visual method is, if anything, less successful than the spelling method (Hinshelwood, 1917; Hall, 1947, *et al.*) This means, in our opinion, that they are unable to learn to identify the visual character of the word without first getting hold of the phonetic structure; they are bound to fail because the phonetic structure of the word is absent.

The mechanism involved can be summarized as follows: When the word is perceived ideo-visually, this visual whole is not without structure, as described by our patient and as demonstrated in tachistoscopic examination. Some details will always stand out and form part of the specific character of the whole, and it seems that these details cannot, at least in some persons, "close" to the visual Gestalt without phonetic support.

The finding that the spoken word should be intact whilst it lacks structure is not as paradoxical as it might appear. There is a transitory stage during normal development of language when words are perceived in a "syncretistic" (Claparède, 1907) way incompletely structured and as a general scheme without details. It is only at a later stage that a more complete structure and organization of the word is attained, but this is not an essential part of spoken language. In conversational speech the emphasis is on sentence formation and the scheme is propositional; consequently the word as a whole becomes part of the total propositional structure. It functions in its general scheme and phonetic details are of minor significance. When, on the other hand, the

word has to be used in written language the propositional scheme is replaced by the word scheme. The word has now become a self-contained unit which requires organization; it is organized as to its phonetic details, and these form the elements of the word in the same way as the word as a phonetic whole is part of the organization of the sentence.

Functionally the word has therefore two distinctive qualities, a propositional and an exclusive word quality; one is linked up with the spoken word, the other with the written language. As aphasia is primarily a disturbance of the spoken word it is of interest to compare the agraphia and alexia in aphasia with the disorder of written language in our case. The character of agraphia and alexia in aphasia may vary considerably, but we can, for our purpose, distinguish two groups; in one there is a close connection between the confusion of the spoken and that of the written word. In the other group no such relation can be discovered. In the first group of cases the reading and writing may proceed fluently, and the mistakes made are very nearly the same as those when the word is spoken. (Read and written paraphasias.) The patients have, therefore, retained the ability to express the spoken word, altered as it is, in reading and writing; to do this its detailed structure must necessarily be available; the paraphasic word must be well organized as to its particular sounds. Therefore, the disorder is not a defect of word structure; it is not the details of the word that are primarily disorganized, but the word as a whole, the Gestalt quality of the word. The word scheme has become unprecise, uncertain and unstable. This is then just the opposite to what we found in our observation. While in our case the structure of the word, the special word quality has been lost, we have in these aphasics a disturbance of the Gestalt or the propositional quality of the word. There is, accordingly, in our case an exclusive loss of written language, whilst in this group of aphasics the word, as it is spoken, can be expressed in the written language; thus the agraphia and alexia of these aphasic patients is not a disorder *sui generis*, but reflects only the altered scheme of the spoken word.

The paraphasic reading in these aphasics is also of interest in view of the reading mechanism previously discussed; the parallelism between written and spoken word shows that the word formation at reading is not determined by the visual character of the word, but by its phonetic structure.

The group of aphasia discussed is relatively easy to analyse with regard to the relation between the spoken and written word. In the other group of aphasics the alexia and agraphia are usually more complex; as indicated by the inability to write and read letters, there are often, apart from aphasic, apractic-constructive and visual agnostic factors effective. One or the other of these factors may be prevalent, since in some cases reading, in other cases writing, is predominantly involved. This is not to say that aphasia leaves the structure of the word necessarily intact; phonetic disintegration in motor aphasia has been recently mentioned by Alajouanine and Mozziconacci (1947), but the complexity of the picture usually makes it difficult to isolate a possible structural disorder of the word. This question could be decided more easily in cases where the restitution of the spoken word precedes that of written language or where the aphasic disturbance is only slight. Such a case was first

described by Déjerine (1891) as a separate syndrome of agraphia and alexia, and a number of similar cases (Serieux, 1892; Stier, 1917; Hermann and Pötzl, 1926; Nielson, 1945; *et al.*) were subsequently reported. In these cases the agraphia was usually predominant and involved the writing of letters as well as that of words. From this it appears that the character of the disturbance is quite different from that found in our case. An exception is a clinical observation by Brandt (1928), in which, after a transient aphasia, agraphia and alexia persisted of a character similar to that in our case; reading, writing and spelling were equally and almost exclusively involved. This observation indicates that an exclusive disorder of written language of the same character as here described can occur as a residual syndrome in aphasia.

Localization.—Since Déjerine's description of agraphia and alexia in connection with a lesion in the cortex of the left angular gyrus, this part of the brain has been generally considered as significant for this syndrome, although anatomical reports have been very rare. No lesion in any other part of the brain is claimed to produce the combination of isolated agraphia with alexia. In our case an encapsuled brain abscess was demonstrated in the triangular-opercular portion of the right hemisphere in a man who was indubitably right-handed. This is an unusual site with regard to the clinical picture. However, the focal lesion need not necessarily be the cause of the syndrome; it may well be due to a general cortical dysfunction. We have so far considered the disorder from a perceptual angle, but seen conceptually our patient's difficulties in spelling and writing can be regarded as an inability to analyse the spoken word, and his difficulties in reading to an inability to synthetize the single letters to the word—a point already made by Thiele regarding cases of congenital wordblindness. If such defect in analysis and synthesis would prove to be general, then the disorder of written language could be regarded as an expression of a general lowering of cortical function; but, as in congenital word-blindness, there is little evidence for such an assumption. Our patient's general intellectual level has not dropped to any extent, and his capacity to analyse and synthetize was found intact on performances other than written language. We might also consider whether the patient's low school standard and rather low level of skill in written language were not factors which made the written language more vulnerable than other functions. The effects of individual ability and acquired degree of automatism upon the clinical picture in brain lesions have been frequently discussed in the literature. Though there is some evidence that these factors may be of importance for particular disorders within a functional complex, it is unlikely that a special function, such as written language, should be singled out by a general process, whilst other functions showing a skill and automatization of about the same level should be spared.

It seems, therefore, that we have to attempt to explain the disorder by the local lesion found in our patient. In relating a disorder of written language to the focal lesion the following has to be considered. There are, as pointed out, aphasias in which the spoken word, though transformed, is well constructed, and the capacity to organize the word as to its sounds is preserved; written language is thus intact so far as it represents the true copy of the spoken word.

The anatomical lesions in these cases can be found in any portion of the speech area of the dominant hemisphere, though specially in the posterior parts, i.e., in the temporal region. As it can hardly be assumed that the damaged area would exclusively maintain the written word, one of the most elaborate functions of the language, these findings would therefore suggest that there is not only a functional but also an anatomical separation of the two functions, the spoken and the written word. There is good reason to believe that under these circumstances written language might be subserved by the corresponding area of the non-dominant hemisphere, an area which seems to be capable of taking over some of the functions of language when the superior hemisphere is out of action, and which is, in the opinion of some authors, responsible for special functions of language. Its significance for written language has been stressed by Orton. In our case an anatomical destruction was found in the right frontal lesion; epileptic seizures of psychomotor character with visual hallucinations would indicate that the temporal lobe was also involved. Thus a large portion of the cortex of the right hemisphere corresponding to the speech area on the left side has probably been damaged. When we accept the opinion that both hemispheres control language, we have to assume that in our case those functions of language which are the basis of the written word were dependent upon the right hemisphere, whilst the left dominated the spoken word. It is perhaps not without significance that the structural dissolution of the word which we found in our case is also a spatial disorganization, as the patient is unable to put the elements of a particular word into the correct spatial order. We know from clinical experience that spatial organization is largely dependent upon the non-dominant hemisphere.

As to the rest of the clinical picture, the patient's visual hallucinations during post-epileptic excitement are specially worth mentioning. Among the visions he experienced were hallucinations of written sentences which, according to his descriptions, were projected on the window and were very vivid, distinct and real; he had no difficulty in reading them, and could still recollect one of the sentences. His word-blindness did not therefore exist in his hallucinations. This seems to show that such experiences are not necessarily derived from perceptive or ideatory sources, because our patient was unable to perceive or visualize the written word.

Summary.

In a twenty-two-year-old, right-handed man, one of the first signs of an abscess in the right inferior frontal lobe was loss of ability to read and to write.

It was found on examination that the patient was unable to spell, read and write the simplest words, with the exception of his name, whilst he could read and write single letters and spell the written word. It could be demonstrated on a variety of tests that the word was completely disorganized as to its phonetic structure. There was no disturbance of the spoken word, nor was there any visual-gnostic disorder.

This syndrome was discussed first in relation to the almost identical defect in a certain group of congenital wordblindness. In both conditions the verbal

alexia seemed to be the disturbance most difficult to explain ; it was suggested that in the reading act visual perceptions were carried into the phonetic sphere so as to complete the word Gestalt ; as the phonetic structure of the word is not available, reading is not possible.

A distinction was made functionally between the word when used in written language and when used as part of the spoken sentence. In written language structural detail of the word is a requisite (special word quality). When the word forms part of the sentence it functions as a whole and structural details are not required (propositional quality). In the case here described there was a disorder of the special word quality only ; therefore the spoken word was intact. In aphasia, mainly a propositional disorder, the word as to its whole may be disorganized without involving the structure of the word ; under these circumstances the written word is a true copy of the spoken paraphasias.

No evidence could be found for a general lowering of cortical function to explain the disorder in written language. The local destruction was in the right lower frontal lobe ; epileptiform seizures of psychomotor character indicated that there was also involvement of the temporal region. A large part of that area which represents, on the corresponding left side, the speech area was therefore probably damaged. The otherwise inferior hemisphere seemed thus to have been dominant for those special functions of language which are the prerequisites of the written word. Such anatomical separation of the two functions, that of the spoken word and that of the language abilities necessary for the written word, does not seem to be exceptional ; it can also be demonstrated in aphasics.

The investigation was carried out at the Bristol Mental Hospitals.

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