as well as his physical requirements. If these needs are met, the majority of patients learn to live with their pain. Those few who cannot carry on should be relieved by surgical means.

(6) Bilateral spinothalamic tractotomy at the level of the first or second thoracic vertebra or higher, has proved most efficacious in relief of pain. 6 cases are reported with a two to eight year follow-up.

(7) One case of bilateral prefrontal lobotomy is reported, with a five-year follow-up.

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Loss of Visualization

By Sir RUSSELL BRAIN, D.M., P.R.C.P.

IN this communication I shall describe 2 patients who, in both cases after a head injury, suffered from a severe degree of inability voluntarily to visualize familiar objects. One patient has been under observation for seventeen years since his head injury, the other died seven years after his. Neither showed any improvement.

This symptom was first described by Charcot (1889). Describing his patient he said: "In every instance the visual memory of forms and colours had completely disappeared, yet he could perceive them when present without difficulty." This patient could not visualize his wife and children nor the home of his youth, and his power to visualize colours was also lost. Charcot added: "It is an interesting detail that in his dreams the patient has no longer the visual representation of objects." Wilbrand (1892) is often credited with reporting another instance, but his patient appears to have suffered from loss of topographical memory rather than from loss of visual imagery for objects.

Case I.—Male, a builder's manager, right-handed. In 1936, at the age of 36, he had a car accident which caused a depressed fracture in the mid-frontal region and after which he was unconscious for eight days. His wife was killed in the same accident. When seen for the first time five years after the accident the patient complained that what he called his "picture memory" was gone. He could no longer form a visual image of his first wife nor of his second wife, nor, indeed, of anyone he knew. This did not interfere with recognition. Even if he had only met a man once, although he could not form a mental picture of his face he would recognize him the next time he met him. As a builder's manager he found it a handicap as he could not visualize a plan or an elevation, in consequence of which he had to keep referring to the specifications when dealing with a house. He built his own house by remodelling four cottages and he would work out all the alterations on a plan at night and would then inspect the work next day in order to correct any mistakes he had made in the plan. Similarly if he was going on a journey by car, although he had travelled on the same route before, he would have to look it up afresh on maps and retrace it because he could no longer picture the route, but he was able to recognize landmarks when he came to them. Nevertheless, he was able to describe an object which he could not visualize, for example, his own house. He could not visualize parts of his own body, e.g. his hand. His difficulty in visualizing applied equally to experiences which he had had before the head injury and to subsequent experiences. He continued to dream, but said that since the accident his dreams had been "uncanny". He said: "When I dream I seem to know what is happening, but I don't seem to see a picture. I can dream about a person without seeing them and can remember the person, but not having seen them." He had no difficulty in reading or writing and could remember what he had learned by heart, but found it more difficult than previously to remember what he had written down, because he could not visualize it. He had some difficulty in spelling, which he attributed to the fact that he could not visualize the word. He had, as he put it, "to work it out".

When examined again ten years later, and fifteen years after his head injury, the patient's complaints were unchanged. His only defect in the sphere of speech was a slight degree of verbal

aphasia. There had never been any apraxia or agnosia, nor disturbance of appreciation of external space. The only disorder of the body-schema was his inability to visualize parts of his body. Nevertheless, he could identify spots touched on his body and mark them accurately on a chart. Routine examination of the fundi and central nervous system yielded no evidence of any physical abnormality. His visual fields were full and showed no central scotomas. There was a shelving circular depression 1½ in. in diameter in the mid-frontal region slightly to the left of the middle line. The report on the EEG on 31.5.51 was as follows: "The EEG is abnormal.

"Alpha activity at 11 c/s occurs in the posterior and central areas but is rarely dominant owing to an excess of fast activity at 20–24 c/s and of slow activity mainly at 5–7 c/s. The alpha rhythm is more clearly seen over the right hemisphere than the left. In both hemispheres it is blocked on eye opening. The fast activity occurs symmetrically but the 5–7 c/s waves appear more often on the left, especially frontally.

"On photic stimulation following responses occurred in both parieto-occipital regions though better on the right. With the eyes open and the lamp so placed as to stimulate mainly one half-field following responses were seen in the right hemisphere when stimulated and not in the left; with stimulation applied to the left hemisphere following responses were less clear and were mainly bilateral.

"The asymmetry of alpha activity is within the limits of normal for a right-handed person, but the impairment of response to photic stimulation on the left is possibly indicative of cortical damage."

Dr. O. L. Zangwill and Dr. J. McFie kindly carried out psychometric tests upon this patient with the following results (31.5.51). Tested on items of the Bellevue scale, this man's intelligence was placed in the superior range with I.Q. about 130. Impairment of some tests sensitive to organic deterioration, 14%, was no more than normally expected at his age, and his performance on tests of retention and learning of visual material was adequate. He had some difficulty in verbal learning, and complained of poor memory for names: his spelling was also slightly impaired. Of the Bellevue scale, he did significantly poorly on the picture arrangement test, which is particularly sensitive to frontal lesions.

Dr. Zangwill commented that "there is no doubt that a degree of intellectual loss on formal tests is negligible and, apart from some impairment of spelling, we were unable to elicit any clear-cut signs of organic disability. Despite his complaint of having lost his visual imagery, he is able to deal quite adequately with visual material when asked to describe it from memory. Thus his "memory span" for a number of objects presented in succession is as good as his "memory span" for words or digits. In cases with focal visual retention defects, I have almost always found that immediate memory for a number of visual objects presented in succession is significantly reduced. He is also able to draw designs and describe pictures from memory entirely adequately. Of course one must bear in mind that normal individuals who claim to experience no visual imagery can do this, but cases with defects of visualization usually show some impairment of such tests." Both Dr. McFie and Dr. Zangwill raised the question whether the patient's loss of visualization could be neurotic and a reaction to the emotional stress associated with his accident in which his first wife was killed, but Dr. Zangwill agreed that if a neurotic element could be excluded he thought the case could be accepted as presenting a circumscribed defect of visualization in the absence of other signs of intellectual or memory loss (apart from the very slight dysphasic residua).

Case II.—Male, a bank manager, right-handed. In 1945, at the age of 50, he tripped over the entrance to the strong room at his bank and hit his head on a steel cupboard, striking the right fronto-vertical region. He became unconscious, but did not know for how long and recovered consciousness lying on the ground. He was taken home and according to his wife he was not completely conscious for three or four days. He remained in bed for three weeks suffering from headache. When seen nine months after the accident he said "I cannot visualize anything. If I go into a shop or a building, or if I look at a picture, and I want to describe it afterwards I can't see it. If I want to remember what I have been reading I have always visualized the print itself: now I can't do that". He could not visualize his wife's face. He said he could visualize things only "if they come to me as an impression, but I can't make them come". Nevertheless, he never had any difficulty in recognizing either people or objects. He said he could draw a plan of his house, or of the route from the station, but this would involve working it out and would be a slow and difficult process. He said: "I can think of a cucumber or a chair, but I cannot see it. I can't see anything if I shut my eyes". He had experienced no difficulty in speech, reading or writing, but he had noticed some difficulty in adding up columns of figures. There had been no disorientation for external space and the only disorder in the sphere of the body-image was that he could not visualize parts of his body.

Investigation of this patient's powers of visualization revealed that they were greatly influenced by opening the eyes. As he had stated that as soon as he shut his eyes he could not see anything at all, he was asked to close his eyes and then try to visualize his house. He then said: "I know that there is a house in the road there, a semi-detached house. It's a terrible strain to picture, because no picture comes". He was then told to open his eyes and continue to describe his house and he then said: "It is semi-detached, white stucco on the right and virginia creeper with a green door and bow windows." The experiment was repeated and he was asked to close his eyes and try to visualize his wife's face and he said: "Only an impression, a quick impression, and it's gone as soon as it comes." He was then asked to do the same with his eyes open and he said "Oh, she's full-faced with greying

hair, heavy eyebrows, grey-blue eyes, a retroussé nose and full mouth." He then said: "Everything is more easy with the eyes open without exception." He was then asked to close his eyes again and describe his own foot. He said: "I can't see a foot: I can't visualize anything at all when my eyes are shut." He was then asked to open his eyes and promptly described a naked foot in detail. He had no aphasia or agnosia. His answers in the 100–7 test were correct. He was able to repeat 7 digits forwards and 4 backwards, and he succeeded in repeating a Babcock sentence accurately at the second attempt.

Routine examination revealed no abnormality in the fundi, visual acuity, visual fields or central nervous system elsewhere.

The patient was seen again six years later and his condition in respect of the symptoms described was unchanged. Six months previously, however, he had been admitted to a mental hospital on account of an attack of depression for which he had been treated with electrical convulsant therapy and modified insulin treatment. When I saw him on the second occasion he was again depressed and I admitted him to hospital with a view to treatment and in the hope of carrying out further investigations, including electro-encephalography. Unfortunately, however, he became worse and had to be certified. He was sent to a mental hospital, where he was subsequently regraded as a voluntary patient, and one day he walked out of the hospital without giving notice and was later found dead on the railway line.

The two patients whom I have described present more features of theoretical interest than it is possible to discuss fully now. Loss of visualization is usually found in association with other forms of higher visual disability; Charcot's patient, for example, suffered from word-blindness—but only when it is encountered in relative isolation can its nature be investigated. The suggestion was made in the case of my first patient that it might be a neurotic symptom, and my second patient suffered also from psychotic depression. But my first patient had in no way a neurotic personality and I do not believe that so clear-cut a syndrome, characterized by symptoms possessing no conscious relationship to each other, and occurring in every case after organic lesions of the brain, is other than organic in origin.

If this be accepted, the main interest of the syndrome is psychophysiological. The loss of visual imagery was more complete in Case I than in Case II, in whom visual images sometimes occurred spontaneously though in an impoverished form, and not under the control of the will. The patient exhibited a striking enhancement of visualization when his eyes were open, as though stimulation of the visual cortex strengthened visual imagery. It is unfortunate that this could not be tested electro-encephalographically. In Case I there was an asymmetry in the response to photic stimulation.

Perhaps the most surprising feature is how little the loss of voluntary visualization impaired functions in which visual imagery might have been expected to play some part. Thus, patient No. 1 had a normal memory span for visual objects and could draw designs and describe pictures from memory. Similarly, though he could not visualize parts of his body, he could chart a point touched upon an outline drawing of the body. Charcot's patient showed the same features. It would seem, therefore, that a patient who has no power of voluntary visualization can, nevertheless, recognize objects and persons, accurately propositionize about them, as Hughlings Jackson might have put it, and also reproduce objects graphically. It follows that visual imagery is not essential to these processes, which therefore must depend upon neurophysiological schemas which do not themselves enter consciousness. And the same is true of dreaming, which in patients who have lost the power of visualization continues without visual images.

What, then, is the value of visual images? The image, whether visual or otherwise, in so far as it is a representation of an object reproducible at will, has the great value of enabling thought to deal with the object in its absence, and the visual image being spatially extended has the special advantage of facilitating imagined action in space. Its function, in fact, is well illustrated by the hampering effect of loss of visualization upon the builder designing a house.

My patients throw no light upon the situation of the lesion responsible for the loss of visualization, but there is some evidence suggesting that it is probably in the parastriate region.

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Basilar Artery Stenosis and Thrombosis

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INTRODUCTION

INTEREST in arteriosclerotic brain disease has been increased, or revived, in recent years for several reasons. These include the common use of arteriography, newer physiological observations of cerebral circulation, and the increased recognition of carotid artery occlusions. Verification by angiography of arteriosclerotic stenosis and thrombosis of the internal carotid artery has been