Broca's and Wernicke's language areas

is divided into two major components named after the pioneers Paul Broca and Carl Wernicke. Broca's area lies in the third frontal convolution, just anterior to the face area of the motor cortex and just above the Sylvian fissure. This is often described as the motor, or expressive, speech area; damage to it results in Broca's aphasia, a language disorder characterized by deliberate, telegraphic speech with very simple grammatical structure though the speaker may be quite clear as to what he wishes to say and may communicate successfully. Wernicke's area is in the superior part of the posterior temporal lobe; it is close to the auditory cortex and is classically considered to be the receptive language, or language comprehension, centre. A patient with Wernicke's aphasia has difficulty understanding language; his own speech is typically fluent but is empty of content and characterized by circumlocutions, a high incidence of vague words like "thing," and sometimes neologisms and senseless "word salad." The entire posterior language area extends into the parietal lobe and is connected to Broca's area by a fibre tract called the arcuate fasciculus. Damage to this tract has been implicated in conduction aphasia, a disorder in which the patient can understand and speak but has difficulty in repeating what is said to him. The suggestion is that, in this condition, language can be comprehended by the posterior zone and spoken by the anterior zone, but it can not be easily shuttled from one to the other.

Distinction between aphasia and apraxia

It is important to note that aphasia is a disorder of language and not of speech (although an apraxia of speech, in which the programming of motor speech output is affected, may accompany aphasia). The writing and reading of aphasic patients, therefore, usually commits the same type of error as their speech, while the reverse is not the case. Isolated disorders of writing (dysgraphia) or, more commonly, reading (dyslexia) may occur as well, but these reflect a disruption of the additional processing required for these activities over and above that required for language.

One particular form of dyslexia deserves mention, as it is a clear example of a disconnection syndrome—a disorder resulting from the disconnection of two areas of the brain rather than from damage to a "centre." This is dyslexia without dysgraphia, or letter-by-letter reading, so called because it is not associated with writing disturbance and because the patients tend to attempt to read by spelling words out loud letter by letter. It usually results from a lesion in the posterior part of the left hemisphere that disconnects the visual areas of the brain from the language areas. This renders the language areas effectively blind, so that they cannot be brought to bear on visible language such as the written word. Writing is unaffected because the right hand is still connected to the left hemisphere, and, if letters can be spoken out loud correctly (which is not always the case), the patient will be able to hear himself say them and reintegrate them into words. Disconnection syndromes are an important concept in understanding behavioral disorders associated with brain damage. The possibility that deficits are caused by disconnection must always be borne in mind.

MEMORY

Memory is one of the most widely studied cognitive functions, and a number of different aspects of memory are recognized. The labels short-term memory, primary memory, and working memory refer to the temporary storage of information that is necessary for the performance of many cognitive tasks. In order to understand this sentence, for example, a reader must maintain the first half of the sentence in working memory while reading the second half. This working memory has been graphically described as the memory one uses to hold a telephone number in mind after looking it up in a directory and while dialing. The capacity of working memory is limited, and it decays if not rehearsed. Long-term memory, secondary memory, and reference memory refer to the storage of information for longer periods. The capacity of long-term memory is very large—in practice unlimited—and it can endure indefinitely. In addition, psychologists distinguish episodic memory, a memory of specific events or episodes normally described by the verb remember, from [illegible] memory, a knowledge of facts normally said to be [illegible] rather than remembered.

Almost certainly, memory is stored over wide [illegible] the brain rather than in any single location. [illegible] amnesia, a disorder of memory, can occur after [illegible] ized bilateral lesions in the limbic system—notably [illegible] hippocampus on the medial side of the temporal [illegible] some parts of the thalamus, and their connections. [illegible] probably implies that these structures, rather than [illegible] constituting a memory store, are important in the [illegible] down of memories and in their recall when needed. [illegible] ory impairment resulting from damage in these [illegible] a disorder of long-term episodic memory and is predominantly an anterograde amnesia—that is, it typically affects the memory of events occurring after the illness or accident causing the amnesia more than it does memories of the past. Substantial retrograde amnesia (loss of the memory of events occurring before the onset of amnesia) [illegible] if ever occurs without significant anterograde amnesia as a result of brain damage, although it may occur alone in psychiatric illness.

Although amnesia is a disorder of long-term episodic memory and leaves short-term and semantic memory intact, both of the latter can be affected by brain damage. Some parietal lobe lesions may affect short-term memory without affecting long-term memory; this fact has contributed to a revision of the old theory that there are distinct short- and long-term stores, the latter being accessible only via the former. It has been suggested that short-term memory impairment—at least for verbal material—can be further subdivided into auditory and visual domains; however, these disorders manifest themselves in difficulty in understanding spoken and written language rather than in memory impairment (*i.e.*, they appear more like aphasia and dyslexia). Impairment of semantic memory, too, results in an impairment that resembles a loss of concepts or a language deficit more than it resembles what would usually be described as a memory impairment. Some forms of visual agnosia have been interpreted as semantic memory impairment, since the patients are unable to recognize objects such as chairs because they no longer "know" what chairs are or what they look like (or can no longer access that knowledge).

EXECUTIVE FUNCTIONS OF THE FRONTAL LOBES

The frontal lobes are the part of the brain most remote from sensory input and whose functions are most difficult to capture. They can be thought of as the executive that controls and directs the operation of the brain systems dealing with cognitive function. Indeed, the deficits seen after frontal lobe damage have been described as a "dysexecutive syndrome."

Frontal lobe damage can affect people in any of several ways, and the results are at once subtle and drastic. On the one hand, they may have difficulty initiating behaviour, in extreme cases being virtually unable to move or speak but more often simply having difficulty in getting started on a task. On the other, they may perseverate, being apparently unable to stop a behaviour once started. Rather than appearing apathetic and hypoactive, they are uninhibited, rude, and boorish. Such people may also have difficulty in planning and problem solving and may be incapable of creative thinking. Mild cases of this deficit can be revealed by a difficulty in solving mental arithmetic problems that are couched in words, even though it can be shown that the patient is capable of remembering the question and performing the required calculation. In such cases it appears that the patient simply cannot work out what to do, a difficulty described as a failure to select the appropriate cognitive strategy.

A unifying theme in these disorders is the notion of inadequate control or organization of pieces of behaviour that may in themselves be well formed. Frontal lobe patients are easily distracted. Although their deficits may be superficially less dramatic than those associated with posterior lesions, they can have a drastic effect on everyday function. Irritability and personality change are also frequently seen after frontal lobe damage. (G.Ra.)