What it is

The symptoms of dementia are commonly listed as memory loss, short attention span, disorientation, impaired judgement, illogical thinking, incapacity for abstract thought, inappropriate emotional responses and the inability to perform the activities of everyday life. These are all associated with general ageing but with Alzheimer's the decline is much more rapid. As mental powers decline, use of the English vocabulary becomes increasingly vague. We need our memory for everything, Alzheimer's is a gradual deterioration into non existence, eventually the sufferer forgets how to walk, talk, eat and in the final stages breathe. Unfortunately this reflects the reality of most sufferers and their carers because at present, there is no cure and the conventional management of the illness holds out little hope of well being.

History

In 1907, a 51-year-old woman came to see the German neuropsychiatrist Alois Alzheimer. Although previously healthy, 'Frau D' (as Alzheimer called her) had begun to lose her memory of things that had recently happened, and she soon began to forget what time it was, where she was and what she was doing there. These difficulties became progressively worse, and Frau D then suffered from severe depression, hallucinations, 'morbid jealousy' and delusions of persecution. By the time she died, she had lost all mental functions, including the ability to speak, was physically deformed and was incapable of carrying out the most basic daily tasks such as eating, dressing and going to the toilet.

After the death of the unfortunate Frau D, Dr Alzheimer examined her brain. Using a newly invented technique of staining slices of brain tissue, he found that her brain contained many dark 'spots' not seen in a healthy brain. The doctor believed that these spots caused the changes in behaviour and the decline in brain function that he had observed. In a paper published in 1911, Alzheimer described Frau D's fate and his subsequent findings, and the collection of symptoms that he outlined came to be known as 'Alzheimer's disease' (AD). Most of the symptoms currently recognised as AD were identified in his original study, and his scientific discoveries have been confirmed by modern research.

We now know that 'spots' seen by Dr Alzheimer are actually **neurofibrillary tangles** and **senile plaques**. These 'neurofibrillary tangles' are thought to damage the internal structure of the healthy nerve cells and prevent the transport of essential chemicals within their cell bodies.

Mechanism of Deterioration

The brain is your most powerful organ, yet weighs only about three pounds. It has a texture similar to firm jelly. It has three main parts:

a) The **cerebrum** fills up most of your skull. It is involved in remembering, problem solving, thinking, and feeling. It also controls movement.

b) The **cerebellum** sits at the back of your head, under the cerebrum. It controls coordination and balance.

c) The **brain stem** sits beneath your cerebrum in front of your cerebellum. It connects the brain to the spinal cord and controls automatic functions such as breathing, digestion, heart rate and blood pressure.

The brain's wrinkled surface is a specialized outer layer of the cerebrum called the cortex. Scientists have "mapped" the cortex by identifying areas strongly linked to certain functions. The real work of your brain goes on in individual cells. An adult brain contains about 100 billion **nerve cells**, or neurons, with **branches** that connect at more than 100 trillion points. Scientists call this dense, branching network a "neuron forest." **Signals traveling through the neuron forest** form the basis of memories, thoughts, and feelings. Neurons are the chief type of cell destroyed by Alzheimer's disease.

Signals that form memories and thoughts move through an individual nerve cell as a tiny electrical charge. Nerve cells connect to one another at **synapses**. When a charge reaches a synapse, it may trigger release of tiny bursts of chemicals called **neurotransmitters**. The neurotransmitters travel across the synapse, carrying signals to other cells. Scientists have identified dozens of neurotransmitters. Alzheimer's disease disrupts both the way electrical charges travel within cells and the activity of neurotransmitters.

100 billion nerve cells. 100 trillion synapses. dozens of neurotransmitters. This "strength in numbers" provides your brain's raw material. Over time, our experiences create patterns in signal type and strength. These patterns of activity explain how, at the cellular level, our brains code our thoughts, memories, skills and sense of who we are. Positron emission tomography (PET) scans can show typical patterns of brain activity.

Specific activity patterns change throughout life as we meet new people, have new experiences and acquire new skills. The patterns also change when Alzheimer's disease or a related disorder disrupts nerve cells and their connections to one another.

Alzheimer's disease leads to nerve cell death and tissue loss throughout the brain. Over time, the brain shrinks dramatically, affecting nearly all its functions. Massive cell loss changes the whole brain in advanced Alzheimer's disease. In the Alzheimer's brain:

The cortex shrivels up, damaging areas involved in thinking, planning and remembering. Shrinkage is especially severe in the **hippocampus**, an area of the cortex that plays a key role in formation of new memories. We all lose brain cells as we age, but most people can perform perfectly adequately without them, perhaps because the remaining neurones make up for the lack by creating more connections with each other. In Alzheimer's, however, the loss is catastrophic, and it occurs in those areas where the number of tangles is greatest - particularly in the **hippocampus** or medial temporal lobe, which can be reduced to half or even less of its normal size within only three or four years. The entire brain also shrinks and may lose up to a third of its weight. **Ventricles** (fluid-filled spaces within the brain) grow larger.

Scientists can also see the terrible effects of Alzheimer's disease when they look at brain tissue under the microscope:

Alzheimer's tissue has many fewer nerve cells and synapses than a healthy brain. **Plaques,** abnormal clusters of protein fragments, build up between nerve cells. Dead and dying nerve cells contain **tangles,** which are made up of twisted strands of another protein. Scientists are not absolutely sure what causes cell death and tissue loss in the Alzheimer's brain, but plaques and tangles are prime suspects. Plaques form when protein pieces called **beta-amyloid** clump together. Beta-amyloid comes from a larger protein found in the fatty membrane surrounding nerve cells. Beta-amyloid is chemically "sticky" and gradually builds up into **plaques**. The most damaging form of beta-amyloid may be **groups of a few pieces** rather than the plaques themselves. In addition, 'senile plaques' form and are deposited mainly outside the neurones. **Beta-amyloid** when mature, appears to have a defined structure, with an inner core containing various minerals. There is little doubt that, when present in large numbers, they interfere with the transmission of messages from one neurone to another. However, 1 in 3 people over the age of 65 who are positive for amyloid plaques do not show any sign of Alzheimer's.

The amounts of certain neurotransmitters also seem to be important. There are at least 80 of these chemicals in the brain, each with a different role to play. Examinations of the brains of Alzheimer's sufferers after death have shown that there are much lower levels of some of the neurotransmitters than in the brains of people without Alzheimer's. The small clumps of amyloid may block cell-to-cell signalling at synapses. They may also activate immune system cells that trigger inflammation and devour disabled cells.

Tangles destroy a vital cell transport system made of proteins. In healthy areas, the transport system is organized in orderly parallel strands somewhat like railroad tracks. Food molecules, cell parts and other key materials travel along the "tracks." A protein called **tau** helps the tracks stay straight. In Alzheimer's disease, minute bundles of a protein called **tau** accumulate abnormally in some neurones, collapsing into twisted strands called **tangles**. The tangles appear to have a predilection for certain sites in the brain - for example, **pyramidal cells** in the parts of the **cerebral cortex** where 'thinking' is carried out, and particularly in the **temporal lobes** where, it is believed, memory resides and complex mental processing takes place. The tracks can no longer stay straight. They fall apart and disintegrate. Nutrients and other essential supplies can no longer move through the cells, which eventually die.

Plaques and tangles tend to spread through the cortex in a predictable pattern as Alzheimer's disease progresses. The rate of progression varies greatly. People with Alzheimer's live an average of eight years, but some people may survive up to 20 years. The course of the disease depends in part on age at diagnosis and whether a person has other health conditions.

Earliest Alzheimer's - changes may begin 20 years or more before diagnosis.
Mild to moderate Alzheimer's stages - generally last from 2 - 10 years.
Severe Alzheimer's - may last from 1 - 5 years.