3 The miracle of the human brain

The human brain is the greatest wonder of creation. This little organ weighs only 1500 grams, but contains more nerve cells than there are people on the earth, more than 10,000 million a simply unimaginable number. Each nerve cell is joined to others by hundreds of little offshoots, and the exchange of information between them is brisker than the telephone exchange of a busy capital city. The number of »telephone connections« in one brain exceeds the number of stars in a galaxy. It would be more than 1,000,000,000,000! No computer or telephone exchange is in a position to store and exchange so much information in such a small space as that occupied by the human brain.

What do you know about your brain?

Most people talk casually about their »little grey cells« without ever taking account of what goes on inside them. While you are reading these words, your brain is carrying out a vast number of highly complex functions. You are turning the pages with the most delicate movement of your muscles. The muscles in your eyes are adjusting so that you can see with equally sharp clarity in changing light conditions. Your retina is picking out the letters on the paper and reducing them to tiny points which the optic nerve sends on in the form of an impulse code to the visual centre, where the words are reassembled into a new picture.

Of course the purely visual recognition of the words isn't enough. The

meaning of the words is fed in at the speech centre, so that the sentence can be compared with information already to hand. This reservoir is gigantic. It holds tens of thousands of words with every possible nuance of meaning. And there is more: Many words and sentences evoke feelings in us – both positive and negative. Often pictures which have impressed us come to the surface.

So a colossal amount of information is bound up with every word, which is recalled to consciousness in fractions of a second, each time it occurs. So the description of an apparently commonplace task performed by our brain leads into the miracle of information handling, memory consciousness and beyond into the riddle the brain always poses us. Even the well known brain researcher and Nobel prize winner John Eccles recognises: »We are always on the brink of understanding the mystery that we are«. The little that is known already is more than enough to fill whole libraries.

The Brain and Psychiatry

Knowledge about the processes inside the brain has opened up new ways to understand and treat psychiatric illness. Biological psychiatry has seen an enormous increase in popularity since the introduction of psychopharmacology fifty years ago, and the successes seem to support it. Drugs have changed psychiatry. In Switzerland it has been possible to remove more than 25% of the beds in psychiatric hospitals in the last forty years alone. In 1931, 155'000 people were treated in psychiatric hospitals in Germany, for an average of 300 days each. In 1983, only 85'000 for an average of 125 days, which is a reduction of more than 70% in the number of hospital days.

Many patients who would have needed permanent hospitalisation before 1950, can now live at home, thanks to medication. To get a better understanding of severe psychiatric illness, we have to apply ourselves to the miracle of the brain – a sheer impossibility in a book which aims to be understood by the average reader. For this reason I will often need to simplify things and use pictorial images for better understanding.

Modern brain research has eroded the sharp division between »organic« and »mental« illness. Earlier only brain damage and degeneration of the brain through ageing were recognised as »organic« disturbances, especially in the literature concerned with pastoral counselling, though also in psychoanalytical circles.

This view can be compared with an investigation of a defective telephone exchange in which the engineers pay attention only to the broken switches and corroded cables, whereas we know that the effectiveness of a telephone exchange depends on connections being properly made. These cannot be corrected simply by repairing the existing components. In the same way, we have now become aware that the important thing about the brain is not just the number of »grey cells«, but how they exchange information with one another.

A Map of the Brain

Where are the movements of the arms and legs steered from? Where is the memory situated? Which part of the brain processes the sounds of a thundering organ prelude, and which the colours of a summer meadow? Which area directs our speech? And which centre tells us we are experiencing hunger, thirst, or tiredness?

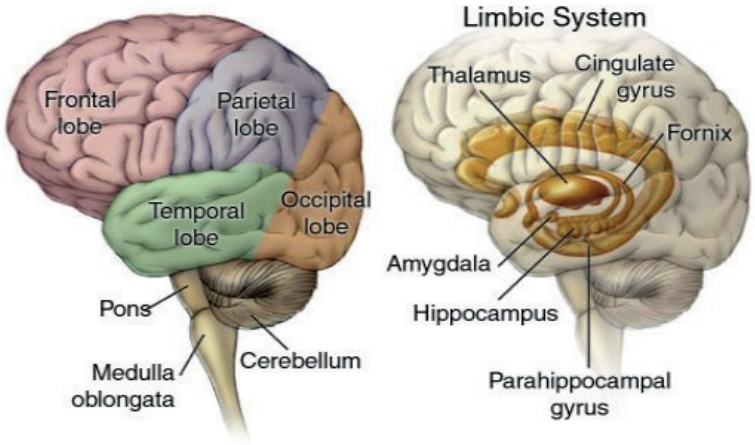
The answers to these questions stem from a mass of tragic experiences. They have been gained as a result of observing people who have suffered from brain damage in an accident, or as a result of a tumour. In them it became apparent, for instance, which functions were affected if someone was injured on the left temple. In this way, over the years, it was possible to build up a map of the brain. Figures 3.1 gives a rough overview, which are much more detailed in modern textbook (or on the internet). Nevertheless, even the most comprehensive presentations are something like a map of the world on which one looks in vain for the streets of a particular city.

The Search for Personality

When Trevor (not his real name) rejoined the youth group, after his severe motor cycle accident, everyone rejoiced with him. »What? Were you really unconscious for four weeks? No one would know to look at you now,« said his friends. Again and again he had to point to the scar on his forehead, but otherwise, there was nothing wrong with him. Yes, he could move everything, and he was as athletic as before, yet something was different. No one could quite say to begin with what it was.

The young man, who seemed so venturesome before, was now quieter and less cheerful. He did his work, but often walked off in the middle of it to eat a snack. If rebuked, he would react in an excessively injured way, and

Figure 3.1: The human brain



burst into tears. Yet five minutes later, he would embrace his boss, talking exuberantly. He behaved the same way in the youth group. Previously, faith had been very important to him, but now he often seemed indifferent. Towards girls, he was forward and obtrusive. If someone reprimanded him, he was sorry for his behaviour, but after a short time seemed to have forgotten everything once more.

Trevor has sustained an *injury to the frontal lobe*, which has connections to every part of the brain, and coordinates its functions. It seems a centre is situated here which controls thought, behaviour and feelings. The discovery of this fact at the beginning of the thirties gave many scientists the hope that they had at last found the location of the personality, indeed of the soul. Attempts were made to change people through brain surgery, but the results soon proved disappointing. Today, such operations are only carried out in rare cases of severe aggression or epilepsy, when all other methods have failed.

The World of Brain Cells

Since then the world of science has turned its attention to research on the functions of brain cells and neuronal networks. Each cell is a world on its own, as complex as a computer. In a multitude of tiny organs highly specialised biochemical substances are produced, which are of the highest importance for the correct functioning of the brain. They can store data, and can determine which impulses will be passed on to other cells.

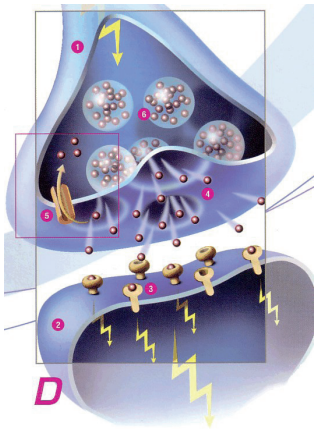
Every cell is connected to its neighbouring cells through a delicate branching network of hundreds of extensions. These convey either arousing impulses or inhibiting, calming ones. One could simplify the picture by talking about *brakes* and *accelerators*, but you must imagine a car which is provided with hundreds of brakes and accelerators. You would need a computer to work out when and how the car should move. However, this is what is happening in each nerve cell many times a second. When the arousing stimuli predominate, the cell begins to fire a staccato of impulses across its nerve fibres. When the restricting signals predominate, it becomes calmer.

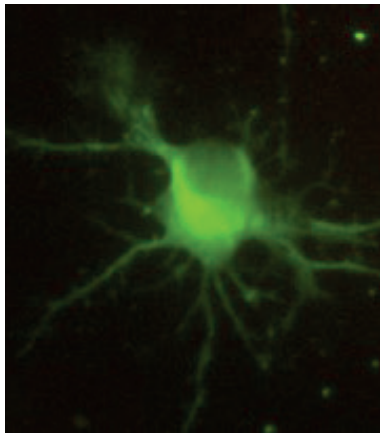
The Miracle of the Synapse

Earlier, the brain was thought to be a great electrical system. With the help of graphs of brain electrical activity (E.E.G.) it was possible to identify the »jamming stations« in the brain of an epileptic person, which led to the uncontrollable muscular spasms of a fit. It could also be demonstrated that an impulse was conducted as a weak current along the nerve fibre. But how could the signal be communicated to the next cell? Research with the electron microscope revealed the existence of bud-like thickenings at the end of each nerve fibre, which were separated from the membrane of other cells by a minute gap. This bud became known as the »synapse«. This small invisible thickening is so wonderfully made that the synapse soon took the centre stage in brain research. Figure 3.2 shows a diagrammatic representation of a synapse.

Biochemical substances are stored permanently in the little vesicles. When a nerve impulse arrives these vesicles empty into the synaptic gap. The substances that are stored within them act in a similar way to hormones. They are thus the essential carriers or messengers between the nerve cells. For this reason they are called neurotransmitters. These neuro-

Figure 3.3: Diagram of the synapse and microscopic picture of a nerve cell.





transmitters can pass on quite specialised information to the neighbouring cells. They work like a key which will only fit a certain lock, but this means that there has to be such a lock, or receiver, on the membrane of the neighbouring cell. The interplay between transmitter and receiver is regulated by a whole range of other substances (neuromodulators). So far, science is only partially able to unravel the exact code. Nevertheless researchers have already made sensational discoveries.

Valium – A Synthetic Neurotransmitter

It has been a well known fact that not everyone experiences pain in the same intensity. A friend described an interesting experience to me. He was on a mountaineering expedition, on a steep face when a storm blew up. Time was short. He banged the irons into the granite with all his strength, in order to reach the summit as quickly as he could. When he reached the top, he noticed a strange throbbing in his thumb, and was shocked to find that it had been badly bruised, quite blue and bleeding – yet during his climb he had felt no pain. How was that possible?

The neurotransmitters give us the explanation. Today we are aware of various substances in the brain which we call »endorphins« or »encephalins«, which display a distinct pain-restricting effect. Many encephalins produce a calming effect. Others can release anxiety. Research teams succeeded in demonstrating specific receptors binding with the widely available tranquilliser valium. There must be substances in the brain therefore, produced by the body itself, which exercise a calming action, like valium. The opposite is also possible, that valium prevents anxiety releasing substances from binding themselves to these receptors.

One thing is certain: biochemical substances play an important role in our feelings, whether it is panicking anxiety, or cheerful relaxation, nervous unrest or inner calmness. However, resorting too hastily to tranquillising pills may be a dangerous shortcut to inner peace. The person may become calmer, but no longer learns to grow through the adversities of life.

On the other hand, one should not conceal the fact that even Christians can fall into a crisis where the nervous system is in such an uproar that the »furioso« of the anxiety arousing substances overrides the »piano« of the calming neurotransmitters. The result: the person becomes nervous, tense, anxious, and cannot sleep. Even despairing cries for help in prayer do not subdue the agonising fear and bring the sleep they long for.

This is a situation for introducing the responsible use of tranquillisers and antidepressants within the framework of a Christian understanding. These medications can open the way for a person to become so much more at peace that they can listen to God like before. Of course, in the process the indivdual needs instruction to become aware of unhealthy life patterns and how to contribute towards relaxation.

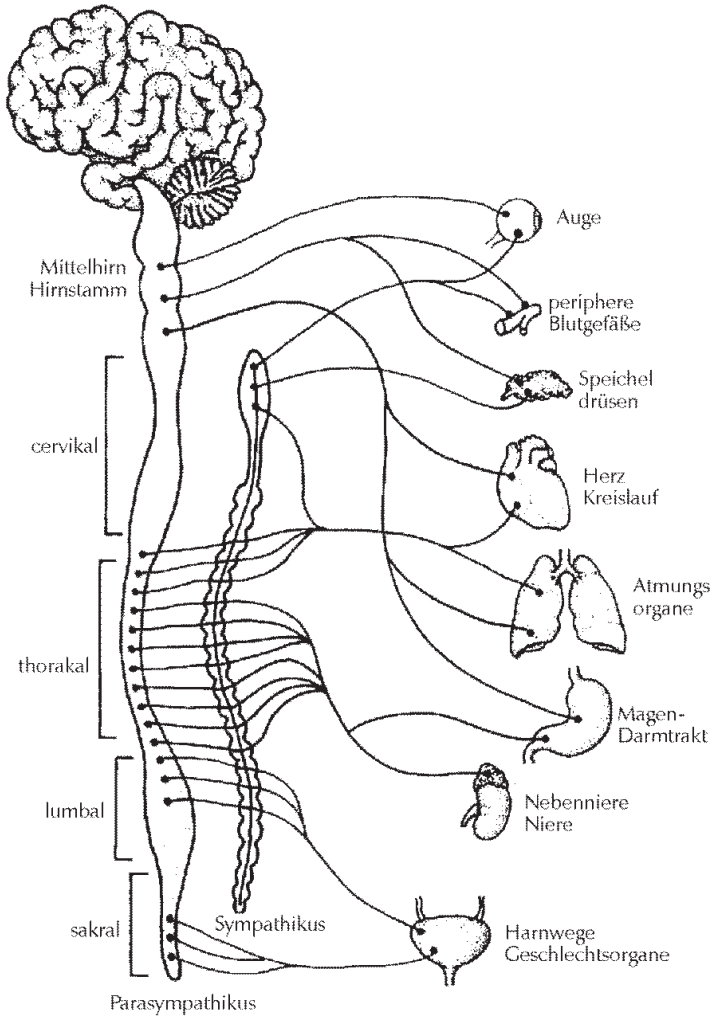
The Autonomic Nerve System

Feelings are not limited to the head. Fear is more than just a thought, and depression involves more than just simply looking at things through dark glasses. Often body language can tell more than words can express. These are age old observations, but they have been freshly understood and scientifically researched during this century through psychosomatic studies. Our speech is rich in images which give expression to the relationships between body and soul:

- We rack our brains over a problem which gives us a sinking feeling in the pit of our stomach.
- We have a heavy heart and sorrow brings a lump to our throat.
- Someone gets cold feet and their hair stands on end.

Such figures of speech are not just flowery ways to describe feelings; they say something about the connection between the brain and the body.

Figure 3.3: The autonomous nervous system



In the last decade, brain research has succeeded in lifting the veil to some degree from this psychosomatic area. It is, of course, a well known fact that every person possesses two nerve systems:

- the motor system, which directs the movement of muscles,
- and the autonomic (or vegetative) nerve system.

The autonomic nerve system weaves its way through all our internal organs, with the most delicate threads, and reaches every lymphatic organ, however small. It is supported in this by a wide variety of hormones (neuropeptides). Today we are aware of dozens of message carrying substances which control digestion alone. A small quantity of one newly discovered hormone can lead to massive suppression, of the appetite and may possibly have a role to play in anorexia nervosa.

Others alter body temperature, breathing, or the heart beat.These substances are released in the central region of the brain, where the seat of the feelings is thought to be, in the thalamus and hypothalamus, and it is now known that they are closely connected with the encephalins. So it is no wonder that psychological moods often lead to alarm signals in the autonomic nerve system: A beating heart, difficulty in breathing, hot flushes and cold shivers, constipation, or loss of appetite. Stress puts the whole autonomic nervous system into an uproar, and this »wailing siren« in the organs reinforces anxiety and depression in a vicious psychosomatic cycle and often brings the patient for the first time to see the doctor who then speaks ofvegetative dystonia or a psychosomatic disorder.

The Brain – A Computer?

We have now learned some of the brain's secrets: the nerve cells, the synapses, the neurotransmitters and the autonomic nervous system. But what does it need to integrate this accumulation of cells and biochemical substances into what we know as the human brain? Basically, the interaction of millions of brain cells makes it possible for us to think, feel, and act. I will quickly admit that the precise details of how the brain is governed are so far hidden from us. We cannot increase our knowledge as we would like, because any interference would destroy these delicate structures.

Nevertheless, we have in broad brushstrokes an idea of the important reactions in the brain which allows us to make better guesses as to how and why major disturbances can come about in the context of psychiatric illness. By way of illustration, I would like to briefly outline a model of the brain as a biological computer. In doing this, I do not want to reduce the human spirit to the level of a simple machine. That would be mistaken and stupid. However, the new discoveries in brain research show that many of the brain's activities do resemble those of a computer, for instance:

- Information gathering (through the sensory organs).
- Information sorting (is that shiny thing on the floor a piece of glass or a coin?)
- Storage of information (memory).
- Information retrieval (e.g. knowledge in a test) application of information (e.g. knitting a pullover according to a pattern).

Many disturbances can be better understood with the help of this model, schizophrenia for example (see chapters 9 through 11). In the process they lose their aura of the sinister and demonic, making room for a more compassionate viewpoint throughwhich genuine help will be possible for the first time.

The requirements of biblical pastoral counselling must not be diminished through this way of thinking about the brain. God has made our brain much more wonderful and complex than any computer will ever be. The way in which the brain processes information can be compared to a computer programme which can at times be disrupted and distorted. But which information determines the brain's thinking and behaviour will depend on a person's life history and inward attitude.

Spirit, Soul or Brain?

What then is the significance of the human brain in a Christian view of humanity? Has modem brain research rendered the soul an unnecessary myth? How can the discoveries of biological psychiatry be harmonised with spiritual concerns? If the brain is the control centre of a human being, what is the significance of the soul and spirit?

Many people seem to look at a person as a purely organic being controlled by an immensely complex computer called the brain. They believe that with the progress of brain research, human behaviour and its disorders will be understood more fully and even better treated. On the other hand, the serious scientist is aware of the provisional nature of his knowledge – »We know in part«. This sentence from the Apostle Paul is still valid in the twentieth century. The results of brain research have revealed something of the wonderful construction and complex functioning of the brain, but hasty conclusions about the nature of the human existence would be premature.

For this reason I find no contradiction between the discoveries of brain research and what the Bible says about human nature. The »spirit or the brain?« question is as complex as the existence of a symphony. What makes a symphony unique? The way the instruments are constructed, or the notes in the score? The dots of printer's ink on the paper, or the sound waves? All these are needed if we are to experience the glorious sound of a concerto. So it is with the human spirit. It needs the brain as an instrument, to communicate itself to others, but the spirit in itself is eternal, beyond material constraints. Personality is like a symphony. The question is:

Who writes the score of a person's life? Whom does the person allow to touch the chords of his instrument?

Again, the sound of a symphony is not only dependant on the virtuoso skill of the musicians, but on the creators of the instruments. Instruments can go out of tune, become warped or even broken, and they cannot always be repaired. This is where we find the limits of the symphony of our lives.

Here we see the significance of our view of human nature. *Damaged instruments are worthless and distressing. For materialists everything stops with the extinction of the brain function, and for the society of the strong, the weak are unimportant and inconvenient. But for God, even a broken harp with hanging strings is of eternal value.*

References

for more details search the Internet