5

Some Theories of Brain and Mind

- **The need for consciousness**
- **A hierarchy of memory**
- **Brain models**
- **A model perspective**

'The brain is not an organ of thinking but an organ of survival like claws and fangs.' (*Szent-Gyorgi*)

In comparison with other animals, human beings are relatively slow and ineffective. Our physical strength and general performance fall far below that of animals of our own size. The human life-span is also short when compared with such different animals as the elephant or the Galápagos tortoise which limits the amount of human accumulated experience. We cannot remain in water for a long time, or fly; our body can only survive within a very limited internal and external temperature range and we must have oxygen to breathe.

We tire rather fast and spend half of our life time resting or sleeping. During the other half we are mostly hungry and engaged in eating or digesting food. The range and sensitivity of our sense organs are also limited; especially in comparison with birds and insects we are not able to see as far or to detect rapid movements. Our hearing and smell are inferior in comparison with that of our own dogs. All our senses are easily saturated by information — not too much per unit of time and of right kind, please!

Copyright 2005. World Scientific.
All rights reserved. May not be reproduced in any form without permission from the publisher, except fair uses permitted under U.S. or applicable copyright law.

EBSCO Publishing : eBook Collection (EBSCOhost) - printed on 6/30/2020 11:17 PM via ALPHACRUCIS COLLEGE
AN: 210756 ; Lars Skyttner.; General Systems Theory: Problems, Perspectives, Practice (2nd Edition)
Account: s4114515.ACHED.ached

Psychologically, we are very subjective beings, always looking for a meaning to our existence. We often compile fragmented data from our senses to construct an artificial whole, sometimes initiating very strange decisions and actions. We are excellent at adapting reality to our personal maps, remembering selectively and putting new facts into old moulds. Facts are generally interpreted to our own advantage. What is unknown frightens us and we attempt to neutralize it by creating myths, rituals and traditions.

The above description ranks human beings low on the scale of existing animals but, looking around, we find ourselves to be in some ways extremely successful. In spite of our shortcomings we somehow solve difficult problems and make reasonable decisions in critical situations. Man is apparently something more than a featherless biped (in the words of Plato) — thanks to his brain with its outstanding information processing capability. This brain with its error tolerances is specialized in the weighing of uncertainty and making creative associations between different objects. It is also special because thoughts cannot be reduced to algorithms and because it is not programmed by an outsider. "The brain is merely Nature's latest means of self-preservation" (Rosh Ashby).

According to Miller's theory the brain is the equivalent of the decider and associator at the individual level. In Beer's *Brain of the Firm* the decider and associator at higher levels are treated as a metaphorical brain. In Lovelock's Gaia hypothesis we find humanity in the role of the huge, global brain of mother earth. Thus we uncover the idea of the brain function as a concept distributed among individuals in the higher levels of systems hierarchies. Genetically specialized individuals fulfilling the role of 'organizational brain' are not known in nature, although other essential functions such as the 'organizational reproducer' (queen bee) have been developed.

Apparently, the organizational brain is too important to be located in one single place as it manages functions directly involving the continuous existence of the organization. To minimize its vulnerability, a distribution strategy has been favoured by the development. Thus, in a sense Lovelock's 'global brain' exists everywhere and nowhere, something which also may be said of the individual mind. Therefore,

EBSCOhost - printed on 6/30/2020 11:17 PM via ALPHACRUCIS COLLEGE. All use subject to https://www.ebsco.com/terms-of-use

it is not possible to identify mind in a single part or centre of the brain. It is the specific mode of interaction between parts of the brain that give rise to the phenomenon of mind.

The mind-brain relationship can be exemplified by written language. No pre-established correlation between a sequence of characters and its meaning exists but at a given time and in a given context, a reliable correlation occur. A self-organizing and self-specifying process is at work.

When treating the human brain and its information processing, the traditional *body/mind* problem is brought to the fore. How can billions of interconnected nerve cells in a brain give rise to feelings, thought, purpose, and awareness?

Regarding the mind, some researchers maintain the *eliminativist position*. This tells us that the body-mind problem is no problem at all. It will simply disappear when brain functions are fully understood. Others see the mind as an *epiphenomenon*, a byproduct of physiological causes where the thoughts relates to the brain as the gall to the liver or the urine to the kidney. The mind is possible to explain by a suitable reduction to antecedent physical conditions. This has been the source of the witticism from generations of lecturers: 'What is mind? No matter. What is matter? Never mind'. While some reseachers maintain the eliminativist position (the body-mind problem is not really a problem at all and will disappear when brain functions are fully understood), other adhere that it has two aspects, one active and one passive.

Usually the active aspect is known as the question of how the conscious mind by its will can influence the motion of material objects. How can the mind, if it has no physical existence, initiate physical changes in the brain? The passive aspect questions how a material object such as the brain can evoke consciousness. How can brain-cell activity give rise to subjective experience of an 'I' looking out at the world?

The body/mind problem thus concerns free-will, intuition, creativity and the subjective unity of experience. The body/mind problem is today often interpreted in terms of quantum physics. The duality of body and mind reflects the basic duality between wave

EBSCOhost - printed on 6/30/2020 11:17 PM via ALPHACRUCIS COLLEGE. All use subject to https://www.ebsco.com/terms-of-use

and particle — the origin of our physical existence according to quantum theory.

*

The need for consciousness

An important tendency of life on earth is that it resides in individuals separated from each other. Therefore, in the hierarchy of nature, consciousness is found at the level of organisms where highly centralized nervous systems with a brain exist. It is not possible, however, to imagine consciousness without an existing memory. Awareness of every kind had to relate certain of its constituents to earlier, not too short, reminiscences. Experience stored in memory gives the possibility to evaluate new information without demanding it to be complete. In very simple terms, consciousness could be defined as the capacity of a system to respond to stimuli. To respond to stimuli is to adapt and adaption is a kind of learning which is the storing of knowledge. The evolution of higher levels of consciousness with expression of will and decision-making appears to rest heavily on the pertinent accumulation of knowledge. Consiousness is not possible to image without the concept of time. Without experience of time we cannot perform a mental synthesis; without that synthesis we cannot handle the flow of information.

The benefit of a conscious mind has sometimes been questioned from a biological point of view and its existence has been interpreted as a secondary product of its own work with no special function *per se*. A different, but well-known point of view is the classic philosophical **panpsychism** which states that consciousness is like the force of gravity and the phenomenon of electricity, an inherent attribute of all matter, an omnipresent quality gradually manifesting itself when matter becomes alive. Consequently, human consciousness does not differ *in nature* from consciousness of elementary life forms or matter, only in degree and complexity.

Several quite reasonable perspectives nevertheless state that consciousness has a strong survival value. To define why it has that value is however very difficult if you compare human beings with

EBSCOhost - printed on 6/30/2020 11:17 PM via ALPHACRUCIS COLLEGE. All use subject to https://www.ebsco.com/terms-of-use

early and primitive species such as ants and flies, which have survived for billions of years apparently without consciousness at all. Thus consciousness is not always necessary for survival. It has its costs and in many environments this is too high. In certain milieus where geographical placing and other environment-variables are important, the possibility of information processing within the individual life-span brings about many advantages. There, a brain with consciousness has its justification. During other circumstances, slower information processing during many generations is more suited to its purpose.

It seems, however, reasonable that consciousness has its most important role in handling entirely new situations where no prior references exist and difficult judgements have to be made. Consciousness allows for greater flexibility of behaviour than is achieved by preprogramming for even a wide range of possibilities. The need for guesses, extrapolations and forcasts justificates the existence of a conscious mind. The precalculation of possible actions implies no risks compared with real trial-and-error and increases chances for survival tremendously. To let bad ideas die instead of ourselves seems to be the very point of consciousness. An important function of the consciousness mind is that reflecting on your own behaviour allows you to predict the behaviour of others. Such predictions in not easy because human behaviour has built into it certain random variations of temperament and pattern of reaction which can trigger a fit of rage over petty incivility. These sudden changes of temperament make us less predictable and more difficult to exploit. They create a healthy respect and sensitiveness of hearing in the environment. No doubt, the most dangerous and fraudulent creature in human environment has been other specimen of her own race.

The recognition of other thoughts to measure our own against, is a focal point of self-awareness. When starting to project into the minds of others we discover our own mental life.

Maybe one can emphasize the special biological necessity of consciousness in connection with an all-embracing global catastrophe. Human beings may attempt to save their species below the water surface or orbiting in space until better circumstances return, thanks to a superior conscious intelligence and prognostic capability.

EBSCOhost - printed on 6/30/2020 11:17 PM via ALPHACRUCIS COLLEGE. All use subject to https://www.ebsco.com/terms-of-use

One of the most popular philosophical arguments for the need of a consciousness is the **antropic principle**, presented by ***John Barrow*** and ***Frank Tipler*** in 1986. This says that the laws of nature seem surprisingly well suited to the existence of life. The very nature of the universe seems to be creative and to include the existence of conscious beings, fulfilling the basic need for the universe to be aware of itself. It is in the end through human eyes that nature has attained the possibility to examine itself. Mind is therefore a necessary social artefact in both the history of the species and the individual. The interpretation of the antropic principle that life should arise inevitably given Earthlike conditions is known as biological determinism. A consequence of this concept is that there is structure in the world and this structure is recognized by the brain. The researcher Steven Weinberg has expressed it in the following way: 'The world is the way it is, at least in part, because otherwise there would be no one to ask why it is the way it is.' Furthermore, without the existence of human beings, reality would have neither form nor function. Consequently, the natural laws are designed to allow for the existence of conscious beings and reality exists as it does in order to create the proper conditions for human evolution. Our existence thus tells us something about the properties of the universe but also that the entire evolution of the universe is reflected in the human brain. As such the brain has got a built-in moral system to ensure its survival.

Regarding the antropic principle some followers prefer to interpret it in a more absolute way, thus coining the idea of a **strong antropic principle**. They proclaim that the existing state of the universe is inevitable and not a result of an accidental occurrence. It is impossible for us to consider another kind of universe as we could neither exist in it nor observe it (note the relationship with the interpretation of *superdeterminism* in Chapter 1). A corollary of the strong antropic principle is what has been called Tipler's 'beautiful postulate', namely that life, having once come into being, will continue for ever.

It is possible to impose a hierarchy of consciousness among living organisms from unconsciousness via consciousness to self-consciousness and omniconsciousness. In a broader context, these concepts are to be found in the higher **existential levels** which have been formulated by ***Ernst Schumacher*** (1978).

EBSCOhost - printed on 6/30/2020 11:17 PM via ALPHACRUCIS COLLEGE. All use subject to https://www.ebsco.com/terms-of-use

- The kingdom of minerals
- The kingdom of plants which compared with minerals have life
- The kingdom of animals which in addition have consciousness
- The kingdom of man which, in addition to minerals, life and consciousness, also possesses self-consciousness.

Another ingenious aspect of live and consciousness has been given by the philosopher of science, ***Karl Popper*** (1959). He states that the existence *per se* consists of three worlds; the physical world, the spiritual world with consciousness, and the world of ideas (the content of the consciousness).

Apparently, consciousness has to do with the physical complexity of the brain. A threshhold may exist above which consciousness sets in. That means that a species with one hundredth of the size and complexity of the human brain has not one per cent of our counsciousness. Consciousness is arguably an all or nothing phenomenon emerging on a certain level of complexity (regarding critical mass in the brain, see p. 143). Some biologists state that brain size is related to the need for animal vision. A correlation exists between brain size and social group size. The demand for an extremely good visual system related to social needs initiated the growing of the brain. The vision plays a main role in social interaction. Recognition of faces and interpretation of expressions was many times a matter of life and death. As a group member, the animal had to process an enormous stream of information in order to be sucessful.

The possession of consciousness is positively correlated to an organism's **intelligence**. This concept can be defined as the capability to change a pattern of instinctive behaviour through the use of experience. To do this, an aptitude to discern common elements of different situations is necessary, together with the ability to store this capacity for future use. Any intelligent organism processes information and has the **capability to learn**. The faster it learns, the smarter it is. An organism not able to learn cannot be considered intelligent. Learning itself is the enduring change in knowledge or behaviour resulting from experience.

Intelligence is close connected to an organism's ability to perceive and analyze its environment. The capability to interpret what happens

EBSCOhost - printed on 6/30/2020 11:17 PM via ALPHACRUCIS COLLEGE. All use subject to https://www.ebsco.com/terms-of-use

in the environment presupposes that the organism has an **internal model of the world**. Such mental representation is possible to change corresponding to external changes and furnish the capacity to predict the effects of alternative actions in the future. This reduces the need for costly trial and error, and enables man to undertake activities that pay off in the future like planting crops and breeding animals. To test alternative behaviours mentally is the basis of human ability to plan ahead, choose between alternatives, invent technology, and modify the external environment. If this works we have a definition of higher intelligence. As a matter of fact, the very sophistication and nature of an organism's intelligence is determined by its environment. Therefore, it can be measured as a ratio of the organism's ability *to control* its environment, versus its ability *to be controlled* by the environment. Consequently, it can also be measured as the amount of success with which the organism is able to create its own positive environment. Intelligence can only be measured in terms of intelligent behaviour and is an irrelevance for an organism in a static state. Characteristics associated with intelligence is thus connected with mobile organisms while immobile ones lack them.

Intelligence exists then among both animals and men. A real difference between animal and man is, however, very difficult to establish in spite of Schumacher's definition. One concrete difference between human species and other organisms is, that humans are able to develop a useful collective memory. This has been done by development of an oral and written cultural tradition passing information from one generation to the next. Storing and retrieving of information has been possible across both space and time. Therefore cultural evolution with its creation of art, religion, and science become more important than biological evolution.

According to the biologist ***Richard Dawkins*** (1989) the main concept behind the cultural evolution is the *meme*. This is the intellectual correspondence to the gene which lays behind all physical evolution. Memes are habits, skills, ideas, inventions or artistic expressions which are passed from person to person by imitation. They are the creators of our minds and also the cause of our big brains (serving to spread the memes). Human brain is the meme's

EBSCOhost - printed on 6/30/2020 11:17 PM via ALPHACRUCIS COLLEGE. All use subject to https://www.ebsco.com/terms-of-use

copying device and it evolved not to spread genes, but to spread memes. Like biological replicators as genes, memes follow the laws of *heredity, variation* and *selection*. Worth to note is that the idea of the meme itself has become a meme.

Memes are inherited when we copy the actions of others or when we pass on an idea. Some ideas are true and useful, others are copied despite being false. Variation (and also mutation) in memes takes place when we retell a story and small details get changed or something is forgotten. Selection exists when only certain parts of received information is passed on to anyone else. Memes which are clever to copy themselves, for whatever reason, would tend to spread. Memes which are copied stay with us — the rest die out. The size of memes can vary within very wide boundaries from some letters written on a paper to a whole book.

Human language must be considered a vast system for the transmission of memes by speech communication. Used as a broadcasting phenomenon, sound can transfer memes to many people at once. By the **invention of writing** and use of the modern alphabet about 700 B.C., big scale storing of memes was possible. This invention cannot be overrated and constitutes the foundation for all progress of the human civilization. It

- preserves the casual speech in an external lasting memory
- separates the speech from the speaker
- renders a formation of lasting concepts possible
- promotes deductions and sequential thinking
- facilitates order and objectivity
- accepts delayed answers

Both animals and man are strongly influenced by their mental world of **emotions** and **feelings** — the ultimate protective invention of nature to guard the organism. What the brain decides with its intelligence is thus motivated by feelings such as disgust or fear. The charge of the feelings is to manage all the important processes of thought. A feeling is the mind's way to summarize an extensive, unconscious mental process. Feelings sum up big all-embracing mental phenomena which reason and consciousness cannot access. In the

EBSCOhost - printed on 6/30/2020 11:17 PM via ALPHACRUCIS COLLEGE. All use subject to https://www.ebsco.com/terms-of-use

necessary choice between different alternatives, feelings constitute the overarching framework which makes such a choice meaningful instead of irrational. Strong feelings are the prerequisite for value-based, emotional decisions. Different kind of emotions like joy, shame, astonishment thus has to be regarded as various aspects of the internal information processing. The feeling paves the way for the interpretation of sensations. If not, we would all, have been bitten by a hissing snake long ago. Emotional states are an integral part of higher biological intelligence and thus also of social intelligence.

Some people state that the real difference between man and animal is embedded in human **morality**, a purely human capability to differentiate between good and evil. This argument is not very strong if one considers what people do to each other in everyday life; dolphins therefore seem to be absolutely superior in morality (Karl Marx states that the real difference between animal and man is indicated by the manner of which man organizes his production). It is also possible to assert that man separates from animal by producings his own provisions. To discuss the true location of morality may, however, be outside the scope of this book. Its origin and function may only be commented on as one of the significant qualities of the self-conscious mind.

A new variation of our ancestors, called *homo habilis*, the skilled man, emerged 2 million years ago. At that time the global climate suffered a dramatic deterioration with a series of ice ages. A main strategy for survival in an ever harder environment was social organization. This demanded a better awareness to cope with a quite new kind of complexity.

There is a strong relation between the size of the cerebral cortex and the group size within the species. A big cortex is necessary to handle complex intrigues and conflicts within a large group. Human beings are innate mind readers. The skill at imagining other people's mental states is a basic capability to avoid dangerous situations and remain in life. The language is not in the first hand used in communication, but to strengthen the social bond within the group. Its main function is to express feelings which are associated to social relations. Important is not what is told but how and to whom. The

EBSCOhost - printed on 6/30/2020 11:17 PM via ALPHACRUCIS COLLEGE. All use subject to https://www.ebsco.com/terms-of-use

informative function belongs to a later part of the development. Time available for grooming is not sufficient for the big group whereas one can speak to more than one person at the same occasion.

An emerging morality became an intelligent adaptation to demands for an improved sensitivity: to know what was right or wrong in a new complex situation of agreements, co-ordination and mediation of knowledge. Ethical behaviour, therefore, is not a luxury but a necessity in social systems of high density and complexity.

Morality is founded on a capability for **empathy**, the comprehension of the inner world and feelings of other beings, the very prerequisite of civilizing (that is, sympathy is to feel *for* somebody, while empathy is to feel *as* somebody). The consequences of individual actions and their impact on other creatures may thereby be predicted reasonably well. What is good or destructive for others is thus related to what should be good or bad for oneself. Symbolic thinking and an explicit understanding of concepts such as me and you are, here, the prerequisites. The continuous training in handling this complicated world of symbols is believed to lie behind the development of the brain as well as all kinds of moral actions.

No doubt, the emergence of **human language** was the most important reason for this development. By use of a language the internal, symbolic world could be conveyed to and understood by other individuals. The language which differ man from the animal has no limitations. It can describe things which is not here and now or that which does not exist. It can express the past as well as the future and communicate thoughts. Spoken language is an entirely new quality which is above body language. Contrary to body language it can express a negation, a denial of a kind that it is *not* raining. Sign language can express the concept of not but only as a recoding of spoken language. Animal which communicate by calls can only handle things which exist in the immediate environment. The capacity to imagine that which does not exist in the present is a main factor that differentiates man from animal.

A spoken language is governed by the will (Broca's area). But disregarding this, it is impossible for man not to communicate. We communicate both with what we are doing and not doing. Silence is

EBSCOhost - printed on 6/30/2020 11:17 PM via ALPHACRUCIS COLLEGE. All use subject to https://www.ebsco.com/terms-of-use

also communication. The calls and cries of animals are, however, unintentional and controlled by an evolutionary older part of the brain (below cortex). 'Language may not be the source of the self, but it certainly is the source of the "I"' — to quote the British reseacher Damasio.

The quality of empathy has, however, an unavoidable complication in the possibility to exert intentional cruelty in order to reach one's goals. Moral awareness based on deep emotions gives man the sophisticated power of both destruction and healing in relation to his fellow beings. Without these emotions, no values working as guidelines for action, should exist.

Returning now to **consciousness**, it is here defined as the ability to create an inner mental world, an abstract model of the reality by use of memory — inseparably connected to perception. This predictive model is used on the external environment and is constantly redefined and disregard tuned to the same with growing experience. Consciousness relates to basic feelings, e.g. pain, contentment, joy and sorrow. Vertebrates are in general conscious beings, albeit to varying degrees.

Self-consciousness is then the creation of active models of a reality wherein the individual self is included; these models serve for both explanation and prediction. A self-conscious mind produces alternative models, even of a non-existing future. Thus both interpretation and anticipation of a future built upon various activities is possible. Self-consciousness gives a freedom of choice and a capability to manifest one's own will. Such an aptitude which offers the possibility to determine one's own fate contributes to a tremendously increased pace of development. While the human brain is the most significant location of self-consciousness, this is also recognized among the more developed animals, e.g. chimpanzees and dolphins. Emergent properties of self-consciousness are the use of languages and artefacts and time- and death-awareness among human beings.

Although dwelling in a world surrounded by physical things created by themselves, human beings mainly exist in the world of symbols. A breakdown in this world of symbols can lead to mental disorder, serious mental diseases, and is often in the background

EBSCOhost - printed on 6/30/2020 11:17 PM via ALPHACRUCIS COLLEGE. All use subject to https://www.ebsco.com/terms-of-use

when suicide is committed. Thus mental diseases and suicide are unknown among other animals.

The highest mode of awareness, **omniconsciousness**, is based on a superior understanding of reality and exemplifies a new stage of development. It is characterized by some authors and philosophers as all-embracing and genuinely ethical and representing the ultimate degree of consciousness achieved by few human beings. Famous religious personages, e.g. Buddha, are said to have achieved this kind of consciousness. While this level is difficult to describe adequately using a lower level language, it can be said to include unity with the environment without the loss of individuality.

The personal ego is understood to be part of an eternal, universal consciousness temporarily residing in the actual body. Persons approaching this level of consciousness see no reason to assert their ego. They are not dependent on the surroundings or its fluctuations and see their own misfortune, losses and criticism of self as real, but not crippling. To be in this state is to witness one's own actions as if watching someone else. (The presented stages of consciousness is sometimes known as *ego-centric, socio-centric* and *world-centric.*)

Apparently, the expansion of consciousness leads to an expansion into space. The possible merging of individual consciousness into one single mind stretching from person to person all over the world has always fascinated both philosophy and science. The resulting global reservoir of information produced by all mankind is often called the *Universal Mind.* That simple forms of consciousness merge to produce higher forms is part of the evolutionary paradigm (see ***R. Fivaz*** 1989). This idea is also integrated in both the Gaia hypothesis and the nōosphere of Teilhard de Chardin (see Chapter 3). The merging process itself has been the subject for several authors, among them the cyberpunk ***Rudy Rucker*** in his book *Software* from 1982.

When discussing concepts of consciousness, the **subconscious** and the **collective subconsciousness** have to be mentioned. These terms were introduced by the early psychoanalysts such as ***Carl Gustav Jung*** and ***Alfred Adler*** and imply that only certain parts of the mind can be embraced consciously. We can recognize our consciousness as part of a wholeness. Most often our consciousness is partial, a

EBSCOhost - printed on 6/30/2020 11:17 PM via ALPHACRUCIS COLLEGE. All use subject to https://www.ebsco.com/terms-of-use

phenomenon we can appreciate after the interruption of a deep sleep with significant dreams. Collective subconsciousness is the realm of the **archetypes**, the inherited patterns for emotional and mental behaviour, shared by all human beings.

Jung and Adler were students of ***Siegmund Freud*** (1856–1939) and based their proposals of the collective subconscious on his psychoanalytical theories. Scientists have always called in question the content of Freud's ideas although they must be considered one of the most famous existing models of human mind.

Freud's model and the brain where it abides can be presented metaphorically like a three-floor, two-family building. It has its entrance in the middle and on both sides there are two apartments which are mirror images of each other (the two brain halves).

In the basement, in the brain-stem, we find the fundamental regulation and control mechanisms which sustain our physical existence and are inaccessible for the consciousness. There the *Id* exists and secure that we breathe, eat and are aware of physical pain. The blind, preprogrammed functions of the organism, exist here.

In the first floor, in the limbic part of the brain, we find the *I* or the *Ego* with all its feelings which constantly play off against each other. Here memory is stored, with its hierarchy of feelings. The Ego is dominated by the *Libido*, or the urge for sexual satisfaction. When the Libido is restrained to realize its urge, a surplus of energy is generated and canalized by cultural activities, art and sciences in the process of *sublimation*. All kinds of talents which are useful for society are often produced by sublimation.

In the upper floors, the *Superego* is lodged in the neocortex. The very thinking and the all-embracing and controlling reason with rational decisions exist here. The superego is specially governing the left half of the brain. The right half is more dominated by the I and its feelings. The Superego is influenced by two instincts complementing each other. That is *Eros*, the urge to live, and *Thanatos*, the death drive. Here, different incentives together with Eros and Thanatos constantly struggle for power in the human existence. The lost alternatives are subconsciously crowded down into lower

EBSCOhost - printed on 6/30/2020 11:17 PM via ALPHACRUCIS COLLEGE. All use subject to https://www.ebsco.com/terms-of-use

levels where they establish different complexes. They get their symbolic expression in dreams which can be understood by dream interpretation. (***Freud 1961***).

Dreaming is common to all mammals and fine-tunes "hardwired" drives and pattern of behaviour with the circumstances of their local experiences. This takes place in a kind of off-line mode during REM (rapid eye movement) sleep, which may be considered a virtual reality simulation by the brain. When this take place, all motor movements are paralyzed in order to block physical action as fantasy must be separated from reality. Somnambulism therefore is a kind of malfunction and sometimes dangerous for the individual.

The sometimes surrealistic nature of dreams is necessary when hypothetical situations are to be simulated and kept separated from factual knowledge (real experiences and prototypical examples). The brain express itself most often by metaphors. Therefore, persons, objects, and images do not represent themselves. They are just metaphors, sometimes with the aim to disguise certain circumstances for the censor, the superego. Dream symbolism shows remarkable similarity with other kind of symbolism existing in art, mythology and religion.

It is evident that the Freudian model has certain similarities with MacLean's "Truine Concept of the Brain" presented on page 283. Interesting is also that Freud's concepts of the "unconscious" show that no single executive is in charge of the mind.

A very interesting and somewhat controversial theory regarding the origin of human self-consciousness has been introduced by the American psychologist, ***Julean Jaynes*** (1976). According to his **bicameral mind theory**, the birth of self-consciousness dates back 3000 years. Prior to that, humanity had no concept of an ego or a personal space of mind within the individual. Of course there were social structures, a culture, languages and diverse experiences. But in terms of this discussion man was schizophrenic, instructed in every movement by insistent voices which were named as gods. Human action was ordered by the gods, not by free-will; feelings and decisions were the result of divine intervention.

EBSCOhost - printed on 6/30/2020 11:17 PM via ALPHACRUCIS COLLEGE. All use subject to https://www.ebsco.com/terms-of-use

From a psychological point of view, man was bicameral, with brain chambers corresponding to the left and right hemisphere. Non-linguistic activities emerging from the right chamber were transferred to the left by way of voices speaking within the head. Thus no individual decisions were taken and the responsibility belonged to the gods. According to Jaynes, the self-consciousness with its ego is a relatively new human quality, a product of historic evolution and therefore changing as time passes. Self-consciousness was not an essential for human survival; even today we perform the majority of our actions without being aware of them, e.g. driving the car or entering the subway automatically. In fact we are very often without consciousness of our ego without being aware of it. We cannot be aware of that which we are not aware.

Of course these ancient 'absent-minded' people were as we are, apart from the lack of a continuous stream of thoughts, regarding something else, which characterizes modern man. When something extraordinary happens modern man becomes attentive; historic man listened for the internal voice and instructions from the gods. These gods were no figment of the imagination, they were the evolutionary side-effect of a language capacity and the real will of the ancient man.

Cultural and political revolution, together with the rising importance of written language, gradually paved the way for human self-consciousness, which appeared in the form of a metaphor 'I' as a side-effect of a personal narrative, similar to that presented in the famous tales of the *Iliad* and the *Odyssey*. Noticeable experiences of the "I" are as follows:

1. Intentionality
2. Self-awareness
3. Reflectivity
4. Ego-experience
5. Attention
6. Choice and free will
7. Experiences related to the unconscious

EBSCOhost - printed on 6/30/2020 11:17 PM via ALPHACRUCIS COLLEGE. All use subject to https://www.ebsco.com/terms-of-use

New and dramatic insights into the nature of consciousness have been presented by the American neurophysiologist ***Benjamin Libet*** (1985). His starting point was the summation of the total information flow passing through our senses. The amount was imposing: the eyes alone transmit more than 10 million bits per second to the brain and all senses taken together more than 11 million bits. Experiments carried out by Libet demonstrated that a maximum of 40 bits per second was possible to perceive for a conscious mind and that the normal capacity was about 15 bits. In terms of communication, this channel capacity, or bandwidth is filtered down to 15 bits per second.

Such a tremendous reduction of the information flow entering the brain is analogous to that of switching from a floodlight to a spotlight in a theatre. You begin by seeing one or two faces on the stage, the spotlight roams about and something in the background becomes visible as you become aware. The conscious mind is extremely flexible but in each distinct moment it is limited to a rather specific area. We perceive much more than we are immediately aware of, but we are able to focus attention on whatever we want. Furthermore, this awareness concerns one sense at a time — compare the reflex to close our eyes when we want to hear better. This mechanism allows us to be aware of surrounding impulses without becoming confused by them — a kind of survival strategy.

Periodically, the consciousness is shut off. Exactly when we do not know for you cannot be aware of your own unconsciousness and remember it afterwards. The consiousness is only something which is necessary to use when we meet a new situation demanding advanced thinking and planning. Alternatively it must be actualized to prevent our subconsious mind to lead us to destruction. Most of our actions are in fact unconscious. Without a behaviour which generally is below the threshhold of consciousness, we should not survive. A constant, conscious reflecting mind is too slow in struggle for life.

Libet's main findings reveal the readiness potential of the brain. He has shown that the conscious will to carry out something appears half a second after its initiation by the brain. The awareness of the action is delayed and projected backwards in time, making us believe

EBSCOhost - printed on 6/30/2020 11:17 PM via ALPHACRUCIS COLLEGE. All use subject to https://www.ebsco.com/terms-of-use

that our will preceded it. The consciousness is delayed and conceals this fact for itself by preserving an illusion of instantaneous awareness. This self-delusion is very practical when it is highly important to act instantly or instinctively. To react more slowly has to be done consciously. In both cases we maintain the impression of being in command of ourselves. The conclusion is the iron rule of thinking before acting.

How then will the **free-will** relate to these findings? Hitherto it has been considered that the higher an organism climbs along the scale of evolution, the higher the degree of free-will and hence the ability to control and influence its own environment. According to Libet's experiments, awareness arises after the activity in the brain has started. But it will take 0.2 seconds from the conscious experience of the decision to its actual execution. Nonetheless, a conscious mind can stop the action before its execution, i.e. the consciousness cannot start the action but it may decide that it should not be executed. This **veto function** of the consciousness works through selection or choice as well as control of outcome of the will, rejecting suggestions presented by the non-consciousness.

The experienced feeling of self-command is the result of a sophisticated feedback of sensory data in time. We only cope with a small part of what we perceive — that part which gives meaning to the context. The delayed awareness enables us to present an adapted and coherent view of the world, an adjusted simulation which makes sense and which we are ready to perceive. Libet's work leaves little doubt that we are all at the mercy of influences of which we are very often unaware and over which we have virtually no conscious control.

*

A hierarchy of memory

A crucial step in the development of the human race was the possibility of using a language. It liberated the individual from the compulsion to merely learn from his own experience. We became a new and advanced kind of information processor. Use of natural

EBSCOhost - printed on 6/30/2020 11:17 PM via ALPHACRUCIS COLLEGE. All use subject to https://www.ebsco.com/terms-of-use

language presupposes an extensive memory, something which in itself has been a basis for human survival and success. This was also a big step forward in the ability to construct mental models as thinking is organized by our language. With language and associated forms of communication, model building could be shared with other fellows. All members of a society now could benefit from knowledge discovered by any individual. It liberated the individual from the compulsion to merely learn from his own experience. Knowledge could be accumulated across generations.

Before the age of general abilities to read and write, the only place for memory storing and retrieval was in the brain. Memory was conserved through transfer from father to son and certain techniques to facilitate this process evolved. The storyteller, who had an important function as a living memory, used tricks like rhythm and rhyme to support the process of remembrance. Here we may see the beginning of poetry and literature.

Special memory techniques, **mnemonics**, were invented in prehistoric times and especially well-known among the ancient Greeks, who had formal courses in the 'art of remembering'. Central to every method was the organization of the material to be learned so that it could be retrieved when needed. Mnemonic systems are designed especially to impose meaning upon otherwise unrelated items. The range of techniques used includes the **method of places**, where some geographical location is used as a cue for retrieving items; the **method of associations**, where simple associations are sought between each of the items, connecting them into a meaningful story; and the **method of keywords**, where otherwise unrelated items are linked to numbers.

People with a special talent for remembering, who are said to have an **eidetic memory**, have always existed. They are noticed in the literature because of the problematic consequences of remembering literally everything that they come in contact with. Since 1991, persons with extraordinary good memory has met in the World Memory Championship in London. The competition has ten different areas. One is to remember the face and name of 99 unknown persons. Another is to remember the sequence of 4500 binary numbers. A

EBSCOhost - printed on 6/30/2020 11:17 PM via ALPHACRUCIS COLLEGE. All use subject to https://www.ebsco.com/terms-of-use

third is to remember the sequence of 52 playingcards shown in five minutes. In "random words" the participants have fifteen minutes to remember as many words as possible from a list and render the succession correct.

Paradoxically, memory researches have found that winners of the contest in most cases do not have a special intelligence or talent. Instead, their capacity depends on motivation and purposeful training. Their memory also seems to be limited to a certain area of knowledge.

With the invention of memory supporting artefacts and the art of writing, it became possible to store information and knowledge outside of the human brain. Human memory and intellect could be released from the task of remembering and be used in the creation and development of knowledge. In a sense, the invention of written language indicates the birth of science.

A more precise analysis of the many aspects of *information* will establish the nature of what really should be remembered and stored in the various kinds of memories. The following terms are used quite differently, depending on context and intention:

— capta
— data
— information
— knowledge
— wisdom

The arrangement can be seen as a continuum, whose parts lead from one to the next, each representing a step upward in human cognitive functioning.

If a basic event in the surrounding world is registered as a change in the state of a sensor (for instance a neuron) it makes sense to speak of *capta.* This change may be preserved for a certain period, being experienced for example as a lingering sense of heat. When some rules, comprehensible for the observer, are applied to organize such basic representations of events, *data* is generated (singular *datum*). Numerals and the alphabet are such representations and the heat can be expressed on a Celsius scale. Naturally, data can be recorded and presented quite mechanically, without the perception of living beings.

EBSCOhost - printed on 6/30/2020 11:17 PM via ALPHACRUCIS COLLEGE. All use subject to https://www.ebsco.com/terms-of-use

Data reaching our senses and making us aware that something has changed or is going on is said to give us *information.* By information is thus meant human interpretation or processing of data. This implies that it had been fitted into categories and classification schemes or other patterns. Then we have cognitive or physical representation of data about which we are aware. In other words, we have been informed. After the interpretation, information is emergent in relation to data. This is why information cannot be quantified, in contrast to data.... Assigning meaning and understanding to information by use of higher mental processes and further systematization and structuring makes it possible to speak of *knowledge.* This in turn may be transformed to *wisdom* when values are included in making judgements.

Poets and philosophers have always been aware of the delicate intrinsic nature of the continuum and the borders of its parts. T. S. Eliot says:

> Where is the life we have lost in living?
> Where is the wisdom we have lost in knowledge?
> Where is the knowledge we have lost in the information?
>
> (*T. S. Eliot*)

A hierarchy of memory, capable of storing relevant parts of the continuum or *intelligence spectrum* presented above, will have the following shape:

- Genetic memory, existing in the genes.
- Immunity memory, existing in antivirus cells.
- Accumulated experience and knowledge, stored in the brain.
- Written information, stored on various materials.
- Magnetic and optical information, stored in databases.
- Encyclopedias, books, paintings etc. stored in libraries.
- Metainformation, stored in universities, museums, gene banks, nature reserves, etc.

From this hierarchy it can be seen how different levels of living systems expand their memory capacity. While the cell stores its

EBSCOhost - printed on 6/30/2020 11:17 PM via ALPHACRUCIS COLLEGE. All use subject to https://www.ebsco.com/terms-of-use

information in the genes and the organism in the brain, the group uses certain common instructions, calendars and almanacs. On the organizational level we find information stored in archives and accounts, whereas the national and supranational levels store their metainformation in valid laws and conventions. The main memory of the phenomenon of science must be considered to be the university. Culture must also be considered a memory wherein humankind has stored its increasing knowledge.

The memory expansion depicted in the hierarchy is only possible if a parallel development among memory artefacts take place. In reality it has always been an interaction between memory and its artefacts. Advanced artefacts make possible advanced information processing and *vice versa*. This interaction, made possible primarily through a capacity for language and writing, and the extension of images far beyond personal experience and lifetime, is a main driving force behind the exponential increase in the speed of human development.

The memory artefacts began with Sumerian cuneiform-inscribed clay and evolved towards pigment on papyrus, parchment and paper. Also, stone and ropes were used to store information in the cultures of the Scandinavians and Incas. During the Middle Ages, paper was the main storage medium, first as paper rolls and later as books. In the 19th century, photographs and phonographs became available and in our own century film, shellac and vinyl records and a great variety of different magnetic and optical media have become available.

The main storage medium is nevertheless still paper. Our paper-bound cultural heritage has always faced sudden serious threats and we are now facing the risk of a collective memory loss through the decomposition of the paper. Before 1850, paper was a high-quality product and the raw material was taken from rags. After 1850, the wooden-fibre content increased — a raw material which now has begun to fall apart in an accelerating self-destructive process.

This problem may be compared to the destruction of Venice, which implies another collective memory loss. The buildings there now tend to slowly fall apart due to the diminishing ground-water level and the beautiful faces decompose due to acid rainfall. There are no natural

EBSCOhost - printed on 6/30/2020 11:17 PM via ALPHACRUCIS COLLEGE. All use subject to https://www.ebsco.com/terms-of-use

counter-measures to these problems and the consequences are very difficult to forecast.

A third example of collective memory loss occurred in Alexandria. It is said that more than 1 million papyrus manuscripts in its large library were destroyed in AD 48 by the Roman Emperor Caesar. This is considered to have delayed European development by at least one hundred years.

Human evolution that was earlier governed by genes is today governed by ideas due to the accessibility of a huge collective memory, but also due to the extension of human sensing capabilities by artefacts. Examples of such artefacts are the telescope, the microscope, the telephone and so on. The principles behind knowledge accumulation and augmentation of mental capability presented here may be called **nōogenetics** (from the Greek *nōos*, meaning mind) to distinguish them from the ordinary biogenetic development. The nōogenetic equivalent to biogenetic mutations are new ideas, inventions and works of art.

*

Brain models

The human brain uses about 20 per cent of the body's energy but is just two per cent of its weight. In proportion to the body mass, the brain is three times as large as that of our nearest relatives. It has more than ten thousand million neurons, interconnected by means of a thousand times this number of synapses. Due to the speed with which biological membranes function this gives around 10^{16} interconnections per second. This is around one billion times faster than today's most powerful network computers. The most complex interconnective communication system in the world is the global telephone system — carrying only 10^{11} calls per year.

For some reason or other the human race emerged with this brain, oversized in performance compared to the needs of the bodily functions. This extra capacity was the basis for the extremely complicated nerve functions necessary for verbal communication. The

EBSCOhost - printed on 6/30/2020 11:17 PM via ALPHACRUCIS COLLEGE. All use subject to https://www.ebsco.com/terms-of-use

richness of internal interconnections enables the owner of the brain to use symbols and therefore permits the development of a language.

The human brain has between 10 and 100 billions neurons and each of them are interconnected with 1000 to 20000 other neurons. The number of possible interconnections between them thus exceeds the number of existing atoms in the Universe. As a survival instrument adapted to the world surrounding us, the brain therefore probably is the most complex system which exists in the universe (with the exception of the universe itself?) because it can form a representation of the enormous complexity of the surrounding world.

Today, a common belief among brain researchers is that the more the brain is used the better it will work. Intense use will cause the branches, called dendrites, in the neuron to grow. Dendrites are rootlike projections connecting the neurons. A typical neuron receives input signals from tens of thousands of other neurons. The more dendrites, the more interconnections promoting information transfer between different parts of the brain. Although divided into areas, each with a specific function, the brain processes information mainly in the same way in all of these areas.

Studies of the brain have shown that the length of dendrites may vary by as much as 40 per cent between different individuals. A most intriguing finding is that those who pursue intellectually demanding jobs have longer dendrites than those who do not. Two possible explanations for this phenomenon are: intellectually challenging life-styles cause dendrites to grow longer or having long dendrites leads people to live intellectually challenging lives. The first alternative, considered to be the most plausible, has received support through experiments with animals: rats raised in 'enriched' environments have been reported to show changes in brain structure.

A widespread attitude among researchers is that the brain is so complex that it will be impossible ever to embrace its whole function and capacity. A classic paradox formulated by the biologist ***Lyall Watson*** is: 'If the human brain was so simple that it was possible to understand its function, human beings would be so simple that they could not understand it.' It is a common view that the brain is a system which cannot be worn out; the brain grows with activity and

EBSCOhost - printed on 6/30/2020 11:17 PM via ALPHACRUCIS COLLEGE. All use subject to https://www.ebsco.com/terms-of-use

will only be better by increased use. It is also assumed that we normally use only approximately one per cent of its total capacity.

The brain's storage capacity is literally astronomical and researchers believe that it can store every impression during a normal life-span — with plenty of room left over. This statement that the brain can store every impression it has come in contact with applies to either of the two halves of the brain (or one of the two co-operating brains); like other essential mammalian organs, such as kidneys and lungs, it is duplicated. But unlike other doubled organs where each half of the pair works on equal terms, the brain pair is individually specialized with an established internal hierarchy.

The left brain seems to be specialized in serial information processing, while the right works primarily in parallel. Verbal processing and writing *via* letters, words, sentences, sections and pages is typically assigned to the sequential and analytical left side. Associative work seems to be assigned mainly to the synthesizing right side. Typically, this side processes more than seven elements in a very short time. It also recognizes musical patterns and chords and discriminates pitch as well. It discerns the form of the whole from its parts and recognizes complex visual forms (pattern recognition). Accordingly, two different kinds of information input may be treated simultaneously, compared and co-ordinated by both halves, thus creating a substantial and all-embracing impression. Functional differences between the left and right side can be listed as follows:

Left	*Right*
— Verbal	— Preverbal
— Analytic	— Synthetic
— Abstract	— Concrete
— Rational	— Emotional
— Temporal	— Spatial
— Digital	— Analogue
— Objective	— Subjective
— Active	— Passive
— Tense	— Relaxed
— Euphoric	— Depressed
— Male	— Female

EBSCOhost - printed on 6/30/2020 11:17 PM via ALPHACRUCIS COLLEGE. All use subject to https://www.ebsco.com/terms-of-use

There is also strong evidence that women have a better integration of the halves than men.

When the two halves of the brain become separated by accident or brain surgery (split-brain), the result is the emergence of two personalities, both with their own information sources and individual self-consciousness. Experiments with such persons involving screened-off vision show that an object held in one hand cannot be compared with a similar object in the other hand. There are simply no connections between the two eyes. When the artificial shield between the eyes is removed the two personalites are joined again to a single personality. The separated hemispheres have simply so many secondary interconnections via the brain-stem that their activities once again can be co-ordinated.

Within our Western-culture an old tradition of analytical and rational thinking is coupled with a need for adequate expressions in speech and writing. The capacity for artistic work, intuitive thinking and creative fantasy is often seen as something less essential for both personal and societal development. From that point of view the left side dominates, sometimes creating the typical modern rational personality (sometimes with a touch of neurosis). For a harmonious development of the personality, society and its educational system must assign equal significance to the capacity of both left and right brain halves.

When discussing the over-arching organization of the brain, a rare quality existing in certain people must be mentioned. Known for more than 300 years, it is called *synaesthesia* and can be described as a multisensory integration in the experience of the surrounding world. Persons with this quality have a sensory crossover which makes them able to experience words, sounds, smells, sensations, etc. as coloured. The experience is involuntary and cannot be suppressed. Those with this faculty find their experience quite natural and can rarely understand that this mixing of senses does not occur in others.

Apparently, synaesthesia is a normal brain function in mankind but, for some reason or other, its working reaches conscious awareness only in a handful of people. It suggests that the brain has some kind of co-ordination centre where recall is reconstructed from numerous

EBSCOhost - printed on 6/30/2020 11:17 PM via ALPHACRUCIS COLLEGE. All use subject to https://www.ebsco.com/terms-of-use

fragments of memories, stored separately, but accessed in an integrated way.

One of the best known concepts of the mind, called the **parallel distributed processing** (PDP) brain-model, is embraced by several neuroscientists (see ***D. Rumelhart*** 1986). According to this model, intelligence emanates from the interaction of a great number of interconnected elementary units, the neurons. This slow and noisy apparatus performs real time processing the only way possible: by working massively in parallel. Such a working mode means that a sequence, requiring millions of cycles if it were to be processed in a serial way, is done in a few cycles in a network of a hundred thousand highly interconnected processors.

In this model, the brain work is regarded as a statistical process; no specially important areas are commanding the decision-making procedure. Decisions are made through co-operation between independent units, the neurons, creating reliability in turn through a huge statistical sample. Under these circumstances brain control is distributed, working in consensus but with no specific precalculated solutions. This kind of system is adaptive and flexible, constantly configuring itself to match the actual input. Although this process has neither classification nor generalization rules, it acts as though such rules were present. Learning itself results in a modified but more durable coupling density and a reconfiguration of the neural network, called **brain plasticity**, a kind of self-organization. The interaction of the brain with its environment, together with the existing genetic information leads to the formation of new information. It is thus possible to say that the brain reprograms itself, creating thereby the very foundation for memory, learning and creative thinking. Supporters of the PDP model often say: 'There is no hardware and no software, there are only connections.'

Generally, human information processing is dynamic, interactive and self-organizing as well as superior in optimization and adaptation, a non-serial task. Also, it is robust and not too sensitive to inaccurate data; it handles incompleteness, ambiguity and false information very well. More specifically, in PDP-model terms the basis for these good qualities is that knowledge is globally stored in the existing network

EBSCOhost - printed on 6/30/2020 11:17 PM via ALPHACRUCIS COLLEGE. All use subject to https://www.ebsco.com/terms-of-use

or structure and is continuously available. Essential information exists as **frames** or **schemata**, which are stored in flexible configurations offering the automatic supply of missing components, in a process of continual adaptation to meet the situation at hand.

Another key concept of the PDP-model is **gentle degradation**. PDP does not know a critical amount of neurons when the network stops working. All parts may be seen as redundant and a damaged brain has a diminishing capacity corresponding only to the area of injury.

A special theory concerning selective mechanisms in the brain has been presented by ***Gerald Edelman*** (1987). It is called **neuronal group selection** (NSG) and is founded on the notion that many brain processes operate by natural selection, a kind of neural Darwinism. Also, processes governing brain formation and growth are of the NSG type. In the developing brain, specialization of cell function is determined by the characteristics of the other surrounding cells in which it finds itself. Cells of a developing nervous system tend to migrate to brain areas favourable for their further specialization. The selection unit is a number of neurons called the *neural group*, more or less specialized to respond to a certain pattern of input. Different groups may have the same input pattern but their reaction will differ a little according to internal structure and relation to other groups. Some groups are strongly specialized to react in a defined way to a certain input and are said to have *repertoires*. *Primary repertoires* become established shortly after birth and do not change. *Secondary repertoires* are established by change of connection strength between and among primary repertoires due to the situation at hand and are therefore in a constant flux.

Stable repertoires emerge by reorganization of old neural groups from other, less stable repertoires, and result in something new and more appropriate. In this reorganization a constant competition takes place between the groups resulting in a growing repertoire and stronger intergroup connections.

Besides the PDP-brain model, several others are well-known. Especially relevant here is the **triune concept of the brain** presented by ***Paul MacLean*** in 1972. According to this theory, the brain is

EBSCOhost - printed on 6/30/2020 11:17 PM via ALPHACRUCIS COLLEGE. All use subject to https://www.ebsco.com/terms-of-use

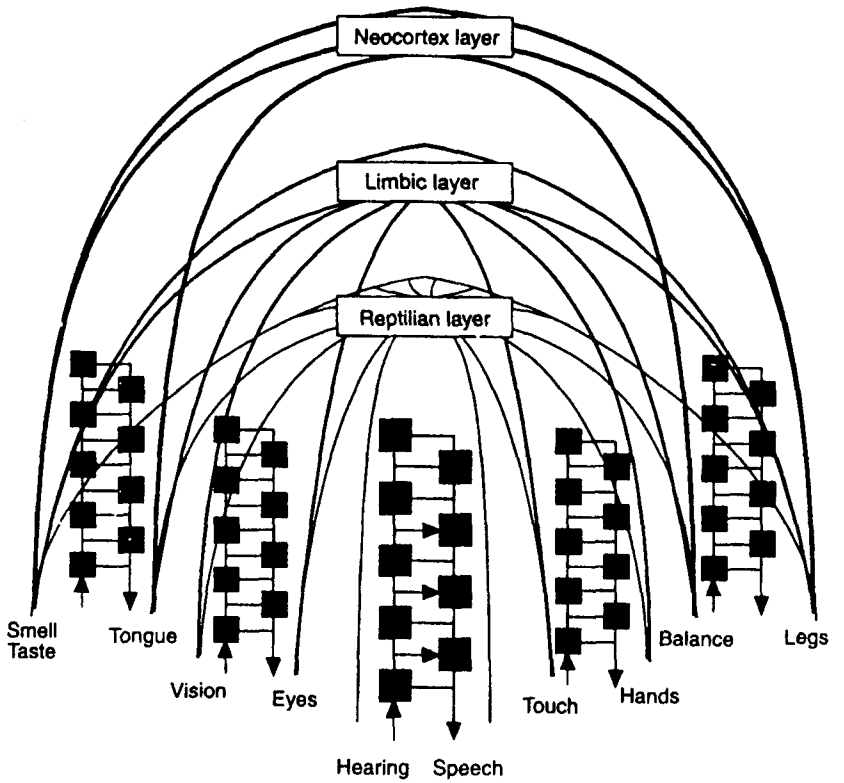

Figure 5.1 The triune concept of the brain.

organized in three main hierarchical layers, arranged with the oldest in the centre surrounded by the others, like the skins of an onion. The human brain is a complicated web of these layers superimposed on to each other according to the different evolutionary stages. It is reminiscent of a thousand-year-old town where old and new buildings exist side by side. Each of us thus carries the history of the whole biological evolution in our nervous system. The three main stages are presented in Figure 5.1.

The oldest layer, the instinct layer, is also called the **reptilian brain** and provides basic reflexes and instinctive responses. It can be characterized by aggression, rituality, territoriality and social

EBSCOhost - printed on 6/30/2020 11:17 PM via ALPHACRUCIS COLLEGE. All use subject to https://www.ebsco.com/terms-of-use

hierarchy. The next layer, the emotional layer or the **limbic brain**, is the location of feelings and the important drive for altruistic behaviour such as the care of offspring. The third layer, the thinking layer or the **neocortex brain**, is capable of manipulating abstract symbols; it can analyze, associate, imagine and plan. Here is to be found the location of the essential human quality of intuition.

If the reptilian layer has a certain degree of consciousness, the limbic may be considered to be conscious and the neocortex wholly self-conscious. Unconsciousness and consciousness, old information and new thus exist side by side in a development similar to that of the city. The general function of these layers may be summarized thus: reptilian as biological, limbic as emotional, neocortex as intellectual. The co-ordination of all three layers defines what can be described as the human mentality.

A simplified anatomical drawing showing the three layers is shown in Figure 5.2.

"The reptilian brain stands for the figures and roles which underlie all literatures. The limbic system brings emotional preferences, selection and development of the scenarios into play. And the neocortex, finally, produces on this substrate as many different poems, tales, novels and plays as there are authors" (***Jantsch 1980***).

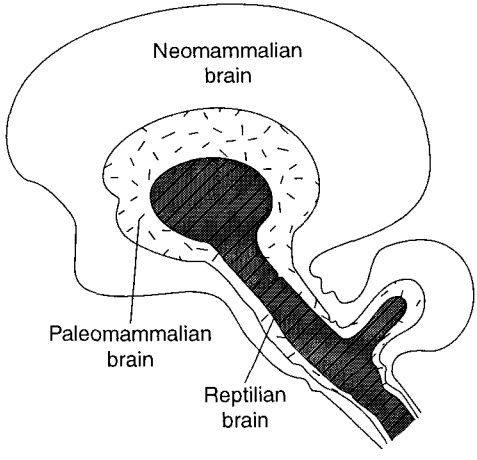

Figure 5.2 Layers of the human brain.

EBSCOhost - printed on 6/30/2020 11:17 PM via ALPHACRUCIS COLLEGE. All use subject to https://www.ebsco.com/terms-of-use

Earlier we have stated that a prerequisite for consciousness is the existence of a memory. Apparently a memory residing in a conscious brain has no storage limitations. During a lifetime each individual gathers a tremendous amount of knowledge and experience for their own benefit. With the development of basic aural and visual communication, this knowledge could be transferred to other individuals to a certain extent. With the advent of a **language** among higher animals, communication was suddenly raised to a superior level and both knowledge and skill began an exponential accumulation. The nature of language implies an overwhelming communication desire as a guiding motive for human life. For humans, an existence without communication with kinfolk is something unthinkable.

However, when self-conscious beings became aware of their own mortality they realized the problem of memory loss. The possessor of the memory sooner or later dies; its content is thereby lost. Another problem was the handling of the memory content: retrieval mechanisms were by no means on a par with the unlimited storage capability. An example of how knowledge could be conserved and transferred to following generations is the traditional storyteller who is both a memory bank and a conveyor of its content. To preserve knowledge and to transfer it between different generations, the ancient storyteller acted both as a memory bank and a conveyor of its content.

The above-presented brain models are mainly of a structural nature. One of the interesting functional models, the **brain resource model** introduced by ***Matti Bergström*** (1991) is based on a theory concerning the attitude of humans towards their the own brain. It is not possible to apply the same view on the brain as we do upon other human organs, such as the stomach, the liver, etc. The brain is the only part of the human organism which studies itself and this implies inevitable consequences for inherent values. These values cannot be excluded when studying the brain; without their application in human morality and ethics there are no qualities which may be called human. Furthermore, our values, coupled with feelings and fantasies, are necessary for the development of a healthy personality. The brain

EBSCOhost - printed on 6/30/2020 11:17 PM via ALPHACRUCIS COLLEGE. All use subject to https://www.ebsco.com/terms-of-use

resource model does not discriminate between values and knowledge, between subject and object.

The growth of the brain is considered to be dependent upon an adaptation to an ever-more complex and demanding environment. A homogenous environment with no sudden changes permits survival with a small brain and an uncomplicated nervous system. The transformation of the planet, with shrinking oceans, formation of new land, severe weather changes, natural disasters, etc. demanded something more. Survival during these circumstances had to be built upon an improved capacity to receive, store and handle information, mirroring a more complex environmental structure. With this perspective, the brain is simply seen as an **interface** between the environment and the internal world of the organism. Its purpose *vis-à-vis* the organism is similar to that of the skin: to adapt to and protect from the environment.

The brain-resource theory takes a very pragmatic view of the old mind/body problem. The mind embraces not only the abstract world belonging to areas like psychology, sociology or philosophy, but concrete physiological nerve processes as well. The 'wholeness' of the system is the mind and the different physical parts of the body. This view is exemplified by thermodynamic concepts: pressure, volume and temperature — macroscopic entities describing the wholeness of a system, but which are not possible to locate anywhere in a gas. The same goes for the mind, which it is not possible to pinpoint at a certain place in the brain.

In so far as the thermodynamic view has made possible both a demystification and a reasonable explanation of the complex concept of mind, it has been adopted into **neurodynamics**. Complex nerve systems with astronomical quantities of simultaneously propagating signals are not possible to analyze in terms of single pulses; the only way to understand such a mechanism is through a statistical approach.

One of the most significant qualities of the brain is its **value function**. This may be defined as the capability to choose and arrange knowledge according to an internal scale. Information and knowledge

EBSCOhost - printed on 6/30/2020 11:17 PM via ALPHACRUCIS COLLEGE. All use subject to https://www.ebsco.com/terms-of-use

have no value of their own but are assigned a value as they become ordered and sorted. To assign values is to control and process information and to create negentropy, the opposite of entropy. Information overload, a serious problem in our current society, can never be handled with more information; a value should be designated to that which exists. To choose, evaluate and see a wholeness is the very core function of the human mind. A value-free science, for example in the nuclear area, is something of a paradox, when generating sophisticated knowledge to be used in an arms race and to promote chaos and potential destruction of the whole world.

A defective value function is always more critical than the quality of the adopted values. Children often reject a school culture overloaded with value-free knowledge which is so apparently without meaning for themselves; they turn instead to the hard gang morality and simple reward system of the street.

Another significant resource of the brain is its **creativity** function. The origin of creativity is found in the chaotic signal pattern of the brain stem, which acts as a random generator for new ideas if not restrained by social constraints. Some of these ideas may reach and influence the ordered levels of the brain, the neocortex, where a sudden change of mind occurs and is experienced. This mechanism may be functionally illustrated by catastrophe theory as a sudden and abrupt change when new ideas are born.

Our contemporary Western society does not support creativity. General social standardization, passivism and information pressure all too often restrain activity, spontaneity and the important work of the brain's random generator. The striving for a successful planning of our future also delimits creativity. To accept creativity is to lose the possibility of planning even the not-too-distant future. While creativity implies new and unpredictable knowledge which can lead to an unpredictable world, it also offers a strong survival value for adaptation to the future. Finally, creativity demonstrates how disorder and chaos are prerequisites of order and harmony.

A further consequence of the brain-stem as a chaos generator is the general human fear of the unknown. The unknown internal ego and the unknown external unbounded world have slowly been mastered

EBSCOhost - printed on 6/30/2020 11:17 PM via ALPHACRUCIS COLLEGE. All use subject to https://www.ebsco.com/terms-of-use

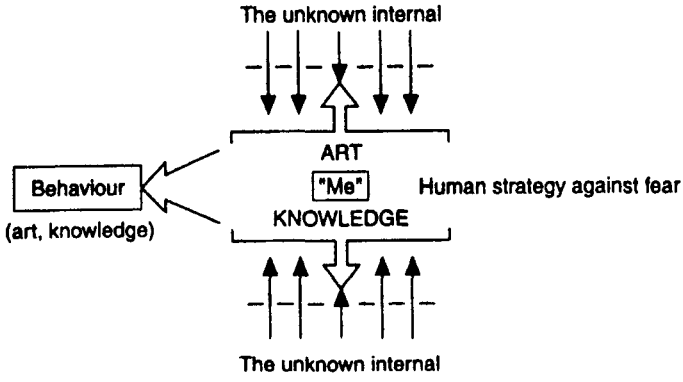

Figure 5.3 Art and knowledge counteracting human fear (from Bergström 1991).

by the strategy of art and knowledge. Figure 5.3 shows how these concepts counteract the fear of the unknown in the human milieu.

Another key concept included in the theory is the **potentiality** of the brain. This term indicates that if one of the existing possibilities is realized by action, the others disintegrate. The responsibility inherent in each action is therefore tremendous; other worlds which are possible are destroyed when a choice is made. This dilemma has traditionally been solved in the Eastern countries introspectively, by decreasing external actions and increasing the internal potentiality of the brain. Could fewer actions instead of more be a more effective way to tackle this dilemma in the Western world as well?

The two competing states, the random and chaotic associated with the brain-stem, and the fixed and ordered linked to the cortex, are the two bipolar extremes of the brain. The simultaneous existence of chaos and order in complex, dynamic systems, however, tends to organize the content in a middle way in some kind of dissipative structure. It seems reasonable that such structures are generated in a self-organizing process of the brain, creating a new and relatively stable order. A large amount of dispersed information is suddenly joined to an integrated whole — a new idea, paradigm or method is born.

The **brain hologram metaphor** has been suggested by a number of scientists, including ***Carl Pribram*** (1969). A **hologram** (from the

EBSCOhost - printed on 6/30/2020 11:17 PM via ALPHACRUCIS COLLEGE. All use subject to https://www.ebsco.com/terms-of-use

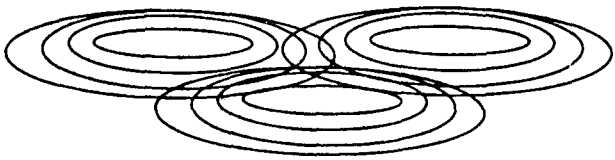

Figure 5.4 Interference pattern in a pond of water.

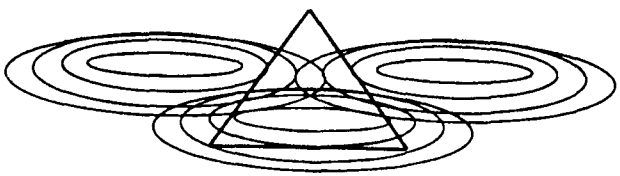

Figure 5.5 Pattern reconstruction using a fragment from Figure 5.4.

Greek *holos*, whole) is a kind of photographic image, created by illumination of a laser beam and has the following properties.

- The image is three-dimensional; it may be viewed from many aspects.
- A part of the hologram may be used to reproduce the whole image. The resolution of the whole image decreases as the area of the part decreases.
- Images can be superimposed and also individually recovered.

The holographic effect is the result of an interference pattern. To explain this phenomenon, let us take the analogy of three stones dropped in a pond of water. The resulting three circular wave systems produce an interference pattern as shown in Figure 5.4.

The pattern holds all information concerning the position of the dropped stones. A fragment of the pattern is sufficient to reconstruct the whole wave system (see Figure 5.5).

A holographic photograph is created by use of a laser light split into two beams. One beam shines directly on the film while the other is reflected from the object to be photographed. Unlike ordinary

EBSCOhost - printed on 6/30/2020 11:17 PM via ALPHACRUCIS COLLEGE. All use subject to https://www.ebsco.com/terms-of-use

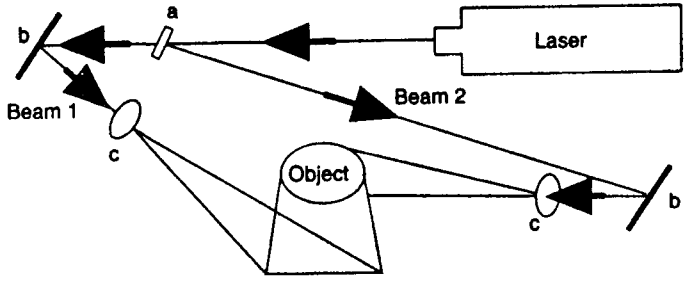

Figure 5.6 Holographic photography.

photographs, the result is a blur covering the whole negative. This blur is a kind of interference pattern and when a laser beam is projected through the negative, the object reappears at a certain distance away from it. Different parts of the object are brought into focus by changing the viewing position (see Figure 5.6).

If images from a number of objects are stored, reflections from each item act as references for the others. Thus, one object may be used to recall another — a kind of **associative memory**.

An examination of the area of the human brain concerned with vision shows that it possesses holographic qualities. When a piece is cut away, nothing specific is lost from the field of vision. What happens is that the wholeness is seen less distinctly. The ability to see whole scenes without decomposing them into features, or to filter out special items from a homogeneous background are also holographic attributes. To discern a particular face in a crowd of people or to recognize a certain voice among all other vociferous voices in a cocktail party are typical examples.

A neural hologram may be imagined as a propagation of waves of dynamic neural activity. It should be obtained as a result of interference of neurons between two patterns. One sent directly acting on the near end of dendrites and one slightly delayed acting on the far end of dendrites. The input information is thus both distributed and redundant by the property of mutual convergence and divergence in neural pathways.

EBSCOhost - printed on 6/30/2020 11:17 PM via ALPHACRUCIS COLLEGE. All use subject to https://www.ebsco.com/terms-of-use

Of course, there is no sign of a complete correspondence between the real hologram and its neural equivalent. As an explanatory theory, though, it may shed light on certain processes of the working brain.

*

A model perspective

In the past many models of the mind have been constructed in an attempt to explain the phenomena of emotion, learning, perception and behaviour. None of them can however disregard the basic connection between the development of the hand and the brain. Freeing the hands by two-footedness made the brain able to grow. Without the use of hands there would have been no invention and manipulation of tools, no evolution of writing and consequently no information storage and tradition. It is important to realize that the brain belongs to the body. Without a body, it is unrealistic to state the existence of a mind.

During the 19th century, brain-models were dominated by analogies of mechanical, thermodynamic and even hydraulic processes. Most were dualistic, founded on the old Western thought that the body was a machine controlled by the brain, while the mind was separated from the body (and the brain). Between the world wars, electric brain metaphors like the telephone exchange were predominant.

Since the 1950s, most models have been associated with the sequential computer with its central processing unit. The brain-mind distinction got its metaphor in the hardware-software distinction. Theories concerning the mind become materialistic by stating that physical and chemical properties of the brain, together with pertinent processes were enough to explain the mechanisms of mind. Thus a material phenomenon, the brain, created the immaterial mind.

In the 1990s, the perspective has changed again and the parallel computer, programmed as a neural network is the most current metaphor for the working brain. This metaphor is often discussed in cybernetic terms as the brain uses *both* positive and negative feedback in managing, for example, sensorimotor control. Such duality is

EBSCOhost - printed on 6/30/2020 11:17 PM via ALPHACRUCIS COLLEGE. All use subject to https://www.ebsco.com/terms-of-use

uncommon in most ordinary control systems, due to the risk of instabilities, but is combined highly successfully in the brain. Positive feedback is used in a feedforward control course to predict what happens next, while negative feedback makes small corrections within the movement.

Today, most biologists seems to take a materialistic, reductionist view of the phenomenon of the mind. Its existence is the emergent properties of chemical and physical processes from a sufficiently complex control system in a living organism. The material base consists of neurons, interacting with other neurons to a certain extent randomly. This interaction creates information patterns existing in a context beyond ordinary time and space. Therefore, most researchers agree upon a distributed mind, occupying the total area of the brain where all elements are of equal importance.

The view of a distributed mind can be extended further, to the whole of the organism. The brain is part of a nerve system existing everywhere in the body. Thus consciousness exists ubiquitously, although on many different levels, throughout the whole organism, suggesting an extension of the distributed-mind perspective.

*

Review questions and problems

1. Discuss whether the traditional body/mind problem still can be considered relevant.
2. Can consciousness always be considered to have a strong survival value?
3. What is the relationship between superdeterminism and the strong antropic principle?
4. How does the problem of free-will relate to Benjamin Libet's findings?
5. Why can the invention of written language indicate the birth of science?
6. What is the difference between functional and structural brain models?
7. Use of the hands is considered to be a main factor in the development of the brain. Try to explain why.

*

EBSCOhost - printed on 6/30/2020 11:17 PM via ALPHACRUCIS COLLEGE. All use subject to https://www.ebsco.com/terms-of-use