9. NEUROLOGICAL DISEASES

The physicians who worked in the tropics were confronted from the onset with a great number of neural disorders, particularly those linked to such wide-ranging transmissible and parasitic diseases as African sleeping sickness, cerebral malaria, tick-borne relapsing fever, and leprosy. These were not the only problems. Pyogenic meningitis as isolated cases or in epidemics, poliomyelitis, tetanus, rabies, epilepsy (rather common in some areas), and frequent convulsions in children, attracted the attention of medical practitioners and laboratory physicians.

Neurology is an intellectually stimulating field, which contributed significantly to the breakthroughs of scientific medicine in the late 19th and early 20th centuries. Neurological diseases stand out against the other branches of medicine by the close relationships between the symptoms and lesions. The profusion of clinical signs at the nervous stage of sleeping sickness was a challenge for the personnel recruited by the Congo Free State. A priority was given to medical research. The consecutive reports of the Congo Free State’s research activities and observations were proof that these investigators wanted to answer the expectations of the leading responsibilities.

The thorough, solidly founded observations of these investigators led to the inclusion of systematic cerebrospinal fluid (CSF) examinations in screening for and monitoring the sleeping sickness from the turn of the century on. It goes without saying that it was in the wake of this avant-garde routine practice that Rodhain and his co-workers discovered, in 1911, the existence of cell and protein changes in the CSF of patients with African relapsing fever.

This approach to health problems created an epidemiological dimension which would constantly influence the physicians’ way of thinking and their actions. The application of epidemiology in order to cope with universal diseases as well as with the previously unknown health problems specific to the tropics produced a wealth of information. One might refer to the situations in Nigeria and Jamaica, for example.

One major concern had been to define the role of syphilis – a contagious disease that was very widespread in the Northern Hemisphere – in the aetiology of neurological and other disorders. The low frequencies of neural syphilis, general paralysis, and, above all, tabes in Central Africa, despite the very extensive endemicity of non-venereal treponematial infections, struck observers. These facts triggered controversies that have still to be resolved.

The influence of various geographic factors and the importance of the environment in general on the existence and the kind of universal neurological diseases were reinforced by the discoveries of such new neurological syndromes as the endemo-epidemic of spastic paraplegia known locally as kitondji or konzo. This spastic paraplegia occurred in Kahamba and Feshi Territories (Kwango). While its aetiology has yet to be established, this disease is just one of the neuropathies that are specific to tropical countries (Nigeria, Jamaica, a.o.).

Endemic leprosy, characterized by a clear predominance of maculo-anaesthetic or tuberculoid forms with hypertrophic neuritis, kept doctors alert to the need to conduct thorough physical and neurological examinations using sometimes very sophisticated methods.

Whereas parasitological and bacteriological research raised few problems, progress in diagnosing the causes of so-called aseptic meningitis, meningo-encephalitis, and myelitis was contingent on the creation of virology departments. In 1919 the virus responsible for poliomyelitis was transferred to a cercopithecus out of the marrow of a child who died during the first epidemic of infantile paralysis in Leopoldville (Kinshasa). Rodhain’s isolation of this virus, conducted ten years after the first isolation by Landsteiner and Popper, was a first in Africa.

Tuberculosis, cryptococcal meningitis and filarial involvement of the Central Nervous System (CNS) were not identified until the fifties.

Eosinophilic meningitis does not seem to occur in Central Africa.

In short, in tropical areas, neurology and neuropathology are very promising fields for medical research.
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HISTORICAL BACKGROUND

A. Evolution of Neurology in the world

It is only recently that neurology was detached from general medicine. Previously it was necessary to know the details of anatomy and physiology before defining consistent nosological entities and precise means of exploration. This process has taken place throughout the centuries and speeded up towards the end of the 19th century.

Documents attest that during antiquity Sumerians and Egyptians could recognize different forms of paralysis and spastic paralysis.

The most primitive populations of early mankind could not have been unaware of such striking diseases as fits caused by epilepsy. For centuries or even millennia this disease has been known as the Grand mal. It was also easy to recognize the after-effects of cranial or vertebral injury by the limb paralysis.

Shooting pains of unknown cause, whether or not with an origin in the nervous system, would be treated by all kind of means. This gave rise to primitive medical methods which are still applied among populations whose life-style has remained unchanged over the centuries. Simple remedies were recognized by instinct, while traumas were treated empirically.

Diseases which appeared frightful and terrifying but had no apparent cause remained obscure. Mysterious or hidden influences were claimed, which resulted in magic procedures carried out by healers on the basis of their suggestive power.

a) Some centres of culture appeared between 3,000 and 1,000 BC among patriarchal communities scattered over the Euro-Asiatic continent. The areas where the first scientific glimmers emerged are quite similar and are located in Mesopotamia between the Tigris and Euphrates rivers, in the Nile valley and at Karoun (Medinet-el-Fayoum), in the Indus (Harappa, Mohenjo Daro) and the Yellow river valley. Only China has, for more than three millennia, kept the same emblematic script, which is still used by Chinese literates. Cuneiform tablets and papyruses reveal useful information on old Sumerian and Egyptian medicine. Various types of palsy or spastic diseases are described in documents or depicted in art works. Neurological after-effects of cranial and vertebral injuries, particularly those caused by dislocation of the cervical vertebrae, are described in Edwin Smith’s papyrus (1,500 BC). In the papyrus of Leyde one can read that palsy follows circulatory impairment of the brain. Berlin’s papyrus mentions facial paralysis.

Such medical knowledge was gathered through careful observation. This rational approach did not eliminate the magic procedures, but allowed a professional medical approach to emerge alongside that of healers, witchdoctors or priests. Such medicine men were enrolled at royal courts, and within armies and administrations; however their activities were limited to specific diseases, not individualized in the neurological field.

Among highly praised Egyptian physicians, Imhotep used this type of archaic medicine, still applied in India, Tibet and China, although altered by syncretism.

Magico-religious beliefs oriented a part of medical activities towards the temples. In Greece, these were devoted to Asclepios. However the meager efficiency of prayers and offerings caused some priests to open schools for the use of more active drugs, even if on an empirical basis. This resulted in the creation of Asclepiadic centres which were unrelated to temples, and in peripatetic physician-seers (perioudeutes) or diviners; some of them were surrounded by pupils, as a first step of apprenticeship.

In the same cultural centres, philosophers were searching for Truth and Absolute Human Values. Medicine was considered as part of philosophical knowledge, while philosophers were often naturalists and physicians with a knowledge of nature. These physicians detected general laws among the large amount of observations and data gathered. The history of sciences is always composed of privileged moments which give a new strength, or even overthrow concepts which had remained stable for a long period. At other times science stagnated or even regressed, and neurology did not escape this trend.

b) Around the fifth century BC, the Greeks benefited from exceptional surroundings, and the pre-Socratic philosophers were forerunners of the Great Three: Socrates, Plato and Aristotle. These founders of specific schools of thought have put their seal on the whole intellectual sphere, including the medical knowledge. In their reasoning the Greek Philosophers tried to locate the organic site of the soul, intelligence, passions, the control of motion and the senses.

Progress does not advance in a vacuum. Travelling much, the philosophers discovered concepts prevailing in the countries they visited. Commercial relations and military campaigns also enabled cultural exchanges and produced steps forward thanks to new information. The undertakings of Darius extended the Persian Empire to Thrace in the west and to the Indus
valley in the east, while Alexander the Great conquered all these territories which gave rise to a fruitful injection of new ideas on both sides.

In their search for Truth, the discovery of the Principle of Life had priority. For the Egyptians the Pneuma was the fundamental substance able to diffuse within all organs, while the concept of dysharmony between fluids as a cause of disease came from India. The site of thinking and of feeling was the origin of major controversies, as to whether the brain or the heart was the central organ. This dispute has preoccupied researchers for centuries.

In the medical field, the pre-Socratic era was illustrated by outstanding pioneers such as Alcmeon from the town Croton, in Calabria, where a flourishing Greek colony lived 500 years before Christ. He was contemporaneous with Pythagoras and a fellow-citizen, and shared with him the certainty that numerical figures are the foundation of everything and result in complete harmony.

Alcmeon was one of the first to dissect animals. He is said to have proved that the brain was the main organ from which the nerves started, and to have discovered that the optic nerve was the link of the sensory organs with the brain. Nerves were considered to be hollow fibres through which the brains exchanged information with the sensory organs. Anticipating the ideas of Empedocles he placed a great deal of importance on harmony between opposites, moist-dry, hot-cold, sour-sweet, tall-small, black-white and so on. Alcmeon was a true pioneer, full of genius; but unfortunately his discoveries were overlooked for centuries.

The philosopher and poet Empedocles of Agrigento in Sicily (504-443 BC) was another pioneer. He borrowed from the Ionian philosophers their Pythagorean fourfold cosmogony. Earth, air, fire and water as fundamental elements governed medical thinking for a long while. Empedocles considered, as did Aristotle and Galen, that the nous was the principle of activity and the heart was the central organ. Plato and Hippocrates thought of the life of the brain.

Plato (429-347 BC), friend and pupil of Socrates, discussed the great problems such as mathematics, music and others, with his listeners in the Academe garden. This brilliant philosopher argued via dialectics, in the search for the truth in ideas. He separated the world of thoughts and the physical universe, considering man as composed of body and spirit. The shape of a triangle can be seen but is nevertheless a concept.

Aristotle (384-322 BC), Plato's pupil, created the Lyceum, a school of opposite attitude to the Academy, seeking for the truth by his observations. For him the world of thoughts was a utopia. This Stagirite, the Prince of philosophers tried to develop a system for the universe based on uncomplicated laws which governed all phenomena and explained everything. As an enthusiast of natural science he systematically assembled and classified the facts he had observed. His ability to assemble such rich material was due to the fact that he was the mentor of Alexander the Great, who provided his teacher with samples during his campaigns. Hereby the natural sciences were greatly advanced. Although Aristotle was Plato's pupil, he chose the heart as the most important structure because he considered it to be a warm organ out of which blood springs, while the function of the lungs was to cool the pneuma and the brain had to cool the heart. The spinal cord was thought to be the medulla of the rachis and the brains were considered to be the medulla of the skull. An axiom of Aristotle should always be remembered: 'The sciences have bitter roots, but their fruits are sweet'.

c) Hippocrates (468-370 BC) was born on the island of Thasos into a family of physicians. His father introduced him to medicine, and he became a physician travelling through Egypt, Libya, Greece and Scythia before settling on Kos. He was the initiator of clinical observations, preferred to use uncomplicated treatments and performed surgery. These approaches gave his school a particular character.

During his training, Hippocrates was submitted to the influence of philosophers such as Georgias from Leontini. At his peak, he had as peers Plato, Sophocles, Demosthenes, Thucydides, Phidias and finally Aristophanes. The latter was the first to laugh at the knowledge of the medical profession. All these famous thinkers made up Classical Greece.

The Hippocratic style of medicine increased considerably the medical knowledge. Despite extremely poor anatomical information, a new medical approach based on direct observation of patients was introduced. It is to Hippocrates that we owe the observation of contralateral paralysis after cranial trauma, and the description of apoplexy and epileptic fits. A link was established between the brain and intelligence.

Observed clinical signs, although undoubtedly limited to externally visible properties, are so valuable that they could still find a place in the clinical descriptions given in modern textbooks. This is the case for the sign of succussion (shaking by shaking) which shows that there is fluid in a cavity, or for clubbed nails and drumstick fingers bearing the name of Hippocrates. He introduced the concept of prognosis and
of critical days in the evolution of a disease. At Kos
the most noticeable progress was the fact of having
separated medical science from sacredness.

Hippocrates asserted that epilepsy was not a disease
related to divine powers but had a definite cause
“without which no disease can occur”, as stated in his
remarkable Corpus Hippocraticum (VI,6). This col-
lection of his theories was however not completely
written by the grand master, as additions were made
by some of his pupils, although always under his
inspiration. In the chapter Epidemic Diseases come
the comments on palsy stating that paralysis occurs on
the opposite side from a cranial injury (VII, 36) and
that paralysis of the arm can be associated with an epide-
mic cough (II,2.).

However Hippocrates is not the father of medicine,
because he did have some famous forerunners. Never-
theless, as explained above, he was the first to make
careful clinical observations based on his experience
and the practice of medicine, instituting a system
which remained of value to future generations. The
foundation of his ideas remains the alteration of
humours in the body.

His maxims remain food for thought: “knowledge
remains, life is short; time and opportunity are fleeting;
experience is deceptive; it is difficult to make a
correct evaluation; neither healing, nor dying can be
predicted with certainty for acute diseases”.

Hippocrates brought a completely new approach to
illness and patients, without provoking a radical
change. His influence transcends the centuries and can
still be felt, even if his way of living and thinking is
different from ours, and if some of his pupils betrayed
the dogmas of the Master of Kos.

d) The School of Alexandria founded by Ptolemy
(330 BC) became the leading centre of science and
remained so for centuries, giving fresh impetus to
medical knowledge, with Herophilus as one of the
leading personalities. Thanks to him important
progress was made in anatomy, both because the dis-
section of corpses had become possible and studies
could be made on living persons.

Erasistratos (310 to 250 BC) was known for his
studies in experimental physiology. From then
onwards the brain and cerebellum were singled out;
the importance of cerebral convolutions and of the
bulb were underlined; and the link was made between
nerves and brain or brain stem, identifying seven of the
twelve pairs of cranial nerves. Also the motor and
sensory nervous systems were differentiated. Nerves,
tendons and ligaments remained somewhat intermingled.
The Torcular heterophili site was considered the
junction of cranial sinuses.

e) The extension of Greece to the south of Italy and to
Sicily, or Magna Graecia, gave asylum to many
philosophers and naturalists, particularly during the
campaigns of Darius and other wars. Several centres
in this area were the sites of important medical
advancements.

Celsus was a poor physician but an extraordinary
encyclopedist and an elegant stylist, therefore called
Cicero medicorum. He has left us a famous treatise in
eight volumes, De re medicina, covering medicine of
his own time and earlier.

Rufus of Ephesus (first century) described the
anatomic wholeness of the brain, cranial nerves, spinal
cord and peripheral nerves.

Aretaeus of Cappadocia (second century) corrobo-
rated the description of signs and symptoms as did
Hippocrates. He added the depiction of the epileptic
aura, basing his reasoning on the fact that the symp-
toms started on the side opposite to the cerebral
lesion, describing also the signs of mydriasis and
myosis.

Galen of Pergam in Asia Minor (131 to 201 AD)
was an excellent physician and therapist using all
kinds of pharmaceutical products. Through his books,
20,000 pages long, he remained for centuries a leading
medical personality.

He composed a complicated system of medical phi-
losophy associating the vitalistic concepts of Aristotle,
the mathematics of Pythagoras, and the three kinds
of spirits or pneuma: the psychicon or animal spirit in
the brain, the zoonticon or vital spirit in the heart, the
physicon or natural spirit in the liver, each with differ-
ent attributes. He also incorporated the four elements
of nature (earth, air, water, fire), the nine conditions
(hot-cold, etc.), the four humours (blood, phlegm or
viscid humor, yellow and black bile), the three spirits
or mental powers, ideas surprising for modern
anatomists.

His numerous dissections, performed on animals,
such as monkeys, dogs, pigs, cattle and even an
elephant did not give him new ideas. For him blood
was produced in the liver, prince of all internal
organs; the heart was the origin of arteries; and the
Vital Force or pneuma was developed in the
left ventricle out of the inspired air passing from
the lungs directly to the heart. Respiration cooled
the blood heated by the heart, while the arteries,
which were observed empty on carcasses, contained
only air.

The system of all organs, he believed, served the
soul. This hotchpotch of shrewdness without objective
basis allowed Galen to be considered a real authority,
till the observations made by Vesalius.
However, unlike Hippocrates, no clinical descriptions were furnished by Galen, except those bearing out his own theories, satisfying his self-sufficiency. His major contribution concerned the nervous system, where he identified the cerebellum as a hard portion against the soft one of the brain, and the nerves as hollow pipes transporting the sun’s rays, air and water. Galen was familiar with the pachymeninx (or dura mater), the pia mater, corpus callosum, third ventricle, sylviduct, fornix, quadrigeminal bodies, processus vermiformis, calamus scriptorius, infundibulum, pituitary body, seven pairs of cranial nerves, sympathetic ganglia, the nervus recurrens and the loss of voice when this nerve is cut. From this Galen deduced that the brain contained the intelligence and its aptitudes. The spinal cord was a bundle of hollow nerves starting from the brain and continuing to their peripheral target. His observations by making cuttings at different heights through the medulla on living monkeys, reconfirmed the findings of Herophilos.

Hippocratic, Hellenic and Roman medicine substantially increased anatomical and physiological knowledge. As already stated, heterolateral paralysis after cranial trauma, strokes and epileptic fits were clearly described; and the connection was made between intelligence and brain. These ideas, whether true or false, remained as dogma for centuries; until Roman or Helleno-Roman medicine sunk with the Roman Empire.

f) The Byzantine era (476-732 AD) brought little adornment to medical science. Oribasios (325-403 AD) examined cuttings at different levels through the medulla and described senile decay as atrophy of the nervous system. He published the Synopsis, an encyclopaedia of seventy volumes. Protopsatarios discovered the nervus olfactorius for the sense of smell.

The Nestorians had an important role in linking Greco-Roman medical knowledge and Arabo-Islamic health sciences. The latter, in its turn, also sank during the twelfth and thirteenth centuries, without contributing to the advancement of neurology.

The School of Salerno also ensured the transfer from Greek and Arab knowledge to the University of Montpellier in the South of France during the eleventh and twelfth centuries, but the opinions of the great masters were accepted as dogmas, while every effort was made to find an explanation for facts when they appeared contradictory to the accepted theories. A typical example was the range of dialectic subtleties invented in order to justify claims of a rete mirabile as found in a dissected bullock, but does not exist in man.

g) It was not until the Renaissance, with its brilliant medical brains such as those of the anatomist Vesalius and the circulation physiologist Harvey that the fanciful ideas disappeared and that medical science also was renewed. Some errors remained deep rooted, such as the belief that the heart was the centre of all physiological activities.

Andrea Cesalpino from Pisa (1519 to 1603), physician and philosopher, was professor at the University of Pisa. He contradicted a series of Galen’s erroneous ideas in the field of circulation. By studying the operational process of the heart-valves, he could deduce how the pulmonary circulatory system worked. Nevertheless he remained convinced, as Galen had been, that the heart was the centre of all activities.

The Italian Renaissance had made it possible to dissect corpses; and as a result Andreas Vesalius could describe, in 1543 at Padua, the human body as he really saw it under his scalpel and not as it had been conjectured.

As in many other fields, Vesalius was a forerunner of neuro-anatomy. He first described the ventricular system. This knowledge was later extended by Gasser, Variolus, Sylvius, Willis and Vieuxsens. One must however acknowledge that Vesalius had been influenced by his Galenist masters at Louvain and Paris. He kept some of the Galen dogmas, except in anatomy.

h) In the eighteenth century, the forerunners of the neuropathologists appeared: Francis Glisson discovered that the excitability of living tissues depended on nerves. The remarkable Stephen Hales, a country priest who was a naturalist with an inquiring mind, discovered that the leg of a decerebrated frog still reacted if stimulated. This underlined the role of the spinal cord as the nervous centre in the absence of the brain.

Histology and histopathology became the main concerns: Ramon y Cajal described the nervous cell, its protoplasmic extensions or dendrites, the nerve fibre or axis-cylinder and the neuron as the basic unit of the nervous system. This elementary knowledge led to the development of exploratory methods such as the reflex hammer of William Erb in 1870 and the lumbar puncture (Quincke, 1891). The acquired science also made possible the description of clinical signs such as Kernig’s sign in 1882 and Babinski’s sign in 1896.

The observation of distinct nervous diseases such as meningitis, encephalitis, cerebro-vascular stroke, Parkinson’s disease, etc. contributed largely to the knowledge of the operation of the nervous system.
B. The ventricular system and the cerebrospinal fluid

The evolution of the knowledge concerning the ventricular system and the cerebrospinal fluid proves how the slow development of anatomical and physiological knowledge of the nervous system did not progress uninterruptedly.

a) The meninges and the cerebral fluid are mentioned in the papyrus of Edwin Smith. Aristotle knew that there were cavities in the brain. Herophilus, Erasistratus and Rufus of Ephesus contributed greatly to increased knowledge of the nervous system, particularly of the ventricles.

b) Galen, by dissecting a great number of animals, gave the first detailed description of the ventricular system. The ventricular system was for him, as it was later for Th. van Sommering (1753 to 1830), the reservoir of animal spirit and psychic pneuma, while the brain was the centre of the soul which was at the origin of movements and sensation by means of the animal spirit. This spirit was constituted by air entering the brains, the choroid plexus and the famous rete mirabilis, through the cribriform plate of the ethmoid bone. This last site played a role for the olfactory system of smell which here reached finally the ventricles.

The two lateral ventricles were known by Galen and they made, with the third and the fourth ventricle a little lower, the inspiration and expiration of the brain (see figure 1). Galen had also seen that there was a channel between the third and the fourth ventricle, later called the aqueduct of Sylvius; considered that the gaseous excretions of the brains egressed through the bone sutures and that the liquid ones passed as phlegm through the pituitary fossa and the cribiform plate. This mosaic of fanciful interpretations prevailed until the sixteenth century.

Although the research-workers remained interested in the ventricles and the membranes surrounding the brains, the fluid itself was mentioned only incidentally. Edwin Smith's papyrus spoke of the fluid oozing from a wound on the skull; the Corpus Hippocraticum and Galen occasionally mentioned the humor in the brain as excreted in the ventricles. It was only in the XIIIth century that Mondino di Luzzi (1275 to 1290) would find any indication of fluid excretion in the ventricles.

c) Nicolo Massa, predecessor of Vesalius at Padua, is the first to give (in 1536) a precise description of cerebrospinal fluid (CSF). Although it was currently considered to develop in the ventricles after death, it was believed to emerge from the animal spirit in a closed system and to be eliminated through imaginary foramina or holes in the cribiform plate. However the intelligence could not be located there, as the ventricles

Fig. 1 – Cerebrospinal fluid and spaces (adapted from Rasmussen, 1952)
have neither arteries nor veins; so intelligence was sited in the arteries and the left ventricle, while blood was conveyed by the veins and the right ventricle. The subarachnoidial fluid would have no relevance as long as the ventricles were considered to be a closed system with hollow nerves as the only outlet.

d) *Vesalius* was able to correct some errors as a result of his dissections. He then carefully described the ventricles, but he ignored the wax impression as made by *Leonardo da Vinci* and the aqueduct between the quadrigeminal bodies. Vesalius denied that there was a throughfare for excretions from the ventricles to the cribiform plate, but he accepted that there was a communication between the third ventricle and the nasopharynx and also that the fourth ventricle enclosed a fluid.

*Giulio Cesare Aranzi* (1530 to 1589) perfected Vesalius's description by detailing the horns of the lateral ventricles, the *choroid plexus*, the link between the hippocampus and the ventricles, and the channel between the third and the fourth ventricle. For Aranzi the air passing through the organ of smell, combined with the vital spirit in the ventricles, constituted the animal spirit.

e) During the seventeenth century the anatomy of the brain's membranes or of the ventricular and choroid system was known; but the anatomic details and the role and origin of the CSF were only described during the XIXth century, as a result of microscopic examination.

*Thomas Willis* (1621 to 1678) was a chemist-healer, professor at Oxford. His name became familiar through the Willis circle or arterial anastomosis at the base of the brain. He considered the ventricular system, the brain membranes and the *choroid plexus* with a Galenic mind, taking into account that nature's aims are never in vain. Therefore he firmly believed, even if he was willing to discuss the current opinions, that there were three *pneumae*. The *psychicon* or animal spirit was located in the brain and was the site of imagination, thinking, memory, voluntary movements and feelings. Hence he easily confused the old theory fixing the origin of the animal spirit in the ventricles. Willis said that such a discerning source of thought, with its various abilities, did not need so much space, but called rather for narrow channels and outlets allowing for movements along pathways and circles to be followed by the soul. Willis also stated that the ventricles were issued from folds of the brain and were making out a closed casing which could not harbour the subtle moving mind.

It was no longer acceptable to consider the ventricles as a sewer for the excretions of the brain through niches of the infundibulum and through the cribiform plate. Also to be contradicted was the belief that the *choroid plexus* furnished the animal spirit to the brain, as indeed those blood vessels are not embedded in the brain or the spinal cord, but hang in the ventricles (which were believed not to shelter the animal spirit). However the *choroid plexus* could have a twofold function: to extract the aqueous portion of the brain's blood which, after clearing out the excreta, could vaporize the spirit as does a chemical distillation. The *choroid plexus* could also regulate the heat in the brain by the circulating blood. Willis suggested the role of the plexus in the production of the ventricular fluid which should be of vascular origin.

g) *Albrecht von Haller* (1708 to 1777), born in Switzerland and favourite pupil of Boerhaave at Göttingen, was a scientist already belonging to the *Scientific revolution*. In his treatise on the physiology of the human body he stated that his experiments proved by injections that fluid was found in the ventricles and at the surface of the brain, and that the fluid spouted from the arteries and returned to the veins. This proves that he had the idea of a circulating liquid. For the first time physical properties of the fluid were given; however von Haller could not shake off the belief that a gaseous substance was condensing as a *lean humour* out of the perspiration of arteries. The same scientist also stressed that a large amount of liquid produced hydrocephalus.

*Dominico Felice Antonio Cotugno* (1736 to 1822) could finally explain that the fluid arose from the blood vessels and surrounded the spinal cord; the ventricular and spinal fluid were communicating. He also underlined that previous observations on empty space or air bubbles were caused by incorrect anatomical techniques, as studies were performed on a cut head. In such conditions, when the skull was opened all liquids would be running out.

No attention was paid to these fundamental data for the simple reason that they were published in a volume on sciatica.

h) *Francis Magendie* (1783 to 1855) credited Cotugno for his discoveries. Magendie launched modern neurology with his communication to the Academy of Sciences in 1824. He introduced the name *cerebrospinal fluid* (CSF) and proved that it was found at the surface of the brain and the spinal cord between the pia mater and inner surface of the arachnoid membrane, and that it communicated with the ventricles (figure, p. 1025). Magendie also studied the origin, the elimination, the peculiarities and the function of the CSF. Thanks to coloured products he could prove that the fluid was absorbed by Pacchionian granulations or arachnoid villi. In his book: *Physiological and clinical research on cerebrospinal or cephalo-
rachidic fluid (1842) he mentioned that the layer of fluid was larger for some areas of the nervous system. H. von Luschka (1820 to 1875), of Swiss nationality, became a distinguished professor of anatomy at the University of Tübingen. His monograph on the choroid plexus of the brain completes Magendie’s description. Von Luschka described the communication between ventricles and subarachnoid space, by detailing the foramina of Luschka opening the fourth ventricle to the asternae lateralis see fig. p. 1025.

For Luschka the CSF was a transudate from the blood vessels of the choroid plexus, a real organ.

In 1853, Ernest Faiivre from Paris, in his observations on the meningeal granulations or Pacchionian bodies (arachnoid villi), formulated the idea that the CSF was produced by those bodies or glands which had an excretory function. However he wrongly stated that these bodies were hernias of the dura mater caused by the pressure of the CSF.

The Swedish Alex Key of Lund (1832 to 1901) and Retzius of the Karolinska Institute at Stockholm (1842 to 1919) promoted the same idea on the Pacchionian granulations in their treatise: Studien in der Anatomie des Nervensystems und des Bindegewebes (Studies on the anatomy of the nervous system and connective tissue). They clearly detailed the pathway followed by the CSF in the brains of adults, children and newborn infants, or of recently killed dogs and sheep. They demonstrated it also in living dogs and rabbits, thanks to the injection of gelatinous particles of Prussian blue and cinnabar (red mercuiur sulphide). The investigations of the Swedish research-workers were carried out under a pressure of 60mn mercury, and proved that the CSF flowed through the Pacchionian granulations to reach the venous lacunae. These two authors asserted that the choroid plexuses were not a pathologic outgrow but had a physiological function. Hence the production of the CSF appeared to rest on a twofold mechanism, mechanical and endomastic, as venous blood has a higher specific gravity than CSF.

h) For forty years the problem was considered to be unquestionable and solved. Meanwhile Quincke introduced the lumbar puncture and neurosurgery came to develop.

Walter Edward Dandy (1886 to 1941), neurosurgeon of Johns Hopkins hospital at Baltimore, where he became famous by performing ventriculography in 1918 and gas encephalography in 1919, proved in 1913, assisted by K.D. Blackfan, that hydrocephalus could be provoked by inserting a cotton plug into the aqueduct of Sylvius. This internal hydrocephalus confirmed that the production of fluid in the ventricles is greater than the absorption. Using phenolphthalein as a marker they traced the route of the absorption of cerebrospinal fluid which takes place in the subarachnoid space, although not selectively by the Pacchionian granulations.

C. Neurological discoveries in Central Africa

1. Trypanosomiasis

To evaluate the findings of the first generation of Belgian physicians in Central Africa, it is useful to recall that Arthur van Gehuchten, a world famous scientist in the field of histology, neurological physiology and pathology described the Wallerian demyelinating neuropathy. He was the first to hold a chair of neurology at the University of Louvain in 1908.

Already in 1888, Mense mentioned the sleeping sickness, under the name of Ntansi. In their 1899-1900 report on the works of the Medical Laboratory in Leopoldville (Kinshasa), Van Campenhout and Dryepondt (1901) dedicated a chapter to the African lethargy. They gave an extremely precise anatomical description of the lesions to the nervous system. They identified diffuse encephalitis, chronic meningitis and myelitis in cases of sleeping sickness.

They also established the link between the diversity of the impaired areas and the great variability of symptoms. They described the generalized or localized epileptic and chorean fits as well as their increased frequency during the third stage of trypanosomiasis. They also described abolition or changes of reflexes, sensitivity disorders, and paralysis of lower limbs during the disease. Broden confirmed these findings in his report of 1906, at the time when trypanosomes were recognised by Castellani (1903) as being the aetiologic agents of sleeping sickness. In 1908, Broden insisted on the importance of the cytological examination of the cerebrospinal fluid to analyse objectively the stage of the disease. The use of systematic lumbar puncture (LP) in screening and treatment campaigns for African trypanosomiasis were largely spread on basis of these findings.

2. Cerebral malaria – Tick-borne fever

In 1901 Van Campenhout and Dryepondt also mentioned and described the occurrence of cerebral forms of malarial fever, as a particular clinical picture. At the same time, they stressed that the acclimatization fever of newcomers was usually due to Laveran’s parasite of red blood cells.

In 1913 Rodhain and his colleagues published their discoveries of 1911 on the meningeal reaction in tick-borne fever. In more than 50% of the cases of African tick-borne recurrent fever, they discovered lympho-
cytes, monocytes and increased protein level in the CSF, at different stages of the evolution of the disease. These data were completed by Lodewycks (1938), who found similar protein and cytological changes of CSF in 19 out of 27 patients examined and even discovered the presence of borrelia in three of these fluids.

3. Meningitis

In 1918, Abetti and Daniel noticed the presence of pyogenic bacterial meningitis in the Kilo area (Ituri, Zaïre). This fact was not new.

During the same period, Rodhain mentioned that an epidemic of meningococcal meningitis had struck the troops of the Northern Brigade in 1916. Pneumococcal meningitis also appeared a year later. Nevertheless, it was not until the twenties that meningitis became a main concern for the medical authorities of Zaïre (Walravens, 1921; Van den Branden and Van Hook, 1922; Bruynoghe and Walravens, 1926; Brutsaert, 1931) and in Ruanda-Urundi (Pergher and Portois, 1936; Neujean, 1938).

In 1955 the Head of the Health Services reported 556 cases of meningococcal meningitis with 159 deaths, and mentioned 909 cases of pneumococcal meningitis with 329 deaths. In 1958 the cases of meningococcal meningitis reached the number of 235, with 50 deaths; while pneumococcal meningitis cases rose up to 1,004 with 324 deaths. These figures represent the years without epidemics.

To these classic forms of bacterial meningitis we must add plague meningitis (Lewillon et al., 1940), anthrax meningitis (Michaux, personal communication) and antenal meningitis due to Flavobacterium meningosepticum (Vandepitte et al., 1958; 1965).

Acute aseptic meningitis was very frequent, particularly the tuberculous meningitis (Fornara, 1923; Camphyn and Frebutte, 1958). In 1913 Mouchet observed tuberculous meningitis in the Middle Congo. In Katanga, he noticed tuberculosis in six out of 72 autopsies, (3% of the cases). He specified that tuberculous meningitis had a similar evolution as compared to European one, the first involvement usually being located in the mediasinal glands.

In 1958, 118 cases of tuberculous meningitis, causing 42 deaths, were reported in the reports.

Among cases of mild lymphocytic meningitis, a large number were to be ascribed to leptospiral serous meningitis (Van Riel, 1956).

4. Tetanus

Tetanus appeared as isolated cases. In particular situations, however, it sometimes occurred in series, for example infecting patients who had all been operated for hernia in the same hospital. Seeking the origin of the infection, the medical staff found that at night visitors came to place under the postoperative dressing a little soil collected at the base of the sacred tree in their village, in order to guarantee the patient's recovery. Unfortunately that tree was also the night shelter for ruminants, bearers of tetanus spores.

The main problem to be prevented was umbilical tetanus, by a complete vaccination of pregnant women.

5. Treponematoses

Although syphilis was rare, it did exist. Specific tertiary cerebral lesions with cortical foci of vasculitis were observed. They provoked the sudden occurrence of apoplectic strokes, sometimes leading to paralytic after-effects. Lesions of diffuse meningeal encephalitis with a chronic evolution were observed, accompanied by a positive serological reaction and a significant testing of the CSF with colloidal benjoin. The clinical aspect of nervous syphilis proved, if necessary, how excessive the denomination of general paralysis was, as paralysis appeared only during the final stage.

Attention was focused on the difficulties in speech, the facial tremors and the movements of the tongue. Typical cases of tabes dorsalis, due to a radiculomedullar location, with ataxia, uncertain gait, tabetic foot, and recurved knee were however extremely rarely seen. Nervous syphilis was studied by Walravens and Walker in 1929, by Marchand and Dewulf in 1933, and by Limbos in 1947. In 1953, Verhaegen and Beheyt described two cases of Erb's spasitic paraplegia.

It has always been difficult to specify the role of Treponema pallidum. Scientists were influenced by different trends: the up-to-date doctrine detected treponema in many chronic visceral diseases, while serological reactions were presumed specific. Furthermore treatments were either insufficient or non-existent. That was at the origin of many cases of late syphilis. Consequently, it was normal to expect many cases of nervous syphilis. However there was also the disturbing interference of non-venerial treponematoses, reducing the value of serological tests; and the possible influence of persistent malaria parasites on the nervous localisations of Treponema pallidum. This was well known by all practitioners to appear late, at the age of 40 to 50 years. But short life expectancy made the development of nervous syphilis uncertain. Also strange was the low frequency of congenital syphilis. Finally, it was necessary to allow for the possible unicity of human treponemata. Calewaert (1947)
wrote that, after yaws had been overcome, syphilis could still remain. Nevertheless this possibility was too vague to draw firm conclusions.

6. Rabies

Rabies had probably never been absent in Central Africa. It was noticed for the first time in 1923 in Boma by Repetto, and in Ruanda-Urundi by Cerutti. The diagnosis was immediately questioned, in particular by Walravens in 1931.

The medical doctors focused their attention on the rabies of dogs (called Makupo in the Tshiluba language), which was known in the region of Luluaubourg (Kananga) since 1914-1916, and had been described by the veterinary surgeon Bouvier, in 1934. This dog rabies was little or not at all pathogenic for man, but in fact few men had been bitten. This lighter form, not very aggressive and rather paralytic, was linked with Oulou-Fato, as described in West Africa by Curasson in 1933.

Belgian medical officers were not familiar with human rabies because they had only a theoretical knowledge of the disease, somewhat coloured by Pasteur’s heroic ventures. On the contrary Italian doctors, and in particular the Sardinians, knew rabies well. In Zaire the disease became recognized little by little, the silence being broken in 1937 by Chesterman and Liégeois who published a case of human rabies. In 1940, the presence of rabies was recognized throughout the country; and it was admitted that Central African rabies behaved like classic rabies.

In the neighbouring countries, the recognition of rabies was similarly slow. The first case of rabies in Nairobi dated back to 1912. In Angola, it had been known for a long time and a special service for its diagnosis was established in 1929. In Tanganyika and in Uganda on the other hand, rabies was not diagnosed until respectively 1932 and 1935.

7. Viral encephalitis

Viral encephalitis, often suspected, was identified in its different types only when virological services were set up (Coxsackie, poliomyelitis by Delville et al., 1957, 1958). Among arbovirus diseases, the neurotropic varieties are not infrequent, including dengue and yellow fever. Yellow fever vaccine, especially the vaccine of Dakar, and to a lesser degree the 17D strain, are neurotropic for newborns because their central nervous system is still immature. Cases of deadly encephalitis were observed, but not published. Neuro-meningeal viral involvement was often ignored in paediatrics.

The very frequently occurring meningeal form of Burkitt’s lymphoma with paralysis of cranial nerves and paraplegia, may temporarily enter a remission phase through chemotherapy (Endoxan®).

8. Nervous pathology by helminths

The nervous pathology associated with helminthic infections rarely attracted any interest. The nervous system is, however, not safe from invasion by these parasites. If worms do not multiply in the host, they produce eggs or microfilariae which are essential for the safeguard of the species. Adults settle rarely in the central nervous system; however it may occur for fasciolae, paragonimus, filariae. The adult helminths will produce foreign body reactions, much heavier when the worm is dead.

The infecting larvae of helminths may either get lost in the nervous tissues or be driven in by very effective therapeutics. The larvae of animal helminths are moving along without precise tropism, and can reach the nervous system. Such cases are certainly common. When the larva migrans visceralis reaches a specific tissue, this tissue will try to envelop and destroy the larva. Reactions of hypersensitivity may occur, but are still little known.

Four deadly meningeal encephalitis provoked by microfilariae of Loa Loa were observed by Kivits (1952) in Mayumbe. In 1955, van Bogaert and coll. studied a case in detail. Since then, similar cases have been published in Gabon, Congo and in Southern Cameroon. This complication of the loiasis, apparently characteristic of these regions, was exceptional before the introduction of diethylcarbamazine (DEC). The risk arises at about 1,000 microfilariae per 20 mm³ of blood. From 1960 to 1969, Habrant observed some 80 to 90 cases of meningeal encephalitis in adults. Once the role of DEC in causing loiasian coma was known, the cases became rare in hospitals, but they occurred in people infected by Loa parasites who used the drug for other disorders such as headache, aching oedema or joint pains. This state of coma is aggravated in 90% of the cases by retina haemorrhages (Maertens and Dechef, 1976).

The frequency of cysticercosis will certainly increase with the spread of Taenia solium in Central Africa. Pain observed, in a person infested for four to five years, the presence of still-alive cysticerci which were not yet calcified.

A transverse myelitis could be induced by Schistosoma mansoni and might be healed through a specific treatment.

The presence of pentastomes in subdural space was described by Fornara in 1923.
9. Spastic endemo-epidemic paralysis of Kwango (Zaire)

Kitondji or Konzo (also called Buka-buka which means “to remain in the sitting position”) is a syndrome of spastic paralysis whose first 25 cases were diagnosed in 1936 by Tessitori in the territory of Kahembba and by Mercken in the region of Feshi, both in South Kwango, Zaire. They formed part of an epidemic disease causing 146 cases in 1936, 140 in 1937 in Kahembba, and 413 cases in Feshi. On that occasion it was established that there was an epidemic outburst within an endemic situation; observed after-effects could be traced back 30 to 40 years before this disease of obscure aetiology was diagnosed by different FOREAMI physicians in Kwango. Their findings were assembled by G. Trolli in 1938.

Giulini, who studied that syndrome thoroughly, found, during the census from 1942 to 1944 on 33,251 people in three villages, 491 persons showing after-effects (1.4 %), all of them spastic cases, and five acute cases in children from six to eight. He found in them deglutition disorders (Guilini, thesis examen B, 1952).

In 1952, Christian Luccesse made an interesting clarification. His study summarized the very characteristic clinical syndrome, with a discussion on the differential diagnosis and on the epidemiological details, noticing that the disease appeared in the beginning of the rainy season.

The study by Luccesse mentioned that paralysis of the lower limbs occurred mainly in children of both sexes and in adolescents or adults only of the female sex. This paralysis caused a defective position and a quite impaired gait. Some necropsies were performed and samples were sent to Professor Ludo van Bogaert at the Institute of Neuropathology of Bunge, Antwerp, without enabling him to identify a specific cause.

This syndrome has recently been called for renewed attention. Localized epidemics limited to small communities in Bandundu province (previously Kwango-Kwili) occurred in 1978 and 1981. In between the epidemics some sporadic cases were seen. New observations were made by Cliff and co-workers in 1985 and by Carton et al. in 1986, during a resurgence of the disease. This enigmatic local syndrome was related to a similar disease in Mozambique called Mantekassa, observed on 1,000 cases; but this is definitely a different disease, whose cause is said to be the consumption of manioc which had not been detoxified.

The twenty cases studied by Carton et al. (1986) corroborate globally the previous clinical observations: sudden onset, bilateral spastic paralysis, possible healing but frequent serious after effects. Rosling et al. (1988) counted 20% of disabled in a village where they examined fifteen typical cases. They established that the serum level of thiocyanate was 163 moles per litre, four times the amount seen in control cases.

This study brought the problem of the aetiology of the disease back into discussion. It was the subject of numerous hypotheses. In the first publication in 1938, an infectious and a toxic cause had been suggested. 1) African recurrent fever was alleged on the basis of the coexistence (in the same geographical limits) of the disease and the transmitters Ornithodoros moubata. It is not likely that a local variety of Borrelia could produce immunological reactions at the level of the lumbar medulla such as to cause the disease only in some sick persons.

2) The possibility of poliomyelitis was mentioned but could not be substantiated since no case of infantile paralysis having provoked spasticity was described. Furthermore an epidemic outburst of poliomyelitis observed in 1949-1950 in the region, did not leave any striking spastic aftereffects.

3) Another possible origin, although unproven, could be an intoxication through vegetable toxins. Every knowledgeable physician working in tropical areas has run across disorders caused by toxic plants, and particularly lathyrisism, a spastic paraplegia observed in Algeria and in India, caused by eating vetches of various species of Lathyrus. But the connection of spastic paralysis with the chronic intoxication through thiocyanates found in inadequately retted manioc is almost impossible because manioc is so widely used in many regions. The role of thiocyanates was linked to the development of endemic goitre in various areas.

4) The fact that the Konzo-Kitondji appears during a drought period, suggests that some children might have eaten as-yet-unidentified wild fruit and vegetables. It must be concluded that no cause has as yet been pinpointed and that the association of various toxic vegetables should not be excluded.

During the sixties a number of syndromes of ataxy, with uncoordinated muscular activity were described in Western Nigeria. Ryberg and co-workers (1987) described a new variety of spastic paraparesis associated with HTLV-1 virus, called tropical but apparently without any valid grounds. This published case and also the one described by Taelman et al. (1989) concern people who left a tropical area more than ten years ago.

Such cases will enable to differentiate the real epidemic spastic paraparesis described in Zaire from this new tropical variety.

The syndrome underlines the fact that the study of degenerative, deficiency or allergic diseases calls for the attention of clinicians, epidemiologists and pathologists.
NEUROLOGICAL DISEASES

MAJOR CHALLENGES

If specifically psychiatric disorders were for a long time neglected by doctors in Central Africa, in contrast neurological disorders received the attention of the medical and allied health professions from the onset.

Neurology had a real appeal because the dominant Central African infectious and parasitic diseases included diseases with strong neurological components. These were mainly sleeping sickness, leprosy, tuberculosis and its complications such as meningitis, meningoencephalitis and Pott’s disease, poliomyelitis, malarial encephalitis, encephalitis due to Loa loa, neurocysticercosis, and rabies.

1. Infectious and parasitic diseases

1.1. Meningo-encephalitis

While these diseases are often called meningitis, an infection purely localized at the meninges is rare. These diseases also involve either occasionally or exclusively, the spinal cord (myelitis) or the cerebellum (cerebellitis).

A distinction is made between acute and subacute or chronic forms of meningoe-encephalitis.

1.1.1. Acute meningoe-encephalitis

a) Bacterial meningitis

Caused by bacteria, this infection strikes in order of preference infants, children, and young adults (see pp. 1342-1343). Studies carried out in the paediatric department of the University of Kinshasa show that the following bacteria are responsible in order of decreasing frequency: pneumococcus, meningococcus, Haemophilus influenzae, E. coli, and Pseudomonas pyocyanae (Nthinyurwa et al., 1979; Omanga, 1976).

The most frequent complications of meningoe-encephalitis are anuric partition, subdural empyema (Thauvoy et al., 1976; Nthinyurwa et al., 1979b; Bulu ben Gentry, 1984), and arterial or venous thromboses.

b) Aseptic meningitis, benign lymphocytic meningitis

Caused primarily by viruses, but also by rickettsiae and even spirochetes, these forms of meningitis are often called benign or curable because recovery often leaves no sequelae, unlike tuberculous or mycotic lymphocytic meningitis. Children and young adults are the prime targets.

1.1.2. Subacute or chronic meningoe-encephalitis

a) Predominantly cortical: Meningo-encephalitic syphilis, general paralysis

This condition, which corresponds to stage IV syphilis, appears five to ten years after the primary chancre, primarily in untreated or poorly-treated cases of syphilis. It seems to have been common in Central Africa more than 30 years ago but, like dorsal tabs and Erb’s syphilitic myelitis, it has practically disappeared.

Today’s resurgence of sexually transmitted diseases (STD) has brought about a new wave of patients with neuropsychic complaints and seropositive cerebrospinal fluid (CSF). Efficacious treatment of stage I syphilis is thus primordial.

b) Predominantly basilar: tuberculous meningoe-encephalitis

This form remains frequent and even seems to be gaining ground among immunodepressed individuals. It is often diagnosed late because of its insidious onset (febrile, headaches, weight loss). The meningoe-encephalitis occurs late and is often not very pronounced, and the CSF is sometimes atypical (Manungu, 1978; Kumboneki, 1978).

Luckily, the combination of current tuberculostatics and corticosteroid therapy to prevent meningoe-encephalitis often makes it possible to cure cases caught early enough.

c) Mycotic meningoe-encephalitis

These forms of meningoe-encephalitis are caused primarily by cryptococci, but Candida has also been implicated. Formerly rare, their numbers have grown with the increase in AIDS cases. Treatment continues to be disappointing, even with the new antifungicotics.

1.2. Primary encephalitis

Such encephalitides can be either multifocal or diffuse. The latter may involve the entire cortex, be localized in the basal cortex, or even involve preferentially the white matter (leucoencephalitis).

1.2.1. Heine-Medin disease

This is a viral infection tending to concentrate in the anterior horn cells of the spinal cord. It affects children in particular and is primarily caused by poliovirus serotype I.

There is also an encephalitic form, characterized by involvement of the truncal motor nuclei and even the
central nuclei, the cerebellum, and sometimes the cortex. It tends to strike young adults and is caused primarily by polioviruses II and III.

Heine-Medin disease, frequent in the 1950s, regressed spectacularly as a result of a vast attenuated live virus vaccination campaign undertaken in Kinshasa in 1958. This campaign gave the first large-scale proof of the efficacy of systematic vaccination against poliomyelitis, for the disease continued to spread where no vaccination took place. The resumption of vaccinations in Kinshasa, after a fresh outbreak linked to a break in the vaccination campaign after the independence, has kept down the number and seriousness of the cases (Badibanga et al., 1981).

**1.2.2. Rabies**

This viral encephalitis affects the brain stem, the central grey nuclei, and the brain cortex, especially the neurons of the hippocampus, in which the intra-cytoplasmic inclusions called Negri bodies are sought during postmortem examinations. Unfortunately, it remains strongly prevalent in Kinshasa, where the control of roaming dogs has proved difficult.

This disease leads inexorably to death within ten days following the appearance of the first symptoms; treatment can only reduce pain during the crises.

Despite the small number of (often reversible) accidents linked to antirabies sero-vaccination therapy, prevention by this means is mandatory in all suspicious cases.

**1.2.3. Epidemic encephalitis, Encephalitis lethargica (Von Economo’s disease or Type A encephalitis)**

This is the main form of epidemic encephalitis. It was described when it reached the European continent, especially during the post-World War I pandemic. It has not been reported in Central Africa.

**1.2.4. Type-B encephalitis**

The diffuse encephalitides tending to total cortical involvement include also type-B encephalitis. Many forms of acute diffuse encephalitis, often occurring in epidemics, have been described in different parts of the world (Japan, previous USSR, USA, Venezuela, and East Africa). It occurs in Central Africa in the form of an endemic disease or small epidemics.

Type-B encephalitis is caused by viruses transmitted to man by mosquitoes and especially by ticks. It is thus a predominantly rural disease. Onset is sudden, often marked by high fever and convulsions. The symptoms often include psychic disorders, delirium, and hallucinations. A period of torpor then sets in, progressing sometimes to a coma.

The mortality is high. However, early aggressive anti-inflammatory treatment can result in integral restitutions. Hence the value of correct diagnosis and virological studies to specify the etiology.

**1.2.5. Acute necrotizing encephalitis**

Acute necrotizing encephalitis, which tends to focus on the basal cortex, is caused by herpes viruses and leads to deep tempo-insular necrosis (Bruchner et al., 1957). Formerly rare, its incidence is rising in parallel with that of AIDS.

The onset is marked by focal epileptiform attacks that may be followed by hemiplegia and possibly aphasia. The disease ends with death in a few days or weeks after a stage of mental confusion and coma. The localized infections must be differentiated from cerebral abscesses and tumours.

**1.2.6. Leuco-encephalitis**

These types of encephalitis are located in the white matter. They include:

a) Leuco-encephalitis of Trypanosoma gambiense (African sleeping sickness)

This is the end stage of Gambian sleeping sickness, which occurs in three anatopathological stages:
1. haemolympathic involvement (early stages), which begins 10 to 15 days after inoculation by the infected tsetse fly, shows diffuse reticulo-endothelitis with lymphocytic and plasma cell infiltration;
2. central nervous system involvement at later stage, characterized by meningoencephalitic reticulitis with perivascular lympho-plasmocytic infiltration of the brain stem; and
3. the terminal stage of usually irreversible diffuse leuco-encephalitis.

The danger of arsenic-induced encephalopathy makes the study of new drugs imperative.

b) van Bogaert’s subacute sclerosing leuco-encephalitis

This disease is currently known as subacute sclerosing pan-encephalitis (SSPE), as it extends well beyond the white matter. It is practically restricted to children between four and fifteen years of age. Its precise aetiology is still not known, although it is definitely connected with measles. A modified measles virus is probably involved.

Measles vaccine has been accused of helping to spread SSPE. This explication is highly controversial and actually is not the case for the pan-encephalitis encountered with increasing frequency. Indeed, this disease, once considered rare, is currently relatively
frequent in Zaire and elsewhere in Africa, especially Abidjan.

The insidious, afibrile onset is marked by gradual mental deterioration. The characteristic myoclonic jerks, increasing the child’s unhandiness, are sometimes followed by epileptic seizures. The distinctive EEG pattern (Radermecker, 1954, 1955) and CSF electrophoresis (Janssens et al., 1958) allow fairly early diagnosis.

Unfortunately, no efficient treatment is currently available and the prognosis is death within two years at the very latest.

1.3. Metastatic encephalitis

This heading covers encephalitides caused by parasites and characterized by the presence in the cerebral parenchyma of embolic necrotic nodules containing the causal parasite in their centre.

1.3.1. Malarial encephalitis or cerebral malaria

This has been observed only in P. falciparum infestations, especially in children, and almost always during a primary infection.

Onset is very rapid. The headaches and vomiting that may occur are followed by coma and high fever or mental confusion with agitation and hallucinations. Convulsions are common (see pp. 1458-1459).

Usually there is neither during nor after the crisis any sign of cerebral involvement at one or another side. While acute-phase mortality is high (more than 25%), there is a chance for sequelae-free recovery, if appropriate treatment is instituted without delay (van Bogaert, 1964; Limbros et al., 1985; Shako et al., 1978; Omanga et al., 1983; Badibanga, 1977; Kayembe et al., 1980a, 1980b; Izemenyigia, 1983; and Ngimbous et al., 1982).

Chloroquine resistance has already appeared in the eastern part of the country (Delacollette, 1983), but has not yet created serious problems, although this resistance is spreading to the whole of Africa (see the chapter Malaria, pp. 1450-1451).

1.3.2. Filarial encephalitis

This has been described basically for Loa loa infections and was studied in depth in Zaire’s forest regions, especially Mayumbe, (Janssens, 1952; Kivits, 1952; van Oye and Pierquin, 1961).

There are two opposing hypotheses:
- either filarial encephalitis is a primary disease
- or it occurs only as a result of uncalled-for or poorly-tolerated diethyl-carbimazine (DEC) therapy.

Both aetiology is possible. Cases of filarial encephalitis with microfilariae in the CSF have been seen in untreated individuals, even if they had not experienced any shock or injury. In many cases filarial coma started during carbimazine therapy (see also p. 1363). It is significant that such cases have become much rarer since a more cautious, gradual treatment has been adopted. A careful gradual therapy must be backed up by the administration of corticosteroids and vasodilators at the slightest warning sign (fever, drowsiness, slight mental confusion). Vasodilators are administered on the basis of Maertens’s observation of microthromboses in the vessels of the ocular fundus in many of such cases (Lamey, 1981).

Appropriate early treatment of filarial encephalitis can lead to recovery without aftereffects, as witnessed in the Neuropsychopathology Centres of Mayumbe and of Kinshasa.

1.3.3. Toxoplasma encephalitis

Toxoplasma infestations, which are very common in men, are usually considered benign unless they occur in women who are more than five months pregnant, because in this case they cause foetal meningoencephalitis with ependymitis and choriorretinitis; hydrocephalus can follow and compound its effects to the primary lesions. The infected neonates will suffer from convulsions from the very first days of life. Delayed neurological and mental development leaves the survivors severely mentally and visually handicapped.

Cases of toxoplasmotic encephalitis were also seen in adults. There is an ongoing rise in number of cases linked to the AIDS epidemic.

1.3.4. Encephalitis due to cestodes

The accidental development of cestode larvae in the central nervous system of man is usually observed as an expanding intracranial mass.

The cases seen in Central Africa are primarily cases of neurocysticercosis and neurocoenuriasis, caused by the larvae of Taenia solium and Taenia multiceps, respectively. Praziquantel has raised hope for the treatment of these diseases (see p. 494).

1.3.5. Schistosomal encephalitis

In Central Africa this involvement is caused primarily by Schistosoma mansoni, with a clinical picture of encephalitis, transverse myelitis, or even with a chronic reaction such as an intracranial mass or a spinal cord compression by embolic eggs or granulomatous reactions.

It should be added that niridazole therapy carries the risk of neurological (convulsions) or mental disorders (confusion, hallucinations, etc.), and EEG changes which were detected in 1966-1967 (Ciba, 1967).
1.3.6. *Amoebic encephalitis*

Two cases have been described recently by Lamey (1981) in Zaire.

1.3.7. *Encephalitis due to Ascarids*

Intracranial hypertension and cerebellar syndromes with eosinophilia linked to intestinal ascaridiasis have been observed. Complete recovery after anthelminthic treatment was observed by P. Verhaegen (1955).

1.4. *Cerebral abscesses*

Cerebral abscesses are caused either by direct infection following a brain injury (open fracture, penetration of the brain by a foreign body) or by a neighbouring infection.

In the European statistics, otitis media is responsible for close to 50% of cerebral abscesses located in the temporal area, while in Africa frontal sinusitis is the main cause of frontal abscesses. This may be due to the size and complexity of the frontal sinuses in many Africans.

A purely medical approach is rarely sufficient, and surgery is necessary. The latter often consists of draining the pus by aspiration after trephination and injecting antibiotics into the abscess cavity. This procedure may have to be repeated. Surgical removal of the entire encapsulated abscess is difficult to perform outside of a neuro-surgery department.

2. *Other inflammatory diseases of the nervous system*

2.1. *Allergic forms of encephalitis*

Cases of *post-vaccination encephalitis* due to the measles or rabies vaccine are known.

Encephalitis is also observed as a complication of exanthematous diseases: measles, German measles, smallpox, or chicken pox. Infectious (basically post-viral) encephalitis is seen following on hepatitis and mumps, but also on pneumonia and other viral or bacterial infections.

These relatively rare forms of encephalitis, as compared with the prevalence of the causal infections, are observed in Central Africa, especially in the case of measles.

Such an encephalitis appears after a fairly stable interval, specific to each disease, during its decline, whatever its intensity might have been. The clinical picture and the lesions are of the same type for the different diseases. There is abundant glial proliferation around the small and medium-sized veins of the nervous system (with substantial serohemorrhagic extravasation in the very acute cases), located selectively in the white matter. These cases progress very quickly to either death or recovery.

The acute cases, which are the most frequent, cause death in about 20% of the time. This is due to disturbances of the autonomous nervous system. If the patient survives the first ten days, regression of the disease can be expected, but is usually dogged by severe sequelae. More than 50% of the cases of post-measles encephalitis come under this category.

2.2. *Multiple sclerosis*

This disease is rare in Central Africa. The few observed cases were patients who had spent their childhoods in relatively cool, humid climates, such as in Northern Europe or Eastern Zaire, Rwanda and Burundi.

3. *Vascular diseases of the nervous system*

The rise in frequency of vascular diseases in Central Africa affects primarily the brain. This increase is parallel to the progress of mean life expectancy (Dumas, 1975). In addition, in Central Africa the onset of acute cases seems to start at an even earlier age, from the forties on. The relatively high number of cerebrovascular accidents is in striking contrast to the scarcity of coronary accidents, despite the fact that atheromatosis and arterial hypertension are as prevalent as in Europe (Shako et al., 1972; Osuntokun et al., 1969a, 1969b).

Cerebral angiography was already being performed in Yangambi before Zaire's independence and further, on a rather large scale, in the neuroradiology department of the University Centre for Neuro-pyscho-pathology at Kinshasa. It has revealed a large number of vascular malformations responsible for these cerebrovascular accidents in relatively young subjects (Odeku et al., 1967; Adeloye et al., 1970; Adeloye et al., 1969;).

The relative frequency of CVD due to neurological complications of Sickle cell disease must also be pointed out (Shako and Clarysse, 1977).

4. *Intracranial tumours*

The remediable and the malignant swellings within the skull include:

4.1. *Neoplastic tumours*

Their number, distributions and various forms differ from those in Europe according to reports dating from before brain tomography was available in Central Africa (Mutombo, 1981). On the whole there are fewer neoplastic tumours in Central Africa than in Europe. This is especially true for gliomas, which account for 40-50% of the intracranial tumours in Europe.
Allowing for the limited diagnostic and especially neurosurgical and neuro-anatomopathological means for verification, the occurrence of tumours can be summarized as follows:
- cancerous metastases are less frequent, because they derive for the most part from lung, breast, and stomach cancers which are less common in Africa;
- gliomas are less frequent in Central Africa than in Europe;
- meningiomas are relatively more frequent.

4.2. *Inflammatory (infectious)* tumours

- Tuberculomas are frequent and respond very well to antituberculous treatment.
- Syphilitic gummas are rare, as is neurosyphilis.
- Cerebral abscesses are frequent.
- Parasite cysts are primarily those of cysticerci.

4.3. *Non-neoplastic tumours of vascular origin*

These tumours are numerous (Mutombo, 1981):
- Arterial or arteriovenous aneurysms;
- Cerebral and extravascular haematomas;
- Cysts secondary to haemorrhages or infarctions.

Surgical treatment, as for all of the other intracranial tumours, poses some difficult problems under our current working conditions.

5. *Injuries to the nervous system*

Their frequency and locations vary with the time and place. They of three main origins:
- injuries due to War, insurrections, or hunting;
- injuries due to falls as those of palm wine tappers;
- injuries due to traffic accidents.

Injuries sustained in traffic accidents have become more and more numerous in Kinshasa, on the two major national roads linking Kinshasa-Matadi-Boma and Kinshasa-Kenge-Kikwit in Zaire (Parsekle, 1975; Trolli, 1938) and on the road Bukavu-Bujumbura with the roads in Burundi and Rwanda. This trend is confirmed on all the traffic roads of these countries.

6. Neurologic deficiency diseases

Unfortunately, the number of cases of polynervitis due to deficiencies, especially of vitamin B₁₂, remains high. This is particularly true in areas where malnutrition is rampant and in the Great Lakes region where heavy drinking is rampant.

These disorders respond well to B-complex therapy (vitamins B₁, B₆, and B₁₂) if instituted in time. Unfortunately, this does not always occur, leaving the patients with severe sequelae, especially motor disabilities.

Lumbar puncture allows recognition of deficiency-induced polynervitis from the Guillain-Barré syndrome, which is not rare in Central Africa and not always reversible. A certain proportion of the cases of Guillain-Barré syndrome progress to Landry's ascending motor paralysis. This can lead to death through bulbar and/or respiratory complications or myocarditis.

7. *Diabetic neuropathies*

Dubois asserted in 1944 that diabetes mellitus was rare in Central Africa (Dubois, 1944). Later studies proved the opposite. Bourgoignie and co-workers conducted a study on diabetes mellitus in the area around Leopoldville that showed how prevalent the disease really was (Bourgoignie et al., 1962; Bourgoignie et al., 1963).

Diabetic neuropathies are frequent in Kinshasa, as shown by studies carried out at Mont Amba University Clinics (Nkanga, 1984).

8. *Neurotoxic diseases*

The arsenic-induced encephalopathy linked to the treatment of sleeping sickness with arsenic containing drugs is well known.

Nervous disorders due to alcohol abuse are also frequent in some regions. In Kinshasa, the current economic difficulties are such that the problems of acute alcoholism (alcoholic coma, pathological drunkenness, injuries) are more frequent than those of chronic abuse. However in certain circles and professions chronic alcohol abuse is often combined with addiction to marijuana or hashish.

Intoxications by drugs tend to be acute rather than chronic, except among the rich. One finds abuse of sleeping pills, amphetamines, etc.

It should be noted that, despite the widespread use of halogenated 8-hydroxyquinolines in Zaire (*Enteroviform*, *Entobex*, *Mestaform*, etc.), subacute myelo-optic neuropathy has never been seen.

In contrast, optic neuritis of toxic origin is encountered.

In Bandundu a nervous syndrome of spastic paraplegia, with or without optic neuritis, might be connected with thiocyanate poisoning from cassava in times of famine (Trolli, 1938; Lucasse, 1952; Stilmant, 1972; see also p. 1030).

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9. Degenerative diseases of the nervous system

9.1. Extrapyramidal degenerative diseases

9.1.1. Parkinson’s disease

With the increase in life expectancy the number of individuals with Parkinson’s disease in Central Africa has become rather large, all the more so as today’s drugs associations (anticholinergics, L-dopa, bromocriptine) enable us to help such patients for many years. Many Parkinsonian syndromes induced by neuroleptics, are also seen at the University Centre for Neurology and Psychopathology at Kinshasa. It is usual to wait for typical signs before administering the corrective treatment.

9.1.2. Sydenham’s chorea

This syndrome is frequent and as a rule completely reversible. It cannot be considered a hereditary degenerative disease.

9.1.3. Huntington’s chorea

Typical cases of Huntington’s chorea, tending to run in families, have been seen at the University Centre in recent years.

9.2. Spino-cerebellar hereditary degenerative diseases

Friedreich’s ataxia and Marie’s ataxia, while not frequent, have nevertheless been seen, sometimes with a clear hereditary pattern.

9.3. Sclerosis of the motor neurons

The different types of sclerosis of the motor neurons which were observed are, in order of decreasing frequency:
- Amyotrophic lateral sclerosis or Charcot’s disease, often evolving into glossolabiopharyngeal paralysis;
- Infantile and congenital spinal muscular atrophies, Werdnig-Hoffmann’s disease, Oppenheim’s disease (Myotonia congenita);
- Chronic anterior poliomyelitis or Aran-Duchenne disease.

9.4. Other degenerative diseases

Among other diseases seldom encountered, can be found Unverricht-Lindborg’s familial myoclonic epilepsy; three cases had already been described by Janssen in Astrida (Butare, in Rwanda) in 1954 (Janssen, 1955).

10. Retarded psychomotor development

The most frequent causes are dystocia and perinatal accidents such as prematurity (Tady et al., 1980), neonatal hypoxia, and kernicterus. Sequelae of infant encephalitis with an epileptic or semi-epileptic convulsive state, sometimes a hemiconvulsion-hemiplegia syndrome, usually progress to an encephalitic syndrome.

Maternal infections (in the broad sense of the word) during pregnancy are also responsible for a retarded development.

11. Congenital abnormalities

Chromosome abnormalities, mainly trisomy, are not rare (Ngandu et al., 1969); nor are encephalopathies of early or late childhood (West’s syndrome and Lennox-Gastaut’s syndrome). The number of congenital malformations of the nervous system (meningo- encephaloceles, encephalocoeles, etc.) is consistent with the high birth rate (Browne, 1962; Shako et al., 1978).

Constitutional metabolic errors exist but are difficult to differentiate in the current working conditions. The problem is under study by the Catholic University of Louvain’s Neuro-Paediatric Department (Mukendi, 1983). The role of hydrocephalus in these disorders should also be pointed out (Shako et al., 1978).

12. Myopathy

Progressive muscular dystrophies do exist, with a marked familial character.

Special attention should be paid to the relatively high number of myasthenic syndromes and infections of the muscles, such as myositis, polymyositis, dermatomyositis, and chronic polymyositis linked to collagen disorders (see the chapter Surgery, p. 1214).

13. Neurogeriatrics

This field has not yet the magnitude that it has in Europe. As the population’s life expectancy has increased, partly by the control of infectious diseases, more and more subjects over 50 are coming for consultations.

This sector will have a considerable future. The hospitalization, rehabilitation, and placement of such patients is starting to give problems.

In addition, the gradual disintegration of familial solidarity in the towns, especially in the face of today’s economic difficulties, is a new development that will considerably exacerbate the situation.

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Neuropsychiatric disorders in Zaïre and prospects are present.


Four cases of epidemic spastic paraparesis are described. In 1936 Tessitori had observed 25 cases.


The author underlines the clinical signs of 24 cases of African trypanosomiasis in childhood, observed at the University Clinics at Kinshasa: fever, lymph node enlargement, early neuropsychiatric disorders and detection of try- pansoma in the cerebrospinal fluid.

The classic subdivision of the evolution into two or three stages has no physiopathological basis in childhood.


Over the twenty years 1960-1979, 116 paediatric cases of acute bacterial meningitis were observed at the University hospital of Kinshasa. Haemophilus influenzae represented 33% of the cases by an identified germ and pneumococcus infection 27%; 96% of the cases were children below three years of age, but exceptionally newborns. Children with Sickle cell anaemia were more vulnerable to Haemophilus infection. Mortality reached 14% of the cases. The main complication was subdural effusion.


A summary of neurological and mental disorders in Zaïre.

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