Europe as the Cradle of Scientific Obstetrics

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2007

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Publication issued to mark the occasion of the exhibition entitled **"Europe, Cradle of Scientific Obstetrics"**, held in the building of the European Parliament in Brussels from 2nd to 5th October 2007.
Exhibition devoted to the famous and unknown warriors who, hundreds of years ago, created a community of scholars in Europe and were responsible for the lives of countless children and their mothers.
The following institutions were involved in hosting the exhibition and releasing this publication: 1st Medical Faculty of Charles University in Prague, the National Museum in Prague, the Medical Museum of the National Medical Library in Prague, in collaboration with other institutions.
Exhibition and publication sponsored by GlaxoSmithKline, www.gsk.cz

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Europe as the Cradle of Scientific Obstetrics
Published by GALÉN, Na Bělidle 34, 150 00 Praha 5, www.galen.cz
in collaboration with the 1st Medical Faculty of Charles University in Prague
The cover features illustrations by Leonardo da Vinci (UK, Windsor, Royal Library): "Studies of the Foetus in the Womb" (1510–1512) and "The Foetus in the Womb" (1510–1513)
Typesetting, graphic layout, cover and printed by: RUDI, a.s.
Komenského 1839, 390 02 Tábor 2, www.rudi.cz
Special-purpose publication – Non-marketable copy
Translation and correction: SKŘIVÁNEK, s.r.o.

ISBN 978-80-7262-507-9
ISBN 978-80-7262-506-2 (Czech version)

Front page of "De humani corporis…" Vesalius 1543

~ Contents ~

Front page of "Traité des maladies…" Mauriceau l668

~ Foreword ~

This text describes the history of scientific progress in the highly important medical branch of obstetrics. It is a very conscientious compilation showing how progress in humanities and natural sciences has helped improve care for pregnant women, women who have given birth and their children. As developed countries see fewer and fewer children born, we are becoming more and more aware of the extreme value of each and every new human life.

Modern civilization has resulted from a complicated evolutionary process that has been happening over thousands of years. Our knowledge of the history of the human race is often rather fragmentary. The inventors of certain revolutionary methods have inventions may have long been lost in oblivion, if they have even been noticed. Two or three generations do not mean much within the course of history. However, they clear a space where long forgotten practices may be rediscovered and the collective memory of our cultural environment may be fed. A historical overview summarizing whole centuries, during which modern obstetrics were forming, thus opens up a far larger space.

Reproductive medicine has now achieved a fascinating level of height of expertise. Children are born in vitro; we have deciphered our genetic code down to the level of molecular details and some experimenters are considering the possibility of cloning human beings. Physicians seem to have banned the curse of diseases, disorders and disabilities from the world. As it were, of course. Humans still enter the world only to face many risks and accept the unavoidability of their unique, yet so obvious mortality.

Modern obstetrics is an important branch of medical science. No longer do pregnancy and delivery in developed countries represent an extreme hazard to the lives and health condition of mothers as well as foetuses and newborn infants. However, as we live in a globalized world we should not forget that this planet still houses poverty- and violence-stricken countries, where the mortality rate of newborn babies soars even above the incredible level of thirty per cent. Europe, which we now consider to have been the cradle of modern obstetrics, did not see circumstances related to pregnancy, delivery and puerperium change for the better until relatively recently. There has never been a lack of major or minor tragedies.

At the dawn of human history, it was various magical rituals in particular that were to improve the lot of mothers as well as their babies. Nowadays, many people will sneer at the naivety of incantations, talismans and evocations of supernatural powers. However, we should see them mainly as an expression of a fatal human desire for something that transcends their limited competence.

At present some would-be experts defy the "medicalization" of something that is said to be as natural as pregnancy and birth. They hold that under normal circumstances birth is not a pathological phenomenon and thus does not require a physician's assistance. This effort to "make obstetrics less medical" stems from a crucial misunderstanding of the historical evolution of this branch of reproductive medicine. Had there not been generations of midwives, assistants, obstetricians and paediatricians looking after newborn babies, there would probably be no maternity hospitals, but there would certainly be plenty of disappointed and miserable people.

The text that is being presented attempts to pay homage to human creativeness and belief in the potential of science. Europe's cultural history is full of wars and other conflicts. But it also contains marvellous examples of creative co-operation between scientists from different countries and different cultural backgrounds.

The essay Europe – the Cradle of Scientific Obstetrics was written on the occasion of the exhibition bearing the same name, which was held in the European Parliament in Brussels in October 2007. However, the text is truly timeless and its power to intrigue and instruct will be experienced not only by professionals, but by anyone interested in the history of medical science. ***Authors***

"A boy, sir", Jean Charles Baquoy 1776

~ Introduction ~

Obstetrics is as old as the human race. Looking back into the history of humanity we are horrified by how much energy, time, experience and skill has been exerted to find more and more efficient ways to kill. The history of obstetrics represents a true opposite; however, the particular victories, falterings and defeats that this history is made of will often fill non-professional readers with terror and dismay. Odiné – throes of childbirth, infertility, loss of life, health of mothers and newborn babies have been among the chief concerns of the human race for ages. Birth is often a cruel natural process; the history of this medical branch in no way resembles a quiet stroll around a well tended French park. Unlike warlords whose deeds of mass slaying are commemorated by countless monuments, obstetricians who struggle to bring new life into the world are not remembered. The history of obstetrics is generally unknown, although the transformation of underdeveloped midwifery into a scientific discipline is one of civilization's greatest victories.

We cannot confuse delivery with christening. Delivery has since time immemorial drawn our attention as "inter faeces et urina homo nascitur" – a human being is born amid faeces and urine, we know of the physical strain women in childbirth have to endure and their response to the labour pains. The close connection that exists between the foetus and mother during her pregnancy has to be interrupted and we hear the baby cry, which signifies that it is healthy, we see the baby dare to take the first moves, we see the colour of the baby's skin, we see the baby take the first breath, suck at his or her mother's breast, we have to make sure that there is enough milk for the offspring; happiness and concerns come in turns as we look after our baby.

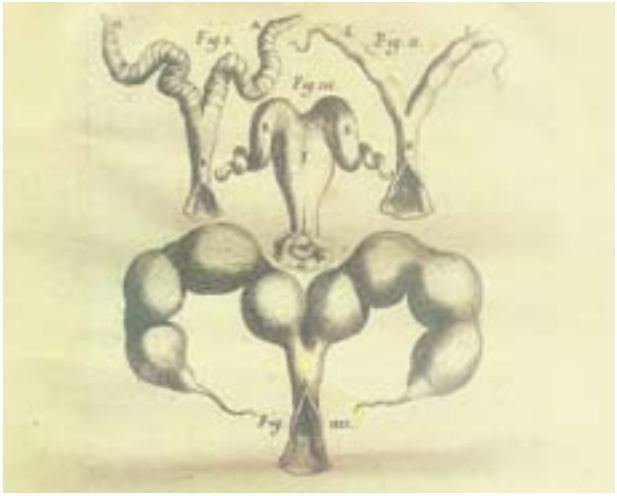
In connection with birth people have always experienced toilsome and long confinements, women in spasms, injuries, bleeding and death during the birth and puerperium. People have always feared lifeless, choked or prematurely born children; they have encountered monstrous-looking children as well as children born dead. Neither magic or shamans, nor religious rituals were any help. These horrid tragedies made people seek some rational explanation. The delivery did not leave the hands of midwives who were ready to help, but not qualified enough, until the 18th century. The humanism of obstetrics must not remain a mere proclamation; it must be realized or materialized and rooted in a solid and true base. Therefore obstetrics was one of the first medical branches to leave speculation behind and apply scientific knowledge. This knowledge was drawn from natural sciences, especially from physics, chemistry, mathematics as macroscopic and microscopic anatomy, physiologic and microbiologic studies played a key part in the theory of obstetrics. The then pioneers laid foundations that have over the past three centuries relieved women from their age-old fears and have provided for the safety of women and new born infants. This attempt at presenting the history of obstetrics is doomed to mention only a handful of clinical and theoretical professionals, most of whom are now forgotten. However, we can prove that the transformation of midwifery into scientific obstetrics began in Europe and spread around the continent like an avalanche. The international co-operation in this field as it was practised then is inspiring even today.

~ Biological Fundamentals of Human Reproduction ~

The human reproduction strategy is as characteristic for the biology of human beings as their perfect thermal regulation preventing the body from overheating (hyperthermia), erect figure or the activity of the central nervous system. Reproduction takes place all year round; children are born after a long period of pregnancy, children are usually born singly – monotocous, their weight is relatively high, however, they cannot move and are entirely dependent on their mother's care and the transformation of a child into an adult being, i.e. maturation, is the longest of all mammals. A human being is a *zoon politicon* – a social animal. Any change of these characteristics would inevitably mean an entirely different society.

Tokos, partus, acouchement, Geburt – delivery is the most labile part of the reproduction process with all mammals including humans. The term "eutokia" refers to a delivery free of complications; the term "dystokia" on the other hand refers to a complicated delivery. Specific features of human delivery were, in the fylogenetic development, influenced especially by the erect position of the human body and walking on two limbs (bipedal locomotion), which was accompanied by a transformation of the pelvis where the direct diameter of the pelvis entrance became narrower. The uteruses of lower mammals are bicorn and suitable for multiple pregnancies – polytokia. The human uterus consists of a single chamber and is suitable for a single pregnancy – monotokia. A single pregnancy lasting approximately 280 days results in the formation of large foetuses with pronounced development of the brain (cephalisation), which then results in the origination of the foetus-pelvic and especially cephalic-pelvic piston phenomenon as the foetus passes through the lesser pelvis during the delivery. The foetus can only be delivered in the lengthwise position, while any other position – crosswise or transverse – means that

Pregnant, human embryos, Jacobs 1772



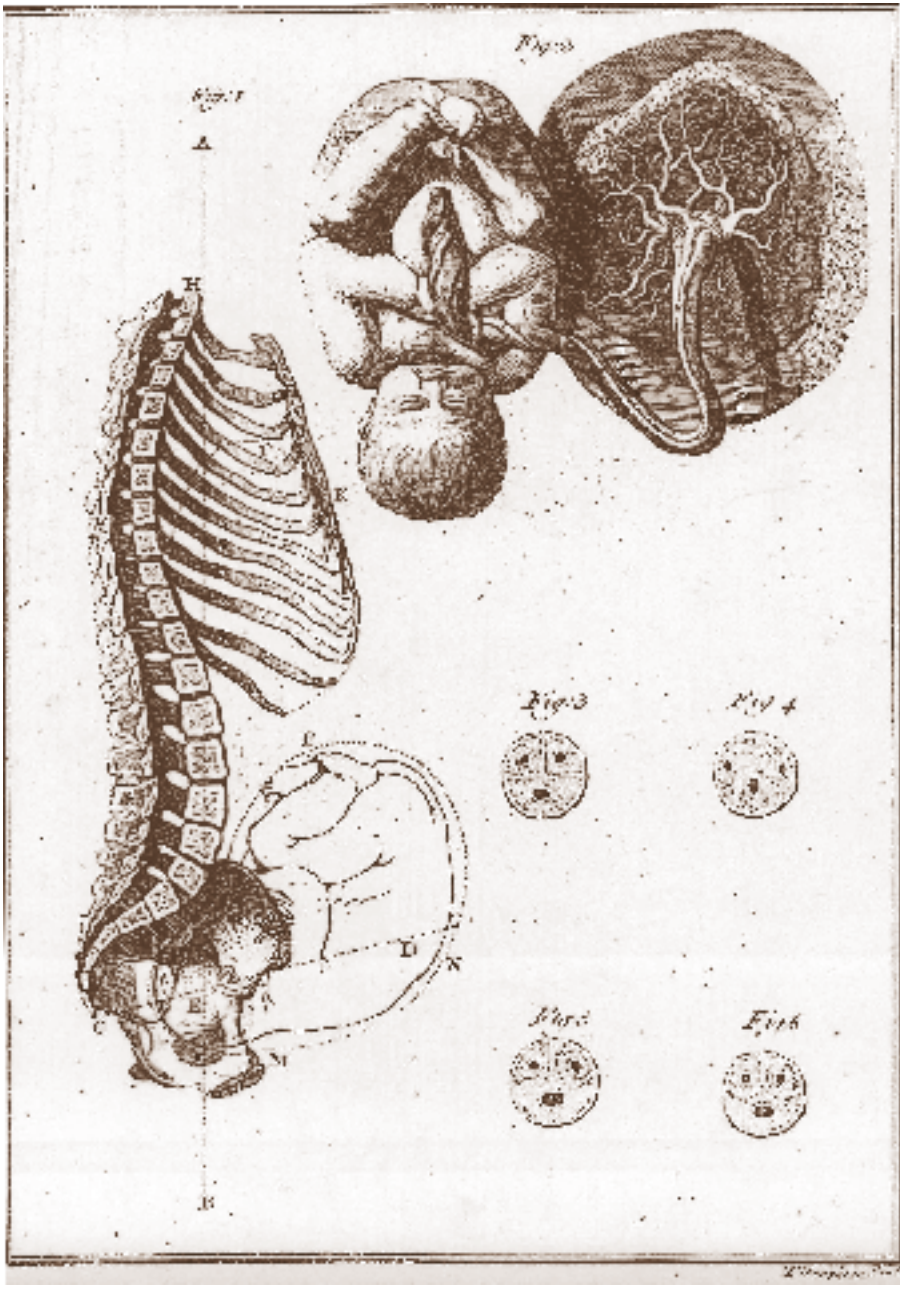
Bicorn uteruses of animals, Mauriceau 1668

a full term infant cannot be delivered. Humans have the most complicated mechanism of delivery of all mammals. The passage of the foetus through the lesser pelvis takes place in several phases, an engagement – flexion of the head, the inner rotation of the head, extension and the rotation of the shoulders.

Complications may always occur. The key issue of the reproduction of mammals is the transportation of nutrients from the air to the tissues of the foetus; during delivery this applies mainly to the transportation of O_2. Oxygen passes through the placenta, where it is transferred from the mother's red blood cells to the red blood cells of the foetus. The human placenta is disc-shaped and is located in a confined area while its villi come into direct haemochorial contact with the mother's blood. The further development of the placenta and its transportation functions largely depends on the preconception state of the endometrium. The human single-chamber uterus (uterus simplex) features a thick layer of muscle (myometrium), which chokes the uterine arteries as living ligatures. If the pregnant woman is lying on her back, the back uterine wall presses the lower hollow vein (vena cava inferior) and the abdominal aorta onto the spine, which may increase the difficulty of transporting oxygen to the foetus. The human funicle is relatively the longest among all mammals, which may result in the choking of the foetus as well as other complications. The above mentioned factors that have emerged over the past fylogenesis of the human race thus limit the area where the changes of the development of individual beings (ontogenesis) take place.

Mechanism of delivery according to Schultze, Rubeška 1910

Looking at primates with social forms of behaviour we will see attempts at internal self-examination and attempts at helping extract the head of the foetus; after the delivery we will see copious examples of "aunt-like caring reactions". The key part in the development of a human being is played by the development of the central nervous system. This system enables communicating information and creating an artificial ecosystem – civilization – and the entire material culture. Natural selection is regulated by conscious sociogenic factors, reflections of which may be seen in obstetrics too.



Section of a pregnant woman, foetus and placenta, Jacobs 1772

~ Prehistory ~

The prehistory of obstetrics is rather difficult to reconstruct and any description is largely based on speculation. Archaeological findings suggest that there was never a golden age for natural woman. The lifespan was short; and women's was even shorter than men's, which may have been linked to reproduction. The findings from prehistoric periods show pathologic forms of the pelvis, graves of mothers and their newborn babies as well as graves documenting the mother's death during the delivery.

Small figurines of so-called Venuses have been found on a vast area from Siberia to south-east Europe, for example in Dolní Věstonice, Wilendorf, Lausell, Lespugue and elsewhere. These figurines date from 29,000 – 24,000 BC. The build of these figurines resembles stout figures with pronounced breasts. These primitive cults of motherhood and fertility prove the well-grounded concerns of native people. The reproduction process was then accompanied by various magical and religious acts, some of which have been preserved right through the Middle Ages until now.

The origins of delivery assistance in prehistory have to a certain extent been preserved in natural nations that can be studied by ethnographers. We can observe the participation of relatives, experienced women, husbands, shamans etc. in the delivery, in addition to self-assistance. The original extensive form of reproduction enabled the human race to survive even though there was no professional medical treatment; however, the loss of life was extremely high. Natural loss would no longer be acceptable nowadays. The age-old principle that a woman about to deliver a child should not be left alone and unsupported is still valid.

The prehistoric childbirths apparently had had a similar process with the one in today's natural tribes

As is proved by written sources, specialized women participated in deliveries in this cultural area; this specialization was very likely one of the first women's occupations.

Babylon and Egypt

The written heritage of Babylon reflects the practices that accompanied deliveries in that era. Cult prayers address infertility, miscarriage, birth, weak foetuses, lactation and death during the puerperium. When the first astronomic knowledge originated at the dawn of history, the length of pregnancy was first determined. There are records of women experts of the womb and the occurrence of rare monsters, which proves that experience was passed on and recorded.

Bodies that were being mummified could not be observed by physicians and that is why it in no way contributed to the development of anatomy. Records on papyrus scrolls that have become well-known under the name of **Kahoun** (2200 – l950 BC) deal with diseases in women, children and cattle; papyrus scrolls found by Edwin **Smith** and Calburg **Elbers** (l700 BC) deal in great detail with the diagnostics of pregnancy, the diseases in pregnancy, the length of pregnancy, the acceleration of delivery, the occurrences of multiple pregnancies, the deliveries of young mothers, the ways of measuring the stature of newborn infants, infertility and contraception. The alleged ways of diagnosing pregnancy and the sex of the expected infant based on pouring urine over corn have never been verified experimentally. People used to wed at early ages; men would often get married around the age of 15 and women around 13 – 14. Inbreeding was a common practice; women strove to have many children while boys were more valued than girls. In the era of Ptolemaios, women of lesser classes would deliver their children in mammisi – a maternity house near a temple. The delivery itself is usually depicted in a standing, kneeling or crouching position, sitting on bricks or a stool. Deliveries were

Egypt. Birth of Cleopatra. A relief on the temple of Esna.

assisted by female helpers who would focus on magical acts appealing to protective deities. Physicians were also priests; magic was supposed to help alongside medical means.

Bes, a chondrodystrophic midget, was worshipped as the benefactor of a good delivery; Hathor was the goddess of health and pregnant women; the pregnancy, delivery and lactation was protected by Taurt (Thoeris, Taweret), a goddess of a hippopotamus appearance, as well as Isis and many others. We suppose that delivery was extremely dangerous with the mortality rate of infants at around 30 % affecting people on all social layers.

Hebrews

Many remarks on pregnancy, fatal complications during deliveries, movements of the foetus, twins, hygienic rules during menstruation and puerperium can be found in the First Book of Moses and the Talmud. There is proof of the existence of Hebrew midwifery. The life of the mother had a greater value than the life of the foetus, which led to the use of embryotomic surgeries to cut down on the size of the foetus, which was sacrificed so that the mother could live. The entire of antiquity is characterized by valuing male newborn infants more than female ones.

Delivery amulet protecting against Lilith (a female demon who slaughters newborn infants). Three guardian angels: Senoi, San-Senori and Sammangelov.

Ancient India

The writings by **Sushrut** (6th century BC) and Carac (2nd century BC) record ample phenomena related to normal pregnancy, birth, puerperium, but also pathologic deliveries. They describe eclampsia – a disease causing severe spasms during pregnancy, death of foetuses, funicle complications, bleeding during delivery, defective positions of foetuses etc. It is possible that ancient Indian knowledge had some influence on the medical practices of ancient Greece.

Greece

The legacy of ancient medical science was a great contribution to later developments in Europe. Moreover, this is an area where we do not depend so much on mere speculation as copious written records have been preserved. Deliveries were assisted by women called omphatolomon – navel-cutters. Such a midwife was referred to as e maia, e omphalotomos, anagestris, anagetria or epostris. The existence of women physicians is proved by the titles of akestrides, akestriai, iatromaiai, and iatrine. On the other hand, male assistants taking part in the process of delivery are witnessed by the masculine forms of the above mentioned nouns – o omphalotomos, o maios, o maieyter. Vast division of labour common in ancient Greece gave rise to the origination of the occupation of a physician and medical schools that are captured in many written records.

Around 500 BC, **Alkmaion** and **Demokedes**, Greek physicians, explained health as a balance between the powers of the wet and the dry, the cold and the warm. **Empedocles** of Akragant (495 – 435 BC) founded a teaching about the four elements as the fundaments of the entire world: fire, water, air and earth.

Epicharmos (550 – 460 BC) was the first one to claim that children born in the eighth month of pregnancy would

not survive, while children born in the seventh month would, which is probably an opinion influenced by ancient Chaldeans. This mistaken view was preserved for centuries. This was due to the fact that there was a lack of profound anatomic and physiological knowledge. The views on fertilization were merely speculative. They thought that the human uterus was bicorn like in animals. If the sperm from either the right or left testicle got to the corresponding side of the uterus, a boy would be conceived; if the sperm from a testicle got to the opposite corner of the uterus, a girl would be conceived. **Leophanes – Cleophanes** believed that boys were conceived from right-hand side testicles while girls from the left-hand side ones. Medical thinking of that era was also influenced by **Democritos of Abdera** (470 – 360 BC). He was a very versatile figure and created a lot of works concerning music, psychology and philosophy. He drew on the teachings of Leucippus and built a closed atomistic system. But he also acquired a medical education and dealt with multiple pregnancies or seeming death.

After defeating the Persians (480, 479 and 465 BC) **Pericles** ruled the empire (493 – 429 BC). Athens then became the world's centre of education, the most wonderful city inhabited by poets, builders, sculptors, historians and rhetoricians. The time of the greatest boom of Athens also saw a steep rise in the observation of the natural world, which was reflected in medical practices too.

This is the era of the most outstanding ancient physician **Hippocrates** (460 – 370 BC). He was born on the island of Kos. **Polybos**, Hippocrates's son-in-law, created the teaching of body fluids: Blood, phlegm, yellow and black bile. Hippocrates classified people by the prevalence of one of these fluids into choleric, melancholic, sanguine and phlegmatic people. The popular practice of drawing blood was preserved until modern times. Midwives had by then become influential figures allowed to use drugs in order to enhance contractions, to perform abortions and to serve as mediators of marriages. The deliveries would often take place in their houses; however, they would also assist with deliveries in the open air. Like Hebrews, the Greeks also held women who had just delivered an infant unclean.

Much of the information on the obstetrics of that era was recorded by Hippocrates himself, his predecessors or disciples – his medical school. Hippocratic teaching translated into Latin and explained by Galen was one of the pillars of medieval medical education and was not abandoned until the 18th century. Hippocrates is often quoted according to the translations into Latin and interpretations by Galen. Obstetrics and gynaecology are dealt with in the five-volume book of "Aforismoi", but also in "Peri gynaikeion", "Peri gynakeies fysios" (De naturae mulieris), "Peri fysios paidion", "Peri eptamenon", "Peri oktamenon", "Peri ektatatomes embryon", "Peri hyperkiesios" (De superfetatione), "Peri aforon" (De sterilitate) and "Peri partenion". We have to distinguish between descriptions of phenomena that enable the classification of a disease, and the explanation is usually based on speculation due to insufficient general knowledge. He held that miscarriage was caused by a small uterus; he described the hydatid mole – tissue not containing any foetus, or an open cervix that is incapable of holding the foetus, which incidentally falls out. He recommended shaking the body and jumping in order to interrupt unwanted pregnancy. He assumed that the true cause of birth was the starvation of the foetus, which was driven by hunger and struggled to get out, pressing his feet against the uterine bottom; the role played by the contractions of the uterus was long unknown. He was aware of the change of the position of the foetus with its head downwards. His therapeutic con-

ceptions are contained in approximately two-thirds of his writings, but it is very difficult to reconstruct as the botanic terminology employed is not always clear. Clysters were often administered. A cannula fitted with a pig's bladder was used to apply liquids, oil, milk and fat mixed with juice squeezed from unripe figs into the vagina. Suppositories would also be inserted into the vagina and rectum. The physicians used a rectal speculum (katopter). They were able to perform surgeries (embryotomy) to decrease the size of the foetus in the event of obstructed labour; they would use a knife - macharion, bone tongs, or a kind of cranioclast piestron and a hook – elekystes. They used lead and pewter probes (mele) of varying thickness, which were used to explore and stretch out the female genitals. Spa cures such as steam baths, fume treatment, cold sprays, sitting baths etc. were also very popular in that era.

Ancient obstetric instruments. Anatolia

Deliveries took place in bed – kliné – and then, as the end of the process was approaching, on a table – difron. The Hippocratic treatment procedures mention shaking, stretching out the cervix with a probe or fingers in order to terminate a miscarriage, abortion – no method is recorded though, forcing the foetus out of the uterus (expressio foetus), extracting the head of the foetus with fingers or a hand, repositioning prolapsed hands or legs, turning the foetus upside down from the outside, pulling the funicle, and removing the placenta manually. The Hippocratic Oath was a product of its time and contains magical incantations, social aspects, duties, bans on euthanasia and abortion, and ethical standards; it also makes a clear division between medicine and surgery and instructs physicians to keep medical information secret. Therefore, the oaths that we swear nowadays are not literally Hippocratic.

Aristotle of Stageira (384 – 322 BC), an illustrious philosopher and natural scientist, also acquired a medical education. A part of his writings makes it possible to classify him among the members of the Hippocratic School. He based his theory on the principle of purposefulness. His writings "Peri ta zoa istoriai" (Animalium historia – On animals), "Peri zoon morion" (De partibus animalium – On bodily parts of animals) and "Peri zoon geneseos" (De generatione animalium – On the reproduction of animals) synthesize the then encyclopaedic knowledge from the fields of zoology, anatomy and anthropology, which concern obstetrics as well. Influenced by the studies of the animal world, he held the human uterus to be bicorn too. He enumerated the changes humans undergo during puberty. He believed that the menstrual blood was in fact female sperm, only insufficiently boiled. He dived into great detail dealing with topics such as the changes that took place during the pregnancy, hydatid mole, length of pregnancy, monsters, occurrence of multiple pregnancies, progress of birth, and types of labour pains, where sacralgias were a symptom of a complicated delivery. He described the resuscitation of a newborn infant that was seemingly dead and recommended placing such a baby below his or her mother so that he or she could be fed by the blood from the placenta. He observed that com-

plications concerning pregnancy and delivery were more frequent in people who did not move enough. Dealing with the features of pregnancy he mentions the closure of the cervix, which he believed opens in the eighth month, oedema and more ample hair. According to Aristotle, boys begin to move in the uterus as early as the 40th day of pregnancy; girls on the other hand do not start to move until the 90th day. He adds that some Egyptian children born in the eighth month of pregnancy survive, however Greek children do not. He knew that the placenta turned inside out during the delivery. He was quite right to explain the position of the head by its weight. He describes the position of the infant and its posture; the infant lies bent forward with the nose between the lower limbs; the eyes are placed on the knees. He also describes the right way to strangulate and cut off the funicle as the infant may bleed out of the funicle to death. The newborn infant retains the meconium for a few hours following the birth, i.e. faeces resembling poppy juice – meconium. He holds that milk is boiled blood. He also believes that bleeding at the time of the monthly period during pregnancy is a pathological phenomenon.

The **Academy of Alexandria**, where the Múseion – Shrine of the Muses established by **Ptolemaios** (322 – 283 BC) around 280 BC became the very centre of Greek medical studies, was a great contribution to the evolution of obstetrics as a scientific discipline. The Academia featured a large botanical garden as well as vast zoological collections. Medical students would learn mathematics and physics; they would also perform anatomic dissections on human corpses and delve into comparative studies. The enormous library housed 700,000 scrolls. The library represented the largest ancient collection of anatomical, botanical and zoological knowledge, which unfortunately burnt down repeatedly in 47 BC and is alleged to have been completely destroyed by a fanatical priest in AD 632.

A number of anatomical and obstetric facts were collected by **Herophilos** of Chalcedony (300 BC). He carried out autopsies on human corpses. That is why he is called a murderer and accused of carrying out autopsies on living convicts and killing living children inside the uterus by Tertullian (2nd century AD), one of the fathers of the church. If he did remove a foetus from the uterus, it proves that he really practised obstetrics. The school he founded did not cease to exist until AD 100. His original writing has been lost, so quotations are the only sources of our knowledge about this person. Soranus was familiar with his work “Maiotikon” (midwifery). He describes a female testicle (orcheis or didimoi) instead of ovaries; and we are not sure whether he knew about the existence of fallopian tubes. He held that the movements of the foetus in the uterus were caused by the nervous system. He was well aware that the uterine closure opened during a delivery. He was interested in anomalies on the female skeleton of women with bent spines. He distinguished between a normally progressing delivery (eutokia) and a complicated delivery (dystokia). He believed that the complicated deliveries were caused by several factors including transversal position of the foetus, imperfect opening of the cervix, stiff membranes, overall weakness of the uterus (atonein), overall weakness of the body, tumours, abscesses, bleeding, extensive stretching of the uterus by the foetus, extensive heat or cold, death of the foetus etc. When performing surgical procedures to decrease the size of the foetus he would use a special knife (embryosfaktes).

Demetrios of Apamea, a disciple of Herophilos, held that the causes of complicated deliveries included a small uterus, extensive stress of the uterus, separation of the external wrap of the foetus (choria) from the uterus, the

placenta in the way of the progressing head causing severe bleeding (placenta praevia), pressure of a full rectum or urinal bladder, accretion of the pubis, spinal disorders and disabilities. Regarding the positions of the foetus he described the raised hands. He was familiar with the version of the position of the foetus on the feet. He divided complications during a delivery into three groups: 1. mental – passion, loss of consciousness, 2. abnormalities of the birthing powers (totiké dynamis) – digestive disorders, extensive emaciation, masculine stature, weak buttocks, uterine diseases, inflammations, overheating, atonicity (atonia) and 3. abnormalities of the foetus – hypertrophy, extremely large head, chest, belly, collision of twins, death of the uterus, abnormal positions of the uterus. He is often said to be the first person who took any notice of pathological deliveries caused by the bones of the pelvis, which is an issue that was not precisely defined until De la Motte published his work in 1715.

The decline of the Alexandrian school anticipated an interruption of the collection of proper anatomical knowledge and an era of overall decline of obstetrics as well as all fields of medical practice.

Ancient Rome

It is interesting to note that the Romans who advanced in many different spheres could do without physicians for 600 years. Their treatment included prayers, incantations, sacrifices, fortune telling as it was performed by haruspices and augures, and ample dietetic instructions. The occupation of a physician was considered to be of low value. Physicians and midwives (obstetrix) came from Anatolia, Greece and Egypt; medical practices were largely performed by slaves.

During the rein of emperors Tiberius and Claudius Aulus, **Cornelius Celsus** (around 30 BC – AD 50) created many works on agriculture, warfare, rhetoric, philosophy, and law and translated writings by Hippocrates. He is the author of "De res medica" (On medical matters). Although he was not a physician himself, he would often encounter ill people as he was a rich person who owned much land and many slaves. He described four symptoms of a local inflammation: tumour – hypertrophy, calor – heat, rubor – flare, dolor – pain; this list was later extended by Galen who added one more: functio laesa – functional disorder. His writings, which were discovered by Pope Nicolas the Fifth (1397 – 1455) in 1426, became teaching materials at medieval universities. The seventh out of eight books is devoted to obstetrics and gynaecology (especially chapters 28 and 29). Men assisted only at complicated deliveries. He records the transversal position of the woman who is giving birth in bed in the event of obstetric surgical procedures. He is able to provide a good description of the turning with head or legs and manual extraction of the placenta. The versio – turning – was later forgotten and not used again until the 17th century when it was rediscovered by A. Paré. He compares the male and female pelvis and articulates the hypothesis that incorrect incurvation of the pelvic bones may prevent delivery from progressing in the desired way. Regarding complicated deliveries he describes the method of removing the head of the foetus (decapitation) and the use of hooks. Archaeological findings from Herculaneum prove the existence of vaginal extractors and probes, catheters and curettes (page 15). The sections devoted to gynaecology deal with inflammations, urinary formations, vaginal descent and rectocele. Book five deals with cancer of the uterus and breast.

Soranus of Effesos (AD 98 – 138) was one of the first ancient physicians who practiced obstetrics and thus occupies an entirely unique position in the history of this medical discipline. His manuscripts are very well known.

First he lived and worked in Alexandria and then he moved to Rome where he lived during the rein of emperors Trayan (98 – 117) and Hadrian (76 – 138). He dealt with fractures, bandages, acute and chronic diseases. He was the first one to write a biography of Hippocrates. His greatest achievements greatly contributed to obstetrics and paediatrics. His major work consists of four books, but he also created a minor compilation, a sort of instruction manual for midwives and practitioners. The original version of this work also featured illustrations of the positions of the foetus as they are captured in the Codex Hafniensis, which was published in the 12th century. The original work bearing the name of "Peri gynaikéion" represents a systematic monograph. Regarding anatomical studies Soranus compares the shape of the human uterus to that of a bulb and describes the difference between the shape of the human and animal uterus. He also distinguishes between the uterus and vagina, which he describes as a cylinder-shaped hollow organ whose nature resembles skin. He is not able though to make a clear distinction between the foetal membranes – chorion and amnion. He deals with the course of pregnancy, difficulties during pregnancy, hygienic measures, and positions of the foetus and holds the view that coitus practiced during pregnancy is harmful. He does not approve of abortion unless necessary for medical purposes and recommends inducing the abortion by starving, bathing, drawing blood, and bumpy rides on coaches. He suggests that surgeons should not use sharp instruments when operating on a patient so that the uterus does not get pierced. He also recommends that fat women kneel during delivery. Whenever a physician is performing a surgical procedure inside the genitals he must put the tips of his fingers together (nails cut short should be an obvious condition). A lapsed arm is put back into its original position by applying pressure to the shoulders and bending the elbow joint. If the foetus did not turn upside down in the uterus successfully, he recommended conducting embryotomy. Retention of the placenta is caused either by its adhesion with the uterus or a closure of the cervix. He recommends manual extraction; he saw the uterus inversion as he was pulling the funicle. He describes the table or delivery chair that a maia would bring to the place of delivery. He set forth demanding requirements concerning the occupation of midwife, which requires only highly competent women. Midwives should be literate, gifted with good memory, hard-working, respectable, they should not have impaired hearing or sight; they should be well-built with long fingers and short nails. Such a woman must be capable of sympathy, but it is not necessary for her to have delivered a baby of her own; she must not be superstitious. The maia is to prepare something to wrap the baby in, a soft sponge, a piece of flax, bandage, a pillow to put under the baby, something to smell. Women deliver their babies on a hard bed, but then are laid in a soft one. The maia needs the assistance of three persons who stand along the sides and apply pressure on the belly from the side downwards while the maia forces the baby out. He describes the method of catching the baby in a piece of cloth as it is coming out. He recommends cutting the funicle 4 inches from the belly of the foetus and strangulating it in two places. The maia is to examine the newborn baby and check for the presence of an innate defect and then articulates the first conclusions concerning the condition of the infant. She is to observe the cry of the baby; a faint or weak cry is suspicious. She is to check that all of the bodily openings of the infant are in normal condition and in the end she presses her finger against the infant's skin to see the reaction. The care for women during the puerperium is dealt with in a fragmentary fashion. However, he deals with the technique of lactation in great detail. He believes that a surgical procedure including drawing out purulence

is necessary if there is an inflammation of the breast. He also writes about the stoppage of formation of milk. Soranus also deals with the care for newborn infants, selection and diet of the wet nurse, tests of milk and describes major infant illnesses.

The gynaecological part of his work deals with anatomy, menstruation, conception, symptoms of imminent miscarriage, stoppage and disorders of menstruation, inflammation of the uterus, satyriase, hysteria, shrinkage of the uterus, bleeding, effusion, gonorrhoea, flexion, version and elevation, complicated deliveries, retention of placenta, abscesses, carcinomas, fistulas, condylomata and prolapsed uterus. His work represents a summary of the notions of obstetrics and women's diseases of that era. He separates hysterical spasm from epilepsy, apoplexy, catalepsy and lethargy; he also recommends hydro-therapy treatment.

Deliveries were hazardous in the ancient world and brought about justified fears. **Plinius maior** (23 – 79) describes folk medical practices and rituals performed on the occasion of a delivery with the intention of making it easier: these habits include fumigation with burnt hyena kidneys or the belief that the right leg of a hyena laid on a thigh will make the delivery easy while the left leg will bring death. If a woman drinks dung of a sow, she will not suffer from any pain; the milk of a sow mixed with honey, a drake's "sperm" or a weasel's uterus will have the same effect. A dog's placenta or a snake's skin would be laid on thighs of the woman in labour; a vulture's feather would be placed under her legs. Most Roman women did deliver their babies in the conditions described by Plinius. The deliveries would take place at their homes and the care was usually very personal and full of compassion for the labouring woman.

Galen of Pergamos (AD 129 – 199), Marcus Aurelius's personal physician, was an outstanding figure and authority in the field of medical studies. He translated the works of Hippocrates and built on his legacy. He created a complete and self-contained medical system. The four main elements: fire, water, air and earth are matched by haima – blood, phlegma – phlegm, cholos – light bile, and melan cholos – black bile. The portions of these four body fluids, their mixture (where the term "temperament" is derived from the Latin verb "temperare" – to mix) is the key factor influencing the physical condition: the term eucracy refers to a good condition, dyscracy on the other hand refers to a condition with certain disorders.

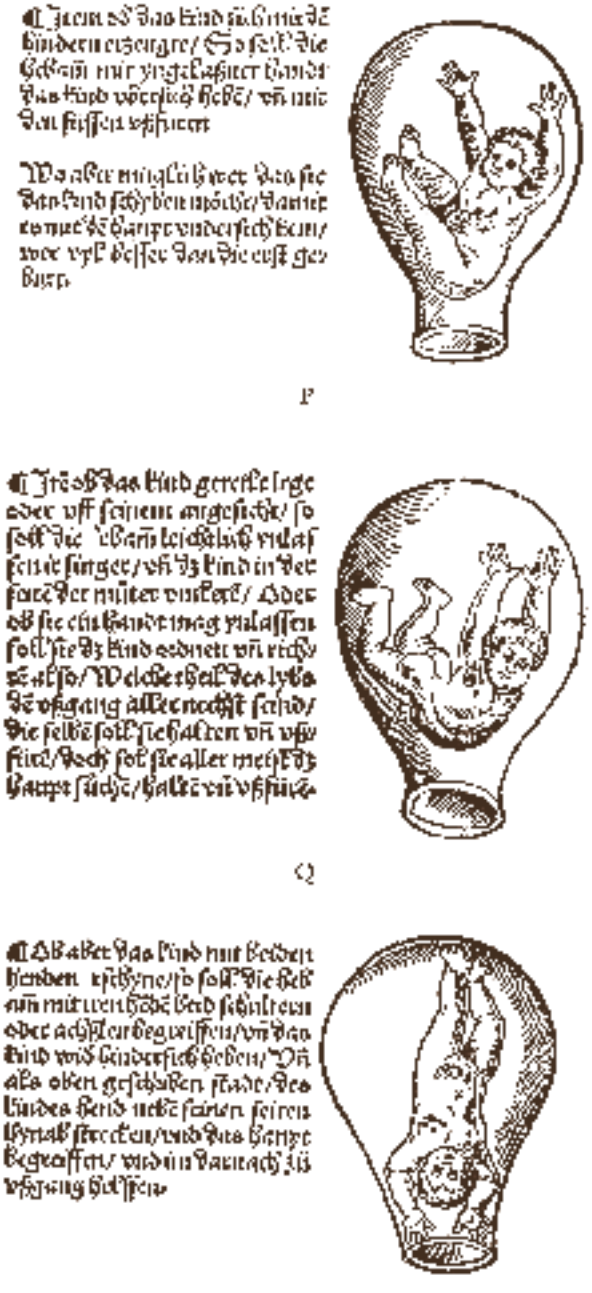
His entire work contains excellent anatomical and clinical observation interspersed with purely speculative assumptions. He emphasized the analogy between male and female organs. However, as compared to men, women are of lesser value as their body is soft, underdeveloped and retained on the ontogenetic level of infants. He says that menstruation begins at the age of fourteen and takes place in intervals of 29 and a half days. As women are colder and moister, do not work hard and do not come into the open air, they have to excrete the superfluous blood that their body is not able to process during menstruation. This superfluous blood is however used to feed the foetus during pregnancy. (A note: In spite of the existence of emenology – studies of menstruation, there was no scientific explanation of this phenomenon until the 19th century).

The uterus performs four functions. Firstly, it serves to receive the sperm during coitus, secondly, it retains the foetus during pregnancy, it provides for the feeding of the foetus, and finally, it serves to excrete blood during menstruation, and to force out the foetus in a miscarriage or delivery. After a woman becomes pregnant, her uterus closes. A pregnant woman's pulse is marked, full and fast, which can be accounted for by the requirements of the foetus. Pregnant women often have dyspnoea and their

breathing is faster and shallower. Complications in pregnancy result from the incapacity of the foetus to consume the menstrual blood, which leads to the accumulation of adverse fluids in the area. He holds that delivery is induced by the starvation of the mature foetus. He repeats the view held by his predecessors, namely that infants born in the seventh month have a better chance of survival than infants born in the eighth month. He does not come up with any new conceptions concerning the pathology of birth.

Like Hippocrates he believes that diseases during the puerperinum result from dysfunctions occurring in the process of excreting the lochia, which he divides into those made of black bile, of red hue and phlegm. If the lochia are retained in the body, cacochymia occurs, i.e. a deterioration of the fluids, the good part of which was transferred to the foetus while the bad part remains in the mother's body. He also mentions fever occurring during the puerperinum. Regarding the diet, he respects the empirical facts and recommends quiet, easily digestible food, abstinence from coitus, laxatives or drawing blood. He also notices some innate defects, such as atresies (narrow rectum), crooked limbs and funicle ruptures. Galen believes that lactation is the best means of feeding infants, unless the mother is ill. In his opinion, milk consists of liquid, cheesy and greasy substances. Galen performed autopsies on animals including apes, but did not do so with human bodies. He also carried out a caesarean section on a goat for experimental reasons. His writings ranked among the most influential and

Front page of a Hippocratic book, Horst 1660



Positions of the foetus inspired by Moschion, Roesslin 1513

most widely used teaching materials from the 14th to the 17th century. His legacy includes the term Galenics, used to refer to medicine prepared according to simple procedures from drugs. Hippocratic and Galenic teaching is the basis of the later Byzantine and Arabic medical studies and practice. However, the above mentioned speculations illustrate the enormous width of the gap between the ancient conceptions and later scientific knowledge.

Moschion (Muscio, Mose, Moshe) drew on the work of Soranus of Effesos. This probably Jewish physician, inspired by Soranus, compiled a brief instruction book for midwives. The manuscripts that have been preserved until now (Brussels, Paris, Munich, Erlangen) contain illustrations of the positions of the foetus, even in the case of multiple pregnancies. Regarding complicated deliveries, he takes over the views expressed by his predecessors, but adds the sites in dents – dental (face) position. The 6th century saw the above mentioned work by Soranus translated into Latin, which then existed in many mutations as the Moschion Manuscript.

~ Middle Ages and Early Modern Times ~

The disintegration of the Roman Empire was followed by a steep decline in science that had by that time been pursued by scholasticism. Greek writings were, however, translated in the Middle East. Thus, in the 10th century long lost ancient texts reached Europe as reversed translations from Arabic and Hebrew via Salerno and Montpelier.

After Toledo was conquered in 1085, Europe experienced the so-called Toledo Shock as they had been exposed to the immense richness of Arabic culture. There were many outstanding physicians among Arabic scholars, such as **Abulkasim** (around 939 – around 1010), who was familiar with the turning and removal of the foetus (embryotomy). Ali Ibn Sina – **Avicenna** (980 – 1037) compiled the "Canon of Medicine". Both of these physicians, together with Hippocrates, Galen and Celsus were the fathers of medieval medicine. However, their contributions to the development of obstetrics were of minor significance. **Mondino dei Luzzi**, an anatomist, would use some Arabic medical terms, for instance mirach – the abdominal wall, siphah – peritoneum, zirbi – omentum, or alchatim – sacrum.

Around 1059 Trota – **Trotula** – a university teacher's wife who could boast of the titles of sapiens matrona, multae doctrinae matrona Salernitana wrote her "De mulierum passionibus ante, in et post partum" (On women's suffering before, during and after delivery).

Some communities of monks would preserve copies of ancient Greek or Roman manuscripts. **Albertus Magnus** (1193 – 1280) a German Dominican, versed scholar and Thomas Aquinas's friend, advocated the coexistence of science and religion. His writings contained in 38 volumes deal with logic, theology, botany, geography, astronomy, zoology and phrenology. He also wrote a work entitled "De secretis mulierum" (On the secrets of women). Matters related to reproduction or deliveries of infants were considered to be women's secret domain where men were not allowed. This writing of poor value was repeatedly published and was also translated into Czech. Scattered pieces of the ancient heritage survived in books written by Eucharius **Roesslin –** Rhodion (died in 1521), who was inspired by the above mentioned writing by Mo-

A section of a painting by Dürer, where we can see midwives

schion. He wrote “Der Swangern Frauen und Hebammen Rosegarten” (Rose garden of pregnant women and midwives), a book issued in 1513. This book was published approximately 100 times and was translated into many European languages. The book gives some dietetic instructions and recommends the correct ways of behaviour during deliveries. This book became so popular mainly for its illustrations: delivery chair, positions of the foetus, twins, and Siamese twins. Regarding the contents the book is worthless and reflects the poor level of medical thinking of its time.

Midwifery and Surgery

In 1613 the Edict of Tours issued by the church banned physicians from performing surgical procedures under the following motto: “Ecclesia abhorret a sanguine” – The church in terror turns away from blood. The surgeons of that era did not obtain university degrees and were kept away from theoretical speculative medicine; however, they could take the opportunity to become familiar with “local anatomy” during countless wars. They were driven by the need to intervene and use instruments forming the surgical arsenal – armamentarium chirurgicum. Therefore, they invented specialized instruments accommodated to the shape of the surgeon’s hand, shapes of patients’ bodies or the nature of the injury they were to treat. These instruments included scalpels, pincers, hooks, spreaders, probes and instruments used for the extraction of bullets, trepanation, amputation and instruments used for embryotomy, which had however been invented as early as ancient times.

The development of obstetrics came to a stop as it was practiced by uneducated and unqualified midwives. They are called Hebammen (hebende – elevating midwives), Nabelmutter (navel-mothers), Wehemutter (mothers of

Delivery on a chair, Roesslin 1529

After a delivery, Roesslin 1529

pain), and Bademutter (bathing mothers) in German speaking countries; comadre in Portugal, commare (together with the mother) in Italy, midwife (together with the wife) in England, vroedwyf in Holland and sage-femme, which signifies a wise woman, in France. Barbers/surgeons would not come to assist at a delivery until called for by the midwife in the utmost need. Unlike midwives, surgeons were skilled in handling their instruments. Their interventions were mostly limited to procedures targeted at quick termination of the delivery by means of embryotomy. These procedures included dividing the foetus into parts, perforating the head of the foetus, removing the head of the foetus and suchlike and were recommended and widely practiced as early as the ancient times. These, as seen from our present perspective, drastic surgeries were the only way of saving the woman's life if severe complications occurred during the delivery; these procedures are however still practiced in the primitive conditions of some Third World countries.

Caesarean Section (sectio caesarea)

This operation, which was known as early as antiquity, was performed very rarely and mainly on dead or dying women and it is interesting that it was also known by primitive tribal communities. According to "Lex regia de inferendo mortuo", which is alleged to have been compiled by **Numa Pompilius** (715 – 672 BC): "Negat lex regia mulierum quae pragnans mortua sit, humari, antequam partus ei excidatur, qui contra fecerit, spem animantis cum gravida peremisse videtur." The royal law bans burying a woman who has died pregnant without first removing the foetus from the uterus; whoever would do the opposite, he would risk destroying the hope of a living being. Jewish **Mishnah** (140 BC) was also familiar with this surgical procedure. Niddah and Talmud do not insist on women who have given birth through the abdominal wall keeping the prescribed cleansing rituals. Later on, the Christian church was in favour of performing this section on dead bodies so that the foetus could be christened.

In 1581, Francoys **Rousset**, a physician, published a monograph entitled "Traite nouvveav de l'Hysterotomotokie ov Enfantement Caesarien" (A new discourse on hysterotomotokia or caesarean section), which deals with the way of carrying out a lateral section on the stomach to remove the infant from the uterus of a pregnant woman who is unable to deliver her baby any other way. He is so enthusiastic that he even claims that this intervention endangers neither the woman's nor the baby's life and is not an obstacle to another pregnancy. He publishes his reports of 15 successful c-sections performed on living women. He also mentions a section of a horse, pig and dog.

The first successful caesarean section ever was allegedly performed by **Jakub Nufer**, a pig gelder, in 1500, in Thurgau Canton, with the assistance of midwives and fellow vets. He is said to have stitched the wound caused by the "tomotokia" – i.e. delivery through a section in "veterinario modo", i.e. in the same way as was practiced in animals.

Another caesarean section on a living woman took place in Wittenberg on 21 April 1610. Ursula, the wife of Martin Opitz, a barrel maker, injured herself while bending iron straps, one of which hit her left groin, where a permanent hernia developed afterwards. Her uterus got stuck in this place as became apparent during her pregnancy, for it was possible to feel the uterus directly under the skin and the movements of the foetus were also clearly discernible. The collegium decided to terminate the delivery by a section. Reliable witnesses were present when the first contractions appeared. Jeremias **Trautmann**, a surgeon, assisted by Christof Seeth, cut through the abdominal wall

Caesarean section, Scultetus 1655

and peritoneum, which was easy to separate from the skin. Having opened the uterus they took out the infant that, as they believed, actively helped their efforts – "selber aktiv mithalf". They had no difficulty separating the placenta because the bleeding was very moderate and they were successful in assuaging it by infusions made of spices. They did not stitch the uterus; all they did was make several sutures on the skin. However, the skin wound opened up after the operation and the uterus was covered with a festering coating. Fortunately, the infection did not spread to the peritoneum, the coating was separated, the wound became clean again and its size decreased so much after a few weeks that they let the patient stand up. On 16 May, a short time after the patient had left bed, she soon wanted to lie down again, and fainted, collapsed and died within half an hour (of embolism, as it seems). We are sure that

the infant outlived his or her mother by at least 9 years.

Rousset introduced the incorrect term of "Enfantement caesarean" – caesarean delivery, caesarean section, Kaiserschnitt, which took hold. His mistake stems from a misinterpretation of Plinius, who writes in his "Historia naturalis" T.I.L. Cap. VI: "Auspicatius enecta parente gignitur: Sicut Scipio Africanus prior natus, primusque Caesarum a caeso matris dictus, qua de causa et Caesones appellati. Simuli modo natus est Manilius qui Carthaginem cum exercitu intravit." (Auspicatius was born and his mother died at the delivery, and so it was Scipio Africanus senior, who was the first one to be named Caesarus on being cut out of his mother, and that is why they were both named Caesones – cut out. Manilus, who entered Carthage as one of the troops, was born in the same way). The adjective "caesarus" originally comes from this area; therefore, caesones – cutting out – signifies the same thing as caesares (secare – cut). The term sectio caesarea is thus a tautology. It has nothing in common with Caesar, for Gaius Julius Caesar (100 – 44 BC) was delivered in the normal way and his mother, Aurelia, lived for several years after that. The emperor's name is likely to have been derived from caedo – slaughter, caesius – blue and grey eyed, caesaries – thatch of hair, or he took the name after his ancestors. Other names used to refer to the c-section, such as gastrohysterotomy, hysterotomotokia, laparohysterotomy or coeliohysterotomy, did not take hold. Some authors, however, hold the view that this operation deserves its noble name for its usefulness despite historical errors.

In l596 Scipio **Mercurio** (1540 – 1615) published his work entitled "la Comare o ricoglitrice", which also contained two wood engravings illustrating this operation. Caesarean section is also described by **Rodrigo de Castro** (1550 – 1630), who deals with it in his book "De universa mulierum medicina" (On general feminine medicine), which was published in 1603. **Scultetus** seu Johan Schultes (1595 – 1645) included plenty of pictures of surgical instruments used to amputate breasts, vaginal specula, instruments used for embryotomy, and instruments used for drawing milk and performing caesarean sections on living women in his richly illustrated "Auctarium ad armamentarium chirurgicum" (1655). He describes the necessary arrangements if the section is to be performed at home. This picture was used as one the examples in "Neueröffnete Hebammenschul" (Newly opened midwifery school), a book by Christof **Völter** published in 1722. Lorenz **Heister** (1683 – 1758) also included a treatise on the caesarean section in his "Chirurgie". However, A. Paré and later on also F. Mauriceau (see below) rejected the section as a barbaric practice. "Sectio caesarea numquam fieri debet nisi post mortem mulieris" – (caesarean section may only be performed after the mother has died). Step by step, a single universal indication of the caesarean section on a living woman evolved. The section was allowed only if the pelvis was so narrow that it was even impossible to insert a hand into the uterus and carry out an embryotomy.

De la Motte (1655 – 1737) writes about a caesarean section that was performed in 1704 and proved to be utterly useless as the foetus was dead with one limb torn off the body in his book "Traité complet des accouchemens …" published in 1715. The surgeon that operated on the woman closed the wound with four stitches, handed the woman over to her husband five days later and never returned again. The author then treated the woman with the assistance of two other surgeons, for her intestines were punctured and festering. The woman healed. Blood and some of the faeces and flatus would, however, leak through the wound. The author then kept treating the woman's severe hernia. Jean **Ruleau**, a surgeon of Sain-

touge, also carried out a successful caesarean section on a living woman whose pelvis had become so contracted that it was only possible to enter her vagina with two fingers, as published in "Traité de l´operation césarienne, et des accouchements difficiles et laborieux" (A treatise on caesarean section and complicated and laborious deliveries), Paris 1704. Further progress did not take place until the 18th and 19th centuries.

Teaching of Midwifery

Permanent complications endangering the lives of women and babies called for a remedy. Initiatives occurred that attempted to bring some rules into midwifery and improve midwives' qualifications. The conditions of teaching midwifery in Germany are particularly interesting. "Hebammenordungen" appeared in the towns of Ulm, Colmar, Heilbronn and Nürenberg as early as the 15th century. Institutions called "Christliche Kerkernordnungen", which also focused on raising midwives' qualifications, were located in Braunschweig, Lüneburg and Nassau-Siegen. The basic duties midwives had to fulfil included christening in dire need, for which the midwives would use special instruments allowing them to christen infants still retained in the mother's genitals. Many European towns and cities required that midwives pass medical examinations. However, as there was a general lack of rational knowledge, such examinations were a practice of proclamations rather than useful facts.

Women who wanted to begin practising midwifery had to be 30 – 35 years old and were supposed to be healthy, handy, kind, silent, able to write, if possible, and were not to drink. Midwives were often recruited from widows. They largely came from poor social backgrounds. Rich and poor mothers were charged differently for the delivery; midwives would thus be rewarded in kind instead of money, but they would frequently get nothing at all for their services. They would work until old age and would live on minimum allowances after that. Midwifery was performed in similar way as other crafts, i.e. younger women were taught by more experienced midwives. The professional standards were mostly appalling; it was often the burgomaster's wife who decided who was to be the local midwife. However, the occupation itself was considered to be prestigious and was one of the first instances of the emancipation of women. Midwives associated with the surgeons' guilds would often participate in court proceedings: attesting virginity, certifying pregnancy of women in prison (as pregnant women were not executed until they had given birth), observing marks of a previous pregnancy if a woman was accused of murdering her baby. Obstetrics was largely practiced by self-confident, but uneducated, often illiterate and superstitious midwives and lacked any potential for further development.

Election of a midwife. Satire, Basel 1818

~ Boom of Science in Modern Times ~

From the Renaissance on, European society witnessed an impressive scientific boom. Let us mention only the most important events in the deluge of discoveries. **Astronomy** was at the top of science from antiquity. Nicolas **Copernicus** (1473 – 1543), a Polish scholar, who also acquired a medical education, advocates his heliocentric view in his writing entitled "Narratio prima" (First narration). He wrote his treatise "De revolutionibus orbium coelestium" (On the revolution of celestial bodies) as he lay on his deathbed in 1543. This writing had an immense impact upon medieval thinking and triggered off the process of abandoning geocentric conceptions, which turned out to be a painful ideological revolution. Johannes **Gutenberg** of Germany (1397 – 1468) invented typography in 1445, which led to a rapid spread of education. Astronomy together with mathematics made way for other sciences, as they inspired the inventions of numerous measuring devices. Besides mechanics, micromechanics appeared and grew as a brand new field. Nicolo **Tartaglia** (1537 – 1551), a mathematician, dealt with external ballistics. In 1545 Girolamo **Cardano** (1501 – 1575) discovered a way of solving cubical equations. He also dealt with probability theory, hydrodynamics, mechanics and geology. He was a physicist, medical professor and a successful physician. Christopher **Colombo** – **Columbus** (1451 – 1506) discovered the American continent in 1492, which helped alter the world views and was the origination of the first globalization. Quinine, cocoa, turkeys, potatoes, tobacco and maize were brought to Europe from the New World. The New World is likely to have been the origin of a new disease that began spreading in 1495 and was known as the "French disease" – morbus gallicus, then renamed to syphilis in 1530 and to lues venera – venereal plague in 1554.

On the other hand, many diseases that were fatal for the Native Americans, such as tuberculosis and others, were brought to America. The voyages across the oceans resulted in the development of astronomic, navigational and chronometric devices.

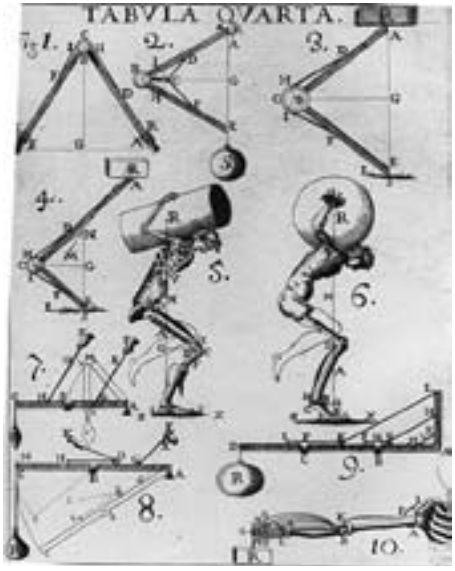
Front page of the book Experiments with Vacuum Instrumentation, Von Guerick, 1692.

However, the Thirty Years War deteriorated the conditions for the development of sciences in Europe and societies wasted their potential on countless religious controversies. Jan Amos **Comenius** – **Komenský** (1592 – 1670) a pedagogue, "Teacher of nations", and René **Descartes** (1596 – 1670) met in 1642, but grew apart because Comenius had not shown any understanding for Descartes's effort to establish a laic science, independent of any divine authority. An immense role in the development of sciences was played by **Galileo Galilei** (1564 – 1642), an ingenious Italian physicist, mathematician, physician and advocate of the heliocentric view. He introduced the notion of experiment in scientific practice, of which it became an integral part. He studied free falling, discovered the isochronism of pendulum oscillations, spots on the Sun and laws of inertia. 1632 saw the publication of his "Dialogo sopra i due massimi sistemi del mondo, tolomaico, e copernicano" (Dialogue concerning the two chief world systems, by Ptolemaios and by Copernicus). His inquisitional proceedings drew a clear dividing line between science and religion.

Jan **Marcus Marci** (1595 – 1667), a physician and physicist living in Prague and working as the personal physician of Emperor Leopold I, studied the impact of elastic objects and the refraction of light. He was appointed a member of the Royal Company of Sciences in London. He also attempted to solve the quadrature of the circle. He described a device to measure the pulse frequency and explained skull fractures in physical terms. He became acquainted with Harvey, of whom he was a great admirer.

Jan Evangelista **Toricelli** (1608 – 1647), Galileo's follower, was the first one to measure atmospheric pressure, discovered the barometer and delved into studies of hydrostatic pressure. Otto **von Guericke** (1602 – 1686), a German natural philosopher, discovered the air pump and thus vacuum technology. His experiment using the "Magdenburger Halbkugeln" – Magdeburg hemispheres – shattered the wide-spread beliefs in the "horror vacui" by proving that this phenomenon could be accounted for as an effect of atmospheric pressure. He also used the barometer to forecast the weather. In 1663 he devised a machine to produce static electricity and observed electrical luminescence.

Giovanni Alfonso **Borelli** (1698 – 1679), a physician, studied capillarity, the mechanics of celestial bodies, was the first one to measure the speed of sound accurately and was one of the pioneers of biomechanics. His monograph "De motu animalium" (On the movement of animals) was published after his death in 1680. His views were based on Galilean physics and concentrated on statics and hydraulics to explain fits, spasms, pains, movement of the heart, movements of female and male genitals and distinguished between passive and active movement.



De motu animalium. Borelli 1680

Denis **Papin** (1647 – 1712), a French inventor and physicist, dealt with the issues of preserving food. In 1679 he devised his illustrious pot/digester, which is nowadays known as the autoclave. In 1690 he inserted a piston in a cylinder in an experiment and his "machine à vapour à piston" lifted a sixty-pound weight, thus becoming one of the predecessors of the steam machine. Olaf **Römer** (1644 – 1710), a Danish astronomer, claimed that the speed of light was not infinite in 1675 – 1676.

Anatomy and its Importance

The origination of scientific anatomy was of crucial importance for the entire medical thinking as well as further development of obstetrics. This turn of the development enabled making use of the knowledge of the morphology of genitals as well as embryology, blood circulation and the nervous system. The church was, however, not in favour of dissection unless carried out for embalming purposes. **Pope Boniface VIII** issued the bull "De Sepulchris" (On sepulchre) in 1300. He condemns dissection as an instance of barbarism and suggests that those who perform it will be excommunicated. These are the reasons why dissections on human bodies were abandoned in medical teaching and were replaced with "anatomia porci", i.e. dissections of pigs as is illustrated in Vesalius's anatomy.

In 1478 "Anatomia Mundini", a medical textbook was published, which by that time had only been available in copies known under the name of Anothomia. This textbook was compiled by **Mondino dei Liuzzi** (1270 – 1326), an anatomist from Bologna, who quoted Galen and Avicenna and whose description of a dissection and a hernia operation as it was performed at that time is very valuable. He also dealt with the uterus, which he described as bicorn with seven chambers. Johannes **Kethan**, a German professor of medicine, published a writing entitled "Il Fasciculus Medicinae" in Venice in 1490. Its Latin translation of 1491 contains 11 fine wood engravings displaying **Petrus de Montagnana** giving a lecture, students and physicians inspecting urine, a naked body with possible cuts marked on it, a bulb-shaped uterus illustrated over a sitting woman, a pregnant woman carrying the foetus in an enlarged uterus and a man with some astrological formulas. The picture capturing a physician visiting a patient with plague is free of any fear; there is even a cat in it. The illustration of a dissection is a blend of loftiness and realism as a professor – ostensor – is sitting at his desk, the dissector is carrying out the dissection while being carefully observed by two of the students, while the remaining five are showing much less interest and chatting with each other. In addition to anatomy the treatise deals with surgery, gynaecology and obstetrics, phlebotomy – drawing blood and plague. Leonardo da Vinci was familiar with this work.

Dissection, Ketham 1491

Caricature of a dissection by Horgarth, 1762

Jacopo **Berengario da Carpi** (1460 – 1530), Vesalius's predecessor, taught anatomy and surgery in Bologna from 1502 to 1527. He also explored the brain and dealt with plastic surgery. Eustachius and Fallopius jointly refer to him as the restorer of anatomy. He described the appendix and cardiac valves rejecting Galen's conception of "rete mirabile" in the heart. He was the first to include illustrations in his medical records. He treated syphilis with mercury. He wrote a treatise on fractures of the skull where he described the first neurosurgery instrumentation. In 1535 he published his "Anatomia Carpi. Isagogae breves perlucidae ac uberrimae, in Anatomiam humani corporis etc." (A brief introduction shedding light upon the richness of the human body).

In 1510 – 1511 Leonardo **da Vinci** (1452 – 1519) created in co-operation with Marc Antonio della Torre, an anatomist, an anatomic work according to approximately 30 dissections. This work contains as many as 750 excellent drawings such as: external female genitals, cross-section of the coitus, uterus, male genitals, appearance of the foetus, connection between the uterus and placenta, internal structure of bovine uterus etc. Unfortunately, this work was not discovered until scientific anatomy had been long established; however, it was highly appreciated by Hunter. The Renaissance saw a boom in anatomy especially at Italian universities in Padua, Bologna and Venice.

Francois Jacques Dubois – Jacobus **Silvius** (1478 – 1555) was an influential French anatomist. Although his work does not contain many innovations, he was the teacher of Paré. He would often demonstrate dissections on dogs, but his students were attracted by anatomizing human bodies. His most outstanding student, Andrea **Vesalius** (1514 – 1564) is one of the most famous Belgians ever. He was the head of the department of surgery and anatomy at the university in Padua – explicator chirurgiae.

"De humani corporis fabrica...", Vesalius 1543

He published six anatomic charts "Tabulae Anatomicae sex" in 1538. Vesalius introduced anatomizing human bodies as a regular part of medical teaching and analyzed the differences between the anatomy of humans and that of animals. His epochal opus "De humani corporis fabrica libri septem" (Seven books on the fabric of the human body) of 1543 laid the foundations of systematic anatomy and corrected many misconceptions taken over from Galen, which led to many disputes with Silvius. The illustrations contained in these books were wood engravings by

Jan Stephen van Calcar – Titian's student. Obviously, he is the author of numerous anatomic innovations. This writing was published when he was thirty and afterwards was issued many times and translated into many languages. This opus also contains illustrations of female genitals and pregnancy, but their artistic value is lower than that of the other illustrations. His systematic anatomy showed a high standard, describing the skeleton and musculature, brain nerves, somatic nerves and vascular system. He devoted a part of this work to experiments on animals. Silvius was not willing to accept Vesalius's criticism of Galen and Hippocrates and, therefore, altered the name of Vesalius to Vesanus – mad.

In 1559, Henry II, King of France, sustained a trauma during a tournament. Splintered wood hurt his eye and brain. Vesalius and Paré participated in the treatment and attempted to discover the scope of the injury and possible treatment by experimenting on the head of an executed person. In spite of their efforts the king died 12 days after incurring the injury. At the age of thirty Vesalius accepted the position of imperial physician in Madrid. While he was dissecting a Spanish nobleman, the corpse is alleged to have moved, which drew the attention of the inquisition. Vesalius was then sentenced to make a pilgrimage to Jerusalem. However, his ship foundered when sailing across the Mediterranean and he starved to death on the Greek island of Zante. His legacy includes a vast bibliography with hundreds of works.

Realdus **Columbus – Colombo** (1516 – 1559), Vesalius's prosector, Harvey's predecessor and teacher, published an outstanding work entitled "De re anatomica libri XV." in 1559. (Fifteen books on anatomy), which unfortunately did not contain any illustrations. He performed dissections as well as vivisections. He described the small blood circulation system and was interested in obstetrics, too.

Bartolomeo **Eustachi** (1520 – 1574) became Italy's greatest anatomist after Colombo's death. He was able to speak Latin, Greek and Arabic. His "Explicatio tabularum anatomicarum Bartholomaei Eustachii" (Explanation of anatomic pictures by Bartholomeo Eustachi) did not come out until 1744 when it was published by **Bernardus Albinus** (1697 – 1770), a professor of anatomy and surgery in Leyeden. The anatomic tables had by then been lying unused for 160 years, for the accompanying text was completed later by Giovanni Maria Lancisi, a physician. Unlike Vesalius, whose illustrations are wood engravings, Eustachi used copperplates, which enabled him to capture greater detail. The author won a great reputation for his works dealing with the middle ear. He would often use a magnifying glass to examine bodily organs. He described the valves on the vena cava and the fact that blood circulated in a single direction. His description of the blood circulation of the foetus is of major significance to obstetrics.

Vesalius was a figure at the dawn of a famous epoch of his students and followers: they would deal with comparative anatomy, embryology, and teratology in addition to morphology; they would perform experiments on animals, which anticipated the origination of physiology. In spite of the church's hostility to the new practices, anatomy spread all over Europe.

Anatomy of Pregnancy

Gabriele Fallopio – **Fallopius** (l523 – l562) was a professor of botany, anatomy and surgery. He was Colombo's successor. He dealt with the anatomy of kidneys, described the structure of the skin, anatomy of the head, lachrymal duct, ossification of bones, cochlea, vestibular apparatus, semicircular ducts, chorda tympani, and he discovered the duct in the os petrosum – aquaeductus Fallopii, through which the nervus facialis passes. His "Observa-

tiones anatomicae" (Anatomic observations) came out in 1561, and contained a description of the sequence of the development of bones of the foetus. Regarding muscles he corrected some of the misconceptions advocated by Vesalius. He was also an important gynaecologist because he studied the female genitals and the fallopian tube has since his time borne the name of its discoverer. He delved into the studies of syphilis in 1564 and described the condom in his book "De morbo Gallico". His works were published posthumously by Volcher **Coiter** (1534 – 1576), a Dutch anatomist. In 1572 he published "Externarum et internarum principalium humani corporis partium tabulae" (Pictures of basic external and internal parts of the human body) as well as a typographic collection of illustrations of the skeletons of many different animals. He would observe the activity of the heart in living animals.

Giulio Cesare **Arantius** (l530 - l589), Vesalius's student, is connected with the discovery of the ductus venosus Arantii, which links the feeding funicle vein (vena umbilicalis) with the blood circulation system of the foetus. He was a professor of anatomy in Bologna. In 1564 his "De humano Foetu opusculum" (A minor work on the human foetus) was published. He knew that the blood circulation systems pertaining to the mother and the foetus were separate, which was a fact many 18th century obstetricians were not familiar with. He was the first one to claim that a delivery that was not progressing was not caused by a contracted pelvis outlet, but inlet. This fact had a significant influence on the obstetric conceptions of that era, for previous fallacious notions held so fast that even De la Motte would consider disorders of the pelvic outlet.

Leonardo **Botallos** (1530 – 1571) wrote that he had discovered the "vena arteriarum nutrix, a nullo antea notata" – a vein fed by arteries that as he thought had never been observed before. The connection between the pulmonary artery and the aorta had in fact been described before; however it bears the name of ductus Botalii. The closure of this duct must be observed in infants born prematurely.

Hieronymus Fabricius **Aquapendente –** Girolamo Fabrizio (1537 – 1619) was a teacher at Padua and Fallopius's successor to the chair of surgery and anatomy. In his days at university the "Teatrum anatomicum" would attract students from all over Europe. In around 1574 he described the venous valves determining the direction of the flow of blood in "De Venularum ostiolis". W. Harvey was by far his most outstanding adherent. He introduced a new term – ovary, ovarium. His writing "De formato foetu" (On the formation of the foetus) published in 1604 may be considered the foundation stone of embryology. He dealt with comparative studies of the foetus, placenta and membranes of humans, dogs, cats, rats, mice, guinea pigs, sheep, horses and pigs. He also wrote about the speech of animals. He built a great reputation as a surgeon. After his death in 1619 "Opera chirurgica" was published as a work illustrating surgical instruments. In 1622 Gaspare **Asselli** (1581 – 1622) discovered, inter alia, lymphatic vessels.

This was an era that saw an enormous growth of the influence of anatomy on obstetrics. Jacob **Rueff** (Ruffen) was a surgeon and lithotomist (l500 – l559). In 1554 he published "Ein schön lustig Trostbüchle von den empfengknussen etc" (A nice, cheerful and pleasing book on conception) in German and later "De conceptu et generatione hominis" (On the conception and reproduction of humans) in Latin with 32 wood engravings by Jost Amman. Embryogenesis is taken over from Aristotle, but anatomy draws on Vesalius's conception. The illustrations of surgical instruments contain the vaginal speculum, cervix dilatator – apertorium, beak shaped thongs – rostrum, bone forceps and delivery chair. This book is well

ahead of all previous works dealing with obstetrics; however, it does not reach the best anatomical standards.

"La commare o Riccoglitrice" (The Midwife), which was compiled by Scipione **Mercurio** (1540 – 1615) in Venice in 1595 is a work that surpasses other works on obstetrics of that era. This book contains basic anatomic information and describes natural birth as well as unfavourable positions of the foetus, turning of the foetus, transmission of syphilis to the foetus etc. The book also contains illustrations of the recommended position of the mother if the delivery is not progressing. The book illustrates the delivery chair as well as a bra.

Anatomy and surgery were frequently taught as a single subject at universities. Ambroise **Paré** (1510 – 1590), a French surgeon and Vesalius's contemporary, was another outstanding figure that helped develop anatomy into a scientific discipline. He was a qualified anatomist. As a military surgeon he took part in a number of campaigns. He invented many instruments – prostheses as well as other devices for disabled people. He introduced the ligature of arteries instead of cauterization. In 1561 – 62 he published "Anatomie universelle du corpe humain" (General anatomy of the human body). Although he was a protestant he managed to survive the St. Bartholomew's Night Massacre on 24 August 1572. His works on surgery include "Dix livres de la Chirurgie, avec le magassin des instrumens necessaires a icelle" (Ten books on surgery with a list of necessary instruments). He is often referred to as the father of modern obstetrics. His writings entitled "De la generation de l´homme et maniere d´extraire les enfants" (On the reproduction of humans and the way of extracting infants) were compiled in 1549 – 1573 and restored the long-forgotten practices of extraction and turning of the foetus. This work was translated into Latin by Guillemau, Paré's adherent. Paré contributed to raising surgery to the

Human monsters. A. Paré 1573

level of a respected occupation. It is rather odd that such an experienced man would let his imagination run so wild in his writing entitled "Des monstres tant terrestres que marins avec leurs portraits" (Terrestrial and marine monsters with their portraits), which was published in 1573.

Experiment based on observing body weight, Santorius 1602

It was becoming apparent that mere morphologic and anatomic observations could not account for the entire performance of an organism; therefore, physicians and medical scholars would often conduct experiments on living animals. Vivisection, which is nowadays condemned as a needless cruelty, was a "malum necessarium" – necessary evil in that era. We should not forget the fact that it was an era when surgeries were carried out without any anaesthetic, torture was an inseparable part of court investigation, and burning at the stake or executions accompanied by torture were watched by large crowds.

Exact sciences began influencing medicine. Physicians at that time set about experimenting on humans, on themselves and others. Santorio **Santorius** (1561 – 1636), Galileo's friend and a physician, was a professor in Padua. He pioneered exact measurements and quantitative experimental studies, which he claimed in his work of 1603 entitled "Methodus vitandorum errorum in arte medica" (A method of avoiding errors in the medical art). His Italian writing "De medicina statica libri octo" of 1614 deals with experiments he performed on himself using special scales to observe the differences between the fluid and food intake and the excrements and attempts to prove the existence of an invisible perspiration – perspiratio insensibilis. He devised a clinical thermometer responding to stretching air – the pulsilogium – to measure the pulse frequency and the hygrometer. He developed an iatromechanic conception of body functions. He was the founder of research into metabolism.

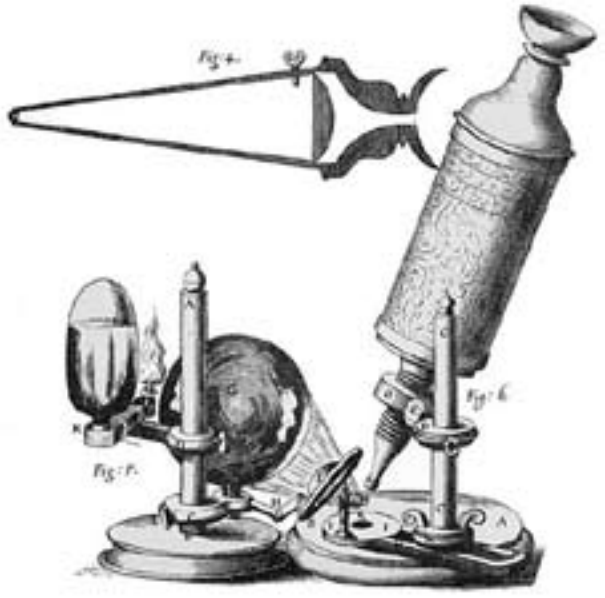
A discovery which proved to be a revolution in anatomy and medicine as a whole was made in 1628 by William **Harvey** (1578 – 1657), an English follower of Colombo and Hieronymus Fabricius Aquapendente, and was described in his "Exercitatio anatomica de motu cordis et sanguinis in animalibus" (An anatomical exercise on the

motion of the heart and blood in animals). The discovery of the pulmonary and systemic circulatory systems as well as the discovery of the separate circulatory system of the foetus disproved Galen's errors, but were defied by a large number of conservative physicians. In another work published in 1651 "De generatione animalum" (On the reproduction of animals) he postulates that "omne vivum ex ovo" – all living things come from the egg. Having returned from Italy he worked as a physician in St. Bartholomew's Hospital and then became a personal physician of Kings of England James I (in 1618) and Charles I (in 1640). Obviously the discovery of the blood's circulatory system had been anticipated by his predecessors, for instance Colombo. Miquel **Servet** (1511 – 1553) dealt with theological issues concerning the Trinity, but his book "Restitution du Christianisme" (Restitution of Christianity) touches upon the topic of pulmonary circulation too. He was burnt to death as a heretic by Calvinists. Harvey was not familiar with his notes though as they were not published until 1694.

Microscopy

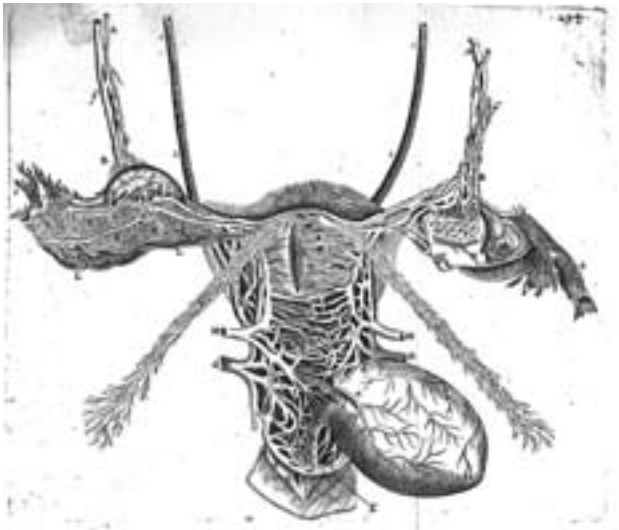
The first double-lens microscopes appeared in Holland in around 1600, and Europe had seen a huge development of this technology by the end of the 17th century.

Marcello **Malpighi** (l628 – l694), Borelli's friend, carried out systematic microscopic studies, examined the structure of internal organs, such as the lungs and discovered vaginal glands, and capillaries in kidneys. He observed incubated embryos to describe the evolution of a chicken. He referred to the placenta as pulmo uterinus – uterin lungs. His "Opera omnia" was published in l687. The proof of the existence of vascular capillaries completed Harvey's discovery of the circulatory systems and the entire controversy was brought to an end.



Double lens microscope, Hooke 1665

Robert **Hooke** (1635 – 1704), a physicist, was an outstandingly versatile personality. He invented the thermometer, water level, spring operated clock, iris diaphragm, carried out original astronomic observations and his double-lens microscope was an enormous contribution to medical studies. In 1665 he published his writing "Micrographia", which contained numerous microscopic observations. He confirmed the observations by Leeuwenhoek, who was the first one to use the term cell – cellula – while observing cork. "If I have seen further than others, it is by standing on the shoulders of giants," Newton writes to Hooke in a letter dating from around 1675 – 1676. Hooke is counted among these unknown giants. Regarding general physiology and especially obstetrics great significance can be seen in the discovery of the ovarian follicle by Regnerus (Reinier) **De Graaf** of Leiden (1641-1673). This follicle was described in "De mulierum organis generationi inservientibus tractatus novus" (A new treatise on



Female genitals according to Swammerdam, 1672.

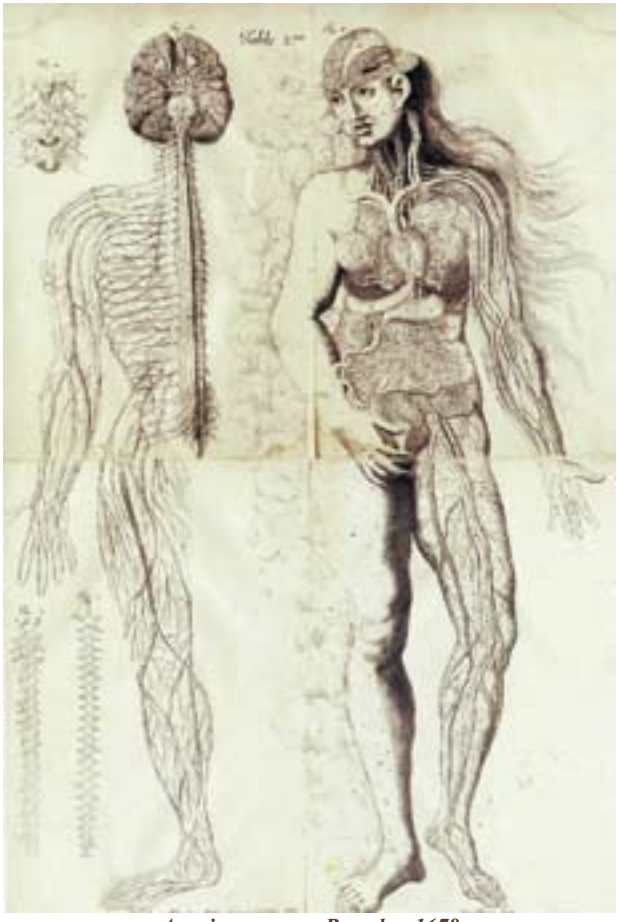
female genitals), which was published in 1672. A similar work on male genitals was published in 1668 and was entitled "De virorum organis generationi inservientibus, de clysteribus et de usu siphonis in anatomia" (... on clyster and the use of injection in anatomy).

Jan **Swammerdam** (l638 – l680) was a scholar who studied medicine in Leiden and Paris. He focused on entomologic studies of the evolution of insects (he owned a collection of 300 species), fish, reptiles and mammals. He would often use a microscope. His research into muscular contractions included measuring their volume and resulted in the discovery of plethysmography. He compared the evolution of animals and plants. His "Miraculum naturae sive uteri muliebris fabrica" (Miracle of nature or on the composition of the uterus) published in 1672 discovered, among other things, the follicles, and contains illustrations of female genitals that are so faithful that they surpass the illustrations of all medical textbooks published afterwards. He engaged in an argument with Graaf about the priority of the discovery. Herman Boerhaave translated this work into Latin and published it from 1737 to 1738 as "Biblia naturae" containing 53 engravings.

Antony van **Leeuwenhoek** (l632 - l723), a Dutchman, was originally a lens cutter. His research is believed to have been inspired by the above mentioned work by R. Hooke: Micrographia. He does not view the microscope as a mere toy, but as a means of seeing the world differently. The single lens microscope that he manufactured by himself allowed him to magnify approximately 275 times, which exceeded the capacities of double lens microscopes. He used the microscope to observe various objects that he described in "Arcana naturae opera exactissimorum microscopium detecta" (Natural mysteries discovered by the most precise microscopes). He discovered the red blood cells, infusorians in 1674, bacteria in 1676, spermatozoa in 1677 – this time he was assisted by Johann **Ham** (1654 – 1725) – and muscular threads in 1682. In 1698 he demonstrated the blood circulation to Tsar Peter the Great using the capillaries of an eel. He may well be considered the father of microbiology. He had his works assessed by scholars united in the English Royal Society through Regnier de Graaf.

Sperm, Leeuwenhoek, 1677

Obstetrics draws not only on the anatomy of the genitals, but also other organs. Samual **Collins** (1618 – 1710), an English anatomist, carried out a comparative study of the brains of mammals, birds, fish, reptiles, insects and humans, which he described in a two-volume work entitled "A System of Anatomy" published in 1685. Such research was an enormous contribution to the development of physiology.



A crying woman, Bourdon 1678

Theodor **Kerkring** (1640 – 1693), a German physician and anatomist, discovered that the bones of the foetus developed from cartilage. 1670 saw the publication of his "Specilegium anatomicum, continens observationum anatomicarum rariorum centuriim unam nec non osteogeniam foetuum" (Anatomic collection containing the observations of one hundred and one anatomic rarities and the creation of bones of the foetus). He also found the non-constant ossification centre located in the occipital bone. His theoretic conceptions were, however, misleading.

Frederik **Ruysch** (1638 – 1731), a Dutch taxidermist, was probably the best anatomic taxidermist, who is said to have used insect larva for the making of corrosive dissections. He was greatly admired by Tsar Peter the Great, who purchased his museum in 1718. His abundant work includes several outstanding opuses such as "Thesaurus anatomicus" issued in ten volumes in the period from 1701 to 1716, or "Tractatio anatomica de musculo in fundo uteri" (Anatomic treatise on the muscle of the uterine fundus) published in Amsterdam in 1723, which proved to be very important to obstetrics.

Anatomists of that era experimented and operated. Thomas **Bartholini** (1616 – 1680) compiled "Anatom Quartum Renovata. Non Tantum ex Institutionibus b. m. Parentis, Caspari Bartholini", which was published in 1684. This work contains illustrations of experimental salivary fistula in a dog and the fistula located at the pancreas duct system. Thus physiology was born. Anatomy, which is closely tied to obstetrics, spread all over Europe. At the end of the 17th century 436 anatomists were recorded.

Experiments on dogs. Collection of saliva, Bartholinus 1684

Women in the Field

Louise Bourgeois **Boursier** (l563 – l636/1650?) was a member of the first generation of Ambroise Paré's students. Her husband, Martin Boursier, a surgeon, was Paré's assistant. Having delivered her baby, she was taught by her husband, studied the writings by Paré and then worked among the poor in Faubourg St. Germaine. After completing five years of practice she obtained a licence in Paris. She remained in the service for 27 years as the sagefemme at the French court and royal family and assisted at the deliveries of all the children of Mary de Medici (1601 – 1609). In addition to a theoretical education she also gathered immense practical experience. In 1609 she published "Observations diverses sur la stérilité, perte de fruict, foecondité, accouchements et maladies des femmes et enfants nouveaux naiz, oevre util et necessaire a toutes personnes dedié a la royne" (Various observations of sterility, miscarriage, fertility, deliveries, diseases of women and infants) in Paris. The book was afterwards reissued many times (in l6l7, l626 and 1652), was translated into German and Dutch and was frequently quoted by English authors at that time. It was the first textbook for the sagefemmes compiled by a woman with profound knowledge of the field. She advised the sagefemmes to observe dissections of women. She advocated the induction of a premature delivery in the case of a contracted pelvis and described prolapsed funicle. She also gave a precise description of the face position and noted that it was possible to mistake this position for the breech position. Her fame did not fade until l627 when Princess Marie de Bourbon-Montpesier died of septic fever.

Justine Dittrichin **Siegemundin** (1650 – l705) was an autodidact. When she was 21, she believed that she was pregnant, which midwives would also confirm. However, after she was examined by a soldier's wife, it was found out that she was not pregnant. Then she became familiar with the book by De Graaf and took to studying female genitals. She worked among poor peasants for twelve years teaching midwives and eventually becoming a chief consultant. After the crowning of Fridrich III she was awarded the title of "Die Chur-Brandenburgische Hoff-Wehe-Mutter" (Brandenburg imperial midwife). In 1690 she published "Einhöchstnöthiger Unterricht, von schweren und unrechtstehenden Geburten, in einem Gespräch vorgestellet, wie nehmlich, durch Göttlichen Beystand eine wohl-unterrichtete und geuebte Wehe-Mutter, mit Verstand und geschickter Hand, dergleichen verhueten, oder wanns Noth ist, das Kind wenden könne, Durch vieler Jahre Übung, selbst erfahren" (Much needed knowledge of hard and complicated deliveries that in the way of dialogue demonstrates how through God's aid a well educated and trained midwife can use her wit and skilled hand to prevent this from happening or if necessary turn the baby, through many years of practice and personally acquired experience). When performing the internal versio, she would apply a Führungsstäbchen – leading stick to strangle the pelvis end and a Wendungschlingen – a turn loop fastened to the feet of the foetus. The book is full of empirical experience, but its theoretical level is rather poor. The writing was nevertheless very popular. She is alleged to have been the first one to describe the abnormal rotation of the head and to pierce the membrane sac to stop the bleeding in the case of placenta praevia. The book in no way exceeds the empirical knowledge of its time, which was laboriously gained in private practice. F. Mauriceau published his work at the same time, but these two works are simply incomparable. Siegemundin was a strictly pious woman. Her world view is expressed by the following verse in the book: An Gottes hilff und Segen, Geschickten Hand bewegen, Ist all mein Tuhn gelegen.

Turning a dead foetus using the loop. Siegemundin 1690

(All my work is based on God's aid and blessing and on the movements of skilful hands).

Examinations

In Amsterdam in l700, midwives had to answer the following questions at the examination – examen obstetricium: l. Names of various parts of the uterus. 2. Overview of symptoms for the diagnosis of pregnancy. 3. Which symptoms help distinguish between the foetus, molar and miscarriage. 4. How we can tell that a delivery has begun. 5. What are the arrangements that must be made before a delivery. 6. What is the position of a woman during her delivery. 7. Description of a normal delivery. 8. What are the measures that must be taken if the foetus is not in the normal position. 9. At which stage of the delivery should the woman be told to push. 10. What should be done if the membranes are not bursting open, but a large amount of blood is being produced. 11. What should be done if the membrane sack has broken open although the delivery is not commencing yet.

~ Paris as the Cradle of Obstetrics ~

In l630 the Hôtel Dieu was established near Notre Dame and the orphanage in Paris. This is where around a hundred poor mothers a month would come to deliver their babies. The hospital stood on the bank of stinking Seine, into which numerous sewers flowed, exposed to occasional fires or floods. There was a candle manufactory located near the hotel. The vaults under the hospital on the river bank were the abode of the poor, wanderers and other grim figures.

The hospital was in appalling condition. The dead would lie amidst those who were getting ready to undergo an operation watching patients who were just being operated on uttering horrid screams. Around l660, when Mauriceau worked in the Hôtel Dieu, poor women were accepted 15 days before the delivery and their stay was free of charge. Some of the women therefore claimed that their last menstruation had taken place some two or three months earlier than it actually did so that their stay could be as long as possible. Surgeons from St. Cosmos's College would be summoned in the event of a complicated delivery; these physicians also participated in the examinations of the sagefemmes. The Hôtel Dieu was managed by experienced sagefemmes, who allowed surgeons to observe and study the delivery from the very beginning. This hospital was the centre of the later spread of obstetrics all over Europe. Besides embryotomy, obstetrics at that time included also a lot more considerate methods such as versio and extractions, and later operations performed with forceps. An important role in the teaching of obstetrics is played by the machine, otherwise referred to as obstetric phantom. It was a leather model of the abdomen, pelvis and foetus in actual size, which was used for practicing suitable maneveurs, especially for interventions using forceps. Obstetrics then became separated from surgery. The social prestige of the obstetrician rose when Jules **Clement** assisted a delivery at the court of King Luis XIV in 1673.

Hôtel Dieu in the 18th century

François **Mauriceau** (1637 – 1709) is counted among the most renowned pioneers of obstetrics. He was Europe's and hence the world's foremost obstetrician. He was awarded the title of "Chirurgien juré et maistre des arts", and later acquired the title of "Artium magister et antiquus magistrorum Chirurgorum Parisiensium Societati Praepositus". He witnessed approximately 3,000 deliveries and his observations concern some 850 complicated cases.

Male and female pelvis and the head of a foetus. Mauriceau 1668

He published "Traité des maladies Des Femmes Grosses et accouchées" (A treatise on diseases of pregnant women and women in labour) in l668, which was then translated into many European languages. However, the book still retains many Hippocratic and Galenic conceptions. His anatomic descriptions are rather superficial, but the basic relation between the size of the head and the pelvis are accounted for correctly; he also illustrates the male and female pelvis, the head of the foetus and its proportions. Regarding the blood circulation he believed that mother's blood was fed from arteries into the placenta – "transfusion mutuelle", where it was taken over by the funicle vein. He was not acquainted with the works by Giulio Cesare Aranzius, Girolamo Fabrizius ab Aquapendente and William Harvey, who proved that the blood circulatory systems of the mother and the foetus were separate. He described symptoms proving that the foetus was still alive during the delivery.

He was familiar with the occurrence of meconium in foetuses that had been choked or in foetuses that had been born in breech presentation. He attempted to account for the effects of the contracted pelvis by referring to the molding of parietal bones. He also in breech introduced the maneuver on after-coming head, which had previously been performed by **Jacque Guillemeau** (1550 – 1609). He was a strict opponent of performing caesarean sections on living women. He supported this view by an appalling story about his sister, who, at the age of 21, fell down on her knees and felt pain in her abdomen in the eighth month of her pregnancy and began to bleed (probably due to premature separation of the placenta). She was then calmed by a sagefemme, however, the bleeding did not stop, and therefore a surgeon was brought to her four hours later. He concluded that there was no hope left and the foetus could not be born, recommended extreme unction and left for home without intervening in any way. Mauriceau did not arrive until 4 hours later and found out that the bleeding was still continuing (his sister had lost about three and a half pounds of blood). Immediately, he inserted his hand into the cervix, stretched it and found that the foetus was in the face position, pierced the membranes with a nail, turned the infant and extracted the foetus still alive followed by the placenta. The foetus was christened by a priest in an adjacent room. The woman died one hour after the delivery. He recalled this event whenever he attempted to prove that it was possible to operate with mere hands without any hazardous instruments. He dealt with many aspects of non-professional conduct of the renowned surgeon and touched upon many issues of medical ethics.

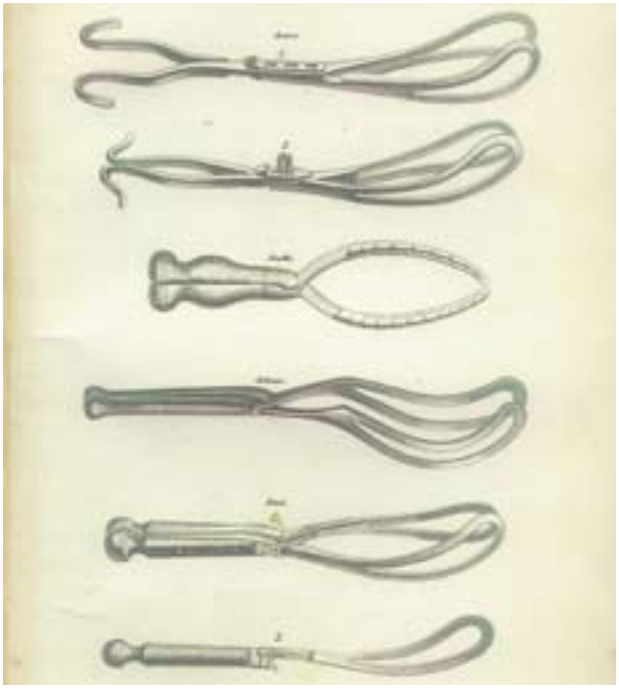
Position of a woman in labour, Busch 1838

Pierre **Dionis** (1643 - 1718), Mauriceau's cousin and professor of anatomy at Jardin du Roi, Jardin des Plantes, became court surgeon of King Luis XIV and his wife. He published his "Traité genéral des accouchemens qui instruit de tout ce qu qu´il faire pour ètre habile accoucheur". (A general treatise on obstetrics, which demonstrates all that one has to do in order to become a skilled obstetrician). He was familiar with Graaf's vesicles; he was an adherent of Harvey's and advocated the ovulation theory. He strongly objected to caesarean sections on living women. He knew rachitic pelvis and asymmetric flat pelvis and dealt with the origination of these disorders in childhood.

Jacob Benignus **Winslow** (1669 – 1760), a Danish anatomist, was another outstanding figure. 1725 saw the publication of his "Éclaricissements sur la circolation du sang dans le foetus" (Explanation of the blood circulation of the foetus). He wrote about the valves in the vena cava as well as the opening in the cardiac screen (foramen ovale). Von Haller, a much celebrated physiologist, was one of his followers.

Forceps

Mauriceau lived to see the existence of the forceps made known to the broad public. The forceps, however, did not become widespread until the 18th and 19th centuries. The term forceps (masculine noun) is derived from formus – hot (thermos in Greek) and capio – grasp, i.e. it refers to an instrument used for grasping something hot, which was known as early as the late Stone Age. The forceps was devised in 1569 by **Peter Chamberlain** (1560 – 1631), a son of a Huguenot refugee, William Chamberlain (died 1596). Hugh **Chamberlain**, Peter's eldest son, decided to sell the forceps for 10,000 thalers in l670. On encountering Mauriceau on 19 August 1670 he claimed that his instrument enabled physicians to deliver even the most complicated cases successfully. Mauriceau was just looking after a twenty-eight year old rachitic midget woman whose amniotic fluid had drained four days before, but who still showed no signs of beginning delivery. She had been given clysters, which were very popular those days, and the delivery began the following day. Mauriceau found the head of the foetus high above the pelvis facing forward while the pelvis was enormously contracted. One of the assistants suggested a caesarean section be made, which Mauriceau rejected. Chamberlain then boasted that a mere 15 minutes would be enough for him to complete the delivery. However, Mauriceau then reported that Chamberlain had been working without any success for three hours, not counting the time he needed to rest. He acknowledged that he had been defeated. The poor woman died the following day without having delivered her baby. The caesarean section on the dead woman came too late as the child was already dead. The uterus was torn. The pelvis was so contacted that it could not be entered by even Mauriceau's small hand, let alone Chamberlain's hand, which was twice as big. The forceps substitutes the missing power or enhances the current power, but is not suitable for overcoming complications caused by contracted pelvis. From the present perspective, the use of the forceps in this case would be contraindicated. So Chamberlain did not succeed in selling the family secret; he won further repute as well as money as the translator of Mauriceau's book into English, where he mentioned the invention of the forceps in the foreword. Chamberlain later sold the instrument to Roger **Roonhuysen**, an obstetrician in Amsterdam, in l688. However, he sold only one branch of the pliers that was used as a vectis – lever. The forceps was discredited for some time. The original forceps was found later in a hiding place. The instrument is a pair of crossed opening pliers with



Types of forceps. Siebold 1836

Application of the Smellie forceps on the following head, 1754

openings and shaped to grasp the head of the foetus. The current contents of the library of the Royal College of Obstetricians and Gynaecologist also includes English translations of Mauriceau from 1697, 1710, 1716, 1718, 1727, 1736 and 1752.

The invention of the forceps is ascribed also to Jean Johann **Palfyn** (1650 – 1730), a professor of anatomy and surgery in Ghent. He described the "manus ferrae Palfyniannae" (Palfyn's iron hands). He presented this instrument to the Paris Academy. This instrument consisted of two modified levers applied to the head and then fixed with laces. They were the true origin of the next generations of parallel forceps. **Gregoire**, a French surgeon, and **Chapmann**, a Britton, made some adjustments of the instrument, which was then widely used. Courses were held in Paris instructing obstetricians on the use of the forceps from the beginning of the century on. In 1747 André **Levret** presented a new model of the instrument, which was originally 44 cm long, but was newly fitted with a lock and curved not only to fit around the head, but also to copy the curve of the pelvis. This forceps then spread far and wide around all of continental Europe. In 1752, William **Smellie,** an English obstetrician, devised short forceps, which were only 30 cm long, very slim and moderately curved according to the pelvis, with leather coating on the openings to reduce the spot pressure on the foetus. It can well be said that every renowned obstetrician of the 18th and 19th centuries left behind a modified type of the forceps bearing his name. In 1849 Kilian counted as many as 130 various types, whose number was obviously yet to grow. In 1976 Gordon claimed that there were approximately 600 types of forceps.

Paul **Portal** (l630 – l703), a master surgeon in Paris, was trained by Mauriceau in the Hôtel de Dieu, where he worked especially among the poor and where around a hundred women a month delivered their babies. 1304 out of 1503 babies born in the hospital in 1678 were given to orphanages. Physicians working in the hospital had to put up with appalling conditions; for instance in 1660 the hotel was so crowded that 4 to 5 women had to share one bed. In 1685 he published his 368-page book "La Pratique des Accouchemens soutenue d´un grand nombre d´observations" (Obstetric practice based on a large number of observations), which was translated into Dutch and English in 1705. His observations are very accurate and well presented. As he was rather conservative, he did not accelerate deliveries, on the contrary he would wait for hours in order to avoid interventions inside the pelvis even in the cases of the face and pelvis end positions. He recommended turns and extraction of the foetus by holding one of its legs. He devised maneuvers to extract the shoulders of the foetus. He was aware that the placenta in the way – placenta praevia – is located permanently in the lower segment of the uterus, while many of his contemporaries were apt to believe that the placenta slid down from its original location. His observation No. 69 of 11 January 1679 describes how he found the cervix dilated so that it was three fingers wide in a woman who had been bleeding for several days by then. He discovered the source of the bleeding by searching for the placenta with a finger. He called for a physician who prescribed some medicine, which however did not stop the bleeding. So he greased his hand with fat, penetrated through the cervix into the uterus, peeled off the placenta, first grasped the funicle and then the belly of the foetus, its thighs, calf and foot. He turned the foetus and extracted it. In this way he managed to save both the baby and the mother who was on the very brink of death. He commented on the intervention as was usual: "I advise surgeons never to follow after another one if they are not sure of success, for it is always the last one who is to blame for the patient's death."

Johan van **Hoorn** (1662 – 1724) was the first one to teach and pioneer obstetrics in Sweden. He was trained in the subject by Portal, but as a foreigner he was not allowed to practice there, so he assisted deliveries of poor women at Madame Allegrain's. In 1697 he published the textbook "The Well-Trained Swedish Midwife – Den Swenska Wäl-öfwade Jord- Gumman". He also translated Portal into Swedish and his "Mirabilia", a treatise on embryology was published in Uppsala in 1709.

The development of obstetrics was radically influenced by Hendrik **van Deventer** (l65l – l724), a Dutch obstetrician. Although he was originally trained as a jeweller, he began studying medicine in Gröningen when he was 17 years old. After graduating he practised surgery, but from l679 on he focused on obstetrics too. As he had married an experienced midwife, he could assist her at deliveries. As an orthopaedist he was interested in the pelvis and showed a feeling for the tiniest anatomic details, variations of standards as well as pathologic cases. He was the first one to put emphasis on the pelvic axis. He wrote "Dogeroat der Vroedvrouwen", a book for midwives, in l696. In l70l he wrote "Manuale operatien, zijnde een nieuw ligt voor vroed-meesters en vroed-vrouwen"; which was translated from Dutch into Latin under the title "Operationes Chirurgicae Novum Lumen, exhibentes etc." (New light shed upon surgeries for those who practise obstetrics, which faithfully demonstrates the art of obstetrics for anyone who would be willing to practise it, showing many illustrations – engravings presenting many different positions of the pelvis as well as some irregular positions). This book was translated from Latin into German and published in

Germany in 1717 and 1728; it was published in English as "The art of midwifery improv'd" in l7l6; the French version came out in 1734 and contained 12 illustrations by the author, whose proportions were very poor and which surround the portrait of the authors and his motto "manet post funera verum" – After the funeral shall the truth remain. After his death, his writing dealing with diseases of the bones, especially rickets, was published in l739.

Before Deventer came out with his observations, obstetricians had not discussed complications caused by an abnormal pelvis. When classifying pathology of the pelvis, he introduced the term "nimis" – excessively. He distinguished between an excessively large pelvis – nimis magna, excessively small – nimis parva seu augusta, and excessively flat – nimis plana. He thus set out in a brand new direction, which was later followed by Levret and others, who delved into the study and measurements of the pelvis. However, Deventer was mistaken assuming that the crucial issue lay in the pelvis outlet, i.e. the area between the ischial bones and coccygeal bone, instead of the pelvis inlet. He was familiar with the flexion of the head. He held that deliveries in face presentation were hazardous. He believed that spontaneosus deliveries of Frank breech presentation were possible. He also dealt with the suffocating of infants. His illustrations include several notable pieces such as an engraving showing the placenta in the case of single deliveries and deliveries of twins. He was the first one to give correct illustrations of the neck position, one foot, and transversal position with a prolapsed funicle. But he was also the first physician to use the term of placenta praevia as he wrongly held that it was not a low position, but a premature separation and decline. Whenever this complication occurred, he recommended piercing the membrane sac or the placenta, turning and extracting the foetus. However, one can hardly understand his radical procedure of removing the placenta immediately after the delivery by means of a manual intrauterine intervention. The image of Deventer as an original and innovative thinker becomes somewhat blurred if we look at his engagement in the then disputes about how to strangulate the funicle, how to turn the foetus or which situations require the use of sharp instruments and which situation are best tackled with blunt ones.

Guille-Manquest **De la Motte** (1655 – 1737) was another pioneer of obstetrics. His "Traité complet des accouchemens naturels, non naturels et contre nature" (A complete treatise on natural, unnatural and counternatural deliveries) came out repeatedly in several editions in Paris from 1715. The book has 946 pages and stems from the analyses of 439 cases of deliveries at homes, which he had collected over his thirty-year practice. Unfortunately, the book contains no illustrations. The book is a valuable source of historical habits, knowledge and practical procedures. The 1729 edition was translated into German; the English speaking world had to wait for a translation until 1746. In the introduction he praises the development of surgery in France and England. He notes the cruel practices of removing urinary sand and pebbles, lithotomy and obstetrics. He also mentions 50 works in Latin and 30 in Greek after 1489, and mentions Viardel, Peu, Dionis, Sigemundin, Solingen, Portal, Amand, Roonhuysen, Guillemeau, Louise Bourgeois and von Haller. He does not evaluate these authors. He mentions the social ranking with 245 women he observed: 111 rich clients – 45.3 % (aristocracy – 21, citizens – 19, ladies – 53, officers' wives – 12, court officers – 7), 44 poor women – 18 % (labourers' wives – 30, farmwives – 14), 90 middle-class women – 36.7 % (craftsmen's and tradesmen's wives one of whom is characterized as a hooker).

The first book contains chapters on natural and unnatural delivery, infertility, symptoms and course of pregnancy, imaginary pregnancy, multiple pregnancy, use of medicine, use of clysters and drawing blood during pregnancy, vomiting, coughing, retaining urine, positions of the foetus in the uterus, turns of the foetus in the seventh month, significance of the membranes and amniotic fluid, determining the term of delivery, delayed delivery, natural delivery and delivery of the placenta. He described the changes of the shape of the head of the foetus during the delivery. His articles concerning infants deal with disorders of the rectum and genitals, the selection of a wet nurse and the nutrition of the infant. Regarding the delivery of the placenta he reveals wholesome conservatism. However, his explanation of the emenology – i.e. the study of the monthly period goes along the traditional speculative lines. The second book describes: abnormal rotations, face position, lying the neck down, funicle strangulation around the foetus, broad shoulders of the foetus, big head, position of the woman, irregular contractions, breech position, external causes of miscarriage and premature delivery, labour pains, delivery of twins and use of laxatives in order to induce abortion. In his third book he advocates avoiding the use of hazardous hooks – crocchets, for he held that the woman could be hurt by mere hand. He also mentions severe bleeding during pregnancy and delivery, bleeding from the nose, hydatid mole, meconium and prolapsed funicle. His narration about the extraction of a placenta praevia, turnings and extractions represent the most dramatic passages of the book. He also writes about extraordinary vomiting, retaining the head in the vagina, tearing off the head, and delivery with overlaid shoulder, armpit or knees. He was familiar with the way of versio twins or triplets during delivery. He also dealt with practising operations. He did not know the forceps and tried to solve a majority of pathologic situations by versio and extractions, for instance in the case of prolapsed funicle. In the case of breech position, he would always perform the extraction holding both feet. He would solve the face positions solely by means of turns. When performing turns he watched the direction of the face as a prevention of an abnormal rotation. He also describes a spontaneous delivery of a woman with innate dislocation of coxas. He diagnosed narrow cervix by means of internal palpation. He was familiar with wedged head, which he always tried to solve by turning, but if that failed, he would merely perforate the head and extract it manually through the opening. The author also describes improvisations during operations. His description of mistakes made by midwives is very down-to-earth, sometimes even fatalistic. The fourth volume deals with excessive or insufficient quantity of the amniotic fluid, delivery of a large infant, death of the infant or mother, terminations of deliveries, operations, hernias, hydrocephaly, caesarean section, preserving the life of the infant or mother, infants without any brain or the uncertainty concerning favourable prognosis preceding a delivery. The fifth book then concerns the retention of the placenta or its part, tearing the cervix, vagina and rectum, vaginal inflammations, prolapsed vagina, effusion, swollen breasts, cancer, pain following a delivery, and injuries of the navel. We can reproach the author for not being systematic enough as he repeatedly deals with the same issues in different places or makes digressions into pathologic conditions while describing the standard; however, there are plenty of confused cases that are not usually included in textbooks. The book is simply a succession of many different phenomena that we still encounter nowadays. Each of the cases described in the book is accompanied by the author's reflection, so readers can experience the thinking of that era. The book

was compiled in an era preceding the origination of the study of delivery mechanism and lacking precise measurements, in an era when neither theoretical nor practical issues were dealt with. He also captured the behaviour of surgeons and midwives, who often failed to pay any attention to mothers and were apt to abandon them even in uttermost need. Discussing the issues of the value of life of the mother and foetus, he would consult church authorities directly as was usual at that time. For instance he attempted to answer the question of whether christening preceding the delivery was valid if the holy water only reached the head inside the woman's genitals. He repeatedly mentioned bloodletting in the case of bleeding women.

He also argued with Philips **Hecquet** (1661 – 1737), who wrote his "De l'indécence aux hommes d'accoucher les femmes et de l'obligation aux femmes de nourrir leurs enfans" (On indecency of men helping women deliver and on the duty of women to nurture their children) where he strongly defied the presence of men at deliveries. De la Motte writes: the former part of the sentence is ridiculous, the latter is correct. Van Haller observed that Hecquet valued the modesty of women above their lives. Pierre **Sue** (1739 – 1816), a historian of medicine, wrote that De la Motte did not have to exert much effort to beat this opponent. De la Motte was a representative of the empirical approach, which was polished to perfection in Anglo-Scottish-Irish obstetric institutions.

Boom of Surgery

Surgery was separate from general medicine and its standard was varied. The guild of barbers united barbers, spa providers, masseurs, blood drawers, leech appliers, eye surgeons, but also surgeons who gathered ample experience in countless wars, bone setters, tooth extractors, hernia cutters – herniotomists, urinal pebble cutters – lithotomists, both illiterate persons and those versed in Latin. In France, qualified surgeons would at the turn of the 18th century be divided into oculists – eye surgeons, herniairies – hernia surgeons, lithotomistes – surgeons operating on urine pebbles and dentateurs – dentists.

Georges **Mareschal** (1658 – 1736) was the chief surgeon in the Hôtel Dieu and, at the same time, a personal surgeon of King Louis XIV. François Gigot de **Lapeyronie** (1678 – 1747) was Mareschal's adherent. His father, a barber, wanted his son to become a physician, however the son preferred surgery. He studied at Jesuit College and was interested in mathematics. He was awarded the "Maistre-chirurgien et barbier de Montpellier" at the age of 17. He gave lectures on anatomy at Saint-Come and Jardin du Roi. He was the author of numerous works on surgery. However, it was his description of the stiffened penis (induratio penis plastica – La Peyroni disease) that left an ineffaceable mark on history. He successfully operated on Duc de Chaulnes, treated Polish King Peter the Great, and was appreciated by Pope Clement XI, Louis XIV as well as Louis XV.

In 1731, Mareschal and Lapeyronie came out with an initiative which led to the establishment of the Academie Royal de Chirurgie, which was to become a corporation whose significance would be commeasurable with that of general medicine. The requirements raised by the surgeons were defied by backward barbers as well as general physicians who viewed surgeons as rivals. However, in

Marie Taft "delivering rabbits". Gullibility, superstitions and fanaticism. Hogarth, 1762

1743 the Academy was raised to the level of a medical faculty. France thus became the European centre of a new and dynamically developing branch closely tied to the Enlightenment movement. This boom was an enormous contribution to the further development of obstetrics. Austria regulated the practices of barbers by General Healthcare Rules, which were issued in 1753. In 1800 the Royal College of Surgeons was established in Great Britain. However, surgeons were not addressed as Doctor, but Mister.

Superstitions

In the 18th century scientific knowledge had to struggle with folk superstitions and fallacious views held by many scholars. The border between religious faith and a superstition is extremely vague. Philippe **Peu** (1623 – 1707), Mauriceau's follower and contemporary, wrote the textbook "La Pratique des Accouchemens" in 1694. He attempted to fight superstitions such as burning candles, roses of Jericho, amulets, red iron ore or devotional objects.

He also improved the technique of the versio and extraction and dealt with prolapsed funicle and placenta praevia. Jacob August **Blonde**l (+1724), an Englishman, struggled against the so-called imagination. His book was repeatedly published from 1727 and was translated into German, French and Dutch. Even Pierre Louis Moreau de **Maupertuis** (1698 – 1759), a serious scientist, opposed preformists, ovists as well as animaculists in his treatise "Venus physique", which was published in 1745, but nevertheless believed in the possibility of imagination in pregnancy. **George I**, King of England, engaged himself in a stunning matter. A woman called **Marie Taft** was alleged to have repeatedly delivered rabbits in 1726. This was proved in an examination performed by Nathaniel St. André, who personally assisted at one of these "deliveries". However, Sir **Manningham** and James **Douglas**, obstetricians, exposed the treachery. This woman had inserted small rabbits into her vagina. This event was mentioned by Voltaire as well.

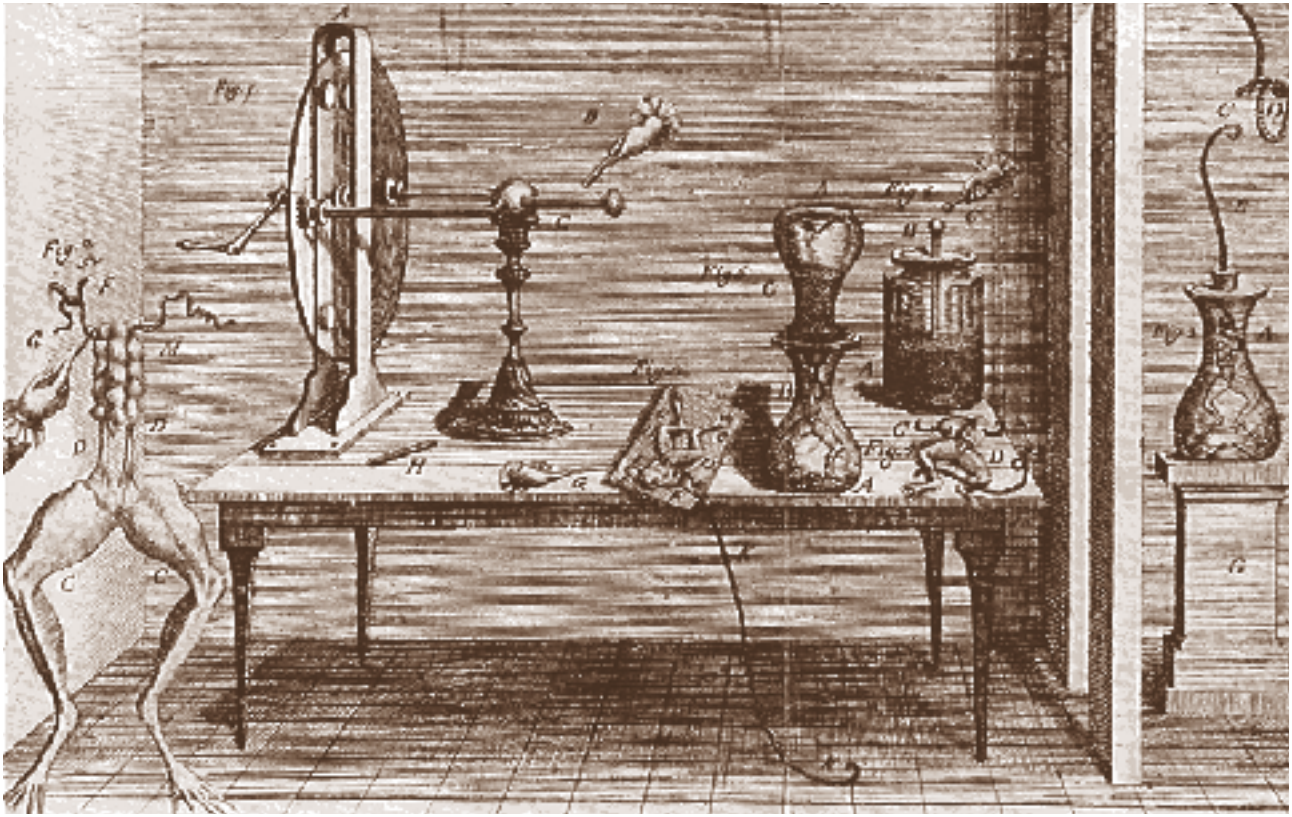
Schools of Obstetrics

Long-term collection of facts and concentration of deliveries in institutions like the Hôtel Dieu rendered France an obstetric superpower. Courses instructing on the use of the forceps held by the Gregoire brothers were attended also by William **Smellie**, a renowned Scottish physician, and Sir Fielding **Ould** (1710 – 1789). Inspired by the French example obstetric schools soon began mushrooming in other European countries, too; thus a school was established in **Great Britain** (Smellie, Hunter). Outstanding personalities may be found in other countries, though: **Scotland** (Hamilton), **Strasbourg** (Fried), **Germany** (Roederer, Stein), **Ireland** (Ould sir Fielding), **Holland** (Deventer, Camper), **Belgium** (Jacobs), **Denmark** (Saxtorph), **Sweden** (van Hoorn), **Austria** (Steidele, Boer), **Bohemia** (Melič) and **Russia** (Ambodik). The establishment of obstetric institutions was rather delayed in the rest of Europe. Maternity hospitals in Strasbourg and Berlin were established in 1727, the Rotunda in Dublin in 1745, Middlesex Hospital in London in 1745, Göttingen in 1751, Copenhagen in 1761, Prague in 1787, Allgemeines Krankenhaus in Vienna in 1789, Petersburg in 1794, etc. These centres concentrated clinical practice, professional medical training, training of surgeons and midwives, and research.

~ Scientific Progress ~

A generation of French scholars issued "Encyclopédie, ou Dictionnaire raisonné des sciences, des arts et des metiers" (Encyclopaedia (= general education) or reasonable dictionary of sciences, arts and crafts in 17 volumes witnessing "man's rule over the world") from 1751 through to l772. The works of this great opus, which involved efforts of many people who have been forgotten, were managed by Denis **Diderot** (1713 – 1784) from 1745 to 1772. The encyclopaedia contains approximately 56 references to important obstetric works, sometimes including a short review. The "Encyclopaedia Britannica" was launched almost simultaneously in l768.

The 18th century was characterized by growing importance of natural sciences that had by then broken free of the religious dominance in developed countries such as England, France, the Netherlands and Prussia. Science was no longer in the hands of dabblers, but qualified professionals. Knowledge piled up especially in physics and chemistry. The European society was deeply influenced by "Philosophiae naturalis principia matematica" (Mathematical



Galvani's experiments. 1791

principles of natural philosophy) by Isaac **Newton** (1643 – 1727), a work published in l687. Newtonism then spread as the most important unifying view of the world, for both celestial and terrestrial mechanical phenomena are included in a single and logically self-contained system.

Mathematical principles improved by the inclusion of infinitesimal calculus enabled describing the processes taking place on the earth as well as in space, of which obstetrics represents a part. The discovery of the spectrum resulted in the manufacture of achromatic lenses and improved microscopes. This led to a further boom in astronomy, as better telescopes featuring micrometers were suddenly available, which enabled discoveries such as the galaxy in 1755, comets, the planet Uranus or measuring the quadrant of the Earth. Daniel **Bernoulli** (1700 – 1782) articulated his kinetic theory of gases around 1738. Daniel Gabriel **Fahrenheit** (1686 – 1736) devised a thermometer based on expansion of alcohol around 1709 and another type based on the expansion of mercury in 1714. Scientists were amazed by electrical phenomena. In 1748 Jean Antoine **Nollet** (1700 – 1770), a physicist, invented an electroscope and became famous for his experiments with static electricity performed on people, such as giving an electric shock to a group of 180 soldiers connected in a conductible way in the presence of King Louis XV.

Knowledge of electricity grew rapidly; 1745 saw the invention of the Leiden jar and in 1780 the lightning conductor was invented by Benjamin **Franklin** (1706 – 1790). Luigi **Galvani** (1737 – 1798), a professor of anatomy and obstetrics, used an electric stimulation to induce contractions of muscles and introduced the notion of animal electricity.

In the 18th century the Institute for Medical Utilization of Electricity was established in Paris. Jean-Paul **Marat** (1743 – 1793), a physician and revolutionary, also focused on the study of electricity and opened his Cabinet de physique in 1778 and carried out numerous experiments, some of which were assisted by Benjamin Franklin. Alexandro **Volta** (1745 – 1827) devised the accumulator in 1800.

Antoine Laurent **Lavoisier** (l743 – l794, guillotined) advocated the introduction of the metric system and published his "Traité élémentaire de chemie" (Elementary treatise on chemistry) in 1788, where he formulated the law of conservation of mass and detected the composition of the air and CO_2. In 1772 he put the equation mark between breathing and consuming energy and created the basis of chemical terminology. Joseph **Priestley** (1733 – 1804), an Englishman, prepared O, N, Cl, NO, NH_3, and SO_2 and discovered photosynthesis in 1779. The discovery of oxygen was a true revolution both in chemistry and physiology. **Davy** sir Humphry (1778 – 1829) discovered sodium and potassium, a number of organic acids, potassium permanganate, hydrogen sulphide and hydrogen cyanide. Carl **Scheele** (1742 – 1786), a Swedish pharmacist, described hydro fluoride, malid acid, vinegar acid, lemon acid, glycerol, acetaldehyde and bleaching effect of chloride. The 18th century's scholars were familiar with a wide range of other chemical elements such as phosphor, hydrogen, platinum, nickel, cobalt, manganese, beryl, titan, chrome, wolfram and molybdenum; the composition of water was known too. And the development was no longer stoppable, so the following elements were isolated in the early 19th century: calcium, barium, cadmium, strontium, bohrium, natrium, potassium, silicon and others. This was an era of the origination of electrochemistry and the spectroscope. Julius Robert **von Mayer** (1814 – 1878), a German physician and physicist, described the vital chemical process of oxidation and discovered the quantitative factor of the transformation of kinetic energy into thermal energy – the mechanical equivalent of heat.

The illustrations in the French Encyclopaedia contain

many technical drawings demonstrating the amazing development of mechanics in many different industries. The invention of the steam engine unleashed the industrial revolution. This is reflected in obstetrics mainly by the expansion and improvement of the instrumentation.

Govard **Bidloo** (1649 – 1713) was a professor of anatomy in The Hague and Leiden, and a personal physician of William III of Orange-Nassau. 1685 saw the publication of the greatest anatomy book of the 17th century "Anatomia humani corporis" – "Ontlending des menschelyken lichaams" containing 105 wonderfully realistic copperplate illustrations by Gérard de Lairesse (1640 - 1711). This book also contains a description of a dissection of a pregnant woman. William **Cowper** (1666 - 1709), an English anatomist, took over the illustrations and included them in a new text entitled "Anatomy of the Human Body" without mentioning the author of the illustrations, which led to significant controversies.

Bidloo, foetus and placenta 1685

Herman **Boerhaave** (1668 - 1738), a Dutch physician and humanist, a scholar versed in Hebrew and Chaldean is usually classed among the iatromechanicians. He is credited with establishing clinical education beside the patient's bed. He became famous as a teacher of medicine, but he was an outstanding chemist and botanist. In Leiden he educated many students who then practiced all over Europe. He wrote "Institutiones medicae" (Leiden, 1708), "Aphorismi de cognoscendis et curandis morbis" (Leiden, 1709) and "Elementa chemiae" (Paris, 1724). He was the teacher of von Haller and van Swieten.

Development of Anatomy and Physiology

Albrecht **von Haller** (1708 - l777), an ingenious Swiss scholar, was an outstanding anatomist. He was the first one to be aware of the importance of experiments on animals. He described the vascular system and flowing of blood, the mechanism of breathing, he discovered cardiac automatics and articulated the doctrine about irritability and sensitivity of living tissues depending on nervous irritations. He influenced European medical thinking in a crucial way. He published eight volumes of his "Elementa Physiologiae Corporis Humani" (Elements of the physiology of the human body) from 1743 through to 1754. Thus anatomia animata was transformed in physiology.

The head, von Haller, 1743 – 1754

Giovanni Batista **Morgagn**i (l682 – l77l) laid the foundations of pathological anatomy in his "De sedibus et causis morborum per anatomen indagatis" (On locations and causes of diseases discovered anatomically) based on 640 dissections in 1761. He proved that diseases were related to changes of organs. He began verifying clinical diagnoses. The speculative Galenic medicine was thus about to vanish. Abbate Lazzaro **Spallanzani** (l729 – l778) studied the physiology of digestion and exchange of gases, disproved abiogenesis in 1765 and fertilized frog's eggs in 1779. He considered breathing, reproducing and digesting to be the elements of life. Caspar Friedrich **Wolf** (l729 – l794) studied the evolution of a chicken embryo and published his "Theoria generationis" (Theory of reproduction) in 1759, where he disproved the pre-formation theory and advocated the theory of epigenesis. He found out that both animals and plants were made of the same elements, which he named bubbles or pellets. Palaeontology is another field experiencing a steep rise. Carl **Linné** (1707 – 1778) published his "Systema naturae" in two volumes: the botanic system in l753 and zoological system in l758.

The comparative anatomy as well as embryology preceded the later evolutionary theories. George Louis Leclerc de **Buffon** (1707 – 1788), a zoologist and Voltaire's friend, proved to have excellent mathematic skills, which is why he was accepted to Academie des Science in 1734. He studied botany and physiology of plants. He was an intendant at Jardin du Roi. He is the author of 36 volumes of "L´Histoire naturele", which deal with the earth, minerals, fossils, flora and, above all, fauna and touch several issues related to humans. He would experiment with sperm. Comparative anatomy was exactly processed by Jean Maria **Daubenton** (1716 – 1800), an anatomist. The work obviously suffers from many imperfections; the opinions that forms of life were not fixed were responded to by church authorities with displeasure. This work was developed by George **Cuvie**r (1769 – 1832), Jean Baptist **Lamarck** (1744 – 1829) and completed by Charles **Darwin** (1809 – 1882) in the 19th century.

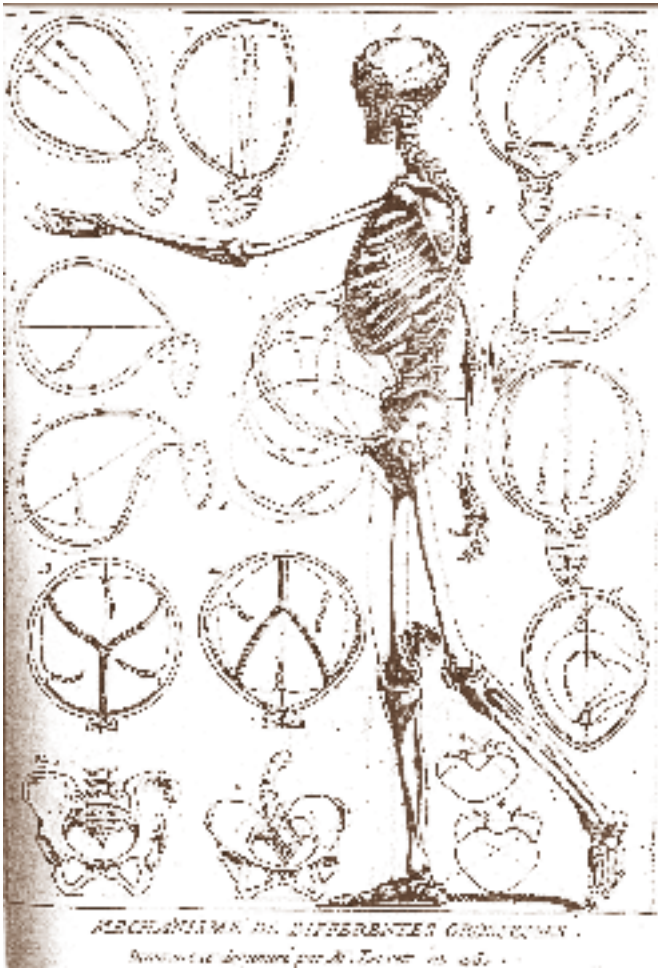
However, all spheres of social life were affected by **The French Revolution** (1789 – 1795), which led to the unification of general medicine and surgery.

Obstetrics as a Science

Jean **Astruc** (1684 – 1766) presented his obstetric theory in his "Traité des maladies des femmes", where he correctly synthesized the anatomic and physiologic knowledge of that time and accounted for uterine contractions,

although he did not assist at a single delivery in his life. Johann Friedrich **Meckel** (1724 - 1774), an anatomist, was another physician who gave lectures on the anatomy and physiology of the female body although he had had no real-life experience in this field. André **Levret** (l703 - l780), an experienced obstetrician and Newton's adherent, became the leading figure in French and European obstetrics. In l753 his treatise "L´Art des Accouchemens, démontré par des principes de physique et de mécanique" (Obstetric art demonstrated by the principles of physics and mechanics) was published only to come out repeatedly in several editions and to be translated into other languages. The crucial issue that obstetrics at the time focused on was the relation between the size and head of the foetus and the pelvis, which is known as the cephalopelvic disproportion. He conducted detailed analyses of the mechanism of birth, described the pelvic inlet and axis and displayed the uterine axis using a projection in the skeleton. He would also perform combined external and internal obstetrical examinations. He devised copious instruments including long forceps shaped according to the head of the foetus and the pelvis, which soon spread all over Europe and which he later fitted with scales – biometers to measure the dilatation. (His son reached the rank of general in the republican army).

Sir **Fielding Ould** (1710 – 1789), a man midwife, appeared to be an original and independent thinker. He completed courses by the Grégoires in Paris, and then was awarded a Master's degree in the Rotunda Hospital in Dublin, where he then worked as an administrator. He described the high straight position and contracted pelvis as contraindicatory to the use of the forceps. He invented and introduced a new maneuver to extract the following head. He recommended doing an episiotomy – cutting the perineum in the event of a narrow vagina. When pushing he preferred the position on the side, which is sometimes referred to as the English position. Regarding the mechanism of birth he studied the head entering a flat pelvis and the flexion of the head. He engaged himself in the establishment of scientific principles. In 1742 he wrote "A Treatise of Midwifery".



Pelvic axis, a walking skeleton with a uterus, Levret 1761

Left – position on the back, right – the English position on the side, Busch 1838

William **Smellie** (1697–1763) began his career in Scotland, then moved to London in 1737, attended courses by Gregoire Jr. in the Hôtel Dieu and returned to London in 1740 to teach obstetrics. From 1752 to 1764 he wrote two volumes of "A Treatise on the Theory and Practice of Midwifery". When laying the fundaments of scientific obstetrics in England, he had to fight many battles against midwives. His contributions also include accurate descriptions of the mechanism of birth in the case of normal, flat, rachitic and contracted pelvis. Regarding the mechanism of the head he mentions rotation. In 1745 he presented instructions on the way of facilitating the rotation with the forceps. He introduced typically English short forceps and became famous for his skilfulness. In the case of the breech position he would use the grip of the after-coming head, which is often referred to as the Mauriceau - Levret, Mauriceau - Smellie, Levret - Smellie, or even Veit - Smellie maneuver. Smellie was able to convince Jan van Riemsdyk, a Dutch artist, who depicted dissections of pregnant women in a series of drawings. His excellent anatomic work including "A Sett of Anatomical Tables" from 1754, which he compiled in a co-operation with Pieter **Camper** (1722 – 1789), a Dutch surgeon and anatomist, left an ineffaceable mark in the history of this field. This set of tables presents the internal processes taking place during a delivery and demonstrates a normal and rachitic pelvis. Outstanding illustrations of the disproportions between the head of the foetus and the pelvis, funicle complications and transversal positions were copied by many authors (such as Steidele or Siebold) and still used in the 20th century. He performed three caesarean sections, but never operated on a living woman. English obstetricians emphasized obstetrics as a science and not as an art. Midwifery was thus being transformed into modern obstetrics.

William **Hunter** (1718 – 1783), a Scottish obstetrician, was according to his contemporaries a true opposite of Smellie. However, his work rather makes him Smellie's successor. In London Hunter became the "premiere man

Breech presentation, Smellie, 1754

Pregnancy, Hunter 1779

midwife". While Smellie would work mainly with the poor and middle classes, Hunter treated the elite. He was awarded the position of extraordinary physician to Queen Charlotte, wife of George III. While Smellie was an outstanding surgeon, Hunter was conservative. The course of history, though, blunted these originally sharp differences. Hunter contributed mainly to the continuation of morphologic studies, which Smellie began to pursue with pregnant women. Hunter would give private anatomy courses. His "Anatomia uteri humani gravidi tabulis illustrata", published in l774, contain thirty-four 660 x 485 mm illustrations of dissections of thirteen pregnant women. He used coloured wax injections to highlight arteries. He co-operated with the same artist as Smellie, Jan van Riemsdyk. Hunter was very demanding and insisted on the highest possible quality of the engravings and paper. The conception of the anatomic illustrations included in his books resembles the conception introduced by Govard Bidloo. Hunter was allowed to become acquainted with anatomic drawings by Leonardo da Vinci in Windsor Castle and wanted to publish them. Although this wish was never granted, Hunter was convinced that drawing and dissection had much in common. The drawings in works by Smellie depict the everyday practice, Hunter's are more theoretical.

His brother, **John Hunter** (1728 – 1793) was one of the world's most famous anatomists and his vast morphological studies and comparative anatomy helped make way for Darwinism. Thomas **Denman** (1733 – 1815) was a representative of the conservative approach characterized by the least liking for operations. He studied the separation of the placenta, delivery convulsions, rupture of the uterus and bleeding. He described a spontaneous birth of a foetus in the transverse position – evolutio spontanea. He was one of the opponents of inducing premature deliveries in the cases of an abnormal pelvis, ill mothers or mothers repeatedly delivering a dead foetus.

The application of Newtonist principles to the explanation of the mechanism of delivery was further elaborated by Louis Joseph **Solayrés de Renhac** (1737 – 1772), who distinguished the position and standing of the foetus. He accounted for the flexion, rotation and extension of the head of the foetus during a delivery and explained the mechanism of the breech delivery. Regarding the mechanism of the delivery, terminology was being made more accurate, especially under the influence of German obstetricians: birthing ways, object of delivery, birth forces, leading point, passing perimeter, purpose of lever, axis of foetus, axis of pelvis, axis of uterus, fixed point of lever – hypomochlion, all of which is a terminology taken from mechanics. He wrote "Elementorum artis obstetriciae compendium" (A compendium of elements of the art of obstetrics) in 1765 and "Dissertatio de partu viribus maternis absoluto" in 1771, where he dealt with dynamic rules of a natural delivery.

His student, Jean Luis **Baudelocque** (l746 – l8l0) improved pelvimetry, studied the mechanism of the separation of the placenta, the mechanism of the tearing of the uterus and described numerous clinical everyday cases. He devised a pelvimeter and suggested measuring conjugata externa. He defied the practice of cutting the pubic bone by compiling a set of theses "An in partu propter angustiam pelvis impossibilis, symphysis ossium secanda" (Why it is impossible to cut the pubic bone in the case of a contracted pelvis). He advocated the use of forceps, internal versio, extraction of the breech presentation and caesarean section on living women in the most complicated cases. He enjoyed great authority and assisted at the births of several monarchs. He was not in favour of pre-

Measuring external dimensions of the pelvis; left – a pelvimeter, right - a cliseometer, Busch 1838

mature induction of a delivery. Like other obstetricians he was accused of causing the death of a mother and child by Jean François **Sacombe** (1750 – 1822), but the prosecution had to pay Maternité a penalty of 3,000 francs. After the Revolution Baudelocque became the head of the Maternité, where he organized training of future sagefemmes. In 1776 he published his "Principes sur l´art accouchemens" (4th edition in 1821). In l78l he issued his "L´art des accouchemens" (6th edition in 1822). His works were translated into German, Italian and Dutch. He helped Paris retain its position of the centre of European obstetrics.

Science entered this medical branch also in the form of applied anthropometry of the foetus and pelvis. Ingenious invention helped devise a number of pelvimeters – devices used for measuring external and internal dimensions of the pelvis, and cliseometers – special devices for measuring the inclination of the pelvis.

In England morphologic knowledge and evaluation of empirical observations were pursued concurrently with the development of Newtonist theory in France. Sir Richard **Manningham** (1690 – 1759) was one of the most prominent English obstetricians. He reached a high social rank as a "Fellow of the Royal Society". He was an adherent of Henrik van Deventer. He preferred manual interventions such as prophylactic versio preceding a delivery, instead of the use of instruments. He wrote his "Artis obstetricandi compendium theoriam & praxim spectans" in London in 1739. This treatise recommends using the phantom in order to practise the maneuvers and learn all the necessary techniques of handling the foetus.

Francois Ange **Deleurye** (1737 – 1780), a follower of Levret, was a royal physician. His method of internal turning of the foetus in the amniotic fluid, which facilitates the versio, is still a valid technique. He distinguished between the versio and extraction. His "Traité des accouchemens en faveur des éleves" published in 1770 was translated into German in 1778. He won a great reputation in 1778 for a successful caesarean section on a living woman, which he described in 1779 in "Observation sur l´opération césarienne a la ligne blanche et sur l´usage du forceps la tête arrèté au détroit superieure par Deleurye" (Observation of a caesarean operation on linea alba and the use of forceps to deal with the head retained in the pelvis inlet).

Jean Bernard **Jacobs** of Ghent (1730 – 1791) compiled an empirical textbook "Kortbondig onderwys aenga de Vroedkundeede" in 1772, which was translated into French under the title of "École pratique des Accouchemens" in 1785. This textbook is widely appreciated mainly for its marvellous illustrations and clear explanations and was translated into German. Readers will find some of the illustrations in this publication.

Johan Jacob **Fried** (1689 – 1769) was the first German teacher of obstetrics. Strasbourg was the place where "Mutterschule aller andern Institute von der Art in Teutschland" was established in l728. Fried was appointed into the position of "Hebammenmeister" in this institution. His duty was to give unpaid lectures twice a week and publish a textbook of obstetrics. He demonstrated anatomic dissections and corpses at the delivery ward to future midwives, visited the maternity hospital three times a week, and checked the "Spitalshebamme" and town's midwives. Candidate midwives were examined by a commission consisting of a magistrate "Oberammenmeister", town's physicist, subdean and the above mentioned "Hebammenmeister". Another examination was prescribed for six senior midwives who were then allowed to train junior ones – "Lehrtochter". The beginnings were rather humble. The ward housed two halls with 30 beds. The capacity did not allow accepting more than 80 women a year. The candidates would be taught on the phantoms and at deliveries

assisted by midwives and medical students. The institution trained only one qualified midwife a year. 85 dissertations in obstetrics were submitted during his presidency.

His son, Georg Albert **Fried** (1736 – 1773), published his "Anfangsgründe der Geburtshülfe" in Strasbourg in 1769, which was the first work written in German to deal with the mechanism of birth. **Johann Georg Roederer** (1726 – 1763) was another prominent personality. He studied obstetrics under Fried, Levret and Smellie. He explored the foetal blood circulatory system and published his "De Foetu perfecto" in 1750. He delved deep into the mechanism of birth, the pelvic axis, which he described in "De axi Pelvis" (On pelvic axis), impaction of the head – paragomphosis, excessive flexion and occipitut transverse position. He introduced the term of lower uterine segment. He described a rare case of spontaneous delivery of a duplicated body in the transverse position – partus conduplicato corpore. He found the amniotic fluid in the lungs of suffocated children and small oedema – ecchymosia on the pleura and pericardium. He coined the following phrase to describe the condition of a complication-free birth: "ut infanti et utero et pelvi una et eadem sit axis" (let the foetus, uterus and pelvis lie in the same axis). He became famous for his classic work that he wrote in 1753, i.e. "Elementa artis obstetriciae" (Elements of the art of obstetrics), which was translated into German, French and Italian. In 1759 he published "Icones uteri humani observationibus illustratae", seven wonderful engravings including remarkable illustrations of a dissection and vascular system of the uterus**.**

German physicians who had completed their studies in France continued to develop the theory and practice with proverbial German carefulness. Georg Wilhelm **Stein** (l73l - l803) was an adherent of Levret's conception of bringing mathematical principles into obstetrics and in-

Vascular system in the uterus, Roederer, 1750

vented original devices to measure internal dimensions of the pelvis, the cliseometer to measure the inclination of the pelvis, cephalometer to measure the size of the head and baromacrometer to measure the weight of the foetus. He distinguished between a completely contracted pelvis – pelvis justo minor and flat pelvis – pelvis complanata, and described the osteomalatic pelvis. He developed nearly all surgical methods under very strict conditions and favoured the caesarean section on living women. He greatly contributed to the use of the Levret forceps, which he fitted with a scale enabling the obstetrician to estimate the pressure applied on the head of the foetus. He devised a delivery chair and a milk pump. Regarding his theoreti-

cal legacy his "Theoretische Anleitung zur Geburtshülfe" (Theoretical introduction to obstetrics), published in l770, deserves the most careful attention. This work came out repeatedly until l805 and was translated into French and Italian. He influenced an entire generation of German-speaking obstetricians.

Jan **Melič** (l763 – l837) worked in his institution in Prague and, according to Steidele and Stein, gave lectures, as well. This Czech obstetrician achieved the top European level of knowledge and was an important personality although, given the poor conditions at that time, he stood alone. He was ahead of his contemporaries with respect to social aspects.

At the turn of the century the German speaking world was the home of approximately 60 professors of obstetrics (such as Siebold, Stark, Busch, Plenk, Aepli, Cranz and Steidele) and saw the origination of hundreds of scientific reports; the situation in England and France was almost identical. At that time obstetrics was an interconnected scientific branch. Obstetricians would visit each other, hold conferences and go for study trips; books published would be translated into German, French, Italian, English, Dutch, Latin and Italian. Monarchs too would send their obstetricians to foreign hospitals under exchange scholarship schemes. German professional journals are also worth mentioning. From l789 on J. Ch. **Stark** issues "Archiv für Geburtshülfe, Frauenzimmer und neugeborner Kinder-Krankheiten", but there are other journals, such as "Journal für Geburtshelfer", "Journal für die Chirurgie" and "Geburtshülfe und gerichtliche Arzneykunde".

Le **Sue** (1739 – 1816), a French historian quotes 114 authors from the 16th century, 430 authors from the 17th century and an incredible 1038 authors from the 18th century. The 18th century was characterized by extraordinary effort on the part of translators.

The state then began issuing incentives to increase the population. After the Thirty Years War was over and absolutism and centralization was stronger than ever before, the German speaking countries implemented the "Verwaltungsreformen". The depleted and depressed population called for medical solutions. In 1680 Gottfried **Wilhelm Leibnitz** (1646 – 1716), a German philosopher, submitted his proposals for the implementation of the "Medizinalbehörde" as well as other proposals to improve the functionality of the state. In l696 "Medicus legalis" was published, a publication in which C. B. **Behrens** summarized extensive hygienic and medical rules. These rules were intended to do away with dabblers and to protect the population; it is however obvious that the level of the theory did not enable causal interventions. This codification process involved education and examination of midwives. Similar measures were implemented in Austria in the 18th century.

Midwives

The burden of reproduction lay most heavily on mothers, but also on midwives. They were able to draw on their acquaintance with the phenomena of birth, but as they were not familiar with anatomy, the entire process was rather obscure to them. Scientific obstetrics, which was on the rise in developed countries, had to face midwives' conservative defiance. Man midwives would often be mocked; in France obstetricians were nicknamed "sage femmes en culottes".

Jean le Bon's statement "haec enim ars viros dedecet" (this art discredits men), which can be found in his Therapia Puerperarum, was remembered until the late 18th century. The most severe resistance was put up by midwives in England. Elisabeth **Nihell** (* 1723) was a famous opponent of man obstetricians. She was trained in the Hôtel

A caricature of a man- mid-wife, 1793

Dieu in Paris. She was famous for her fierce attacks. This is what she writes about Smellie's students: "bankrupt barbers, tailors or even butchers, who, having spent half their life stuffing sausage, are turned into dauntless physicians and male midwives, and their hands, their instruments are but weapons of death". "A Treatise on the Art of Midwifery setting forth various abuses therein, especially as to the practice with instruments" published in London in 1760 was allegedly written by her husband. This book was translated into French as "La cause l´humanité, référée". This is "Old Chiron's" reply: "Midwives stuff their patients with digestive liquors to keep them drunk during the delivery; make the poor women run up and down the stairs despite their crying and shake them so violently that they induce convulsive contractions; pretending to be accelerating the delivery they mock at the mothers' weeping and make fun of the poor women's suffering in many ways, a sight that makes a sensitive man shiver with terror". Aggressive female midwives, however, hit a wall. **Fielding Ould** wrote a treatise "Misconduct of female midwives", and the conference held by physicians and surgeons of Glasgow medical faculty on 3 December 1739 prohibited practicing midwifery unless the midwife passed an examination by a commission consisting of surgeons. Other European countries did not witness such open controversies.

France suffered from a lack of qualified midwives, especially in the countryside, which was tackled by mass courses organized by Madame Angélique Margaritte Boursier **de Coudray.** In 1759 "Abrégé de l´art des accouchemens" (An abstract of the art of obstetrics) was published. The teaching included merely theory, practical knowledge was practised on the phantoms – machines, which had to be carefully locked and kept away from inquisitive looks of men during breaks. The attendants had to learn all the rules by heart. The course focused mainly on the key issue of distinguishing normal deliveries from complicated ones endangering the mother and calling for a surgical intervention. Her method was used in France by 200 demonstrators, who were able to train over ten thousand midwives from 1760 through to 1790.

The Enlightenment

In Austria the Enlightenment resulted in the implementation of systemic changes. One of the major changes rested in the introduction of obligatory basic education (reading, writing and counting). Given the previous decline of population as a consequence of wars and epidemics, the state was interested in providing the uneducated and poor with good health care so that the population could be healthy

and multiply without epidemics and also so that the government could prevent venereal diseases from spreading. The health care policies of Theresian absolutism were based on population theories. The Country Health Care Order issued in l753 changed the situation in Bohemia. A decree issued at the Viennese Court in l749 required that midwives and their assistants must attend dissections of female corpses and pass examinations.

Hermann **Boerhaave**, an illustrious Dutch physician, adherent of the iatromechanic approach, was a teacher of Gerhard **van Swieten** (1700 – 1772), who became a personal physician of Empress **Maria Theresa** (1717 – 1780), who would often consult him on issues connected with medical and educational reforms. He made the Empress send **Crantz** to study under Levret and Puzos. **Joseph II** (1741 – 1790) showed much interest in the system of health care when he was visiting France and sent Boër to study in France, Italy and England. Midwives, medical students and future surgeons were often educated together. The number of obstetricians was growing, observations were piling up and discoveries took place independently of one another. In l756 the German textbook for midwives "Einleitung in eine wahre und gegründete Hebammenkunst" was published. This book was written by Johann Nepomuk **Crantz** (1722 – 1799) and was translated into Czech in the same year. Rafael Johann **Steidele** (1737 – 1823) wrote another textbook called "Lehrbuch der Hebammenkunst" in 1774. A decree was issued requiring that all midwives keep this book throughout their entire practice. The Empress ordered the translation of this book into Czech, Polish and Italian. The book was reprinted several times.

Jiří (Georg) **Prochaska** (l749 – l820), a renowned physiologist, anatomist and ophthalmologist, was an important personality of Czech origin. His "Lehrsätze aus der Physiologie des Menschen", (Textbook of the human physiology) published in l797 places physiology next to anatomy. The author no longer cherished traditional galenic views, included a rich treatise on the morphology and life of the foetus and quoted Hunter, Michaelis, Heller, Buffon, Wolf and others; he was also familiar with the discoveries made by English and French chemists as well as the study of electricity. He also includes facts of comparative physiology, claims that the conception takes place in the fallopian tube, which he deducts from the occurrence of extra uterine pregnancy, he gives an accurate description of the embryonic ovum, the separate blood circulation systems of the mother and the foetus, the transport of oxygen to the foetus, he is familiar with the foetal ossification process, frequency of multiple pregnancies and the course of pregnancy and birth. He also describes physiological reactions taking place during sexual intercourse. Section 951 says: "Labour pains are caused by a contraction of the uterus, which begins at the uterine fundus and presses the infant against the cervix (Muttermund)", which is a piece of knowledge that he correctly derived from power vectors long before the discovery of the scendent gradient by the Montevideo School in the 20th century. His treatise on the function of the nervous system published in 1784 involves the following passage: "At last the time has come to abandon the philosophical method by Descartes and introduce the method of Newton believing that the pursuit of truth via hypotheses and speculations is lengthy and uncertain while the path that leads to a cause a posterior is much safer, better and shorter".

Some obstetricians prefer a conservative approach relying on natural forces; on the other hand, there are obstetricians emphasizing proactive approaches, which are often defied as needless surgeries. Many obstetricians hold the forceps as the symbol of their occupation. Friedrich Benjamin **Osiander** (1759 – 1822), a professor in Göttingen,

was an adherent of proactive, surgery-based obstetrics and would intervene in as many as 40 % of deliveries. He devised an apertorium – dilator of the cervix, he used his own design of forceps, which he used to handle most complications. He also modified the procedure of the caesarean section – he recommended pushing the head of the foetus up towards the front wall of the abdomen and opening the uterus in the lower part. He wrote several books including "Lehrbuch der Hebammenkunst" in 1796 and "Handbuch der Entbindungskunst" in 1802 (a note: the German Handbuch is not a mere manual, but a comprehensive summary of knowledge). James **Blundell** (1791 – 1878), a conservative obstetrician, who became famous for successful blood transfusion following a post-delivery bleeding, wrote: "Do not yield to that temptation; as soon as you put your instruments into your bags, they are prone to slip out of the bag and get into the uterus."

Johan Lucas **Boër** (1751 – 1835) studied in Paris and London upon the Emperor's request in 1785 – 1788. He was a representative of the "awaiting school" and rarely used instruments. He was also the first one to use electricity to resuscitate a suffocated foetus. In 1812 he published his "L. J. Boeri naturali medicinae obstetriciae libri septem" (Seven books on natural obstetrics by Boer). Alexander **Hamilton** (+1802) was another fan of the conservative approach. He worked in Edinburgh. He is ascribed the quotation that still applies to obstetric interventions: "arte, non vi" - by art, not by force, to which obstetricians favouring the use of forceps replied: "Vi et arte" - by force and by art. He dealt with the classification of the pelvis. He wrote several books: "Elements of the practice of Midwifery" in 1775 and "A treatise of Midwifery" in 1781, translated into German.

Obstetricians of German nationality played the key roles in the 19th century. Gustav Adolf **Michaelis** (1798 – 1848), who focused on the study of the mechanism of birth, was an exceptional personality. He analyzed more than 1000 patients and summarized his findings in "Das enge Becken" (On the contracted pelvis). This treatise came out three years after his death. Carl Conrad Theodor **Litzmann** (1815 – 1890) wrote "Die Formen des Beckens" (Forms of the pelvis) in 1861. Franz Karl **Naegele** (1778 – 1851) studied the mechanism of birth. Hermann Friedrich **Kilian** (1800 –1863) improved obstetric operations. These personalities contributed to the development of theory and clinical practice, but also provided for translations from French and English and thus completed the classical era. Personally, I believe that their activities represent the very best of German history. There are examples proving the existence of international co-operation at that time. Obstetricians were citizens of an international republic of scholars.

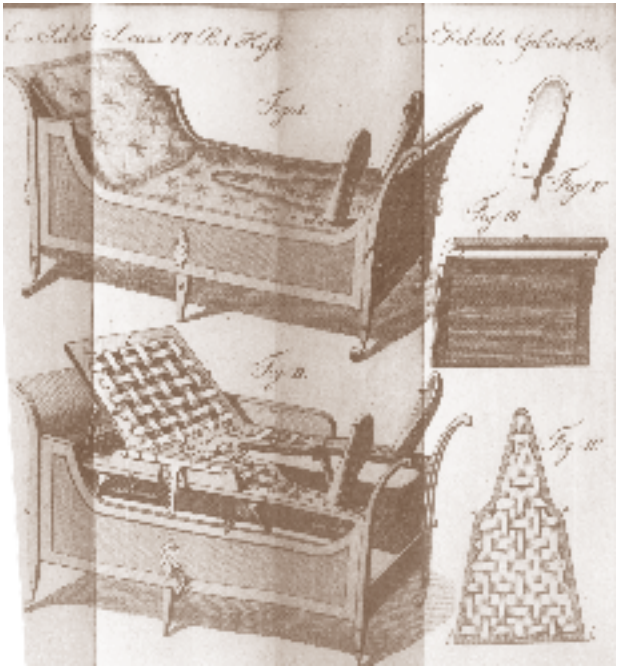
Viability of the Foetus

Obstetricians were able to tell whether the foetus was alive or not only by its spontaneous or induced movements, or by feeling the chest of the foetus in the case of turns performed internally or by feeling a prolapsed funicle. Although Philip **Legoust** described the echoes of the foetus, which sounded like the clacking of a windmill, this discovery was unknown until the 18th century. The stethoscope (derived from stethos – chest and scopio – observe), i.e. an instrument similar to hearing aid used for listening to the activity of the heart was invented by René Théophile **Laennec** (1781 – 1826) in France in 1819. This instrument consisted of a wooden pipe the extended end of which was placed on the patient's chest and the narrow part to the ear. As this instrument made the heart sounds clearly audible, Jean Alexander Lejumeau de **Kergaradec** (1788 – 1877) utilized it in obstetrics, which he described in the report "Mémoire sur l´auscultation

appliquée a l´étude de la grossese" (Memory for hearing used for studying pregnancy) claiming that acoustic manifestations of the heart activities of the foetus in the uterus are very deep and much less audible than the echoes of an adult heart. The discovery of the auscultation of the fetal heart sounds was a revolution that drew obstetricians' attention towards the foetus. Stethoscopy remained the only method enabling obstetricians to detect the life of a foetus until the discoveries of objective methods (phonocardiography, ECG, ultrasound) in the 20th century.

Delivery Stool

The position of the woman during delivery attracted the attention of women and obstetricians. The 18th century saw many different types of delivery stools invented. The included lit de misere, Kreistuhl, Hebammnestuhl, Feldbett, lectus imperialis, the French or Viennese bed invented by Mercurio, Deventer, Heister, Arnaud, Fried, Steidele, Stein, Mesnard, De la Motte, Roederer, Solingen, Siegemundin, Baudelocque, Hunter and others.



A 19th century delivery bed, Siebold

Paediatrics

Paediatrics originated as a medical discipline as treatises on infants and children were regularly included in obstetric textbooks. The first monographs concerning these issues were published at the end of the 18th century. The first textbook of paediatrics ever was written by Nils Rosén **von Rosenstein** (1706 – 1773), a Swedish physician, in 1764 under the title of "Anweisung zur Kentniss und cur der Kinderkrankheiten" (Diseases of children and their treatment). The book was translated into English in 1776, and the German translation published in Göttingen in 1785 was the fifth improved edition. In 1793 Johann Jacob **Roemer** (1763 – 1819), a Swiss physician and professor of botany, published his "Annalen der Geburtshülfe Frauenzimmer und Kiderkrankheiten für das Jahr 1790". In 1820 Adolf **Henke** (1775 – 1843) published his "Handbuch zur Erkenntniss und Heilung der Kinderkrankheiten" (A manual for detecting and treating children's diseases) in Frankfurt; and in 1826 Johann Christian Gottfried **Jörg** (1779 – 1856) wrote his "Handbuch zum Erkennen und Heilen der Kinderkrankheiten" in Lepzig. In 1825 A. **Mükisch** published his "Beiträge zur Kentniss des Kindlichen Organismus" (A contribution to the exploration of the organism of children) in Vienna, Friedrich Ludwig **Meissner** (1796 – 1860) "Die Kinderkrankheiten zum Unterricht für practische Ärzte" (Children's diseases for practicians) in Leipzig in 1828 and Philipp **Seifert** his monograph "Die Brochiopneumonie der Neugebornen und Säuglinge" (Bronchopneumonia in newborn infants and nurselings) in Berlin in 1837.

These are authors concentrating on nutrition, lactation techniques, disorders of the formation of milk, congenital anomalies such as inability to pass through, harelip, spasms, fever diseases and premature infants. Jörg and Mükisch specialized in obstetrics; the others were general physicians.

Embryotomy

The disproportion between the size of the head of foetus and a contracted pelvis has for centuries been solved by embryotomy. Embryotomy was an everyday practice. It was performed if the delivery was not progressing or the foetus was in a transversal position, the woman was exhausted or there was a likely crack of the uterus. The head of the foetus was sometimes torn off as the obstetrician or midwife attempted to turn the infant inside the uterus. In spite of the horror of these reminiscences bring we must not forget that this practice was the only way to save the mother's life in the era preceding the development of anaesthesia, microbiology or blood transfusion. The obstetricians had to be extremely careful when conducting the embryotomy so as not to hurt themselves or the mother. These operations are still practiced in some Third World countries.

Performing embryotomy, Busch 1838

Caesarean Section

Solving the disproportion of the sizes of the head of the foetus and the pelvis by means of caesarean section may seem plausible; however the introduction of this opera-

Caesarean section, Siebold 1836

tion as an everyday practice was not facilitated by suitable conditions. The first caesareans were thus conducted on dead women, then on dying women and finally as planned operations. This operation would not be performed on a living woman unless the indication absolutely ruled out any other possibility, i.e. the pelvis was so contracted that even embryotomy was impossible: large tumours, osteomalacia, deformed pelvis, extra-uterine pregnancy. Regarding convulsive conditions, the section was indicated as ultimum refugium – the ultimate possibility indicated if the mother was completely exhausted and dying. However, women would not die until after the operation and then mainly of infections and bleeding. Each survival was at that time a true historic event. As the wounds that had been stitched kept opening, stitching was abandoned. Théobald Etienne **Lauverjat** (+1800) successfully performed a transversal section on the fundus in 1782 and observed that the wound closed on contractions while it opened in the case of a lengthwise section.

The 18th century witnessed 64 cases that showed that this operation might have some positive future outlook. However, surviving the caesarean section was exceptional and the mortality rate exceeded 95 %. As the French Revolution was slowly fading away in 1797, Jean Francois **Sacombe** (around l750 - l822), the author of a textbook of obstetrics written in verses in 1792 "La Luciniade, ou l´art des accouchemens, poème didactique" (Luciniade, art of obstetrics, didactic poem), founded his militant "École anti-césarienne" – Anti-caesarean school.

Symphyseotomy

Jean René **Sigault** (* 1740) assisted by Alphons Louis Vincent **Leroy** (1742 – 1816) conducted the first symphyseotomy, i.e. the division of the symphysis pubis. He operated on Madame Souchot, a forty-year old woman, whose pelvis was deformed by rickets and who had lost five children in deliveries. Both mother and baby survived this operation. The method spread immediately, but this intervention did not suffice to compensate for a very contracted pelvis; moreover, women who had undergone this surgery would often suffer from incontinence of urine, fistulas or duck walk. This extension of the pubis at the same time resulted in damage to the joint of the sacrum and coxa. Obstetricians divided into those who were in favour of this method and those who preferred the caesarean section. (This operation is still performed in the Third World).

Artificially Induced Premature Birth

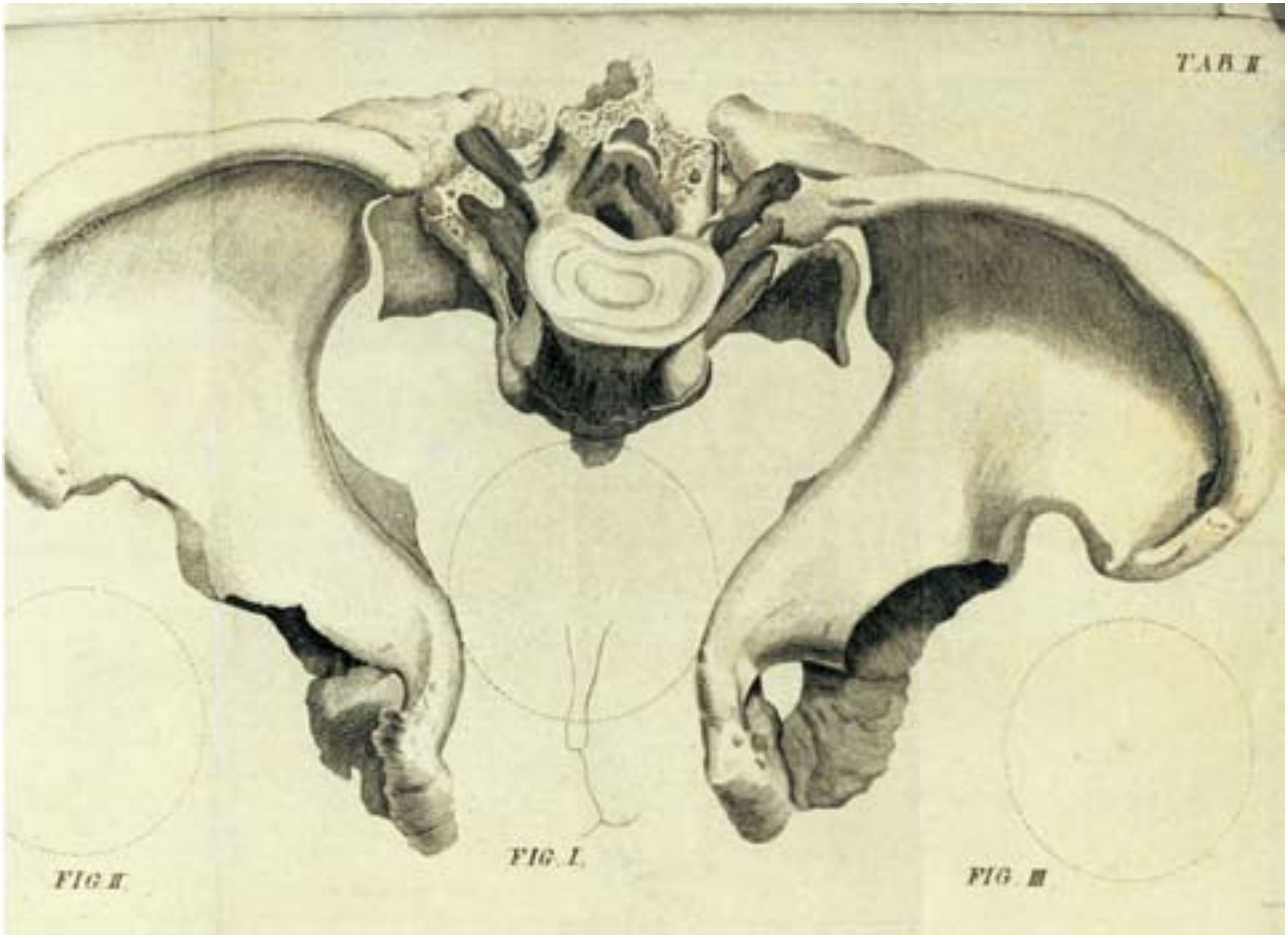
Thomas **Denman** (1733 – 1815) recommended solving the disproportion by inducing a premature birth artificially. However, this procedure did not prove useful, neither did a diet consisting of a limited supply of food and drink. The only way out of this situation led through making the caesarean safer. The mass use of train oil as a dietary supplement implemented in the late 19th century was a significant enhancement of rickets prevention.

Narcosis – Fighting Pain

Tinctura opii has been known since time immemorial. In 1803 Fridrich **Sertürner** (1783 - 1841) isolated neat morphine out of opium. **Faraday** (see below), a physicist, and **Orfila** (1787 - 1853) became familiar with the aesthetical effect of ether (CH_3-O-CH_3), which was tested in 1846 by William Thomas Green **Morton** (1819 - 1868) both on himself and on his stomatologic patients. On 19 January 1847 Jammes Young **Simpson** (1811 - 1870), an extraordinarily experienced obstetrician, used ether at a

delivery and so did Jules **Roux** (1807 – 1877) in the same year. In 1853 and 1857 John **Snow** (1813 – 1858), a royal obstetrician, used chloroform to manage the delivery of Queen Victoria. She gave birth to Prince Leopold, who died at the age of 30 suffering from severe bleeding, which was blamed on the use of chloroform. The use of anaesthetics was widely supported in France.

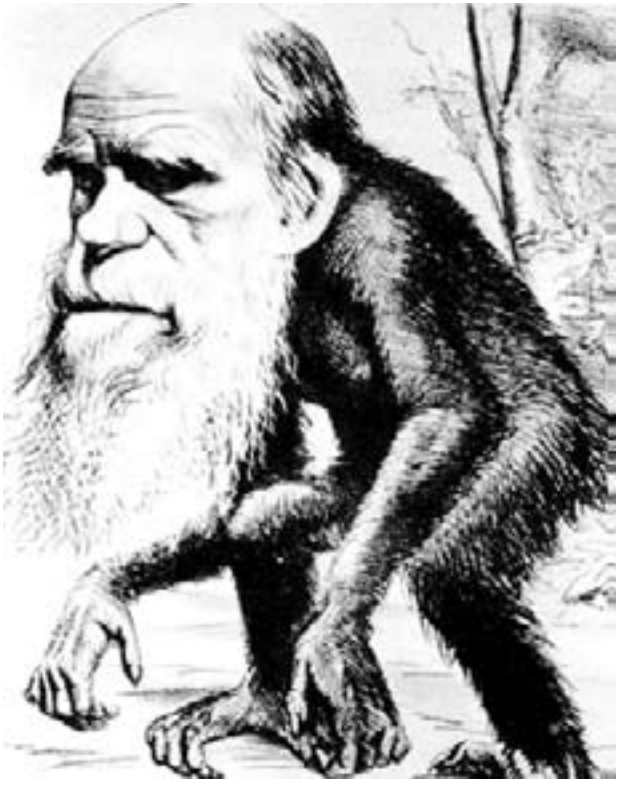
Sir James Young **Simpson** (1811 – 1870), a world-famous obstetrician, worked in Edinburgh. In 1847 he devised typically English forceps, which then penetrated into continental Europe and have been preserved virtually unchanged until the present. He devised other instruments such as the cranioclast, which was used to crush the head of a foetus and replaced the basiotribes and cephalotribes. The use of anaesthetics during childbirth provoked a fierce religious opposition. Simpson was a Free Mason and freethinker. He was the first physician to be knighted. His funeral was attended by 100,000 people.



Symphyseotomy, the 19th century

Steam driven engines were mushrooming in water transport and in 1825 George **Stephenson** (1781 – 1848) designed the first functional locomotive. The world was experiencing the industrial revolution and capitalism with all its social and biological impacts upon human existence. Michael **Faraday** (l79l – l867) studied liquefy gases and in 1831 discovered electromagnetic induction and electrolysis, which represents a significant influence on the entire future development. In 1831 James Prescott **Joule** (1818 – 1889) determined the mechanical equivalent of heat and formulated the law of conservation of energy (l84l – l853). Justus von **Liebig** (1803 – 1873) was one of the founders of organic chemistry, studied metabolism and classified the nutrients of the human body (proteins, saccharine and fats). In 1828 Friedrich **Wöhler** (1800 – 1882) synthesized urea and deleted the border between organic and inorganic chemistry. In 1822 Joseph **Niepce** (1765 – 1833), a physicist and chemist, discovered the principle of photography using the "camera obscura" and Jacque **Daguerre** (1789 – 1851), a painter, took the first photographs in 1839.

Karl Ernst **Baer** (l792 – l876) discovered the ovum of mammals in 1827 and developed comparative embryology. In 1845 he verified that the embryo is formed out of three layers that were later named ento-, ecto- and meso- derm. Johannes **Müller** (1801 – 1858) gave an accurate description of the evolution of genitals of amphibians, birds, mammals and humans. Geoffroy **Saint Hilaire** (1771 – 1844) published his "Traité de teratologie" in 1832 and "Des monstruosités humaines" in 1822 – 1834, works on innate defects that are still quoted nowadays.



A caricature of Darwin.

Jan Evangelista **Purkyně** (1787 – l869), a Czech researcher, morphologist and physiologist, described the ovum vesicle, granules and the course of the threads forming the uterine muscles. In 1837 he articulated the main themes underlying the cellular theory, which was further developed in 1839 by Theodor **Schwamm** (1810 – 1882) and Jakob **Schleiden** (1804 – 1881). In 1847 Karl Friedrich Wilhelm **Ludwig** (1816 – 1895), a Viennese physiologist, discovered the kymograph, which enabled him to capture muscular movement, changes of blood pressure as well as other physiologic parameters.

The second half of the 19th century was charged with revolutionary thoughts and inventions. James Clerk **Maxwell** (1831 – 1879) created the theory of the electromagnetic field in 1864 and anticipated the existence of electromagnetic waves. Rudolf **Virchow** (l82l – l902), a phenomenal researcher and pathologic anatomist, published his "Die Cellular-Pathologie etc" (Cellular pathology) in 1858, where he postulated that "Omnis cellula e cellula" – every cell is formed out of a cell. He rejected vitalism and advocated a strictly scientific approach towards medicine. He participated in the 1848 revolution and strove for a healthcare reform – he advocated of citizens' right to health. He believed that "Die Medicin ist eine sociale Wissenschaft, und die Politik ist nichts weiter als Medicin im Großen" – medicine is a social science and politics is but a large-scale medicine. He greatly contributed to the building of public hospitals, slaughterhouses, markets and sewerage systems. A year later, Charles **Darwin** (l809 – l889) published his "Origin of Species" – an evolutionary theory of natural selection, and "The Descent of Man" in 1871 – a work that meant a revolution in biology as well as world view.

Gregor **Mendel** (l822 – l884) reported on his experiments with hybridizing green peas in 1865 and formulated three basic laws of heritability. Ernst **Haecke**l (1834 – 1919) articulated in his "Generelle Morphologie der Organismen" in 1866 a biogenetic law claiming that "ontogenesis is an abbreviated fylogenesis". He introduced the notion of ecology in the field of biology. Karl **Marx** (1818 – 1883) published the first volume of Capital in 1867. Dimitriy Ivanovich **Mendeleyev** (l834 – l907) published the periodical system of elements in l869.

~ The Prague School ~

At the turn of the century Czech obstetrics underwent dramatic changes. **Antonín Jungmann** (l775 – l854), Josef Jugmann the philologist's brother, started in the maternity hospital of St. Apolinnaire's Church. He was the chief physician from 1811 to 1850. Like in the Hôtel Dieu a hundred years ago, this institution became a big maternity clinic and a centre of training for midwives and medical students. Jungmann, staying in the clinic day and night, witnessed approximately 50,000 deliveries. While Prague was becoming a maternity centre, the theoretic fundaments were already laid and waiting to be taken over. The institution could use English, French and German instruments; moreover modification of the instrumentation to respond to the hospital's specific needs was made by Ignac Stelzig. Jungmann, who was very modest and not assertive enough, founded the far-famed "Prague School", whose members included many outstanding physicians such as: Wilhelm **Lange** (1813 – 1881), Franz Karl **Kiwisch** (1814 – 1852), Bernard **Seyfert** (1817 – 1870), Jan **Streng** (1817 – 1887), Johan **Chiari** (1817 – 1854), Fridrich Wilhelm **Scanzoni** (1821 – 1891), August **Breisky** (1832 – 1888), Ludwig **Bandl** (1842 – 1892); each of these is a name in obstetrics. The opportunity to learn the speciality in practice attracted attendants of the obstetric and gynaecologic courses from Poland, Denmark, Iceland, Norway, Sweden, England, Italy, Switzerland and Germany, Russia and even North America. In this respect Europe was the cradle of the New World's obstetrics too. The graduates of the Prague School worked in other institutions all over Europe.

Lists of attendants of the Prague School with their addresses

Jungmann's library is a significant part of Europe's cultural heritage and nowadays houses some 500 of the original books, of which: l9 % are French sources, both original and translations, 6 % are translations from English, and 5 % are translations from Danish, Swedish and Italian.

Puerperal Fever

The 18th century saw growing interest in the fever occurring during the puerperium, which was a deadly menace to mothers. In 1795 Charles **White** of Manchester pointed out that the disease was caused by dirtiness; his work on this topic was translated into German. Therefore Friedrich **Günther,** a veterinary doctor, introduced the practice of washing hands in chlorine hydrate when treating diseases in cows in 1830. Robert **Collins** (1801 – 1861), an Irishman and chief physician of the Rotunda Hospital in Dublin, put a stop to accepting women about to give birth, disinfected the floors, walls and furniture with chlorine hydrate, and had sheets exposed to high temperatures in order to manage the epidemic in l829. These measures really helped him control the infection. These preventive measures were accepted quietly. These principles were supported and im-

plemented by Oliver **Holmes** (1809 – 1894) in Boston in the period of 1840 – 1843, which was not known in Europe. Small English maternity hospitals never had to tackle epidemics on such enormous scales as some of the big institutions on the continent. Ignac Philipp **Semmelweis** (l8l8 – l865), a Hungarian physician, found out that the mortality rate of women in puerperium reached 11.4 % in the institution where medical students assisted at dissections as compared to a mere 2.7 % in the maternity hospital managed by midwives. He articulated a thesis that the puerperinal sepsis was transmitted by decaying particles of corpses sticking to hands. After the introduction of chlorine hydrate disinfection in 1847, the original mortality rate dropped from 9.92 % to 1.27 %. In 1861 he published his "Die Aethiologie der Begriff und die Prophylaxis des Kindbettfiebers" (Origin, notion and prophylaxis of the puerperal fever).

Death of a woman in puerperium, Gärtner 1905

Nowadays we find it very hard to understand the dramatic controversies that were often very emotional and concerned ethical issues, which would have been meaningless had physicians been acquainted with the micro organisms discovered by A. Leeuwenhoek. Neither were they familiar with L. Spallanzani's work published in l768 and dealing with the impossibility of a spontaneous origination of living embryos – abiogenesis although it was utilized by Nicolas Francois **Appert** (1750 – 1841), a French researcher, the inventor of the tin can, as early as in 1795.

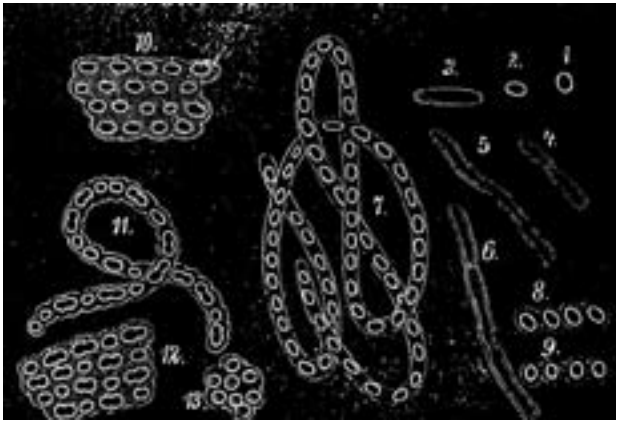
The establishment of microbiology as another scientific discipline was further accelerated by Edward **Jenner** (1749 – 1823), who in 1796 introduced the practice of vaccination (vacca – cow), i.e. using cowpox vaccine in order to protect humans against smallpox (variola). Thanks to vaccination this disease has vanished from the world.

Microbiology – Bacteriology

Microbiology and bacteriology considerably influenced human and veterinary medicine as well as other specializations. The origination of microbiology is ascribed to Otto Friedrich **Müller** (1730 – 1784), a Danish biologist. He carried out research on invertebrates and discovered a number of sea animals. He won a great reputation for his works on bacteria "Animacula infusiora", which were published in 1786, i.e. after his death. He distinguished between bacteria and spirilla. However, these works did not attract much attention from physicians. Fermenters had been described by Leeuwenhoek before; Theodor **Schwamm** discovered sacharomycetes during a fermentation process in 1837. Agostini **Bassi** (1773 – 1885) found that the disease affecting the silkworm moth is caused by a fungus (Cordyceps bassiana). This finding inspired Friedrich **Henle** (1809 – 1885), one of the founders of microscopic anatomy, who observed the presence of microbes in dissections. In 1840 he wrote an article entitled "Von den Miasmen und Kontagien" (On possible effects of contagious parasite micro-organisms). Robert Koch was at that time one of his students. Louis **Pasteur** (l822 - l895), a French chemist, found that the fermentation was caused by fermenter organisms, discovered the cause of anthrax, did some research of the anaerobism of microbes (i.e. living without oxygen) and introduced active vaccination against rabies and fowl pest.

A caricature of Pasteur

Robert **Koch** (l843 - l9l6), a physician and one of the founders of medical bacteriology, verified the cause of anthrax in 1876, tuberculosis (l882), cholera (1883) and set forth the rules of detecting the specificity of microbes, microscopic organisms and cultivations. Ilya **Mechnikov** (1845 - l9l6), a Russian zoologist, discovered fagocytosis. Paul **Ehrlich** (1854 - 1915) was the first one to discover tripaflavine and to use Salvarsan chemotherapy against syphilis in 1909. Emil **Behring** (1854 - 1917) introduced passive vaccination against diphtheria. Friedrich **Loeffler** (1852 - 1915) and Émile **Roux** (1853 - 1933) studied bacterial toxins. These achievements were followed by a series of other microbiologic discoveries, especially in France and Germany: anthrax in 1855, gonorrhoea in 1879, typhus and malaria in 1880, cholera in 1883, diphtheria and tetanus in 1884, brucellosis in 1887, salmonellosis in 1888, plague in 1894, tetanus in 1897, dysentery in 1898 and syphilis in 1906. Joseph **Lister** (1827 - 1912), an English surgeon, implemented around 1865 strict cleanliness and antiseptic measures by means of carbolic acid, and introduced the use of carbolic spray in 1870. These innovations were soon followed by asepses, sterilization of instruments, use of rubber gloves etc. and these practices were first adopted by surgeons and then by obstetricians. These achievements were paralleled by huge progress in virology and parasitology.

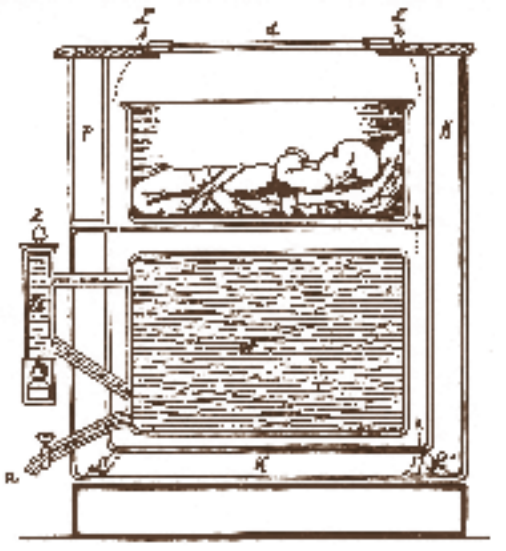


Negative colouring of microbes, Vejdovský 1882

Caesarean Section

Thanks to the use of narcosis, the caesarean section was no longer painful; aseptic measures made it safer. First dimethylether would be used to anesthetize the mothers who were to undergo this operation, but it was later replaced with chloroform. The indication of the c-section was expanded to also cover unmanageable convulsive fits (eclampsia), placenta praevia and premature separation of the placenta. Eduardo **Porro** (1842 – 1902), an Italian obstetrician, successfully operated on a midget and rachitic woman in 1876. After completing the caesarean section, he removed the uterus as a potential source of infection and prevented the bleeding from continuing by applying a copper ring on the cervix and amputating it above the vagina. Only 57 of the first 100 women to undergo this operation died, which was tremendous progress. Later on, the mortality rate dropped to 30 %. Porro and his assistants used a solution of carbolic acid to wash their hands as well as the woman's abdominal cavity, and chloroform to anesthetize the woman. The introduction of aseptic surgical procedures was a true medical revolution. In 1882 Max **Saenger** (1853 – 1903) a Leipzig physician, reintroduced the practice of stitching the wound after the section. In 1882 he used silver threads, which helped curtail the occurrence of fatal bleeding. Most surgeons gradually preferred stitching the uterus in two layers. In 1882 Adolf **Kehrer** conducted a transversal section in the lower segment immediately over the peritoneum insertion. In the 1880s and 1890s the mortality rate in relation to the caesarean section oscillated around 6 %. The improvement can be ascribed to several factors including earlier operations, aseptic procedures, safer anaesthetics and advanced surgical techniques. Otto Küstner mentions in his monograph on caesarean section published in 1915 665 authors writing about the section. (Compare: The technique of operating on the appendix was not elaborated until the 1880s and 1890s; this disease had previosly been fatal). At present millions of caesarean sections take place virtually every day.

The attention shifted to the infant and obstetrics began to concentrate on their mortality and injury rates; this is also an era that saw the first incubators for premature children.



An incubator for a premature infant from the late 19th century

~ Changes at the End of the 19th Century and at the Turn of the Century ~

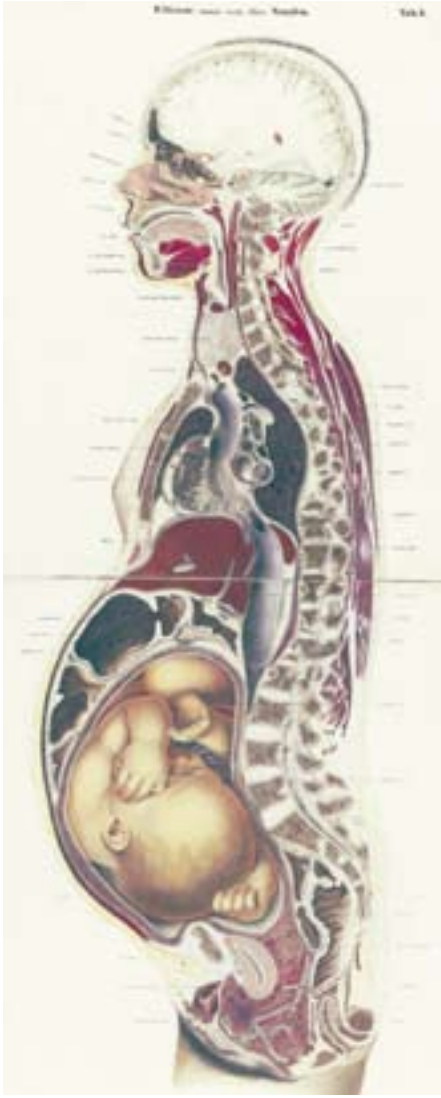
Cytologists discovered the core, nucleus, chloroplast, mitochondrion, Golgi's apparatus, membranes and the process of cellular division. František Vejdovský (l849 – l939) discovered another cellular organelle – centrosome in 1886. It is typical that the first Czech publication "On bacteria" was written by this author, a cytologist and embryologist in 1882.

The mystery of menstruation was discovered. Histological research helped describe cyclic changes in the ovary and endometrium. At first, menstruation was believed to be a period of ovulation, in the 1870s it was characterized as a miscarriage of non-fertilized ovum, which were theories that crushed the traditional emenology explaining the phenomenon as a process of blood cleaning or plethora – blood congestion in the pelvis area.

Physiology made enormous progress. Claude **Bernard** (1813 – 1878) delved into the research of digestion, glycogen, regulation of the blood pressure and endocrinology. Physiology was dynamically developing all over Europe.

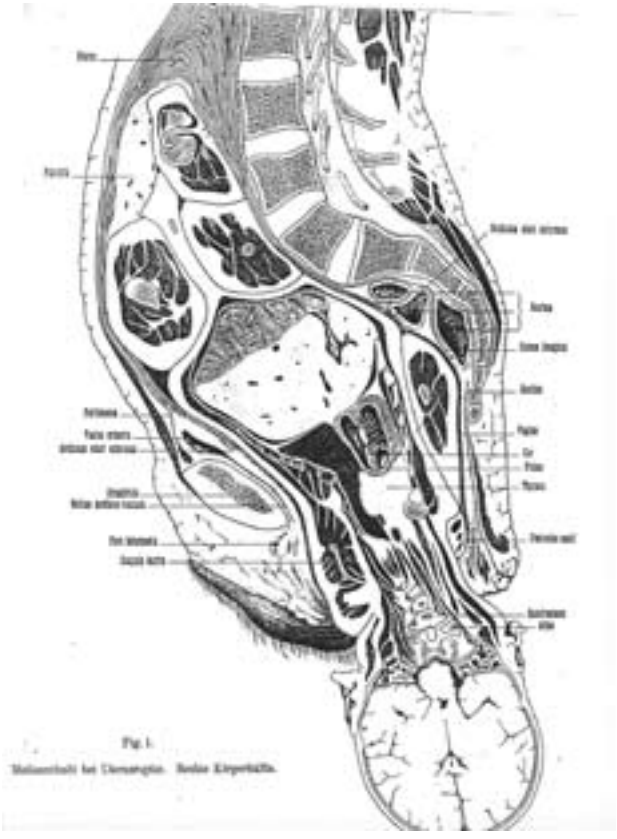
Triggered by workers' movements and initiatives of corporate physicians, social legislation was being introduced through the state's health care policies and medical police. The working conditions were improving, the working hours were shorter, child labour was vanishing and pregnant and lactating women could enjoy legal protection. The affects of several obvious industrial pollutants, such as mercury, phosphor and lead, were also on the decline. In 1888 Austria passed laws on health care insurance. The civilised countries saw a significant improvement of the population's nutrition; Max von **Pettenkofer** (1818 – 1901) set forth principles of communal hygiene. Positive changes were, however, frequently interrupted by wars and economic recession.

Macroscopic morphology of pregnancy was not completed until in 1872 when Chr. Wilhelm **Braune** (1831 – 1892) published his "Die Lage des Uterus und Foetus am Ende der Schwangerschaft", which was a report on longitudinal section on frozen bodies of pregnant women. This report was also published by Paul **Zweifel** (1878 – 1927) in Lepzig under the title of "Zwei neue Gefrierschnitte Gebärender" in 1893.



A section of a pregnant woman at the beginning of the expelling period, Braune 1872

We can find several outstanding personalities. German morphologists, such as Johann Fridrich **Meckel** (1781 – 1833), the founder of teratology (study of monsters). Carl **Breus** (1852 – 1914) and Alexander **Kolisko** (1857 – 1918) elaborated their "Pathologische Beckenformen" (Pathologic shapes of the pelvis) in 1904, 1910 and 1912. They dealt not only with how a pathological pelvis affects the delivery, but also with the causes and mechanism of its formation. This is an unbeatable work, for no equally rich clinical material has been collected from the discovery of the cure for rickets in the 1920s.



A section of a dead mother who has delivered the head, Zweifel 1893

Blood Transfusion

Issues concerning bleeding and embolism remained the last problems to solve. Mechanical methods proved to be inefficient. A method of safe transfusion of human blood depended on the development of haematology. The first blood transfusions in humans were not performed to compensate for loss of blood, but for speculative reasons. In 1492 Pope Innocent VIII having suffered a cerebrovascular accident was given the blood of three ten-year-old boys, who had been sacrificed solely for this purpose. In 1615 Andrea **Libavius** applied a young man's blood to an old one. This resulted in further experiments conducted by Christopher Wren and William **Boyle** in 1658, who injected wine, beer, opium, water and acid into animals' arteries. Richard **Lower** (1631 – 1691) carried out a blood transfusion in 1665, and used a quill to transport the blood from the donor's carotid artery (arteria carotis) into a dog's jugular vein (vena iugularis). He reported on this experiment in "Tractatus de corde" (A tractate on the heart). Many experimental applications of animal blood soon followed Jean Baptist **Denis** and Paul **Emmerez** applied a calf's blood into the carotid artery of a young woman, who survived. They observed a disintegration of the blood cells after the transfusion. Denis applied blood to several people. However, the Parliament of Paris banned further transfusions after one of the patients had died, and this practice was abandoned for some time. Transfusion sets housed in decorated cases that were made in this era have been preserved until the present.

In the period of 1825 – 1830 James **Blundel** (1791 – 1878) would repeatedly perform blood transfusions in patients with many different indications. He was successful in the case of bleeding during delivery, where the donor was the mother's husband. He attempted to give the blood rapidly in order to prevent it from coagulating. In 1914

Lewisohn used a citrate as an anticoagulant. In the 19th century solutions of NaCl and milk would often be applied intravenously.

The haematological research carried out in 1900 by Karl **Landsteiner** (1868 – 1930), a Viennese physician, showed that the serum would in certain people lead to the coagulation or disintegration of blood cells, whilst it did not occur in others. Thus he discovered the A, B and 0 blood groups. AB was discovered in 1902. This discovery ensured safer conditions during clinical applications. Blood transfusion did not advance until the 1920s. The Rh properties of blood were not discovered until 1940. Then the treatment of haemolytic diseases in newborn infants began and researchers discovered as many as 250 different antigens.

Inventions and Discoveries

The late 19th century and the beginning of the 20th century were characterized of a number of inventions that soon appeared as parts of practical applications. Let us mention just a few of them: The phonograph in 1877, bulb in 1879, electrical dynamo in 1881 and others by Thomas Alva **Edison** (1847 – 1931). The development of theoretical physics and chemistry was soon reflected in practice. Wilhem Konrad **Röntgen** (l845 – l923), a physicist, discovered X rays in l895. Henri André **Becquere**l (1852 – 1908) discovered natural radioactivity in 1896; Marie (1867 – 1934) and Pierre **Curie** (1859 – 1906) discovered polonium and radium in 1898. Albert **Einstein** (1879 – 1955) articulated his special (1905) and general theory of relativity (1916), Ernest **Rutheford** (1871 – 1937) realized the first artificial nuclear reaction in 1919 and thus anticipated the beginning of the atomic age.

In l900 Ludwik **Fraenkel** found that the yellow body (corpus luteum) is an indispensable condition for the nidation of the ovum; adrenaline was isolated in 1901 and secretine in 1902. In 1906 Henry **Halle** found that the extract produced in the rear lobe of the pituitary gland stimulated uterine contractions and thus discovered forceps in an injection. Adrenalin and pituitrin were soon adopted as a means of stopping bleeding during caesarean sections. In 1914 thyroxin was isolated. This triggered off a further boom of gynaecologic endocrinology.

After the EKG was invented by Willem **Einthoven** (1860 – 1927) in 1903, it was soon applied to monitor for the heart activity of a foetus; Max **Cramer** was the first obstetrician to do so in 1906. Kazimierz **Funk** (1884 – 1967) studied the beriberi disease and introduced the term vitamins in l913.

In 1915 – 1917 Frederick **Twort** (1877 – 1950) and Felix **D´Hérelle** (1873 – 1949) discovered the existence of bacteriophage.

Frederick **Banting** (1891 – 1941) and Charles Best (1899 – 1978) isolated neat insulin in 1921. In l928 Bernard **Zondek** and Selmar **Aschheim** induced oestrum in a young mouse by an implantation of the pituitary gland, which enabled discovering the function of gonadotropin and further development of gynaecologic endocrinology. The endocrinology advanced another step forward when Hans **Selye** (1907 – 1982) articulated his stress theory in 1936. The invention of the EEG meant the discovery of another area where electronic devices might be applied. Ernst **Ruska** (1906 – 1988) devised the first electron microscope in 1931. In 1937 Hans Adolf **Krebs** (1900 – 1981**)** discovered the cycle of dicarbon and tricarbon acids and thus established the fundamental facts concerning tissue metabolism and breathing. In 1935 Ulf Svante **Eule**r (1905 – 1983), who was yet to discover noradrenalin, published his first works on the effects of prostaglandins on the motility of the uterus.

World War II "enriched" human knowledge with experiments on humans performed in concentration camps. The siege of Leningrad in 1941 and 1942 and the blockade of Rotterdam from 1944 to May 1945 demonstrated the effects of famine on pregnancy and childbirth. The bombing of Hiroshima and Nagasaki showed the effects of the atomic bomb upon human health.

Alexander **Fleming** (l88l – l955) is noted for the revolutionary discovery of the penicillin (l928 – l945), the industrial production of which was launched during the war and which was first applied in Europe in 1945. This discovery made way for dozens of other effective antibiotics. It sparked off a revolution in the field of obstetrics as it enabled effective treatment of post-delivery infections and venereal diseases; it also altered the indications of the caesarean section and triggered off the worldwide population boom. However, this discovery has since the very beginning been accompanied by the issue of the resistance of microbes to the antibiotics.

After 1945 the issues connected to the Rh factor and immunization with anti D gamma globulin were successfully solved by the insertion of exchange transfusion and transfusion in utero. The Montevideo School greatly contributed to the development of pathological physiology in the 1950s. Roberto **Caldeyro Barcia** (1921 – 1996) conducted exact clinical and physiological measurements of the contractions of uterine muscles. He discovered the ascending and descending gradient and different levels of incoordination of uterine functionality; he also studied the pressure on the aorta and vena cava as well as the relations between the mother and foetus during the delivery. The birth of European obstetrics was much facilitated by Erich **Sahling** (* 1925). Paediatricians' contribution to decreasing the mortality and disease rates of the foetus were on the increase and soon played a key role.

Obstetrics began making full use of objective ultrasound methods ranging from the initial examination of the foetus (amnioscopy), via permanent monitoring of the heart activity, examinations of the acidobasic balance as far as pulse oxymetry and many more. In 1961 Egon **Diczfalusy** shed light upon the metabolism of the steroids within the foetus-placenta unit. In 1971 S. M. M. **Karim** provided for the basic information about the use of prostaglandins for obstetric purposes. In 1950 T. **Malström** introduced his vacuum suction device, which immediately became a part of the obstetric instrumentation; the forceps is however still used. The treatment of the failure of the cervix has since 1955 used the method of a strangulating loop (cerclage). The progress of haematology led to a significant redefinition of the therapy of hazardous bleeding during and after delivery caused by a lack of the fibrinogen. Blood transfusion became a widespread and safe method; however, the risk of transmission of viral diseases by transfusion could not be wholly eliminated.

Fighting pain during delivery was first taken into consideration in the 19th century when women in labour would be given chloroform, morphine, laughing gas (N_2O) or Trilen, but as the development was unstoppable, new methods were discovered later such as psychosomatic conditioning, hypnosis, lytic mixtures (Dolsin, Chlorpromazin, Dihydroergotoxin, Prometazin) and many more; the most effective method is the application of epidural analgesia.

In 1960 Nobert **Wiener** (l894 – l964) published his work on cybernetics; the same year saw the discovery of the transistor and supra-conductivity, which resulted in a further deluge of electronics and computation technologies into medical practice. The use of ultrasound methods that began in 1958 was a true revolution in obstetrics. It meant that previous methods of diagnosing the placenta

praevia, i.e. radioscopy, isotopy and thermography could be replaced by a safer and more effective method. The ultrasound monitoring enabled studying ontogenetic evolution, growth dynamics, anthropometry as well as diagnostics of certain innate defects – for instance Down's syndrome. This method also increased the safety of certain invasive methods such as the examination of the amniotic fluid (amniocenthesis). Doppler's methods enabled registering the flow of blood in arteries, both its direction and velocity. In 1982 several methods were replaced with the nuclear magnetic resonance imaging, discovered by **P. Ch. Lauterbure**. This only highlighted the key role of medical engineering.

Postnatal paediatric care also made enormous progress through elaborated infusion nutrition, better ventilation technologies, use of efficient antibiotics, solution of the postnatal reconstruction of blood circulation etc. Not only was the progress of the care for extremely premature infants with low weights beneficial to these children, but also to those with higher weights who were born premature. Medical science gradually managed to find solutions to the issues of insufficiently formed lungs, prenatal application of corticoids, more considerate methods of artificial breathing, measures to close the ductus arteriosus, functionality of premature and insufficiently formed intestines and skin complications.

Paradoxically, this boom resulted in the origination of defects caused by physicians. For instance, in 1961 there was a shocking tragedy caused by the application of Contergan, an excellent analgetic, which having been used to treat pregnant women led to defects of the development of limbs of the foetus. This tragedy forced the pharmacological industry to adopt systemic measures to detect any potential teratogenic effects, which had never been done before. The fear of potential teratogenic effects in pregnancy frequently made doctors adopt the approach of sheer therapeutic nihilism. Or if premature children are treated with oxygen, they may develop retrolentar fibroplasy leading to blindness. Children of women who have undergone treatment of potential miscarriage with stilben encounter vaginal cancer more frequently. As a consequence of sterility treatment risky multiple pregnancy occurs much more often and requires the reduction of superfluous foetuses.

In 1950 the first organ transplants took place. The first organ to be transplanted was a kidney. The first heart was transplanted in 1967, and, simultaneously mothers with transplanted kidneys, livers, pancreases or hearts deliver their children, which means that specialized maternity wards have to take care of patients in extremely hazardous situations.

Social Factors

Obstetrics is constantly influenced by both positive and negative social factors: women's emancipation, overpopulation, climate, housing, working conditions, unemployment, single mothers, quality and quantity of food, recreational possibilities, physical activities, sport, ethnic issues, refugees, traumas, insufficient education and lack of health care awareness, disregard for personal hygiene, avoiding prenatal care etc. The population has developed other addictions besides alcoholism and addiction on tobacco, such as addiction on heroin, amphetamines etc., which may exert a negative impact upon the evolution of the foetus and result in the occurrence of withdrawal syndromes in the infants. Defects in the growth of the foetus, premature births, malformations and higher frequency of premature separation of the placenta have been observed in cocaine addicts. Another issue of the post-modern world sui generis lies in the wiseacre rigid adherents of various fundamentalist alternatives, natural, as they say,

methods excluding the assistance of a qualified physician, which represents a sheer hazard.

Although colonialism has ended, the Third World still suffers from famine and endemic diseases as well as physical and mental impoverishment. In these countries obstetrics is performed in utterly primitive conditions: lack of water, electricity, lack of qualified personnel and insufficient technical equipment. Although preventive vaccination has succeeded in eliminating smallpox, underdeveloped countries still have to face other diseases such as malaria, and AIDS, which can moreover be transmitted to the foetus. On the other hand, developed countries face increasing obesity, diabetes, and strenuous and physically demanding work has been limited to a minimum, so people go and work out in gyms, where they exercise on machines requiring maximum muscular load. The rich countries are experiencing a steep drop of the natality rate, a decrease in the quantities of sperm and general increase of stress. We are facing global pollution of the environment with heavy metals and chemicals. Globalization accelerates all kinds of contacts, including hazardous ones. Europe will soon have to tackle the danger of the spread of tropical diseases, adenoviruses for instance, which have not occurred on the continent before. Free media facilitate not only progress, but also the circulation of antihuman ideologies and pseudo-scientific methods. We are experiencing the lethal consequences of militarism, religious fundamentalism, nationalism, warfare and genocide.

Genetic Revolution

In 1953 James D. **Watson** and Francis H. C. **Crick** presented the structural model of the DNA double screw. This momentous discovery was soon followed by the discovery of the triplet genetic code, mitochondrial DNA. The "Human Genome" project focusing on decoding the complete human genome has been going on since 1988. Genetic engineering and cloning requires vast capacities and funds. Genetics is gradually becoming the key part of medical prevention. On 25 July 1978 L. **Brown** delivered the first baby born thanks to the method of assisted reproduction, which has since then developed into a widely used practical method. Experiments on amphibians and mammals prove that reproduction is possible through cloning.

Detail of Studies of the Foetus in the Womb, Leonardo da Vinci (1510–1512)

Dissection according to Vesalius by Howarth

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A painting by Dürer, where we can see midwives