МИНИСТЕРСТВО ЗДРАВООХРАНЕНИЯ РЕСПУБЛИКИ БЕЛАРУСЬ
БЕЛОРУССКИЙ ГОСУДАРСТВЕННЫЙ МЕДИЦИНСКИЙ УНИВЕРСИТЕТ
КАФЕДРА ОБЩЕСТВЕННОГО ЗДОРОВЬЯ И ЗДРАВООХРАНЕНИЯ

ИСТОРИЯ МЕДИЦИНЫ
HISTORY OF MEDICINE

Рекомендовано Учебно-методическим объединением по высшему медицинскому, фармацевтическому образованию в качестве учебно-методического пособия для студентов учреждений высшего образования, обучающихся на английском языке по специальностям 1-79 01 01 «Лечебное дело», 1-79 01 07 «Стоматология»

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Рассматривается история медицины от первобытного общества до наших дней. Общая характеристика эпох дополнена описанием вклада отдельных ученых в развитие медицины. Содержатся иллюстрации и таблицы. Материалы могут использоваться как для индивидуальной работы, так и для работы на семинарских занятиях по истории медицины.

Предназначено для студентов медицинского факультета иностранных учащихся, обучающихся на английском языке по специальностям 1-79 01 01 «Лечебное дело», 1-79 01 07 «Стоматология».

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PERIODIZATION OF THE HISTORY OF MEDICINE

– **Prehistoric medicine** (medicine of primitive society) (2 million years ago-IV century BC)
– **Medicine of the Ancient World** (IV century BC-476)
– (476–fall of the Roman Empire)
– **Medieval (Middle Age) medicine** (476–1640)
– (1640–english revolution)
– **Early Modern Medicine** (1640–1917 (18))
– (1917–First World War)
– **Modern medicine** (from 1917 (18) — till present moment)

PREHISTORY

Prehistory is the time before written records!

Background Information Prehistoric man lived in nomadic lives:

– They were hunter-gathers, they didn't grow crops.
– They left no written records, historians rely on archaeological evidence which may be hard to interpret.
– One way round the problem of evidence for prehistoric medicine is to study people who, until very recently, lived in a similar way to prehistoric man. For example, Australian aborigines and Plain Indians.

What did prehistoric people die from?

Warfare
Pregnancy and childbirth
Infection
Famine and food shortages

Using aboriginal cultures to find out about prehistoric medicine

Attitudes and practices of modern aborigines are used in guessing what ancient people did.

Some modern aboriginal medicine combines basic practical methods like setting broken bones and bandaging with spiritual explanations of illness and cure.

Witch doctors, shamans and medicine men are credited with the ability to cure and inflict illness.

Warding off evil is practiced as well as driving off the evil.

Rituals are often involved. Rituals involved herbs, potions and techniques of practical value — but seen as magic rather than medicine.

Natural Beliefs and Treatments

Trephining is the cutting of holes in people's heads. Skulls show that people survived the operation because the bone continued to grow afterwards. It may have been to allow evil spirits out or to grant special powers of communication with the spirit world.

There were two types of healers, Medicine Men and women. Medicine Men were important people in prehistoric tribes, as they could deal with spirits. Women were in charge of everyday health and knew about the healing power of herbs. For every day ailments and injuries with an obvious cause, they had a range of simple, effective remedies based on observation and common sense.

Supernatural Beliefs and Treatments

Prehistoric people thought that everyone own their own spirit and these explained why you became ill.

You may feel ill if your spirit had been removed from your body or if an evil spirit had entered your body whilst you were sleeping.

Prehistoric man wore lucky charms to keep away evil spirits and to stay free from disease.

If you became ill, Medicine Men would try to find your stolen spirit by hunting for the pointing stick which removed your spirit. When they found it, they would throw it into water to set the spirit free.

MEDICINE OF THE ANCIENT WORLD

General features of Ancient World countries:

– Inventing writing, first medical documents.

– Two branches of medical practice are formed: empirical medicine based on practical experience and religious medicine based on religious beliefs.

– Concepts of the origin of illnesses are developed (connected with natural phenomena, ethics, religion).

– Training medicine-men in family schools, church schools.

– Ancient sanitation facilities appear, people develop hygienic habits and traditions.

– Medical practice acquires class approach.

– Basic medical ethics is formed.

– Different civilizations influence on each other in medicine.

ANCIENT CHINA

Ancient Writings on Medicine:

– The Yellow Emperor's Canon of Interior Medicine;

– Shen Nong's Canon of Herbs;

– Compendium of Materia Medica, which are all comprehensive and profound works;

– There are also wide-spread stories praising the experienced and notable doctors in ancient China like Hua Tuo in the Three Kingdoms Periods (220–280).

The basic principles are rather distinctive:

Relative Properties -Yin and Yang

The Physiology of Chinese medicine holds that the human body's life is the result of the balance of yin and yang:

– **Yin** is the inner and negative principles;
– **Yang**, outer and positive.

The key reason why **there is sickness** is because the two aspects lose their harmony. Seen from the recovery mechanism of organs, yang functions to protect from outer harm, and yin is the inner base to store and provide energy for its counterpart.

Doctors of traditional Chinese medicine **believe that vital energy - moving and energetic particles, state of blood, and body fluid are the essential substances that combine together to form the human body, and the basis for internal organs to process**. They are channeled along a network within the body.

On the physical side, vital energy serving to promote and warm belongs to the properties of **yang**, and blood and body fluid to moisten possesses the properties of **yin**.

Concept of the disease: balance of 5 natural elements

– Water (kidney and bladder),
– Wood (liver and gallbladder),
– Fire (heart and small intestine),
– Earth (stomach and spleen),
– Metal (lungs and large intestine)

Diagnosis

It is a wonder that traditional chinese medicine doctors could cure countless patients without any assisting apparatus but only using physical examination. The **four methods** of diagnosis consist of observation, auscultation and olfaction, interrogation, pulse taking and palpation.

Observation indicates that doctors directly watch the outward (physical) appearance to know a patient's condition. When the inner organs function in the wrong way, it will be reflected through skin pallor, tongue, the facial sensory organs and some excrement.

Auscultation and olfaction is a way for doctors to collect information through hearing the sound and smelling the odor. This is another reference for diagnosis.

Feeling the pulse means that doctors note the pulse condition of patients on the radial artery, and then establish the inner change of symptom. Doctors believe that when the organic function is normal, the pulse, frequency, and intensity of pulse will be relatively stable.

Interrogation suggests that doctors question the patient and his relatives, so as to know the symptoms, evolution of the disease and previous treatments.

Treatment

In traditional Chinese medical science, the drugs are also different from the West, because **doctors have discovered the medicinal effects of thousands of herbs over a long period of time**. There are distinctive methods of medicines preparation, associated with **acupuncture, moxibustión and massage**.

Acupuncture is the stimulation of specific acupuncture points along the skin of the body involving various methods such as penetration by thin needles or the application of heat, pressure…

Moxibustion is a traditional Chinese medicine therapy using **moxa** made from dried mugwort (Artemisia argyi).

Massage is the manipulation of superficial and deeper layers of muscle and connective tissue using various techniques to enhance function, aid in the healing process, decrease muscle reflex activity, promote relaxation and well-being, and applied as a recreational activity.

Prevention

– Personal hygiene,
– cleanliness of houseware,
– physical exercises,
– diet.

First Public health institution — Medical order.

ANCIENT INDIA

– Ancient Writings on Medicine Atharvaveda (a medical textbook explaining how to treat diseases);

– Ayurveda (traditional medicine system meaning the «complete knowledge for long life»);

– Charakasamhitā (Compendium of Charaka. 600 BC);

– Suśrutasamhitā (Compendium of Suśruta. 600 BC).

Disease concept

Irrational

Like the medicine of the Ancient Near East it is based on concepts of

– the exorcism of demons;
– magic;
– suggestion that diseases are caused by bad spirits, and you treat the disease by killing the spirits with poisons or spells.

Rational

By about 200 AD, Indian doctors, like Chinese doctors and Greek doctors, had abandoned the idea of bad spirits in favor of the idea of dosha or humors.

Charaka recognized three humors — bile, phlegm (snot), and wind.

By this time, Indian doctors also had learned more about how the human body worked: Charaka knew that blood vessels both brought food to various parts of the body and also carried wastes away.

Philosophical traditions: yoga.

Classification of Diseases

Most remarkable is Sushruta's scientific classification: His medical treatise consists of 184 chapters, 1,120 conditions are listed, including injuries and illnesses relating to ageing and mental illness.

The Sushruta Samhita described 125 surgical instruments, 300 surgical procedures and classified human surgery in 8 categories.

Diagnosis

– disease history;
– patient questioning;
– palpation and auscultation;
– examination of the body;
– examination of excrement.

Sanitary measures

– improvement of housing;
– the division of the city into quarters;
– the presence of sidewalks, water, sewage;
– the public baths;
– the designated areas for garbage collection.

Prevention

– Personal hygiene (early awakening, cleaning teeth, cleanliness of houseware, physical exercises, diet).

– Charaka recognized that prevention was the best cure for many diseases, and he recommended keeping all body humors in balance in order to stay healthy.

– Charaka also made the earliest Indian reference to smallpox. Indian doctors were the first to invent a way to inoculate people against smallpox.

Treatment

Different types of treatments applied:

– 760 herbal plants;
– Mineral substances;
– Animal-based preparations;
– Surgery.

Surgery was very developed:

– plastic surgery (skin flap from forehead or cheek);

– complicated eye surgery (could remove cataract);
– pre- and postoperative care;
– obstetric techniques (caeserian operation);
– laparotomy, amputation;
– many surgical instruments.

Ways to Get Knowledge of Medicine:

– observation;
– maceration (soaking the body in running water in order to remove skin layers and tissues);
– medical schools.

The Ayurvedic classics mention eight branches of medicine:

– internal medicine (kāyācikitsā),
– surgery including anatomy (śalyacikitsā),
– eye, ear, nose, and throat diseases (śālākyacikitsā),
– pediatrics (kaumārabh-tya),
– spirit medicine (bhūtavidyā),
– toxicology (and agada tantra),
– science of rejuvenation (rasāyana),
– aphrodisiacs, mainly for men (vājīkara-a).

Training of doctors

Apart from learning these, the student of Āyurveda was expected to know ten arts that were indispensable in the preparation and application of his medicines: distillation, operative skills, cooking, horticulture, metallurgy, sugar manufacture, pharmacy, analysis and separation of minerals, compounding of metals, and preparation of alkalis.

The teaching of various subjects was done during the instruction of relevant clinical subjects. For example, teaching of anatomy was a part of the teaching of surgery, embryology was a part of training in pediatrics and obstetrics, and the knowledge of physiology and pathology was interwoven in the teaching of all the clinical disciplines.

The normal length of the student's training appears to have been seven years.

Medical ethics

Ethical requirements for doctors: to dress modestly, to avoid alcohol, to be self-controlled, modest, attentive, to direct all the knowledge and attention to the patient, not to tell the patient about incurable disease, to keep medical secrecy.

MESOPOTAMIA

Sources of studying Mesopotamia:

– 660 medical tablets from the library of Asshurbanipal at Nineveh (668 BC) Assyria,

– 420 tablets from the library of a medical practitioner from Neo-Assyrian period,

– Law Code of Hammurabi (1700 BC). According to these laws, both the successful surgeon's compensation and the failed surgeon's liability were determined by the status of his patient.

Two distinct types of professional medical practitioners:

1. **Ashipu** — a sorcerer or the witch doctor. One of the most important roles of the ashipu was to diagnose the ailment. In the case of internal diseases or difficult cases the ashipu determined which god or demon was causing the illness.

2. **Asu** — a specialist in herbal remedies, and in texts he is frequently called «physician» because he dealt with empirical applications of medication.

Disease concepts:

– Rational — associated with the nature phenomena (weather, climate, bad water) and the way of life of people.

– Related to religious beliefs (punishment of gods, violation of rituals).

Classification of the diseases

The first attempts to classify the diseases: «Mesopotamian range of diseases» (typhoid disease (or diseases of the winds), diseases of nervous system, sexual diseases, from the bites of venomous snakes).

Diagnostics: physical examination of the patient (the mouth, nose, lips, position of the body).

Doctors tried to analyze the natural human fluids (blood, urine, woman milk).

Differentiation of the specialties: «Knife medicine» (surgery) and «Herbal medicine» (therapy).

Different **drugs**: oil, silver, garlic, onion, mustard etc.

Hygiene:

– improvement of housing,
– the division of the city into quarters,
– the presence of sidewalks,
– water,
– sewage.

Sanitary measures:

– burning things and deceased patients,
– isolation of patients,
– the closure of borders in case of epidemics.

ANCIENT IRAN MEDICINE

Sources of studying — «Avesta» — a collection of hymns and religious texts with notes on medicine.

Diagnostics: the appearance of the patient, the study of pulse, urine.

Specialization: eye doctors, dentists, doctors for venereological diseases, for mental illnesses.

Description of pathological conditions (traumatic shock) and diseases (smallpox, orchitis, hemorrhoids, etc.)

Drugs (salt, cinnabar, sulfur, honey wax, etc.). Pharmacy gardens in towns.

Surgery was well developed, there was a wide range of surgical instruments.

Preventive medicine: ancient Iranian doctors are among the first to take an interest in professional diseases of a blacksmith, stonemason, skin tanner, etc.

ANCIENT EGYPT

Ancient Egyptian Society

– The Egyptian civilisation was an agricultural one that spread in a narrow band along the River Nile. Every year the Nile floods fertilised the fields and the river provided water for irrigation.

– Successful agriculture provided spare food, so more people were doctors, priests and other professionals.

– More trade and communication — ships imported new herbs and plants, which were used as medicines.

– The Egyptians had writing — ideas could be recorded and communicated better than previously.

Sources of studying medicine of ancient Egypt

– Kahun papyrus: women's diseases (bleeding, menstrual disorders, displacement of the uterus, inflammation of the abdomen and breasts).

– Brugsch Papyrus: childhood diseases.

– Berlin papyrus: description of the heart, blood vessels, joint diseases.

– Smith Papyrus: surgical diseases (48 types of injuries and traumas, recommendations for their treatment and prognosis).

Natural Beliefs and Treatments

– The River Nile led some to suggest that, like the Nile and irrigation systems, the body was full of channels. They thought that you became ill if the channels of your body were blocked.

– They used purging, vomiting and blood-letting to unblock the channels when someone became unwell.

– These ideas weren't accepted by all and those who believed them did not abandon spiritual treatments.

– The Egyptians also knew diet was important — medical procedures included recommended foods.

– First described skin diseases (eczema, scabies, carbuncle).

Supernatural Beliefs and Treatments

The Egyptians believed that Gods could cure and cause disease. Priests kept books which contained accepted treatments and spells. The instructions were exact as to what should be done, what medicines given and what words should be used when talking to the patient.

Some drugs used, including opium, are used today. They were probably thought of as driving away evil.

Supernatural Beliefs — Mummification of Dead Bodies

Egyptians believed the body was needed in the afterlife. They preserved bodies through mummification. They prepared bodies for mummification by extracting soft organs such as the brain and the intestines, then drying what remained with salt. This gave the Egyptians some knowledge of anatomy. They believed that destroying someone's body meant that they wouldn't go to the afterlife, so experimental dissection was not allowed. This limited the amount of knowledge that could be gained. Egyptian papyrus has been found that outlines some simple surgical procedures (dressings, amputation, circumcision, castration). Carvings in temples have also been found which show a variety of surgical instruments.

Observation and Writings

– The Egyptians were the first to have doctors. Egyptian doctors actually looked after their patients.

– Diagnosis means the observation of a patient and the recognition of their symptoms.

– Egyptian writings survive that demonstrate that they included diagnosis in their medical rituals.

Ancient Egyptian Hygiene & Sanitation

– Cleanliness was valued (they bathed, shaved their heads and had toilets; they also changed their clothes regularly).

– Egyptian toilets have also been found. Sanitation (restrooms in the form of pit latrines, constructed aqueducts, pools).

– Sanitary laws (the burial of the dead, the strict inspection of beef meat before its intake).

– General health measures (early ambulation, gymnastics, sponging the body with cool water, etc.).

In the Egyptian climate this would have made life more comfortable, but hygiene also appears to have had a religious significance — priests washed more often than others.

What was new?	**What stayed the same?**
There were specialist doctors (surgeons and physicians internists)	People still had supernatural beliefs, they believed that Gods and spirits caused disease
Doctors looked for logical causes of disease and could identify some parts of the body	People still did not understand how the body worked
New herbs were used as medicines	People still did not understand what caused disease
Metal instruments were used for surgery	

ANCIENT GREECE

Background Information:

– They grew more than enough food and traded with many other Mediterranean countries.

– They used slaves which gave the Greeks time to educate themselves.

– Wartime wounds needed treatments and doctors learned about anatomy.

– Wealthier people could employ doctors.

– Improvements in the strength of materials helped to make better surgical instruments.

Natural Beliefs and Treatments

The Theory of the Four Humours: Aristotle suggested the body was made up of four humours — blood, phlegm, yellow bile and black bile. These were linked to the four seasons and the four elements. They need to be in balance for good health. Treatments developed from the theory aimed at bringing humours into balance. You could get rid of an excess humour by purging, vomiting or blood-letting.

Natural Beliefs and Treatments — Hippocrates

Hippocrates is acknowledged as the father of modern medicine. He was born on the island of Kos.

– He believed in natural causes of disease, and encouraged doctors to treat illness using natural methods.

– The Hippocratic Oath is a promise made by doctors to obey rules of behaviour in their professional lives Doctors still take the Hippocratic Oath today!

– The Hippocratic Corpus is a collection of medical books, some written by Hippocrates or his followers.

– Hippocrates also came up with the «clinical method of observation» which doctors still use today. This involves studying a patient's symptoms to diagnose their illness and then treating them.

Healthy Living

– The Ancient Greeks believed that to be healthy they needed to exercise.

– Hygiene was important, with emphasis placed on washing.

– Diet was also thought to be important. Many Ancient Greeks followed a diet that changed with the seasons — eating lots in winter, but drinking little — while in the summer drinking more and eating less.

Supernatural Beliefs and Treatments — the Greek God of Healing, Asclepios

Temples were called Asclepions and people went there to stay when they became ill. Visitors bathed and relaxed, prayed to Asclepios and slept in a building called an abaton. An abaton was a building with a roof but no walls. Whilst sleeping a god came to them in a dream and cured them. Priests also did «ward rounds», performing rituals which involved placing snakes on the patients. Success stories were recorded in inscriptions on the walls of the Asclepions.

Asclepios' daughters, Hygeia and Panacea, were also involved in healing.

Alexandria and Dissection

– The library of Alexandria attempted to collect all the knowledge of the world.

– Unlike the rest of Ancient Greece human dissection was allowed in Alexandria.

– Alexandria became famous for training medics and surgeons. Accurate observation was the key to much of the advancement made there. Doctors from Alexandria went to practise all over the world.

– Erasistratus identified the differences between arteries, veins and nerves and saw that nerves were not hollow and so couldn't be vessels for fluid.

Surgery

The mechanics of surgery advanced slightly in Ancient Greece, although it was still a risky procedure. Ancient Greeks used surgery as a last resort — most treatments were performed outside the body. Surgeons developed good techniques for setting broken bones and in extreme cases would amputate. A range of surgical instruments were developed, made from iron, steel and brass.

ANCIENT ROME

Connections in Greek and Roman Medicine

– Greek doctors were unpopular because they were foreign and some were jealous of their skills.

– The main medical books in Rome were written by Hippocrates and his followers who were all Greek.

– The Romans took over universities and libraries in Alexandria, it was the centre of medical learning.

Background Information

– Romans were very wealthy.

– People of the Roman Empire were taxed.

– It was a slave owning society.

Sanitary measures

They noticed that bad smells, unclean drinking water, sewage, swamps and dirt made people become ill. They build aqueducts to carry clean water into cities. They also built public baths, toilets and sewers to remove waste.

Claudius Galen — He wrote 60 medical books!

Galen was a Greek physician. Like Hippocrates, he believed that illness was caused by imbalances of the four humours. Just as Hippocrates did, he told doctors to observe patients carefully and record symptoms.

He developed the idea of opposite humours for counter-balancing the body's humours.

Galen discovered that the brain, not the heart, controls the speech.

He found that the arteries, as well as veins, carry blood through the body.

He proved that animal's anatomy is different from humans.

HOWEVER… Galen made mistakes because he had to use only animals.

He said there were holes in the septum of the heart which would let blood pass from the right to the left side. Galen also believed that the blood was consumed rather than circulated.

Beliefs and Treatments

Romans were not as interested as the Greeks in developing theories about the causes of disease. Doctors recommended more exercise, changes in diet or prescribed herbal medicines as opposites. Doctors were too expensive for most people. The head of the family was expected to look after their household. They would use herbal remedies and common sense methods.

Surgery. The most common surgical treatment was bleeding. Internal operations were still rare because they were too risky. There were amputations; trephining was used to relieve pain in the head.

MEDICINE OF THE EARLY AND HIGH MIDDLE AGES (V–XV CENTURY)

Background Information:

– Wars destroyed the Roman public health systems and medical libraries.

– The rulers of the small kingdoms built up armies rather than improved medical skills or public health.

– War disrupted trade so countries became poorer.

– Travelling became more dangerous, reducing the communication between doctors.

– Training of doctors was abandoned. Copies of Galen's books were either lost, or hidden away for safety.

HOWEVER, LATER:

– The church set up universities where doctors could be trained.

– Armies took trained doctors to war with them where they gained experience as surgeons.

– Rules were developed to clean up towns.

– Merchants and scholars were once again travelling around Europe, sharing ideas.

Influence of the Christian Church

The Christian Church grew stronger in the Middle Ages. Monasteries controlled education, priests and monks were the only people who could read. The Church opened medical schools where the ideas of Galen were taught. The only libraries were in monasteries, church sometimes banned books they did not want people to read. Monasteries made an effort to provide clean running water and toilets.

Medieval Hospitals

Medical care for the poor came from hospitals set up by monasteries, and run by monks and nuns. They provided «hospitality» for visitors. Seriously ill people were often turned away due to fear of disease spreading.

The Return of Hippocrates and Galen

Galen's ideas were rediscovered. Church leaders looked carefully at Galen's works and decided that they fitted in with Christian ideas because he referred to «the creator» in his works.

Doctors believed Galen's ideas were correct and it was nearly impossible to improve his work.

Medical schools began to appear in Western Europe, starting with the one in Salerno, Italy. Translations of Galen's and Hippocrates' work were accepted as absolute truth in medical schools.

Arab Medicine — Islamic scholars picked up and developed ideas from the Greeks whom they greatly admired.

– Aristotle's four humours, Galen's treatment by opposites and Hippocrates' clinical observation lived on.

– Books were written that brought together the ideas of Aristotle, Galen and Hippocrates. These books were important means by which these ideas got back to Western Europe.

– The attitude of Muslims towards the Koran meant that they were unwilling to criticise the works of Galen.

The Four Humours Theory

Medieval doctors believed illness was caused by an imbalance of the four humours. The theory developed into a more complex system, based on the position of the stars. Although human dissection was carried out in medical schools, findings were interpreted as the theory of the four humours — although some later doctors began to challenge traditional understandings.

New Developments in Medieval Medicine

– More schools sprang up and human dissection was allowed. There were some doubts about classical texts.

– New techniques included diagnosis by urine sample. This is a good aid to diagnosis, which is done today!

– Doctors also believed the stars caused disease and relied on astrology when deciding on treatments.

– Trained doctors were very expensive. Medicine was provided by monasteries and housewife-physicians, using traditional cures and their experience.

Supernatural Beliefs and Treatments

– The church believed that illness was a punishment for sins — they prayed to god if they became ill.

– Some believed that pilgrimages to holy shrines could cure illness.

– Doctors had superstitious beliefs, saying magical words when treating patients and consulting stars.

Developments in Surgery

In the Middle Ages, there was great demand for surgery because of warfare. Surgery was held in such low regard that many procedures were often left to untrained barber-surgeons. Wine was first used as an antiseptic. Surgical treatments were still simple, as major surgery was risky.

Public Health Measures

– Towns lacked the public health schemes of the Romans.

– People relied on cesspits and wells. Waste was frequently disposed of into the street.

– People found it healthier to drink beer, than to drink water.

The Black Death: A Bubonic and Pneumonic plague epidemic

When: 1330–1350s and continuing sporadically for hundreds of years.

Where: Began somewhere in Asia and spread to Western Europe.

What did people think caused the plague and how did they treat it?

– **Miasma** — carried sweet smelling herbs, sat between two large fires.

– **God** — tried to appease god by praying, or becoming flagellants (whipping themselves as a punishment).

– **Humours out of balance** — use of opposites, purging, vomiting and bloodletting.

– **Poisoned water** — blamed the Jews.

Quick Summary of Medieval Medicine.

– Doctors followed the ideas of Galen. They believed illness was caused by an imbalance in humours.

– Believed that God and the Devil influenced health. Disease was seen as God's punishment for sins.

– Astrology became important. Doctors studied star charts because they believed that the movement of the planets affected people's health.

MEDICINE IN THE MIDDLE AGES

In the second century, Origen wrote, «For those who are adorned with religion use physicians as servants of God, knowing that He himself gave medical knowledge to men, just as He himself assigned both ***herbs*** and other things to grow on the earth».

The practice of medicine in the Middle Ages was rooted in the ***Greek tradition***. Hippocrates, considered the «father of Medicine», described the body as made up of four humors — yellow bile, phlegm, black bile, and blood — and controlled by the four elements — fire, water, earth, and air. The body could be purged of excess by bleeding, cupping, and leeching — medical practices that continued throughout the Middle Ages.

In 65 A.D., **Dioscorides**, a Greek, wrote his *Materia Medica*. This was a practical text dealing with the medicinal use of more than 600 plants. In the second century, Galen synthesized much of what has been attributed to Hippocrates. To further his understanding of bodily functions, he performed animal and even human dissections and was able to demonstrate that the arteries carried blood rather than air. Galenic theories had great longevity, prevailing in western Europe until the sixteenth century.

The Arabs were the great translators and synthesizers of medical texts. Many Greek texts were translated first into Arabic and then into Hebrew. Consequently, Arabs and Jews were renowned for the practice of medicine, and Arabic and Jewish doctors were often employed by kings (for example, James II of Aragon [died 1327]).

One cannot overestimate the importance of medicinal plants in the Middle Ages. Although the original text of Dioscorides is lost, there are many surviving copies. His texts formed the basis of much of the herbal medicine practiced until 1500. Some plants were used for specific disorders, while others were credited with curing multiple diseases. In many cases, draughts were made up of many different herbs. No monastic garden would have been complete without medicinal plants, and it was to monasteries that the sick went to obtain such herbs. Additionally, people might have gone to the local witch or to the apothecary for healing potions.

By the twelfth century, there were **medical schools** throughout Europe. The most famous was the school of Salerno in southern Italy, reputedly founded by a Christian, an Arab, and a Jew. A health spa as early as the second century, Salerno was surprisingly free of clerical control, even though it was very close to the famous and very powerful monastery of Monte Cassino. The medical faculty at Salerno permitted **women to study there**.

The medical school at **Montpellier** traces its roots back to the tenth century, though the university was not founded until 1289. Count Guilhem VIII of Montpellier (1157–1202) permitted anyone who had a medical license to teach there, regardless of religion or background. By 1340, the university at Montpellier included a ***school of anatomy***.

The University of **Padua** was founded in 1222 as a school of law and was one of the most prominent universities in early modern Europe. The University began **teaching medicine** in 1222. It played a leading role in the identification and treatment of diseases and ailments, specializing in autopsies and the inner functions of the body.

In 1140, Roger of Sicily forbade anyone from practicing medicine without a **license**, indicating that doctors were clearly under some form of regulation. In the late Middle Ages, apothecary shops opened in important towns. Interestingly, these shops also sold artists' paints and supplies, and apothecaries and artists shared a guild — the Guild of Saint Luke.

Physicians were trained in the art of diagnosis — often shown in manuscripts holding a urine flask up for inspection, or feeling a pulse. In fact, in the sixth century, Cassiodorus wrote that «for a skilled physician the pulsing of the veins reveals [to his fingers] the patient's ailment just as the appearance of urine indicates it to his eyes». **Observation, palpation, feeling the pulse, and urine examination would be the tools of the doctor throughout the Middle Ages**.

Surgery such as amputations, cauterization, removal of cataracts, dental extractions, and even trepanning (perforating the skull to relieve pressure on the brain) were practiced. **Surgeons would have relied on opiates for anesthesia and doused wounds with wine as a form of antiseptic.**

Many people would have sought out the **local healer** for care, or might have gone to the barber to be bled or even leeched. Midwives took care of ***childbirth*** and childhood ailments. For the sick and dying, there were hospitals. Although many large ***monasteries*** did have hospitals attached to them—for example, Saint Bartholemew's in London and the Hotel Dieu in Paris—and all would have had at least a small infirmary where sick and dying monks could be cared for, it is unclear just how much time the monks dedicated to care of the sick. The ***medicus*** in a monastery would have devoted himself to prayer, the laying on of hands, exorcizing of demons, and of course the dispensing of herbal medicine. The hospital of Santa Maria della Scala in Siena was initially administered by the canons of the cathedral. It was renowned for its efficient administration and, supported by wealthy patrons, was richly endowed with works of art. Many communities had hospitals to care for the sick that were independent of monasteries.

Some of the most notorious illnesses of the Middle Ages were the **plague** (the Black Death), **leprosy**, and **Saint Anthony's fire**. From 1346, the plague ravaged Europe, and rich and poor alike succumbed with terrifying speed. Pneumonic plague attacked the lungs and bubonic plague produced the characteristic buboes; there was no cure for either form. The only hope for those who escaped the dread disease was prayer or pilgrimage. While **leprosy** was very disfiguring and therefore sufferers were feared and kept apart, in fact, leprosy has a very slow incubation period and may not have been as contagious as it was believed. Lepers were obliged to live outside a town or village and to carry a bell to warn people of their approach. Many ***medieval parish churches*** in England have leper «squints» that allowed a leper to see the Mass and even receive the sacrament without coming into contact with other parishioners.

Sufferers from **St. Anthony's fire** were afflicted with burning extremities. As the disease, caused by the ingestion of tainted rye, progressed, the bright red extremities — hands, feet and whole limbs — could become gangrenous and fall off. There were many Antonine hospitals to which patients flocked. These hospitals, dedicated to Saint Anthony Abbot, gave patients a mixture called Saint Vinage and cooling herbs such as verbena and sage were applied to soothe the burning heat. Amputations of the affected limbs were also performed.

Many people died of much less dramatic diseases. Women often died in childbirth or succumbed to postpartum infections. Children frequently did not live into adulthood. Laborers must have had multiple problems, such as accidents, osteoarthritis, and fractures. Kidney disease, dental problems, hemorrhoids, and heart disease would have been common. Battle-related injuries were frequent and often fatal.

The most important exemplar for any healer was Jesus himself. The Gospels recount that Jesus healed the blind, caused the paralyzed to walk, cast out devils from the possessed, healed a woman with an issue of blood, and even raised the dead. The healing touch was appropriated by English and French kings, and many miraculous cures were attributed to the royal laying-on of hands. In England, for example, the King's Touch was believed to heal scrofula, a form of tuberculosis. Prayers to Christ, the Virgin, and saints were always considered the most efficacious form of help. Saint Margaret was invoked for help in childbirth; Saint Fiacre for relief from hemorrhoids. Pilgrimage to a shrine might also lead to miraculous healing. Often these sites and the relics they displayed were related to specific diseases and to specific saints.

Objects associated with the shrine of Saint Thomas Becket attest to the importance of Canterbury as a pilgrimage site where many sick people received miraculous cures. Becket was described as «the best physician of virtuous sick people» and the thirteenth-century windows at Canterbury provide a vivid record of miraculous cures of blindness, leprosy, drowning, madness, and the plague. At Canterbury, the saint's blood was believed to be particularly beneficial — ampullae containing blood mixed with water were distributed at the shrine. Canterbury seems to have been a particularly important pilgrimage destination for people suffering from bleeding disorders — perhaps because of the blood shed by Thomas at his martyrdom.

Pilgrims arriving at their destination would be able to touch the relics and even carry home with them secondary relics — perhaps a piece of cloth that had been applied to a reliquary, or an ampulla of liquid that had been poured over a tomb. These secondary relics could then be used to heal those who were too ill to make the journey. Ultimately, **the power of faith was potent medicine for the sick in the Middle Ages.**

Inscribed in Greek: If anyone shall dare to bury another person along with this one, he shall pay to the treasury three times two thousand [whatever the unit was]. This is what he shall pay to [the city of] Portus, but he himself will endure the eternal punishment of the violator of graves (fig. 1).

Fig. 1. Sarcophagus with a Greek physician. Date: early 300s. Culture: Roman; Ostia, Italy

Pilgrim flasks (ampullae) bearing the image of Saint Menas flanked by two camels (fig. 2) are associated with the pilgrimage center that developed around the tomb of the Egyptian soldier who was martyred during the reign of the emperor Diocletian (r. 284–305). Pilgrim flasks were an important souvenir from a shrine. They could be filled with oil or water that had been poured over the shrine or reliquary. This liquid could then be poured over a sick person or broken limb in order to effect miraculous cures at home.

Scenes from the legend of Saint Margaret of Antioch are tooled into this case for a reliquary in the form of a foot (fig. 3).

Fig. 2. Pilgrim flask with Saint Menas. Date: 610–50. Culture: Byzantine. Medium: Earthenware

Fig. 3. Shoe Reliquary. Date: ca. 1350–1400. Culture: French or Swiss. Medium: Leather and Iron. Dimensions: H: 5 1/4" W: 13.3 x 28.6 x 11.7cm

According to her legend, Saint Margaret was swallowed by a dragon, but, fortunately, she was carrying a cross that caused the dragon's belly to split open and the saint to be freed. Saint Margaret was one of the fourteen Holy Helpers and patroness of childbirth, invoked by women for protection during delivery.

A short ladder surmounted by a cross was the emblem of the hospital of Santa Maria della Scala in Siena, where it stood in front of the steps (scala) of the city's cathedral. The hospital also had a branch in Florence, and this work could have served as a drug container in the pharmacy of either location (fig. 4, 5).

Fig. 4. Pharmacy Jar with the Arms of the Hospital of Santa Maria della Scala. Date: 1425–50. Geography: Made in probably Siena, Tuscany, Italy. Medium: Tinglazed earthenware. Dimensions: Overall: 32 x x 23.3 x 16.5 cm

Fig. 5. Pharmacy Jar. Date: 1515. Geography:Italian (Siena). Medium:Tin–glazed earthenware (majolica). Dimensions: H. 25.4 cm

ISLAMIC GOLDEN AGE

The Islamic Golden Age, spanning the 8th to the 15th Centuries, saw many great advances in science, as Islamic scholars gathered knowledge from across the known world and added their own findings.

One of these important fields was Islamic medicine, which saw medical practice begin to resemble our modern systems. Certainly, this period of the history of medicine was centuries ahead of Europe, still embedded in the Dark Ages.

Central to Islamic medicine was belief in the Qur'an and Hadiths, which stated that Muslims had a duty to care for the sick and this was often referred to as «Medicine of the Prophet». According to the sayings of the Prophet Muhammed, he believed that Allah had sent a cure for every ailment and that it was the duty of Muslims to take care of the body and spirit. This certainly falls under the remit of improving the quality of healthcare and ensuring that there is access for all, with many of the Hadiths laying down guidelines for a holistic approach to health.

Initially, in the early days of Islam, there was some debate about whether Islamic physicians should use Greek, Chinese and Indian medical techniques, seen by many as pagan. After intense debate, the Islamic physicians were given free rein to study and adopt any techniques they wished.

Islamic Medicine, Hospitals and Qualifications

The major contribution of the Islamic Age to the history of medicine was the establishment of hospitals, paid for by the charitable donations known as Zakat tax. There is evidence that these hospitals were in existence by the 8th Century and they were soon widespread across the Islamic world, with accounts and inventories providing evidence of at least 30.

These **hospitals**, as well as providing care to the sick on site, sent physicians and midwives into the poorer, rural areas, and also provided a place for physicians and other staff to study and research. These hospitals varied in role, some aimed at serving the general population, with others providing specific services, such as the care of lepers, the disabled and the infirm.

The **system of educating** physicians was well structured, usually on a tutoring basis, and the reputation of the individual physicians in certain areas ensured that students would travel from city to city to learn with the best. In addition, the Islamic physicians were meticulous with their recordkeeping, partly as a way to spread and share knowledge, but also to provide notes for ***peer review*** in case the physician was accused of malpractice.

The Islamic Physicians and TheirDiscoveries

Many Islamic physicians made outstanding discoveries in all aspects of medicine during the Islamic Golden Age, building upon the knowledge of Galen and the Greek and adding their own discoveries. The most notable Islamic scholar in the history of medicine was **al-Razi** (fig. 6).

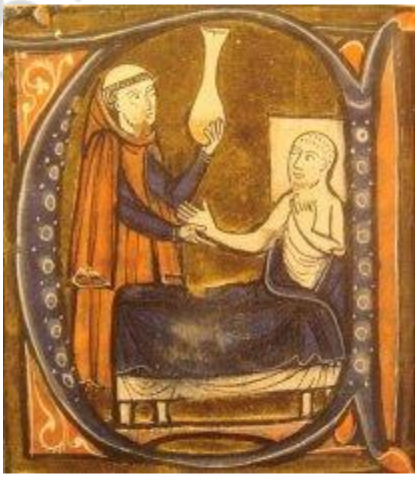

Fig. 6. Al Razi Receuil de traite de medecine translated by Gerard de Cremone Second half of 13th century (Public Domain)

The Father of Islamic Medicine — Al Razi (Rhazes)

Al-Razi, known to the Europeans as Rhazes (may be spelt Rhases, Rasis, Rasi or ar-Razi) (865–925), was at the forefront of Islamic research into medicine. A prolific writer, he produced over 200 books about medicine and philosophy (fig. 7), including an unfinished book of medicine that gathered most of the medical knowledge known to the Islamic world in one place. This book was translated into Latin and it became one of the backbones of the western history of medicine.

Rhazes was also famous for his work on refining the scientific method and promoting ***experimentation and observation***. His most famous achievement, when asked where to select a location to build a hospital in Baghdad, was to hang meat in locations around the city, and select the spot where the meat rotted the least. He assumed that the patients would be less likely to suffer from illness and putrefaction of the flesh in this location. He served as the director of this hospital for a large part of his career and performed most of his research that defined Islamic medicine.

Fig. 7. Reproduction in «Inventions et découvertes au Moyen-Âge», Samuel Sadaune (Public Domain). Source Gerardus Cremonensis «Recueil des traités de médecine» 1250–1260

Al Razi wrote extensively on the crucial relationship between doctor and patient, believing that they should develop a relationship built upon trust and, as the doctor had a duty to help the patient, the patient had the duty to follow the doctor's advice. Like Galen, he believed that a holistic approach to medicine was crucial, taking into account the background of the patient and also considering any ailments suffered by close family, as with modern medicine.

His other great achievement was in understanding the nature of illness, which had previously been described by the symptoms, but Rhazes made the great leap of looking for what was causing the symptoms. In the case of smallpox and measles, he blamed the blood and, as he could not have known anything about microbes, this was a logical statement.

Al Razi wrote extensively about human physiology and understood how the brain and nervous system operated muscles, and only the Islamic distaste for dissection prevented him from refining his studies in this area.

Abu Ali al-Hasan ibn al-Hasan ibn **al-Haytham**, also known by the Latinization Alhazen or Alhacen, was an Arab physicist, mathematician, and astronomer. Ibn al-Haytham made significant contributions to the principles of optics, astronomy, mathematics, meteorology, visual perception and the scientific method. Alhazen studied the process of sight, the structure of the eye, image formation in the eye, and the visual system.

Ibn Sina, the Great Polymath

The Islamic scholar **Ibn Sina** (980–1037), Avicenna, was a true polymath who excelled in many academic fields, including philosophy, theology, Islamic medicine and natural sciences. From a young age, he gained renown as a physician and teacher, writing many detailed treatises about medicine. His publication, **«The Canon»,** became a core text for physicians across the Islamic world and Europe, laying out a detailed guide for diagnosing and treating ailments.

Ibn-Sina believed that many diagnoses could be made by simply checking the pulse and the urine, and a large part of the Canon is given over to making diagnoses from the color, turbidity, and odor of urine. Of course, this also needed to be set alongside the Islamic holistic approach of looking at diet and background.

His other breakthroughs were some suggestions for **infant care** and, based upon his belief that bad water was responsible for many ailments, he included guidelines on how to check the purity of water.

Al Kindi — The Documenter of Islamic Medicine

Al-Kindi (800–870), another of the great Islamic polymaths, further contributed to the history of medicine. This scholar was heavily influenced by the work of Galen, and also made unique contributions of his own to the field. In his Aqrabadhin (Medical Formulary), he described many preparations drawn from plant, animal and mineral sources.

To the drugs known to physicians such as Hippocrates and Galen, he added knowledge drawn from India, Persia and Egypt. Like many Islamic works, the books contained information based upon medicinal herbs, aromatic compounds, such as musk, and inorganic medicines. It could, quite legitimately, be argued that the Islamic contribution to the history of medicine saw the first division between medicine and pharmacology as separate sciences.

Ibn Al Nafis and the Respiratory System

Ibn Al-Nafis (born 1213) goes down in the history of medicine as the first scholar to understand the **respiratory and circulatory system**, although his knowledge was incomplete (fig. 8). He understood that the **heart** was divided into two halves and stated that there were **no holes** connecting the two halves of the heart, as proposed by Galen. Al-Nafis stated that the blood could only travel from one side of the heart to the other by passing through the lungs.

This was the first example of a scholar divining the nature of the pulmonary system. Although he was unsure of the mechanism, Al Nafis **correctly observed that the blood in the lungs mixed with air**, although he also proposed that the blood was also infused with 'spirit' in the left cavity of the heart.

Fig. 8. The opening page of one of Ibn al-Nafis's medical works. This is probably a copy made in India during the 17th or 18th century (Public Domain)

His other observation was that the heart was nourished by the net of capillaries surrounding it, but not, as proposed by Avicenna, by the right ventricle of the heart. **He touched upon the subject of the role of capillaries in circulation, proposing that the pulmonary artery and vein were linked by microscopic pores**; it would not be until four centuries later that this theory was rediscovered and the idea of capillaries was extended to the rest of the body.

The pulse was well known to Islamic medicine, and to the Egyptians before them, but Al-Nafis was the first to **understand the mechanisms behind the pulse**. Galen proposed that the arteries pulsed naturally, and that the entire length of the artery contracted simultaneously, but Al Nafis believed that the pulsation was caused by the action of the heart pushing blood around the body. He correctly noted that the pulsation of the arteries lagged behind the action of the heart and that it did not occur simultaneously down the whole length.

However, Al Nafis believed that this motion of the blood was a means to disperse spirit, which would burn out the heart if it resided there for too long. He proposed that this spirit would become stagnant if left to rest in the arteries, and so the circulation was essential. Whilst his theories of the heart and pulmonary circulation were reliant upon this invisible spirit, there is little doubt that his proposals were a major step towards understanding how the body works. Sadly, much of his knowledge did not pass into western history.

Some of his other observations were based upon his observations in dissection, of which he was a great proponent, and he corrected many misconceptions in physiology concerning the brain, gall bladder, bone structure and the nervous system. Sadly, because very little of his work was translated into Latin, his work was unfortunately underutilized by western scientists and even Leonardo Da Vinci made incorrect observations based upon Galen and Avicenna, without realizing that Al Nafis had already addressed many of these issues.

His other great contribution to Islamic medicine was his pharmacological works, which drew remedies from all across the world but also introduced mathematics and the idea of dosages to administration of treatments.

Other Contributors to Islamic Medicine

Serapion, a Syriac Christian, wrote a detailed treatise about pharmacology in the 9th Century, which describes several diseases and lists the known remedies for them. Al Dinawari followed this with a book called «The Book of Plants», and this book, translated into Latin, influenced the western history of medicine.

There are many examples of medicines unknown to the Arabic regions passing into their medical books, and, in the 6th Century the Persian doctor, Burzoe, traveled to India and brought back many remedies, in addition to gathering information from the hired Indian physicians and healers working for the Caliphate. Many Sanskrit works translated into Arabic and Indian medicine certainly lay at the heart of Islamic medicine.

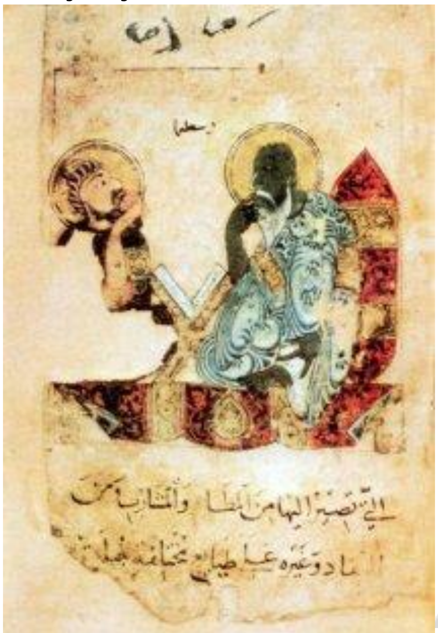

Fig. 9. Aristotle teaching, from document in the British Library, showing the great reverence of the Islamic scholars for their Greek predecessor (Public Domain)

Al Tabari (810–855), wrote a book known as «The Paradise of Wisdom», in 850, which was based largely upon the earlier works of Galen and Hippocrates, but it also included an appendix with translations from Indian sources. Like many physicians of the time, his work involved providing better and more detailed encyclopedias, containing the medical knowledge available at that time. Sadly, it is believed that most of his works are lost and are only referred to as quoted in later texts (fig. 9).

Al Tabari's work was made up of nine discourses, each divided into many chapters. These were:

– General pathology, symptoms of internal disorders and general therapeutic principles
– Diseases and conditions affecting the head
– Diseases of the eyes, nose, face and mouth
– Nervous diseases
– Diseases of the chest and throat
– Diseases of the stomach
– Diseases of the liver
– Diseases of the heart and lungs
– Diseases of the intestines, urinary tract and genitals

Al Hakm (Died 840) wrote the earliest known book in the medical sciences in the Islamic world and it drew heavily upon Greek sources, including information about physiology, surgery and general healthcare, amongst other sections.

Yuhanna Ibn Masawyh (777–857) was regarded as one of the great translators of work from Greek into Arabic, but he also acted as a physician to the Caliphs and served at a hospital. He is believed to have written the works «Disorders of the Eye» and «Knowledge of the Oculist Examinations» as well as Kita al Mushajjar al-Kabir, a short work including descriptions, diagnosis, symptoms and treatments of diseases.

Hunayan ibn Nishaq (808–873), known as Johannitus in the West, was one of the titans of Islamic medicine and was a prominent author of medical texts, covering a variety of disciplines. As well as extensive translation work, he wrote a book called «The Book of *Introduction to Medicine*», which drew heavily upon Galen but also included many unique and novel additions. His work was probably the first Islamic medical text translated into Latin.

Islamic Medicine and its Place in the History of Medicine

Whilst the Age of Islam was a time of intellectualism and scientific, social and philosophical advances, the greatest contribution to the world was Islamic medicine. The Islamic scholars gathered vast amounts of information, from around the known world, adding their own observations and developing techniques and procedures that would form the basis of modern medicine. In the history of medicine, Islamic medicine stands out as the period of greatest advance, certainly before the technology of the Twentieth Century.

Medieval medicine and healing practices in Europe

When the Roman Empire fell in the fifth century, Europe fell into what became known as the early medieval period or the dark ages. Much of the knowledge gained by earlier civilisations was lost leaving medieval medicine and healing practices in Europe largely reliant on superstition and speculation.

During this time, Europe was run by local lords who ruled over small fiefdoms. With such small estates, infrastructures were basic so universities and public health systems were rare. Although a corpus of knowledge did grow over the period, traveling was dangerous so any knowledge that was learned tended to spread at a very slow rate.

The vast amount of war and social unrest also contributed to the slow progress of medicine, as did the influence of the church which forbade human dissection, encouraged people to look to prayer for their healing and agreed blindly with much of what was said in the writings of Galen, a second century Roman doctor. That said, it was largely on the battlefield that butcher-surgeons learned their trade, it was the Church that first brought about hospitals to care for the sick and dying and Galen's teachings were exceptional for their time, though not always accurate.

By the later middle ages (which began around the middle of the eleventh century), kingdoms had grown and ruling elites had begun to regain a great deal of the luxuries and refined lifestyles that make up higher civilisation. Universities and schools began to appear and travel became a lot safer making the sharing of knowledge between territories easier, though still very limited.

Beliefs About Medicine and Healing in the Later Medieval Period

The Four Humours — One of the prevailing theories about disease in medieval medicine was that of *the four humours*. The idea was that the body had four bodily fluids:

– yellow bile,
– black bile,
– blood,
– phlegm,

and these were used to analyse the state of a person's health. The belief was that an imbalance in these bodily fluids was the cause of many health problems so treatment was often geared towards addressing this. This could be done in various ways: by inducing a patient's vomiting or bleeding; by applying leeches to the skin; neither of which had too much success.

Disease and Smell — Another belief that was prevalent was that disease was carried by smell, so avoiding anything with a bad smell such as rotting flesh was seen as prudent. To protect themselves in times of epidemics, medieval doctors often carried with them something with a nice smell such as posies, believing it would counteract the bad smell and prevent them from catching the disease themselves.

Astrology — Astrology and the stars also played a part in healing practices, for example during the first plague epidemic (1348–1350), the Pope's doctor Guy de Chauliac believed it to be caused by a conjunction of Saturn, Mars and Jupiter. (However he also correctly deduced that poor diet would make people more susceptible to disease).

Divine Intervention — Despite the appearance of a few universities in Europe, most of the learning that was happening was in the monasteries. The monks believed in the need for divine intervention for healing the sick as they tended to see it as a punishment from God or even demonic possession. During the middle ages, people were extremely superstitious and most would follow the authority of the Church without question so many relied solely on faith and prayer to cure themselves and their loved ones.

Hospitals — Hospitals began to appear in the monasteries to help the sick and dying. The earliest was in the monastery of St Gall, built in 820 and known to be able to hold six people and to have its own garden for growing herbal medicine. The idea grew over time and by the twelfth century, many larger hospitals were being built across Europe, mostly by Church institutions.

Medieval Doctors

While Europe had lost most medical knowledge that had been passed down by ancient civilisations, the Muslim world had managed to retain much of it and were far more advanced than their counterparts in the West. This benefited European doctors because ancient books were occasionally brought to the West, for example by scholars fleeing from Bagdad when it was destroyed by the Mongols. Throughout the later medieval period, the Crusades also helped as they brought Europeans into some contact with Muslim Doctors.

Because medieval doctors were so superstitious, it was often the case that sick people they treated got worse. The knowledge they retained from the ancient world was scant and what they did have they followed blindly. Very few schools dedicated solely to the study of medicine were set up in the period and only one, Padua University, made it mandatory that trainee doctors actually visited sick people. What's more, during a really bad epidemic such as the plague, doctors would often refuse to visit those with the disease for fear of catching it themselves. The fourteenth century poet Petrarch said in a letter to Pope Clement VI;

«I know that your bedside is besieged by doctors, and of course this fills me with fear. As Pliny said, in order to gain fame they buy it with our lives. They learn their art at our cost, and even our death brings them experience; only a doctor can kill without punishment. Remember what it says on the gravestones: "I died of too many doctors».

Local Wise Women

Most people could not afford to pay for a doctor so a viable alternative would be to go and see a local wise woman (or sometimes a man) who were skilled in the prescribing of herbal medicine. Knowledge would be handed down from one generation to the next in what herbs cured what illness and they would also act as midwives to their community.

Healing was often associated with magic and by the later part of the middle ages what was a dark time in women's history, local wise female healers were being associated with the devil and many were put to death for witchcraft.

A Medieval History of Surgery

The history of surgery in the middle ages is a surprisingly progressive one, thanks largely to experience gained by the butcher-surgeons on the battle field and due to natural and herbal medicines such as mandrake root, hemlock and opium, which were used as anaesthetics and wine which was used as an antiseptic. In the thirteenth century, Theodoric Lucca wrote;

«Every day we see new instruments and new methods [of removing arrows from wounded soldiers] being invented by clever and ingenious surgeons».

One man in particular stands out in the field of surgery in the medieval period, William of Saliceto, who lived in the thirteenth century and helped set up a school dedicated to surgery. He was one of the first to realise that pus on a wound was a bad thing, he recommended using a knife to perform surgery instead of the cautery and he was years ahead in his techniques, even managing to stitch together severed nerves.

A skilled medieval surgeon is known to have been able to perform operations on many external problems such as facial ulcers, removal of teeth and eye cataracts and also some internal ones such as the removal of bladder stones. However despite advancements, the history of surgery is still barbaric compared with modern standards and they lost a lot of patients due to infection as they did not realise that an unclean environment would cause problems.

Though they had a certain level of skill, butcher-surgeons were still bound by Christian belief. One common technique that was used by them to cure epilepsy was known as *trephining*, which involved removing a piece of the skull in order to allow a demon to escape through the hole it created. Muslim doctor *Usama ibn Munqidh wrote in around 1175;*

«They brought to me a knight with a sore on his leg; and a woman who was feeble-minded. To the knight I applied a small poultice; and the woman I put on diet to turn her humour wet.

Then a French doctor came and said, «This man knows nothing about treating them». He then said, «Bring me a sharp axe». Then the doctor laid the leg of the knight on a block of wood and told a man to cut off the leg with the axe, upon which the marrow flowed out and the patient died on the spot.

He then examined the woman and said, «There is a devil in her head». He therefore took a razor, made a deep cross-shaped cut on her head, peeled away the skin until the bone of the skull was exposed, and rubbed it with salt. The woman also died instantly».

RENAISSANCE MEDICINE (XVI–XVII CENTURIES)

Background to the Renaissance

– Renaissance means rebirth. It began with close study of classic texts and was critical of old translations.

– There was a greater interest in how the human body worked based on observation and dissection.

– Artists attended dissections of human corpses and did wonderful illustrations for medical books.

– Return of classical texts led to a renewed faith in the four humours theory and treatment by opposites.

Iatrochemistry

Iatrochemistry (fig. 10) was an early form of pharmacology, influenced by alchemy. Practiced in the 16th and 17th centuries, most famously by Paracelsus, it sought to address the balance of the bodily fluids which comprise the four humors. Paracelsus, in a stance viewed as heretical by his contemporaries, theorized that external sources could influence the body's humors and effect health. His contention was that while a given harmful substance may impact health negatively, degree of exposure played a significant role in determining how harmful its effects could be. Indeed, Paracelsus's experiments utilized herb- and plant-sourced medicines, but also included the use of arsenic.

Fig. 10. Iatrochemistry

Iatrophysics or iatromechanics

Iatrophysics or iatromechanics (fr. Greek) is the medical application of physics. It was a school of medicine in the seventeenth century which attempted to explain physiological phenomena in mechanical terms. It was related to iatrochemistry and was particularly associated with the work of Giovanni Borelli.

Leonardo da Vinci studied anatomy in the context of mechanics. He analyzed muscle forces as acting along lines connecting origins and insertions, and studied joint function. Da Vinci tended to mimic some animal features in his machines. For example, he studied the flight of birds to find means by which humans could fly; and because horses were the principal source of mechanical power at that time, he studied their muscular systems to design machines that would better benefit from the forces applied by this animal.

Galileo Galilei was interested in the strength of bones and suggested that bones are hollow because this affords maximum strength with minimum weight. He noted that animals' bone masses increased disproportionately to their size. Consequently, bones must also increase disproportionately in girth rather than mere size. This is because the bending strength of a tubular structure (such as a bone) is much more efficient relative to its weight. Mason suggests that this insight was one of the first grasps of the principles of biological optimization.

In the 16th century, ***Descartes*** suggested a philosophic system whereby all living systems, including the human body (but not the soul), are simply machines ruled by the same mechanical laws, an idea that did much to promote and sustain biomechanical study. ***Giovanni Alfonso Borelli*** embraced this idea and studied walking, running, jumping, the flight of birds, the swimming of fish, and even the piston action of the heart within a mechanical framework. He could determine the position of the human center of gravity, calculate and measured inspired and expired air volumes, and showed that inspiration is muscle-driven and expiration is due to tissue elasticity. Borelli was the first to understand that the levers of the musculoskeletal system magnify motion rather than force, so that muscles must produce much larger forces than those resisting the motion. Influenced by the work of Galileo, whom he personally knew, he had an intuitive understanding of static equilibrium in various joints of the human body well before Newton published the laws of motion.

LEONARDO DI SER PIERO DA VINCI

Leonardo di ser Piero da Vinci (15 April 1452–2 May 1519) (fig. 11) was an Italian polymath, painter, sculptor, architect, musician, mathematician, engineer, inventor, anatomist, geologist, cartographer, botanist, and writer. He is widely considered to be one of the greatest painters of all time and perhaps the most diversely talented person ever to have lived. His genius, perhaps more than that of any other figure, epitomized the Renaissance humanist ideal.

Fig. 11. Leonardo di ser Piero da Vinci

Leonardo's formal training in the anatomy of the human body began with his apprenticeship to Andrea del Verrocchio, who insisted that all his pupils learn anatomy. As an artist, he quickly became master of topographic anatomy, drawing many studies of muscles, tendons and other visible anatomical features.

As a successful artist, he was given permission to dissect human corpses at the Hospital of Santa Maria Nuova in Florence and later at hospitals in Milan and Rome. From 1510 to 1511 he collaborated in his studies with the doctor Marcantonio della Torre. Leonardo made over 240 detailed drawings and wrote about 13,000 words towards a treatise on anatomy.

These papers were left to his heir, Francesco Melzi, for publication, a task of overwhelming difficulty because of its scope and Leonardo's idiosyncratic writing. It was left incomplete at the time of Melzi's death more than fifty years later, with only a small amount of the material on anatomy included in Leonardo's Treatise on painting, published in France in 1632. During the time that Melzi was ordering the material into chapters for publication, they were examined by a number of anatomists and artists, including Vasari, Cellini and Albrecht Dürer who made a number of drawings from them.

Leonardo's anatomical drawings include many studies of the human skeleton and its parts, and studies of muscles and sinews (tendons). He studied the mechanical functions of the skeleton and the muscular forces that are applied to it in a manner that prefigured the modern science of biomechanics.

He drew the heart and vascular system, the sex organs and other internal organs, making one of the first scientific drawings of a fetus in utero. The drawings and notation are far ahead of their time, and if published, would undoubtedly have made a major contribution to medical science.

As an artist, Leonardo also closely observed and recorded the effects of age and of human emotion on the physiology, studying in particular the effects of rage. He also drew many figures who had significant facial deformities or signs of illness.

Leonardo has often been described as the archetype of the Renaissance Man, a man of «unquenchable curiosity» and «feverishly inventive imagination».

Leonardo’s vision of the world is essentially logical rather than mysterious, and that the empirical methods he employed were unusual for his time.

ANDREAS VESALIUS

The Flemish physician **Andreas Vesalius** (also Andreas Vesal, André Vesalio or Andre Vesale, 1514–1564) (fig. 12) is widely considered to be the founder of the modern science of anatomy. He was a major figure of the Scientific Revolution. Vesalius’s book «De Humani Commis Fabrica»» (On the Structure of the Human Body) is one of the most important works about human anatomy.

Fig. 12. Andreas Vesalius

Early Life and Education:

Born in Brussels, Belgium in a family of physicians and pharmacists, Andreas Vesalius’s father was court apothecary to Charles V of Spain, the Holy Roman Emperor. Vesalius learned medicine from the University of Louvain and the University of Paris. He later obtained his medical degree from the University of Padua in 1537. After his graduation, Vesalius became very interested in anatomy.

Contributions and Achievements:

During that time, scholars thought that the work of the ancient Greek physician Galen was an authority when it came to human anatomy. As Greek and Roman laws had disallowed the dissection of human beings, Galen had evidently reasoned out analogies related to human anatomy after studying pigs and apes. Vesalius knew that it was absolutely essential to analyze real corpses to study the human body.

Vesalius restored the use of human dissection, regardless of the strict ban by the Catholic Church. He soon began to realize that Galen's work was an evalution of the dissection of animals, not human beings. Vesalius once demonstrated that men and women have the same number of ribs, contrary to the biblical story of Adam and Eve which tells that Eve was brought into existence from one of Adam's ribs, and that men had one missing rib as compared to women. Vesalius proved that belief wrong.

Vesalius published his influential book about human anatomy «De Humani Commis Fabrica» (The Structure of The Human Body) in 1543. It contained over 200 anatomical illustrations. The work was the earliest known precise presentation of human anatomy. It disgraced several of Galen's doctrines, for instance the Greek belief that blood has the ability to flow between the ventricles of the heart, and that the mandible, or jaw bone, was made up of more than one bones. Particularly, his visual representation of the muscles was found to be very accurate. The seven volumes of the book laid down a solid understanding of human anatomy as the groundwork for all medical practice and curing.

Later Life and Death:

Andreas Vesalius was appointed as a court physician to Charles V of Spain and his family. Vesalius's bravery and intelligence, however, made many conservative physicians and Catholic clergy his worst enemies. They charged him of being involved in body snatching.

He was accused of murder in 1564 for the dissection of a Spanish noble who, his disputants said, was still alive. Vesalius was also accused of atheism. King Philip II, however, reduced his sentence to a pilgrimage of penitence to the Holy Land. Regrettably on his way back, his vessel was badly harmed by a storm. Vesalius was rescued from the sea, but he died shortly thereafter.

MICHAEL SERVETUS

Michael Servetus (1511–1553) (fig. 13) was the first doctor ever to challenge and scientifically argue against the theories of Galen, which predominated for 14 centuries in medical schools worldwide. Even though he was relatively correct in scientific terms, Servetus was punished because of his boldness in challenging Galen's theories and was condemned to death by the Holy Inquisition. Yet, by publicly challenging Galen's and Hippocrates' predominant and unquestionable lessons on medicine for the first time, Servetus opened the door for other doctors to challenge and correct those theories and subsequently to bring about a new view of human anatomy and physiology. Servetus to the described of the pulmonary circulation (1532).

WILLIAM HARVEY

William Harvey (1578–1657) (fig. 14), the father of modern physiology, was the first researcher to discover the circulation of blood through the body. Although we take this knowledge for granted, until Harvey's time, people were not aware that the blood travels through the body and is pumped through its course by the heart.

Fig. 13. Michael Servetus

Fig. 14. William Harvey

Harvey's Contribution

Harvey's great contribution to medicine was his revolutionary discovery of the circulation of blood. By dissecting both living and dead animals, Harvey became convinced that the ancient Greek anatomist Galen's ideas about blood movement must be wrong, particularly the ideas that blood was formed in the liver and absorbed by the body, and that blood flowed through the septum (dividing wall) of the heart. Harvey first studied the heartbeat, establishing the existence of the pulmonary (heart-lung-heart) circulation process and noting the one-way flow of blood. When he also realized how much blood was pumped by the heart, he realized there must be a constant amount of blood flowing through the arteries and returning through the veins of the heart, a continuing circular flow.

Harvey Publishes His Findings

Harvey published this radical new concept of blood circulation in 1628. It provoked immediate controversy and hostility from the medical community of the time, contradicting as it did the usually unquestioned teachings of Galen. The most virulent critic, Jean Riolan, scorned Harvey as a «circulator», an insulting term for a traveling quack. Harvey calmly and quietly defended his work, and although his medical practice suffered for a time, his ideas became widely accepted by the time of his death. The discovery of capillaries by Marcello Malpighi in 1661 provided factual evidence to confirm Harvey's theory of blood circulation.

In addition to his blood circulation research, Harvey was one of ***the first to study embryology*** (the study of reproduction in its earliest stages) by observing the development of the chick in the egg. He performed many dissections of mammal embryos at various stages of development. From these experiments Harvey was able to formulate the first new theory of animal generation since antiquity, emphasizing the primacy of the egg, even in mammals. Prior to Harvey's work, it was thought that the male sperm was the primary source of new life, and that the egg was simply an empty home, so to speak, for the sperm to develop.

Thanks to Harvey's willingness to abandon old wisdom and observe and test for himself, we have our modern understanding of physiology.

MARCELLO MALPIGHI

The 17th century Italian scientist, **Marcello Malpighi** (1628–1694) (fig. 15), though not the first to employ the microscope to study tissue from living systems, so extensively applied the newly invented optical instrument for that purpose, and so cleverly developed experimental techniques to extend its application thereto, that historians generally credit him as the **«Founder of Microscopic Anatomy»**, the latter discipline commonly referred to as **histology**.

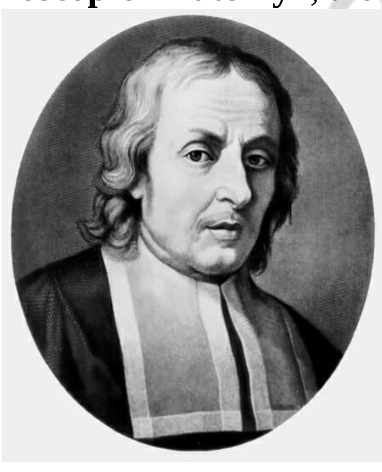

Fig. 15. Marcello Malpighi

Malpighi observed and reported on microscopic anatomical features of the spleen, kidneys, liver, lungs, urinary bladder, brain, spinal cord, skin, and numerous other animal and plant organs and tissues. He so changed the view of the anatomy of organisms, including that of humans, that a turning point occurred in the history of medicine that enabled the progress in research necessary to develop our modern understanding of the physiology of living systems.

One notable example that helped secure his election to the History of Medicine's Hall of Fame, Malpighi's microscopic anatomical studies, led him to identify, in 1661, first in the lungs and urinary bladder, the capillaries, the myriad minute (invisible to the naked eye) blood vessels that conveyed blood pumped by the heart from the arteries to the veins. This link must exist to complete the blood circuit from the heart's left to right ventricle through the body, and from the right to left ventricle through the lungs — the so-called greater (systemic) and lesser (pulmonary) circulations, respectively — circuits that Harvey's macroscopic (visible to the naked eye) anatomical studies, abetted by mathematical calculations, led him to infer.

Malpighi's **discovery of the capillary circulation** was published in the form of two letters, «De Pulmonibus», addressed to (his lifelong friend and colleague, Giovanni Alfonso) Borelli (famous Italian mathematician, physicist and physiologist), published at Bologna in 1661 and subsequently reprinted at Leiden and elsewhere. These letters also contained the first account of the vesicular structure of the human lung, and for the first time they made possible a theory of respiration.

PARACELSUS

Paracelsus (born Philippus Aureolus Theophrastus Bombastus von Hohenheimborn November 11 or December 17, 1493 in Einsiedeln, Switzerland, died September 24, 1541 in Salzburg, Austria) (fig. 16) is sometimes called ***the «father» of toxicology***. He contributed greatly to the fields of medicine and toxicology. He rejected Gnostic medicinal traditions such as cauterizing wounds and amputating injured limbs and advocated keeping wounds clear of infection and allowing them to heal on their own. He is also considered to be Renaissance physician, botanist, alchemist, astrologer, and general occultist.

Fig.16. Paracelsus

Paracelsus also pioneered the use of chemicals and minerals in medicine, coining the name of «zink» («zinc» today). He felt that sickness and health in the body relied on the harmony of man, the microcosm, and Nature of the macrocosm. He took an approach different from his medicinal predecessors by stressing that man must have a certain balance of minerals in their bodies, and that certain illnesses of the body had chemical remedies that could cure them. He was, therefore, a precursor of modern-day medicine and of the use of vitamins and minerals to maintain health.

He wrote on toxics:

«The dose makes the poison» (A popular short version). All things are poison and nothing (is) without poison; only the dose makes that a thing is no poison.

«Many have said of Alchemy, that it is for the making of gold and silver. For me this is not the aim, the aim is to consider only what virtue and power may lie in medicines».

Paracelsus was an alchemist, though he eschewed the common goal of chrysopoeia, the creation of gold from lesser metals; his interest was primarily medical. He was the main figure associated with Iatrochemistry, an early predecessor of pharmacology that combined alchemical and medical principles. He wrote extensively on the topic of alchemy, and some of his writings are available today.

SANTORIO SANTORINI

Santorio Santorini (29 March 1561 – 22 February 1636 Venice) (fig. 17), also called Sanctorio Sanctorio, Santorio Santorii, Sanctorius of Padua, and various combinations of these names, was an Italian physiologist, physician, and professor, who introduced the quantitative approach into medicine. He is also known as the inventor of several medical devices, including the thermometer. His work De Statica Medicina, written in 1614, saw five publications through 1737 and influenced generations of physicians.

Fig. 17. Santorio Santorini

Inventions. Santorio was the first to use a wind gauge, a water current meter, the pulsilogium (a device used to measure the pulse rate), an early waterbed and a thermoscope. Whereas he invented the former two devices, it is unclear exactly who invented the latter two; it could be his friend Galileo Galilei or another person of the learned circle in Venice of which they were members.

Santorio introduced the thermoscope in the work titled Sanctorii Sanctorii Commentaria in Artem medicinalem Galeni in 1612.

The pulsilogium was probably the first machine of precision in medical history. A century later another physician, de Lacroix, used the pulsilogium to test cardiac function.

Study of metabolism. Sanctorius studied the so-called perspiratio insensibilis or insensible perspiration of the body, already known to Galen and ancient physicians, and originated the study of metabolism. For a period of thirty years Santorio weighed himself, everything he ate and drank, as well as his urine and feces. He compared the weight of what he had eaten to that of his waste products, the latter being considerably smaller because for every eight pounds of food he ate, he excreted only 3 pounds of waste. This important experiment is the origin of the significance of weight measurement in medicine. While his experiments kept to be replicated and augmented by his followers and were finally surpassed by the ones of Lavoisier in 1790, he is still celebrated as the father of experimental physiology. The «weighing chair», which he constructed and employed during this experiment, is also famous.

RENÉ DESCARTES

While the great philosophical distinction between mind and body in western thought can be traced to the Greeks, it is to the seminal work of **René Descartes** (1596–1650) (fig. 18), French mathematician, philosopher, and physiologist, that we owe the first systematic account of the mind/body relationship.

Fig. 18. Rene Descartes

From 1612, when he left La Flèche, until 1628, when he settled in Holland, Descartes spent much of his time in travel, contemplation, and correspondence. From 1628 until his ill-fated trip to Sweden in 1649 he remained for the most part in Holland, and it was during this period that he composed a series of works that set the agenda for all later students of mind and body. The first of these works, De homine was completed in Holland about 1633, on the eve of the condemnation of Galileo. When Descartes' friend and frequent correspondent, Marin Mersenne, wrote to him of Galileo's fate at the hands of the Inquisition, Descartes immediately suppressed his own treatise. As a result, the world's first extended essay on physiological psychology was published only well after its author's death.

Fig. 19. The mechanism for automatic reaction in response to external events, illustrated in Descartes' De homine (1662)

In this work, Descartes proposed a mechanism for automatic reaction in response to external events (fig. 19). According to his proposal, external motions affect the peripheral ends of the nerve fibrils, which in turn displace the central ends. As the central ends are displaced, the pattern of interfibrillar space is rearranged and the flow of animal spirits is thereby directed into the appropriate nerves. It was Descartes' articulation of this mechanism for automatic, differentiated reaction that led to his generally being credited with the founding of reflex theory.

Although extended discussion of the metaphysical split between mind and body did not appear until Descartes' Meditationes, his De homine outlined these views and provided the first articulation of the mind/body interactionism that was to elicit such pronounced reaction from later thinkers. In Descartes' conception, the rational soul, an entity distinct from the body and making contact with the body at the pineal gland, might or might not become aware of the differential outflow of animal spirits brought about through the rearrangement of the interfibrillar spaces. When such awareness did occur, however, the result was conscious sensation - body affecting mind. In turn, in voluntary action, the soul might itself initiate a differential outflow of animal spirits. Mind, in other words, could also affect body.

In 1649, on the eve of his departure for Stockholm to take up residence as instructor to Queen Christina of Sweden, Descartes sent the manuscript of the last of his great works, Les passions de l'ame, to press. Les passions is Descartes' most important contribution to psychology proper. In addition to an analysis of primary emotions, it contains Descartes' most extensive account of causal mind/body interactionism and of the localization of the soul's contact with the body in the pineal gland. As is well known, **Descartes chose the pineal gland because it appeared to him to be the only organ in the brain that was not** bilaterally duplicated and because he believed, erroneously, that it was uniquely human.

FRANCIS BACON

Francis Bacon, **Baron Verulam**, **Viscount St. Alban** (22 January 1561–9 April 1626) (fig. 20) was an English philosopher, statesman, scientist, jurist, orator, essayist and author. He served both as Attorney General and Lord Chancellor of England. After his death, he remained extremely influential through his works, especially as philosophical advocate and practitioner of the scientific method during the scientific revolution.

Fig. 20. Francis Bacon

The *New Organon* is the second part of Bacon's larger work, the *Great Instauration,* which aims to offer a new method of investigating nature, called the Interpretation of Nature. A better use of the mind and the understanding is needed to investigate nature. Bacon suggests an entirely new system of logic, which is based on induction rather than on the syllogism. Induction begins with the facts of nature and works slowly towards general axioms or propositions, by building up tables of comparison. Experiments are to be used to assist the senses in this process.

Currently, men's minds are filled with various foolish and incorrect notions that prevent them from understanding nature properly. Bacon seeks to eradicate these notions, which he calls the idols, which originate in human nature, interaction between people and in the work of various philosophers, particularly Aristotle.

Bacon was very skeptical about medical advances of his time and at the same time understood that its subject is the most complex and diverse nature of the bodies: «... the volatility and heterogeneity of the subject made the art of medicine based on guesses rather than on a strong knowledge». He singled out ***three medical problems: preservation of health, treatment of diseases and prolonging life***, while noting that modern medicine is on the wrong path, leaving little or no attention to the third problem. Offering to make medicine part of the «experimental science», Bacon had in mind not only the research of anatomical theaters and rigorous testing of drugs, but also the study of human tissues and organs.

AMBROISE PARÉ

Ambroise Paré (born 1510, Bourg-Hersent, France–died 1590, Paris) (fig. 21), French physician, one of the most notable surgeons of the European Renaissance, is regarded by some medical historians as the father of modern surgery.

About 1533 Paré went to Paris, where he soon became a barber-surgeon apprentice at the Hôtel-Dieu. He was taught anatomy and surgery and in 1537 was employed as an army surgeon. By 1552 he had gained such popularity that he became surgeon to the king; he served four French monarchs: Henry II, Francis II, Charles IX, and Henry III.

At the time Paré entered the army, surgeons treated gunshot wounds with boiling oil since such wounds were believed to be poisonous. On one occasion, when Paré’s supply of oil ran out, he treated the wounds with a mixture of egg yolk, rose oil, and turpentine. He found that the wounds he had treated with this mixture were healing better than those treated with the boiling oil. Sometime later he reported his findings in La Méthod de traicter les playes faites par les arquebuses et aultres bastons à feu (1545; «The Method of Treating Wounds Made by Harquebuses and Other Guns»),

Fig. 21. Ambroise Paré

which was ridiculed because it was written in French rather than in Latin. Another of Paré's innovations that did not win immediate medical acceptance was his reintroduction of the tying of large arteries to replace the method of searing vessels with hot irons to check hemorrhaging during amputation.

Unlike many surgeons of his time, Paré resorted to surgery only when he found it absolutely necessary. He was one of the first surgeons to discard the practice of castrating patients who required surgery for a hernia. He introduced the implantation of teeth, artificial limbs, and artificial eyes made of gold and silver. He invented many scientific instruments, popularized the use of the truss for hernia, and was the first to suggest syphilis as a cause of aneurysm (swelling of blood vessels).

NEW AGE MEDICINE

(Early Modern time: from 1640–1649 to 1917 (18)

Background Information

Why Had They Stopped Reading Galen?

– New understanding of the body and Galen's descriptions were incomplete and sometimes wrong.

– The invention of the proof that Harvey's ideas were right.

– Theory of the four humours no longer accepted. People initially thought that miasma caused disease.

– Doctors carried out dissections and used microscopes. Galen's books were no longer important.

– Differentiation of scientific knowledge.

– Medical societies.

– Medical congresses.

– Medical journals, academic and popular science books.

– Specialization of clinical disciplines.

THE NEW METHODS FOR DIAGNOSES

DANIEL GABRIEL FAHRENHEIT

Daniel Gabriel Fahrenheit (24 May 1686 – 16 September 1736) was a German physicist, engineer, and glass blower who is best known for inventing the mercury-in-glass thermometer (1714), and for developing a temperature scale now named after him.

Fahrenheit came up with the idea that mercury boils around 300 degrees on this temperature scale. Work by others showed that water boils about 180 degrees above its freezing point. The Fahrenheit scale later was redefined to make the freezing-to-boiling interval exactly 180 degrees, a convenient value as 180 is a highly composite number, meaning that it is evenly divisible into many fractions. It is because of the scale's redefinition that normal body temperature today is taken as 98.2 degrees, whereas it was 96 degrees on Fahrenheit's original scale.

Until the switch to the Celsius scale, the Fahrenheit scale was widely used in Europe. It is still used for everyday temperature measurements by the general population in the United States.

In 1742, Swedish astronomer **Anders Celsius** (1701–1744) created a temperature scale which was the reverse of the scale now known by the name «Celsius»: 0 represented the boiling point of water, while 100 represented the freezing point of water.

In 1743, the Lyonnais physicist Jean-Pierre Christin, permanent secretary of the Académie des sciences, belles-lettres et arts de Lyon, working independently of Celsius, developed a scale where zero represented the freezing point of water and 100 represented the boiling point of water. On 19 May 1743 he published the design of a mercury thermometer, the «Thermometer of Lyon» built by the craftsman Pierre Casati that used this scale.

In 1744, coincident with the death of Anders Celsius, the Swedish botanist Carolus Linnaeus (1707–1778) reversed Celsius's scale. His custom-made «linnaeus-thermometer», for use in his greenhouses, was made by Daniel Ekström, Sweden's leading maker of scientific instruments at the time and whose workshop was located in the basement of the Stockholm observatory. As often happened in this age before modern communications, numerous physicists, scientists, and instrument makers are credited with having independently developed this same scale; among them were Pehr Elvius, the secretary of the Royal Swedish Academy of Sciences (which had an instrument workshop) and with whom Linnaeus had been corresponding; Daniel Ekström, the instrument maker; and Mårten Strömer (1707–1770) who had studied astronomy under Anders Celsius.

Since the 19th century, the scientific and thermometry communities worldwide referred to this scale as the centigrade scale. Temperatures on the centigrade scale were often reported simply as degrees or, when greater specificity was desired, as degrees centigrade. The symbol for temperature values on this scale is °C.

JOSEF LEOPOLD AUENBRUGGER OR AVENBRUGGER

Josef Leopold Auenbrugger or Avenbrugger (19 November 1722–17 May 1809), also known as Leopold von Auenbrugger, was the Austrian physician who invented percussion as a diagnostic technique. For the strength of this discovery he is considered one of the founders of modern medicine.

Auenbrugger was a native of Graz in Styria, an Austrian province. His father, a hotel keeper, gave his son every opportunity for an excellent preliminary education in his native town and then sent him to Vienna to complete his studies at the university. Auenbrugger graduated as a physician at the age of 22 and then entered the Spanish Military Hospital of Vienna, where he spent 10 years.

He found out that, by applying his ear to the patient and tapping lightly on the chest, one could assess the texture of underlying tissues and organs. This technique of percussive diagnosis had its origins in testing the level of wine casks in the cellar of his father's hotel. With this method, he was able to determine the outlines of the heart. It was the first time that a physician could relatively accurately and objectively determine an important sign of diseases. He published his findings in a booklet, but nobody paid much attention to it.

During his ten years of patient study, Auenbrugger confirmed his observations on the diagnostic value of percussion by comparison with post-mortem specimens, and besides made a number of experimental studies on dead bodies. He injected fluid into the pleural cavity, and showed that it was perfectly possible by percussion to tell exactly the limits of the fluid present, and thus to decide when and where efforts should be made for its removal.

His name is also associated with Auenbrugger's sign, a bulging of the epigastric region in the thorax, in cases of large effusions of the pericardium, the membrane which envelops the heart.

His later studies were devoted to tuberculosis. He pointed out how to detect cavities of the lungs, and how their location and size might be determined by percussion. He also recognized that information with regard to the contents of cavities in the lungs and conditions of lung tissue might be obtained by placing the hand on the chest and noting the vibration, or fremitus, produced by the voice and breath. These observations were published in a little book called Inventum Novum ex Percussione Thoracis Humani Interni Pectoris Morbos Detegendi, the full English title being «A New Discovery that Enables the Physician by Percussion of the Human Thorax to Detect the Diseases Hidden Within the Chest». It is considered a book that marks an epoch in the modern history of medicine.

Like most medical discoveries, Auenbrugger's method of diagnosis was at first met with indifference. Before his death, however, it had aroused the attention of French physician René Laennec, who, following up the ideas suggested by it, discovered auscultation. The value of percussion in physical examination was later recognized by Jean-Nicolas Corvisart, who popularized it teaching it to his students in France, and by Josef Skoda in Vienna. He also translated and illustrated Auenbrugger's book in 1808, which helped to make Auenbrugger's work on percussion better known.

Auenbrugger lived to the happy old age of 86. He was especially noted for his cordial relations with the younger members of his profession and for his kindness to the poor and to those suffering from tuberculosis. He is sometimes said to have died in the typhus epidemic of 1798, but he actually died over a decade later.

RENÉ-THÉOPHILE-HYACINTHE LAENNEC

René-Théophile-Hyacinthe Laennec (17 February 1781–13 August 1826) (fig. 22) was a French physician. He invented the stethoscope in 1816, while working at the Hôpital Necker and pioneered its use in diagnosing various chest conditions.

Fig. 22. René-Théophile-Hyacinthe Laennec

He became a lecturer at the Collège de France in 1822 and professor of medicine in 1823. His final appointments were that of Head of the Medical Clinic at the Hôpital de la Charité and Professor at the Collège de France. He died of tuberculosis in 1826 at the age of 45.

Laennec wrote the classic treatise De l'Auscultation Médiate, published in August 1819. The preface reads:

«In 1816, I consulted a young woman laboring under general symptoms of diseased heart, and in whose case percussion and the application of the hand were of little help on account of the great degree of fatness. The other method just mentioned (direct auscultation) being rendered inadmissible by the age and sex of the patient, I happened to recollect a simple and well-known fact in acoustics, ... the great distinctness with which we hear the scratch of a pin at one end of a piece of wood on applying our ear to the other. Immediately, on this suggestion, I rolled a quire of paper into a kind of cylinder and applied one end of it to the region of the heart and the other to my ear, and was not a little surprised and pleased to find that I could thereby perceive the action of the heart in a manner much more clear and distinct than I had ever been able to do by the immediate application of my ear».

Laennec had discovered that the new stethoscope was superior to the normally used method of placing the ear over the chest, particularly if the patient was overweight. A stethoscope also avoided the embarrassment of placing the ear against the chest of a woman.

Laennec is said to have seen schoolchildren playing with long, hollow sticks in the days leading up to his innovation. The children held their ear to one end of the stick while the opposite end was scratched with a pin, the stick transmitted and amplified the scratch. His skill as a flautist may also have inspired him. He built his first instrument as a 25 cm by 2.5 cm hollow wooden cylinder, which he later refined to comprise three detachable parts.

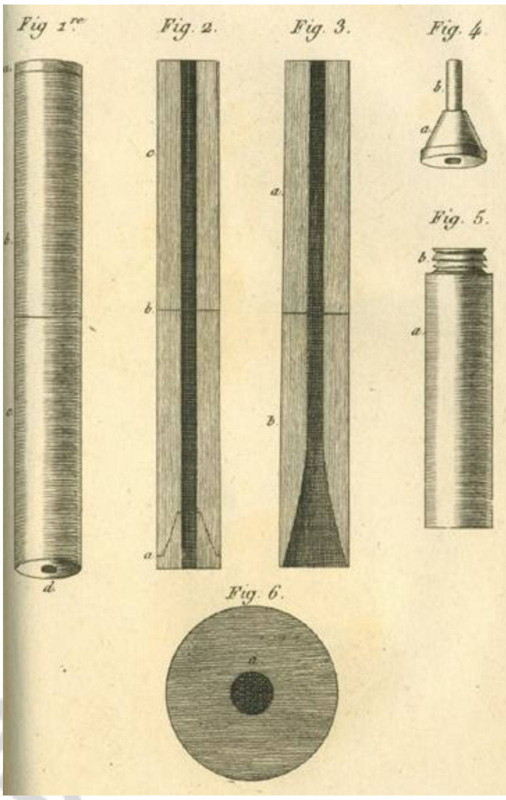

Fig. 23. The first drawing of a stethoscope, 1819

His clinical work allowed him to follow chest patients from bedside to the autopsy table. He was therefore able to correlate sounds captured by his new instruments with specific pathological changes in the chest, in fact pioneering a new non-invasive diagnostic tool. Laennec was the first to classify and discuss the terms rales, rhonchi, crepitance, and egophony — terms that doctors now use on a daily basis during physical exams and diagnoses. In February 1818, he presented his findings in a talk at the Academie de Medecin, later publishing his findings in 1819 (fig. 23).

Laennec coined the phrase mediated auscultation (indirect listening), as opposed to the popular practice at the time of directly placing the ear on the chest (immediate auscultation). He named his instrument the stethoscope, from stethos (chest), and skopos (examination). One of the original stethoscopes belonging to Rene Theophile Laennec was made of wood and brass (fig. 24).

Fig. 24. Laennec's stethoscope (from wood and brass), France, 1815–1825

Not all doctors readily embraced the new stethoscope. Although the New England Journal of Medicine reported the invention of the stethoscope two years later, in 1821, as late as 1885 a professor of medicine stated, «He that hath ears to hear, let him use his ears and not a stethoscope». Even the founder of the American Heart Association, L. A. Connor (1866–1950) carried a silk handkerchief with him to place on the wall of the chest for ear auscultation.

Laennec often referred to the stethoscope as «the cylinder», and as he neared death only a few years later, he bequeathed his own stethoscope to his nephew, referring to it as «the greatest legacy of my life».

The modern binaural stethoscope with two ear pieces was invented in 1851 by **Arthur Leared**. **George Cammann** perfected the design of the instrument for commercial production in 1852, which has become the standard ever since.

Other medical contributions. Laennec performed auscultation of a patient in front of his students.

He developed the understanding of peritonitis and cirrhosis. Although the disease of cirrhosis was known, Laennec gave cirrhosis its name, using the Greek word (kirrhos, tawny) that referred to the tawny, yellow nodules characteristic of the disease.

He coined the term melanoma and described metastases of melanoma to the lungs. In 1804, while still a medical student, he was the first person to lecture on melanoma. This lecture was subsequently published in 1805. Laennec actually used the term «melanoses», which he derived from the Greek (mela, melan) for «black». Over the years, there were bitter exchanges between Laennec and Dupuytren, the latter objecting that there was no mention of his work in this area and his role in its discovery.

He also studied tuberculosis. Coincidentally, his nephew, Mériadec Laennec, is said to have diagnosed tuberculosis in Laennec using Laennec's stethoscope.

Laennec advocated objective scientific observation.

HERMANN LUDWIG FERDINAND VON HELMHOLTZ

Hermann Ludwig Ferdinand von Helmholtz (31 August, 1821–8 September, 1894) was a German physician and physicist who made significant contributions to several widely varied areas of modern science. In physiology and psychology, he is known for his mathematics of the eye, theories of vision, ideas on the visual perception of space, color vision research, and on the sensation of tone, perception of sound, and empiricism. In physics, he is known for his theories on the conservation of energy, work in electrodynamics, chemical thermodynamics, and on a mechanical foundation of thermodynamics. As a philosopher, he is known for his philosophy of science, ideas on the relation between the laws of perception and the laws of nature, the science of aesthetics, and ideas on the civilizing power of science. The largest German association of research institutions, the Helmholtz Association, is named after him.

Ophthalmic optics. In 1851, Helmholtz revolutionized the field of ophthalmology with the invention of the ophthalmoscope; an instrument used to examine the inside of the human eye. This made him world famous overnight.

Helmholtz's interests at that time were increasingly focused on the physiology of the senses. His main publication, entitled Handbuch der Physiologischen Optik (Handbook of Physiological Optics or Treatise on Physiological Optics), provided empirical theories on depth perception, color vision, and motion perception, and became the fundamental reference work in his field during the second half of the nineteenth century. In the third and final volume, published in 1867, Helmholtz described the importance of unconscious inferences for perception. The Handbuch was first translated into English under the editorship of James P. C. Southall on behalf of the Optical Society of America in 1924-5. His theory of accommodation went unchallenged until the final decade of the 20th century.

Helmholtz continued to work for several decades on several editions of the handbook, frequently updating his work because of his dispute with Ewald Hering who held opposite views on spatial and color vision. This dispute divided the discipline of physiology during the second half of the 1800s.

Nerve physiology. In 1849, while at Königsberg, Helmholtz measured the speed at which the signal is carried along a nerve fibre. At that time most people believed that nerve signals passed along nerves immeasurably fast. He used a recently dissected sciatic nerve of a frog and the calf muscle to which it attached. He used a galvanometer as a sensitive timing device, attaching a mirror to the needle to reflect a light beam across the room to a scale which gave much greater sensitivity. Helmholtz reported transmission speeds in the range of 24.6–38.4 meters per second.

The electrocardiography

The last decade of the 19th century witnessed the rise of a new era in which physicians used technology along with classical history taking and physical examination for the diagnosis of heart disease. The introduction of chest x-rays in 1895 and the electrocardiograph (electrocardiogram) in 1902 provided objective information about the structure and function of the heart. The original electrocardiograph employed a string galvanometer to record the potential deference between the extremities resulting from the heart's electrical activation. In the first half of the 20th century, a number of innovative individuals set in motion a fascinating sequence of discoveries and inventions that led to the 12-lead electrocardiogram as we know it now.

Precursors of the electrocardiogram:

In the 1786, Dr. **Luigi Galvani**, an Italian physician and physicist at the University of Bologna, first noted that electrical current could be recorded from skeletal muscles. He recorded electrical activity from dissected muscles.

In 1842, Dr. **Carlo Matteucci**, a professor of physics at the University of Pisa, demonstrated that electrical current accompanies every heart beat in a frog.

Thirty-five years later, **Augustus Waller**, a British physiologist of St Mary's Medical School in London, published the first human electrocardiogram using a capillary electrometer and electrodes placed on the chest and back of a human. He demonstrated that electrical activity preceded ventricular contraction.

In 1891, **William Bayliss and Edward Starling**, British physiologists of University College London, demonstrated triphasic cardiac electrical activity in each beat using an improved capillary electrometer.

The first human electrocardiogram was recorded by **Augustus D. Waller** of St Mary's Medical School showing simultaneous electrometer and cardiograph tracings showing an electrical activity preceding every heart beat.

Fig. 25. Willem Einthoven

Einthoven and the birth of clinical electrocardiogram

Dr. **Willem Einthoven** (fig. 25), a Dutch physiologist inspired by the work of Waller, refined the capillary electrometer even further and was able to demonstrate five deflections which he named ABCDE. To adjust for inertia in the capillary system, he implemented a mathematical correction, which resulted in the curves that we see today. Following the mathematical tradition established by Descartes, he used the terminal part of alphabet series (PQRST) to name these deflections. The term 'electrocardiogram' used to describe these wave forms was first coined by Einthoven at the Dutch Medical Meeting of 1893. In 1901, he successfully developed a new string galvanometer with very high sensitivity, which he used in his electrocardiograph. His device weighed 600 pounds (fig. 26).

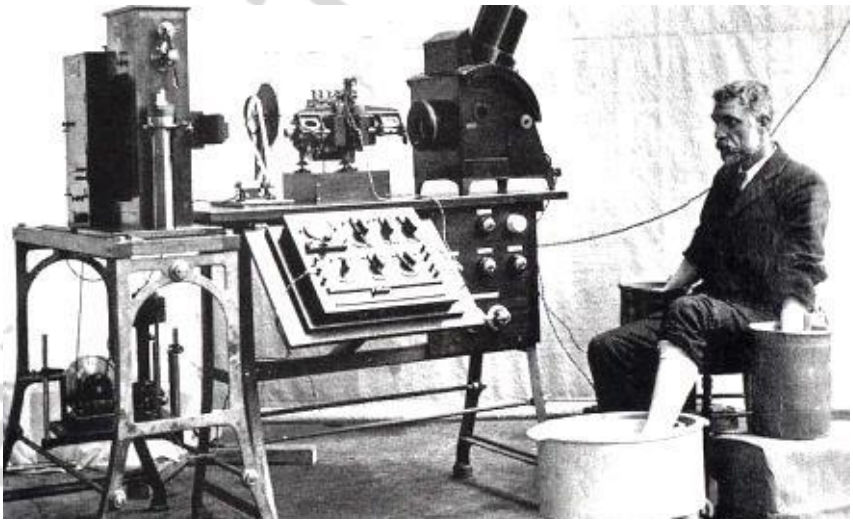

Fig. 26. An early electrocardiogram device

Earlier electrocardiograms recorded by Waller used five electrodes, one on each of the four extremities and the mouth, with 10 leads derived from the different combinations. Einthoven was able to reduce the number of electrodes to three by excluding those which he thought provided the lowest yield, the right leg and the mouth electrodes. The resulting three leads were used to construct Einthoven's triangle, an important concept to this day. In 1924, Einthoven was awarded the Nobel Prize in physiology and medicine for the invention of electrocardiograph.

WILHELM CONRAD RÖNTGEN (X-RAY)

Wilhelm Conrad Röntgen (27 March 1845 – 10 February 1923) was a German physicist, who, on 8 November 1895, produced and detected electromagnetic radiation in a wavelength range known as X-rays or Röntgen rays, an achievement that earned him the first Nobel Prize in Physics in 1901.

Fig. 27. First X-ray images taken by Wilhelm Roentgen 22nd December, 1895 shows the hand of Wilhelm’s wife with ring

In late 1895, W. C. Roentgen was working with a cathode ray tube in his laboratory. He was working with tubes similar to our fluorescent light bulbs. He evacuated the tube of all air, filled it with a special gas, and passed a high electric voltage through it. When he did this, the tube would produce a fluorescent glow. Roentgen shielded the tube with heavy black paper, and found that a green colored fluorescent light could be seen coming from a screen setting a few feet away from the tube. He realized that he had produced a previously unknown «invisible light», or ray, that was being emitted from the tube; a ray that was capable of passing through the heavy paper covering the tube. Through additional experiments, he also found that the new ray would pass through most substances casting shadows of solid objects on pieces of film. He named the new ray X-ray, because in mathematics "X" is used to indicate the unknown quantity.

In his discovery Roentgen found that the X-ray would pass through the tissue of humans leaving the bones and metals visible. One of Roentgen’s first experiments late in 1895 was a film of his wife Bertha's hand with a ring on her finger (fig. 27). The news of Roentgen’s discovery spread quickly throughout the world. Scientists everywhere could duplicate his experiment because the cathode tube was very well known during this period. In early 1896, X-rays were being utilized clinically in the United States for such things as bone fractures and gun shot wounds.

MICROBIOLOGY AND IMMUNOLOGY

EDWARD JENNER

Edward Jenner (17 May 1749 – 26 January 1823) (fig. 28) was an English physician and scientist who was the pioneer of smallpox vaccine, the world's first vaccine. He is often called «the father of immunology», and his work is said to have «saved more lives than the work of any other human».

Edward Jenner, the father of vaccination, created the first vaccine for smallpox. He did this by inoculating James Phipps with cowpox, a similar virus of smallpox, to create immunity, unlike variolation, which used smallpox to create an immunity to itself.

Fig. 28. Edward Jenner

In 1765, John Fewster published a paper in the London Medical Society entitled «Cow pox and its ability to prevent smallpox», but did not pursue the subject further.

Jenner's Hypothesis:

The initial source of infection was a disease of horses, called «the grease», which was transferred to cattle by farm workers, transformed, and then manifested as cowpox.

Noting the common observation that milkmaids were generally immune to smallpox, Jenner postulated that the pus in the blisters that milkmaids received from cowpox (a disease similar to smallpox, but much less virulent) protected them from smallpox.

On 14 May 1796, Jenner tested his hypothesis by inoculating James Phipps, an eight-year-old boy who was the son of Jenner's gardener. He scraped pus from cowpox blisters on the hands of Sarah Nelmes, a milkmaid who had caught cowpox from a cow called Blossom, whose hide now hangs on the wall of the St George's medical school library (now in Tooting). Phipps was the 17th case described in Jenner's first paper on vaccination.

Jenner inoculated Phipps in both arms that day, subsequently producing in Phipps a fever and some uneasiness, but no full-blown infection. Later, he injected Phipps with variolous material, the routine method of immunization at that time. No disease followed. The boy was later challenged with variolous material and again showed no sign of infection.

Immunity to smallpox can be induced much more safely than by variolation.

Donald Hopkins has written, Jenner's unique contribution was not that he inoculated a few persons with cowpox, but that he then proved [by subsequent challenges] that they were immune to smallpox. Moreover, he demonstrated that the protective cowpox pus could be effectively inoculated from person to person, not just directly from cattle. Jenner successfully tested his hypothesis on 23 additional subjects.

Jenner continued his research and reported it to the Royal Society, which did not publish the initial paper. Some of his conclusions were correct, some erroneous; modern microbiological and microscopic methods would make his studies easier to reproduce. Eventually, vaccination was accepted. The success of his discovery soon spread around Europe.

1803–1809 in London, he was a president of the Jennerian Society, concerned with promoting vaccination to eradicate smallpox.

Jenner observed a significant number of cases of smallpox after vaccination. He found that in these cases the severity of the illness was notably diminished by previous vaccination. In 1821, he was appointed physician extraordinary to King George IV, a great national honour, and was also made mayor of Berkeley and justice of the peace.

ROBERT HEINRICH HERMAN KOCH

Robert Heinrich Herman Koch (11 December 1843 – 27 May 1910) was a celebrated German physician and pioneering microbiologist. As the founder of modern bacteriology, he is known for his role in identifying the specific causative agents of tuberculosis, cholera, and anthrax and for giving experimental support for the concept of infectious disease. In addition to his trailblazing studies on these diseases, Koch created and improved laboratory technologies and techniques in the field of microbiology, and made key discoveries in public health. His research led to the creation of Koch's postulates, a series of four generalized principles linking specific microorganisms to specific diseases that remain today the «gold standard» in medical microbiology. As a result of his groundbreaking research on tuberculosis, Koch received the Nobel Prize in Physiology or Medicine in 1905.

Anthrax. Robert Koch is widely known for his work with anthrax, discovering the causative agent of the fatal disease to be Bacillus anthracis. Koch discovered the formation of spores in anthrax bacteria that could remain dormant under specific conditions. However, under optimal conditions, the spores were activated and caused disease. To determine this causative agent, he dry-fixed bacterial cultures onto glass slides, used dyes to stain the cultures, and observed them through a microscope. Koch's work with anthrax is notable in that he was the first to link a specific microorganism with a specific disease, rejecting the idea of spontaneous generation and supporting the germ theory of disease.

Koch's four postulates. Koch accepted a position as government advisor with the Imperial Department of Health in 1880. During his time as government advisor, he published a report in which he stated the importance of pure cultures in isolating disease-causing organisms and explained the necessary steps to obtain these cultures, methods which are summarized in Koch's four postulates. Koch's discovery of the causative agent of anthrax led to the formation of a generic set of postulates which can be used in the determination of the cause of most infectious diseases. These postulates, which not only outlined a method for linking cause and effect of an infectious disease but also established the significance of laboratory culture of infectious agents, are listed here:

1. The organism must always be present, in every case of the disease.

2. The organism must be isolated from a host containing the disease and grown in pure culture.

3. Samples of the organism taken from pure culture must cause the same disease when inoculated into a healthy, susceptible animal in the laboratory.

4. The organism must be isolated from the inoculated animal and must be identified as the same original organism first isolated from the originally diseased host.

Isolating pure culture on solid media. Koch began conducting research on microorganisms in a laboratory connected to his patient examination room. Koch's early research in this laboratory proved to yield one of his major contributions to the field of microbiology, as it was there that he developed the technique of growing bacteria. Koch's second postulate calls for the isolation and growth of a selected pathogen in pure laboratory culture. In an attempt to grow bacteria, Koch began to use solid nutrients such as potato slices. Through these initial experiments, Koch observed individual colonies of identical, pure cells. Coming to the conclusion that potato slices were not suitable media for all organisms, Koch later began to use nutrient solutions with gelatin. However, he soon realized that gelatin, like potato slices, was not the optimal medium for bacterial growth, as it did not remain solid at 37˚C, the ideal temperature for growth of most human pathogens. As suggested to him by Walther and Angelina Hesse, Koch began to utilize agar to grow and isolate pure cultures, as this polysaccharide remains solid at 37˚C, is not degraded by most bacteria, and results in a transparent medium.

Cholera. Koch next turned his attention to cholera, and began to conduct research in Egypt in the hopes of isolating the causative agent of the disease. However, he was not able to complete the task before the epidemic in Egypt ended, and subsequently traveled to India to continue the study. In India, Koch was indeed able to determine the causative agent of cholera, isolating Vibrio cholerae. The bacterium had originally been isolated in 1854 by Italian anatomist Filippo Pacini, but its exact nature and his results were not widely known.

Tuberculosis. During his time as the government advisor with the Imperial Department of Health in Berlin in the 1880s, Robert Koch became interested in tuberculosis research. At the time, it was widely believed that tuberculosis was an inherited disease. However, Koch was convinced that the disease was caused by a bacterium and was infectious, and tested his four postulates using guinea pigs. Through these experiments, he found that his experiments with tuberculosis satisfied all four of his postulates. In 1882, he published his findings on tuberculosis, in which he reported the causative agent of the disease to be the slow-growing Mycobacterium tuberculosis. His work with this disease won Koch the Nobel Prize in Physiology and Medicine in 1905. Additionally, Koch's research on tuberculosis, along with his studies on tropical diseases, won him the Prussian Order Pour le Merite in 1906 and the Robert Koch medal, established to honour the greatest living physicians, in 1908.

LOUIS PASTEUR

Louis Pasteur (1822–1895) (fig. 29) was a French chemist and microbiologist renowned for his discoveries of the principles of vaccination, microbial fermentation and pasteurization. He is remembered for his remarkable breakthroughs in the causes and preventions of diseases, and his discoveries have saved countless lives ever since. He reduced mortality from puerperal fever, and created the first vaccines for rabies and anthrax. His medical discoveries provided direct support for the germ theory of disease and its application in clinical medicine. He is best known to the general public for his invention of the technique of treating milk and wine to stop bacterial contamination, a process now called pasteurization. He is regarded as one of the three main founders of bacteriology, together with Ferdinand Cohn and Robert Koch, and is popularly known as the «father of microbiology».

Fig. 29. Louis Pasteur

Pasteur was responsible for disproving the doctrine of spontaneous generation. He performed experiments that showed that without contamination, microorganisms could not develop. Under the auspices of the French Academy of Sciences, he demonstrated that in sterilized and sealed flasks nothing ever developed, and in sterilized but open flasks microorganisms could grow. This experiment won him the Alhumbert Prize of the academy.

Although Pasteur was not the first to propose the germ theory, he developed it and conducted experiments that clearly indicated its correctness and managed to convince most of Europe that it was true. (He was preceded by Girolamo Fracastoro, Agostino Bassi and others, with the significant experimental demonstration by Francesco Redi in the 17th century.) Today, he is often regarded as (one of the) fathers of germ theory.

Pasteur's work on diseases included work on chicken cholera.

In the 1870s, he applied immunization method to anthrax, which affected cattle, and aroused interest in combating other diseases.

Pasteur gave these artificially weakened diseases the generic name of «vaccines», in honour of Jenner's discovery. Pasteur produced the first vaccine for rabies by growing the virus in rabbits, and then weakening it by drying the affected nerve tissue.

The rabies vaccine was initially created by Emile Roux, a French doctor and a colleague of Pasteur who had been working with a killed vaccine produced by desiccating the spinal cords of infected rabbits. The vaccine had been tested in 50 dogs before its first human trial. This vaccine was first used on 9-year old Joseph Meister, on July 6, 1885, after the boy was badly mauled by a rabid dog. This was done at some personal risk for Pasteur, since he was not a licensed physician and could have faced prosecution for treating the boy. After consulting with colleagues, he decided to go ahead with the treatment. Three months later he examined Meister and found that he was in good health. Pasteur was hailed as a hero and the legal matter was not pursued. The treatment's success laid the foundations for the manufacture of many other vaccines. The first of the Pasteur Institutes was also built on the basis of this achievement.

ILYA ILYICH MECHNIKOV

Ilya Ilyich Mechnikov (16 May [O.S. 3 May] 1845 – 16 July 1916) (fig. 30) was a Russian zoologist best known for his pioneering research into the immune system.

In particular, he is credited with the discovery of phagocytes (macrophages) in 1882, and his discovery turned out to be the major defence mechanism in innate immunity. He and Paul Ehrlich were awarded the 1908 Nobel Prize in Physiology or Medicine «in recognition of their work on immunity». He is also credited by some sources with coining the term gerontology in 1903, for the emerging study of aging and longevity. He established the concept of cell-mediated immunity, while Ehrlich that of humoral immunity. Their works are regarded as the foundation of the science of immunology. In immunology he is given an epithet the «father of natural immunity».

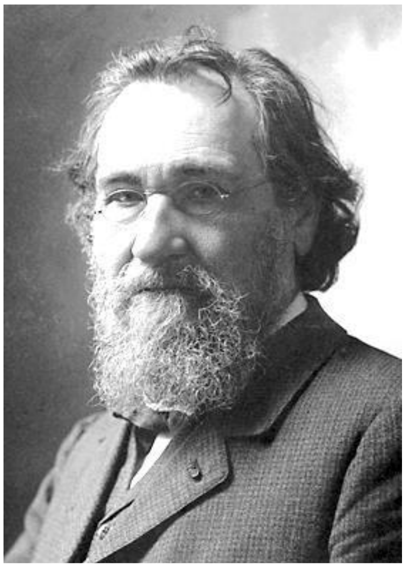

Fig. 30. Ilya Ilyich Mechnikov

PAUL EHRLICH

Paul Ehrlich (14 March 1854 – 20 August 1915) (fig. 31) was a German physician and scientist who worked in the fields of hematology, immunology, and antimicrobial chemotherapy. He invented the precursor technique to Gram staining bacteria. The methods he developed for staining tissue made it possible to distinguish between different types of blood cells, which led to the capability to diagnose numerous blood diseases.

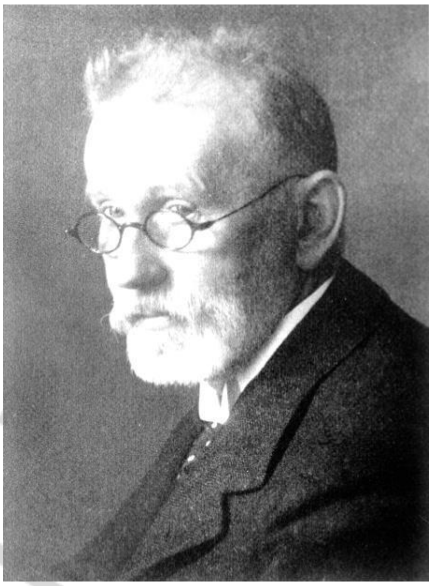

Fig. 31. Paul Ehrlich

His laboratory discovered arsphenamine (Salvarsan), the first effective medicinal treatment for syphilis, thereby initiating and also naming the concept of chemotherapy. Ehrlich popularized the concept of a magic bullet. He also made a decisive contribution to the development of an antiserum to combat diphtheria and conceived a method for standardizing therapeutic serums.

In 1908, he received the Nobel Prize in Physiology or Medicine for his contributions to immunology. He was the founder and first director of what is now known as the Paul Ehrlich Institute.

FRANÇOIS MAGENDIE

François Magendie (6 October 1783 – 7 October 1855) was a French physiologist, considered a pioneer of experimental physiology. He is known for describing the foramen of Magendie. There is also a Magendie sign, a downward and inward rotation of the eye due to a lesion in the cerebellum. Magendie was a faculty at the College of France, holding the Chair of Medicine from 1830 to 1855 (he was succeeded by Claude Bernard, who worked previously as his assistant).

CLAUDE BERNARD

Claude Bernard (12 July 1813 – 10 February 1878) was a French physiologist. Historian Ierome Bernard Cohen of Harvard University called Bernard «one of the greatest of all men of science». Among many other accomplishments, he was one of the first to suggest the use of blind experiments to ensure the objectivity of scientific observations. He was the first to define the term milieu intérieur, now known as homeostasis.

Claude Bernard's first important work was on the functions of the pancreas gland, the juice of which he proved to be of great significance in the process of digestion; this achievement won him the prize for experimental physiology from the French Academy of Sciences.

A second investigation — perhaps his most famous — was on the glycogenic function of the liver; in the course of his study he was led to the conclusion, which throws light on the causation of diabetes mellitus, that the liver, in addition to secreting bile, is the seat of an internal secretion, by which it prepares sugar at the expense of the elements of the blood passing through it.

A third research resulted in the discovery of the vaso-motor system. In 1851, while examining the effects produced in the temperature of various parts of the body by section of the nerve or nerves belonging to them, he noticed that division of the cervical sympathetic nerve gave rise to more active circulation and more forcible pulsation of the arteries in certain parts of the head, and a few months afterwards he observed that electrical excitation of the upper portion of the divided nerve had the contrary effect. In this way he established the existence of vaso-motor nerves, both vaso-dilator and vaso-constrictor.

THE CLASSIFICATION OF DISEASES

Nosology (from Ancient Greek νόσος (nosos), meaning «disease», and — λογία (-logia), meaning «study of-») is a branch of medicine that deals with classification of diseases.

The **Ayurveda** is a collection of early Indian works about medicine. In China the **Huangdi Neijing** is another ancient text. In the West, **Hippocrates** was one of the earliest writers on the subject of disease. The Metzora (parsha) also includes an early discussion of the treatment of skin diseases.

In the 10th century the Arabian psychologist Najab ud-din Unhammad classified a nosology of nine major categories of mental disorders, which included 30 different mental illnesses in total. Some of the categories he described included obsessive-compulsive disorders, delusional disorders, degenerative diseases, involutional melancholia, and states of abnormal excitement.

In the 18th century, the taxonomist **Carl Linnaeus, Francois Boissier de Sauvages**, and psychiatrist **Philippe Pinel** developed an early classification of physical illnesses. **Thomas Sydenham's** work in the late 17th century might also be considered a nosology. In the **19th century, Emil Kraepelin** and then **Jacques Bertillon** developed their own nosologies. Bertillon's work, classifying causes of death, was a precursor of the modern code system, the International Classification of Diseases.

The early nosological efforts grouped diseases by their symptoms, whereas modern systems (e.g. SNOMED) focus on grouping diseases by the anatomy and etiology involved.

THE HISTORY OF THE RED CROSS

The creation of the Red Cross was spurred by the publication of Un Souvenir de Solférino (1862), an account by **Jean Henri Dunant** of the suffering endured by the wounded at the battle of Solferino in 1859. Dunant, a Swiss citizen, urged the formation of voluntary aid societies for relief of such war victims. He also asked that service to military sick and wounded be neutral.

The Société genovoise d'Utilité publique, a Swiss welfare agency, actively seconded Dunant's suggestion, the result being the formation (1863) of the organization that became known as the Red Cross. The next year, delegates from 16 nations met in Switzerland, and the Geneva Convention of 1864 for the Amelioration of the Condition of the Wounded and Sick of Armies in the Field was adopted and signed by 12 of the nations represented. It provided for the neutrality of the medical personnel of armed forces, the humane treatment of the wounded, the neutrality of civilians who voluntarily assisted them, and the use of an international emblem to mark medical personnel and supplies. In honor of Dunant's nationality, a red cross on a white background—the Swiss flag with colors reversed—was chosen as this symbol (fig. 32).

Fig. 32. The Red Cross and Red Crescent emblems

The original Geneva Convention, its subsequent revisions, and allied treaties such as the Hague Convention for naval forces and the Prisoner of War Convention have been signed (although not always ratified) by almost all countries and their dependencies. The International Committee of the Red Cross was awarded the Nobel Peace Prize in 1917, 1944, and, with the League of Red Cross Societies, in 1963.

The Red Crescent, which was first used by the Ottoman Empire in 1876, was formally recognized by the League of Red Cross Societies in 1929. Iran used the Red Lion and Sun, formally recognized in 1949, until 1980. The adoption of the Red Crystal symbol in 2005 (effective in 2007), although occurring primarily as a means to provide an emblem under which Israel's Magen David Adom could become a full member (2006) of the international movement, also established a neutral emblem that could be used by any national society that preferred to avoid using the Christian cross or Islamic crescent.

MOVEMENT OF NURSES

FLORENCE NIGHTINGALE

Florence Nightingale (12 May 1820 – 13 August 1910) (fig. 33), was a celebrated English social reformer and statistician, and the founder of modern nursing.

She came to prominence while serving as a manager of nurses trained by her during the Crimean War, where she organised the tending to wounded soldiers. She gave nursing a highly favourable reputation and became an icon of Victorian culture, especially in the person of «The Lady with the Lamp» making rounds of wounded soldiers at night.

Fig. 33. Florence Nightingale

In 1860, Nightingale laid the foundation of professional nursing with the establishment of her nursing school at St Thomas' Hospital in London. It was the first secular nursing school in the world, now part of King's College London. The Nightingale Pledge taken by new nurses was named in her honour, and the annual International Nurses Day is celebrated around the world on her birthday. Her social reforms include improving healthcare for all sections of British society, advocating better hunger relief in India, helping to abolish prostitution laws that were over-harsh to women, and expanding the acceptable forms of female participation in the workforce.

Nightingale was a prodigious and versatile writer. In her lifetime, much of her published work was concerned with spreading medical knowledge. Some of her works were written in simple English. She also helped popularise the graphical presentation of statistical data.

Florence Nightingale's most famous contribution came during the Crimean War, which became her central focus when reports got back to Britain about the horrific conditions for the wounded. On 21 October 1854, she and the staff of 38 women volunteer nurses that she trained, including her aunt Mai Smith, and 15 Catholic nuns (mobilised by Henry Edward Manning) were sent (under the authorisation of Sidney Herbert) to the Ottoman Empire. Nightingale was assisted in Paris by her friend Mary Clarke. They were deployed about 295 nautical miles (546 km; 339 mi) across the Black Sea from Balaklava in the Crimea, where the main British camp was based.

Nightingale was considered a pioneer in the concept of medical tourism as well, based on her 1856 letters describing spas in the Ottoman Empire. She detailed the health conditions, physical descriptions, dietary information, and other vital details of patients whom she directed there. The treatment there was significantly less expensive than in Switzerland.

Florence Nightingale exhibited a gift for mathematics from an early age and excelled in the subject under the tutorship of her father. Later, Nightingale became a pioneer in the visual presentation of information and statistical graphics. She used methods such as the pie chart, which had first been developed by William Playfair in 1801. While taken for granted now, it was at the time a relatively novel method of presenting data (fig. 34).

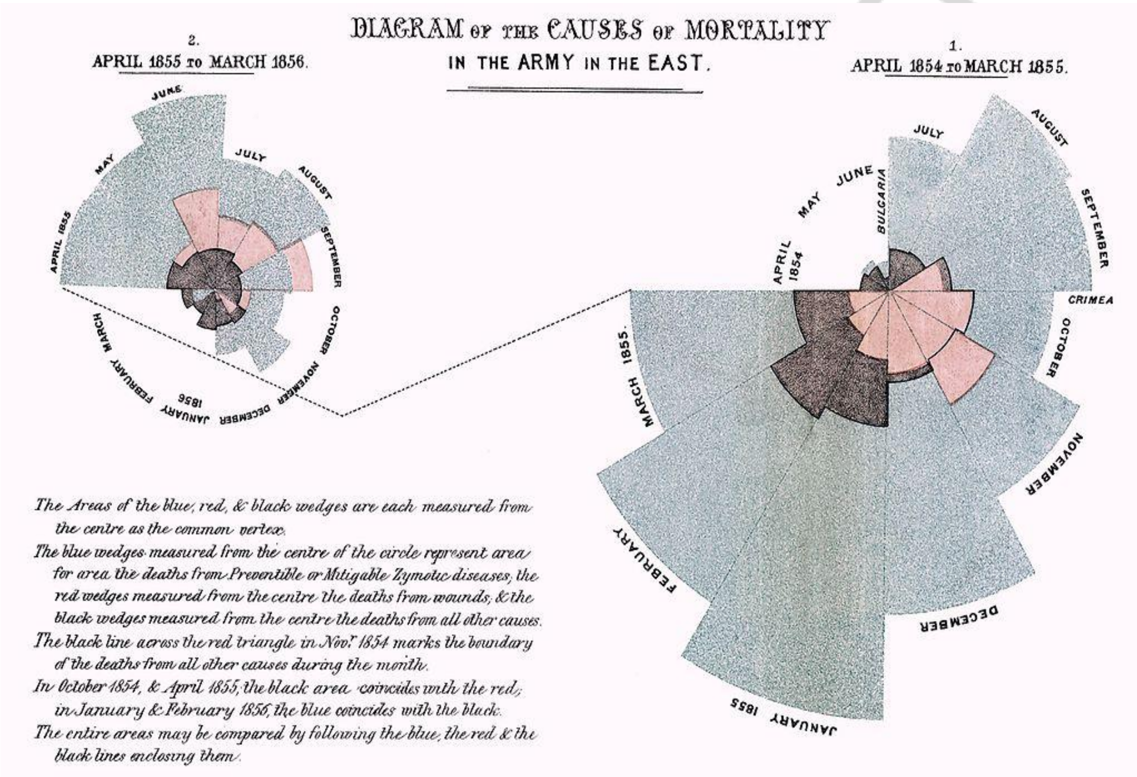

Fig. 34. The Diagram of the Causes of Mortality in the Army in the East (Fl. Nightingale)

Indeed, Nightingale is described as «a true pioneer in the graphical representation of statistics», and is credited with developing a form of the pie chart now known as the polar area diagram, or occasionally the Nightingale rose diagram, equivalent to a modern circular histogram, to illustrate seasonal sources of patient mortality in the military field hospital she managed. Nightingale called a compilation of such diagrams a «coxcomb», but later that term would frequently be used for the individual diagrams. She made extensive use of coxcombs to present reports on the nature and magnitude of the conditions of medical care in the Crimean War to Members of Parliament and civil servants who would have been unlikely to read or understand traditional statistical reports. In 1859, Nightingale was elected the first female member of the Royal Statistical Society. She later became an honorary member of the American Statistical Association.

THE FORMATION OF TOPOGRAPHIC ANATOMY AS A SCIENCE IN RUSSIAN EMPIRE

PETER ANDREEVICH ZAGORSKI

Peter Andreevich Zagorski (1764–1846) — the founder of an independent domestic anatomic schools, in addition, he was the first in Russia, who laid the foundations of experimental and comparative physiology. He was the follower of the evolutionary view of anatomy. Zagorski tested Russian anatomical terminology in his book «Condensed Anatomy» (1802).

ILYA VASILEVICH BUYALSKY

Ilya Vasilevich Buyalsky (1789–1866) — Russian anatomist and surgeon, academician of the Imperial Academy of Arts.

He created surgical instruments of domestic production, provided a surgical instrument to displace tissue without damaging them, which is a narrow spatula of slightly curved oval shape with a smooth surface and a blunt, equipped with a flat handle (blade Buyalsky).

He implemented drainage of paravesical area, carried out through the obturator foramen.

Together with the sculptor P. K. Klodt and artist A. P. Sapozhnikov, using the method of freezing a corpse, he created an anatomical muscular figure «The lying body», which was cast in bronze and sent to London and Paris academies.

He invented the way of embalming human bodies.

Buyalsky is the author of one of the first Russian guidelines for forensic medicine. The most significant work by Buyalsky is «Anatomical and Surgical Tables», published in three parts (1828, 1835, 1852). It is the first Russian original atlas of operative surgery. The total number of works by Buyalsky reaches 100, among them anatomical atlases and guides.

NIKOLAI IVANOVICH PIROGOV

Nikolai Ivanovich Pirogov (25 November [O.S. 13 November] 1810 – 5 December [O.S. 23 November] 1881) was a prominent Russian scientist, medical doctor, pedagogue, public figure, and corresponding member of the Russian Academy of Sciences (1847). Topographical anatomy appeared when N.Pirogov began to use frozen corpses. This allowed surgeons to be aware of the mutual arrangement of tissues, which are discussed in detail in Pirogov's atlas, and this led to less traumatization of operated and faster recovery. Also Pirogov's atlas became the basis in the applied field of surgery — surgical surgery. He is considered to be the founder of field surgery, and was one of the first surgeons in Europe to use ether as an anaesthetic. He was the first surgeon to use anaesthesia in a field operation (1847), invented various kinds of surgical operations, and developed his own technique of using plaster casts to treat fractured bones. He is one of the most widely recognized Russian physicians.

Peter Franzevich Lesgaft

Peter Franzevich Lesgaft (1837–1909) was a Russian teacher, anatomist, physician and social reformer. He was the founder of the modern system of physical education and medical-pedagogical control in physical training, one of the founders of theoretical anatomy. Lesgaft National State University of Physical Education, Sport and Health in St. Petersburg is named after him. Unity and integrity of all organs in human body was the basis of Peter Lesgaft system of exercises for both physical development and intellectual, moral and aesthetic education.

Outdoor games were his favorite means in both physical development and formation of character of a child.

GENERAL AND LOCAL ANESTHESIA

History of anesthesia discovery

– **1799** — Humphrey Davy discovered **nitrous oxide** NO (laughing gas). It was used only for entertainment.

– **1829** — Michael Faraday showed similar effect of **ether.**

– **1844** — Horace Wells uses NO as dentistry anesthetic, but public demonstration was unsuccessful.

– **1846**, 16 October – John Collins Warren (1778–1856), of Boston, was one of the most renowned American surgeons of the 19th century. In 1846 he gave permission to William T.G. Morton to provide ether anesthesia while Warren performed a minor surgical procedure. News of this first public demonstration of surgical anesthesia quickly circulated around the world.

– **1847** — James **Simpson** in England started to use **chloroform** for painless childbirth.

– **1853** — Charles Pravaz and Alexander Wood invented **syringe.**

Crawford Williamson Long (November 1, 1815 – June 16, 1878) was an American surgeon and pharmacist best known for his first use of inhaled sulfuric ether as an anesthetic.

N. I. Pirogov was the first surgeon to use anaesthesia in a field operation (1847).

BLOODLESS SURGERY

EMIL THEODOR KOCHER

Emil Theodor Kocher (25 August 1841 – 27 July 1917) was a Swiss physician and medical researcher who received the 1909 Nobel Prize in Physiology or Medicine for his work in the physiology, pathology and surgery of the thyroid. Among his many accomplishments are the introduction and promotion of aseptic surgery and scientific methods in surgery, specifically reducing the mortality of thyroidectomies below 1% in his operations.

Kocher had recognized the importance of aseptic techniques early on, introducing them to his peers at a time when this was considered revolutionary. In a hospital report from 1868, he attributed the lower mortality directly to the "antiseptic Lister's wound bandaging method" and he could later (as director of the clinic) order strict adherence to the antiseptic method.

Kocher also contributed significantly to the field of neurology and neurosurgery. In this area, his research was pioneering and covered the areas of concussion, neurosurgery and intracranial pressure.

Thyroid surgery, which was mostly performed as treatment of goitre with a complete thyroidectomy when possible, was considered a risky procedure when Kocher started his work. Some estimates put the mortality of thyroidectomy as high as 75% in 1872. Indeed, the operation was believed to be one of the most dangerous operations and in France it was prohibited by the Academy of Medicine at the time. Through application of modern surgical methods, such as antiseptic wound treatment and minimizing blood loss, and the famous slow and precise style of Kocher, he managed to reduce the mortality of this operation from an already low 13% (compared to contemporary standards) to less than 0.5% by 1912. By then, Kocher had performed over 5000 thyroid excisions.

THEODOR BILROTH

Christian Albert Theodor Billroth (26 April 1829 – 6 February 1894) was a Prussian-born Austrian surgeon and amateur musician. As a surgeon, he is generally regarded as the founding father of modern abdominal surgery.

Billroth worked as a doctor from 1853–1860 at the Charité in Berlin. In Berlin he was also apprenticed to Carl Langenbuch. From 1860–1867 he was Professor at the University of Zurich and director of the surgical hospital and clinic in Zurich. While in Zurich, Billroth published his classic textbook Die allgemeine chirurgische Pathologie und Therapie (General Surgical Pathology and Therapy) (1863). At the same time he introduced the concept of audits, publishing all results, good and bad, which automatically resulted in honest discussion on morbidity, mortality, and techniques — with resultant improvements in patient selection. He was appointed professor of surgery at the University of

Vienna in 1867 and practiced surgery as chief of the Second Surgical Clinic at the Allgemeine Krankenhaus (Vienna General Hospital).

An early adopter of the white coat, Billroth was directly responsible for a number of landmarks in surgery, including the first esophagectomy (1871), the first laryngectomy (1873), and most famously, the first successful gastrectomy (1881) for gastric cancer, after many ill-fated attempts. Legend has it that Billroth was nearly stoned to death in the streets of Vienna when his first gastrectomy patient died after the procedure.

Billroth was instrumental in establishing the first modern school of thought in surgery. Among his disciples were luminaries such as Alexander von Winiwarter, Jan Mikulicz-Radecki and John B. Murphy. William Halsted's pioneer surgical residency program was greatly influenced by Billroth's own methods of surgical education.

DEVELOPMENT OF ASEPTICS AND ANTISEPTICS PRINCIPLES

IGNAZ PHILIPP SEMMELWEIS

Ignaz Philipp Semmelweis (1 July 1818 – 13 August 1865) was a Hungarian physician of German origin now known as an early pioneer of antiseptic procedures. Described as the «savior of mothers», Semmelweis discovered that the incidence of puerperal fever (also known as «childbed fever») could be drastically cut by the use of hand disinfection in obstetrical clinics. Puerperal fever was common in mid-19th-century hospitals and often fatal, with mortality at 10–35%. Semmelweis proposed the practice of washing hands with chlorinated lime solutions in 1847 while working in Vienna General Hospital's First Obstetrical Clinic, where doctors' wards had three times the mortality of midwives' wards. He published a book of his findings in Etiology, Concept and Prophylaxis of Childbed Fever.

JOSEPH LISTER

Joseph Lister (1827–1912) was a Scottish surgeon who picked up the work of Louis Pasteur and used it to change the success rates of surgery. In 1865 Lister read about Pasteur's work on how wine went bad because of microorganisms in the air. Lister was convinced that microorganisms in the air were also the cause of the infections which killed up to half of his patients after they had successfully survived surgery. The open wounds made it easy for the germs to get into the body.

Lister had heard that carbolic acid had been used to get rid of a cattle parasite in fields, and to treat sewage. He decided to see if it could also stop wounds becoming infected. He started to clean the wounds of his patients with carbolic acid, and soak the dressings in antiseptic liquid as well. In the years from 1864-

66 the death rate for Lister's surgical patients was 45.7%. Between 1867-70, when he introduced his new antiseptic treatment, this fell to 15%.

Lister went on to develop an antiseptic spray which was used in operating theatres during surgery to keep the wound clean. This spray was not used for long though, because carbolic acid actually damages the tissues and breathing it in causes many problems. More successful was the special dressings he developed which contained carbolic acid to keep the wound clean but a barrier to keep it away from the flesh so it didn't cause any damage.

Lister's work revolutionised surgery once his aseptic techniques were accepted. Although the antiseptics and disinfectants used have changed, aseptic surgery is still the basis of saving millions of lives.

BLOOD GROUPS

Two blood group systems were discovered by **Karl Landsteiner** during early experiments with blood transfusion: the ABO group in 1901 and in co-operation with Alexander S. Wiener the Rhesus group in 1937. Development of the Coombs test in 1945, the advent of transfusion medicine, and the understanding of ABO hemolytic disease of the newborn led to discovery of more blood groups, and now 33 human blood group systems are recognized by the International Society of Blood Transfusion (ISBT), and across the 33 blood groups, over 600 different blood group antigens have been found; many of these are very rare or are mainly found in certain ethnic groups.

Czech serologist **Jan Janský** is credited with the first classification of blood into the four types (A, B, AB, O) in 1907, which remains in use today. Blood types have been used in forensic science and were formerly used to demonstrate impossibility of paternity (e.g., a type AB man cannot be the father of a type O infant), but both of these uses are being replaced by genetic fingerprinting, which provides greater certainty.

DEVELOPMENT OF PHYSIOLOGY

ALEXEY MATVEEVICH FILOMAFITSKY

Alexey Matveevich Filomafitsky (1807–1849) was an early advocate of the experimental method in Russian medical physiology. With N. I. Pirogov he developed a method of intravenous anesthesia, studied questions of physiology of breathing, digestion, blood transfusion (A Treatise on blood transfusion, 1848); created an apparatus for blood transfusion, a mask to ether anesthesia and other physiological devices.

EFREM OSIPOVICH MUKHIN

Efrem Osipovich Mukhin (1766–1850) along with the issues of anatomy and physiology also dealt with surgery; he published «the First beginning of chiropractice science», «Description of surgical operations and other And».

IVAN MIKHAYLOVICH SECHENOV

Ivan Mikhaylovich Sechenov (1829–1905) named by Ivan Pavlov as «The Father of Russian physiology». Sechenov authored the classic Reflexes of the Brain introducing electrophysiology and neurophysiology into laboratories and teaching of medicine.

Selected works:

– 1860 Some facts for the future study of alcohol intoxication, in Russian;
– 1862 On animal electricity, in Russian;
– 1863 Reflexes of the brain, in Russian;
– 1866 Physiology of the nervous system, in Russian;
– 1873 Who should develop Psychology and how to do it, in Russian;
– 1897 The Physiological Criteria of the Length of the Working Day;
– 1900 Participation of the Nervous System in Man's Working Movements;
– 1901 Participation of the Senses and Manual dexterity in Sighted and Blind Persons;
– 1901 Essay on Man's Working Movements.

IVAN PETROVICH PAVLOV

Ivan Petrovich Pavlov (26 September [O.S. 14 September] 1849 – 27 February 1936) was a Russian physiologist known primarily for his work in classical conditioning. From his childhood days Pavlov demonstrated intellectual brilliance along with an unusual energy which he named «the instinct for research». Inspired by the progressive ideas which D. I. Pisarev, the most eminent of the Russian literary critics of the 1860s, and I. M. Sechenov, were spreading, Pavlov abandoned his religious career and decided to devote his life to science. In 1870 he was enrolled in the physics and mathematics faculty at the University of Saint Petersburg to take the course in natural science. Ivan Pavlov devoted his life to the study of physiology and sciences, making several remarkable discoveries and ideas that were passed on from generation to generation. He won the Nobel Prize for Physiology or Medicine in 1904, becoming the first Russian Nobel laureate. A Review of General Psychology survey, published in 2002, ranked Pavlov as the 24th most cited psychologist of the 20th century. Pavlov's principles of classical conditioning have been found to operate across a variety of experimental and clinical settings, including educational classrooms.

Pavlov contributed to many areas of physiology and neurological sciences. Most of his work involved research in temperament, conditioning and involuntary reflex actions. Pavlov performed and directed experiments on digestion, eventually publishing The Work of the Digestive Glands in 1897, after 12 years of research. His experiments earned him the 1904 Nobel Prize in Physiology and Medicine. These experiments included surgically extracting portions of the digestive system from animals, severing nerve bundles to determine the effects, and implanting fistulas between digestive organs and an external pouch to examine the organ's contents. This research served as a basis for broad research on the digestive system.

Further work on reflex actions involved involuntary reactions to stress and pain. Pavlov extended the definitions of the four temperament types under study at the time: phlegmatic, choleric, sanguine, and melancholic, updating the names to «the strong and impetuous type, the strong equilibrated and quiet type, the strong equilibrated and lively type, and the weak type». Pavlov and his researchers observed and began the study of transmarginal inhibition, the body's natural response of shutting down when exposed to overwhelming stress or pain by electric shock. This research showed how all temperament types responded to the stimuli the same way, but different temperaments move through the responses at different times. He commented «that the most basic inherited difference... was how soon they reached this shutdown point and that the quick-to-shut-down have a fundamentally different type of nervous system».

NIKOLAY EVGENYEVICH VVEDENSKY

N. E. Vvedensky's research was devoted to clarifying the regularities in the reaction of living tissue to various irritants. Having applied the method of telephonic auscultation of the excited nerve he showed that a living system changes not only under the influence of irritation but also during its normal activity; he thus introduced the time factor into physiology. In his master's thesis «Telephonic Research on Electrical Phenomena in Muscle and Nerve Apparatus», N. E. Vvedensky provided a thorough analysis of the literature on muscle contracrtion and nerve fatigue. In his doctoral dissertation «On the Relationship Between Stimulus and Excitation in Tetanus» (1886) he formulated the theory of the optimum and minimum irritation, on the basis of which he established the law of relative functional movement (lability) of tissue. N.E.Vvedensky examined nerve muscle preparations as heterogeneous formations (consisting of nerve tissue, nerve endings, and muscles), which possess different lability.

Vvedensky's outstanding achievement was his theory of parabiosis, developed in «Excitation, Inhibition, and Narcosis» (1901), in which he generalized his ideas on the nature of the processes of excitation and inhibition, showing their identity.

THE NOBEL PRIZE

WINNERS OF THE NOBEL PRIZE IN PHYSIOLOGY OR MEDICINE

1901 — Emil von Behring «for his work on serum therapy, especially its application against diphtheria, by which he has opened a new road in the domain of medical science and thereby placed in the hands of the physician a victorious weapon against illness and deaths».

1902 — Ronald Ross «for his work on malaria, by which he has shown how it enters the organism and thereby has laid the foundation for successful research on this disease and methods of combating it».

1903 — Niels Ryberg Finsen «in recognition of his contribution to the treatment of diseases, especially lupus vulgaris, with concentrated light radiation, whereby he has opened a new avenue for medical science».

1904 — Ivan Pavlov «in recognition of his work on the physiology of digestion, through which knowledge on vital aspects of the subject has been transformed and enlarged».

1905 — Robert Koch «for his investigations and discoveries in relation to tuberculosis».

1906 — Camillo Golgi and Santiago Ramón y Cajal «in recognition of their work on the structure of the nervous system».

1907 — Alphonse Laveran «in recognition of his work on the role played by protozoa in causing diseases».

1908 — Ilya Ilyich Mechnikov and Paul Ehrlich «in recognition of their work on immunity».

1909 — Theodor Kocher «for his work on the physiology, pathology and surgery of the thyroid gland».

1910 — Albrecht Kossel «in recognition of the contributions to our knowledge of cell chemistry made through his work on proteins, including the nucleic substances».

1911 — Allvar Gullstrand «for his work on the dioptrics of the eye».

1912 — Alexis Carrel «in recognition of his work on vascular suture and the transplantation of blood vessels and organs».

1913 — Charles Richet «in recognition of his work on anaphylaxis».

1914 — Robert Bárány «for his work on the physiology and pathology of the vestibular apparatus».

1915–1918 — No Nobel Prize was awarded these years. The prize money was allocated to the Special Fund of this prize section.

MODERN TIME MEDICINE (XX–XXI CENTURY)

The 20th century has produced such a plethora of discoveries and advances that in some ways the face of medicine has changed out of all recognition.

For instance, the average life expectancy in the countries of the world, a primary indicator of the effect of health care on mortality (but also reflecting the state of health education, housing, and nutrition), has increased.

The average life expectancy in the countries of the world at different times

The average life expectancy in the countries of the world at different times	**United Kingdom**	**Germany**	**Russia**	**USA**	**France**	**Japan**	**Roman Empire**	**Worldwide**
200	–						21	
XIII century AD	35							
XVI century AD	33–38							
XVII century AD	34–39							
1701–1750	32–38			50–51				
1751–1800	35–39			44–56	26–36			
1801–1850	38–50	37–38	40–50	39–43	32–42	36–38		
1851–1900	41–50	37–47	40–50	37–50	40–47	36–44		
1901–1950	47–69	44–67	50–58	49–68	46–67	37–61		
1951–2000	69–77	68–77	59–69	69–76	67–78	62–80		47–66

Other industrialized nations showed similar dramatic increases. Indeed, the outlook has so altered that, with the exception of diseases such as cancer and AIDS, attention has become focused on morbidity rather than mortality, and the emphasis has changed from keeping people alive to keeping them fit.

The rapid progress of medicine in this era was reinforced by enormous improvements in communication between scientists throughout the world (through publications, conferences, and—later—computers and electronic media). Although **specialization increased, teamwork became the norm.** It consequently has become **more difficult to ascribe medical accomplishments to particular individuals**.

In the first half of the century, emphasis continued to be placed on combating infection, and notable landmarks were also attained in endocrinology, nutrition, and other areas. **In the years following World War II**, insights derived from cell biology altered basic concepts of the disease process; new discoveries in biochemistry and physiology opened the way for more precise diagnostic tests and more effective therapies; and spectacular advances in biomedical engineering enabled the physician and surgeon to probe into the structures and functions of the body by noninvasive imaging techniques like ultrasound (sonar), computerized axial tomography (CAT), and nuclear magnetic resonance (NMR). With each new scientific development, medical practices of just a few years earlier became obsolete.

MEDICINE

Placebo–controlled, randomized, blinded clinical trials became a powerful tool for testing new medicines.

Discovery of penicillin had changed the world of modern medicine by introducing the age of antibiotics.

Antibiotics drastically reduced mortality from bacterial diseases and their prevalence.

A vaccine was developed for polio, ending a worldwide epidemic. Effective vaccines were also developed for a number of other serious infectious diseases, including influenza, diphtheria, pertussis (whooping cough), tetanus, measles, mumps, rubella (German measles), chickenpox, hepatitis A, and hepatitis B.

Epidemiology and vaccination led to the eradication of the smallpox virus in humans.

X–rays became a powerful diagnostic tool for a wide spectrum of diseases, from bone fractures to cancer. In the 1960s, computerized tomography was invented. Other important diagnostic tools developed were sonography and magnetic resonance imaging.

Development of vitamins virtually eliminated scurvy and other vitamin–deficiency diseases from industrialized societies.

New psychiatric drugs were developed. These include antipsychotics for treating hallucinations and delusions, and antidepressants for treating depression.

The role of tobacco smoking in the causation of cancer and other diseases was proven during the 1950s (see British Doctors Study).

New methods for cancer treatment, including chemotherapy, radiation therapy, and immunotherapy, were developed. As a result, cancer could often be cured or placed in remission.

The development of blood typing and blood banking made blood transfusion safe and widely available.

The invention and development of immunosuppressive drugs and tissue typing made organ and tissue transplantation a clinical reality.

New methods for heart surgery were developed, including pacemakers and artificial hearts.

Cocaine/crack and heroin were found to be dangerous addictive drugs, and their wide usage had been outlawed; mind–altering drugs such as LSD and MDMA were discovered and later outlawed. In many countries, a war on drugs caused prices to soar 10x–20x higher, leading to profitable black market drugdealing, and to prison inmate sentences being 80% related to drug use by the 1990s.

Contraceptive drugs were developed, which reduced population growth rates in industrialized countries.

The development of medical insulin during the 1920s helped raise the life expectancy of diabetics to three times of what it had been earlier.

Vaccines, hygiene and clean water improved health and decreased mortality rates, especially among infants and the young.

NOTABLE DISEASES

An influenza pandemic, Spanish Flu, killed anywhere from 20 to 100 million people between 1918 and 1919.

A new viral disease, called the Human Immunodeficiency Virus, or HIV, arose in Africa and subsequently killed millions of people throughout the world. HIV leads to a syndrome called Acquired Immunodeficiency Syndrome, or AIDS. Treatments for HIV remained inaccessible to many people living with AIDS and HIV in developing countries, and a cure has yet to be discovered.

Because of increased life spans, the prevalence of cancer, Alzheimer's disease, Parkinson's disease, and other diseases of old age increased slightly.

Sedentary lifestyles, due to labor–saving devices and technology, contributed to an "epidemic" of obesity, at first in the rich countries, but by the end of the 20th century spreading to the developing world.

Specialization and integrity of medicine.

The XXIst century is the current century of the Anno Domini era or the Common Era, in accordance with the Gregorian calendar.

2003 — Completion of the Human Genome Project

2003 — Severe acute respiratory syndrome (SARS) spreads around the globe.

2005 — The first successful partial face transplant is performed in France.

2006 — Australian of the Year Dr Ian Frazer develops a vaccine for cervical cancer.

2007 — Visual prosthetic (bionic eye) Argus II.

2008 — Japanese scientists create a form of artificial DNA.

2008 — Laurent Lantieri performs the first full face transplant.

2009 — Influenza A virus subtype H1N1 spreads around the globe.

2012 — The first successful complete face transplant is performed in Turkey.

2012 — Doubts raised over Statin medication.

2013 — First kidney grown in vitro in the U.S.

2013 — First human liver grown from stem cells in Japan.

2014 — Ebola virus spreads in Western Africa, prompting the largest ever epidemic, with more than 20,000 cases. The first cases outside Africa are reported.

INFECTIOUS DISEASES AND CHEMOTHERAPY

In the years following the turn of the century, ongoing research concentrated on the nature of infectious diseases and their means of transmission. Increasing numbers of pathogenic organisms were discovered and classified. Some, such as the rickettsias, which cause diseases like typhus, were smaller than bacteria; some were larger, such as the protozoans that engender malaria and other tropical diseases. The smallest to be identified were the viruses, producers of many diseases, among them mumps, measles, German measles, and poliomyelitis; and in 1910 Peyton Rous showed that avirus could also cause a malignant tumour, a sarcoma in chickens.

There was still little to be done for the victims of most infectious organisms beyond drainage, poultices, and ointments, in the case of local infections, and rest and nourishment for severe diseases. The search for treatments aimed at both vaccines and chemical remedies.

EHRLICH AND ARSPHENAMINE

Germany was well to the forefront in medical progress. The scientific approach to medicine had been developed there long before it spread to other countries, and postgraduates flocked to German medical schools from all over the world. The opening decade of the 20th century has been well described as the golden age of German medicine. Outstanding among its leaders was **Paul Ehrlich**.

While still a student, Ehrlich carried out some work on lead poisoning from which he evolved the theory that was to guide much of his subsequent work — that certain tissues have a selective affinity for certain chemicals. He experimented with the effects of various chemical substances on disease organisms. In 1910, with his colleague **Sahachiro Hata**, he conducted tests on Salvarsan (arsphenamine). Their success inaugurated the chemotherapeutic era, which was to revolutionize the treatment and control of infectious diseases. Salvarsan, a synthetic preparation containing arsenic, is lethal to the microorganism responsible for syphilis. Until the introduction of penicillin, Salvarsan or one of its modifications remained the standard treatment of syphilis and went far toward bringing this social and medical scourge under control.

SULFONAMIDE DRUGS

In 1932 the German bacteriologist Gerhard Domagk announced that the red dye Prontosil is active against streptococcal infections in mice and humans. Soon afterward French workers showed that its active antibacterial agent is sulfanilamide. In 1936 the English physician **Leonard Colebrook** and his colleagues provided overwhelming evidence of the efficacy of both Prontosil and sulfanilamide in streptococcal septicemia (bloodstream infection), thereby ushering in the sulfonamide era. New sulfonamides, which appeared with astonishing rapidity, had greater potency, wider antibacterial range, or lower toxicity. Some stood the test of time; others were replaced by safer and more powerful successors.

ANTIBIOTICS PENICILLIN

By 1927, **A. Fleming** (fig. 35) was studying staphylococci. He noticed that one culture was contaminated with a fungus, and that the colonies of staphylococci that had surrounded it had been destroyed.

Fleming grew the mould in a pure culture and found that it produced a substance that killed a number of disease–causing bacteria. He called it penicillin.

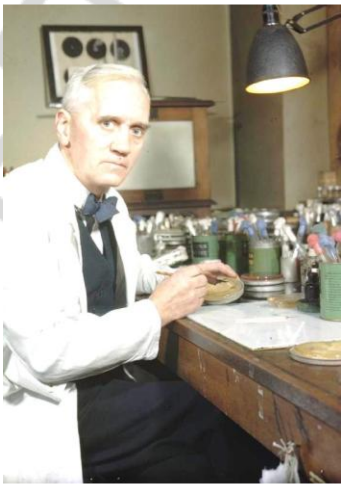

Fig. 35. Alexander Fleming

Penicillin affected bacteria such as staphylococci and many others that cause scarlet fever, pneumonia, meningitis and diphtheria, but not typhoid fever or paratyphoid fever.

In 1940 **F. W. Florey and E. B. Chain** (fig. 36, 37) discovered how to isolate and concentrate penicillin and understood its correct structure. It finally became practical drug.

Fleming, Florey and Chain received Nobel Prize in 1945.

In the Soviet Union in 1942, the Soviet microbiologist **Zinaida Yermolieva** (fig. 38) received penicillin from the mold Penicillium Crustosum, taken from the wall of one of the shelters in Moscow. In 1944, he began to be widely used in the treatment of wounded soldiers.

Fig. 36. Foward Walter Florey

Fig. 37. Ernst Boris Chain

Fig. 38. Zinaida Vissarionovna Yermolieva

ANTITUBERCULOUS DRUGS

While penicillin is the most useful and the safest antibiotic, it suffers from certain disadvantages. The most important of these is that it is not active against *Mycobacterium tuberculosis*, the bacillus of tuberculosis. In view of the importance of tuberculosis as a public health hazard, this is a serious defect. The position was rapidly rectified when, in 1944, **Selman Waksman, Albert Schatz**, and **Elizabeth Bugie** announced the discovery of streptomycin from cultures of a soil organism, *Streptomyces griseus*, and stated that it was active against *M. tuberculosis*. Subsequent clinical trials amply confirmed this claim. The M. tuberculosis becomes resistant to it. But with a combination of two or more of preparations, the outlook in tuberculosis improved immeasurably. The disease was brought well under control.

IMMUNIZATION AGAINST VIRAL DISEASES

With the exception of smallpox, it was not until well into the 20th century that efficient viral vaccines became available. In fact, it was not until the 1930s that much began to be known about viruses. The two developments that contributed most to the rapid growth in knowledge after that time were the introduction of tissue culture as a means of growing viruses in the laboratory and the availability of the electron microscope. Once the virus could be cultivated with comparative ease in the laboratory, the scientist could research. **There are two requirements for vaccines — safety and effectiveness**.

The first of the viral vaccines to result from these advances was for yellow fever, developed by the microbiologist Max Theiler in the late 1930s. About 1945 the first relatively effective vaccine was produced for influenza; in 1954 the American physician **Jonas E. Salk** introduced a vaccine for poliomyelitis; and in 1960 an oral poliomyelitis vaccine, developed by the virologist **Albert B. Sabin**, came into wide use.

In the case of influenza, a major complication is the disturbing proclivity of the virus to change its character from one epidemic to another. Even so, sufficient progress has been made to ensure that a pandemic like the one that swept the world in 1918–19, killing more than 15,000,000 people, is unlikely to occur again. Centres are now equipped to monitor outbreaks of influenza throughout the world in order to establish the identity of the responsible viruses and, if necessary, take steps to produce appropriate vaccines.

During the 1960s effective vaccines came into use for measles and rubella (German measles).

In 1974, the World Health Organization (WHO) has launched a major international campaign, called Expanded Programme on Immunization (EPI). The aim of programme: to provide timely and full vaccination of children against the most important infectious diseases. These currently include **7 infections**: diphtheria, polio, tetanus, whooping cough, tuberculosis, measles, hepatitis B.

ENDOCRINOLOGY (INSULIN)

In 1869 Paul Langerhans, a medical student in Berlin, was studying the structure of the pancreas under a microscope.

He identified some different previously unnoticed tissue. Now it's known as the islets of Langerhans.

Edouard Laguesse later suggested they might produce secretions that play a regulatory role in digestion. The term «insulin» originates from insula, the Latin word for islet/island.

The pancreas's internal secretion which regulates sugar in the blood stream, might be the treatment of diabetes.

In 1921 Romanian physiologist **Nicolas C. Paulescu** reported the discovery of a substance called pancrein, now thought to have been insulin, in pancreatic extracts from dogs. Paulescu found that diabetic dogs given an injection of unpurified pancrein experienced a temporary decrease in blood glucose levels. Also in 1921, working independently of Paulescu, Canadian physician **Frederick Banting** and American–born Canadian physician **Charles H. Best** isolated insulin. They then worked with Canadian chemist **James B. Collip** and Scottish physiologist **J. J. R. Macleod** to purify the substance. The following year a 14–year–old boy with severe diabetes was the first person to be treated successfully with the pancreatic extracts. Almost overnight the lot of the diabetic patient changed from a sentence of almost certain death to a prospect not only of survival but of a long and healthy life.

Then Banting, Best, and Macleod, working at the University of Toronto, succeeded in isolating the elusive hormone and gave it the name insulin. Frederick Banting and J. J. R. Macleod won Nobel Prize in 1923.

Insulin was available in a variety of forms, but synthesis on a commercial scale was not achieved, and the only source of the hormone was the pancreas of animals.

VITAMINS

In the second half of the XIX century the nutritional value of products was believed to be determined by the content of protein, fat, carbohydrates, mineral salts and water. Mankind has accumulated considerable experience of long voyages, when people died of scurvy. Why? This question has not been answered.

In 1880, Russian scientist **Nikolai Lunin** studied the role of minerals in the diet. He noticed that mice with an artificial diet consisting of all known parts of milk (Casein, fat, sugar and salt), became ill and died. Mice that ate milk were active and healthy. «From this it follows that other substances in milk are essential for nutrition», — concluded the scientist.

Even after 16 years, scientists have found the cause of the disease «beriberi», common among residents of Japan and Indonesia. Residents of these countries generally ate purified rice.

Dr. Eikman (fig. 39), who worked in the prison hospital on the island of Java, watched the chickens in the yard. The chickens roamed the yard, they were fed purified grain rice. The birds suffered from illness resembling «beri–beri». As soon as purified rice replaced brown rice the disease occurred.

The first vitamin in a crystalline form was identified by the Polish scientist **Casimir Funk** in 1911.

A year later, he came up with the name — **vitamine**. It assumed that substances are amines, compounds derived from ammonia. When it was realized that they were not amines, the term was altered to **vitamin**.

In 1912 F. **Gowland Hopkins** (English biologist) (fig. 40) published the classical experiments. These experiments were so conclusive that it was clear — the «accessory substances» in the food were essential for health and growth. Hopkins discovered vitamins A and D and worked on products enriched with vitamins (eg., margarine).

Fig. 39. Christiaan Eikman

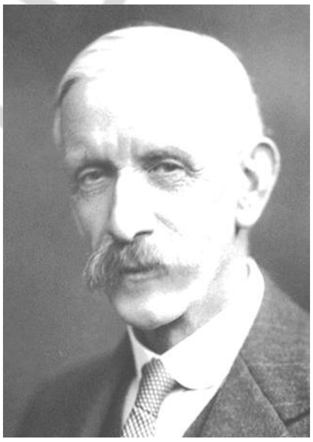

Fig. 40. Frederick Gowland Hopkins

Eikman and Hopkins both received the Nobel Prize in 1929.

The concept of vitamins had a scientific basis. After that there was a discovery of a long series of vitamins, best known by the letters of the alphabet.

Diet with vitamin supplements virtually eliminated diseases such as rickets (due to deficiency of vitamin D) and scurvy (due to lack of vitamin C, or ascorbic acid) in Western Europe.

The deficiency diseases such as beriberi (caused by lack of vitamin B_1, or thiamine), which were endemic in Eastern countries, either disappeared or could be remedied with the greatest ease.

The isolation of vitamin B_{12}, or cyanocobalamin, was of particular interest because it almost rounded off the fascinating story of how pernicious anemia was brought under control. Throughout the first two decades of the century, the diagnosis of pernicious anemia was nearly equivalent to a death sentence.

In 1948 almost at the same time in the United States and Britain, cyanocobalamin was isolated from liver. This vitamin became the standard treatment for pernicious anemia.

SURGERY IN THE 20TH CENTURY

Three seemingly insuperable obstacles beset the surgeon in the years before the mid–19th century: pain, infection, and shock. Once these were overcome, the surgeon believed that he could burst the bonds of centuries and become the master of his craft. There is more, however, to anesthesia than putting the patient to sleep. Infection, despite first antisepsis (destruction of microorganisms present) and later asepsis (avoidance of contamination), is still an ever–present menace; and shock continues to perplex physicians. But in the 20th century, surgery progressed farther, faster, and more dramatically than in all preceding ages.

The increasing scope of surgery led to specialization. Admittedly, most general surgeons had a special interest, and for a long time there had been an element of specialization in such fields as ophthalmology, orthopedics, obstetrics, and gynecology; but before long it became apparent that, to achieve progress in certain areas, surgeons had to concentrate their attention on that particular subject.

Organ transplantation is the moving of an organ from one body to another or from a donor site to another location on the patient's own body, for the purpose of replacing the recipient's damaged or absent organ.

Organs that can be transplanted are the heart, kidneys, liver, lungs, pancreas, intestine, and thymus. Tissues include bones, cornea, skin, heart valves, nerves and veins. Worldwide, the kidneys are the most commonly transplanted organs, followed by the liver and then the heart.

The first reasonable account is of the Indian surgeon Sushruta in the 2nd century BC, who used autografted skin transplantation in nose reconstruction, a rhinoplasty.

The first transplant in the modern sense — the implantation of organ tissue in order to replace an organ function — was a thyroid transplant in 1883. It was performed by the Swiss surgeon and later Nobel laureate **Theodor Kocher**.

In 1902 **Alexis Carrel** performed transplant experiments on dogs. He was surgically successful in moving kidneys, hearts, and spleens, he was one of the first to identify the problem of rejection.

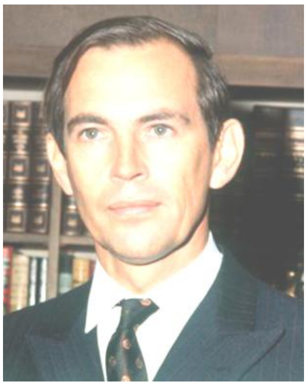

Fig. 41. Christiaan Neethling Barnard

The discovery of transplant immunity by the German surgeon **Georg Schöne**, various strategies of matching donor and recipient, and the use of different agents for immune suppression were important.

Apart from rejection issues, the heart deteriorates within minutes of death, so any operation would have to be performed at great speed. The development of the heart–lung machine was also needed.

The first success in heart transplantation was achieved on December 3, 1967, by **Christiaan Barnard** (fig. 41) in Cape Town, South Africa. The recipient survived for eighteen days.

Identifying the immune reactions in 1951, Medawar suggested that immunosuppressive drugs could be used. Cortisone had been recently discovered and the more effective azathioprine was identified in 1959.

With the discovery of cyclosporine in 1970 transplant surgery found a sufficiently powerful immunosuppressive.

SUPPORT FROM OTHER TECHNOLOGIES

The surgeon tried to do too much himself, but before long his failures taught him to share his problems with experts in other fields. This was especially so with respect to difficulties of biomedical engineering and the exploitation of new materials. The relative protection from infection given by antibiotics and chemotherapy allowed the surgeon to become far more adventurous. Much research was still needed to find the best material for a particular purpose and to make sure that it would be acceptable to the body.

Plastics, in their seemingly infinite variety, have come to be used for almost everything from suture material to heart valves; for strengthening the repair of hernias; for replacement of the head of the femur (first done by the French surgeon Jean Judet and his brother Robert–Louis Judet in 1950); for replacement of the lens of the eye after extraction of the natural lens for cataract; for valves to drain fluid from the brain in patients with hydrocephalus; and for many other applications. This is a far cry, indeed, from the unsatisfactory use of celluloid to restore bony defects of the face by the German surgeon Fritz Berndt in the 1890s. Inert metals, such as vitallium, have also found a place in surgery, largely in orthopedics for the repair of fractures and the replacement of joints.

The scope of surgery was further expanded by the introduction of the operating microscope. This brought the benefit of magnification particularly to neurosurgery and to ear surgery.

NEW REPRODUCTIVE TECHNOLOGIES

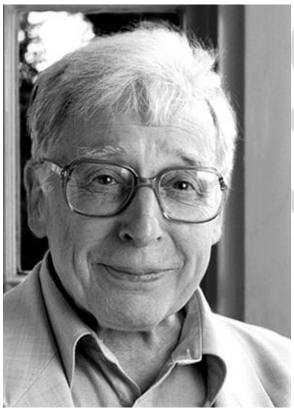

Fig. 42. Robert Geoffrey Edwards

Reproductive technologies can improve the quality of life for everyone and greatly reduce genetic disease.

In 1966 **Robert Edwards** (fig. 42) defined that human ovum matures in vitro in 36–37 hours after lutein hormone peak.

In 2010 he got the Nobel Prize for the in vitro artificial insemination technology.

Married couples that aren’t able to have children are given the ability to use their own genes to create a child of their own. These technologies can also allow parents to choose the physical and even mental attributes of their children. Despite whether these technologies are beneficial or not, controversy arises when the decision comes to how much they should be regulated. Some people want the technology banned altogether, while others want loose regulations or none at all. Most people stand somewhere in between these two extreme positions.

HELICOBACTER PYLORI

Helicobacter pylori bacterium was found in the stomach.

It was identified in 1982 by Australian scientists **Barry Marshall** and **Robin Warren** (fig. 43), who found that it was present in patients with chronic gastritis and gastric ulcers, conditions that were not previously believed to have a microbial cause.

It is also linked to the development of duodenal ulcers and stomach cancer. Dr. Robin Warren and Dr. Barry Marshall won the Nobel Prize in 2005.

Fig. 43. Robin Warren (left) and Barry Marshall

DISCOVERY OF HUMAN IMMUNODEFICIENCY VIRUS (HIV)

From the earliest reports of a new disease, scientists around the world focused their efforts on finding the cause of Acquired Immune Deficiency Syndrome (AIDS). They circulated information informally; they held meetings to exchange ideas; and they published promising findings. A pioneer in this effort was **Dr. Robert Gallo** (fig. 44) of the National Cancer Institute, who only recently had discovered the first two human retroviruses, HTLV–I and HTLV–II. In 1984, research groups led by Dr. Gallo, **Dr. Luc Montagnier** (fig. 45) at the Pasteur Institute in Paris, and Dr. Jay Levy at the University of California, San Francisco, all identified a retrovirus as the cause of AIDS. Each group called the virus by a different name.

As has happened many times in scientific history, contention emerged about who had been first. In 1987, the president of the United States and the prime minister of France announced a joint agreement on the issue–the first time a medical research question had reached this level of political negotiation. More importantly, the identification of that virus, renamed human immunodeficiency virus, or HIV, provided a specific target for blood–screening tests and for scientists around the world conducting research to defeat AIDS.

In 2008, Robert Charles Gallo, **Françoise Barré–Sinoussi** (fig. 46), Luc Montagnier were awarded the Nobel Prize in Physiology or Medicine, for their discovery of HIV.

Fig. 44. Robert Charles Gallo

Fig. 45. Luc Antoine Montagnier

Fig. 46. Françoise Barré-Sinoussi

HISTORY OF WORLD HEALTH ORGANIZATION (WHO)

When diplomats met to form the United Nations in 1945, one of the things they discussed was setting up a global health organization.

WHO’s Constitution came into force on 7 April 1948 — a date we now celebrate every year as World Health Day.

WHO currently defines its role in public health as follows:

– providing leadership on matters critical to health and engaging in partnerships where joint action is needed;

– shaping the research agenda and stimulating the generation, translation and dissemination of valuable knowledge;

– setting norms and standards and promoting and monitoring their implementation;

– articulating ethical and evidence–based policy options;

– providing technical support, catalyzing change, and building sustainable institutional capacity; and

– monitoring the health situation and assessing health trends.

Regional Offices of WHO

Region	Headquarters	Notes
Africa	Brazzaville, Republic of Congo	AFRO includes most of Africa, with the exception of Egypt, Sudan, Djibouti, Tunisia, Libya, Somalia and Morocco (all fall under EMRO).The Regional Director is Matshidiso Moeti.
Europe	Copenhagen, Denmark	EURO includes Europe, Israel, and former USSR, except Liechtenstein.
South–East Asia	New Delhi, India	North Korea is served by SEARO.
Eastern Mediterranean	Cairo, Egypt	Eastern Mediterranean Regional office includes the countries of Africa that are not included in AFRO, as well as the countries of the Middle East, except for Israel.Pakistan is served by EMRO.
Western Pacific	Manila, Philippines	WPRO covers all the Asian countries not served by SEARO and EMRO, and all the countries in Oceania. South Korea is served by WPRO.
The Americas	Washington D.C., USA	Also known as the Pan American Health Organization (PAHO), and covers the Americas.

CONTENTS

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