General and Special Theory of Lymphology

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By

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To my parents Georgiy Pavlovich Samokhin
and Anna Mikhailovna Samokhina

"Vita brevis, ars longa"

Hippocrates

TABLE OF CONTENTS

Preface ... ix

Acknowledgments ... xiii

Introduction ... xv

Chapter I ... 1
History of Lymphology
- 1.1 Socio-economic prerequisites for the development of sciences in the ancient world: Greece, Hellenism, Rome. The first studies of lymphatic vessels. Aristotle. Herophilus. Erasistratus. Galen
- 1.2 The Middle Ages. Socio-political situation. Development of science
- 1.3 Renaissance
- 1.4 XVII century. Rediscovery of the lymphatic system. Advances made by European anatomists in the study of the lymphatic system.Caspar Azelli. Jean Peche. Thomas Bartolin. Olaf Rudbeck. Niels Steton
- 1.5 XVIII-XIX centuries. Development of ideas about the lymphatic system. Progress of biological sciences. The doctrine of the cell. Formation of scientific medicine
- 1.6 Russia in XVIII-XIX centuries. Economy. Socio-political condition. Development of science and manufacture. Literature and art
- 1.7 Development of medicine in the Russian Empire. Matvey Yakovlevich Mudrov. Ilya Ivanovich Buyalsky. Nikolai Ivanovich Pirogov. Vladimir Alekseevich Bets. Vladimir Mikhailovich Bekhterev. Ivan Mikhailovich Bekhterev. Ivan Mikhailovich Sechenov. Ivan Petrovich Pavlov. Ilya Ilyich Mechnikov
- 1.8 Development of lymphology in Russia. Gordey Maksimovich Iosifov, Dmitry Arkadyevich Zhdanov, Yury Ivanovich Borodin, Ivan Vasilyevich Yarema, Gennady Vladimirovich Chepelenko

Chapter II ... 41
General Theory of Lymphology
- 2.1 Terminology and definition of the concepts
- 2.2 Experimental and clinical studies of the lymphatic system
- 2.3 Role and importance of the lymphatic system

2.4 Experimental studies
2.4.1 Study design
2.4.2 Dynamics of clinical manifestations of purulent-inflammatory process
2.4.3 Non-specific resistance of the organism
2.4.3.1 Phagocytic index (PI)
2.4.3.2 Percentage of phagocytosis (PP)
2.4.3.3 Bactericidal activity of blood serum (BASK)
2.4.3.4 Lysozyme activity
2.5 Methods of clinical lymphology
2.5.1 Direct endolymphatic therapy
2.5.2 Regional lymphotropic therapy
2.5.3 Method of lymphotropic drug administration
2.5.4 Control of lymphodynamics
2.5.5 A method of physiotherapeutic control of lymphodynamics

Chapter III 79
Special Theory of Lymphology
3.1 Diseases of the musculoskeletal system
3.2 Endolymphatic therapy in the complex treatment of diabetic polyneuroangiopathy of the lower extremities
3.3 Demyelinating diseases (multiple sclerosis as an example)

Concluding Remarks 107

Bibliography 109

PREFACE

Nowadays, science in many of its directions is developing extremely intensively. Sometimes it becomes impossible to keep track of the growing number of publications and to assess the role and significance of new facts in the field where a specialist works, and even more so in the general picture of the world. All of the above is fully applicable to biology and medicine. This situation leads to the forced division of scientists into theorists, experimenters and practitioners. In 1954 the Italian and American physicist Enrico Fermi (1901-1954) died, who was called the last physicist who combined the talents of theoretical and experimental physicist in equal measure (on the website of Argonne National Laboratory he is called "the last universal scientist"). It was in the middle of the last century when penicillin was discovered (Alexander Fleming 1881-1955; Zinaida Ermolieva 1898-1974). It was a time when the world had not yet recovered from the consequences of the world war. Science was not funded to the extent required for its dynamic development. One way or another, but it was still possible for one person to professionally own the flow of new scientific information on a particular subject. Now this situation is impossible. The purpose of studying published data is its practical application. This leads to the fact that proposed scientific hypotheses and theories cannot meet all the data obtained at the time of their publication. What is important is that a theory provides a key to understanding the regularity of the processes taking place. On its basis it is possible to explain the mechanism of development of this or that process, to predict the outcome and, ultimately, to manage the process.

In biology and medicine, the understanding of disease mechanisms is based on accumulated factual knowledge, its comprehension, classification and theory formation. With the development of science in general, in medicine there is a change of ideas in the anatomy, physiology and pathogenesis of diseases, which is directly related to the treatment and prevention of diseases.

At present, a great deal of factual material has been accumulated on the anatomy, biochemistry, physiology, and functions of the lymphatic system. Doctors and researchers offer methods of treatment of various diseases taking into account the role of the lymphatic system. The problem of the place of methods of clinical lymphology in the therapeutic process remains unsolved.

The origins of lymphology go back centuries to ancient Greece and Rome, when lymphatic vessels were first described. They were then safely forgotten until the first half of the 16th century, when they were rediscovered. By this time our society had developed to the point of understanding the importance of the lymphatic system and this branch of medicine developed. The lymphatic system began to be actively studied first of all by anatomists, then physiologists joined them. There was a process of accumulation of factual material. In the first half of the XX century there was a determination, based on experimental data, to begin the study of the lymphatic system in a living person. Almost immediately the importance of this system in the pathogenesis of disease was determined. The role and importance of the lymphatic system in the human and animal organism grew steadily: the work was transferred from research laboratories to clinical institutes and universities, and the practical value of lymphology was increasingly recognised. If we look at the published books and articles devoted to lymphology, it can be noted that attention to the clinical application of the results of lymphatic system research is mostly paid by surgeons associated with work at the operating table (purulent, abdominal, thoracic surgery, gynaecologists, traumatologists). Up to this point, there is debate about the presence of the lymphatic system in one organ or another. Eventually, the lymphatic system came under constant study and this lead to significant discoveries, for example, in the central nervous system, which has raised hopes for solving complex problems in clinical medicine-treatment of Alzheimer's disease, multiple sclerosis, problems of resuscitation category of patients, fight against septic conditions, etc. Unfortunately, up to now there is no unified notion of what terms are used to describe events related to the lymphatic system and in general, what it is-the lymphatic system and lymphology. Theoretical and applied lymphology are published, but there is no general and special theory of lymphology, which are the theoretical and practical foundation of the methods of clinical lymphology, which form the strategy and tactics of patient management and disease prevention.

Several remarkable works on lymphology based on proven experimental and clinical data have been published. First of all, it concerns the scientific works of Yarema (1995), Chepelenko and Lutsevich (1995), Foldi (1998), Shilds (2001), Borodin (2010), and Levin (2014). The general and special theory of lymphology offered to your attention gives a real opportunity to predict the course of the disease and give recommendations for optimising the treatment process. It is assumed that the theories of the lymphatic region and the ordered structure of the lymphatic system can be an integral part of the general theory of lymphology.

In the published edition the General and special theory of lymphology is proposed. The theory unites the currently known data on the lymphatic system and on this basis offers ways of solving the main tasks of medicine in the treatment, rehabilitation and prevention of diseases. In some ways it may entail changes in the general theory of medicine. The publication is intended for lymphologists, researchers, practical doctors, students of medical faculties, veterinarians. The book will be of interest to people actively interested in lymphology, medicine, veterinary medicine and biology in general.

The study is not without shortcomings and the author will gratefully accept comments and additions aimed at improving the understanding of the material.

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I had and have people who determined my life interests and profession. I am grateful to my teachers and mentors. First of all, I am grateful to Lev Khristoforovich Baghdatyan, under whose influence I formed my way of thinking, my desire to practice medicine and science in the broad sense of the word: the study of history and art – literature, art paintings, theatre, ballet, classical music. I was led into lymphology by the hand of an outstanding scientist and person, one of the founders of clinical lymphology Ivan Vasilyevich Yarema, who, not counting on time, not only told me about lymphology, but also taught me concrete methods of endolymphatic therapy, taught me scientific thinking. I kept in touch with my teacher practically till his untimely death. I worked under the guidance of the famous lymphologist Yuri Markovich Levin. I was amazed by the depth of his analysis of scientific data and the ability to draw the right conclusions. He always tried to teach us, his employees, the basics of this skill. Working under the guidance of Professor Emmanuil Vikentyevich Lutsevich, I defended my degree. Here I met Gennady Vladimirovich Chepelenko, the creator of the "Theory of the Orderly Structure of the Lymphatic System". A man of great labour power, an excellent analyst, able to see and notice what his colleagues did not see, he was always distinguished by a non-traditional approach to solving the problems of lymphology. His theory was confirmed in scientific centres of the world and appreciated. During many friendly conversations I learnt about his books of poetry. He was a member of the Union of Writers of Russia. Truly, a talented person is talented in everything. I am very grateful for methodical, educational, friendly help of Anton Roaldovich Gorbushin. Without his help and constant support not only in word but also in practice, my plans to write a book would not have come true. A man far from medicine and lymphology in particular, very busy and passionate about his section of immense science, found time not only for words of support, but also for practical matters. A great influence on the correct interpretation of the obtained experimental or clinical results, analysis of summary data had Eugenia Alexandrovna Ganshina. Her amazing mind, analytical skills, and patience in systematising the data were of invaluable help in working on this book.

I am extremely grateful to my colleagues and friends for their patience and support of my work.

INTRODUCTION

The science of person is full of mysteries and unexpected discoveries. Over the time span of literary sources available to historians, individual has constantly tried to study and explain natural phenomena, his environment, animals and himself. Hidden in the depths of millennia are those firsts that laid the beginnings of medicine. The living conditions of people were harsh and any injuries, infectious and non-infectious diseases could lead to human death. These circumstances dictated the search for means and methods of getting rid of ailments, which required knowledge of flora and fauna and, of course, the structure and laws of the human body itself, the study of human diseases in the broad sense from birth to death. Life expectancy in those ancient times was rarely more than 30 years. Millennia passed before this indicator increased first to 40 years, then to 50. Nowadays, the average life expectancy in different countries ranges from 60 to 82 years. This was largely due to the development of medicine, which is a reflection of the cultural, social and economic development of society.

It is known that already in ancient times in China and India, treatment was carried out not only with the help of medicines. Surgical operations were used, which required knowledge of human anatomy.

The development of science occurs in the conditions of demand for the studied facts and practical application for the benefit of human. This is possible under the created historical conditions, political structure of society, when there are people who can solve certain problems, possessing knowledge of philosophy, which allows to comprehend and generalise the ongoing events in society, nature, science.

CHAPTER I

HISTORY OF LYMPHOLOGY

1.1 Socio-economic prerequisites for the development of sciences in the ancient world: Greece, Hellenism, Rome. The first studies of lymphatic vessels. Aristotle. Herophilus. Erasistratus. Galen

Ancient Greece... Ancient Rome... Why did European and world civilisation largely originate in them? Before Greece there were also states with their own culture, art and science. Archaeological excavations in Assyro-Babylonia, India, Egypt confirm this fact. This also applies to the Amerindian peoples of the Americas from the late Palaeolithic to the highly developed cultures of Mexico, Central America and the Peruvian Plateau (Plutarch 1941; Keram 2019). Thematically, it is enough to begin the study of the achievements of Hellas and its influence on other countries. It was from Greece that scientific knowledge began to spread to Rome, Egypt, and the countries of Europe. The geographical location and climatic conditions, the peculiarities of the terrain led to the development of trade routes, and in consequence to the flourishing of the economy. People communicated with each other more, exchanged understanding of beautiful things. This was the birth of culture. Society became capable of responding to the achievements of human thought. This syncretism formed the Hellenistic era from the history of the eastern Mediterranean and Alexander the Great to the Roman invasion.

This period of history was called the Hellenistic era. The name was suggested by the German historian Johann Gustav Dreuzer in the 1930s (Grundriss 1858; Droysen 1925). Probably that it was thanks to syncretism that new forms of art, trends in philosophy and medicine appeared. In the words of Lev Gumilev, in Greek society the passionary impulse was growing, i.e.

> "a behavioural impulse with an orientation opposite to the instinct of personal and species self-preservation" (Gumilev 2020).

The active policy of the Greeks and Macedonians, aimed at penetrating the East, was carried out under the conditions of the appearance of passionaries in society

> “people whose passionary impulse exceeds the impulse of self-preservation”. (Gumilev 2020).

Numerous wars, the conquest of new territories, entailing an increase in population, led to the development of the economy, entrepreneurship and the spread of the influence of the Greeks on neighbouring states. From the V century BC to the beginning of the I century AD (Tiange 2019), the possessions of the Greeks spread to large territories in Southern Italy, Asia Minor, colonies in the Ionian and Aegean Seas, in Sicily. Expansion of the Greeks into other regions arose. The change of economic relations gave rise to the slave system and, as a consequence, to the strengthening of the power of the Greeks. Especially it affected the technical progress in the countries of Eastern Hellenism. Along with migration flows, Hellenic achievements in culture, philosophy, biology and medicine spread (Lunkevich 1936; Kovalev 1936).

One of the brightest representatives of the Hellenistic era is Aristotle. He was born in 384 BC in the city of Stagira, for which he became known as Stagirite. His parents were Nicomachus and Festida. Aristotle came from a line of hereditary physicians, raised to the god of healing Asclepius. Aristotle died in Chalkida having drunk aconite and was seventy years old.

According to Diogenes of Laersk, Aristotle was the most devoted of Plato's students. At the age of 30, Stagirite left his teacher and went to Athens, where, along with his scientific work, he founded the Lyceum. The Lyceum lasted as long as Plato's Academy. One of his students was Theophrastus, who created systematics in botany and later became Aristotle's direct successor (Diogenes 1979).

Aristotle's desire to study the world around him, his scientific mind, and his efficiency led to the fact that quantitatively and qualitatively he brought natural science to a new level of understanding of nature, something that researchers before him could not achieve. Numerous studies, united in the books "Physics", "Metaphysics", "Mechanics", "Great Ethics", "Poetics" and in many other works clearly show the widest range of interests of Stagyrite. He studied insects and fish, birds and rare, little-studied animals such as the two-humped camel, bison, cheetah and monkeys. Aristotle performed autopsies on animals, which was the beginning of comparative anatomy and morphology. The findings allowed him to begin to classify animals. Systematising animals Stagyrite used a whole complex of features such as morphological features, primary and secondary features serving for adaptation of animals to the environment. Aristotle divided all animals into blooded and bloodless. This now corresponds to vertebrate and invertebrate animals. He writes that

> "all animals have blood or its substitute fluid, lymph. Animals legless, bipedal, and quadrupedal have blood. And those with more than four legs have lymph."

This is the first mention of the term lymph being used to divide animals (Lunkevich 1936).

The ancient Greek physician Herophilus, who "was physician to Ptolemy II", was the first to initiate the study of human anatomy as a scientific branch of medicine. Living in Alexandria he, together with his compatriot Erasistratus, who was also a physician, founded the Alexandrian Medical School. Despite the prohibitions that existed in Alexandria, the researchers systematically performed autopsies on corpses. Thanks to their constant study of anatomy, they found and described the shells of the brain, its blood supply, the structure of the gastrointestinal tract, and the shell of the eye. Herophilus was the first to give a name to the 12-rectum, and he also identified the pulmonary vein. And Erasistratus established the connection between the brain and nerves, noting the important role of the medulla oblongata in coordinating the brain and peripheral nerves. These two learned anatomists were the first to describe the elements of the lymphatic system. Herophilus discovered the thoracic lymphatic duct, although he did not know its purpose. Erasistratus gave the world the first description of the lymphatic vessels of the mesentery. These two ancient Greek geniuses were born early and their discoveries remained unclaimed until 1622, when the lymphatic vessels of the mesentery were rediscovered by the Italian physician and anatomist Gaspar Aselli. This is understandable. Their discoveries did not correspond to the level of science, culture, were not demanded by the society (Lunkevich, 1936). We will return to the question of the timeliness of scientific discoveries later.

The era of the ancient world was coming to an end. At this time the "star" of Galen rose (131-201). Despite unfavourable political conditions, which did not favour the development of science, Galen laid the foundations of scientific medicine.

This may have been helped by the then reigning Roman emperor and thinker Marcus Aurelius (160-180). Galen's works became known in the Middle Ages through translations made by Arabs in the ninth century.

Galen was born in Pergamum (Galenus Pergameos). In his youth he moved to Greece, where he received the most perfect education of the time. Galen was most attracted to medicine. Galen settled in Rome, where along with a large medical practice, was engaged in the study of anatomy and physiology, believing them to be the foundation of scientific medicine. Developing the teachings of Dioscorides, Hippocrates and Erasistratus he had his own opinions. One of the main provisions of all his discoveries Galen built on the doctrine of the structure and work of the neuromuscular apparatus. The assertion that the brain receives impulses from sensations (receptors) and from muscles was built not only on the study of cadavers, but also on experiments on animals with transection of nerves innervating various muscles. This required complex solutions, and Galen introduced vivisection. Thus, when cutting the lingual pharyngeal nerve there was paresis or paralysis of the tongue muscles, depending on whether one or both of these nerves were cut. The same results were obtained with dissection of other nerves innervating other muscles, including the diaphragm, intercostal muscles, muscles of the mouth, hind and fore limbs and others. Transection of nerves innervating organs of vision, hearing, and smell resulted in loss of perception through these senses. Experimental study of the functions of the spinal cord has shown that its horizontal dissection entails not only paralysis of muscles, but loss of sensation of all parts of the body below the intersection. Many people know the fact that Galen was the first to describe blood circulation and the presence of blood, not air, in the arteries. The ancient world was coming to an end. Galen completed the initial period of philosophical, scientific and social development of mankind. The time of the Middle Ages was coming, which was a logical continuation of the dying Rome.

1.2 The Middle Ages. Socio-political situation. Development of science

The Middle Ages, a period when the Church acquired powerful, sometimes undivided power. A time that Professor V.V. Lunkevich characterised with the words

> "a grave of thought, a desert poisoned by the burning breath of religious fanaticism and illuminated only by the light of the bonfires on which heretics and their apostate writings were burned" (Lunkevich 1934).

In the remarkable book "History of English Literature" French philosopher Hippolyte Adolphe Taine (1828-1893) wrote:

> "Instead of Christianity-Catholic Church; instead of free belief-compulsory religion; instead of moral warmth-learned ritualism; instead of heart and mind-external and machine discipline" (Taine 1871).

During this period, the development of science in general, biology and medicine in particular, slowed dramatically. Monks were engaged in the healing of souls. In the early Middle Ages, Basil the Great (329-379), Blessed Augustine (354-430) and their followers developed the biological and medical sciences whenever possible. The trouble is that the researchers were interested in nature mainly from an applied point of view, in the measure of its usefulness for individual and public use: plants, animals, their organisation and manners were regarded from a narrowly practical point of view. Classifications were made in harmony with the doctrine of the six days of creation, and attention was centred on the facts which confirmed the words of the sacred Scriptures. Theory was absent; everything least plausible and exceptionally ridiculous in Pliny was given special credence (Lunkevich 1936).

In this period monks were the most prepared for medical activity. They believed themselves to be "healers of the soul", cared about the health of the body and therefore practised medicine.

For such work they had to copy and learn by heart the most famous statements of the Hippocratics and Galen, study the works of Aetius, Alexander of Trallium, and Caelius. The Greek physician Alexander of Trallium (525-605) lived in Rome, but was born in Lydia, in the city of Tralli. He was well educated by his father Stephen, who was a favourite of Emperor Justinian. Before Rome, Alexander travelled extensively and studied the sciences. On the basis of his knowledge and medical practice, Alexander of Tralla wrote a large work consisting of 12 books entitled "On Internal Diseases and Their Treatment", dealing with many diseases, except surgical diseases. It remains a mystery why Alexander did not describe surgical diseases. The book was first published in the Greek original in 1548 and was reprinted several times in Latin translation. Alexander took a place of honour among the best physicians of all time. In his lectures he urged not to bow blindly to authority, he taught doctors to first find out the causes of the disease, and to prescribe treatment individually for each sick person. These instructions were contrary to the practice of the time, which was based on the expulsion of "spirits" through prayers, holy water and fasting, pilgrimages, applying to relics, using talismans and cabalistic signs. To deep regret such examples in the Middle Ages are not few. And this is explained by the reasons mentioned above: the dominance of the Church and the Inquisition, which built biology and medicine in harmony with religious dogmas.

The light of enlightenment came to Britain. Remote Ireland was perhaps the only country that had not been reached by the barbarian invasion. It was mainly here that the remnants of ancient science and culture survived. To this country, when the onslaught of Germanic tribes destroyed the achievements of European civilisation, young men were drawn by the light of knowledge and the desire to learn the laws of nature. During the reign of Pope Gregory I (late VI century), a large number of Benedictine monks moved here to study and master theoretical and practical sciences such as agriculture, horticulture, and the doctrine of healing. Later, these monks moved to European countries as teachers, preachers, and missionaries for enlightenment activities.

Charlemagne (742-814) created not only an empire, but being one of the most educated people of his time, paid much attention to the development of science and art.

Thus, he wrote in a letter to the monks of one monastery:

> "Let it be known to your God-pleasing piety that we and our faithful have reasoned for the good that in all bishoprics and monasteries, by the grace of Christ entrusted to our administration, in addition to observing the rules of monastic life and conversations about the holy faith, – all to whom God has given the ability to learn, would still be attached to scientific studies and teach others as much as they can... And although it is better to act well than to know well, but knowledge must precede our actions. And therefore it is our desire that you, as befits the soldiers of the church, should be both pious and learned, and chaste in manner of life and men educated in speech..." (Levandovsky 2021; Levandovsky 1999; Hagermann 2003).

The same desire to revive the sciences can be seen in England in the ninth century under the reign of King Alfred the Great. He showed concern for enlightenment in the face of constant military confrontation with the armies of the Normans.

The endeavours of kings to develop sciences through enlightenment of the people, unfortunately, were quickly forgotten, which is explained by general political tendencies in Europe of IX-XI centuries.

1.3 Renaissance

The Renaissance Era... It is a special time that began in Italy. It did not just appear, out of connection with the events of past centuries. Contradictions embedded in the socio-political structure were expressed in the growth of technology, crafts and trade. Independent of theology, various secular schools arose, which led to the emergence of universities. Under these conditions, titans such as Dante (1265-1321), his friend, Giotto (1276-1336), and Francesco Petrarch (1304-1374), the pioneer teacher of Renaissance artists, emerged. In science, a researcher like Leonardo da

Vinci (1452-1519), who was a brilliant painter, anatomist, engineer, and philosopher, emerged.

The book "Leonardo da Vinci, literary and philosophical fragments" ("Leonardo da Vinci, Frammenti letterari e filosofici"), published in 1913, contains the main of the remaining works of the genius scientist devoted to biology, anatomy, engineering, architecture, sculpture and painting (Dzhivelegov 1935; Lazarev 1952; Leonardo da Vinci. 2020).

In 16th century medicine, Galen enjoyed unwavering authority. Artists, such as Raphael, Michel Angelo, and Dürer, also showed interest in the study of the human body (Costantino d'Orazio 2019; Bruno Nardini 1986; Martin Gayford 2021; Albrecht Durer: Diaries and Letters. 2020).

Dürer published a book "On the symmetry of the human body" (De simetria partium corporis humani) illustrating it with beautiful engravings (Albrecht Durer 1528). Berengario, a professor of anatomy from Bolonia, on the basis of many autopsies of human bodies, discovered the goitre gland, the worm-like process of the cecum, the cartilage of the larynx, the medulla oblongata and spinal cord, and the uterus in women. Silvius, Eustachius, and Fallopius build the study of anatomy with a bias towards the study of physiological functions. Silvius describes for the first time the valve apparatus of the veins (Makatsaria and Fallopius, 2016, 123-124; Gutner 1904).

Sylvius' students Miguel Servet (1509-1553) and Andrew Vesalius became some of the most famous anatomists of the 16th century.

Andrew Vesalius (1514-1564) was already at the age of 23 the head of the chair of anatomy in Padua, and at the age of 29 (1543) he published a textbook of human anatomy richly illustrated with tables and drawings by I. S. V. Calcar), a pupil of Titian. In his scholarly work Fabrica, he discusses in detail the descriptive and topographical anatomy of man. The book became a classic manual for physicians of various specialities, especially surgeons, and required persistent study.

Miguel Servetus, who had done much to study the circulation of the blood, lived only 44 years and was mercilessly burned at the stake along with the book. It was 1553. The fanatic Calvin was in charge of the execution.

In his work Servetus wrote: "The communication between the right and left halves of the heart does not take place through the septum of the heart, as is usually thought, but by a remarkable adaptation the blood passes from the right ventricle to the lungs; here it is processed, takes on a yellow colour and passes from the pulmonary artery to the pulmonary vein. Then, in the pulmonary vein it mixes with air and at the moment of exhalation it is cleared of soot. Finally at the moment of diastole this mixture enters the left ventricle, where it serves to form the vital spirit (quoted from N. Gutner, "History of the Discovery of the Circulation"). Thus the small circle of the circulation was discovered (Prokopyev 2015, 7-15).

Descriptive, comparative and surgical anatomy in the XVI century developed thanks to the studies of scientists-encyclopaedists. In favourable social and economic conditions, Eustachius (1510-1574) conducted experiments and researches, who supplemented the works of Fallopius on the study of the hearing organ (Eustachian tube). Fabricius of Aquapendente (1537-1619) laid the foundations of embryology.

1.4 Seventeenth century. Rediscovery of the lymphatic system. Advances made by European anatomists in the study of the lymphatic system. Caspar Azelli. Jean Peche. Thomas Bartolin. Olaf Rudbeck. Niels Steton

At the beginning of the 17th century, the fascination with descriptive anatomy led to a second discovery of the lymphatic system. On 22 June 1622, the Italian professor of anatomy and surgery Gaspar Aselli discovered lymphatic vessels in the mesentery of the small intestine of the dog.

At lunchtime, drinking good wine with the appetisingly cooked meat, the inquisitive Azelli fed the dog with the leftover scraps of greasy food. The constant desire to learn what was going on and how led to the dog being subjected to an autopsy and a thorough examination of the stomach and intestines. They found milk coloured vessels coming from the small intestine.

This made it possible to call the vessels milky, which was covered in detail in the book "De laktibus, sive lacteis venis". The book was published in 1628. So the lymphatic vessels were discovered for the second time. This shows that society should be prepared for the emergence of new development not specifically any branch of medicine, in this case anatomy, but the whole science, culture, social development as a whole. More than 1800 years have passed since the first discovery of the lymphatic vessels of the mesentery and thoracic lymphatic duct. This time was required for the comprehensive development of mankind to perceive and understand the findings, which served as the basis of lymphology.

Thus, with the discovery of Azelli began a rapid study of the lymphatic system. And this science until the end of the XIX century remained the domain of anatomists and was descriptive.

In 1647, French anatomist Jean Peca was performing an autopsy on a dog's corpse. After removal of the heart, he accidentally discovered in the thoracic cavity a whitish fluid, which flowed from the vessel flowing into the left subclavian vein.

This vessel he called the thoracic lymphatic duct. J. Pecquet published the results of his research under the title "Anatomical experiments by which the hitherto unknown collector of milky juice and the milky vessels running from it through the chest to the subclavian branches are discovered" in Paris in 1651.

Having learnt about this work, the Danish anatomist Thomas Bartolin, and a few months later, independently of him, the Swedish anatomist Olaf Rudbeck in 1651 conducted studies of the bodies of dead people and came to the conclusion about the existence of the lymphatic system as a separate entity, not part of the circulatory system. In 1662, after labour-intensive work, the Danish anatomist Niels Stenotom discovered the right lymphatic duct and established the presence of a valve at the mouth of the left (thoracic) duct. Developing these studies in 1665 the Dutch researcher Frederick Ruysch published the work "Dilucidatio valvular uminvasis lymphatic isetlactewis", in which he described the presence of valves not only in the thoracic duct, but also in the lymphatic vessels.

1.5 XVIII-XIX centuries. Development of ideas about the lymphatic system. Progress of biological sciences. The doctrine of the cell. Formation of scientific medicine

In the 18th and 19th centuries, the lymph nodes in humans were discovered. This discovery belongs to the English anatomist William Hewson (1739-1774). Italian professor of anatomy (University of Siena) Paolo Mascagni (1755-1815) became famous for having discovered irregular constrictions in lymphatic ducts and lymphatic vessels by conducting numerous studies with the use of mercury injection. The formed cavities were later called lymphangions, and the role of the discovered semilunar valves was very important in revealing the mechanisms of lymphodynamics and was later appreciated by oncologists and immunologists.

It should be noted that, in general, the XIX century took its special place in the history of Europe in general and Russia, in particular. In 1804 Napoleon Bonaparte became Emperor of France. In the period from 1805 to 1815 Napoleonic wars swept across Europe, which brought death and destruction to people. On 24 June 1812, Napoleon's troops invaded Russia and the Patriotic War began, ending in Napoleon's total defeat. It is noteworthy that throughout the century there were wars between the countries of Europe. A similar pattern was observed on other continents. From 1810 to 1826, the War of Independence of the Spanish colonies in

Latin America continued, while the American Civil War took place between 1861 and 1865. The century ended with the Spanish-American War of 1898. In the East, Abd al-Qadir's war of liberation in Algeria against the French invaders progressed. Wars took place in China, India, Egypt, Japan, Ethiopia.

There is an opinion that war is the engine of progress. In any case, the need for new technology led to the development of industry, and this was possible only thanks to the rapid development of science, which was taken advantage of by scientists studying medicine and biology.

The achievements of medical science in the XIX century were possible on the basis of data obtained as a result of the great work of researchers of previous centuries. In 1665, Robert Hooke first described the cell, thus initiating the study of the biological microcosm. Antoni van Leeuwenhoek, a Dutch naturalist, designed, built and later improved the microscope. In 1673 he published his sketches of protozoa, bacteria, spermatozoa and red blood cells. The naturalists Marcello Malpighi and Nehemiah Grew described the "sacs or vesicles" found in plant cells. The introduction of new technologies in the creation of microscopic techniques allowed physiologist Jan Purkinje to discover the nucleus in a chicken egg in 1825, and Karl Baer in 1828 discovered and described the human ovum, suggesting that it was the source of new life. In 1830, the German botanist Franz Meyen described the cell as an isolated structure in which metabolism takes place. At this time (1831), botanist Robert Brown was engaged in the microscopic study of cells and described the cell nucleus in detail for the first time. Based on his research, Brown concluded that the cell nucleus was an essential part of any cell.

In Europe, biology and medicine, the nineteenth century was marked by the works of botanist Matthias Schleiden (1804-1881) and zoologist Theodore Schwann (1810-1882). devoted to the cellular theory of the structure of organisms. This theory influenced the development of biological thought in Russia, as we will discuss later.

Restless, contradictory and impetuous Matthias Jakob Schleiden at the age of 26 achieved a good social and financial position as a lawyer. But in 1830 he abruptly changes his life, leaves the practice of law and becomes a medical student at the University of Heidelberg. Five years later, Schleiden became a professor of botany and plant physiology at the University of Jena. He was very interested in the mechanism of cell reproduction. In this process, the researcher assigned a leading role to the cell nucleus. Unfortunately, Schleiden lacked the imagination to combine morphology and physiology in plant and animal cells. In 1844, the professor wrote a paper entitled "Towards a Question on Plants". A review of the paper was written by the German physiologist Johann Müller. He was assisted in preparing the review by his assistant Theodor Schwann.

Theodor Schwann (1810-1882) was born into a well-to-do family and prepared himself for the ministry of a priest while studying at the Faculty of Philosophy of the University of Bonn. The constant interest in natural science and medicine prompted T. Schwann to enter the medical faculty after graduation. The versatility of the scientist's interests is simply surprising. At the age of 26, studying the physiology of digestion, he discovered a special substance in the gastric juice, which is involved in the digestion of food. The substance was called pepsin. A year later Schwann independently of German botanists F.T. Kützing and M. Schleidon discovered yeast fungi. Studying fermentation processes, he proved, like his predecessor Kützing, that "yeasts are living cells and they grow, multiply and convert sugar into alcohol and carbon dioxide". This conclusion was in conflict with the theory of Justus Faraiherr von Liebich, a famous German chemist and professor at the University of Hesse, who believed that fermentation was the result of a purely chemical process by which sugar was converted into alcohol. At that time it was impossible to compare the authority of T. Schwann and J. Liebich, so the report on the biological essence of fermentation was met either indifferently or even dismissively.

It was in this situation that Schleiden and Schwann had their momentous meeting. They met in October 1838 during a lunch break in a café. Schleiden was already a well-known biologist. In conversation he talked about his research and his remarkable results. This greatly interested Schwann. Their common interests formed the basis for a strong friendship. The friends often began to exchange opinions on the results of their research. Schleiden substantiated his cell theory for plants.

T. Schwann did titanic work on the study of plant and animal tissues. Schleiden put in his hands a wonderful compass-to look for cell nuclei. A year later Schwann summarised the results of all his work and published them in the book "Mikroskopische Untersuchungtn ber die Uebereinstimmung in der Struktur und dem Wachstum der Tiere und Pflanzen". The basic thesis on the similarity of plant and animal cells made Theodor Schwann and Matthias Schleiden the founders of the doctrine of the cell, its structure and life activity (Vernadsky 1988).

For nearly two hundred years the basic tenets of cellular theory have been maintained:

a. The self-reproducing, self-renewing, self-regulating cell is the basis and elementary unit of life.
b. All terrestrial organisms are characterised by their identical structure.

c. The cell is a complex of high molecular weight compounds that is reconstituted from inorganic components.
d. Their reproduction is carried out by division of the mother cell.
e. Multicellularity of organisms implies specialisation of elements united into tissue, organ and system structures.
f. All specialised cells are formed by differentiation of totipotent cells.

The significance of the cell theory is that it made it possible to understand the processes of origin, development and functioning of a living organism, which was the basis for the evolutionary theory of the development of life. The cellular theory made it possible to understand the physiology of the organism and the pathogenesis of diseases at the cellular level. This was the key to new possibilities in the diagnosis and treatment of diseases. The phylogenetic unity of the entire living world became clear.

The theory of M. Schleiden and T. Schwann served as a starting point in the creation of histology, pathological anatomy, molecular biology, biochemistry, physiology, pathological physiology, embryology and other areas of biology and medicine. Russian researcher I. Chistyakov in 1874 and German biologist E. Strasburger discovered the mechanism of mitotic (sexless) cell division. Then followed the discovery of chromosomes and their role in heredity, variability of organisms, deciphering of DNA replication and translation and its role in protein biosynthesis, etc.

I would also like to say that Schwann is also known as a histologist. Studying the fine structure of blood vessels, smooth muscles and nerves, he discovered and described a special sheath of nerve fibres. It was named after the author-the Schwann sheath.

We will talk about the role of the Schwann sheath a little later when discussing diseases of the nervous system.

The work of T. Schwann and M.J. Schleiden served as a basis for the creation of cellular pathology by Rudolf Virchow (1821-1902). P. Virchow, an outstanding German scientist, devoted his life to the study of the cells of the body. He saw his task in establishing the cellular nature of vital phenomena, both physiological and pathological, both in the animal and plant kingdom, in proving the unity of life in the entire organic world. These views were published by him in 1858 in a book entitled Cellular Pathology, based on the physiological and pathological doctrine of tissues. His assertions stated:

> "For every living being the cell is the final morphological element from which all vital activity, both normal and morbid, proceeds".

And as a conclusion from the above: the life of an organism is in the life of its constituent cells, and its disease is in their disturbed vital activity.

These studies were the foundation for the construction of the building of scientific medicine. Researchers from different countries, relying on the data of their colleagues, using modern achievements of technology (chemistry, microscope, other devices) solved problems that at that time were relevant and required scientific explanation and search for ways to apply in medicine.

1.6 Russia in XVIII-XIX centuries: Economy. Socio-political condition. Development of science and manufacture. Literature and art

Throughout its existence Russia had to defend its independence and interests with arms in its hands very often. Almost always Russia achieved victory. Much rarer Russians suffered a draw or defeat. Only in XIX there were nineteen wars. But the XIX century in Russia was famous not only wars. As already mentioned, the origin of any war was the rapid development of science and technology and not only. Against the background of battles and battles in Russia there was a flourishing of literature, the emergence of writers, poets, artists, composers, who influenced the formation of culture and education. The development of culture and public thought was greatly influenced by the Patriotic War of 1812, which caused the patriotic rise of the people and the growth of their self-consciousness.

These events occurred alongside the European bourgeois revolutions and the Decembrists' uprising on the Senate Square in December 1825. Changes in political views and approaches to solving life issues took place in Russia with its inherent emotionality and, at times, uniqueness. At the same time, there is no doubt that the development of Russia was directly related to the development of science, both theoretical and practical orientation. As gears of a single mechanism interacting with each other achievements in physics, chemistry, engineering, biology, medicine were intended to solve life's problems. On the other hand, cognition of nature and development of science in general is impossible without development of culture and art. Everything must develop together. And the ultimate goal is to improve the quality of life. We observe these developments on the example of the history of the XIX century.

It is known that the dominant class in the 19th century was the nobility. Most of the nobility did not have large estates and fortunes and were in civil or military service, and some lived on a salary. In their majority the creative intelligentsia, teachers, lawyers were nobles. We see that there was a decline in the role of the nobility in the economy of the country, at the same time in politics remained leading. The cultural needs of the nobility were different from those of the peasants, where their own traditions were formed. At the beginning of the XIX century access to education had a privileged strata of the people, and the country was gradually forming a capitalist way of life and it required a wider introduction of education. In this regard, in 1802 the Ministry of Public Education was established to organise and manage educational institutions. At that time there was only one higher educational institution-Moscow University. This shortcoming was eliminated: universities in St. Petersburg, Dorpat, Kazan, Vilna and Kharkov began to be organised at an accelerated pace. Privileged educational institutions were opened in Tsarskoye Selo, Yaroslavl and Nezhin. In 1829 the Main Pedagogical Institute was restored, where teachers for gymnasiums and universities were trained. These processes were slower than desired, but still by the middle of XIX century the number of students reached 4 thousand people, and by 1855 the number of gymnasiums numbered 78 institutions, and county schools-439. Changes began to be observed in the social composition of educated people, among whom there were considerably more people from the Dissenting classes. These phenomena were a reflection of the growth of the urban population by the end of the XIX century, it increased by 70 per cent, while the population of Russia was 82 per cent peasants.

It is of great importance that scientific achievements made by Russians had both theoretical and practical significance. And here are some of our compatriots who glorified our Motherland with their discoveries and immortalised their names.

The great Russian mathematician Nikolai Lobachevsky (1793-1856) created the theory of non-Euclidean geometry. Mathematicians all over the world had been struggling unsuccessfully over this problem for more than two thousand years. Lobachevsky discovered new possibilities of geometry, which differed from the classical, Euclidean geometry. He published his work in the journal Kazan Bulletin. The provisions of the new theory were too complicated for his contemporaries. Many years later, after the scientist's death, non-Euclidean geometry was widely recognised: the Lobachevsky International Prize was established. A monument to Lobachevsky was erected in Kazan, where he spent most of his life.

Professor M. V. Ostrogradsky (1801-1861) published works on analytical mechanics, theory of numbers, mathematical physics, probability theory, which were appreciated both in Russia and in European countries.