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ДЕМКОВИЧ Лілія Ігорівна
Чортківський державний медичний коледж
lilya.do.15@gmail.com
Чортків, Тернопільська область

ШЕВЧУК Оксана Романівна
Чортківський державний медичний коледж
oxana_shevchuc@ukr.net
Чортків, Тернопільська область

FORMATION AND DEVELOPMENT OF ANIMAL AND PLANT PHYSIOLOGY

Modern biology is a combination of many disciplines that study the structure and function of organisms, species and ecosystems, their spread, origin and evolution, the various relationships between them and the environment. In its own turn, the history of biology to which the proposed article is devoted, engages with forms, methods and content of scientific activity which is directed at acquiring knowledge about biological systems and the processes that take place in them.

The help is intended to give the researcher holistic view about the development of biology as branch of knowledge from the first stages of human development to the latest discoveries of the third millennium.

The author focuses on the history of biological ideas and concepts, which were created and developed by specially trained people in specific socio-cultural conditions within specific disciplines and institutes using specific methods, instruments and tools.

As an interdisciplinary science, the history of biology studies cognitive, including philosophical and methodological, as well as institutional, instrumental, socio-cultural, ideological, political and psychological factors in the development of biological knowledge. This approach gives a better understanding of the development of a complex process of knowing the living and allows us to consider modern theories as a certain stage of contradictory intellectual history. The solution of one problem in it puts dozens of others, prompting us to new comprehension in search of the eternal question about the essence of life.

The history of biology is a reconstruction of intellectual quests and misconceptions, clashes, discussions and struggles of different ideas and thoughts, the interaction of entire scientific schools and communities. Eventually, these searches led to the development of modern norms and values of biological knowledge. In the course of this reconstruction, it becomes clear how easy it is to make a mistake in the process of learning about life and how difficult it is to take every step forward. Studying the history of biology contributes to the development of intellectual honesty, independence from authoritarian coercion, the desire to test even the common postulates and dogmas. At the same time, history demonstrates the continuity of biological knowledge, the conditionality of each discovery of the work of many previous generations with their achievements and disappointments, findings and failures, discoveries and mistakes.

The history of biology enables biologists to look at their specialty as an interesting section of human culture, to find out about people who have dedicated themselves to finding the most difficult questions of wildlife and breaking the secrets of it, thereby making progress in the most essential areas of human practice: in medicine, in agriculture, environmental management, finally, in the creation of biotechnology – the foundations of modern civilization and industry. The historical process of the emergence, development, and change of theories controlled by experiment, critique, and social practice has never flowed evenly, but by the simple accumulation of proven knowledge.

Keywords: *history of biological science, anatomy of animals and plants, biology, evolution.*

СТАНОВЛЕННЯ ТА РОЗВИТОК ФІЗІОЛОГІЇ ТВАРИН І РОСЛИН

Сучасна біологія є сукупністю багатьох дисциплін, що вивчають будову і функції організмів, видів і екосистем, їх поширення, походження і еволюцію, різноманітні зв'язки між ними і навколишнім середовищем. У свою чергу, історія біології, якій присвячено пропонована стаття, займається формами, методами і змістом наукової діяльності, направленої на придбання знань про біологічні системи і протікаючі в них процеси. Допомога покликана дати досліднику цілісне уявлення про розвиток біології як галузь знання з перших етапів розвитку людства до новітніх відкриттів третього тисячоліття.

Основну увагу автор приділяє історії біологічних ідей і концепцій, що створювалися і розроблялися спеціально підготовленими людьми в конкретних соціально-культурних умовах в рамках спеціальних дисциплін і інститутів з використанням певних методів, приладів і інструментів. Як міждисциплінарна наука, історія біології вивчає когнітивні, у тому числі і філософсько-методологічні, а також інституційні, інструментальні, соціально-культурні, ідеолого-політичні і психологічні чинники розвитку біологічного знання. Такий підхід дозволяє краще зрозуміти розвиток складного процесу пізнання живого і розглянути сучасні теорії як певний етап суперечливої інтелектуальної історії. У ній рішення однієї проблеми ставить десятки інших, спонукаючи до нових осмислень у пошуках відповіді на одвічне питання про суть життя.

Історія біологія – це реконструкція інтелектуальних шукань і помилок, зіткнень, дискусій і боротьби різних ідей і думок, взаємодії цілих наукових шкіл і співтовариств. Кінець кінцем ці шукання привели до вироблення сучасних норм і цінностей біологічного пізнання. В ході цієї реконструкції стає зрозуміло, як легко помилитися в процесі пізнання життя і як важко давався кожен крок вперед. Вивчення історії біології сприяє виробленню інтелектуальної чесності, незалежності від авторитарних примушень, прагненню перевіряти навіть загальноприйняті постулати і догми. В той же час історія демонструє спадкоємність біологічного пізнання, обумовленість кожного відкриття працею багатьох попередніх поколінь з їх досягненнями і розчаруваннями, знахідками і невдачами, відкриттями і помилками.

Історія біології дає можливість біологу поглянути на свою спеціальність як на цікавий розділ людської культури, дізнатися про людей, що присвятили себе пошуку відповідей на найскладніші питання живої природи і що вирвали у неї сокровенні таємниці, забезпечивши тим самим прогрес в найвагоміших сферах людської практики: у медицині, в сільському господарстві, природокористуванні, нарешті, в створенні біотехнологій – основи сучасної цивілізації і промисловості. Історичний процес виникнення, розвитку і змін теорій, контрольованих експериментом, критикою і суспільною практикою ніколи не протікав рівномірно, а шляхом простої акумуляції перевірених знань.

Ключові слова: *історія біологічної науки, анатомія тварин і рослин, біологія, еволюція.*

СТАНОВЛЕНИЕ И РАЗВИТИЕ ФИЗИОЛОГИИ ЖИВОТНЫХ И РАСТЕНИЙ

Современная биология является совокупностью многих дисциплин, которые изучают строение и функции организмов, видов и экосистем, их распространение, происхождение и эволюцию, разнообразные связки между ними и окружающей средой. В свою очередь, история биологии, которой посвященный *предлагаемая статья, занимается формами, методами и содержанием научной деятельности, направленной на приобретение знаний о биологических системах и протекающих в них процессах. Помощь призвана дать исследователю целостное представление о развитии биологии как отрасли знания с первых этапов развития человечества до новейших открытий третьего тысячелетия.*

Основное внимание автор уделяет истории биологических идей и концепций, которые создавались и разрабатывались специально подготовленными людьми в конкретных социально-культурных условиях в рамках специальных дисциплин и институтов с использованием определенных методов, приборов и инструментов. Как междисциплинарная наука, история биологии изучает когнитивные, в том числе и философско-методологические, а также институционные, инструментальные, социально-культурные, ідеолого-політичні и психологические факторы развития биологического знания. Такой подход позволяет лучше понять развитие сложного процесса познания живого и рассмотреть современные теории как определенный этап противоречивой интеллектуальной истории. В ней решение одной проблемы ставит десятки других, побуждая к новым осмыслениям в поисках ответа на извечный вопрос о сути жизни.

История биология – это реконструкция интеллектуальных исканий и ошибок, столкновений, дискуссий и борьбы различных идей и мнений, взаимодействия целых научных школ и сообществ. Наконец эти поиски привели к выработке современных норм и ценностей биологического познания. В ходе этой реконструкции становится понятно, как легко ошибиться в процессе познания жизни и как тяжело давался каждый шаг вперед. Изучение истории биологии способствует выработке интеллектуальной честности, независимости от авторитарных принуждений, стремлению проверять даже общепринятые постулаты и догмы. В то же время история демонстрирует преемственность биологического познания, обусловленность каждого открытия трудом многих предыдущих поколений с их достижениями и разочарованиями, находками и неудачами, открытиями и ошибками.

История биологии дает возможность биологу взглянуть на свою специальность как на интересный раздел человеческой культуры, узнать о людях, посвятивших себя поиску ответов на сложные вопросы живой природы и вырвали у нее сокровенные тайны, обеспечив тем самым прогресс в важных сферах человеческой практики: в медицине, в сельском хозяйстве, природопользовании, наконец, в создании биотехнологий – основы современной цивилизации и промышленности. Исторический процесс возникновения, развития и изменений теорий, контролируемых экспериментом, критикой и общественной практикой никогда не протекал равномерно, а путем простой аккумуляции проверенных знаний.

Ключевые слова: *история биологической науки, анатомия животных и растений, биология, эволюция.*

Introduction

The revolution in physics and chemistry made a significant impact on tools, devices and techniques, but with fundamentally different scientific standards. The sciences became a model for imitation primarily in the physiology and anatomy of organisms, which were increasingly regarded as machines. Scientists who worked in these areas of knowledge, that was born, as a rule, differed from natural history professionals. Being deeply faithful people they as a rule, they left their beliefs outside their scientific concepts and sought to explain the phenomena of natural scientific reasons studied by them, without resorting to teleological or theological evidence [1].

Within the framework of yet undifferentiated knowledge, a special type of research was developed – laboratory research. For these scientists, museum work and field research were sidelined. The advancement of biological knowledge in medicine increasingly accepted the character of fundamental anatomical and physiological studies. Scientists sought to reach universal laws of structure and functioning of organisms. Prerequisites were created for the emergence of experimental biology, the beginning of which came in the second half of the XIX century [2].

Research Methods

In the preparation of the article, chronological, typological, comparative methods of historical cognition, classification and systematization of historical sources and bibliographic material were used, which made it possible to systematize and critically evaluate the sources used, to highlight the most important in the present state of study of the topic and results of other researchers. The methodological toolkit of the study is based on the general principles of historicism, scientificism and objectivity [3]. The stages of formation and development of the doctrine of plant and animal physiology are analyzed in the article. The process of forming scientific thought is considered: from the first written mentions of scientists of the ancient world to the scientific work of outstanding researchers in plant and animal physiology.

Results and discussion

During the XVII century anatomical studies turned into comparative ones. At the same time the problem of interrelation of structure and function of the organ was brought to the fore. Increasingly, they were solveв by experimental methods, in particular by vivisection. Human was used as an object often [4].

A leader in the use of physico-chemical concepts in the knowledge of the living became an English doctor William Harvey (1578–1657) who, through numerous vivisections of different vertebrates, described the large and small circles of blood circulation. In 1658 in the book "An Anatomical Exercise on the Motion of the Heart and Blood in Living Beings" he likened the heart to the muscle which as the beginning and the center of circulation, moves the blood through the vessels. Harvey calculated the amount of blood flowing through the heart and concluded that blood cannot be created continuously from food (as previously thought) and therefore there must be continuous circulation of blood in the body. Putting experiments with cutting and clamping of vessels he found out the direction of blood movement and the value of the heart valves so he refuted the former conception of the liver as one of the centers of circulation and about the existence of a membrane between the right and left half of the heart.

Harvey's work marked a new phase in the knowledge of organisms proving the usefulness of the combined use of observation and experiment. His conclusions were confirmed almost simultaneously by Sweden O. Rudbeck (1630–1702) and Dane T. Baholinus in the experimental study of the lymphatic system of many animals. They influenced science in general. Under their impression, Descartes put forward the idea that the processes in the nervous system are carried out automatically and do not require the participation of the soul. The center of the nervous system is the brain from which the nerve "tubes" diverge. External actions at the end of nerve "threads" are automatically transmitted from brain to muscle. That is how the idea of reflex as a general principle of nervous activity was formulated and its determination by external stimuli. Descartes extended the principle of automatic reflex response to all "involuntary" acts which served as a compass for neuromuscular physiology and outlines new "nerve points" [5]. Starting from the idea of the brain as a machine and analyzing great clinical material T. Willis (1621–1675) tried to differentiate between different levels of neuromuscular reactions. Another English doctor, anatomist and physiologist F. Glisson (1597–1677) introduced an annoying concept, and denied Descartes' idea of muscle gain as he contracted, stating that muscle fibers are contracted by internal movement.

Reducing the laws of life to the simple laws of mechanics was considered the most important task. This area is called yatromechanics. Representatives of whom tried to explain all physiological phenomena and processes based on mechanics, believing that the disease is a consequence of violations of the patterns of movement of the smallest particles of the body, which is a kind of mechanical machine [6]. The word "mechanisms" in the writings of anatomists and physiologists of that time was not a figurative expression, but was interpreted literally. Mechanical interpretation of the physiology of motion was laid by the Italian J. Borelli (1608–1679). In the book "On the Movement of Animals" (1680–1681) he gave a mechanical and mathematical description of movements during walking, running, swimming, jumping, flying and breathing in various mammals, birds and fish, and described the role of muscles and skeleton in maintaining balance and movement. He established the role of the intercostal muscles in the act of breathing, the passivity of the lungs, first interpreted the movement of the heart as a muscle contraction. Finding that the heart periodically ejects blood into the vessels, Borelli suggested that their elasticity ensures the continuity of blood flow in the capillary. S. Hells (1677–1761) measured the blood pressure in animals (1733) and calculated the volume of blood flowing through the heart. The German physician F. Hoffman (1660–1742) came up with the idea that the human body is like a machine made up of organs of various shapes and sizes and driven by body fluids. One of the creators of modern physics, R. Hook (1635–1703), understood the mechanism of inhalation and exhalation, correcting the mistake of anatomists and physicians who believed that the lungs themselves contracted and contracted without the participation of respiratory muscles.

The proponent of yatromechanics was the famous Dutch physician and chemist G. Burgava (1668–1738), who tried to reconcile the latest data in physiology and chemistry with clinical experience. In his work, the mechanistic interpretation of life reached its height. He believed that there was nothing in the body that could not be expressed in terms of physics. The Italian physiologist and physician L. Bellini (1643–1704) used the laws of mechanics to develop a filtration theory of urine formation. His colleague and compatriot S. Santorio (1561–1636) in the book "Static Medicine" sought to apply physical methods in the study of a person's metabolism and breathing, creating an experimental camera, which took into account not only the weight of the person but also the weight of his food and selections.

Experimental studies of the digestive system have been varied, during which new techniques of vivisection have been developed. The Dutch anatomist and physiologist R. de Graaf (1641–1673) opened the abdomen of the dog and brought out the duct of the pancreas. He managed to get pure digestive juice and to determine some of his physical and chemical properties. However, they could not judge what makes this juice with food. In the future, his technique of imposing salivary and pancreatic fistulas was used to study the chemistry of digestion and to develop a method of chronic experiment. Almost a century later, the French naturalist R. Reomur (1683–1757) forced birds to swallow pieces of spongy material with thread attached to them. After a while, he removed the sponge that had been swallowed by the animal and, squeezing the juice from which it had seeped into the gastrointestinal tract, analyzed it.

These studies aimed at identifying universal physiological processes, formed the basis of ideas about man as a machine in the writings of the French materialist Also. La Mettrie (1709–1751). However, the mechanistic interpretation of life that represented the body as a complex, superb machine, elicited objections from a growing number of professionals who indicated that without the presence of the forces, integrating the organs and functions, the body would disintegrate into its constituent substances, as occurs after death. As such, the integrator called the soul – the only derivative of all vital functions, these beliefs received a concentrated expression in the works of G. Stahl (1660–1734), laid the Foundation of modern vitalism.

A qualitatively new stage in the application of the laws of physics in anatomy and physiology associated with the activities of the Swiss natural scientist and poet A. Haller (1708–1777), who have not joined any mechanic nor vitalism. At the same time, he was instrumental in the formation of a new paradigm in animal physiology associated with the recognition of differences in the body from the truck and comparability of its functions to the mechanics. Unlike his predecessors, he focused not on the individual body and its functions, and on the whole body, paying attention to the interaction between different systems. In eight volumes "Physiological elements of the human body" (1757–1766) Haller gave comprehensive information on the total human physiology. He made additions to the teachings of V. Garvey, noting the relationship of the various elements of the circulatory system, and put forward the position that the muscle fiber is able to contract due to its special properties – irritability. This property is the basis of the movement of the muscles, heart, internal organs, and is reflected in the fact that the weak holds incentive effect is not proportional to the force action. Haller studied the functions of the nerves, irritating them artificially, investigated the mechanisms of respiration and circulation, function of the eyes, throat, etc., trying to prove that irritation and sensitivity – the phenomenon of a different order, the result of two different forces. He suggested the term physiology [7.

The study of the body was closely connected with the problem of regulatory mechanisms to maintain its integrity. In this regard, the study of the nervous system has gained great importance and popularity. The largest German anatomist and physiologist I. Prochazka (1749–1820) conducted experiments on frogs. Studying the "reflective activity", opened by Descartes, he suggested that the reflex principle of nervous system function and the term "reflex", described coughing and sneezing reflexes. He shared sensory and motor nerves, examined the transition of the pulse with sensitive upon the motor nerves, studied anatomy of the nervous system. However, Prokhazka's brain functions only thought without going beyond the natural-philosophical methodology that prevailed in Germany. The gist of it was that the knowledge of the world must be through observation and reasoning, but not by experiment, which allegedly distorts the nature of the studied phenomena, and leads to erroneous knowledge.

Another Englishman, a priest, botanist and chemist C. Gayles (1677–1761), based on the mechanics of Newton, in his "Statics of plants" (1727) formulated the hypothesis that the absorption of water through root, and it is the plant is the result of the action of capillary forces of the porous body. He was able to detect the root pressure, and in the observations of the evaporation of plants – the suction effect in this process of the leaves, thereby establishing the lower and upper end motors that provide water rise. He put a large number of experiments on the transpiration. Calculate the time that has passed since suction of water by roots to its evaporation through the leaves, he calculated the speed of water movement in the plant. He also determined the amount of water evaporated by the plant per day, measured the intensity of transpiration of plants with and without leaves, at different hours of the day and seasons, in leaves tender and leathery, lit and shaded. In addition, he identified an exemplary force with which to absorb water swelling seeds, and explained the biological significance of the swelling, which begins with germination of: mechanical force in order to break the shell family and to overcome the resistance of soil particles around it.

S. Gayles, who first suggested the idea that a large portion of plant substance is taken from the air, as during their decomposition with release of gas substances. Gayles did not know how the air is processed in the solid plant matter, but assumed that under the action of light. Because chemists are not yet able to distinguish between gases, composition of air, Gayles could not investigate the exchange of gases in plants. For the same reason was such that it did not understand the observations of the Swiss š Bonn, described in 1754, the bubbling gas plants, submerged in the world and the cessation of selection in the dark. Gayles also drew attention to the selective ability of roots to absorb from the soil minerals.

Successfully borrowing the methods of laboratory physics (measuring, weighing, counting), Gayles quickly became known far beyond the borders of England and subsequently was known as the "father of plant physiology and the experimental method". In 1806, the English botanist anatomist T. E. Knight (1759–1838) to study the phenomenon geotropism constructed that rotates water wheel, by which he proved experimentally the value of the force of gravity to manifestations geotropic reactions.

In electrical and magnetic phenomena have long been regarded as miracles. The The discovery by B. Franklin atmospheric electricity (1752) prompted a student of G. Stahl F. Boise de Sauvage (1706–1767) to propose the idea that the electric fluids are the basis of the neural processes regulating nutrition, respiration, movement and the senses and their interactions. In 1781, the French abbot P. Bertolon (1742–1800) wrote the book "On electrical matter of the human body", claiming the building electromedicine system according to which all diseases are the result of excess or lack of the body's "electrical energy" violation of the balance between positive and negative charges in the human body. Nervous essence (spiritus animalis) were interpreted as electric process ("animal electricity"). Later, in 1784, I. Prochazka replaced these fluids some kind of "nervous force," which he likened to the forces of gravity in mechanics.

Italian physician and anatomist L. Galvani (1737–1798) conducted experiments to study the contractions of the muscles of frogs, which opened muscle electric currents, which he called "animal electricity". His observations he stated in the "Treatise on the forces of electricity in muscular motion" (1791). According to Galvani, muscles and nerves by electric current charged like a Leyden jar. For 1786–1798. he proved in the experiment that the living tissue is able to generate electrical energy. Despite the high authority of his compatriot physicist, and physiologist A. Volta (1745–1827), which denied the validity of the data obtained Galvani, the latest work has gained huge popularity and became the basis for the special direction in the interpretation of life – of "galvanism". In electricity, the nature of which was unknown, saw an analog of various fluids, which are the basis of life views. In 1820–1830-ies in the presence of bioelectric phenomena, no one doubted, however, few dared to study experimentally these mysterious phenomena, despite their complexity.

About the formation of anatomy, physiology and embryology. The Renaissance intensified interest in the structure of man, although the autopsy was still officially banned [8]. Anatomical information was still to be obtained not from experience, but from the books of Aristotle and Galen, disagreement with which was regarded as heresy. However, many artists and sculptures, refining their skills, came to believe that without knowledge of the internal structure of the human body cannot be properly depicted, especially in motion. At great risk, they studied human anatomy on corpses and did vivisection. Among them was Leonardo da Vinci (1452–1519). His treatises on human and animal anatomy with beautiful drawings testified to a deep knowledge of the structure of man and his embryology, which could be acquired through the opening of corpses, and possibly vivisection. Describing the location in the body of an adult veins, nerves, muscles, heart, Leonardo da Vinci sought to show changes in them during movement. His "Treatise on Anatomy" contains data on human changes since conception. In his creative work, he applied a statistical approach to assessing the variability of parts of the human body, depicting several variants of their structure, choosing the mean as the norm. In one of his drawings, a man's hand is depicted with a monkey's hand, which emphasizes the homology of these extremities. He noted the presence of "similar members" in all terrestrial animals. However, his works remained unpublished for more than 400 years and did not have a direct impact on the development of knowledge about human anatomy and physiology.

In 1501 Magnus Hundt's book Anthropology on the Dignity, Nature and Properties of Man and on the Elements, Parts and Members of the Human Body was published. Later, in 1533, the work of Haleazzo Capella's "Anthropology, or Discourse on Human

Nature" was published, which also contained data on the individual variability of humanity. It records the formation of human morphology.

Enthusiasm for the physical and spiritual qualities of people allowed to actively develop knowledge about the person. One of the first anatomical studies on human corpses was started by the French doctor Jacobus Silvius (1478–1555), who studied the structure of the vena cava, peritoneum, etc. His disciple, the medical doctor of Emperor Charles V. A. Vesalius (1514–1564), in 1543 published a fundamental work, The Factory of the Human Body. The original anatomical material was collected by him as a result of anatomy of the corpses, which he removed from the gallows. Vesalius developed methods of preparation, sketched, revised the terminology, creating a topographic and descriptive anatomy of man. He described in detail the skeleton, ligaments, muscles, blood vessels, nerves, digestive organs, urinary system, heart, brain, sensory organs. Vesalius found that the right and left ventricles of the heart did not connect with each other, but mistakenly believed that the blood somehow leaked from one ventricle to another. The book was provided with beautiful drawings by one of Titian's students. The images and texts do not yet have mechanics. The body has not yet become a system of levers. But it was no longer just an aesthetic object like that of artists, having been prepared for the skeleton, muscles, nerves, blood vessels, internal organs. The book was put on trial by the Inquisition, which found Vesalius insane and sentenced him to repentance. Stunned by the sentence, the author went on a journey to Jerusalem and died on the way back.

Even more tragic was the fate of M. Servetus (1509–1555), the author of the Circulatory Circulation, who opened a small circle. Calvin ordered him burned in Geneva. However, to stop the growth of knowledge could no longer the Catholic Church, or what he gained from the beginning of the XVI century. the power of Protestantism. Regardless of Servetus, a small circle of blood circulation was described by M. Colombo in the book "On the Anatomy" (1559). He, for the first time, began vivisection on dogs. Human anatomy in those years was studied by B. Eustachius

(1520–1574), G. Fallopius (1523–1562), V. Koiter (1534–1576), and D. Fabricius (1533–1619). The names of the first two are called the open internal organs of human.

For the first time since Aristotle W. Aldrovandi tried to trace the stages of development of chicken eggs and chicken. The technique was simple. Laying two or more dozen eggs under a chicken, he then took out one egg each day. Italian researcher D. Fabrizio, studying the embryos of humans and animals (rabbit, guinea pig, mouse, dog, cat, sheep, pig, horse, cow, etc.), obtained the facts of comparative embryology made good drawings of embryos at different stages of development. Fabricated works on the embryology of various groups of animals (1600, 1621) suggest that he is the founder of comparative embryology. The series of works of this brilliant galaxy of anatomists and physiologists created the preconditions for further penetration not only into the structure but also into the function of a living organism.

Biological information on physiology and biochemistry was also accumulated in medieval alchemical tracts. An example is the "Book of Plants" of the famous alchemist of the XV century. I. Holland [9]. Studying the processes of decay and fermentation, alchemists have accumulated knowledge about the chemical composition of plants and animals, have developed technologies for obtaining pure substances in small quantities. In the sixteenth century. Jatrochemistry occurs, which interpreted pathological processes in the body as a violation of chemical equilibrium, the restoration of which is possible only through chemical means. Finding and manufacturing such drugs was the main task of iatrochemistry.

Interest in the sciences that studied natural compounds directly affected the chemistry of life [10]. The most prominent figure of this time was Philip Aureol Theophrastus Bombast of Hohenheim, known by the name of Paracelsus (1493–1541). An enemy of scholastic wisdom and a proponent of the direct study of nature pantheistic, from the point of view of the doctrine of the unity of the micro- and macrocosm, he conducted numerous experiments on animals and humans, studying the therapeutic effects of various chemical elements. He came to the conclusion that there are no universal diseases, he believed that many diseases are characteristic of their pathogen ("living family"). Paracelsus had a deep knowledge of living chemistry and successfully applied them in medical practice, formulating the doctrine of the five invisible causes of diseases and methods of their treatment. He analyzed the pathological state of organisms caused by disorders of the processes underlying physiological functions, and the role of the end products of metabolism in the emergence of diseases. Paracelsus has developed the doctrine of drug dosage and methods of treatment of infectious diseases (syphilis – mercury, sapa – arsenic drugs). He made his observations in the form of alchemical treatises.

Conclusions

The history of biology is a reconstruction of intellectual quests and misconceptions, clashes, discussions and struggles of different ideas and thoughts, the interaction of entire scientific schools and communities. Eventually, these searches led to the development of modern norms and values of biological knowledge. In the course of this reconstruction, it becomes clear how easy it is to make a mistake in the process of learning about life and how difficult it is to take every step forward. Studying the history of biology contributes to the development of intellectual honesty, independence from authoritarian coercion, the desire to test even the common postulates and dogmas. At the same time, history demonstrates the continuity of biological knowledge, the conditionality of each discovery of the work of many previous generations with their achievements and disappointments, findings and failures, discoveries and mistakes.

The history of biology enables biologists to look at their specialty as an interesting section of human culture, to find out about people who have dedicated themselves to finding the most difficult questions of wildlife and breaking the secrets of it, thereby making progress in the most essential areas of human practice: in medicine, in agriculture, environmental management, finally, in the creation of biotechnology – the foundations of modern civilization and industry. The historical process of the emergence, development, and change of theories controlled by experiment, critique, and social practice has never flowed evenly, but by the simple accumulation of proven knowledge.

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Рецензент:
Бородай І.С., д.і.н., професор
Кучер В.І., д.і.н., професор

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