

Department of Invertebrate Zoology, and 200 years of zoological history at Saint Petersburg University

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ABSTRACT: The 200th anniversary of the Department of Zoology of St. Petersburg State University and the 150th anniversary of its daughter Department of Invertebrate Zoology are decent reasons to consider the important historical phenomenon. The history of the Department is the story of development of Zoology, the story of revolutionary changes in society. But, at the same time, it is the story of the continuity of generations of zoologists. The article presents a brief historical review of two centuries, but also contains elements of analysis: the long and fruitful existence of the zoological department makes it possible to trace the main trends in its development. Many of its features are likely to be common to the logic of evolution of “biodiversity departments”, but of course, each department with a long history is unique. Here is a historical case study. I hope that reflection on historical events can help identify the trends and even the reasons of the Department’s sustainability throughout this considerable time interval.

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KEY WORDS: Department of Invertebrate Zoology, Saint-Petersburg State University, history, 200th and 150th anniversary.

Кафедра зоологии беспозвоночных и 200 лет истории зоологии в Санкт-Петербургском университете

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РЕЗЮМЕ: 200-летие кафедры зоологии Санкт-Петербургского государственного университета и 150-летие ее дочерней кафедры зоологии беспозвоночных — достойные основания присмотреться к этому устойчивому научно-педагогическому феномену, который теперь уже приобрел и культурно-исторический смысл. История кафедры — это история развития зоологии, история революционных изменений в обществе. Одновременно это история преемственности поколений зоологов. Статья представляет собой краткий исторический обзор двух столетий, но также содержит элементы анализа: длительное и плодотворное существование кафедры зоологии Императорского Санкт-Петербургского университета — зоотомического кабинета — кафедры зоологии беспозвоночных Ленинградского — Санкт-Петербургского университета — позволяет проследить основные тенденции ее развития. Многие черты

этого процесса, вероятно, являются общими в логике эволюции «биологических» кафедр, но, безусловно, каждая кафедра с многолетней историей уникальна. Общие закономерности двухвекового развития и уникальные черты сплетаются в единый «исторический кейс». Надеюсь, что осмысление исторических событий поможет выявить тенденции, а возможно даже понять причины устойчивости кафедры на протяжении этого значительного временного интервала.

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КЛЮЧЕВЫЕ СЛОВА: Кафедра зоологии беспозвоночных, Санкт-Петербургский государственный университет, история, 200-летняя и 150-летняя годовщина.

Introduction

St Petersburg University is celebrating the Year of Zoology in 2022. Its program, rich in events, exhibitions and meetings, is highlighting a remarkable double anniversary at the University that has, according to the changes in the city's name and historic circumstances, been named the Saint Petersburg Imperial / Petrograd / Leningrad / and Saint Petersburg State. Here, 200 years ago the Department of Zoology was established, and 50 years later gave rise to the two fellow departments, of Vertebrate and Invertebrate Zoology.

In this brief sketch I do not mean to exhaustively describe the history of the Department of Invertebrate Zoology SPbU. Its scientific path, famous teachers and students, outstanding destinies are worth a detailed depiction, perhaps in many volumes. For now I aim to observe the development of the Department as if from the outside, as a “naturalist studying the ontogenesis” (in this case, the ontogenesis of the Department) and highlight only the key milestones. Such a view may help identify the trends and even the reasons of the Department's sustainability throughout this considerable time interval.

1. The origin of zoology at the Imperial Saint Petersburg University

In 1822 a seemingly unremarkable event happened at the Imperial Saint Petersburg University (ISPbU). The position of a full professor at the Department of Zoology (that used to just formally exist), vacant for several preceding years, was taken by Andrey Vasilyevich

Rzhevsky. A student of the famous Georges Cuvier, Andrey Vasilyevich began teaching at the revived department in the same year. This is how the tradition of zoological research and education began at the ISPbU, and remained uninterrupted for two centuries, as the university has been changing its name to Petrograd / Leningrad / St Petersburg State (SPbU).

The further history of the Department of Zoology and the Department of Invertebrate Zoology advanced against the background of successive empires, social upheavals, and world wars. However, the ongoing sequence of teachers and students sharing the ideals of devotion to science, unity of research and education, equality in expressing opinions, turned out to be surprisingly strong. The scientific and pedagogical traditions of the Department ensured the stability of this community.

The courses specifically focusing on invertebrates appeared at the Department of Zoology quite soon. Already in 1824 A.V. Rzhevsky started teaching Entomology. And Stepan Semenovich Kutorga (Fig. 1), who succeeded as Head of the Department in 1833, taught not only the general zoological disciplines, but also the courses “On Invertebrates” and “On Sea Nettles”. In the study by S.S. Kutorga “Natural History of Infusion Animals” (1839) the topic of unicellular organisms (protists) has come up for the first time at the Department of Zoology.

Since 1836 the Department of Zoology has been housed in the building of the Twelve Collegia on Vasilievsky Island in St. Petersburg. From that moment until today, the history and the present of zoology at SPbU has been tied to these enfilades of rooms on the third floor of the University's main building, completing our narrative with a lively “certainty of place”.

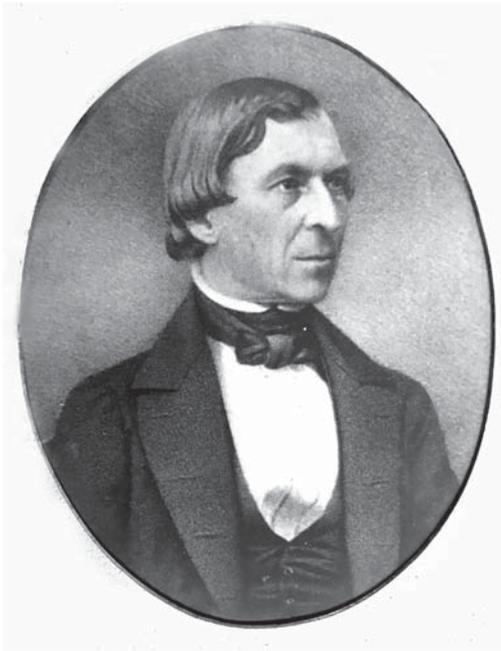


Fig. 1. Stepan Semenovich Kutorga (1805–1861). Professor, head of the Zoology Department of Imperial Saint Petersburg University in 1833–1861 (photo from the archive of the Department of Invertebrate Zoology).

Рис. 1. Степан Семенович Куторга (1805–1861). Профессор, заведующий кафедрой зоологии Императорского Санкт-Петербургского университета в 1833–1861 гг. (фото из архива кафедры зоологии беспозвоночных).

2. The first period in the development of the Department of Zoology. The foundations of future achievements and first successes

Let's outline the three periods in the development of the Department of Zoology — and Invertebrate Zoology — at SPbU. The first one was spanning from 1822 until the 1880s. Diversity of multicellular animals was a dominant topic of zoological research at that time. The staff activities contributed to setting up the



Fig. 2. Museum of the Department of Invertebrate Zoology. Our days.
Рис. 2. Музей кафедры зоологии беспозвоночных. Наши дни.

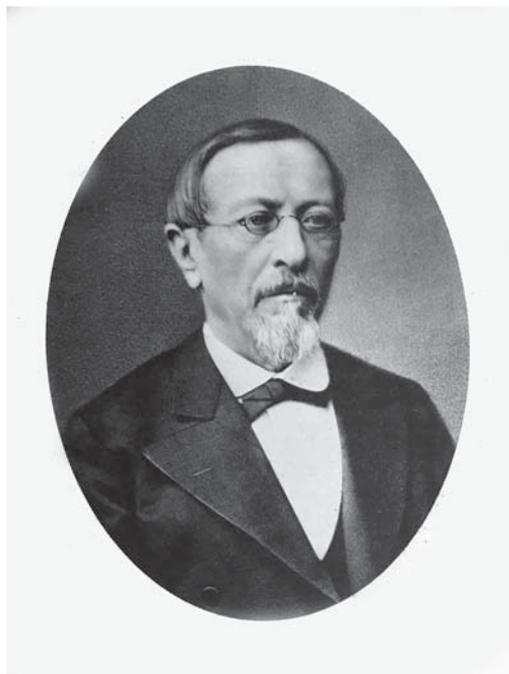


Fig. 3. Karl Fedorovich Kessler (1815–1881). Professor, Rector of Imperial Saint Petersburg University (1867–1873); head of the Zoology Department in 1862–1871; head of the Office of Zoology in 1871–1881 (photo from the archive of the Department of Invertebrate Zoology).

Рис. 3. Карл Федорович Кесслер (1815–1881). Профессор, ректор Императорского Санкт-Петербургского университета (1867–1873); заведующий кафедрой зоологии в 1862–1871 гг.; заведующий зоологическим кабинетом в 1871–1881 гг. (фото из архива кафедры зоологии беспозвоночных).

department's collection. These specimens got integrated into both educational and research projects, had methodological role and later served as a basis for the department's museum. The core of this collection had already formed by the second half of the 19th century. The staff's own samplings were supplemented with private collections purchased by the university and donated by enthusiasts. For example, Archbishop of Yaroslavl and Rostov Nil (N.F. Isakovich) donated his collection of mollusk shells to the University in 1874. Since then the zoological museum has been an essential component of the department's work (Fig. 2). As time passed, it has also gained cultural and historical signif-

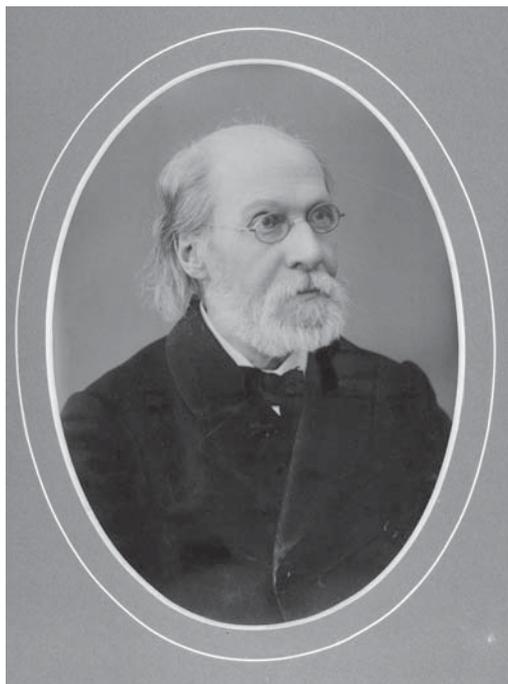


Fig. 4. Nikolai Petrovich Wagner (1829–1907). Professor, head of the Office of Zootomy in 1871–1885 (photo from the archive of the Department of Invertebrate Zoology).

Рис. 4. Николай Петрович Вагнер (1829–1907). Профессор, заведующий зоотомическим кабинетом в 1871–1885 гг. (фото из архива кафедры зоологии беспозвоночных).

icance due to the imprint of the work of famous scholars.

As the Department's research scope and museum collection expanded, it became clear that it could not flourish without access to marine field material. As a result, in 1871 the first Russian marine biological station was founded on the Black Sea coast (the Sevastopol Biological Station, now Institute of Biology of Southern Seas). The main inspirer and manager of this important business was the head of the Department of Zoology at ISPbU since 1862 (and simultaneously the rector of the University) Karl Fedorovich Kessler (Fig. 3). A decade later, in 1881, Nikolai Petrovich Wagner, professor of zootomy (see below) (Fig. 4), organized a biological station at the Solovetsky monastery on the White Sea (1882) (Fig. 5), in



Fig. 5. The first biological station of Russian North on the Bolshoi Solovetsky Island of the White Sea (photo by B.V. Sukachev, 1887).

Рис. 5. Первая биологическая станция российского севера на Большом Соловецком острове Белого моря (фото Б.В. Сукачева, 1887 г.).

cooperation with the local abbot Archimandrite Meletiy. The marine component in the life of the zoological departments was also later fulfilled by setting up the biological station in the village of Alexandrovskaya (Kola Bay, Barents Sea), as well as by the annual work of students and teachers of the department at the Naples station and the Russian biological station in Villefranche-sur-Mer (Mediterranean Sea). Nowadays the traditions of marine research and education of biologists are continued at the “Belomorskaya” station SPbU (since 1975).

As the work at the Department of Zoology advanced, its logic called for two branches of research, based on the two kinds of study objects. First the collection was divided into two offices: the Zoology (collection of vertebrates) and the Zootomy (collection of invertebrates). By 1871, the Office of Zootomy got its own position of full professor, which was taken by Nikolai Petrovich Wagner of Kazan University. Thus the formal administrative separation was first outlined, and the present departments of Vertebrate and Invertebrate Zoology trace their 150-year history back to that moment.

3. The second period. Mature zoology

The next period in the educational and scientific life of the Office of Zootomy / the Department of Invertebrate Zoology was roughly 100 year-long, from the late 19th to the late 20th century. Persistent scientific and pedagogical schools have formed, and the methodological basis of zoological education at different levels has refined. The Department was largely shaping the trends of biology at the whole University; its graduates were influencing the biological research in Russia.

The research pathways that started in the end of the 19th and the first quarter of the 20th were destined to become the scientific and pedagogical schools of the coming decades. Professors Vladimir Timofeyevich Shevyakov (Fig. 6) and his student, Valentin Alexandrovich Dogiel (Fig. 7), laid the foundation for the school of protistology. It further developed when Yuriy Ivanovich Polyanskiy (Fig. 8) succeeded his teacher Prof. Dogiel as a Head of the Department of Invertebrate Zoology in the last quarter of the 20th century; and also when Lev Nikolaevich



Fig. 6. Vladimir Timofeyevich Shevyakov (1859–1930). Professor, head of the Office of Zootomy in 1886–1913; Deputy Minister of Public Education (1911–1917) (photo from the archive of the Department of Invertebrate Zoology).

Рис. 6. Владимир Тимофеевич Шевяков (1859–1930). Профессор, заведующий зоотомическим кабинетом в 1886–1913 гг.; Заместитель министра народного просвещения (1911–1917) (фото из архива кафедры зоологии беспозвоночных).

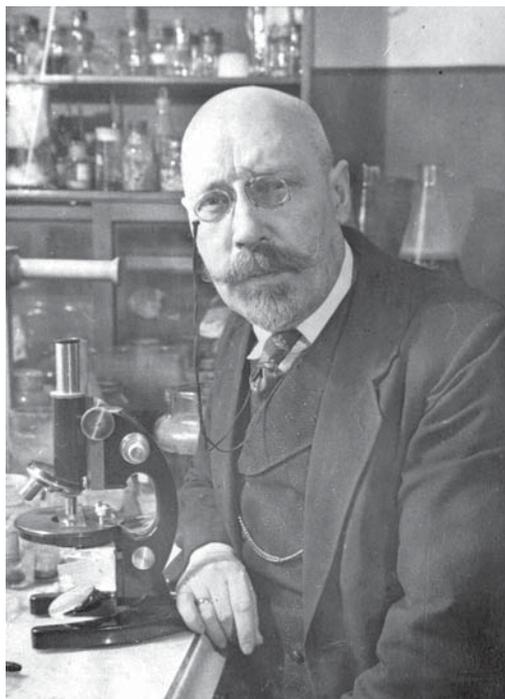


Fig. 7. Valentin Alexandrovich Dogiel (1882–1955). Professor, head of the Office of Zootomy – Department of Invertebrate Zoology in 1913–1955 (photo from the archive of the Department of Invertebrate Zoology).

Рис. 7. Валентин Александрович Догель (1882–1955). Профессор, заведующий зоотомическим кабинетом – кафедрой зоологии беспозвоночных в 1913–1955 гг. (фото из архива кафедры зоологии беспозвоночных).

Seravin was heading the Laboratory of Invertebrate Zoology in the Biological Institute in Peterhof. Later, members of this protistological school of SPbU (still the largest in Russia) contributed to changing the concept of what the objects of zoology are. Large-scale studies of foraminifers, sporezoans, ciliates, amoeboid and flagellate protists are still a considerable part of the research at the Department of Invertebrate Zoology. For almost 30 years now, the first Protistology course in Russia has been taught to first-year biology students.

Prof. Dogiel has been heading the Department for 43 years (1913–1955, Fig. 7) and facilitated the onset of two more scientific schools here: in parasitology and in evolutionary and functional morphology.

In parasitology Prof. Dogiel and his students followed the ecological approach. The idea was to consider not just host-parasite interactions, but also to analyze the distribution of parasites, how their life cycles are completed, and how they interact with the external environment. The key focus was on the conditions of existence of host-parasite systems, on the role of parasites in natural communities, and on the processes of parasite faunas formation. These endeavours of Prof. Dogiel were continued by his students T.A. Ginetsinskaya, M.M., Belopolskaya, A.A. Dobrovolsky (headed the Department in the last years of the 20th century, Fig. 9); and also by a series of brilliant parasitologists who were educated at the Department and then worked in academia and industry in Russia and abroad.



Fig. 8. Yuriy Ivanovich Polyanskij (1904–1993). Professor, head of the Department of Invertebrate Zoology in 1955–1983 (photo from the archive of the Department of Invertebrate Zoology).

Рис. 8. Юрий Иванович Полянский (1904–1993). Профессор, заведующий кафедрой зоологии беспозвоночных в 1955–1983 гг. (фото из архива кафедры зоологии беспозвоночных).

The traditional zoological studies of multicellular animals in the 20th century were probably dominated by the evolutionary and functional morphology. The works of Prof. Dogiel “Comparative anatomy of invertebrates”, “Oligomerization of the homologous organs as one of the main paths in animal evolution”; the fundamental work of zootomy graduate Vladimir Nikolaevich Beklemishev “The basis of the comparative anatomy of the invertebrates”; works of Artemiy Vasilyevich Ivanov and many other zoologists who studied at the Department, constitute a backbone of classic zoological literature, which still remains relevant and is used to train zoologists.

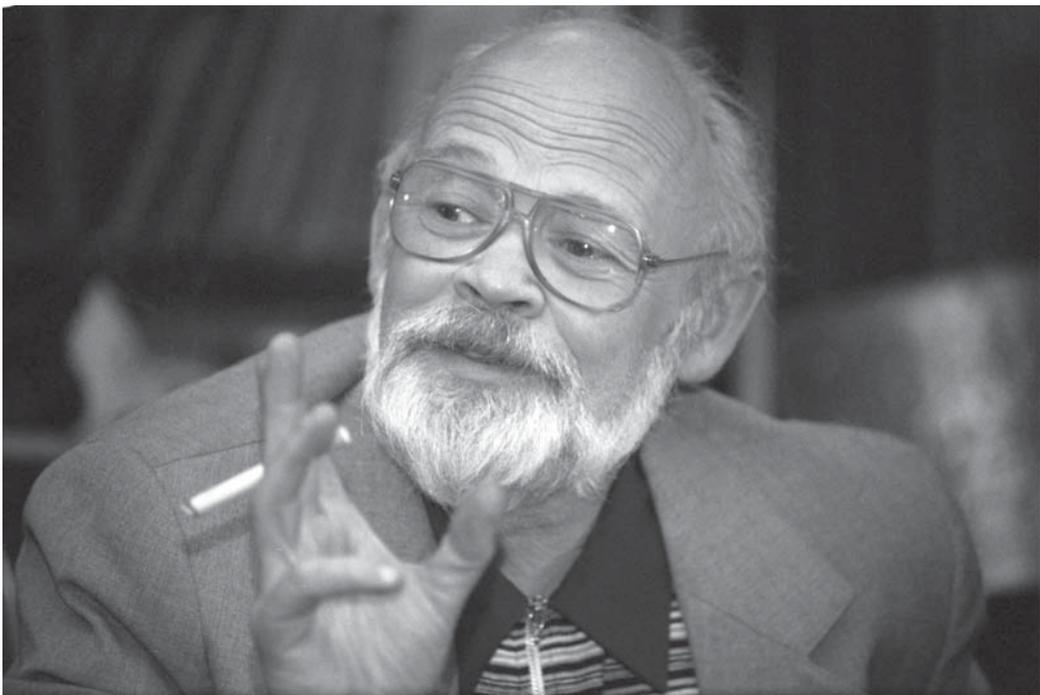


Fig. 9. Andrei Alexandrovich Dobrovolsky (1939–2019). Professor, head of the Department of Invertebrate Zoology in 1991–2000. (photo by M.L. Fedyuk)

Рис. 9. Андрей Александрович Добровольский (1939–2019). Профессор, заведующий кафедрой зоологии беспозвоночных в 1991–2000 гг. (фото М.Л. Федюка).

Summing up, the scientific topics of the Department of Invertebrate Zoology in the 20th century were a harmonious combination of studies on unicellular animals (protistology), multicellular invertebrate animals (evolutionary and functional morphology), and interaction of organisms (parasitology). Noteworthy, a thorough textbook on each of these three disciplines was developed. We owe this primarily to Prof. Dogiel, but this would hardly have been possible without the support and involvement of the entire team of the Department. Later reprints of these books were arranged by Prof. Dogiel's students and followers. The textbooks "General Protistology" (1951), "Course of General Parasitology" (1941) and "Comparative Anatomy of Invertebrates" (1938–1940) were based on lectures and for many years have become the basic educational and methodological works in these fields. And the fate of the "Textbook on Invertebrate Zoology" (1934) is unique: it served as a main university textbook on the subject in Russia and survived seven editions. Moreover, as late as early 21st century it was repeatedly reproduced in reprint by various publishers. The widespread use of this textbook will soon mark its centennial anniversary.

During the extremely busy times at the turn of the 19th and 20th centuries the Office of Zootomy was under the leadership of Professor Vladimir Timofeyevich Shevyakov (see Fig. 6).

In addition to the zoological museum with an excellent set of macroobjects, including anatomical preparations, the Office significantly upgraded its teaching facilities. The foldable models of invertebrates were bought from Brendel (Germany), dozens of coloured posters by leading zoologists of that time were bought from A. Pichlers Witwe & Sohn, Buchhandlung und Lehrmittelanstalt, Wien & Leipzig. Even today, more than 100 years later, these visual aids are still useful in the teaching process. The setup of a microscopic slides collection in the museum was a groundbreaking event, influencing both research and education. The collection has been growing as an integral part of the Department; in particular, it was one of the prerequisites for the development of the protistology branch. About the same time, the so-called "large practical training" becomes a significant component in teaching future zoologists, and the general zoology courses for all the

biology students get accompanied by their own practical training.

Different branches of biology were becoming more and more diverged, and by early 20th century a number of new research and teaching units appeared at St Petersburg University. The Department of Zoology supplied these units with staff members, highlighting how broad-minded and qualified zoology graduates were. They headed the new departments: the first Russian Department of Genetics and Experimental Zoology (1917, Yu.A. Filipchenko), Entomology (1919, M.N. Rimsky-Korsakov), one of the first departments of Hydrobiology and Ichthyology (1929, K.M. Derugin). In general, the history of the Department of Zoology at the turn of the 19th – 20th centuries obviously demonstrates the ongoing specialization within biology and its reflection in the organizational structure of the educational and scientific process.

An important milestone for the Office of Zootomy (bearing its modern name Department of Invertebrate Zoology since 1930) was the foundation of the Biological Research Institute in Peterhof (Sergievka, the former estate of the Duke of Leuchtenberg, 1920). The research and the summer field courses of the students were largely based at this Institute. The Laboratory of Invertebrate Zoology became a subdivision of the Institute, while remaining the part of the Office of Zootomy and later the Department of Invertebrates Zoology. Later on two more "departmental" laboratories stemmed from the Laboratory of Invertebrate Zoology (headed by Lev Nikolaevich Seravin): the Laboratory of Unicellular Karyology (headed by Dmitry Vladimirovich Osipov, for many years also the director of the whole Peterhof Biological Institute and head of the Department of Invertebrate Zoology in 1983–1991), and the Laboratory of Marine Studies (headed by Alexander Ivanovich Railkin). At present, following the reorganization of the Biological Research Institute, the laboratory divisions in Peterhof are united again: a single "departmental" Laboratory of Protistology and Experimental Zoology is operating.

4. The third period. Integrative biology

The late 20th century was a time of significant changes for zoology and hence for the Department of Invertebrate Zoology of Leningrad / St. Petersburg State University. The primary reason was the rapid development of new methods. In the 1960s, transmission and then scanning electron microscopy were introduced into zoological research. By the end of the 20th century, molecular genetic methods became popular at the Department; the “molecular” age in biology began. New molecular phylogenetic data showed that the ideas about plants, animals, fungi as major elements of biodiversity of eukaryotic organisms, major “phyla”, “taxonomic kingdoms”, were not true. The former system of organisms has simply ceased to exist, and a stable new one had not yet been proposed. One of the important challenges the Department of Invertebrate Zoology faced at the time was the choice of system to present information about the biodiversity to students. Did we have to pretend that nothing happened in science and use the “old” taxa, or tell first-year students about the dozens of new proposed “molecular” systems that contradict each other?

The beginning of the 21st century has qualitatively changed the situation in biology. This was facilitated by the accumulation of huge amounts of data on the gene sequences of various organisms and the structure of their genomes. The first sign of these changes was the emergence of a “stable” (i.e., broadly replicated in independent publications) new system of organisms based on both traditional comparative morphological and — largely — molecular phylogenetic traits. Protistologists from the Department of Invertebrate Zoology SPbU were fully involved in this revolutionary process — a radical breakthrough in ideas about the structure of biodiversity. They participated, as part of international research teams of specialists in key groups of organisms, in regular publications of the newest phylogenetic systems and corresponding taxonomic summaries, as well in updating them up to the last summary of 2019. These works serve as a reference of the current state of the system of organisms.

In addition, the work of zoologists has acquired completely new features. Firstly, it has

become impossible to operate with huge amounts of molecular data without the use of computer algorithms and the introduction of bioinformatic approaches into the daily practice of zoologists. This, in turn, made it possible to aim at analyzing not just “elements” of the molecular structure of organisms, but the totality of its various components. It was manifested in the new “omics” disciplines — genomics, transcriptomics, proteomics, metabolomics. The period of “decomposition into molecules” at the end of the 20th century was replaced by a new period: synthesis of new knowledge about organisms based on all the information about their molecular composition. The pendulum of cognition swung towards an interest in holistic notions. Zoologists again began to build the concept of a holistic organism, but from the point where knowledge on its constituent elements had already been accumulated.

Research at the Department of Invertebrate Zoology has expanded traditional zoological approaches to the study of groups of multicellular animals and protists by integrating information obtained at different levels of structural organization of living matter. At the current stage of development of zoological science, the description of new species is no longer possible only at the level of the morphology and anatomy, but must be accompanied by information on molecular markers. The evolutionary history of groups of organisms appears in the form of multigene phylogenetic cladograms. Physiological studies are accompanied by the analysis of biochemical processes and gene networks controlling them. The life cycles are studied by analyzing regulatory gene cascades. The interactions of organisms in the population are estimated considering gene flow and molecular interactions of individuals using computer modelling. Interactions between parasites and their hosts are considered at the molecular and molecular genetic level. Even traditional organ systems reconstruction is performed by visualization of individual molecular components of cells and organisms using immunofluorescence and 3D modelling. And this is by no means a complete list of projects at the Department of Invertebrate Zoology SPbU in the last two decades. The goals are becoming more “functional” and more ambitious. Zoologists have gained the ability to consider the biological phenome-

non at different levels of biological organization and to understand the interrelation of these levels.

The new methods toolbox has not only opened up new horizons for research topics, but also added new dimensions to the traditional studies of zoologists. The study of organisms in terms of their structure now also includes gaining in-depth knowledge of the molecular and molecular-genetic features of their organization. At the current level of scientific development, it is necessary not just to study and describe processes and phenomena, but to analyze their molecular and biochemical background. Zoologists have to take on the difficult task of combining multilevel knowledge into holistic representations of organisms. These are the signs of an approach that has been called integrative, and the expanded field of scientific knowledge is called integrative biology.

One of the key aspects of integrative biology is the complex research incorporating the methodologies of several fields of biology simultaneously. Studies of living systems at several levels of their organization complement each other and, in fact, are becoming interdisciplinary. In particular, this is reflected in the increasing involvement of initially “non-biological” disciplines in scientific analysis. We have already mentioned one such assimilation: bioinformatics and the “mathematization” of biological research in general. Further expansion towards interdisciplinarity of methods and approaches implies active involvement of physics and chemistry, cybernetic approaches and meth-

ods of modern computational sciences in the analysis of biological phenomena. Previously independent fields of knowledge are getting integrated into a single consortium, and the result of this integration is the synergy of research, leading to a much deeper and more comprehensive understanding of the facts, processes and phenomena occurring in living nature. This is a field of analysis of living systems that takes into account trends at different levels of biological organization, their co-subordination and interconnection. There is no doubt that the future belongs to this “integrative” approach, gradually blurring the traditional boundaries between separate fields of science.

All publications of the staff and students of the relatively small Department of Invertebrate Zoology SPbU in recent years, which is more than 80 articles annually in leading international journals, can illustrate how, on the basis of traditional “zoological” topics at the Department, the research framework and set of methods are expanding, implementing the ideology of integrative biology. But the principles of unity of the scientific and educational process, a sense of bicentennial continuity of generations and the motto “Teacher of Seekers” remain unchanged.

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