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**Main areas of researches in the field of natural sciences in the XIX  
- early XX centuries.**

**Annotation.** The article describes scientific condition in the territory of Uzbekistan in XIX – early XX centuries. There has been given the contribution of native scholars and the significance of Russian and European scientific societies, expeditions, scholars and travelers.

**Key words.** Scientific heritage, expeditions, travelers, geographical societies, natural sciences, geography, science, astronomy.

**Introduction**

The development of science in Uzbekistan goes to deep historical roots. It is mostly seen in particular periods of historical development, especially, the IX – XII centuries. During the Renaissance and the reign of Amir Temur and Temurids, and science and culture grew on a high level in the territory of our country, which had a significant influence on world civilization. Great ancestors, scientists and thinkers of Central Asia not only left a noticeable mark in the history of world science and culture, but also made a significant contribution to its development. They were able to create invaluable works that are an integral part of both national and world heritage.

This article is devoted to the history of scientific research and works on the natural sciences, systematized by language and region basing on domestic and foreign studies.

**Main part**

XIX – XX centuries play significant role in intellectual development of the country. Because, during this period, after some centuries break, representatives of the eastern and western science conducted a significant number of joint researches in the country. Central Asia became an important object of scientific researches of Western researchers particularly during this period. Especially from the middle of XIX century, while geopolitical importance of the region increased in the foreign policy of the Russian and British Empires which made conduct researches due to their interest to study this area [1].

Besides, European researchers from France and Germany and other countries drew great attention to the study of the natural environment conditions, resources, trade routes and logistics, history, culture, economy, traditions and customs of the local population and systematically organized scientific expeditions and travels. In recent years, in the process of research conducted by the authors of this monograph, more than 300 studies created in Europe and over 1000 works of Russian scientists have been identified [2].

In addition, the centuries-old traditions of traditional scientific schools kept developing. Despite the fact that inventions in world level were not created in traditional scientific schools in this period, work was carried out to familiarize the generation of that period with the scientific achievements of ancestors, which were supplemented and enriched with new knowledge and worldviews. According to research results, there have been defined over 600 sources relating to science and religion written and rewritten in the studied period [2: 30-175].

First, the works of local scientific schools specialized in the natural sciences are dwelled. During the researched period, main attention was drawn to the importance of geology, geography, astronomy, astrology, and physical phenomena of nature, history, chronology and traditional medicine based on natural resources. These areas were supplemented and enriched with new information due to their practical significance. Transformational processes were observed in some areas under the influence of the achievements of European culture and science.

The analysis of local sources in the field of geology, which is an important area of the natural sciences, shows that special importance was paid to mineralogy during this period. Special attention in it was drawn to the study of the composition and properties of precious stones, their positive effect on the human body, the use of various minerals, stones and metals. In addition, their location was investigated .

Until the beginning of the XIX century, there was not enough scientific research on the geological structure and natural resources of Central Asia in Europe, and therefore, there was superficial knowledge that was not proven about the region. During this period, a significant number of expeditions, missions, foreign travelers' notes put the task of studying geological structure, natural resources and their use.

A significant amount of information has been identified in the results of expeditions carried out by Russian scientists in Central Asia in the first half of the 19<sup>th</sup> century. However, geological knowledge on the region was fragmented and they did not meet the interests of the government of the Russian Empire. Since the first years of the conquest of Turkestan, there had been conducted targeted and systematic scientific research on geology in the area. The Organization of geologists enhanced knowledge in the area. Special attention was also paid to the practical implementation of information collected during expeditions. During this period, the geographical range of studies expanded including Turkestan, Sirdarya, Samarkand, Semirechiye, Trans-Caspian regions and Bukhara and Khiva Khanate.

There has been observed clear transformational processes in the field of geography. During that period, cosmography and historical geography were developed in traditional geography. The study of the heavenly bodies and the reasons for their changes were dominated by religious concepts and theories, while geographical knowledge served for the location of various regions, cities, seas and rivers.

At the beginning of the twentieth century, fundamental changes took place in the field of geography. Works by jadid representatives such as Mahmood Khoja Behbudy and Munavvarkari Abdurashidkhonov contributed to the formation and

development of innovative knowledge and trends, as well as the enrichment of new concepts and terms of geography. The approach of dividing the globe into continents and oceans, comments on various maps with new concepts were also introduced [3:76-77].

The textbook “Yer yuzi (The Earth)” written by M. Abdurashidkhonov in 1908 (textbook for 3-4 forms of jadid schools) was admitted as a program and textbook for all schools of Uzbekistan in 1915 and was important until 1928. It illustrated information about general and primary knowledge about geography, the face and motion of the earth, its circulation around its axis and the sun, maps, the concepts of four sides including the north, the south, the east and the west, the earth formation including land and water reservoirs, island, peninsula, sea, lake river, bay and etc. [3:97] .

Role of Russian scientists is invaluable in geography. During the XIX century, more than 70 expeditions and missions were organized to Central Asia. In the first half of the XIX century, studies were held as a part of embassies’ and military missions’ tasks.

Analyzing data in researches from regional point of view, it can be seen that Russia directed more than 10 different missions and expeditions to the Tienshen, more than 20 ones to Kokand Khanate, 13 ones to Khiva Khanate, and 30 ones to the Emirate of Bukhara.

From the middle of the XIX century, scientific expeditions were conducted on the initiative of Russian Imperial Geographical Society established in 1845. According to the Society there were organized about 15 scientific expeditions in the region, which scientifically studied mountain systems, water resources, valleys and villages, deserts and roads, terrain, flora and fauna, soil and minerals, in general geographical resources of the Central Asian region. There were formed geographical and topographic maps. They were included collections and herbariums gathered from samples of flora and fauna. Detailed information is concentrated on the meteorological and astronomical points of the region.

Surveys were conducted in Zerafshan Valley, Kashkadarya and Fergana by the Society of Naturalists, and anthropologists and ethnographers of amateur and established in Turkestan in 1870. Central Asian Society held researches in the territory of the Kokand Khanate and the Kizyl-Kum desert. In the short term of its activity, the society gathered 57 000 zoological specimens and 1500 species of vegetation in the expeditions.

Turkestan branch Russian Imperial Geographical Society's expeditions carried out researches for the study of water resources, climate and landscape, glaciers, mountains, deserts, and natural resources of Turkestan and physical and geographic features of the Aral Sea.

Hydrographic studies began in the region from the middle of the XIX century. Russian scientific societies organized about tens of expeditions to study the Aral Sea, the Amudarya and the Sirdarya. Among them, special attention should be paid to the results of the Aral expedition ( 1848 - 1849 ), the lower flow of the Syrdarya ( 1850 ), the expedition of the Urundaya, the study of old bed of the Amudarya ( 1873 ), the dried beds and the delta of the Amudarya ( 1874 ), expeditions that studied the Sarikamysh ( 1876 ), the middle and lower flow of the Syrdarya ( 1878 ), the upper reaches and the delta of the Amu Darya ( 1879 ), the lower reaches and the ancient channels of the Amu Darya ( 1879 - 1883 ), as well as the Aral Sea and its environs ( 1899 - 1902 ).

Turkestan branch Russian Imperial Geographical Society and Russian Geographical Society were organized and financed by Ministry of Maritime Affairs and the Ministry of Railways of the Russian Empire.

As a result of the expeditions, there were formed reconnaissance and leveling of the Aral Sea, the Amu Darya and the Syr Darya, there were defined the level, latitude, flow rate, sedimentation rate, water temperature at different times of the year, upper lower flow of rivers, freezing regimes, chemical composition of water, as well as the amount of river water used for irrigation. Along with this, there was collected interesting information, and flora and fauna, ichthyology, history, ethnographic statistical data on the population.

During this period, in the field of astronomy and on the basis of traditional views, special attention was paid to areas that met the modern requirements of science. This was mainly the study of the movements of celestial bodies, that is, astronomy; theoretical astronomy is the determination of the orbits by the location of visible celestial bodies; astrophysics is the study of the structure of celestial objects and explaining their movement; stargazing, astronomical chronology is the measurement of time, clear measurement of the day, week, month, year and the calendar system, as well as astrology.

Tashkent astronomical and physical observatory established in 1878 played an important role in the development of this direction. Despite the fact that the initial activity of the observatory and was directed to topographical surveys, there were organized meteorological, astronomical, seismological studies. Meteorological stations were opened in every province. They held an important research on the climate of the region.

Furthermore, the staff of the observatory carried out studies on scientific astronomy. In particular, materials on the study of the movements of the sun and stars, Galileo and Darrey comets were published on the pages of magazines. Another important scientific achievement of the staff of the observatory was a photo images of stars from various angles. These photos has provided an opportunity to study the movement of stars even in the modern period .

Seismic events from 1900 to 1916 in Turkestan were not unnoticed by Observatory staff members. In particular, they studied the earthquake in the mountainous and foothill areas Andijan, Fergana and Tashkent. The main task of the staff of Tashkent Observatory was to research topographical expeditions. In this regard, researchers identified more than 700 points of astronomical coordinates and about 150 gravimetric quantities.

An important event was the formation of chemical laboratory for researches. In 1868, the first Chemical Laboratory was opened in Tashkent. A special building was built for the laboratory and was brought the appropriate

equipment. Laboratory studies mainly dealt with mining geology, court and medical examinations, sanitation and food-governmental directions.

In the XIX – early XX centuries special expeditions were organized to research the fauna of Central Asia. They worked in Zerafshan valley and Kizilkum, Aral, It was an innovation in entomology, parasitology, ichthyology and ornithology of Central Asia.

The rational use of natural resources in folk medicine is clearly reflected in the analysis of works on medicine. According to the content of the works of that period, in the treatment of diseases healers usually used natural sources such as herbs, roots, ripe and dried seeds of fruits, in general flora, as well as a variety of minerals, salt, springs sources, mud, fauna (snake, turtle, hedgehogs, fish, various parts of wild animals), the sun's rays, snow, rainwater and soil.

The range of studies conducted in the region during this period was very large, through which new directions were introduced into science. In particular, in the direction of geography and on the basis of complex research, there were studied paleogeography, physical geography, geography, geobotany, meteorology and climatology. As part of the geographical expeditions, there were involved specialists in geodesy, botany, geology, topography, hydrology, zoology, ornithology, entomology, ichthyology, hydrology and they published colossal works in these directions.

Such complex surveys were the characteristic of large expeditions organized in the Aral Sea, the Amu Darya, the Syr Darya, and the ridges of the region. They were able to collect in a large number of important and new materials. A significant number of them were scientists, initiators and organizers of scientific research with responsibility to fulfill their obligations. The various data collected in the course of these works, herbariums and other types of materials introduced new sources into science. Many of them were awarded with government awards and degrees for achievements in science.

The works that were carried out were inextricably linked with cartography and toponymics. Every explored region was marked on the map and road

directions.

The results of research published in the pages of periodicals and collections were published in Turkestan, Russia, Europe, the United States in Russian, English, German, French. As a result, there were published a large amount of scientific articles and papers.

During this period, the interest of foreign researchers in Central Asia grew considerably. This, first of all, was reflected in the rivalry between Great Britain and the Russian Empire. In the West, it was called “Great Game”. Despite the fact that interstate relations with Great Britain were established during the reign of Temurids, the rivalry on geostrategic interests of Russian Empire and British Empire intensified in the region improved scientific researches. The Geographical Society of the British Empire played an important role in the organization of scientific expeditions. The society systematically provided expeditions with qualified personnel sent to Central Asia. The results of research were published in such journals as “*The Journal of the Royal Geographical Society*” and magazine and British Geographical Institute “*The Geographical Journal*”.

During scientific journeys and expeditions carried out in the XIX – early XX centuries, there were identified valuable materials on geography, flora and fauna, hydrography and the climate of the region. They were published on the pages of “*The Times*”, and “*The Daily Telegraph*”, “*Edinburgh Review*”, “*Economist*”, “*Journal of the Royal Geographical Society*”, “*Proceedings of the Royal Geographical Society*”, “*Geographical Magazine*”, “*The Geographical Journal*”. More than 100 scientific articles and reports on the history, nature, and economy of Central Asia were published in these periodicals.

Works in English historiography can be divided into works of military-political, scientific and memoirs, travelers in accordance with the author and content.

During this period, French researchers were active. Between 1840 and 1917, Central Asian region in terms of social economy and geopolitics was

investigated by 161 French speaking researchers and travelers. Especially important results were achieved in the natural sciences.<sup>1</sup>

It should be noted that the expedition in the natural sciences were carried out for socio-political, geopolitical and strategic purposes.<sup>2</sup> They focused on studying the natural biodiversity, physical geography of previously unexplored territories, mountains and rivers, climate and soil composition. This, within the framework of scientific interests, allowed disclosing a new range of the object of study. As a result, in foreign sources on mineralogy, there were covered explorations and production of gold-rich areas, cultivation of silkworm cocoon in the field of entomology and reducing its imports and, comparing similarities and differences of mountain regions, originality of exotic flora and fauna.

The research results were originally published in popular scientific articles. These articles were devoted to a certain area of researches, where each of them was divided into several areas (ethnography, history, mineralogy, geology, flora and fauna) and was published in a small volume on the pages of leading newspapers and magazines. Moreover, in the famous European publications such as “*Revue des deux Monde*”, “*La Gazette géographique*”, “*Exploration*”, “*Revue du monde catholique*”, “*Revue de France*”, “*Revue des science naturelles appliquées*”, “*Revue française de l'étranger*”, “*Bulletin de la Société de Geographie de Lion*”, “*Bulletin de la réunion des officiers*”, “*Bulletin de la Société de Géographie de Paris*”, “*Annales agronomiques*” there were reflected the peculiarities of the Eastern world.

Bio-bibliography of researchers lead to the conclusion that they were experts in different directions: travelers, diplomats, engineers, militants, geographers, amateurs, anthropologists and historians.

In the XIX century, as it was in entire Europe, German researchers were also active to organize foreign expeditions. They participated in expeditions in Central

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<sup>1</sup> Gorshenina S. La Route de Samarcande. L'Asie cenrale dans l'objectif des voyageurs d'autrefois. – Geneve, Editions Olizane, 2000, 61 p.

<sup>2</sup> Ziyayeva D. Kh. The Sources on the History of Intellectual Heritage in Uzbekistan. // Halaqa: Islamic Education Journal, 2(1), 2018 P. 120. doi: <http://dx.doi.org/10.21070/halaqa>.

Asia and carried out extensive scientific work. Expedition and conducted scientific researches were financed by the Academy of Sciences, Geographical Societies and research institutes (Landeskundemuseum). These works acquainted the entire scientific world with materials previously unknown about Turkestan.

The results of the expeditions were published on the pages of the periodical press and presented to public. Such newspapers and journals as :“*Geographische Zeitschrift*”, “*Leipzig*”, “*Mitteilungen der Geographischen Gesellschaft in Hamburg*”, “*Neue Zuericher Zeitung*”, “*Petermann’s Geographische Mitteilungen*”, “*Sitzungsberichte der Akademie der Wissenschaften zu Wien*”, “*Verhandlungen der Gesellschaft fuer Erdkunde zu Berlin*”, “*Wiener Zeitschrift fuer die Kunde des Morgenlandes*”, “*Zeitschrift der Deutschen Morgenlaendischen Gesellschaft*”, “*Zeitschrift der Gesellschaft fuer Erdkunde zu Berlin*” were active in this direction. The scientific works of German researchers on Central Asia were mainly published in Russia, Germany and Austria-Hungary.

Starting from the second half the XIX century, foreign policy of Russian Empire in Central Asia was conducted against a background of broad relations with Germany. This was observed not only in military cooperation, but also in social and economic life. All specialists who visited Central Asia through Russia were scientists, traders, technicians, and others. German militants were even involved in state affairs. High pay for military service in the Russian army in Central Asia and rapid career growth served for the increase in the number of German volunteers among them. Among them were individuals who were fluent in Russian and Oriental languages. As a result, they were able to write significant scientific work.

The friendly relations between Germany and Russia in Europe at that time were decisive factors in the invention of Orient-East, which was “terra incognita”. Consequently, Germans researchers and scientists who were far from military service worked in Turkestan.

The works about the mountain ranges of Central Asia provides a detailed analysis of the landscape, ethnographic researches, their observations, the

definition of the mountains as the geographic micro cosmos as well. German works about orography and hydrology of Turkestan gained recognition in science.

Collections of German naturalists' collected in Central Asia made it possible to study more than one hundred new species of flora and fauna specimens in Turkestan. For example, a young German scientist Lehman enriched with 180 new species and 20 new varieties of previously unknown plants. Works of German researchers in cartography, geology and mineralogists, climatology, ornithology, zoology, entomology and ichthyology and other spheres allowed opening new directions in science in Turkestan.

### **Conclusion**

The abovementioned works made a great contribution to the development of the natural sciences in Uzbekistan. These studies become a great contribution to science not only in the region, but also throughout the world. They served as an important source in the natural sciences of Central Asia. The mapping and research data are comprehensively covered in the field of science.

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