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The origins of the Moscow school of modern stellar astronomy – the Tashkent trace: B.V. Kukarkin, N.F. Florya and V.V. Stratonov

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The Moscow School of Modern Stellar Astronomy, which received international recognition already in the 1950s, arose and developed, among other things, thanks to the efforts of astronomers who were given a professional start by the Tashkent Observatory. Among those who left their mark in the history of astronomy, the P.K. Sternberg State Astronomical Institute, the names of the first civilian astrophysicist of the Tashkent Observatory, V.V. Stratonov, and two scientists who began their professional career in Tashkent and then successfully worked in Moscow. We review the bright Tashkent trace in the formation of the Moscow school of stellar astronomy.

Keywords: Tashkent observatory, history of astronomy, variable stars, Kukarkin, Florya, Stratonov

According to modern sociological research in Soviet Russia (Rozhkov 2014), starting in 1917, there was a large stratum of people who were denied continuing education in universities because of the origin and background. It included the children of nobles, merchants, kulaks, priests, tsarist officials and officers. The number of those who have been denied education because of their background ranged from 500,000 to four million. Here I would like to report on two famous astronomers, both of whom, most likely due to their origin, did not receive higher education in their professional field, but nevertheless became famous scientists who left a significant mark on science. The professional activity of these scientists began at the Tashkent Observatory. Boris Vasilyevich Kukarkin was born on October 30, 1909 in Nizhny Novgorod, to the family of Vasily Vasilyevich Kukarkin (1876–1938), a teacher of Russian literature, and Elena Alexandrovna, née Allendorf (1883–1920), the daughter of a full state councillor. After his mother's death in 1920, Boris found himself in the care of Anna Allendorf, his mother's younger sister, his aunt.

In the autumn of 1922, Boris was accepted into the 6th grade of the experimental school of the first stage, in the same building where the Nizhny Novgorod Physics and Astronomy Lovers Club was located. This fact played a special role in Boris

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Kukarkin's life and also the fact that the experimental school was the base platform for the practice of students of the pedagogical institute, located in the same building. An important event in the life of the Circle was the creation of a section for young astronomy enthusiasts (1923). Boris, who joined the youth section of the NCLFA in 1925, became its leader and the most active young researcher of the Circle. He not only deepens his knowledge of mathematics, physics, astronomy, history and philosophy through self-education, but also organized a group of amateurs to observe variable stars. In 1928, Kukarkin discovered the relationship between the period and the spectral class of eclipsing variable stars. The result concerning the eclipsing variable star Epsilon Ascendant (ε Aur) was published in the German journal Astronomische Nachrichten. This success inspired the young researcher to take an ambitious initiative to organize the publication of the scientific research and information bulletin "Variable Stars" in Nizhny Novgorod. Despite the fact that nine of the established Soviet astronomers responded negatively to the request for the organization of a special printing body, the first issue of the bulletin "Variable Stars" was published on May 15, 1928 (Kukarkin 1948). B.V. Kukarkin himself became the editor of the publication and he carried out this work for 49 years. Since then, the study of variable stars and the systematization of information about them have become his main interest and his life's work. It is from this moment that B.V. Kukarkin's scientific mission begins. In December 1928, the Fourth Astronomical Congress was held in Leningrad. Then the first All-Union Conference of Variable Star Observers was held in Nizhny Novgorod (June 2–4, 1930). Boris Vasilyevich Kukarkin became a well-known and sought-after astronomer and researcher of variable stars and he was invited to Tashkent. Here, in 1931, at the Tashkent Observatory, Kukarkin's biography began as a professional astronomer, i.e. here he began to receive a salary for his work. By this time, he was a corresponding member of the Russian Society of Lovers of World Studies. Kukarkin worked in Tashkent for only a year and in 1932, he was invited to Moscow, to the newly established United State Astronomical Institute named after P.K. Sternberg. The archive contains correspondence between the young and ambitious scientist and the director of the institute, A.A. Kancheev, from which it is clear that Kukarkin knew his worth, despite the formal lack of higher education. During the year in Tashkent, B.V. Kukarkin published 20 scientific articles.

Nikolai Fedorovich Florya, another well-known young researcher by that time, was invited to Tashkent from Leningrad, where he gained observation experience under the guidance of Professor G.A. Tikhov at the Lesgaft Observatories and at the Main Astronomical Observatory in Pulkovo, as well as as an independent observer in the same year, 1931. Nikolai became interested in astronomy thanks to Flammarion's books from the age of eleven. At the age of thirteen, he independently made a telescope out of cardboard and glasses with a decent magnification (120 times), on which he made his first observations. Later, having become acquainted with astronomy enthusiasts of the Russian Society of Lovers of Studies of the World, he became not only an active member, lecturer, but also an observer. After school in 1928, he entered a chemical college, but in parallel with his studies he continued his activities as an amateur astronomer at the Odessa observatories. The young man began to treat his work, self-education and upbringing with full responsibility and awareness quite early. At the age of 16, he developed a whole life program and formulated life principles: to give his maximum strength to science without giving up life. According to the

young man, a scientist should engage in physical labor, participate in public life, play sports, dance, and listen to music. He also developed a scientific program: to master perfectly all existing methods in the field of astronomy: to solve the problem of the structure of evolution and the life path of variable stars, to solve the problem of stellar energy sources and to approach the solution of cosmogony issues. Moreover, as Florya realized, the last task was very bold, and his life might not be enough to solve it, but, as he believed, only courage drives science. And finally, there was such a dream – to make a flight into interstellar space. In 1930, on the recommendation of V.P. Tsesevich, Nikolai moved to Leningrad, where, under the guidance of G.A. Tikhov, he mastered photometry methods and worked with glass libraries. In 1931, Florya was invited to Tashkent.

The year 1931 marked the beginning of a new period in the development of variable star research at the Tashkent Observatory. In the summer of 1931, V.P. Tsesevich was sent here and V.A. Maltsev, who was well-known for his work in the Russian Society of Lovers of Studies of the World, arrived from Leningrad, and B.V. Kukarkin, a young but already well-known specialist, was invited from Nizhny Novgorod. The Tashkent Observatory participated in the All-Union program – the service of Antalgols, variable stars of the type RR Lyrae. V.P. Tsesevich became the ideological inspirer and leader of this work. Of the 19069 observations of 75 stars, 12669 were made by Florya. During this time, 37 separate articles in the bulletin "Variable Stars" and a number of small notes by Florya were devoted to the study of stars of the type RR Lyrae. An interesting technique was used by him at that time in his work: photographing short-period variables was carried out in such a way that several exposures were made on one plate, sometimes more than 20. In addition to the Antalgols, Florya and Kukarkin observed a number of eclipsing variables and cepheids. A significant event that influenced the direction of further activity in the field of studying variable stars was the discovery in early 1932 of a pattern in the changes in the periods of cepheids by B.V. Kukarkin and N.F. Florya. Taking the most reliable data from the literature on secular changes in periods, they found that the increment of the period, expressed in fractions of the period dP/P, strictly depends on the period P. Thus, it takes at least 60 years for a star with a period of 5 days to detect these secular changes, but if the period is 50 days, then it takes only 10 years. To test the dependence, extensive processing by the Gershprung method was carried out on more than 6 thousand Sge observations made by various observers over 40 years. And the discovered age-old change in the period of the studied star fully confirmed the discovery of the young scientists. After careful processing of a number of other stars, new confirmations were found. Such "critical stars" were also found, for which there were not enough observations to verify the obtained dependence. The need for continuous observations of all cepheids has become apparent in order to ensure the possibility of obtaining secular changes in periods for them.

Thus the "Cepheid Service" was born. In this regard, in 1932, N.F. Florya began a series of observations of 57 long-period cepheids. According to the planned program, it was necessary to obtain 200 visual observations for each star. In 1933, all the series of observations were completed, and 300–400 observations were obtained for seven of the stars. In 1933, N.F. Florya launched and applied the Rosenberg polarizing wedge photometer, obtained from abroad back in 1929, which had not previously been used in research. After calibration and verification of the instrument, measurements of

stellar magnitudes for a number of variable stars began on the photometer, and by 1935, stellar magnitudes for 82 variable stars were measured. A very interesting object turned out to be the North Star, which Florya explored in 1933–34. A total of 70 observations were carried out, each of which consisted of 4 independent measurements. As a result, a "light curve" was obtained, which showed that the North Star is a variable star with a variable period, although before that it was considered a classical Cepheid. In 1932, N.F. Florya used a collection of photographs of the ring nebula in Lyra, obtained by V.V. Stratonov, to study 2 variable stars in detail. By the way, Vsevolod Viktorovich Stratonov (1869–1938) is another Tashkent scientist associated with the P.K. Sternberg Astronomical Institute. He received his higher education in 1891 after graduating from the Physics and Mathematics Department of Novorossiysk University with a 1st degree diploma and a gold medal awarded to him for his thesis "Passage instrument and determination of geographical coordinates". It was he who became the first civilian astronomer at the Tashkent Observatory (1895–1904) (Florya 1935). Prior to that, astronomers at the observatory were appointed from among the military. During his ten-year work here, Stratonov took more than 400 pictures of the starry sky and celestial objects. Among them are almost 200 photographs of globular and open star clusters, 85 images of the minor planet Eros, the Milky Way, light and dark nebulae, variable stars and the surface of the Sun. Due to eye disease, he had to give up his career as an astronomer-observer. In 1905–1911, he was the vice-director of the office of the Governor of the Caucasus I.I. Vorontsov-Dashkov in Tiflis. After the revolution, V.V. Stratonov was a scientific consultant to the People's Commissariat for the publication of scientific literature. In 1920, he became the head of the Faculty of Physics and Mathematics at Moscow University.

At the same time, V.V. Stratonov proposed to create an astrophysical observatory in the south of Russia and equip it with the most modern instruments. The project was supported by many scientists. In 1921, the organizing committee of Main Russian Astrophysical Observatory was established, headed by V.V. Stratonov. In 1922, V.V. Stratonov was one of the organizers of the strikes of MSU professors, organized in protest against government interference in the university's activities. In August 1922, he was arrested, and in October 1922, he was expelled from the Soviet Union along with a large group of scientists. Back to N.F. Florya. Usually, astronomers observed exactly the stars that they then examined. And they can be located so far apart in the sky that after observing one group of stars, you have to wait for the other to rise, and there are interruptions in the observations. Florya proposed an innovative collectivist approach: to observe the stars located next to each other, that is, whole "bundles", based on the places highlighted in the sky. Then the observation program, the location of the equipment and the work on it are calculated to the nearest second, and the workflow is completely revised. The telescope is installed first approximately "by eye", according to the stars visible to the naked eye, and then according to the map, usually copied from the BD catalog (German Bonner Durchmusterung – Bonn Survey). According to Florya at a conference on variable stars in Moscow, he conducted in a year 20,000 observations of variable stars in Tashkent, spending an average of 48 seconds on each star, and in three years he carried out at least 60,000 measurements.

The innovative method, somewhat similar to the Stakhanov method, first used by Florya to observe variable stars, was noted by the All-Union Astronomical and Geode-

tic Congress in 1934. Several observatories (Stalinobadskaya, Abastumanskaya) began to work using the method of "limited areas of the starry sky." Then this method was developed and developed into the Parenago plan, named after a remarkable scientist, one of the founders of the Department of Stellar Astronomy at Moscow State University. In 1931–32, N.F. Florya developed a new method of photometry of lunar eclipses and obtained curves of the integral brightness of the Moon during the lunar eclipses of September 26, 1931 and September 14, 1932. The essence of the method lies in the fact that measurements of the integral brightness of the Moon are reduced to sequential photometry of star-shaped glare from the Moon on the surfaces of metal well–nickel-plated balls of different diameters, which is easily carried out by comparing glare with stars. In addition, in 1934, Florya studied two well-known photometric catalogs and made corrections to the scale and color coefficients in order to bring the catalogs in line with the international system.

During his time at the Tashkent Astronomical Observatory, Florya was repeatedly awarded a work trip in 1932 to work in Moscow and Leningrad, a watch in 1934 and a two-month salary in 1935. In connection with the 60th anniversary of the Tashkent Observatory, Florya's work in the field of studying variable stars was noted in a resolution of the Council of People's Commissars of the Uzbek SSR. It is clear that the young scientist lived according to his multifaceted program, missing nothing. Nikolai Fedorovich Florya, the youngest of those working on variable stars at that time, was invited to Moscow to the P.K. Sternberg Astronomical Institute in September 1935 as a senior researcher and scientific secretary of the Institute with a salary of 350 rubles and housing at the Krasnopresnenskaya Observatory. The scientist's observational capabilities here in Moscow have narrowed, but he has begun to study photographic material. The main theme of his work was the interstellar absorption of light, from which he moved on to the structure of the Galaxy.

On October 21, 1935, a meeting of the qualification commission was held at the institute, which decided to include several people in the list of persons for awarding academic degrees without defending a dissertation: for obtaining doctoral degrees: Ivan Alexandrovich Kazansky, Pavel Petrovich Parenago and Boris Vasilyevich Kukarkin, as well as for awarding the degree of Candidate of Science to Mitrofan Stefanovich Zverev and Nikolai Fedorovich Florya.

As a result, Parenago was awarded a doctorate, while Kukarkin received only a PhD. In Russia, you first get a candidate's degree by defending one dissertation, and a doctoral degree by defending a higher-level dissertation. At that time, many successful scientists received their degrees without defending their dissertations. Zverev received his PhD without defending his dissertation only in 1938, and Florya was given the opportunity to finalize his dissertation, awarding him a nominal Stalin scholarship and relieving him of his job as scientific secretary on his personal application.

An interesting fact: both B.V. Kukarkin and N.F. Florya participated in high-altitude observations of total lunar eclipses. The first experience of observations from an airplane was acquired by B.V. Kukarkin on January 19, 1935. That evening, cloudy weather was over all the astronomical observatories of the Union. The observations were carried out only in Moscow, and even then, rising above the clouds on an open aircraft "R-5" "USSR-L-1541", equipped for blind flight. Kukarkin and a special correspondent of Pravda, I. Exler, were on board the plane. The climb time was calculated accurately, the plane rose above the clouds before a total lunar eclipse.

The plane flew north–south over the clouds for 40 minutes. B.V. Kukarkin observed the moon through binoculars. The participants of the flight observed the movement of the Earth's shadow across the Moon's disk until the onset of a total eclipse. The flight allowed B.V. Kukarkin to classify the lunar eclipse according to special scales developed by French and American astronomers Dangeon and Fischer. The total brightness of the lunar eclipse was also compared with the brightness of the stars. The results showed that the eclipse was slightly brighter than during normal lunar eclipses. B.V. Kukarkin took advantage of the flight to also observe a New Star in the constellation of Hercules, which Moscow astronomers had not seen for seven days due to bad weather. It turned out that its brightness increased from the third to the second magnitude. A year later, on January 8, 1936, Florya's flight "to the Moon" took place on a stratostat. The crew of the stratostat consisted of two people – the commander of the stratostat K.J. Zille and the young pilot Agafonov. Astronomer N.F. Florya joined them. He took a number of instruments with him, including an integrated photometer to determine the total brightness of the moon. In this most difficult flight, at an outdoor temperature of minus 37^{circ}C, Florya completed the entire planned observation program at an altitude of 6500 meters, which lasted until the end of the eclipse for 3.5 hours. The built-in photometer was used to measure the integral brightness of the Moon during the various phases of the eclipse. This is important for studying the properties of the upper atmosphere. In addition, it was necessary to determine the transparency of the air at various heights and evaluate the quality of images of celestial bodies. The stratostat drifted and was blown away from Moscow at a distance of 400 kilometers to the Gorky region (currently Nizhny Novgorod), although it was assumed that the landing would take place 170 kilometers from Moscow. Florya always worked hard and with passion, and in his life he was modest, cheerful, loved children, and played sports. He was the author of popular articles for young people in the Pioneer magazine and the Pionerskaya Pravda newspaper. Colleagues noted the depth of the young scientist's penetration into the detail and factual, technical material, into colorimetric measurements with electrophotometers and the ingenuity of processing observations. The scientist studied the absorption of light in interstellar space for a large number of directions, using the color indicators of many stars, including faint ones. He determined the distribution of absorbing matter within ± 25 pc of the galactic plane. Florya's dissertation was almost completed, but the outbreak of war prevented the publication of his results. In the early days of the Great Patriotic War, N.F. Florya, who had an exemption as a valued researcher, did not use it and, like many students and staff of Moscow University, joined the 8th Krasnopresnenskaya Division of the armed People's battalion. He was appointed assistant platoon commander of the 2nd Division of the 975th Artillery Regiment, and supervised the preparation of a topographic map of the division's artillery positions. In early October 1941, the unit in which N.F. Florya served participated in the battles to repel the Spas-Demensky breakthrough of the fascist troops. N.F. Florya died in battle surrounded by Vyazma, in the so-called "Vyazma pocket". After the war, his colleagues published the materials of his dissertation. Then at the Department of Stellar Astronomy, this topic was developed. During his short life, N.F. Florya made very significant contributions to research into variable stars and performed several tens of thousands of visual observations of the brightness of variables of various types, as well as some asteroids, studied the absorption of light in interstellar space

for a large number of directions, using the color indicators of many stars, including faint ones.

The Moscow School of Stellar Astronomy began to take shape from the moment when a strong team of researchers of variable stars was formed at the P.K. Sternberg Institute in Moscow. Professor P.P. Parenago (1906–1960), Associate Professor B.V. Kukarkin (1909–1977), senior researcher N.F. Florya (1912–1941), M.S. Zverev (1903–1991) began to dream of creating a department of Stellar Astronomy at Moscow State University. The Department (with laboratories of astrophotometry and astrophotography) was established at the Faculty of Mechanics and Mathematics in September 1940 (MSU archive 1940).

Now this branch of science is called Galactic astronomy. Each of these scientists made an invaluable contribution to the Moscow School of Stellar Astronomy, which was characterized by its special attention to variable stars.

Two of these scientists (B.V. Kukarkin and N.F. Florya) began their professional careers in Tashkent, relying on the research of a man, of direct importance for the history of the P.K. Sternberg (V.V. Stratonov) State Astronomical Institute. Also, the untimely death of N.F. Florya prevented the realisation of his aspirations and ambitions but what he failed to do was then developed by his colleagues. The journal "Variable Stars" by Kukarkin is still published in electronic form. Stratonov's ideas were realized in the form of the Crimean Observatory of the Astronomical Institute of Moscow State University and the Caucasian Mountain Observatory located in the Karachay-Cherkess Republic.

Thus, it can be summarized that the Moscow School of Modern Stellar Astronomy, which already received international recognition in the 1950s particularly in research in variable stars and galactic structure, arose and developed further through the efforts of astronomers who were given a professional start by Tashkent Observatory. We can safely say that the Tashkent Observatory has left its bright mark in the history of Moscow University, the P.K. Sternberg Astronomical Institute and the Moscow School of Stellar Astronomy.

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