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The History of Kazan Neurological School

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The historical prerequisites for the foundation and teaching of neurology at Kazan University are described; the relationship between the history of Kazan Imperial University Kazan medical university and neurology school is shown. Brief biographies of outstanding representatives of Kazan Neuroscience (D.P. Skalozubov, V.M. Bekhterev, L.O. Darkshevich, N.O. Kovalevsky, N.A. Mislavsky, A.V. Kibyakov, A.S. Dogel, A.V. Favorsky, L.I. Omorokov, and Y.Y. Popelyansky) are presented. The description of scientific interests of the Kazan neurological school and its specific features related to the one century period since 1885 are described.

Keywords neurology school, Kazan University, history of science

The origin of the Kazan Neurological school is closely connected with the medical faculty of Kazan Imperial University. This University was opened by decree of Alexander I in Kazan in 1804. Kazan is the capital of Tatarstan — one of the republics of the Russian Federation that celebrated its millennium in 2005.

In the middle of the nineteenth century, mainly due to the support of N.I. Lobachevsky,[1] outstanding scientists were invited, graduates were sent to the best European clinics and scientific centers, and new experimental methods of investigation were introduced. In 1814, the Medical Faculty was opened at Kazan Imperial University and in 1840 a 60-bed University Clinic was set up. Until 1850 the teaching of some subjects was done in German, French, and Roman languages, because of the recruiting of foreign professors (I.O. Braun, I.F. Erdman, K.F. Fuks etc).

The evolution of neurology into a separate discipline is closely connected with the name of the Russian clinician N.A. Vinogradov (1831–1886). He was not only a prominent therapist but a neurologist as well. He was interested in topical diagnosis of the central nervous system and in brain and cerebellar tumors. In 1876 doctor of medicine A.A. Neschastlivzev was appointed to the post of associate professor of practical nervous

[1]N.I. Lobachevsky (1792–1856) was the founder of the non-Euclid geometry and rector of Kazan University (1827–1846).

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pathology at the department of special pathology and therapy headed by Professor N.A. Vinogradov. He delivered lectures on neurology for the medical students of Kazan University. The practical seminars in neurology were given under tuition of A.M. Dohman (1854–1892). So at the beginning, the scientific evolution of neurological schools in Kazan as well as in Moscow progressed mainly by the activities of eminent therapists.

At the end of the nineteenth century the neurological world was divided in "two parts" debating the nature of localization of cerebral function. The 7th International Medical Congress held in London in 1881 provided the triumph of cerebral localizationalist theory (Tyler & Malessa, 2000). The most prominent neurologists of Europe and America understood that much effort was needed to describe the anatomy of the brain and spinal cord and to study the physiology of the nervous system. The Kazan Neuroscience center was in a fortunate position for the evolution because of the close cooperation between physiologists, histologists, and neurologists at Kazan University.

Kazan Physiological & Histological Schools

The history of Kazan Physiological and Histological Schools may be divided in several periods (Table 1). The teaching of physiology at Kazan University started in 1806. The Physiology Department was organized in 1837, but, until 1858, the teaching process was not well organized. F.V. Ovsyannikov (1827–1906) worked at the university from 1858 to 1863 and is considered the founder of the scientific morphofunctional approach. He is the founder of two scientific physiological schools, notably at Kazan and St. Petersburg. He founded the first Russian physiology institute in Kazan, as well as a physiology laboratory at the Russian Academy of Sciences in St. Petersburg.

Several of his pupils later became heads of departments, the famous physiologist I.P. Pavlov being among them. N.O. Kovalevsky (1840–1891), Ovsyannikov's pupil and successor at Kazan Imperial University department of physiology, considered parallel studies on morphology and physiology of the brain to be particularly important. He published a review on R. Wagner's work *Introduction to the Scientific Morphology and Physiology of the Human Brain* (Wagner, 1860) in the Archives of Kazan University (Kovalevsky, 1862). The author tried to clarify the role of the brain in psychic activity. In his paper "Current State of the Question Concerning the Origin of the Brain Gyri" (1886), Kovalevsky agreed with Wundt's hypothesis with respect to the "inner mechanisms of brain growth" and criticized Henle's idea that the skull prevents the growth of the brain (Kovalevsky, 1886).

Table 1
Kazan physiological school

Heads of the Physiological Department (1858–1928)	Date	Contribution
F.V.Ovsyannikov	1858–1863	Physiological Laboratory Teaching experimental physiology
N.O.Kovalevsky	1865–1891	Founded Physiological School, Physiological Institute (1890). Rector Kazan university (1880– 1882). Invited scientists A.K. Arnshtein, V.M. Bekhterev
N.A. Mislavsky	1891–1928	the influence of the cerebral cortex upon internal organs "On the problem of the respiratory center" (1885)

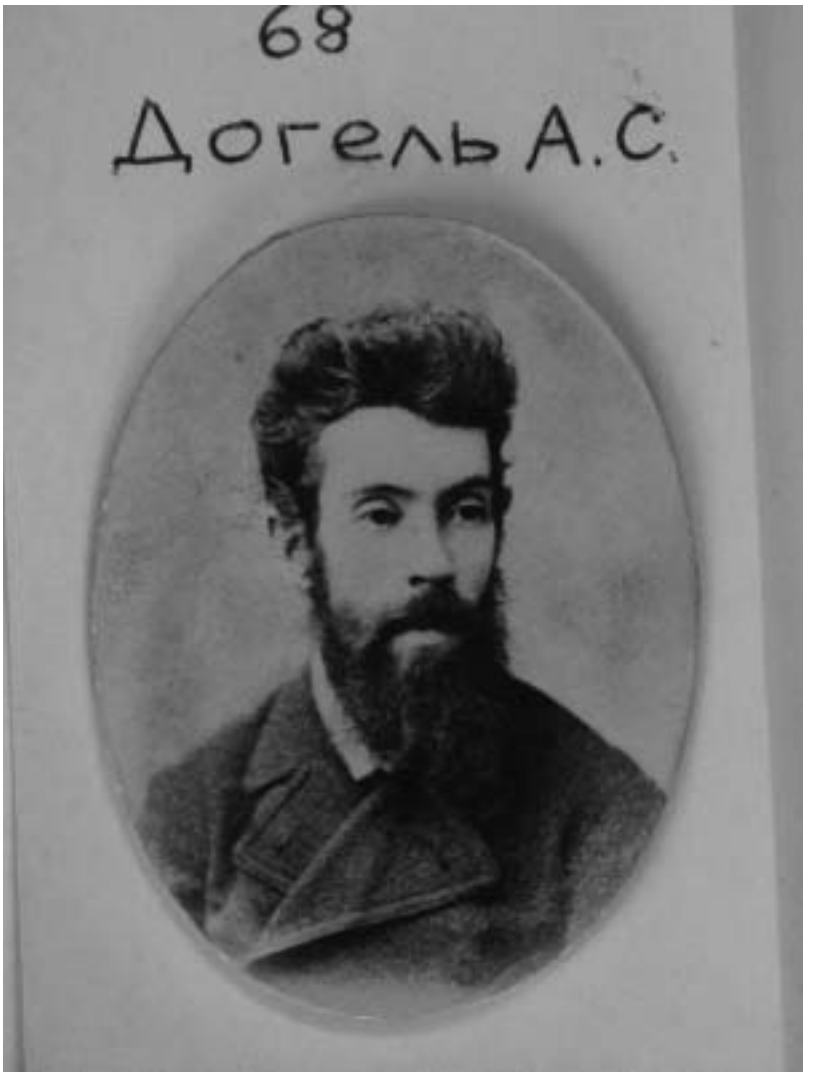

Figure 1. A.S. Dogel.

N.A. Mislavsky's (1854–1929) thesis *On the Problem of the Respiratory Center* (1885) is a classical example of Kovalevsky's laboratory works (Mislavsky, 1885). Using histological and morphological methods the author proved the localization of the respiratory center in medulla oblongata at the intermediate fascicle near the roots of hypoglossal nerve and described its histological structure that had not been revealed by Gierke, who worked at R. Heidenhain's laboratory (Gierke, 1873). S. Ramón y Cajal "studied afferent and efferent projections of nerves related to respiration in cats and rats" (Ramón y Cajal, 1909; Bolton, 2002). In 1895, Mislavsky published a paper on neurophysiology, "On the Physiological Role of Dendrites," coming to the conclusion that "dendrites are nothing else but means of increasing the contiguity of the cell surface i.e. they are really protoplasmatic projections (Mislavsky, 1895). They are excitable and constantly transmit this excitation which is conducted by special terminal endplates, described by A. Kölliker or its collaterals…" (Kölliker, 1890).

In his paper "On Nissl's Bodies in Neurons", Mislavsky's pupil D.V. Polumordvinov (1867–1919) studied the morphological structure of the spinal cord neurons in animals and proved the presence of Nissl's bodies that had been denied by H. Held (Polumordvinov, 1901). On the basis of the new histological methods of Ehrlich and Golgi, Polumordvinov discovered and described the sensitive terminal apparatus in the electric skate (Polumordvinov, 1898). In 1902, he showed that muscle spindles preserve their structure after the cutting of the motor nerves (Polumordvinov, 1902). Thus he confirmed the pioneer experiments of C. Sherrington (Sherrington, 1894–1895).

In 1931, Kybyakov proved the chemical mechanism of irritation from afferent nerve fibers to blood vessels (Kybyakov, 1931). Two years later, he performed experiments on the humoral transmission of excitatory stimuli from one neuron to another in the interneuronal synapses of ganglion cells (Kybyakov, 1933). He was the first to prove the role of the chemical mechanism of acetylcholine in the transmission of excitation stimuli in the interneuronal synapses of ganglion cells. W. Feldberg and J.H. Gaddum from H. Dale's Laboratory in Cambridge repeated Kybyakov's experiment of 1933 and revealed that the chemical transmitter in a sympathetic ganglion is acetylcholine (Feldberg & Gaddum, 1934). Later on, in 1937 in his Harvey Lecture, Dale mentioned Kybyakov for his technique, but he said nothing about his idea and confirmation of the chemical mechanism.

In 1924, A.F. Samoylov, professor of physiology at the faculty of physics and mathematics of Kazan University demonstrated the different mechanisms of the impulse propagation within the nerves (physical factor) and transmission of irritation from the nerve to the effectors (chemical mechanism). He formulated his doctrine of circle reflexes in 1930 (Samoylov, 1930).

The Kazan histologists K.A. Arnshtein and A.S. Dogel studied the morphology of the peripheral nervous system mainly with respect to nerve endings and sense organs. Dogel continued his research in Tomsk and St. Petersburg. He set up the journal *Archives of Anatomy, Histology, and Embryology* in 1915. He is the author of classical works on the autonomic nervous system (Dogel, 1870, 1877).

Kazan Neurological School

D.P. Skalozubov

Thus all necessary conditions for the development of neuroscience and neurological practice were created in Kazan in the latter half of the nineteenth century. D.P. Skalozubov (1839–1892) received his medical training at the medical faculty of Moscow University. He obtained his MD in 1868 and subsequently worked under the supervision of Prof. A.Ya. Kozhevnikov in Moscow. At the beginning of his career Scolozubov's scientific interests were focused on anatomical studies of different parts of the pathology of the nervous system. In 1876 he defended his doctor's thesis *Paralysis Due to Arsenic Poisoning*. He paid attention to the treatment of diseases of the nervous system by electrotherapy. He is the author of one of the first manuals on electrotherapy, which was published in Moscow in 1881 with a second edition in 1884. From 1876 to 1883 he was associate professor and taught electrotherapy at Moscow University. In January 1884 he was invited to provide a course of lectures on nervous diseases at the medical faculty of Kazan University, where he was elected as associated professor.

Prior to the arrival of Skalozubov to Kazan, lectures on psychiatry were given by director of the Province psychiatric hospital A.I. Freze (1866–1884) and those on nervous diseases by associate professor of special pathology and therapy A.A. Neschastlivtsev

(1870–1879). In the opinion of the rector of the university (1883–1885) N.N. Bulich, teaching of nervous diseases and psychiatry should be given by one person. However, in 1884 the new law restricted the autonomy of universities and Bulich retired. January 1, 1885, when Skalozubov became extraordinary professor at the department of nervous diseases, may be regarded as its birthday, but the university clinic of the nervous diseases was set up in 1887. Skalozubov became ordinary professor in 1888 and was planning to take the post of extraordinary professor of nervous and mental diseases. Finally, he gave only neurology lectures and was suffering from a bad health, and was dismissed from his post in 1892. Professor V.M. Bekhterev, who headed the department of psychiatry, delivered the lectures on psychiatry at Kazan University from October 3, 1885.

V.M. Bekhterev at Kazan University (1885–1893)

In 1884, Kovalevsky became dean of the medical faculty and invited V.M. Bekhterev (1857–1927), at the time private-associate professor of psychiatry and neurology at St. Petersburg Medical-Surgical Academy, to accept the chair of psychiatry at Kazan University. In 1884–1885, Bekhterev was an assistant of P.E. Flechsig in Leipzig, where he discovered the superior vestibular nucleus that would later bear his name (Bekhterev, 1885). Bekhterev also worked with Meynert in Vienna, with Du Bois-Reymond in Berlin, and with Charcot in Paris.

Upon his arrival at Kazan University in 1885, Bekhterev founded the psychophysiological Laboratory, the second in Europe after Wundt's Laboratory (Bekhterev, 1892). He also built a laboratory specialized in brain morphology where they performed joint studies with N.A. Mislavsky devoted to the influence of the cerebral cortex on the function of the internal organs. In 1885–1886 they studied the effect of stimulation of different parts of the brain on blood pressure and cardiac function (Bekhterev & Mislavsky, 1886). Subsequently, the centers regulating bladder function, intestine (Bekhterev & Mislavsky, 1889), genital organs, and lacrimation were identified (Bekhterev & Mislavsky, 1891a).

In terms of bladder control, the previous data was not clear, for instance, Bochefontaine (1876) showed four points in the gyrus sygmoideus. Similar findings were demonstrated by Francois-Franck (1887). Bekhterev and Mislavsky found the cortical center at the inner side of anterior and posterior parts of the gyrus sygmoideus; the subcortical center localized at the frontal part of thalamus (Mislavsky, 1888). The data about the localization of the tearing center were also puzzling. Czermak elicited tearing by stimulation of trigeminal nerve at the ipsilateral side (Czermak, 1860). Herzenstein (1868) and Demchenko (1872) published doubtful data about the lack of influence on tearing after n. sympaticus interruption. In 1891, Bekhterev and Mislavsky localized the cortical tearing center in the inner part of anterior and posterior parts of the gyrus sygmoideus; the subcortical center was localized at the thalamus (Bekhterev & Mislavsky, 1891b). They defined the cortical centers for intestine regulation in the sigmoid gyrus (Bekhterev & Mislavsky, 1889).

In 1883, Bekhterev performed experimental labyrinthectomy on animals and showed that long-lasting changes in the brainstem, predominantly in the vestibular nuclei, are likely responsible for the recovery of static symptoms. If the remaining labyrinth is removed a few days or weeks after a unilateral vestibular loss, the animal shows a nearly complete pattern of behavioral responses, just as if this second labyrinthectomy were the first labyrinthectomy on a normal animal (Bechterew, 1883). The studies of this "Bekhterev Phenomenon" show that multiple mechanisms must operate during vestibular compensation (Curthoys & Halmagyi, 1999).

Being a neurologist and a psychiatrist at the same time, Bekhterev provided consultations at the Province Psychiatric Hospital, which was founded in 1869 by A.I. Freze for a

thousand inpatients. He saw neurological patients at Kazan Military Hospital and at the Province District Hospital. During this period, he began to establish his school. The fruitful results were more than a hundred scientific papers on various branches of neuropathology and the anatomy of the nervous system. A few articles from those years became world famous, including one relating to "spine numbness" — later called Bekhterev's disease (Bechterew,1893) — and two describing pathways in the brain (one on "the nerve fibers which cause the pupil to narrow" and "localization of a center for the iris and for contraction of the eye muscles" [Bechterew, 1884]), and the other describing the function of central gray matter of the third ventricle (Bekhterev, 1883b, 1893). In 1892, Bekhterev founded the Kazan Society of Neurologists and Psychiatrists. In Moscow a similar society was organized in 1891. While working in Kazan in 1893, Bekhterev started one of the first neurology journals in Russia — *Neurological Herald* — that continued until 1918. The journal published articles of clinicians, physiologists, histologists, psychologists, philosophers, pharmacologists, anatomists, etc. (Bekhterev, 1928). Thus, Bekhterev may be considered one of the Founders of Russian Neurology. By the term neurology he meant the complex of anatomy, embryology, physiology of the nervous system, experimental psychology, as well as neuropathology, and furthermore psychiatry with forensic psychopathology.

L.O. Darkshevich

After Skalozubov's death in 1892, Livery Osipovich Darkshevich (1858–1925) became the Head of Neurology department. This marks the beginning of the flourishing period of the Kazan school of neurology. Darkshevich graduated from the medical faculty of the Moscow University in 1882, from 1883 to 1887, then took a postgraduate course in neurological clinics and laboratories in Europe: he visited Meynert's laboratory in Vienna, Flechsig's laboratory in Leipzig, Westphal's clinic in Berlin, and Charcot's clinic at the Salpêtrière hospital in Paris. During his training period abroad he published a number of fundamental works on neuroanatomy in cooperation with well-known persons, including Dejerine (Darkshevich & Dejerine, 1885) and the founder of psychoanalysis S. Freud (Darkschewitsch & Freud, 1886). In his paper "Über den oberen Kern des N. Oculomotorius" [On the Upper Nucleus

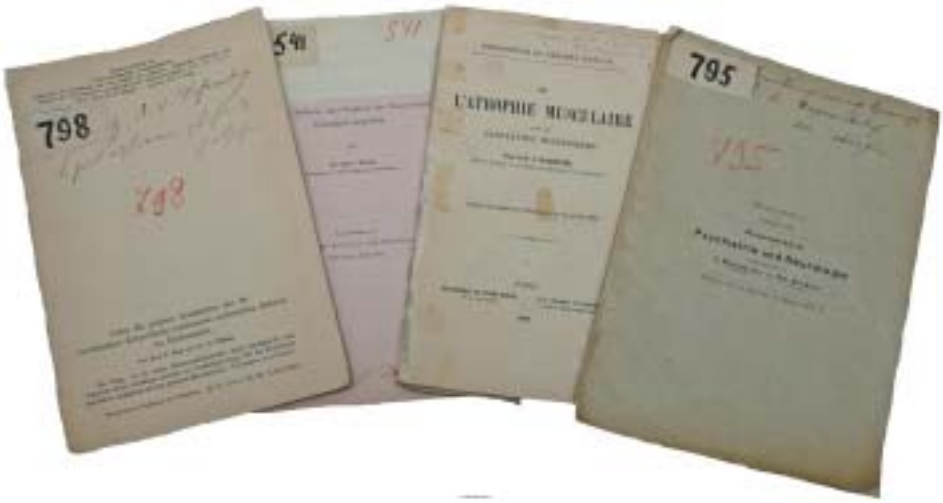

Figure 2. Books from the personal library of L.O. Darkshevich with the personal addresses of the authors.

Figure 3. L.O. Darkshevich with the collegues during the discussion of the patient.

of the Oculomotor] (Darkshevich, 1889), he described the lateral interstitial nucleus of the midbrain (nucleus of Darkshevich) for the first time. He directed the department of nervous diseases of Kazan Imperial University from 1892 to 1917 and is considered one of the founders of Kazan school of neurology. During his stay in Kazan, he practically organized the University neurological clinic and laboratory. By the time of his appointment it comprised five to six beds and a one-room outpatient department. By 1900 it was rather well equipped with a separate outpatient department, laboratory, and electrotherapy room, and, after ten more years, it represented a first-class equipped clinic with the best microscopes, Zeiss projection apparatus, X-ray machine, museum, and operating room.

The principle scientific subjects of the Kazan school of neurologists at the time were brain anatomy and its pathways as well as the morbid anatomy of the nervous system in the case of disease, using the results of morphological examination in the evaluation of the clinical findings. Darkshevich described the distribution of the posterior root fibers, up to Clarke's column, and the distribution of the fibers arising from Goll's and Burdach's nuclei as part of restiform bodies; secondary degeneration of nerve fibers and their changes, degeneration of the posterior columns as the result of primary damage of the *cauda equina* or some other roots, in the case of *tabes dorsalis* in particular. He studied the nucleus of the accessory nerve and described recurrent oculomotor neuropathy in 1892 pointing to the vascular character of the process (Darkshevich, 1892). He also demonstrated the reflexive mechanism of arthrogenic muscular atrophies and autonomic disturbances in peripheral nervous system disorders. Darkshevich's three-volume book, *Course of Nervous Diseases*, was published in Kazan in 1904 –1911. It became the first Russian handbook on nervous diseases. The section on myology was reprinted later in a well-known German manual on the morbid anatomy of the nervous system as "Die Pathologische Anatomie der Muskeln," which played a significant role in the development of

Figure 4. L.O. Darkshevich.

Russian and European neurology in the beginning of the twentieth century (Darkshevich, 1904). In cooperation with Bekhterev, Darkshevich organized one of the first scientific societies of Russia in Kazan: the Society of Neurologists and Psychiatrists. He became the first editor-in-chief of a Kazan Medical Journal (*Kazanskii Medicinskii Jurnal*), which is being published up to the present.

The cooperation of Darkshevich with the physiologist Mislavsky and the surgeon V.I. Rasumovsky contributed to the origin and subsequent evolution of Russian neurosurgery. One of the operating rooms for major brain surgery was arranged in the building of the university clinic, and, in 1907, being the first in Russia, Rasumovsky extirpated a patient's trigeminal ganglion (Rasumovsky, 1908). Starting at the end of the nineteenth century, Rasumovsky, supported by Darkshevich, performed neurosurgical operations for epilepsy by extirpating cortical centers following Horsley (Horsley, 1886; Rasumovsky, 1913).

A.V. Vishnevsky[2] started his activities as a consultant-surgeon at the clinic of nervous diseases in the autumn of 1910. He accepted Darkshevich's proposal to treat some

[2]A.V. Vishnevsky (1874–1948) is one of the most distinguished Russian (Soviet) surgeons. The Institute of Surgery of Russian Academy of Science in Moscow is named after him.

neurological diseases by surgery. In contrast with the existing stereotype, he operated on the brain and spinal cord, only after detailed study of all pathophysiological changes caused by disease, having profound knowledge of the clinical features, and after discussing the operation plan with Darkshevich. The concept of local anesthesia, which saved thousands of soldiers during World War II, is considered his main scientific achievement.

Having moved to Moscow in 1917, Darkshevich took an active part in the organization of the third Moscow Medical Institute. He became director and also worked at the Moscow Regional Clinical Institute. Darkshevich together with other leading Russian neurologists G.I. Rossolimo and L.O. Minor was invited for the medical consultation of V.I. Lenin in 1922 (Lerner et al., 2004). In 1923, he published the brochure: *Apostle Paul. Brief Characteristics of the Figures from the Holy Scripture Times. On the Problem of Hysteria in the History of Nations* (Darkshevich, 1923).

A.V. Favorsky

Aleksei Vasilyevich Favorsky (1873–1930) became Darkshevich's successor at the department of nervous diseases. In 1886 he graduated from the medical faculty of Kazan University (cum laude) and later on he trained in Darkshevich's clinic. In November 1903, Favorsky studied abroad. During a two-year period he was engaged in pathological physiology and histology of the nervous system in Berlin with Oskar Vogt. He also cooperated with Max Bielschowsky (1869–1940) and Korbinian Brodmann, who at the time worked with Vogt. He attended clinical lectures by Oppenheim, studied bacteriology in Louis Pasteur's institute in Paris and wrote a paper on botulism. In 1910, he visited Alzheimer's laboratory in Germany where he finished his studies on the pathomorphology of *tabes dorsalis* that he had started in Kazan. The subsequent year Favorsky visited Pavlov's laboratory in St. Petersburg, where he got acquainted with the study of conditional reflexes. Back to Kazan, Favorsky continued his scientific work and described the pathologic-anatomical picture of spinal compression and investigated the nerve endings of the olfactory bulb. He also established the insusceptibility of lower animals to botulinum toxin and worked out the method of using salvarsan in the treatment of *tabes dorsalis*. Furthermore, he studied malaria inoculation to induce fever for the treatment of neurosyphilis instead of mercury therapy following Wagner-von Jauregg, who won the Nobel prize for malaria treatment of neurosyphilis, which he first suggested in 1887 and about which he published the results in 1917. In 1927 after Favorsky's death, the department of nervous diseases of the Medical Faculty of Kazan University passed to Isaak Samuilovich Aluf (1883–1935). Between 1932 and 1935 he was rector of Kazan State Medical University.

L.I. Omorokov

In the 1930s the neurohistological method of Kazan clinic was fully preserved and subsequently carried on by the outstanding neurologist L.I. Omorokov (1881–1971). He got his professional training at St. Petersburg Medical-Surgical Academy (1901–1907). In 1905 he interrupted his training and went to the Russian-Japan war where his efforts were awarded with the George cross. After graduation in 1907, he stayed for advanced training in nervous and mental diseases under the guidance of Bekhterev. He studied the fundamentals of the clinical phenomena of nervous and mental patients.

From 1910 to 1912, he worked in the best clinics and laboratories of Europe, including those of Oppenheim, Dejerine, Babinski, Kraepelin, Yakobson, Ashof, Alzheimer, Ehrlich, and Mechnikov. In October 1917 he was appointed Professor of Neurology at

Figure 5. L.I. Omorokov.

Tomsk University, where he set up the first department of the nervous and mental diseases in Siberia of which he was superintendent up to 1936. It is of interest that between 1917 and 1920 Omorokov worked under the anti-Bolshevik government established in Sibiria by Admiral Kolchak. Subsequently Omorokov became head of the department of the nervous diseases of the Kazan Medical Institute until 1967.[3] The range of Omorokov's scientific interests was wide and embraced both questions of neurology and psychiatry. The most significant series of works by which he became well known was dedicated to the study of *Epilepsia partialis continua* that was originally described in Russian adults (Koshewnikow, 1895) suffering from Russian spring-and-summer encephalitis (Omorokow, 1927; Bien, 2005). He studied the epidemiology, pathomorphology, and clinical picture of this disease that was prevalent mainly in Siberia. He presented the evidence of its infectious origin. Long before the discovery of Russian tick-borne encephalitis he expressed his opinion on the epidemiological similarity of Kozhevnikov's epilepsy and progressive poliomyelitis of adults, paying attention to the possible infectious etiology in a woody environment. Having worked out the concept of the cortical origin of "continuous partial epilepsy," he pointed to the significance of cell damage in the second layer of the cortical motor zone caused by infection, trauma, or cysticercosis. In his theoretical conclusions Omorokov suggested the idea of the reflexive origin of the convulsive impulse in the development of epileptic seizures. Omorokov's textbook *Introduction to Clinical Neuropathology*, which was reprinted several times, was a nice concord of a scientific character with lucidity of presentation of the material that was illustrated with the original pictures made by the author. In his last years L.I. Omorokov was member of the editorial Board of the Neurology section of the Soviet Medical Encyclopedia.

[3]Kolchak A.V. 1874–1920. Leader of the anti-Bolshevik government in West Siberia during the civil war 1918–1920. Russian admiral, Arctic explorer, scientist; took part in an expedition to the North Pole explored New Siberia in the Arctic Circle by dogsled, commanded a torpedo boat in the Russo-Japanese War, worked at the Academy of Sciences, where he tested the first icebreakers.

Y.Y. Popelyansky

From 1967 until 1987 the department of nervous diseases of Kazan Medical Institute was directed by Yakov Yuryevich Popelyansky (1918–2003), Konovalov's pupil, who began his neurological career under Darkshevich in Moscow. He was honorary academician of the Euro-Asian Academy of Medical Sciences. From 1978 up to December 2000, he was the head of the All-Russian Center of Vertebroneurology (Orthopedic Neurology) in Kazan. Popelyansky described a number of reflexive, myo-adaptive, muscle-tonic, neuro-vascular, and neuro-dystrophic syndromes of "osteochondrosis," the term suggested by Hildebrandt in 1933. In Russia this term so far is more common than spondylosis, which is in use in Europe and the United States. Besides clinical neurology he was an expert in History of Medicine and wrote a book on L.O. Darkshevich (Popelyansky, 1976).

Thus, at the end of nineteenth and beginning of twentieth century Kazan was the third (after Moscow and St. Petersburg) Center of Neuroscience in Russia. This may partly be due to the fact that gifted Russian scientists came to Kazan University from St. Petersburg and Moscow (V.M. Bekhterev and L.O. Darkshevich, respectively) after studying and doing research abroad, creating close relations with European Scientists. A good example of this cooperation is the discussion on the brainstem connections of the VIIIth cranial nerve, when Sigmund Freud and Darkshevich erroneously concluded that the "vestibular nucleus of Deiters was the third acoustic nucleus…" (Darkschewitsch & Freud, 1886; Wiest & Baloh, 2002). In April 1885, Bekhterev published a paper in the *Neurologisches Centralblatt* distinguishing anterior and posterior roots of the VIIIth cranial nerve. He called the posterior root "ramus cochlearis and anterior root ramus vestibularis" (Bekhterev, 1885). The discoveries and laboratory investigations during this period strengthened neurology as a specialty and brought Kazan Neurology School to a position of international stature.

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