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The Maximow 1909 centenary: A reappraisal

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Portrait of A.A. Maximow in the uniform of the Russian Army general (taken between 1903 and 1910, from the archive of the Department of Hematology and Cellular Therapy named after him, Pirogov National Medical Surgical Center, Moscow, Russia)

The international hematological community marks 2009 as the 100-year anniversary of the publication of the famous paper by the prominent Russian scientist A.A. Maximow, in which he proposed the unitarian theory of hematopoiesis. It is noteworthy to mention that in this summary paper "Der Lymphozyt als gemeinsame Stammzelle der verschiedenen Blutelemente in der embryonalen Entwicklung und im postfetalen Leben der Säugetiere" ("Folia Haematologica", Vol. VIII, 1909), it was postulated that the lymphocyte-like cell acts as a common stem cell and migrates through tissues to seed in appropriate environments. 100 years later, the announcement text for the German Hematology-Oncology meeting, scheduled for 2–6 October 2009, reads "The hematologist Alexander Maximow who worked in Berlin introduced the term "stem cell" for the complete blood-building system in 1909, which is exactly 100 years ago".

Interestingly, in the review published in the 50th Anniversary Issue of the American Society of Hematology (50th anniversary review, 2008) "Stem-cell ecology and stem cells in motion" by T. Papayannopoulou and D. T. Scadden, the part "Historic travelogue for circulating stem cells" starts with the quotation by A.A. Maximow "...[U]nder the influence of stimulation, they [hemocytoblasts, aka stem cells] can be mobilized and become transformed into free, wandering...elements...." [1]. Further in the review it is postulated that the concept of circulating stem cells was first presented as a vision at the dawn of the 20th century by A.A. Maximow.

Alexander A. Maximow was an outstanding Russian scientist who developed and introduced the unitarian theory of hematopoiesis (i.e., "common stem cell for all blood elements"), and pioneered other concepts about stem cells and their microecological niches within bone marrow stroma.

Alexander A. Maximow was born in St. Petersburg on January 22, 1874. After finishing at a German gymnasium in St. Petersburg in 1891 with a top award for academic excellence, he entered the Imperial Military Medical Academy. During his study there, Maximow showed a keen interest in morphological problems and won a special distinction for his work on the experimental production of amyloid entitled "The histogenesis of experimentally induced amyloid degeneration of animal liver" ("Russian Archive of Pathology", Vol. I, 1896, in Russian). He graduated from the Academy in 1896 with another gold medal and, accordingly, his name was printed on the marble honor plaque at the main building of the Imperial Military Medical Academy. After receiving his MD degree A.A. Maximow worked as an Assistant Professor at the Department of Pathology for three years. In 1899 he was awarded his Ph.D. after a successful defense of his doctoral dissertation dealing with the pathological regeneration of the testes. From 1900 until 1902 Maximow worked in Freiburg and Berlin, Germany, in the field of embryology and experimental pathology. Then he returned to St. Petersburg and first procured a position of Privat-Dozent of Pathology and later (in 1903) of Professor of the Department of Histology and Embryology at the Military Medical Academy, which he held until 1922 (Figure 1).

Figure 1. The entrance to the Military Medical Academy building, where the Departments of Histology, Anatomy, and Pathology are located. Maximow worked at the Department of Histology, located on the second floor. Modern view (from the archive of the Department of Hematology and Cellular Therapy named after A. A. Maximow, Pirogov National Medical Surgical Center, Moscow, Russia)

During this period Maximow made his major fundamental and experimental findings in hematology and histology. Maximow's authority as a prominent expert was growing, and he was elected to the position of Professor of the Department Embryology at the St. Petersburg University in 1919 and became a member of the Russian Academy of Sciences in 1920. It's of interest to note that the first Russian Nobel Prize winner in the field of medicine and physiology, Prof. I. P. Pavlov, supported Maximow's nomination for the latter position. Unfortunately there were no possibilities to continue research in Russia after the communist revolution of October 1917 and, as the result of this, A.A. Maximow emigrated to the USA in 1922, where he took the position of Professor of the Anatomy Department at the University of Chicago. He worked there until his death in 1928 (Figure 2).

Maximow died on December 3rd, 1928, at the age of 55. He passed away unexpectedly, at the peak of his professional career, while actively and seriously involved in theoretical and experimental work. He is buried at the Oak Woods Cemetery in Chicago [2,3].

Maximow's contribution to fundamental and experimental hematology and histology can be hardly overestimated. In the first phase of his career, from 1896 until 1902, he published both descriptive and experimental papers in the field of normal histology and pathology, establishing the background for his future work. In 1902 he published his monograph on experimental aseptic inflammation (the findings of his work in E. Zeigler's laboratory), which is considered to be the classic work in the field and "is still admired today as a pioneering study of great foresight and exactness" [4].

The next phase of Maximow's career, from 1902 until 1922, was focused on research devoted to the histogenesis of blood and connective tissue. His pioneering studies were the result of experimental investigations into the problems of this field. In 1906 Maximow proposed the unitarian theory of hematopoiesis (Anat. Anz. 28: 24–38, 1906). He updated and confirmed this theory in his later works (1909–1928) by proving that all blood cells develop from a common mother cell. Among his other experimental findings were confirmatory evidence that "polyblasts", lymphocyte-like cells of the blood as well as of lymph nodes, are undifferentiated cells, and proof of the purely extracellular origin of argyrophile and collagenous fibers in tissue cultures.

Figure 2. The house in Chicago where A. A. Maximow lived (from the archive of the Stem Cell Bank Pokrovsky, St. Petersburg, Russia)

At that time A.A. Maximow implemented the newly discovered method of tissue culturing in his research (in 1914), which he considered to be of great value. He used this method to verify the relationship between blood and connective tissue cells, and to prove the concept of structure and development of blood and connective tissue cells. In the

Figure 3. Maximow's microscope at the collection of the museum of the Department of Histology of the Military Medical Academy (from the archive of the Department of Hematology and Cellular Therapy named after A.A. Maximow, Pirogov National Medical Surgical Center, Moscow, Russia)

current exposition at the museum of the Department of Histology of the Military Medical Academy, Maximow's thermostat for tissue cultures, microscope, reagents, histological tools and other belongings are on display, carefully preserved for nearly a century (Figure 3).

In 1914, Maximow published his two-volume textbook The Essence of Histology (Osnovi Histologii in Russian). This book became the standard textbook for students in Russian medical universities and remains a useful manual for histologists. This book later became the basis of the famous Textbook of Histology.

In his time at the Military Medical Academy Maximow developed his major scientific concepts and confirmed these via experimental studies as well as creating schools of thought in histology.

During the last six years of his life in Chicago Maximow was deeply involved in experimental work. At the same time he published more than 20 papers: some of them are based on the results obtained in his laboratory in St. Petersburg; others deal with his findings in Chicago. It is worth mentioning his monograph summarizing both fundamental and experimental issues on connective tissue and hematopoiesis in embryonic and adult organisms. It was published in von Moellendorff's Handbuch der Mikroskopischen Anatomie des Menschen in 1928, the year of his death. Dr. W. Bloom, of the Department of Anatomy and Physiology, worked closely with Maximow in the last four years of his life. Bloom then continued Maximow's work and brought the Textbook on Histology to completion, a book that became a standard text for many generations of medical students and ran to 12 editions after its original publication in 1930 (Figure 4).

Figure 4. The building of the Chamber of Anatomy and Histology at University of Chicago (from the archive of the Stem Cell Bank Pokrovsky, St. Petersburg, Russia)

A.A. Maximow was not only a world famous scientist but an extraordinary personality. He was a refined Russian aristocrat, and a polyglot who spoke fluent English, German, and French. Maximow was a brilliant lecturer, and his presentations were always exciting. He was a talented artist who made wonderful drawings, the unique feature of which is their dramatic precision. Maximow's Essence of Histology (1914), which is now preserved at the library of the Military Medical Academy in St. Petersburg, is accompanied by the drawings made by its author (Figure 5).

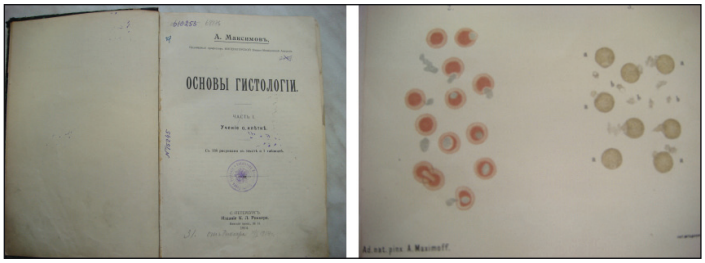

Figure 5. The first page of the first edition of the Essence of Histology by Maximow (1914), and Maximow's drawing of red blood cells in this textbook (the collection of the library of the Military Medical Academy, from the archive of the Department of Hematology and Cellular Therapy named after A.A. Maximow, Pirogov National Medical Surgical Center, Moscow, Russia)

The collection of Alexander A. Maximow's papers at the University of Chicago contains numerous drawings he made, along with correspondence, laboratory notes and sketches, manuscripts of scientific papers and addresses, English translations of Maximow's Russian works, Russian textbooks, and photographs [5].

In conclusion, the presentation of these biographical notes on Alexander A. Maximow in the special issue of the Journal "Cellular Therapy and Transplantation" did not occur by chance. A.A. Maximow is considered to be the founder of the hematopoietic stem cell concept. The year 1909, the year the paper "Der Lymphozyt als gemeinsame Stammzelle der verschiedenen Blutelemente in der embryonalen Entwicklung und im postfetalen Leben der Säugetiere" was published, is considered to be the starting point of the stem cell epoch, though the proof of the development of all tissue cell lineages from one single cell came much later [6-8].

Remarkably, nearly 50 years later, the hematopoietic stem cell concept in its present interpretation forms the basis for revolutionary treatment strategies such as hematopoietic stem cell transplantation, opening up a new era in the management of a variety of life-threatening hematological malignancies.

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Key papers by A. A. Maximow

1. Maximow A. Der Lymphozyt als gemeinsame Stammzelle der verschiedenen Blutelemente in der embryonalen Entwicklung und im postfetalen Leben der Säugetiere (Demonstrationsvortrag, gehalten in der außerordentlichen Sitzung der Berliner Hämatologischen Gesellschaft am 1. Juni 1909). Folia Haematologica 8.1909;125-134.

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Ссылка: Клеточная терапия и трансплантация, том 1, номер 3, 2009

Научное наследие А.А. Максимова: сто лет спустя

А.А. Новик, Т.И. Ионова, Г. Городокин, А.Б. Смолянинов, Б.В. Афанасьев

Резюме

Статья посвящена 100-летию опубликования известной мировому научному сообществу статьи выдающего русского ученого А.А. Максимова «Лимфоцит как общая стволовая клетка разнообразных элементов крови в эмбриональном развитии и постфетальной жизни млекопитающих», в которой впервые сформулировано положение о стволовой клетке крови. А.А. Максимов создал унитарную теорию кроветворения и во многом предопределил научное развитие мировой науки в области клеточной биологии. Его труды стали научной классикой и до настоящего времени остаются одними из наиболее часто цитируемых работ по клеточной биологии. В статье представлены сведения о жизни и научном наследии А.А. Максимова, дано описание наиболее значимых работ А.А. Максимова в различные периоды его жизни, включая его работу в Императорской Военно-медицинской академии в Санкт-Петербурге и в Чикагском университете в период эмиграции.

Публикация данной статьи в журнале «Клеточная терапия и трансплантация» в 2009 году является знаменательным событием, подчеркивающим признание мировым научным сообществом неоценимого вклада А.А. Максимова в создание учения о кроветворной стволовой клетке, заложенного в 1909, и его развития в таком важном и перспективном направлении современной медицины, так трансплантация костного мозга и стволовых гемопоэтических клеток.

Ключевые слова: стволовая клетка, концепция гемопоэтической стволовой клетки, трасплантация стволовых кроветворных клеток