Professor Aleksei Vasilevich Pogorelov (1919 – 2002)

See:
http://www-groups.dcs.st-and.ac.uk/history/Biographies/Pogorelov.html

Aleksei Vasilevich Pogorelov's parents, Vasiliy Stepanovich Pogorelov and Ekaterina Ivanovna, were peasant farmers. They lived in a peasant house and were 'kulaks', that is relatively prosperous peasants owning their farm and several head of cattle and horses. Aleksei [1]:-

... spent his childhood in the countryside and his first for years in the local elementary school. Hunting and fishing have been lifelong activities for him.

In 1921 the Soviet Union introduced its 'New Economic Policy' which essentially favoured the kulaks and for several years production improved markedly. However, in 1927 high taxes were introduced for kulaks and, two years later, forced collectivisation of agriculture was introduced with the setting up of the 'kolkhoz', a cooperative agricultural enterprise operated on state-owned land by peasants from a number of households. The Pogorelovs, like most other kulaks, strongly opposed the efforts to force them to give up their small privately owned farm and join a large cooperative agricultural establishment. Vasiliy Stepanovich was forced to leave his native village in 1931 and went to Kharkov where at first he was involved in constructing tractors, but then became a blacksmith. The living conditions for the family were harsh and Vasiliy Stepanovich worked at night and slept in the daytime. He did this so that at night his wife, son and daughter could have a sound sleep in the cramped conditions.

Aleksei Vasilevich attended High School Number 80 in Kharkov. His mathematical talents became clear when he was around 13 years of age for at this time was very successful in the Mathematical Olympiad competitions which had recently been started up. At this stage he was given the nickname "Pascal" by his classmates, a clear indication of their respect for his talents. While at the high school his teacher introduced him to Naum Il'ich Akhiezer, the head of the function theory research group at Kharkov State University. Pogorelov entered

Kharkov State University in 1937 to study mathematics and physics - this was largely due to the influence of Akhiezer since Pogorelov also showed considerable artistic skills and his parents had been keen for him to develop these talents. He studied there for four years but by then it was 1941 and the course of World War II had taken a dramatic turn for the Soviets.

In September 1939, Russia, allied with Germany, had invaded Poland from the east. This had little effect on the life of students in Kharkov. However, in June 1941 the course of the war changed since Germany invaded their country and German troops moved east along a broad front between the Baltic to the Black Sea. Pogorelov was conscripted into the army and, as one of the most talented students, was not sent to the front but sent to the N E Zhukovskii Military Aviation Engineering Academy in Moscow. He graduated from the Academy in 1945, worked for a while for the army as a specialist on aircraft engines, then was appointed as an engineer designer to the Central Aero-hydrodynamics Institute. There he worked on the development of the first Soviet missiles, advised by Germans who had been involved in the V-2 rocket programme. However, now that World War II was over, Pogorelov wanted to complete his mathematical education which had been disrupted when he had been conscripted in 1941, so he registered for a part-time course leading to a Candidate's degree (equivalent to a Ph.D.) at Moscow State University.

Pogorelov's interests were in geometry and his postgraduate studies at Moscow State University were jointly supervised by Nikolai Vladimirovich Efimov in Moscow and Aleksandr Danilovic Aleksandrov who was based in Leningrad. Research on "geometry in the large" had begun in Russia when Stefan Cohn-Vossen, who had worked closely with Hilbert, emigrated there to escape from the Nazis. After Cohn-Vossen had died in 1936, A D Aleksandrov continued to make substantial progress on the problems he had studied and published the important paper *On one class of closed surfaces* (1938). Within a year, Pogorelov had solved the problem that Aleksandrov had proposed for him. Pogorelov's work proved definitive leading to him proving that any two isometric closed convex surfaces are congruent in 1951. He announced these important results, which solve all rigidity questions for closed surfaces, in *Unique definition of general convex surfaces* (1951). His proof appeared in a 92-page booklet - Busemann writes:-

.. the proof is long and involved, but very appealing to those who like subtle, often purely geometric arguments.

But we have got ahead of ourselves in describing Pogorelov's career, for after the award of his Candidate's degree by Moscow State University in 1947, he was appointed to the Geometry Department of Institute of Mathematics at Kharkov State University. He was awarded his doctorate (equivalent to a D.Sc. or habilitation) by Kharkov State University in 1948 and, two years later, he was appointed to the Chair of Geometry at Kharkov University. It was Pogorelov's choice to teach at Kharkov University for he received, but rejected, offers of positions in both Leningrad State University and Moscow State University. He was head of the Geometry Department of the Institute of Mathematics of Academy of Sciences of Ukraine in 1959-60 and, from 1960 until 2000, he headed the Geometry Department at the B Verkin Institute for Low Temperature Physics & Engineering of the Ukrainian Academy of Sciences. In the year 2000 Pogorelov moved to Moscow where he worked at the Steklov Institute of Mathematics.

His skills, as we have seen, were not confined to geometry since he had gained considerable engineering skills during his time in Moscow. He was able to combine these and produce a wide range of important contributions. The authors of [7] write:-

Brilliant mathematical gifts and exceptional engineering talents have determined the broad area of scientific interests of Pogorelov, an area encompassing both theoretical and applied directions. He has solved a number of key problems in geometry in the large, in the foundations of geometry, and in the theory of the Monge-Ampère equations, and he also has obtained remarkable results in the geometric theory of stability of thin elastic shells.

As well as a remarkable research record, Pogorelov has written a large number of books, both monographs on specialist research topics and textbooks designed for teaching both at universities and in secondary schools. The number makes it impossible to look at anything other than a small selection of these. First we note that his textbooks are all in the general area of geometry and run to many editions. They include: *Differential geometry* (1955); *Lectures on analytic geometry* (1957); and *Lectures on the foundations of geometry* (1966).

Pogorelov writes in the Preface to the first of these:-

The author's aim is to present a rigorous discussion ... without disturbing well-established tradition. A large amount of factual material ... has been relegated to exercises and problems.

The last of these three textbooks has the following chapters:

1. An historical sketch of the foundations of geometry. 2. The modern axiomatic construction of Euclidean geometry. 3. A study of the axioms of Euclidean geometry. 4. Lobachevskian geometry.

Now consider six examples from the list of over twenty monographs he has written:

1. *1.   On Monge-Ampère equations of elliptic type* (1960). We quote from the Introduction:-

   This book presents a systematic exposition of a number of publications of [A D Aleksandrov](#) and his students, dealing with [Monge](#)-[Ampère](#) equations of elliptic type. It contains a number of new results on the setting of boundary-value problems, and on questions of uniqueness and regularity of generalized solutions.

1. *2.   Strictly convex shells in supercritical deformations. I. Spherical shells* (1965). Z Kaczkowski writes in a review:-

   In the first chapter the approximate elastic analysis of the postbuckling behaviour of a spherical shell, where the buckled region snaps into the mirror-image of itself, is discussed. ... The investigations of the second chapter have a purely geometrical nature. They concern the problem of the isometrical transformation of a spherical shell. In the third chapter the author discusses the conditions by which the deformation of a spherical shell under an axisymmetrical load remains axisymmetrical.

1. *3.   Geometric methods in the nonlinear theory of elastic shells* (1967). S Drobot writes in a review:-

   This monograph, based on the author's previous publications, gives a method of determining elastic deformations of a large class of shells in their post-critical stages. The basis for the method consists of two variational principles.

1. *4.   The extrinsic geometry of convex surfaces* (1969). The author of [17], Yu Aminov, explains that this monograph:-

   ... summarised the results of extensive scientific investigations. Even the title of the monograph stresses that it can be regarded as a continuation and development of the results presented in the monograph by [A D Aleksandrov](#) "Intrinsic Geometry of Convex Surfaces" published in 1948. Moreover, the same title also means that the subject covered by the Pogorelov's monograph is much larger. Parallel with the method of approximation of the surfaces by polyhedra, Pogorelov significantly develops the regular theory of surfaces in the Euclidean and Riemannian spaces.

1. *5.   The Fourth Hilbert Problem* (1975). A Urban writes in a review:-

   The booklet contains a solution of [Hilbert](#)'s well-known fourth problem concerning the determination of all realizations up to isomorphism of the system of axioms of classical geometries (Euclidean and non-Euclidean) supposing that the axioms of congruency are replaced by the axiom "triangle inequality".

Pogorelov's solution to [Hilbert](#)'s Fourth Problem, which he presented to a meeting of the Kharkov Mathematical Society held at the Kharkov University, was described by I Kra as a "mathematical jewel" [17]:-

This meeting attracted a large audience formed not only by the members of the Kharkov Mathematical Society but also by students and professors of the university. The talk, highly appreciated by the mathematicians, was followed by the long discussion.

However, Pogorelov looked back at this important work later and explained that there were problems [1]:-

In my article published in 1973 I have admitted some immodesty when I entitled it as "The Complete Solution of the Fourth Hilbert Problem". In fact, it did not contain a complete solution of the fourth problem, because only the two-dimensional case was examined. Moreover, the article contained one incorrect statement. Probably therefore Busemann originally considered my work with some scepticism. In 1975 I published a monograph entitled "The Fourth Hilbert Problem," in which the three dimensional case was considered. After that the opinion of Busemann changed. I knew about it when Busemann was visiting Moscow because he was awarded

the Lobachevsky Prize.

6. *Bendings of surfaces and stability of shells* (1986). Vadim Komkov writes in a review:-

This is a popular exposition of the so-called "geometric theory" of stability of shells, mainly of axially symmetric shells.

Pogorelov received many honours for his outstanding contributions. He was awarded the Lenin Prize (1962), the USSR State Prize (1950), the International Lobachevsky Prize of the Ukrainian Academy of Sciences (1959), the Ukrainian State Prize (1973), and the Krylov Prize of the Ukrainian Academy of Sciences (1988). He was decorated with two Lenin orders, the order of the Red Banner of Labour, and the Diploma of Presidium of the Supreme Soviet of Ukraine. For his secondary school geometry textbook he was given the title "Excellent Teacher of USSR" and received the A S Makarenko medal. However, the honours given to him did not end with his death in 2002. For example [17]:-

... in May 2004, *the Department of Geometry at the Institute for Low-Temperature Physics and Engineering of the Ukrainian National Academy of Sciences, together with the Chair of Geometry of the Kharkov National University, organized the International Seminar "Geometry in the Large" dedicated to the 85th anniversary of Academician Pogorelov.*

Again, a year later another honour was given to Pogorelov [17]:-

On May 13, 2005, *the memorial plaque of Academician A V Pogorelov was unveiled during the meeting held at the Kharkov Institute for Low-Temperature Physics and Engineering of the Ukrainian National Academy of Sciences. In their speeches, Academicians V A Marchenko and V V Eremenko, A A Borisenko (Corresponding Member of the Ukrainian National Academy of Sciences), representatives of the other institutions and Kharkov administration, Consul of Russian Federation in Kharkov, and others described the outstanding contribution made by Academician Pogorelov to various fields of science, his life, and remarkable features of his mind and character.*

Let us end this biography with the following summary of his personality from [4]:-

Pogorelov was one of the brightest representatives of the branch of geometry created by A D Alexandrov. He was peerless in his skill in overcoming difficulties in the solution of hard mathematical problems. Together with his brilliant mathematical talent and well-founded self-respect, Aleksei Vasil'evich combined modesty, friendliness, and attentiveness to his colleagues and students.

Article by: *J J O'Connor* and *E F Robertson*

MORE ON POGORELOV…

Professor Aleksey Vasilevich Pogorelov (1919 – 2002)

See:
http://www.univer.omsk.su/LGS/pogorelov_e.html
http://en.wikipedia.org/wiki/Aleksei_Pogorelov
http://www.amazon.com/A.-V.-Pogorelov/e/B001I7AHFC
http://www.barnesandnoble.com/c/a.-v.-pogorelov

The following was written before the death of A. V. Pogorelov in 2002.

Comment:
POGORELOV Aleksey Vasilevich is the outstanding mathematician of our country, the scientist renowned throughout the world, the academician of Academy of Sciences of Russia and Ukraine, the Honoured Scientist of Ukraine.

Biography:
A.V. Pogorelov was born in 1919, March 3, in Korocha of Belgorod district (Russia). He graduated Kharkov

University (1941) and N.E. Zhukowsky Air Force Academy (1945). His professional experience advanced from engineer-designer at TsAGI (1945). At the same time he attended the external post-graduate courses. A.V. Pogorelov defended the Candidate's thesis (1947) and the Doctor's thesis (1948). He was elected Corresponding Member of UkrSSR Academy of Sciences (1951), Corresponding Member of USSR Academy of Sciences and Academician of UkrSSR Academy of Sciences (1960). Since 1976, he is the Academician of USSR Academy of Sciences. He headed (i) the Chair of Geometry at Kharkov State University (1950-1959), (ii) Geometry Department of Institute of Mathematics at Kharkov State University (1947-1950), (iii) Geometry Department of Institute of Mathematics of Academy of Sciences of Ukraine (1959-1960) and (iv) Geometry Department at B.Verkin Institute for Low Temperature Physics & Engineering, Academy of Sciences of Ukraine (1960 up to now).

Interests and Works:
The scope of his scientific interests is defined by a rare combination of gifts for mathematics and engineering. The studies made by A.V Pogorelov are concerned with geometry in the large, fundamentals of geometry, theory of partial differential equations, theory of stability of thin shells, cryogenic electric machine engineering. They were generally recognized when he solved the very difficult problem of rigidity of general convex surfaces by their metrics. The theorem proved by A.V. Pogorelov includes the well-known A. Cachy, H. Liebmann, S. Cohn-Vossen results as partial cases. Subsequently, he also obtained a number of fundamental results: proved that a convex surface with a regular metrics is also regular, solved the generalized Weyl problem on isometric immersion of a Riemannian manifold homeomorphic to the sphere in the Riemannian 3-dimensional space, the problem of infinitesimal bendings of general convex surfaces, the Dirichlet problem for multidimensional Monge-Ampere equation of elliptic type, obtained a regular solution of the Minkowsky multidimensional problem and a complete solution of the Hilbert's fourth problem.

A.V. Pogorelov has developed the original geometrical theory of stability of elastic shells and determined a series of new results on value of the critical loads, which was corroborated by himself experimentally. He also suggested original solution in the field of the superconducting electric machine engineering. A.V. Pogorelov is the author of the textbooks written for higher schools on all basic geometrical subjects which are notable for their original text, mathematical strict proof and clarity. His attention has been also concentrated on the improvement of the school mathematical education. He created the textbook of geometry which was included into school curricula in 1982 after being experimentally tested in a number of secondary schools. The textbook is noted for its practical aspect of teaching geometry, from one part, and direction of attention towards a development of logical thinking, abilities of pupils according to their age features and individual gifts, on the other part, that fully meets up-to-date requirements.

A.V. Pogorelov is an author of more than 200 publications including about 40 monographs and textbooks. Nearly all his monographs were translated into other languages abroad.

His achievements in the scientific researches were appraised at their true worth and A.V. Pogorelov was awarded Lenin Prize (1962), USSR State Prize (1950), Ukraine State Prize (1973), International Lobachewsky Prize (1959) and Krylov Prize of Academy of Sciences of Ukraine (1988). For his scientific and pedagogica activity A.V. Pogorelov was decorated with two Lenin orders, order of the Red Banner of Labour and Diploma of Presidium of the Supreme Soviet of Ukraine. For the textbook of geometry written by A.V. Pogorelov for secondary schools he also received the title "Excellent Teacher of USSR" and was rewarded with a A.S. Makarenko medal.

A.V. Pogorelov's monographs:

1. Die eindeutige Bestimmung allgemeiner convexer Flachen(in German).- Berlin: Akad. Verl., 1956.- 79 s.
2. Die Verbiegung konvexer Flachen (in German).- Berlin: Akad. Verl., 1957.- 135 s.
3. Surfaces of bounded extrinsic curvature (in Russian).-Kharkov: Universitetizdat, 1956.- 128 p.
4. Einige Untersuchungen zur Riemannschen Geometrie "im Grossen" (in German).- Berlin : VEB Deutch. Verl. Wiss., 1960.- 71 p.
5. Infinitesimal bending of general convex surfaces (in Russian).- Kharkov: Universitetizdat, 1959.- 106 p.
6. To the theory of convex elastic shells in postcritical stage (in Russian).- Kharkov : Universitetizdat, 1960.- 78 p.
7. On Monge-Ampere equations of elliptic type (in Russian) .-Kharkov: Universitetizdat,1964.- 114 p.
8. Topic in the theory of surfaces in elliptic space (in English). - New-York : Gordon & Breach, 1961.-130 p.
9. Some results on surfaces theory in the large (in English). Advances math., 1964, 1, N 2., p. 191-264.
10. Cylindrical shells under postcritical deformations (in Russian)
I. Axial pressing.- Kharkov: Universitetizdat, 1962.- 52 p.
II. Extrinsic pressure.- Kharkov: Universitetizdat,1962.-62 p.
III.Torsion.- Kharkov: Universitetizdat, 1962.- 72 p.
IV. Limitarily elastic shells.-Kharkov: Universitetizdat,1963. - 92 p.
11. Strictly convex shells under postcritical deformations (in Russian):
I. Spherical shells.- Kharkov: Universitetizdat, 1965.- 91 p.
II. Loss of stability of shells.- Kharkov: Universitetizdat, 1965.- 79 p.
12. Geometric theory of stability of shells (in Russian).- Moscow: Nauka, 1966.- 296 p.
13. Geometrical methods in non-linear theory of elastic shells (in Russian).- Moscow: Nauka, 1967.- 280 p.
14. Extrinsic geometry of convex surfaces (in English).-Providence, R.I., AMS, 1973.- 665 p.
15. Elementary geometry: planimetry (in Russian).- Moscow: Nauka, 1969.- 127 p.
16. Elementary geometry: stereometry (in Russian).- Moscow: Nauka, 1970.- 100 p.
17. Geometria elemental (in Spanish).-Moscow: Mir Publishers,1974, 224 p.
18. Hilbert`s fourth problem (in English).- Washington: Scripta, 1979.- 97 p.
19. The Minkowsky multidimensional problem (in English).- Washington: Scripta, 1979.- 97 p.
20. Bending of surfaces and stability of shells (in English).- Providence, R.I.: AMS, 1989.- 77 p.
21. Multidimensional Monge-Ampere equation (in English). Rev. in Math.&Math.Phys., 1995, v. 10., p. 1-103.

A.V. Pogorelov's textbooks:

22. Lectures on differential geometry (in English).- Groningen, P. Noordhoff, 1957.- 172 p.; 2nd ed. 1967.
23. Lectures on analytic geometry (in Russian).- Kharkov : Universitetizdat, 1957.- 162 p.; 2nd ed. 1963.
24. Lectures on the foundations of geometry (in English).- Groningen, P. Noordhoff, 1966.- 137 p.
25. Analytical geometry (in Russian).- Moscow: Nauka,1968.-176 p.; 2nd ed. 1978.
26. Differential geometry (in Russian).- Moscow: Nauka, 1969.- 176 p; 2nd ed. 1979.
27. Foundations of geometry (in Russian).- Moscow: Nauka, 1969.- 152 p.; 2nd ed. 1979.
28. Geometry (in Russian).- Manual for teachers.- Moscow: Prosveschenie, 1979.- 176 p.
29. Geometry (in Russian).- Experimental text-book for comprehensive school.- Kiev: Radjanska shkola, 1980.- 224 p.
30. Geometry 6-10 (in Russian).- Experimental text-book for secondary school.- Moscow: Prosveschenie, 1981.- 261 p.
31. Geometry 6-10 (in Russian).- Manual for secondary school.- Moscow: Prosveschenie, 1982.- 288 p.; 2nd - 8th eds. 1983 -1989.
32. Geometry (in English).- Manual for higher school, speciality "Mathematics".- Moscow: Mir Publishers,

1987.- 312 p.

33. Geometry 7-11 (in Russian).- Text-book for secondary school.- Moscow: Prosveschenie,1990.-384 p.; 2nd. - 5th eds. 1991-1995.
34. Geometry 7-9 (in Ukrainian).- Manual for secondary school.- _ iev: Osvita.- 1994.- 224 p.
35. Geometry 10-11 (in Ukrainian).- Manual for secondary school.- Kiev: Osvita.- 1994.- 128 p.

Source: http://www.ilt.kharkov.ua/personnel/pogorelov_e.html