Victor Borisovich Lidskii (1924–2008)

This volume is dedicated to Victor Borisovich Lidskii who died on 29 July 2008. It is a collection of papers in subject areas related to Lidskii’s work, some of which are written by people who knew him well. The editors of this volume, Michael Levitin and Dmitri Vassiliev, are former students of Lidskii, both at undergraduate and PhD level.

Lidskii was born in Odessa in the Soviet Union on 4 May 1924. As with most men of his generation, his life was severely affected by the Second World War. Lidskii finished secondary school on 20 June 1941, two days before Germany invaded the Soviet Union. After his parents’ divorce he remained with his father and stepmother, so at that time Lidskii was living in the city of Bobruisk (now Minsk region, Belarus). His mother lived separately and died in the Minsk ghetto in 1942.

Lidskii escaped the advancing German troops and found himself, on his own, in the city of Saratov. Shortly afterwards he was drafted into the Red Army and sent to a military intelligence school. The main reason for him being assigned to military intelligence was the fact that he knew German. Lidskii studied German at school and he knew some Yiddish as well (which was helpful in learning German). After

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1 The correct date of his birth was established only in the mid 1970s. Lidskii’s original birth certificate was lost and until he got an authorised copy he considered 5 May to be his birthday and put 5 May in all forms and documents.
graduating as an officer, Lidskii spent the last two years of the war on the front line serving in field reconnaissance and going behind enemy lines. Here the German he mastered at intelligence school proved handy in allowing him, on one occasion, to be taken for a German by Nazi soldiers when he lead his group back from behind enemy lines. During these two years he was decorated on four occasions, see [1] for details. Lidskii’s war ended on VE Day in Prague and he was demobilised in 1946.

As a decorated officer and member of the Communist Party (he joined the Party at the front line), Lidskii was offered a job in the NKVD – the secret police. Instead, he chose to study mathematics and enrolled as an undergraduate at the Faculty of Mechanics and Mathematics of Moscow State University. As for many war veterans studying maths was not easy for him but in the end he proved to be good enough to be recommended for postgraduate study under the supervision of I.M. Gelfand. However, by that time (1951) problems already started for students of Jewish origin and he was refused a full-time place at the Graduate School of Moscow State University. Lidskii managed to secure a teaching post at an engineering college and did his PhD at Moscow State as an external part-time student. Despite the difficulties, Lidskii successfully completed his PhD thesis *Questions of spectral theory for systems of second order differential equations* in three years (1954).

In 1954 Lidskii started teaching at the Moscow Institute of Physics and Technology universally known as FizTech (we write more about FizTech below) where he worked for the rest of his life. In 1959 he was awarded a DSc by the Steklov Mathematical Institute for his thesis *Conditions for the completeness of the system of root subspaces of non-self-adjoint operators with discrete spectra* and shortly afterwards (1961) became a full professor at FizTech. From 1966 until 1988 he also held a part-time research position at the Institute for Problems in Mechanics of the USSR Academy of Sciences.

V.B. Lidskii made significant contributions to various branches of analysis. In this short note we will not attempt to review all his work. For a survey see [2] with additional bibliography in [3, 4]. We will only highlight two research topics.

The first — with which Lidskii’s name is most closely associated — is the spectral theory of non-symmetric matrices and non-self-adjoint operators in a Hilbert space. The famous result of 1959 which is widely referred to as Lidskii’s Theorem states that the matrix trace of a trace class operator in a separable Hilbert space equals its spectral trace (sum of its eigenvalues). Despite its apparent simplicity it is a deep and difficult achievement, see, for example, B. Simon’s book [5]. Later Lidskii devised a summation method for series over root vectors of an operator (with discrete spectrum or compact) which is not necessarily close to self-adjoint and established sufficient conditions for summability. In some sense Lidskii’s works on non-self-adjoint operators together with the works of I. Gohberg and M.G. Krein were far ahead of their time. The recent resurgence of interest in non-self-adjoint problems and the deeper understanding of the underlying difficulties (see some of the papers in this volume) is strongly influenced by Lidskii’s scientific heritage.

The other, rather unexpected subject, to which Lidskii devoted the second half of his career, is the rigorous analysis of differential operators arising in elasticity and hydroelasticity. His favourite research object was the operator of shell theory. This operator describes the dynamics of a thin elastic structure such as, say, a hull of a ship or a fuselage of an airplane. In mathematical terms, dealing with the operator of shell theory means looking at a self-adjoint Agmon–Douglis–Nirenberg elliptic
system of partial differential equations of mixed order acting on a two-dimensional manifold with or without boundary. This system depends singularly on a small asymptotic parameter (relative shell thickness) and can be reduced to a higher order analogue of the scalar stationary Schrödinger equation with a pseudodifferential potential which feels in a complicated way the geometry of the manifold. In this highly nontrivial subject area Lidskii and his collaborators obtained a collection of delicate rigorous results which at that time required the use of and contributed to the development of cutting-edge methods of analysis. Regrettably, these achievements remain largely unknown: the statements of the problems are too complicated to attract pure mathematicians and the techniques used too advanced for the applied mathematics community. Nevertheless, some of the results buried in Lidskii’s works on the subject later became classical through the work of other authors. For example, Lidskii was probably the first to prove that the essential spectrum of a self-adjoint Agmon–Douglis–Nirenberg elliptic operator $A$ (say, on a manifold without boundary) coincides with the set of values of the spectral parameter $\lambda$ for which the principal symbol of $A - \lambda I$ is not invertible \cite{6}. The fact that Lidskii’s works on elasticity and hydroelasticity are not widely known in the West is not surprising given that in Soviet times he was allowed to travel abroad only once, that only trip being a trip to Romania.

Lidskii’s conversion to shell theory was spontaneous and happened at Gelfand’s seminar at Moscow State. One day in the mid 1960s the speaker was A.L. Gol’denveizer, a prominent specialist in shell theory. After the talk Gelfand stood up and said: “You, people, forever keep studying the Laplace operator. Is anyone prepared to handle something more challenging, like shell theory?” And Lidskii was the (only) participant of Gelfand’s seminar who accepted this challenge.

One of the defining aspects of Lidskii’s career which is not widely known was his teaching at FizTech. Here we need to explain the unique status of this university within the Soviet higher education system. FizTech was created in 1946 (for the first few years it was a department of Moscow State University before becoming an independent institution in 1951) as a result of an initiative of a group of prominent Soviet scientists which included the future Nobel laureate P.L. Kapitsa. The purpose was to provide elite training of researchers, mostly in physics, who would later contribute to the Soviet nuclear and ballistic missile programmes. The university was based just outside Moscow, in the town of Dolgoprudny, on the site of the former airship factory of Umberto Nobile. This location served two purposes: it was a first attempt to create a Western style university campus where all the students and many of the staff lived but it also stopped foreigners from visiting as most needed special permission to leave Moscow. Despite the secrecy and close association with the military industrial complex, academic freedom at FizTech was unparalleled. Students at FizTech received additional extensive training working directly in leading research establishments of the USSR Academy of Sciences or industry as part of their undergraduate degree programmes. This gave academics a lot of freedom in choosing and building their own courses. An interesting feature of the FizTech “system” was the entrance test which involved not only very strict examinations but also an informal interview with world leading scientists whose opinion ultimately determined who was admitted. Unfortunately, as many other Soviet achievements, this became distorted in later years and strong anti-Semitic tendencies developed.
The unique features of FizTech attracted not only the best students from the whole of the USSR but also the best lecturers. The names of physicists, mathematicians, engineers, chemists and later also biologists who taught there make an illustrious list. It suffices to say that Nobel laureates V. Ginzburg, P.L. Kapitsa, L.D. Landau, A.M. Prokhorov and N.N. Semenov lectured at FizTech. But even amongst these Lidskii stands out as a true FizTech legend. His unique passionate teaching style, deep involvement with the subject and students and strong personality made him one of the most popular and loved lecturers, even though he was not by any means a soft touch as an examiner.

To this day, many years after his peak in the 1960s and 70s, anecdotes about Lidskii’s teaching and personality still circulate on the web. We cite two such stories here.

Once in a lecture Lidskii gave an example of an everywhere discontinuous function and sketched its graph. Later on, in the same lecture, he mentioned that in physics all functions are continuous and differentiable. He was immediately asked how this agrees with the quantisation of energy. Lidskii replied that quantisation occurs precisely because the wave function and its derivative are assumed to be continuous. At this point he noticed the graph still displayed on the board. “This is not a function,” he said, and stopped and waved his hand in the air trying to find a proper word, “but some sort of pathology!” He got so angry with this “pathology” that he smashed the board with his fist so that chalk dust flew everywhere.

On another occasion, in an oral examination for his course, Lidskii became so upset with a student’s answers that in order to calm down he dashed towards the grand piano standing in the corner of the exam hall, played angrily some classical piece and only then rejoined the unfortunate examinee.

It must be said that overall classical music played an important role in Lidskii’s life. It is probably no accident that his youngest son Mikhail Lidsky, from his second marriage to literary translator Inna Bernshtein (born 1929), became a well known concert pianist. Lidskii’s first marriage was to Militsa Neuhaus (1929–2008), a fellow student at Moscow State University and daughter of the famous pianist Heinrich Neuhaus.

Lidskii also coauthored the legendary exercise book *Problems in Elementary Mathematics* (authors V. Lidsky, L. Ovsyannikov, A. Tulaikov and M. Shabunin, Mir Publishers, Moscow, 1973) used by Soviet high school students preparing for university entrance examinations. Everyone who went on to study maths in the Soviet Union at university level in the 1960s and 70s associates Lidskii’s name with this exercise book.

The other place where Lidskii worked, part-time, maintaining his full-time job at FizTech, was the Institute for Problems in Mechanics (IPMech). IPMech was founded in 1965 by A.Yu. Ishlinsky, a distinguished applied mathematician who gained prominence by developing gyroscopes for the Soviet space programme. Most of the staff of IPMech had very applied research interests and many were experimentalists. However, being a well educated and sophisticated person, Ishlinsky recognised that his institute needs a small group of “proper” mathematicians. The group of mostly part-timers which came into being as a result included, apart from Lidskii, O.A. Oleinik and M.I. Vishik. IPMech was a purely research establishment so staff were not obliged to teach and, moreover, the institute had no undergraduates of its own. Nevertheless, like many other institutes of the USSR Academy
of Sciences, IPMech had close links with FizTech: full-timers from IPMech had the opportunity of teaching part-time at FizTech and full-timers from FizTech had the opportunity of doing research part-time at IPMech. Some lecture courses for FizTech students were taught at IPMech and many student projects and theses were supervised there. Thus, Lidskii’s part-time research job at IPMech was a natural extension of his full-time teaching job at FizTech.

For several decades Lidskii served as Deputy Editor of Functional Analysis and its Applications, an influential Soviet journal founded by I.M. Gelfand. His efforts contributed to this journal becoming one of the best know in the West and helped to maintain its reputation in the difficult times following the collapse of the Soviet Union.

Lidskii had around 20 PhD students most of whom became professional mathematicians. We were amongst his very last students and remember fondly not only his academic guidance but his openness and friendship. Coming to his family apartment for discussion was always a pleasure. Lunch or dinner was immediately served, questions regarding family members and events of our lives kindly discussed and immediate help offered if needed. In many ways Victor Borisovich Lidskii influenced our careers and shaped our lives.

Michael Levitin and Dmitri Vassiliev

References

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