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A few reminiscences about some peculiarities of getting a mathematical education in Moscow in the 80-s.

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Thanks to the organizers for suggesting that I try to say a few words from a perspective of a former student of NU – "Народный университет" (i.e., People's University).
I reluctantly agreed to this role. There are two reasons I find it difficult to fulfill the organizers wish.

1. I have very little personal recollection of Bella Abramovna (or as I should say Bella Subbotovsky/aya).
2. I generally dislike talking about many aspects of Moscow life in the 80-s for the reasons well versed by a post-modern Russian bard:

"There is nothing to explain, if one needs an explanation..."
(*А если что-то надо объяснять,*
То ничего не надо объяснять.
А если всё же стоит объяснить,
То ничего не стоит объяснить.)

After failing to convince the organizer to find a better suited person (who, I am sure, he himself would be a more informative and more eloquent speaker) I agreed to try for essentially one reason: The deep and long lasting awe, all of us, graduates of NU, keep for Bella Abramovna, and for all who were involved in NU, some of whom we are happy to have here today. It is difficult to find adequate words to express our gratitude for what they did for us and what standard they have set for us at the very start of our adult life. The things they taught us were small technical things (like the fact that the vector space and its dual are not really isomorphic), greater things (that there are people who are ready to take risks so that we can learn mathematics) , and grand things (that one have to try to do what is right even if this might be scary) .

I guess one has to say few words about the general atmosphere in which NU was created. This is the part I don't like to talk about. But following the Russian proverb ("Кто старое помянет, тому глаз вон... А кто забудет - тому два") which in the translation is reduced to "Those who cannot remember the past are condemned to repeat it" , I will say a few words (for those who need it) about a few peculiarities of the mathematical profession Jews encountered at the Fall of CCCP. By the way, there is no worry that this part of the history would not be forgotten in Russia. It is forgotten already long time ago (which is understandable considering how much Russia changed itself in the spirit, and in the size). The new generations of graduates in progressive Moscow schools have no clue that the people who were involved in the anti-Semitic practices of that time are still at the helm without ever murmuring any sigh of repentance. But we are not in Russia now.

The anti-Semitic policies of the Soviet government, heartily executed by the officialdom of the Math nomenclature, are well documented and well known in the West since the 1970-s (for those who cared to know, of course). Still one of the best pieces describing these practices is the Kanevski-Senderov "Intellectual genocide" and Grisha Freiman's "It turns out I am a Jew". I also recommend articles by A. Shen and A. Vershik published first in the "The Mathematical Intelligencer" and the handy collected in the book edited by M. Shifman "You have failed cmrd. Einstein". In short, the aim of these policies was

to purify Math from Jews and their kind (e.g., graduates of Math schools). And I guess Math was the last place left to do the job. Physics, Biology, History etc. were made "Judenfrei" long before that.

So, how did it look through the eyes of a 16 year old somewhat inclined towards math?

To tell the truth, I can only partially answer this. This is due to my half usual half unusual circumstances which I have to disclose at this point. By the end of the school studies, in 1980, at the prestigious math school N. 57 I was quite exposed to the mathematical world thanks to the unusual way mathematical education was carried away in our school. It was built on two levels: one by the regular teacher, Rafail Kalmanovich Gordin, who taught the standard curriculum with unparallel pedagogical skills. This was however secondary to the instruction we were getting from young MechMat students, under the loose supervision of an accomplished Computer Scientist, Fima Dinitz. As a side remark, not all classes were as good as math classes. Chemistry was excellent, Physics was not (and I learned it with my classmate, Vitya Ginzburg, by going to a private tutor! That paid off when I passed Physics exams at FizTech better than Math).

By the last year in the school, my student mentor, Andrei Khohlov, got tired of me and suggested I go to MechMat to one of the student seminars. That landed me in the seminar of E. Landis for 1&2. year students. This was quite fun. Although I doubt I learned much from it, still I remember Landis explaining some beautiful geometric notions (like index of a vector field and Morse functions). I knew many participants since they were older graduates from the 57th or similar schools (in particular M. Kapranov, who helped me a lot at that and later times). I read Spivak's "Calculus on manifolds" and Kolmogorov, Fomin "Introduction to funct. analysis", although only the general topology part, and enjoyed both.

In fact, I might be viewed as a typical product of the Moscow style pre-university math ed system, set in motion by Dynkin in late 50-s (with origins in pre-war math circles of Shklyarskii and others). By the time I got into this system, solely thanks to the efforts of my parents, it was run over by the government already few times, but still existed and even flourished.

The system included competitive math circles from the young age (mine were from 6^{th} grade in the famous school N.2, where I met Kontsevich), Moscow math olympiad (which I attended in 6-7-8-9-10^{th} grades and through which I got friendly with A. Razborov), and the system of Math school (in fact I knew no other: grades 1-7 I spent in a little known math school 52 (this was the first math school in Moscow and it flourishes now again) with my first very dedicated teacher M. M. Gorelic, and grades 8-10 I spent in 57th which was created by N. N. Konstaninov, but who was banished from it during my time).

But this was it. According to the great design of I. M. Vinogradov and alike I was not supposed to do more math as I was not of the right breed. In fact, by 1980 the problem of entrance of Jews to MechMat was solved. I vividly remember how in early 1980 the late Andrei Turin come to our home to say that there is no point for me to try to be admitted to MechMat since Kostrikin was removed from the Deans office before his time and was substituted by a well-known anti-Semite named Lupanov. As I learned later, Kostrikin paid the price of badly bungling Polterovich-Bialy admission in the previous year. Its

hard to believe, but Lupanov would be the head of MechMat even today .... wouldn't he die a few weeks ago, still serving as the sole Dean for more than 25 years (compare to great Petrovsky, Kolmogorov, Efimov and others who served for 4 years each). One shouldn't worry that MechMat anti-Semites were left without an occupation once the Jewish problem was solved: the next victims were students of Math schools.

For me, there was nothing dramatic in Turin's words, as I never thought that I would get to MechMat at the first place. This is because my parents decided to emigrate to Israel long time before that and by 1980 were already sitting in the notorious state called "отказ". My father lost his job at Physics dept. of MGU and my mother was forced to quit her academic position at IPU (abbreviation for almost "Институт по отработки ориентации ракет в безвоздушном пространстве").

I should admit that I wasn't worried by the state of affairs around me. This was solely due to youthful ignorance of course. But in fact, the hand of KGB and their co-thinkers in math (e.g., Mishenko) was tightening the screws. We were just blind, or blinded by big events: Afganistan war. It turns out that I participated in the last "free" Moscow olympiad (started in 1935 when headed by Alexandrov, then Kolmogorov and in my time by Manin, Tichomirov and other respectable and honest mathematician; on the practical level it was run by Konstantinov and many students on the voluntary basis of course). In 1980 Mishenko got hold on it and wrote a "донос" to the Party leaders. From then on it was headed by, surprise-surprise, the same Lupanov till the collapse of.... CCCP!

Soon after Brezhnev became dysfunctional and KGB in the form of Andropov got complete hold on the country, we started to feel the claws much closer to the flesh and pre-80's started to look like a distant fairy tale world. I should confess that the younger generation of refusinks managed to get through these years mostly unscathed. The main burnt was felt by our parents who shed us from these earthy troubles.

To continue with my story, I failed the famous FizTech interview, but got out with my 16 points for Math and Physics and the coveted passing grade for the composition in Russian. With these grades I was refused enrollment to the theoretical physics dept. at MISIS (Institute for Steel; my class mate was admitted, but he had "Russian" in the appropriate place being only a 1/4; I should admit their choice was right: he became a very good physicist, before switching to the money business with even greater success; he also attended NU for some time), failed the exam at VMK (Computer Science dept. of MGU) (at hands of a well-known anti-Semite) and landed at the Mechanical engineering dept. of the famous "Kerosinka" (from where a year later I transferred to the standard Applied math dept. by winning my last, and probably the only one which had any formal consequences, olympiad) . Oh, and by the way the applicant/place ratio at the entrance exams to Mechmat in 1980 was 0.93. It didn't help any Jew though.

From then on I should have been heading to one of the "safe havens" of boring engineering jobs at some place with a weird name (I should have dreamed about some НИИЧАВО, but this was unlikely; in fact when I graduated I wasn't able to get any job due to the fear of 1st departments at any place to get a potential Israeli bound citizen), and slowly should have become accustomed to the idea that mathematics will not be an important part of my life.

But Bella Abramovna decided otherwise. I do not know how it worked, but people who wanted to study math or those who were around those who wanted to study math had some chances to hear that there are some courses were they can learn the MechMat level math. I was told by my parents to go to so and so address where the organizational meeting should take place. In my case this was not a coincidence, as my mother knew Bella Abramovna from their joint university years (they were in the same group for the first two years at MechMat). Anyway, I found myself wondering in "Хрущебах" (i.e., notorious Chrushev's ear 5 store buildings) looking for, as it turned out, Bella Abramovna's home and meeting on the way typically looking people of my age going in the same direction, some of them even my classmates. So here we were on a late hot early autumn afternoon 30-40 kids squeezed into a small 2 room apartment (50m^2?) equipped with a blackboard. And what did we have for the starters? If my memory serves me right (which is unlikely), we had two lectures: by D. B. Fuchs on "27 lines on a cubic", and by A. B. Sosinsky on "Groups and the Rubik puzzle". At the end we were told that those who want to attend a regular course in mathematics should come at a certain Saturday to a particular place (I think to the elementary school were Bella Abramovna was teaching at the time). By "word to mouth" principle, the second only to the Voice of America source, at the first class the number of interested kids surpassed 100. From that meeting in the autumn of 1980 and till the spring of 1982 almost every Saturday we had 3 full lectures and usually an additional seminar. In the first year our course of 1980 enjoyed the lectures of Fuchs in Linear algebra (and later in Differential geometry), of A. Sosinski in Algebra and of A. Zelevinsky in Analysis. Seminars were run by B. Kanevsky. In the second year B. Feigin gave a course on "Commutative algebra".
Above I told my story not to make you feel pity for me (in fact, I feel that my path to math was quite fortunate and there were many who had nothing which remotely could compare to opportunities I had), but to show who were these kids whom NU pretended to teach math.

As every one knows the number of students tends to decrease rapidly with time. I would say that about 20 students "graduated" from the first year. The exams were optional, but I think most of us took these, at least in one of the courses. I should admit that passing the exam in the Zelevinsky course with a reasonable grade for me was incomparably more difficult than any other exam I ever took. Not to mention that all of us attended some official institutes 5 days a week, for fear of being drafted to the army at least. But our "home" was there at Bella's NU. That's how we identified ourselves in a crowd.

How many of us eventually became mathematicians? From our year I think there are: Vitya Ginzburg, Alesha Kanel, Fedya Malikov, Sasha Odesski (I am not sure about his year though), Misha Shapiro and me. But I do not think this is how one should measure the mark NU had on the participants. It is difficult for me to tell what is a perception NU left in a person who did not became a mathematician, physicist etc. But the same question one should ask about MechMat or any other regular institution graduates. Do we know it? One usually tells stories about effectiveness of mathematics in sciences. But this hardly was the point of those lectures. These lectures were devoted to the pure mathematics per ce. All of us were taking applied courses anyway at our different technical institutes.

For me personally, on the "professional" level it was the gate to MechMat advanced courses. (The real gates to MGU of course were guarded by the police quite literally!) Even if I started to go to these courses before NU, I wouldn't continue for a simple

reason. One needs some kind of a community in order to study math. In the beginning, at least, one needs a community of fellow students to discuss problems and lecturers from whom to get an advice (I still remember D.B.'s comparative remark about choosing between a course in Advance Homotopy theory or Kirillov's Geometric quantization). It is true that we had a lot of friends among the MechMat students, but very soon it wasn't that easy to have a common language with them living completely different life. There also was a continuing attempt by Feigin, Fuchs and Zelevinsky to run a student seminar. It lasted past the formal dissolution of NU (till spring 1983). I guess it wasn't very successful, but it kept us afloat long enough till we started feeling easier in the not so friendly to outsiders MechMat corridors.

What can I say about the teaching at NU? As there are no teaching evaluations to rely on, I try to tell what is left of that feeling after more than 25 years. I still feel that pedagogically lectures of Dimity Borisovich Fuchs on linear algebra are the best I ever attended on any subject. I appreciate this even more now when I teach linear algebra myself (with less and less satisfaction I admit). I recently looked into the notes of the Analysis course by Andrei Zelevinsky – notes remarkably Xeroxed by Kanevsky, a crime in those days. It reads like a novel and I couldn't stop marveling how original they are and how condense and clear at the same time. I remember that well at the end of my PhD studies at Weizmann (where I wish I had such lectures) I realized what that 2^{nd} year course on "Commutative algebra and algebraic geometry" of Boris Feigin was about. Apparently he built the course with the aim of proving Bernstein's theorem on analytic continuation with the further aim of discussing D-modules.

There is one thing about NU which might mislead people who were not there and would try to interpolate how it was perceived at the time. NU defied the Soviet system on a grand scale. And on the other hand it was completely apolitical in its functioning. To the best of my knowledge (and this is contrary to the immediate events preceding the tragic end of NU) there were no explicit political component to NU at any level or for that matter the Jewish culture component (in spite of the fact that students, and lecturers, were mostly Jews). NU was what it declared openly: teaching mathematics to everyone who wants to learn (conforming to its official name: "Курсы повышения квалификации преподавателей вечерних математических школ"). The great lesson of humanity the organizers gave to the students by defying the unjust system, didn't required words.

I am not aware of anything comparable to NU among what might be called unofficial movements in CCCP. Yes, there was Jewish fight for emigration, much more dangerous movements for human rights and other anti-Soviet activities. On the other hand there were, also foreign to the Soviet ideology, but non-confrontational organizations like КСП (how could one translate this? Student Club for singing?!). But all these were of two opposite types: a hardcore anti-Soviet or a pretending that there is nothing wrong with CCCP ("не на что не намекаем, только песенки поем"). The first type was always underground and the second type was allowed to be semi-public. Well, maybe it all was less simplistic in practice. But Bella Abramovna's NU was unique. It challenged the Soviet institutions in one of their core area of "national policy", that it is the politics of nationalities.

I am supposed to tell something about the logistics of this unusual institute of high learning. I have no clues how the organizers, in our case the two visible were Bella Abramovna and B. Kanevsky, were able to pull this out. It required infinite determination

and great abilities to run this enterprise for those 4 years (1978-1982). And those were not the friendliest years of the Soviet regime. But each Saturday there was a room reserved, in a school, in some department of the den of the academic persecution itself – MGU, or in some other place in Moscow. Copies of lecture notes were made, and the famous snack and the tea were made for the break.

I would like to end with the only semi-personal story I have about Bella Abramovna. It is not about those times, but from few years ago, long past her tragic death. Of course I visually remember her sitting at almost all of our lectures. And I remember well her silent funeral. I knew she was from the same MechMat course as Fuchs, Vinogradov and my mother. But that's it. I never had a meaningful conversation with her or visited her, maybe a concert at her home once.

A few years ago under the instigation of Lilia Marinov (wife of the late Misha Marinov, whom I knew through the refusenics seminar, but who also gave a course in physics from the very start of NU, as I learned much later) I was asked to provide any biographical data on Bella Abramovna and NU. I was saddened to learn that after almost 25 years only few scarce attempts were made to pay a public tribute to Bella Abramovna. As in today's event, Lenya Polterovich (who himself gave an interview about NU in an Israeli Russian newspaper few years before that) "kindly" challenged me to do something about it. As a result, together with A. Kanel we were able to organize a publication in the Moscow journal "Mathematical Education" and some of those materials were translated into the book edited by M. Shifman. In fact, we simply passed our duty to Fuchs, Zelevinsky and Vinogradov who wrote about NU and to whom we are grateful for this (more people sent us some short comments).
With Lenya we vaguely remembered that Bella Abramovna wrote some mathematical papers and wondered if this would be of interest for a memorial publication.
We searched MathSciNet and found 2 short papers in logic written in the late 60's (in fact she had 3 more under the name Muchnik). As the subject of these papers was completely outside of our fields of the expertise, I wrote to Razborov to see what he knows about these works. His reaction was immediate and very pleasing. Sasha wrote that he personally never met Bella Abramovna, but he knows very well her works and will be more than happy to write about it. It turned out that Bella Abramovna made an extremely important contribution in the field of complexity, well ahead of her time, so her results hold a prominent role even today. This showed us how little we knew about Bella Abramovna and how nontrivial was her life line. G-d bless her memory.