Memories of Roland Dobrushin

Robert Minlos, Senya Shlosman, and Nikita Vvedenskaya

Roland Dobrushin died in Moscow on November 12, 1995, at the age of sixty-six. His friends and colleagues are preparing a systematic description of his life and career. The present short account is not of this nature; instead it is a personal reflection on the mathematician and the conditions under which he worked.

Dobrushin's work is known to many mathematicians in probability, information theory, and mathematical physics. His interest in probability began in the late forties when he was an undergraduate at Moscow University. His first area of research was Markov chains. In the mid-fifties he became fascinated by the then new subject of information theory, and he made substantial contributions also in that field. In 1962 he turned to statistical physics. Here his legacy is considerable. He was one of the pioneers in the rigorous study of the Ising model and in the elaboration of the more general concept of Gibbs random field. The importance of the Ising model is that it provides a vehicle for studying the question of how the local dependence between sites determines the global nature of the random field. This is a fundamental question not only in statistical mechanics, but also in quantum field theory. Dobrushin's outlook was that the Gibbs state describing the statistical equilibrium of a classical mechanical system should be viewed as a probability measure on the space of all possible configurations of the system at infinite volume. The equations determining this probability measure were formulated by Dobrushin and independently at about the same time by Lanford and Ruelle, and they are now known generally as the DLR equations.

In the seventies Dobrushin was able to combine his experience with Gibbs random fields and Markov processes in the study of Markov processes with local interactions. The stochastic version of the Ising model, first introduced by Glauber, is an example. At each site (point with integer coordinates) there is a spin value ± 1. This configuration evolves by having the spin at each site occasionally flip, that is, change sign. The rate of random flips of the spin at a site increases with the number of disagreements with the spins at neighboring sites. Does this process lead to a unique equilibrium probability measure? Or can differing initial conditions produce distinct equilibria, for example, ones where the spins prefer to have a particular sign? Again, this is a question of how local interaction leads to global order. Dobrushin studied such processes in considerable generality. He had many other scientific interests, ranging from kinetics to complex queuing networks to linguistics. A characteristic of his scientific work was an optimism that the viewpoint of statistical physics—looking at a large system as a collection of interacting components—would be fruitful in many other areas.

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Dobrushin had a habit of continually changing the text of his written work in the course of making improvements. For this reason he never considered writing a book, on the grounds that the process might continue forever and never converge. His only book (written jointly with R. Kotecky and S. Shlosman) came about by chance—the text turned out to be too long for a paper. The book is *The Wulff Construction: A Global Shape from Local Interaction*, and the main content is the proof of one theorem: If in the usual equilibrium Ising model at low temperature one fixes the fraction of minus spins, then the sites with minus spins condense into a drop having an asymptotically nonrandom form given by an explicit construction.

Roland L′vovich Dobrushin was born on July 20, 1929, in Leningrad (now St. Petersburg). At the age of six he lost his father, after which his family moved to Moscow. He was a teenager when his mother died, and he fell under the care of his uncle and aunt. When he was a student in the university, his uncle, a writer who published in Yiddish, was arrested. (In 1948–1949 many people active in Jewish culture were arrested.)

While still a student in school, he became attracted to mathematics and participated in school mathematical Olympiads. He liked to tell the following story. In the work for the Olympiad, he wrote that he could not prove the seemingly obvious fact that a line intersecting one side of a triangle must also intersect one of the other two sides. In his paper he added that, to his shame, he does not know what a line is. Obviously, this confession made a strong impression on the organizers of the Olympiad.

In 1947 Dobrushin entered the mechanical-mathematical faculty at Moscow State University. (In Russia a "faculty" is the analog of a department.) The years of his student life were the years of the postwar glories of this faculty. At that time he was tall, thin, and a very lively youth. He looked on the world with unusual joy, and everything was of interest to him. It seems that he could not imagine that there was something that he could not achieve or not find time to do. He was one of the brightest students in the faculty. Of course, he actively participated in the community life of the faculty. He conducted a mathematical circle for school children. This was also the time when he began to actively work in mathematics. He was a member of the famous student seminar of E. B. Dynkin. It was in this seminar that he did his first work on Markov chains. Then he did his diploma work with A. N. Kolmogorov, and after finishing the university he became a graduate student of Kolmogorov. (It was difficult for Dobrushin to be accepted as a graduate student in 1952, in the midst of the Stalinist anti-Semitic campaign of the time, but Kolmogorov insisted on his admission and succeeded in obtaining it.)

Roland Dobrushin

In 1956 Dobrushin was awarded the prize of the Moscow Mathematical Society for young mathematicians. In 1955 he defended his candidate degree dissertation at Moscow State University for the work on Markov processes. He obtained the higher degree of doctorate in 1962 at the Institute of Applied Mathematics (now the Keldysh Institute) for the research on information theory.

Dobrushin became interested early in social questions; while he was still a boy he began to read the newspapers attentively. This remained his passion for the rest of his life. He read eight to ten newspapers every day. His position as a citizen was nonconformist and active. Precisely that (more specifically, a speech in a well-attended meeting of the faculty, a speech that we would now call democratic) cost him his university career. Dobrushin left the university in 1965 and began to work in the Institute for Problems of Information Transmission, where he founded the Laboratory of Multi-Component Random Systems. He turned out to be a good organizer. This, together with his scientific authority, led to his laboratory becoming one of the mathematical centers of Moscow. It has now been renamed the Dobrushin Mathematical Laboratory.

In the company of his friends he was one of the first to think and speak of the fate of his country and of how the seeds of various internal inconsistencies and conflicts were beginning to lead to its dissolution. At the beginning of "perestroika," during the years of general euphoria, he said that the change in the country will require long and difficult years. In spite of

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this, he always remained an optimist and was confident of a positive result.

This optimism was a characteristic personality trait. Everyone who knew Dobrushin knew of his energy and civic spirit and scientific enthusiasm. However, those who knew him only in recent years could hardly guess that in his youth, as was typical of boys of the '40s and '50s in Moscow, he liked to descend from hills on cross-country skis—later he even learned to ski on downhill skis. In fact, he was not that good a skier. At the beginning he fearlessly hurled himself down the slope, crashing through whatever was in his way. He eventually learned how to "snowplow". So, as on so many other occasions, the optimism was justified.

Dobrushin also liked to go on hiking trips—sometimes shorter ones of two or three days in the vicinity of Moscow or longer ones lasting two or three weeks in the summer. (In these hikes the participants carried all their food in rucksacks, slept in tents, and cooked on fires.) There were trips to the mountains or the taiga. (It has often been described how mathematicians in Russia used to go on such hikes.) Dobrushin also traveled extensively in the Soviet Union to go to conferences or to give lectures. He went everywhere, from the Baltic states to the Far East, from Karelia to Central Asia. In the last years he was able to travel extensively throughout the world, from China to America, and once again he was fascinated by all he saw. But the most interesting place was Russia, to which he always returned with joy.

Dobrushin was married several times, and he had five daughters. The oldest is an artist, and the next two work as linguists. The youngest are still young girls, aged six and ten. He loved his daughters and was a good friend to them. He was in no way ready for death; in fact, he had many plans for the future and worked almost to the last days of his life.