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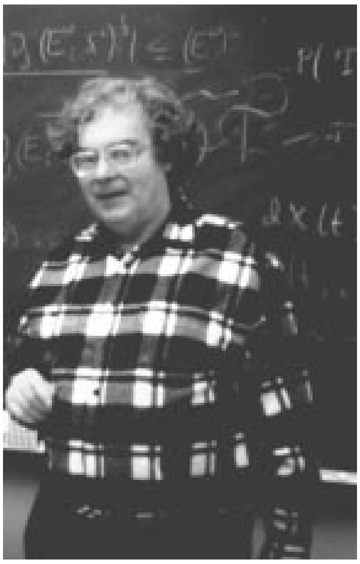

Roland L. Dobrushin

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We dedicate this issue of *Communications in Mathematical Physics* to our dear friend and colleague Roland Dobrushin, who died of cancer on November 13, 1995, at the age of 65. Dobrushin was not only a great, classic scientist, but he was also a man of integrity, courage, and good humor. These qualities stood out at a time and place where they were extremely scarce commodities. His joy of life was infectious and his death is an irreplaceable loss to his family, his friends, and the world scientific community.

Dobrushin made fundamental contributions to many fields of mathematics and to mathematical physics. Others have treated his work on analysis and probability theory, [1, 9, 10, 12, 13, 14, 15], so we concentrate here on his achievements in mathematical physics.

Trained as a probabilist, Dobrushin became intrigued early in his career with the question of how to formulate the notion of a statistical state in infinite volume. In a finite volume, there is no problem, as one can use standard Gibbs distributions. Taking this as a starting point, Dobrushin introduced an interesting mathematical definition of an equilibrium statistical state by specifying a net of conditional distributions, obtained by imposing different boundary conditions in finite volumes [2]. Lanford and Ruelle introduced a similiar notion at approximately the same time [11]. Since then, we usually refer to conditions for conditional distributions as DLR-equations. This point of view had an immediate effect: researchers in the field began to regard the problem of characterizing phase transitions as a problem of how to describe the set of all possible Gibbs states for a given inter-particle potential and thermodynamic parameters. Today, Dobrushin's point of view has become generally accepted – not only by mathematicians – but also by theoretical physicists.

Dobrushin pioneered the development of a mathematical formulation of the famous Peierls' contour method in the theory of phase transitions [17], rediscovering it independently of the related work of Griffiths [8]. Dobrushin proved the existence of phase transitions in the low-temperature Ising model, establishing non-uniqueness of the infinite-volume Gibbs' state [3]. Combining his ideas on limiting states with Peierls' method, Dobrushin established a remarkable phenomenon – the existence of a non-translationally invariant Gibbs state at low temperatures for Ising models in dimension $d \geq 3$ [4]. Today, this is known as the "roughening transition" or the "Dobrushin phase".

In his last years, working together with R. Kotecky and S. Shlosman, Dobrushin developed the theory of phase "droplets" in Ising type models [5]. This body of work justifies the famous Wulff construction in the theory of solids [18].

Dobrushin possessed an unusual intuition about probabilistic matters, as did his teacher A. N. Kolmogorov. A manifestation of this quality can be seen in the paper on the absence of continuous symmetry breaking in two-dimensional lattice models. Dobrushin and Shlosman reduced this old question of Mermin and Wagner [16] to a well-known result in probability theory about the distribution of sums of special, non-identically distributed, random variables [6].

Dobrushin always had some interest in the dynamical problems of statistical mechanics. One of several examples was his result with J. Fritz showing the existence of dynamics for statistical mechanical systems in two dimensions containing an infinite number of particles, along with partial results in three dimensions [7]. These problems lead to difficulties that look similar to those in the study of the Navier-Stokes equations; they are under control in two dimensions, but may lead to singular behavior of the energy in three dimensions that is not yet understood.

References

1. Bassalygo, L., Malyshev, V., Minlos, R., Ovseevich, I., Pechersky, E., Pinsker, M., Prelov, V., Rybko, A., Suhov, Yu., Shlosman, S.: In memory of Roland L'vovich Dobrushin. Problemy Peredachi Informacii, **32** nr. 3, 3–24 (1996)
2. Dobrushin, R.L.: Gibbsian random fields for lattice systems with pair interaction. Funct. Anal. and Appl. **2**, 31–43 (1968); Problem of uniqueness of a Gibbs random field and phase transitions. Funct. Anal. and Appl. **2**, 44–57 (1968); Gibbs field: The general case. Funct. Anal. and Appl. **3**, 27–35 (1969)
3. Dobrushin, R.L.: Existence of a phase transition in two- and three-dimensional lattice models. Prob. Theory and Appl. **10**, 209–230 (1965)
4. Dobrushin, R.L.: Gibbs states which describe the co-existence of phases for a three-dimensional Ising model. Prob. Theory and Appl. **17**, 612–639 (1972)

5. Dobrushin, R.L., Kotecky, R. and Shlosman, S.: Wulff construction – A global shape from local interaction. Translations of Math. Monographs, **104**, Providence, RI: AMS, 1992
6. Dobrushin, R.L. and Shlosman, S.: Absence of breakdown of continuous symmetry in two-dimensional models of statistical physics. Commun. Math. Phys. **42**, 31–40 (1975)
7. Dobrushin, R.L. and Fritz, J.: Non-equilibrium dynamics of two-dimensional infinite particle systems with a singular interaction. Commun. Math. Phys. **57**, 67–81 (1977)
8. Griffiths, R.: Peierls' proof of spontaneous magnetization of a two-dimensional Ising ferromagnet. Phys. Rev. **A136**, 437–439 (1964)
9. Gurevich, B., Ibragimov, I., Minlos, R., Ovseevich, I., Oseledec, V., Pinsker, M., Prelov, V., Prohorov, Yu., Sinai, Ya., Shiryaev, A., Holevo, A.: Roland L. Dobrushin: Teor. Veroyatnos. i Primenen. **41**, 164–169 (1996)
10. Gurevich, B., Ibragimov, I., Minlos, R., Prelov, V., Suhov, Yu.: Memory of R. Dobrushin. Russian Mathematical Surveys **52**, (1997)
11. Lanford, O. and Ruelle, D.: Observables at infinity and states with short-range correlations in statistical mechanics. Commun. Math. Phys. **13**, 194–215 (1969)
12. Malyshev, V.A., Minlos, R.A.: Roland Lvovich Dobrushin (1929–1995), (English), *Markov Process. Related Fields*. **1**, no. 4, 447–458 (1995)
13. Minlos, R., Pechersky, E. and Suhov, Yu.: Remarks on the life and research of Roland L. Dobrushin. Jour. Appl. Math. and Stochastic Anal. **9**, 337–372 (1996)
14. Minlos, R., Shlosman, S., Sinai, Ya.: Obituary: Roland L. Dobrushin (1929–1995). (English), Ergodic Theory Dynam. Systems **16**, no. 5, 863–869 (1996)
15. Minlos, R., Shlosman, S. and Vvedenskaya, N.: Memories of Roland Dobrushin. Translated from Russian by Wm. Faris, Notices of the American Mathematical Society **43**, 428–429 (1996)
16. Mermin, D. and Wagner, H.: Absence of ferromagnetism or " antiferromagnetism in one or two-dimensional isotropic Heisenberg models. Phys. Rev. Lett. **17**, 1133–1136 (1966)
17. Peierls, R.: Ising's model of ferromagnetism Math. Proc. Cambridge Philos. Soc. **32**, 477–481 (1936)
18. Wulff, G.: Zur Frage der Geschwindigkeit des Wachstums und der Auflösung der Krystallflächen. Z. Kryst. **34**, 449–430 (1901)