

BOOK REVIEWS

Scientific concepts such as two-step melting in a 2D hexagonal lattice, renormalization group theory analysis of the BKT transition are explained in a lucid and transparent way accessible to non-experts. At the same time serious scientific discourse is seamlessly woven with anecdotes, stories of missed opportunities, of going on wrong tracks and coming back. For example, for a scientific community that remains deeply engrossed in scientometric scores of evaluation, it is interesting to know that the first paper of Kosterlitz and Thouless got a total of about 2200 citations, of which just three citations were in the first 5 years. It also gives delightful insight on a spectacularly productive collaboration between a seasoned senior scientist (Thouless) and a bright but relatively inexperienced young postdoctoral fellow (Kosterlitz). This chapter would make a perfect companion for anyone trying to learn defect-driven phase transitions from more formal textbooks such as *Principles of Condensed Matter Physics* by Chaikin and Lubensky.

The remaining chapters of the book cover diverse topics related to BKT physics and are based mostly on the choice of the authors. Some chapters are more pedagogical and comprehensive and some less so. Chapters 2 (by Jose) and 3 (by Ortiz, Cobanera and Nussinov) outline theoretical developments post BKT. Chapter 2 is devoted to the work of Jose, Kadanoff, Kirkpatrick and Nelson, which provided theoretical justifications to the approximations made in BKT theory. Chapter 3 describes recent developments on duality transformations applied to 2D XY model. In Chapter 4, Goldman reviews the BKT transition in superconductors. The theoretical background in this chapter is in most part a repetition of the discussion in chapter 1 and could have been much shorter. On the other hand, the experimental review covers only a small subset of early transport experiments on superconducting thin films and Josephson junction arrays, leaving out most of the recent experiments such as BKT transition in interfacial superconductors and measurements on superfluid density in ultrathin superconducting films. This is partly compensated in chapter 5, where Benfatto, Castellani and Giamarchi describe some of these experiments in the context of their recent formulation of the BKT transition within the sine-Gordon approach.

This powerful approach allows a quantitative comparison of the BKT transition in superconducting films with theory by allowing the vortex core energy to deviate from the 2D XY model. Chapter 6 by Teitel is a technical review of the fully frustrated XY model. In Chapter 7 Fazio and Schonreview discuss the theory of BKT transition in Josephson junction arrays and introduce the concept of charge-vortex duality. In Chapter 8 Vinokur and Baturina review their recent theory based on charge-vortex duality to explain the superconductor-insulator transition in thin superconducting films. This unconventional and rather controversial theory has been a topic of passionate debate in recent times¹⁻³. In Chapter 9, Hadzibabic and Dalibard give an overview of the emerging area of BKT transition in ultracold atomic gases. Chapter 10 by Fertig and Murthy is a theoretical review of vortex physics in quantum Hall bilayer devices. In both Chapters 7 and 10, the reader would have greatly benefited from a review of the experimental status of the field, which sadly is missing.

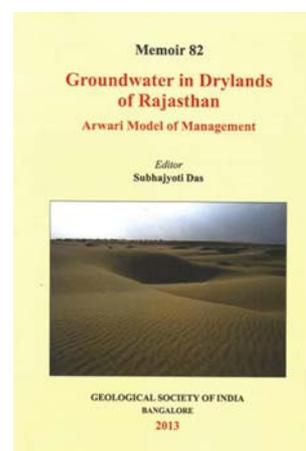
While the book covers a large canvas of topics, one notable omission is the BKT transition in superfluid helium films. Torsional oscillator experiments on superfluid films were the first ones to provide experimental validation of BKT theory and till today remain the neatest experimental demonstration of BKT transition. While these experiments are referred to in the context of theories in Chapters 1 and 2, a review of these experiments would have been appropriate in a volume dedicated to BKT theory. Also, repetition between different chapters could have been avoided. However, despite these limitations, the book provides a useful review of the current status of the field. I would recommend it to graduate students and researchers working on BKT transition. It would be a valuable addition for institutional libraries, mostly as a reference book, but also as a pedagogical text for some of the chapters.

1. Vinokur, V. M. *et al.*, *Nature*, 2008, **452**, 613; Efetov, K. B., Feigel'man, M. V. and Wiegmann, P. B., 2008; <http://arxiv.org/abs/0804.3775>.
2. Fistul, M. V., Vinokur, V. M. and Baturina, T. I., *Phys. Rev. Lett.*, 2008, **100**, 086805; Efetov, K. B., Feigel'man, M. V. and Wiegmann, P. B., *Phys. Rev. Lett.*, 2009, **102**, 049701.

3. Ovadia, M., Sacépé, B. and Shahar, D., *Phys. Rev. Lett.*, 2009, **102**, 176802; Altshuler, B. L., Kravtsov, V. E., Lerner, I. V. and Aleiner, I. L., *Phys. Rev. Lett.*, 2009, **102**, 176803.

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Groundwater in Drylands of Rajasthan – Arwari Model of Management. Subhajyoti Das (ed.). Memoir 82, Geological Society of India, P.B. 1922, Gavipuram P.O., Bangalore 560 019. 2013. xvi + 298 pp. Price: Rs 800.

This memoir by the Geological Society of India (GSI) is an excellent attempt to present the knowledge of guidance on water resources, water quality, watershed management strategies and successful water conservation and management techniques adopted by an NGO, Tarun Bharat Sangh in the semi-arid and desert region of Alwar district, Rajasthan. It is an output of selected peer-reviewed papers presented in the national seminar on 'Changing geohydrological scenario and its environmental impact' jointly organized by GSI, Tarun Bharat Sangh and Central Ground Water Board at Bhikampur, Alwar district, Rajasthan during July 2009. Most of the papers are by practising hydrogeologists of State and Central Government Departments work-

ing in the area of groundwater exploration and management in Rajasthan.

Students, researchers and scientists working in the area of groundwater and management in arid and semi-arid regions of Rajasthan will have access to basic knowledge about occurrence of groundwater, its potential, prevailing hydrogeological conditions, recharge characteristics, groundwater problems, management strategies, etc. in this book. This memoir justifies the need of educating the general public as well as researchers involved in watershed development and management solutions in Rajasthan, where 50% of the area is in arid climate and has a rainfall less than 400 mm. The methods of harvesting meagre quantum of rainfall are well documented.

The contents of the memoir are organized in four sections, namely (i) groundwater regime, development and its impact, (ii) groundwater quality changes and pollution, (iii) water harvesting and conservation, and (iv) Arwari Model of community participation and management. Each section has selected papers bringing out aspects of information based on existing hydrogeological techniques for resource assessment/quality issues and measures for controlling groundwater pollution with case studies. In the introduction, the editor has nicely brought out the present status, problems, need for integrated water resource management and describes the successful Arwari Model community-based management of water resources. The significant findings of various papers are:

(1) The degradation of water resources in both quality and quantity in Rajasthan is about 80% since 1984 to 2004. It can be inferred that the situation in 2013 might be more alarming.

(2) Canal irrigation though has a positive impact of environment and improved agricultural productivity in the desert region, it also has a negative impact of soil degradation and waterlogging. Integrated

participatory management and effective water management strategies are the solutions for controlling these problems.

(3) Based on water level and rainfall analysis, improved agricultural practices are suggested to overcome the problem of serious water level decline in alluvial aquifers around Alwar urban area.

(4) Remote sensing and GIS are proven to be useful techniques in assessing spatial variation in recharge and estimating annual recharge and draft.

(5) Over-exploitation of water resources is not only causing water depletion, but also disturbing fresh-saline water equilibrium and bringing more areas under saline category.

(6) Aero-electromagnetic survey followed by surface geophysical techniques are useful in locating potential aquifers in hard-rock areas.

(7) Multiple potable freshwater aquifers up to 140 m depth in Quaternary alluvium and Tertiary sediments below shallow brackish/saline zones in Hanumangarh District in northern part of Rajasthan have been demarcated for management.

(8) The data show that most of the districts in Rajasthan have fluoride concentration higher than the permissible limit for drinking.

(9) Based on conceptual model, impact of rainwater harvesting on groundwater recharge was assessed for the Arwari River catchment. The study shows that potential recharge varies with the number of rainwater harvesting structures, their sizes and landscape. Potential recharge is higher from anicuts (barrages) on the river than that of Johads. The rainwater harvesting structure has a positive impact, but decreases stream flow downstream. Simulation study also shows that increasing groundwater recharge does not benefit irrigation.

The memoir is dedicated to the excellent work done by Rajendra Singh, water conservationist also popularly known as

the 'Water man of India', who has transformed the water-starved and dwindling water table of Alwar region to one of the best surface and groundwater potential zones. The Tarun Bharat Sangh helped build 9000 Johads and other water conservation structures to collect rainwater from few high-intensity rainfall events during monsoon months, and this has brought water back to over 1000 villages and revived five rivers of Rajasthan, namely Arwari, Ruparel, Sarsa, Bhagani and Jahajuali. Rajendra Singh's ideas, opinions and leadership with dedication are the driving force behind community-based efforts in water harvesting and water management of Alwar region. Here people have abandoned the traditional water conservation practices. Rajendra Singh proves that dedicated, selfless thinking and strong leadership can change the attitude of the people. Once the attitude of the people changes, the movement gains momentum.

The memoir with 298 pages of substantial information and data, particularly with reference to water quality, degradation of existing groundwater resources – both quality and quantity and emphasizing the importance of management strategies for drinking water solution, particularly in semi-arid and desert regions having less than 400 mm annual rainfall, is reasonably priced and should find its place in libraries of schools of management, colleges, groundwater organizations and research institutions. It is a good collection of useful information, all available in one place. The editor, Subhajyoti Das deserves compliments for bringing out this memoir.

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