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Book Review: *Selected Papers of N. G. van Kampen*

Selected Papers of N. G. van Kampen. Paul H. E. Meijer, ed. World Scientific, 2000.

This book gathers a rich collection of Nico van Kampen's essays and miscellaneous writings on a variety of topics. As the title reads, they express and convey the personal views and opinions of the author, an outstanding physicist who has been, for over half a century, a pioneering force in theoretical physics and statistical mechanics.

Edited by Paul H. E. Meijer, this collection assembles and makes accessible to an English speaking public, many essays originally written in Dutch. A wide range of subjects is touched on and writings for special occasions like inaugural lectures, invited speeches, book reviews, popular science articles and obituaries are included. But there are also several illuminating critical essays on present-day physics like the "Danger of Science Management" or "Physics in the Twentieth Century," and on more basic and controversial physical issues, like "Irreversibility," "Entropy," "Probability and Noise in Physics;" "Introduction to Chaos Theory" or "From Statistical Mechanics to Quantum Theory."

This book is organized in six chapters, most of which convene the essays around a unifying theme. For instance, in the first chapter entitled Philosophy of Physics, the question Physics, is it a science? is posed and discussed by the author within the context of what the general features of physics are and in terms of the way physics is done. However, different points of view are also considered which range from the fashionable assertion that "science is determined by social and cultural factors and cannot, therefore, claim to have objective validity," an idea already contained in a quoted statement due to Hitler, to the conclusion put forward by the author which characterizes science as "common sense, based on knowledge and experience." But, of course, says van Kampen, "if you give me a definition of common sense I shall give you one of science."

The chapter on Statistical Mechanics contains the material presented by van Kampen in four lectures and two articles on specific topics of nonequilibrium statistical mechanics. The underlying theme is the connection

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between the macroscopic and microscopic descriptions of irreversibility. In a very clear approach the author discusses under what conditions observed irreversible behavior is not incompatible with reversible microscopic equations of motion of molecules. He points out the logical impossibility of deducing from reversible equations an irreversible consequence, without adding an element that breaks the symmetry. In this context the true content of the concept of entropy and the entropy law is first reviewed. Then, the way in which the growing misuse of the word "entropy" to support vague considerations is discussed. Van Kampen illustrates how this abuse actually leads to a process of degeneration of the word into a fashionable term, "which leads to many even more incomprehensible utterances."

Another topic addressed in this chapter is that of dynamical systems and the theory of chaos. "Dynamical systems are the same as the physical systems that were our object of study—says van Kampen—but they are now reduced to the abstract mathematical form of a set of differential equations." He makes us aware of the danger of indulging in mathematics to deduce exact results by the process of abstracting, that is, "by eliminating the bothersome connection with reality and the knowledge of the physics of the system. But this is not done with impunity, relevant information is also lost by this process."

Dynamical systems are an abstract form of classical mechanics, but nature is quantum mechanical and van Kampen warns us again, "At best rigorous results are an approximation to the quantum mechanical reality and valid only for a limited time. After a long time the discreteness of the energy spectrum is felt and all rigorous results that refer to the infinite time are, therefore, beside reality. But yet, the concept of chaos has no clear and uniquely defined analog in quantum mechanics."

Some of these essays are based on lectures delivered by van Kampen and do not include references. However, for those readers who want to delve more deeply into the subject, it would have been useful to give the references of two brilliant, but neither accessible nor well known, articles by van Kampen on these subtle topics, namely, "The Case against Linear Response Theory,[1] mentioned by D. ter Haar,[2] and "The Gibbs Paradox," in Essays in Theoretical Physics (in honor of D. ter Haar), W. E. Parry, ed. (Pergamon Press, Oxford, 1984).

The article How do Stochastic Processes enter into Physics? actually describes the underlying ideas of one of van Kampen's major lines of research, namely, that of the theoretical analysis of nonlinear fluctuations

[1] Physica Norvegica **5**:278–284 (1971).
[2] Physics World, January 2001.

and of the stochastic treatment of noise in physical systems. It also defines precisely his position with respect to the fundamental way in which fluctuations and noise should be introduced into a physical description. Although its presentation is too technical for readers who are not familiar with the subject and his fundamental contributions to this field, it clearly discusses how statistical mechanics leads, on the macroscopic level, to a stochastic description in terms of a master equation. The way in which subsequently, deterministic equations plus fluctuations can be extracted from it through suitable limiting procedures is also presented and contrasted with Langevin-like approaches where the fluctuations are added on the macroscopic equations.

A theme that repeatedly emerges in many essays is that of the interpretation of Quantum Mechanics. At present time a new dissatisfaction with the common quantum mechanical picture has arisen which try to return to a classical, deterministic description, to construct a causal basis for quantum mechanics but without abandoning its successes, i.e., the excellent agreement of its results with observations. "In spite of the fact that quantum mechanics has been with us for three quarters of a century and has shown its worth by explaining and computing numerous observed phenomena and predicting new ones, discussions about its "real meaning" are still undecisive as in the early days. The reason is that there are still many people who believe implicitly that there must be an underlying "real" world, in which particles are particles and waves are waves, and where laws are deterministic. This belief has given rise to strange constructions for which there is no need nor use." Van Kampen is emphatic about those who try to endow quantum mechanics with some kind of "mysticism:" quantum mechanics is a perfectly logical and coherent physical theory, which can be understood rationally. The mysticism is theirs."

The chapter on Great Physicists includes the text of a lecture on "The Legacy of Einstein and Smoluchowski in Statistical Physics." Although more technical than other essays, it gives a beautiful illustration of the differences between the inductive and deductive approaches. By using several examples from statistical mechanics, van Kampen shows how in many cases the desire to build general schemes has prevailed over the sound understanding of the physical basis. How a bit more of Smoluchowski's inductive mentality would have saved us from a lot of confusion and misguided ideas, and how his inductive approach has been not only fruitful, but indispensable. Impressive mathematical theories cannot serve to turn statistical mechanics into a purely deductive framework; the relation to experience (reality) remains indispensable. "Let there be more Smoluchowski's!" concludes van Kampen. Yes, indeed!

Perhaps some of the most delightful essays of this chapter and of the whole book, are those about van Kampen's recollections of Kramers, his

former teacher, "Remembering Kramers," "H. A. Kramers: 1894–1952," "Kramers and the Problem of Escape over a Barrier" and "Historiography and the Work of H. A. Kramers." In them we find the personal element through the memories and anecdotes; we get glimpses of Kramer's personality and a subtle, clear and first hand analysis of Kramer's work and achievements. Through them we also get a taste and a feeling of how science was done in those good old days.

"In those days—tells van Kampen—it was not expected to be encouraged by appreciation or praise by your professor. I remember that once Kramers said to me that he had received some reprints from de Broglie. Since he was going to visit Paris, he asked me to read them and tell him the contents. After a week's struggle I gave up and told him that either I was a fool or de Broglie (was). He replied that he guessed that it was de Broglie. This was the only explicit expression of appreciation I received during my thesis work! Nonetheless, Kramers managed to convey the feeling of a shared effort and a common aim, which was more stimulating than words of praise, and did more to create friendship."

He also tells about Kramers scientific style and achievements: "In 1924–1925 he managed to construct a formula for the scattering of light by an atom, even though quantum mechanics had not yet existed. He did this by an inimitable combination of knowledge and insight; others might say that by hook and by crook. The importance of this Kramers-Heisenberg dispersion formula was not confined to the special problem of light scattering. It served as a stepping stone from which Heisenberg arrived at the general formulation of quantum mechanics and thereby stole the show." In response to the criticism sometimes addressed to Kramers, in the sense that in many subjects Kramers did all the groundwork but failed to make the decisive step, van Kampen replies: "There is a grain of truth in it, but to consider that as a basic flaw of Kramers as a physicist seems to me unfair. Does one blame Lorentz for not taking the final step to relativity? Einstein for not going on to discover quantum mechanics? Columbus for stopping half way on his voyage to India? Rather, I think that it is in the nature of things that those who laboriously lay the foundations for the new development no longer have the freshness of mind needed to discern an entirely new approach."

As van Kampen's well known scientific papers, his essays are also lucid, critical, carefully written and sparkled with flashes of good humor. Paul H. E. Meijer says in the Preface of this book, "These essays are almost always enjoyable for their style alone. His style is incisive but not derogatory and often playful." However, these features demand on behalf of the reader a caring attentiveness in their reading. True, these essays may be easy to read, but are not easy to grasp. They are deep and witty, written in an agile, vivid style, which makes seem easy the difficult and usually

controversial topics they address. D. ter Haar has already warned us, "van Kampen's papers have to be read carefully."

Van Kampen's work has been marked by powerful lines of thought and originality. His scientific papers stand out for their clarity, critical content and scientific quality, assets that are also reflected in these writings on a different genre. This is a delightful book that is fascinating to read.

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