

INDETERMINACY:
The Mapped,
the Navigable,
and the Uncharted

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Nebula (Latin for small cloud) denotes a cloud of interstellar gas and dust. In astronomy, it is subcategorized into diffuse-, emission-, reflection-, or dark-nebulae; hazy speech and cloudy ideas can be “nebulous” (German *Nebel* for fog; Greek *Nephélé* for cloud).—*Ed.*

Graphic: The Great Orion Nebula. © istockphoto/Manfred Konrad
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Preface and Acknowledgments

Theoretical and empirical indeterminacy and indeterminability engender ontological, epistemological, axiological, empirical, and methodological puzzlements in ways and with consequences very distinct from those generated by vagueness, ambiguity, or uncertainty. In their practical impact, these puzzlements profoundly affect interpretations, approaches, findings, and applications, in all realms of human thought, industrial research, scientific discovery, professional deontology, and social innovation.

In a multidisciplinary approach, across its logically sequenced, closely interlinked, and knowledgeably insightful short chapters, this cohesive book seeks to offer an enjoyably edifying systemic view and holistic understanding of indeterminacy and indeterminability. This is attempted by a scrutiny of the compound challenges and opportunities, the manifold liabilities, and the complex dilemmas these two systemic conditions can generate at the levels of structure, function, process, context, and action, in an array of disciplines and professions—from language to music to physics to engineering to economics and finance, and also in the areas of rational interpretation and in the purviews of forward-looking agency: strategic planning, urban design, and regional development among them. Our critical glance at the indeterminabilities embedded in pursuits of ideals such as freedom, and in retrospective assessments of historical accounts, completes the intellectual journey undertaken in company of, and service to, students, teachers, experts, scholars, researchers, generalists, and policy makers as well.

(In)determinacy is foremost an ontological phenomenon. After the import of indeterminacy became evident in quantum physics, the notion began to receive due attention in the theories and models of a number of natural (biological and ecological, for example) and social

sciences. Involved here are especially structural aspects of systems, states, and events, in observer-independent contexts. *Ontological* (in)determinism concerns (in)determinate state changes in complex systems, independently of how different categories of observers may (or may not) be able to acquire knowledge about these changes. *Epistemological* (in)determinism, on the other hand, characterizes systems as (non)determinable by idealized observers, who may (not) be able to obtain complete and accurate information about the system's present state, in order to convert such into data about future state(s) by using the appropriate dynamical laws. *Axiological* indeterminacies, in turn, engage value-relevant indeterminism.

(In)determinabilities refer to whether observers or experimenters are (un)able to know under given circumstances, the *whys* and the *hows*. They are mainly of epistemological import and empirical consequence. Depending on the nature or mode of the (in)abilities exhibited in a certain situation by an observer or an experimenter, we suggest that (in)determinabilities can be categorized into at least four types: *observational*, for (in)ability to identify observed objects or to compute predictions from recorded past observations; *synthetic*, for (in)ability to build or to program particular artifacts; *hermeneutic*, for (in)ability to interpret, understand, and use cultural artifacts; and *dialogical* (or *constitutive*), for social actors' (in)ability to bring forth or constitute, and—cooperatively—to maintain, the social artifacts in which they (in)voluntarily and (in)actively participate.

Vagueness is the state in which the exact meaning of words or phrases is indeterminable. Vague texts and utterances—whether they are of descriptive, prescriptive, or normative import and implication, or of communicational consequence as well—make it quite impossible to establish their truth or falsity. Their being vague impedes ability to distinguish between the (un)knowable and the (un)known and can come to complicate matters at epistemological, empirical, and methodological levels of thought and action, especially in combinations with modes of ambiguity and uncertainty in the complicating presence of indeterminacy and indeterminability.

Ambiguity—the presence of two or more distinct meanings for a single word or expression—would be considered, at best, an ordinary, benign, useful, often interesting, artifact of pregnant language, were it not—at its worst—an unintended, uninvited, even unsuspected, form of ideational and communicational impediment: a linguistic *situation*, capable of leading to potential logical fallacies likely to aggravate

and exacerbate the cognitive examination of unknowns and unknowables.

Uncertainty, practically always, is associated with one kind of information deficiency or another. Uncertain states or events are epistemologically evaluated and methodologically addressed. Notably, both uncertainty and indeterminacy are intended to apply to events in, or states of, state-dependent systems—indeed, to the universe itself, *if* the universe is the “state dependent system” it is held to be. In applications, these notions can and usually are extended to values of observables, parameters, properties, and relations; here, one may begin to speak of “multi-valued” or “indeterminate” observables, parameters, and the like.

Historically, scientific and humanistic traditions of thought have placed significant focus on chance and necessity, on chaos and cosmos, and on questions of randomness, with special concern for their part in humanity’s grand interrogations—Free Will, Divine Providence, and Human Destiny—but also on account of their impact on intellectual and scientific pursuits: of their effects on the tenor of scientific method, on the validity of scientific knowledge, on interpretations of the nature of disorder in physics and mathematics, and their role in other existential topics discussed and debated by thinkers and doers for several millennia.

Conceptual and methodological problems related to indeterminacy arise in many areas of intellectual and scientific inquiry, and there are benefits in developing a comparative understanding of the many guises of indeterminacy at work, usually in the presence of other complicating factors. It is in the pursuit of a broader understanding of the universal features of indeterminacy and of the compound-complex ramifications that ensue when it impacts everyday situations in any of its many combinations and permutations that we have decided to produce this cross-disciplinary volume—the first of five, in the framework of an interfaculty seminar series convened and dispensed by the editor on the campus of the University of Pennsylvania under the “ecumenical” title *Cross-Campus Conversations at Penn*.

Ideated, consolidated, organized, launched, directed, and produced with an unshakable ideal—the *One-University* precept—the *CCC-at-Penn* series of seminars sought to connect expert scholars and practitioners across schools, departments, programs, and disciplines, to encourage a de-compartmentalization of knowledge on campus, and also to facilitate the voluntary exchange of ideas among individuals

and worldviews with postures or positions—whatever their personal, ideological, or other principled reasons—differing from, or somewhat aloof of one another.

I thank Dr. Stephen N. Dunning, Professor and then Chair of the Department of Religious Studies at Penn, for extending an invitation, and providing visiting privileges, making my return to the campus of my triple alma mater a fruitful one for the duration of my work on this topic. I direct my cordial thanks also to Professor of Slavic Languages and Literature, Dr. Peter Steiner, then Director of Language House on Penn campus, for offering the seminar hospitable refuge at a critical juncture, and to the Dining Facilities Manager of the moment, Mr. John Henkel, for helping transform our dinner chats into memorably festive occasions. To the Director of Instructional Technology, Dr. J. C. Treat, and to his affable team members at Penn's School of Arts and Sciences, a cordial thank you for allocating the requisite electronic means permitting to conduct our seminars from a virtual blackboard that I could share with each subset of our more than 70 participants. Thanks also to philosophy professors Dr. Zoltan Domotor and Paul Guyer and to communications professor K. Krippendorff, who at times served as "anonymous" peer-reviewers and house-critics for the philosophical expositions of those among us, who come from many other disciplines. Their no-nonsense critique and argumentation on matters philosophical and informational were appreciated by all concerned. From the outset, Professor Domotor helped us bring complex cosmos into creative chaos. Needless to say, this volume would not have seen the light of day were it not for the collegial collaboration and dedicated support of its distinguished participants, through thick and thin. To each and every one of them my iterated kudos and considered felicitations for welcoming my at times deep-delving exigencies and manifold requests.

It would be somewhat insensitive of me not to remember the late Penn Physiology Professor Emeritus, Arnost Kleinzeller, at this time. Under his aegis, a few experienced and talented professors, whom I had the privilege to join, alas, only toward the end, used to meet in one of the cavernous backrooms of the Laboratories of Pathology, Physiology, Pharmacology Building, to discuss scientific and philosophical topics of the day, over brown-bag lunch. No product ever ensued. That amiable multidisciplinary group, the *Schmoozers*, promptly dissolved upon his death. As I now prepare to leave campus myself, I can have no illusion that *Cross-Campus Conversations at Penn* will be a gift

likely to live on after my departure, palpable product and potential notwithstanding.

Embarking on life-consuming projects in modes requiring fullest permanent immersion is always a sacrifice at the expense of time best spent with one's family, especially at a certain station in life. In that sense, last and foremost, I am grateful beyond words to someone who, for more than four decades now, has never ceased encouraging me to pursue my intellectual adventures. It is to her that I dedicate this book.

Jose V. Ciprut