The Improbability Principle: Why Coincidences, Miracles, and Rare Events Happen Every Day.

David J. HAND. New York: Scientific American/Farrar, Straus and Giroux, 2014, xii + 269 pp., $27.00(H), ISBN: 978-0-374-17534-4.

Offering explanations for rare, spotty, and highly improbable occurrences is indubitably a tall task. To attempt to measure or quantify chance intersections of life would be laughable to many. In his book, however, Hand embarks upon this journey with careful thought and a bit of boldness. For example, one considers the following improbability of two specific happenings that are true:

- Super Bowl XLVII featured the Baltimore Ravens and the San Francisco 49ers. The head coaches of both teams were biological brothers.
- The reviewer of this book's parents were *both* born on July 23, 1941.

This book assays to show how circumstances such as these are more commonplace than one would imagine, given five probabilistic laws that undergird what the author dubs as the Improbability Principle.

Chapter 1 presents and defines what Hand calls the Improbability Principle and promises to resolve what seeming contradiction it has when analyzed against Borel's law. Chapter 2 attempts to debunk any notion that rare events, especially miracles, should be explained using rationale anchored in the supernatural or metaphysical. Chapter 3 provides an in-depth discussion of chance and branches into exploring how the central limit theorem supports the Improbability Principle. The law of inevitability provides the basis of discussion for Chapter 4, discussing how occurrence will always happen despite how small odds may be concerning it. Chapter 5 investigates the law of truly large numbers, which promises an event's definiteness of occurrence, given that there are almost endless opportunities for it to happen. Chapter 6 explores the law of selection, which lays the foundation for properly assigning probabilities to an event after it has happened. The law of the probability lever, describing how a modest change in circumstances can evoke probabilities, provides the framework for the discussion in Chapter 7. Chapter 8 explores the law of near enough, positing that events that are alike in enough ways may be ultimately regarded as equal. Chapter 9 discusses how the human mind's perception or psychological construct tends to color one's grasp (or failure thereof) of the Principle. Chapter 10 addresses how the Improbability Principle easily undergirds notions surrounding the development of the universe, the evolution of life, and, hence, everything else. Finally, Chapter 11 expands on Hand's Principle by discussing how it is evidenced in everyday life and across varying fields, including education (detection of plagiarism) and finance (the stock-market crash).

Broadly, Hand's book is a casual but highly engaging read. Some parts are rather entertaining and could be read on a beach boardwalk. The numerical footnoting technique, as opposed to the MLA-based, internal citation method, gives the work less of a thesis-like feel and more of an easy-read flair. Readers may skip the diagrams, tables, and references without losing the nucleus of Hand's thought.

The biggest challenge the author seems to grapple with is how to make the book equally enjoyable and accessible to varying audiences. In some instances, the pendulum of the book's tone swings from being highly instructional and pedantic to being more amicable and lighthearted within the same chapter. Depending on the reader, such fluctuation in tone may come across as slightly forced.

In a similar vein, the author aims to bolster an understanding of the Improbability Principle by introducing Borel's law. In subsequent chapters where Borel's law is evoked, however, authorial construction of the ideological bridge reconciling Borel's law of nothing happening and that of certainty of occurrence is somewhat frail. A clearer path may have started with Borel's law and transitioned to ideas espoused by von Kries, the maverick whose views on small probabilities uncannily foreshadow the abstractions that Hand promulgates in his Principle (Shafer and Vovk 2006).

Of the five laws that provide the basis for the Principle, the author's presentation of the law of the probability lever is the most sterling. His treatment of this law would resonate well with the more traditional student of physics or statistics and also with a reader devoid of intense university training. The author does a superb job of exploiting the idea of the normal curve in a context to which many can relate: money. Also, the use of figures and tables in this chapter helps the reader internalize visually what Hand means by "slight change" (p. 142). Landing on topics of discussion like gambling and lightning strikes would tend to draw in and maintain attention from most readers as it relates to understanding this law and, hence, the Principle.

On a final note, the author may have done well to remove "Everything" from the title of Chapter 10. The strength of any principle is revealed by its sense of restriction or constraint. In legalese, there is talk of laws having statutes of limitations. In physics, even the effects of gravity change with altitude. Principles matter but so does the context in which they operate. Hand's own words suggest the urgency of nullifying any principle or canon that solely claims to explain everything. In an effort to debunk the contribution of supernatural explanations of chance events, he unwittingly poises himself to debunk the contributions of his own Principle. He comments on the futility of using the supernatural, with all of its contributing laws, to explain rare occurrences. "At first glance," he states, "this sounds like a great way of explaining chance events. But a little thought shows that it is in fact a *useless* explanation; it's just too powerful, since it can explain everything" (p. 26). Near the book's end, though, the author is quite meticulous in intimating how certain tentacles of the Improbability Principle underscore such weighty concepts as evolution, the formation of the universe (or multiverse), and all that emanates from them, which is everything else. Specifically, Chapter 10's title, "Life, the Universe, and Everything," presents what the author believes is subject to his Principle. Therein lies the difficulty. First, he posits that any idea that purports to explain everything is useless. Second, he suggests that the Improbability Principle, with its laws working, may be invoked to explain everything. Hence, by transitivity, the conclusion becomes frighteningly apparent.

Hand's Improbability Principle indeed is not useless. It is very useful. His approach at tackling such slippery concepts of rare-event phenomena is first-rate. The work resonates with clear-cut examples, top-notch writing, and stellar research. The author should strive to communicate the Principle's limits, nonetheless. John Donne, in one of his most famed poems, pens:

> No man is an island,
> Entire of itself,
> Every man is a piece of the continent,
> A part of the main.

No principle is either. Once the author clarifies how his Principle works within a context that is larger than itself and populated by other, neighboring principles associated with rare-event happenings, it will shine in all of its intended glory, uniqueness, and splendor.

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REFERENCES

Shafer, G., and Vovk, V. (2006), "The Sources of Kolmogorov's *Grundbegriffe*," *Statistical Science*, 21, 70–98.