

PREFACE

This work is a new study of patterns, systems, things. My original impetus was to write a direct follow-up to an earlier book, *Metapatterns Across Space, Time, and Mind*.¹ In that work, I had permitted myself the freedom of a high-flying bird, seeking themes and similarities across fields of natural science and even social sciences and humanities.

Metapatterns are scale-bridging patterns, with ties to geometric arrangements of parts in wholes. These patterns often recur in biology and cultural systems because of properties they have that can offer functional advantages. Examples include spheres, tubes, borders, organizational centers, and cycles.

Progress, I felt, would emphasize patterns that come about from evolutionary processes versus those that do not. That idea did turn out to be a key motif here. But the conceptual zygote from which this new work grew truly took off with a simple insight about the body. A question I had walked up to in the earlier work turned into an expansive doorway.

The metapattern called "layers" concerns the widely found pattern of a nested hierarchy (or, as I prefer, holarchy) of parts and wholes in the most general sense. In my earlier work, I had guessed there might be fundamental layers (levels) but had left hanging the question about how to find them. Now I realized that the question could be put into very concrete form by thinking from a particular angle about things in the human body and also about time.

As you go down into the body, you go back in time: from the body inward to cells, to molecules, and then to atoms. Passing from life to

physics, each first type in this series of nested things came into existence earlier.

That's interesting, I said to myself. *Would it be possible to discern fundamental levels?* Let's reverse the list, going from ancient to modern time. Can one start at the simplest things of physics and ratchet along a course in time that simultaneously progresses outward in scale? And perhaps during this tally, let's not halt at our bodies as a terminal level but continue the logic on up to larger patterns that we as bodies and minds participate in, such as the social systems of complex culture.

Jacob Bronowski, scientist, master explainer, and bridge between the natural sciences and the humanities, developed in *The Ascent of Man* a concept that he named "stratified stability." I still recall evenings in the mid-1970s when I was between architecture school and future graduate work in earth systems science and ripe for hearing about deep patterns in nature. A group of friends and I lounged weekly, glued to the thirteen televised episodes covering the ideas in Bronowski's book. The words from one episode still ring for me: "Nature works in steps. The atoms form molecules. . . . [T]he cells make up . . . the simple animals. . . . [S]table units that compose one level or stratum are the raw material for . . . higher configurations . . . a ladder from simple to complex by steps, each of which is stable in itself. . . . I call [this] *Stratified Stability*."²

Bronowski did not attempt to count the strata (and he died young, at age sixty-six in 1974, still in the fullness of his powers). In addition, he applied his concept in ways both similar and dissimilar to my pursuit. For instance, in details not quoted here, it is clear that he did not distinguish, as I will, between the arrival of new configurations *within* a level and the transition *to* new levels.³ And I want a term that emphasizes a *repeated process* in the forming of fundamental levels. Therefore, for better or worse, I have coined an active word: *combogenesis*.

Combogenesis is the combination and integration of things from a prior level to make a new level of things. As described in this book, a sequence of such events of combogenesis has over time produced an increasingly expansive nestedness of things from the simplest particles of physics, such as quarks, to the geopolitical state in human culture.

To be sure, many have remarked on and explored the attribute of nestedness. After chemists found the atom, physicists discovered it had parts,

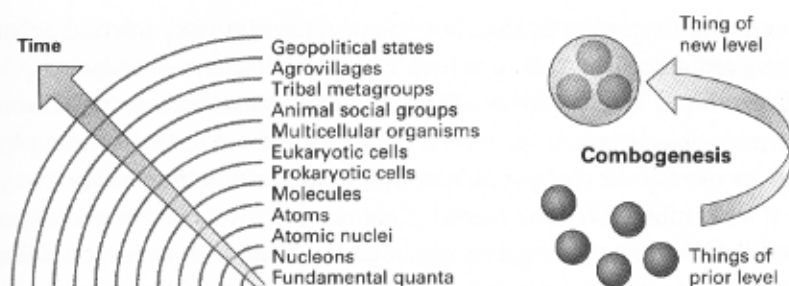


FIGURE P.1

Twelve levels of the grand sequence, shown as concentric rings. Each level was created from an event of combogenesis, with a generic event shown on the right. Combogenesis repeated as a rhythm that went from the fundamental quanta (quarks, etc.) to geopolitical states by a series of levels whose initial things combined and integrated things from previous levels. (On the right, the combined components are shown as a trio inside the thing or system at the upper, new level only for simplicity's sake.)

and one of those parts, the nucleus, had parts, and those parts contained quarks. The search for deeper layers of the onion continues apace.

The book *The Major Transitions of Evolution* by Maynard Smith and Eörs Szathmáry galvanized biologists to seek principles in such transitions, a significant number of which involve an increase in the degree of nestedness.⁴ Bronowski had earlier noted one such transition: cells evolved to animals composed of cells.

An aspect of Bronowski's insight was that the process of combining and integrating could link the fields of physics, chemistry, and biology. His friend and colleague Jonas Salk, of polio vaccine fame, even extended the concept of building up into culture.⁵ This is also my purpose here. Though the older idea from cultural scholars that humanity progressed in a distinct series—small bands enlarged into tribes, and tribes grew into states—has been judged too simplistic, we can acknowledge that over human history social scale remarkably increased and created more complex nestings.

In *Consilience: The Unity of Knowledge*, the biologist and writer Edward O. Wilson developed the metaphor of a thread that could be passed

seamlessly from physics to culture.⁶ I won't get into any hurried debate about reductionism versus holism here (good science—and any good scholarship, I would add—works with both ideas), but one of Wilson's concerns was to point out where the thread of our understanding has gaps as worthy sites for young researchers to position themselves in.

If we combine Wilson's thread of connectivity with Bronowski's stratified stability and the ongoing, vigorous wrestling with concepts of nestedness in physics, biology, and cultural studies, we might expect a worthwhile quest would be to examine transitions and levels not just within any one large field but also across the whole shebang of phenomena from physics through biology to culture. I made such an examination for this book, and I call this run of transitions and levels the *grand sequence*. The grand sequence crosses the foundational structures of physics, the wonders of major inventions of life and evolution, and the majesty and enigmas of major cultural transitions.

Here I also offer a dose of intellectual thanks to systems theorists and thinkers—for example, those who have forged new territory in the topics of complexity, emergence, self-organization, networks, and all related inquiries that seek descriptive or formal mathematical commonalities across nominally disparate fields or phenomena.⁷ I greatly admire this kind of work. But I do not engage in parsing it and comparing it point by point to what I am proposing here. For example, I do not regularly use the terms *emergence* and *synergy*, which are used elsewhere.⁸ My focus is not on general emergence, networks, or synergy as a topic or topics (vast!).

I am instead trying to do something rather simple, almost architectural. Can I find a foundation? If so, what does it have that allows the walls? Then what do the walls have that allow the roof? I want to ask about *things and relations* in a grand sequence from quarks to culture, using combogenesis as an iterative or rhythmic theme. Can we define fundamental levels? You might think of these levels as specific categories of emergence or perhaps as the major transitions of biology extended inward into chemistry and physics and outward to culture.

I have done a share of math modeling in my work with the global carbon cycle and advanced life support,⁹ but I'm not doing math here. It wasn't relevant for my architectural approach. I instead try to stay on course with the logic of the concepts I propose and discuss: innovations

of things and relations at each level. I naturally try to draw on the best scholarship wherever I think I have found it. If there is anything new here, it's in my synthesis. And perhaps it's in the webs of questions the approach leads to. It has been a thrill for me to attempt to balance my integrative synthesis with an examination of the state of knowledge in various fields.

The book has three parts. Part 1 introduces the goal of defining an overall sequence from quarks to culture and develops the general concept of combogenesis, the process of combination and integration of things that results in levels, each with new things or systems that possess new relations.

Part 2 unfolds each of twelve levels derived from combogenesis. I provide my understanding of the cosmically patentable accomplishments achieved at each level. How did these accomplishments facilitate the next event of combination and integration? I aim to weave established science with more than a few outstanding mysteries. Just attempting to review the knowns and unknowns of these levels made me revel in every scale of nature and culture so much more than I had previously. I tend to be a reveler in these matters, anyway, so it takes a great deal to ramp up my enthusiasm even higher. I hope some of this feeling gets conveyed to you.

Finally, after I have fleshed out the levels in part 2, I seek out additional themes and parallels across those levels in part 3. I propose a trio of *dynamical realms* in the grand sequence: the realm of physical law, the realm of biological evolution, and the realm of cultural evolution. Each realm consists of multiple levels and its own special base level. I use these realms within the grand sequence to reinterpret generalized evolutionary dynamics, aided by a pattern that I call the *alphakit* because it is both genetic and linguistic. And there is more to uncover by using the special base levels as anchors for novel inquiry. Finally, I ask if my findings can help frame what is happening in today's world, where a transformative future seems to be manifesting itself at an ever more rapid rate.

I hope my readers are in the creative class in the widest possible sense, from artists to complexity theorists, intellectuals in all fields, "big-history" educators, social scientists, humanists, natural scientists, systems thinkers, technologists, writers, musicians, lay scholars, spiritual seekers—anyone with passionate interests in the big picture. This is easy to say, but

I mean it. For instance, I have always warmed to opportunities at my university to teach courses that bring me in contact with students from a diversity of fields and interests. I also hope that those interested in popular or semipopular writings in physics, biological evolution, and human origins will want to join in my exploration of the grand sequence and its implications. I hope to avoid any grievous injustice to anyone's specialty. I know I have left out favorite nuances and debates, but I hope any slip-ups will not affect the general argument.

I have tried to write in a welcoming, jargon-free style, carefully defining and deploying any key new concepts. I use technical terms for findings crucial to the relevant fields of scholarship. I hope I have adequately guided readers through the main concepts of those fields by sticking to results. Also, I had to coin some terminology, but only when I knew I would be using a given new word often and would gain from having a shorthand for certain key concepts developed in the book.

I have written this book in part to satisfy a dual longing: for a narration of how we came to be and of our place in the lived universe as well as for the logic and operating principles that have powered that narration. In this work, these operating principles are very general. Perhaps they will seem philosophical. Fine! I sometimes think of them as topological-functional, based in words and images that describe patterns of systems. However one might categorize them, I use the principles to derive and explore a sequence of levels from physics to life and biological evolution and on to our legacy of cultural transitions. May any answers in this work also serve as guides to more questions, with the potential for opening awe and individual inquiry.