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James Valentine (20 November 1926–7 April 2023), co-founder of *Paleobiology* and master of idiographically informed nomothetism

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Invited Article

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In 1980, Steven J. Gould published an essay on the emergence of paleobiology as a nomothetic discipline (Gould 1980), nomothetism referring to the search for general laws or principles. Gould contrasted this with the foundation of paleontology, the idiographic tradition of detailing the history of life from the description of new fossil taxa to the elucidation of the long-term patterns of change through time. Among the pioneers of this nomothetic expansion was Jim Valentine. Here I pay tribute to Jim as one of the first paleobiologists, a colleague, coauthor, and friend, emphasizing his intellectual style and insights as much as his lasting contributions. I have written this in part as a eulogy, a remembrance for those who knew him, but also as an introduction to the continuing relevance of his work for those who may be unfamiliar with it.

Born in South Los Angeles, Jim was raised during the Great Depression by his mother, who taught piano and managed apartments in exchange for rent-free accommodations (A. Miller personal communication, based on an interview with Jim). He appeared destined for gang life (J. Valentine personal communication), but avoided that fate when he joined the U.S. Navy in 1944. He saw action on the USS *Cape Johnson*, captained by Harry Hess of seafloor spreading fame, as U.S. forces freed Pacific islands from the Japanese, including the Battle of Iwo Jima (J. Valentine personal communication to A. Miller), but not before suffering a back injury in a motorcycle accident that would plague him throughout his life. Although he was underage (but legally enlisted with the permission of his mother), the Navy recognized his abilities by designating him as a quartermaster, and he was assigned many duties beyond the standard responsibilities of navigation, including manning the machine gun on an amphibious landing craft. Upon returning home he used the G. I. Bill, which paid for college for returning veterans, to attend the now-defunct Phillips University in Enid, Oklahoma, but finished his degree via correspondence through the University of Oklahoma (J. Valentine personal communication to A. Miller). From there, he went on to pursue a master's and Ph.D. at UCLA under the supervision of Ulysses. S. Grant IV, a grandson of the commander in chief of the Union Army and 18th president of the United States, Ulysses S. Grant. It was Grant who fostered Jim's lifelong love of Californian mollusks. He then took a job at the University of Missouri, Columbia (1958–1964) (postdocs were not common then). He moved to the University of California, Davis (1964–1977), then to the University of California, Santa Barbara (1977–1990), and finally to the University of California, Berkeley (1990–2023), formally retiring in 1993 but remaining active until shortly after the COVID closure of the campus, which sadly left him relatively isolated.

The thematic underpinning of Jim's remarkably broad contributions was the use (and celebration) of Darwin's theory of evolution to try to understand the history (the idiographic) and processes (the nomothetic) responsible for the evolution of marine animal biodiversity writ large. This began with his dissertation on the paleoecology and biogeography of the exceptional Pleistocene molluscan fossil record of California, but quickly grew into a full-fledged research program from explaining these most recent patterns all the way back to (and before) the Cambrian explosion.

I emphasize the word "try," because one of the hallmarks of Jim's career was his humility in face of the complex unknown. This humility was made manifest in two ways. First was his ever-present drive to seek out the implications of non-paleontological advances for paleobiological questions. This meant that he was repeatedly at the forefront of integrating disparate bodies of knowledge into paleontological analysis, from isotope and trace element geochemistry, to plate tectonics, to ecology, to biogeography, to oceanography, to population genetics, to developmental biology, including the genetic basis of development. The second was his openness to learning from others, plainly evident in his delightful response to receiving the 1996 Paleontological Society Medal (Jablonski 1997):

> But in the final analysis it's been the graduate students and post-docs … that have taught me the most … by being so creative in offbeat ways. These men and women regularly come up with ideas that are, well, different. Where do they get that stuff? I suppose most of the ideas are gleaned from work in other fields, some

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> sound suspiciously like fiction, and some must surely be created de novo. The amazing thing is that those ideas often end up as dissertations, or at least get worked into them. Even the most pedestrian-sounding of projects will turn out to have some special edge, some delightful twist that teaches the advisor as much as it does the student. So for constantly sending me back to the books, back to school so to speak, to try to understand new developments and new approaches, it's appropriate to dedicate this award to my grad students and post-docs, mentors indeed. (Valentine 1997: p. 740)

This openness kept Jim fresh, at the cutting edge, for close to 70 years!

Material evidence of Jim's Darwinian foundation included his personal library of 4800 Darwin volumes, including two first editions of the *On the Origin of Species*, minor works, and translations. Weighing about a pound and half per volume, that amounts to some 3.5 tons of books, many perched on high shelves that ringed the small cozy library in his house in the Berkeley Hills not far from the Hayward Fault—I always wondered whether Jim would meet his demise by being buried under all those Darwins in a major earthquake, a fitting but premature way to go. But there was no earthquake, and Jim removed the risk by donating the volumes (which will be joined by his papers) to the American Philosophical Society as he moved closer to campus.

So, what of Jim's copious contributions? Seldom can the breadth and depth of a scholar be gauged from just a single publication. But Jim's 1973 book *Evolutionary Paleoecology of the Marine Biosphere* (Valentine 1973) captures this, as well as his rich epistemological style. Jim intended the book as a reference and advanced text, representing a theoretical review of biological aspects of the marine animal fossil record. Built into the fabric of the book is the argument that selective regimes are determined by ecological interactions that operate within a hierarchically structured physical and ecological environment. He also explicitly dealt with the fact that our knowledge of life's history is filtered through an incomplete but "deserving" (to use Jim's word) fossil record. But the book was also an introduction to the principles and ideas relevant to, but lying outside, paleontology, including the emerging theory of plate tectonics, oceanography, island biogeography, Hutchinson's *n*-dimensional ecospace at the cutting edge of ecological theory, the structure of DNA (discovered during the time he was working on his master's degree), and population genetics, including an introduction to the Hardy-Weinberg equation. He even has a delightful section on quantitative modeling, incorporating a component so often missing from treatments of analytic methods, the importance of "sheer invention," which he placed at the very base of his diagrammatic representation of the process (Valentine 1973: fig. 1–5). As a measure of just how far ahead of its time his book was, an English paleontologist said to Jere Lipps (who was at Oxford University on sabbatical at the time), "Everyone thinks it is wonderful, but no one understands it" (J. Lipps personal communication).

Jim incorporated material that would later become mature subdisciplines, including taphonomy (Valentine 1973: fig. 1–1), the fact that the sedimentary rock record consists of hiatus-bound packages of rock (Valentine 1973: fig. 1–3, taken directly from Barrell 1917: fig. 5), thus presaging sequence stratigraphy, and the simple fact that the past can be used as the key to the present (which now underpins conservation paleobiology), inverting Hutton's principle that laid the foundation for the geological sciences. He advocated for the use of monophyletic groups before the cladistic revolution had run its course. He incorporated the implications of an underrated article by Niles Eldredge on the importance of allopatric speciation (Eldredge 1971), providing a diagram that perfectly captures the notion of punctuated equilibrium (Valentine 1973: fig. 2–4), even though the term was coined after Jim wrote that part of the book (Gould and Eldredge 1972). He also grappled with the nature of animal body plans and their origin, including the distinction between long- and short-fuse hypotheses for the origin of the phyla during the Cambrian explosion (Valentine 1973: Fig. 10–5). Some 30 and 40 years later, he would write definitive books on the phyla (Valentine 2004) and, with his former graduate student Douglas H. Erwin, the *Cambrian Explosion* (Erwin and Valentine 2013), which was enriched through integration of data from the revolutions in our understanding of the genetic basis of development and genome evolution (e.g., see our paper on the importance of genomic pre-adaptation and the origin of the phyla [Marshall and Valentine 2010]).

While most of these ideas have reached maturity in the 50 years since the book was published, there are deeper ideas that have yet to be properly examined. The core of this unfinished part of Valentine's legacy is twofold—the first is the hierarchical nature of the evolutionary process, informed by our rich knowledge of the physical, climatic, geographic, and ecological underpinnings of macroevolutionary change. This hierarchical view, which he later sharpened in Valentine and May (1996), is captured beautifully in Valentine (1973: fig. 3–10), derived from Valentine (1968), framed like a Fourier analysis with four distinct temporal scales. The shortest is at population biology–scale lengths (which he terms "niche dynamics"), then to the slower ecosystem dynamics, provincial system dynamics, and finally entire biosphere dynamics. Moreover, he incorporated the additional challenge of inferring the evolutionary consequences of this temporally and spatially hierarchical process through the temporally incomplete rock record, something that is only now being dealt with analytically, but still at only one level in the hierarchy (Zimmt et al. 2021). Because Jim assumed that you cannot meaningfully analyze the hierarchical system unless you understand the structure and function of each of the hierarchical levels, he devoted space in the book to how continental configurations, the Earth's rotation, tidal forces, and the temperature, salinity, and oxygenic structure of the oceans all shape the biosphere today (e.g., see Valentine 1973: figs. 4–10, 4–30).

The second major unfinished legacy stems from his view that evolution and macroevolution are fundamentally rooted in geography. As he approached and entered his 90s, Jim focused his energy exclusively on this his first love, the nature and macroevolution of the major biogeographic patterns and patterning of macroevolution. In the last decade or so, this area has begun to reach a maturity, largely through Jim's papers with his long-term collaborator and former postdoc, David Jablonski at the University of Chicago (the closeness of their relationship reflected in the fact that when we went into Jim's office to deal with his papers, we found his Rolodex open at Dave's number). Jim's view that evolution is fundamentally a spatiotemporal phenomenon, which he couched in terms of ecogeographical units, has yet to be embraced as fully as it should. In fact, one of the many motivations for the creation of the Paleobiology Database stemmed from the frustration that the Sepkoski taxonomic compendia do not include spatial data, but the community has been slow to realize this opportunity (but see Cermeño et al. 2022).

This geographic framing of the paleobiological research agenda, which began with Jim's Ph.D. work, adds an additional

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underappreciated dimension to the meaning and assessment of the quality of the fossil record. In the heady days of the 1970s and 1980s, it was an open question as to whether the fossil record was up to the challenge of allowing us to understand even first-order diversity change through the Phanerozoic, in part because the observed trend in lower taxon richness is matched by a similar trend in sedimentary rock availability. Jim was a coauthor (with Sepkoski, Bambach, and Raup) of the famous "consensus" paper (Sepkoski et al. 1981) that made the case that the observed global pattern does indeed capture the first-order pattern of marine animal diversity change, in part because measured changes in local richness (alpha diversity), which is presumably independent of the total amount of rock available, mirrored the global diversity trajectory. Notably, Jim tacitly accepted Raup's estimate of a threefold increase in diversity over the Phanerozoic, not his own estimate of a 10-fold increase (Sepkoski 2012).

After Sepkoski et al. (1981), and with the advent of sample standardization (Alroy 2010), it has generally been accepted that the fossil record can be taken at face value. However, Valentine's (and Jablonski's) mastery of the idiographic indicates that even with sample standardization, the fossil record may not capture all of the first-order diversity changes. Valentine et al. (2013) compared the provincial bivalve diversity pattern of the Pliocene with that of the Recent under the expectation that the patterns should be closely similar given the temporal proximity of the Pliocene to the Recent. But they are not; the enormous species richness in the Recent of the tropical western Pacific is seriously underrepresented in the Pliocene fossil record, irrespective of whether the Pliocene fossil record is sample standardized. The fact that the Recent can be used to help quantify the incompleteness of the fossil record lends support to the hypothesis of a late Cenozoic tropical diversity high not seen in the fossil record. As usual, Jim had his finger on the pulse of what is important, and this more recent work (published when he was 87 years old) shows that we have yet to fully understand the spatial heterogeneity in the completeness of the fossil record, and thus what needs explaining—perhaps Jim's earlier work that posited a 10-fold increase in Phanerozoic diversity peak may yet prove correct.

I emphasize this example because it reflects the rich manifestation of the search for the nomothetic, the search for generalities, built upon a remarkably rich knowledge of the idiographic. In Jim's work, the nomothetic meets the idiographic square on; generalities flow directly from the complexity of the raw, hard-won data. In contrast, the early papers on the nomothetic, for example Raup and Gould (1974), posited that the history of life could be largely accounted for by stochastic processes, similar to how the gas laws (e.g., $PV = nRT$) emerge from a huge number of tiny contingencies. I find it ironic that the person who introduced the term "nomothetism" into paleontology advocated in his *Wonderful Life* (Gould 1989) a law of no laws, the idea that contingency is the dominant factor in the evolution of life. Nonetheless, in the festschrift honoring Jim edited by Jablonski, Erwin, and Lipps (Jablonski et al. 1996), Gould wrote in his acknowledgments: "We who had the great privilege to participate in the excitement of forging a new explanatory discipline within evolutionary theory—paleobiology … —owe an enormous debt to Jim Valentine for being there first in a truly uncharted territory" (Gould 1996: p. 460).

Jim also had a sophisticated understanding of the complex relationship between developing new knowledge per se and the sociological context within which new knowledge is generated. We tend to celebrate scientists for significant new contributions. However, the biggest advances typically also involve paradigm shifts that meet with resistance from the current community; great contributions can be as much about sociology as new knowledge (Kuhn 1962), for example, Darwin's theory of evolution.

An admirer of Kuhn, Jim understood the importance of this sociological component. Desiring an expansion of the type of question that falls under the purview of paleontology, a major goal of his presidency of the Paleontological Society (1974–1975) was to establish a new journal to further this expansion (C. Campbell personal communication). He thought it should be called the *Journal of Paleobiology*, but his wife, Cathryn Campbell, suggested dropping the "Journal of," and so it became known as *Paleobiology* (while Tom Schopf thought it should be called *Geobiology*; J. Valentine personal communications to D. Erwin and D. Sepkoski). Incidentally, Jim and Cathryn (who did her Ph.D. with Francisco Ayala) published the first paleontological paper on how the discovery of gene regulation might explain the rapid appearance of the animal phyla (Valentine and Campbell 1975). Jim was the force that made the new journal happen within the Paleontological Society Council (R. Bambach personal communication). His vision of a new journal found an immediate ally in Tom Schopf, who played a leading role in gathering the data needed for the council to commit to the journal. Tom became the first editor (along with Ralph Johnson; see chapter 6 in Sepkoski [2012] for an excellent account of this part of the history). Most of the objections centered on the finances, and the concern that the new journal might undermine the *Journal of Paleontology* (which was administered through the Society of Economic Paleontologists and Mineralogists [SEPM] at the time). But some of the more senior members of the community also felt that we simply did not know enough to start answering the questions that Jim and other younger workers felt could be answered (D. Raup personal communication), not recognizing that small samples can capture large-scale patterns, in the same way that Gallup polls can capture the sense of collective opinion despite only sampling a tiny proportion of the population. In what turned out to be one of my last conversations with Jim, it was clear that he thought that this was one of his most important contributions; his impact was more than "simply" advancing our knowledge; he was instrumental in reshaping the very nature of our discipline.

Personally, Jim was shy, private, and self-effacing. Consistent with his introverted nature, Jim once said to his then graduate student Doug Erwin, after asking him to do a lecture for him: "Just get up there and give the lecture, and you don't have to ever look at the students—I just look off to either side or at the back wall above their heads" (D. Erwin personal communication). Nonetheless, I am also told that in the classroom (C. Campbell personal communication), he could be driven to passion, jumping up on tables to emphasize his points, especially when changing course mid-lecture, caught up in the excitement of his current thoughts. In one extreme case, he forgot that the students were present, turning to the chalkboard to work out a sudden inspiration with chalk in one hand and eraser in the other (C. Hickman personal communication).

He was one of the few academics whose thinking I found easier to understand by reading his papers than listening to his talks. Most people provide a succinct framing in their talks, explaining how they got interested in their topic, what problems led them to this or that approach, and so on. In contrast, in the literature the perceived demands of objectivity typically mean that this context is largely omitted, making it harder to understand how the author

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came to do what they did. But for me at least, Jim was more easily understood via his writings, in part because of the extraordinary care he took in drafting his papers, and in part because his shyness could cloak the clarity of his mind.

Jim was honored numerous times by his peers, including being named a fellow of the National Academy of Sciences, the American Philosophical Society, and the American Academy of Arts and Sciences, receiving the Lapworth Medal of the U.K.'s Palaeontological Association, and the Paleontological Society Medal.

Jim's work represents one of the first and richest fusions of the idiographic, the detailed account of life's unique history, and the nomothetic, the attempt to account for that history with theory, laws, and principles; that is, he used traditional paleontological methods (taxonomy, biostratigraphy, paleoecology, paleobiogeography) to uncover general controls on the evolution and distribution of life. Along with earlier pioneers, George G. Simpson and Norman D. Newell, and younger paleobiologists (at the time), Richard Bambach, David Raup, Tom Schopf, Steve Stanley, Steve Gould, Jack Sepkoski, as well as Geerat Vermeij, among many others, Jim led the charge into the challenging but rewarding science of paleobiology. Beyond his productivity, breadth of interests, and depth of scholarship, his sheer imagination was, and still is, a beacon, a call to action.

Jim kindled a warm affection and generosity in his colleagues. He was well liked, and well appreciated. He had a wry wit and remarkable patience. People had a lot of time for Jim, regardless of the circumstance. Jere Lipps recounts from when they were at Davis together: "One time after spending many mornings keeping conversations going, I decided I would not say a word. We picked up our coffees, drank them in silence for half an hour, and then he said, 'Shall we go now?' And back we went to our offices. Jere went on to add: "A few beers loosened things up at night and I learned a lot more personal stuff then." Jim will be sorely missed by many.

Capturing the essence of Jim and his contributions in a single essay is not possible. Beyond the subject areas outlined above, he made numerous other contributions (see the appended bibliography) as wide ranging as the possible multiple origins of life (Raup and Valentine 1983), to the fact that island biogeography suggests that there should be a standing stock of unfilled niches (Walker and Valentine 1984). To read more, see: Lipps (1971), which presages Jim's talents and future promise; Robert Sanders's online obituary at *Berkeley News*; and the obituary written by David Jablonski in the *Proceedings of the National Academy of Sciences* (Jablonski 2023).

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