Vignettes: Overseers

Managers make many mistakes. More often than not these hurt the people they manage, rather than themselves.

—*Peter J. Feibelman*, in *A Ph.D. Is Not Enough! A Guide to Survival in Science* (Addison-Wesley)

An example of the paranoia that had been creeping into the place was characterized by the plastic and tape sculpture that was hung in one of the stairwells by one of the inventive staff members. Certain members of the administrative staff felt so unloved that each believed independently that he had been hung in effigy. It seemed like a good idea, but that was not the intent.

—*Robert C. "Jack" von Borstel*, in *The Early Days of Yeast Genetics* (Michael N. Hall and Patrick Linder, Eds.; Cold Spring Harbor Laboratory Press)

of the first tRNAs—which would each have donated their 3′-terminal nucleotide to the growing RNA chain. Such a process could also have allowed critical parts of RNAs (such as those with enzymatic activity) to be amplified selectively in the absence of full replication. Protein synthesis could then be viewed as a further step along this path leading to the divergence of enzyme synthesis from genome replication.

That the RNA world must have had many complexities is evident, but a number of this book's authors believe that its time was very brief—limited to the period between the cooling of the Earth to life-sustaining temperatures and the date of the oldest fossils containing conventional DNA organisms. P. Moore argues that it must have lasted less than 100 million years, and that "when one starts thinking along these lines, one must consider the unthinkable, i.e., that the length of time that RNA-based organisms bestrode the earth might actually be zero." In a foreword, F. Crick addresses this issue by invoking "Directed Panspermia," by which life is viewed as having been "sent here" in several different forms, all "likely to have evolved originally from a common ancestor (on another planet) that existed some billions of years before the origin of our solar system." Such thinking may be necessary, especially in light of the arguments, presented by G. Joyce and L. Orgel, that getting from zero to RNA would seem even more difficult and time-consuming than getting from RNA to the present state of affairs.

Standing in opposition to such cries for a *deus ex machina* are three outstanding chapters that underscore RNA's inherent fitness for a dual role as template for life and catalyst thereof. As D. Turner and P. Bevilacqua argue in their illuminating discussion of RNA thermodynamics, "The many functional groups, high charge density, and strong interactions of RNA provide thermodynamic advantages for RNA in initial stages of evolution." The reader's confidence in RNA's abilities is further enhanced by its clever use of divalent metal ions to improve folding and catalysis, as discussed by T. Pan, D. Long, and O. Uhlenbeck, and by the revealing analysis by J. Wyatt and I. Tinoco of how familiar and unfamiliar secondary and tertiary structural elements blend to give RNA an almost protein-like complexity. In chapters such as these, but also in those more aimed at review or speculation, the reader can readily see the value and timeliness of this volume, and can anticipate further excitement to come from explorers of the RNA world.

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A Theory of Everything

The Quark and the Jaguar. Adventures in the Simple and the Complex. MURRAY GELL-MANN. Freeman, New York, 1994. xviii, 392 pp., illus. $23.95.

In the late '50s, when I was a graduate student at the California Institute of Technology, the two senior professors in elementary particle theory were Richard Feynman and Murray Gell-Mann. The modernist Man Ray once remarked that when he came to Paris as a young painter the other painters he met were Picasso and Braque; he decided to switch to photography. We Caltech grad students understood his feelings perfectly.

We idolized Feynman, with his dazzling style and his radical originality, but we went to Gell-Mann when we wanted a research problem. Gell-Mann was at the center of particle theory; he had been there for almost a decade and would remain there for over a decade more. The long road from the rebirth of quantum electrodynamics in the late '40s to the construction of the standard model in the early '70s is marked by monuments with Gell-Mann's fingerprints all over them: strangeness, the renormalization group, the V-A interaction, the conserved vector current, the partially conserved axial current, the eightfold way, current algebra, the quark model, quantum chromodynamics—and this is the short list.

At Caltech Gell-Mann was almost as famous for his erudition as for his physics; he was enormously learned in subjects most of us didn't even know existed. A story is told about a physicist, much bothered by this, who decided to become expert in some obscure corner of human knowledge, so that, just once, he could trump Gell-Mann. Of course, for the plan to work the subject had to be one that could be introduced naturally into conversation. He knew that the dining room of the Caltech faculty club was decorated near the ceiling line with the heraldic shields of universities; he decided to learn blazonry, the technical descriptive language of heraldry. When next he had lunch with Gell-Mann at the faculty club, he allowed his gaze to drift upward. "How interesting," he said (and here I must make up babble, for I know no blazonry myself), "gules rampant on sable argent." Gell-Mann looked up. "No," he said. "No, it's sable rampant on gules argent."

In recent years Gell-Mann's interests have shifted from particle theory to what he sometimes calls plectics, "the emerging science of complexity." Ten years ago he helped found a research center devoted to the study of complex systems, the Santa Fe Institute, where he is now a professor, having taken early retirement from Caltech.

The Quark and the Jaguar is an attempt to describe a Theory of Really Everything (my terminology, not Gell-Mann's), a theory not just of quarks but also of jaguars and economies and bacteria, a general theory of how complex systems develop from simple elements and of how they behave after they have developed. I say "describe" rather than "construct" because this theory does not yet exist. More precisely, it exists only in hints and fragments, but Gell-Mann believes it is emerging from research on complexity, especially from the sort of research being done at the Santa Fe Institute. Indeed, the very SFI concept of complex

adaptive systems is everywhere in this book (and has by far the longest list of entries in its index).

Does the attempt succeed? Of course not; it can't. No one can judge an emerging theory until it has finished emerging. The veil of the temple is always trembling, and there's no way to know if what is coming forth is the Darwinian revolution or just the dawning of the Age of Aquarius, whether complex adaptive systems are an immensely fruitful way of thinking about the world or just so much phlogiston.

Nevertheless, in order to describe a theory of really everything, Gell-Mann has to describe really everything, or close enough as makes no difference, and this is a task for which he is singularly well equipped. In addition to all the big stuff about the heterotic string and the importance of disorder in evolution and the transition to a sustainable world, this book is about Charles Bennett's definitions of crypticity and depth, about the system of the naming of the California coast, about Arthur Lintgen, who, by looking at the grooves of a long-playing record, could determine the composer of the music recorded on it, about the practice of deception among the birds, and about Arthur Gell-Mann, the author's father, who learned English so well that "the only way one might have guessed he was foreign born was by noticing he never made any mistakes."

Whatever you think of the forest, these are quite some trees. This book is a grand tour of one of the most powerful and richly structured complex adaptive systems of our time, the mind of Murray Gell-Mann. The tour is very much worth taking.

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Emergence of Civilization

The Uruk World System. The Dynamics of Expansion of Early Mesopotamian Civilization. GUILLERMO ALGAZE. University of Chicago Press, Chicago, 1993. xii, 162 pp., illus. $39.95 or £31.95.

World systems theory, based on the pioneering work of Immanuel Wallerstein, has received considerable attention in archeology in recent years. Although it is more obviously relevant to recent periods—Wallerstein concentrates on the development of the capitalist world system—scholars have also explored its applications to precapitalist societies, including prehistoric ones.

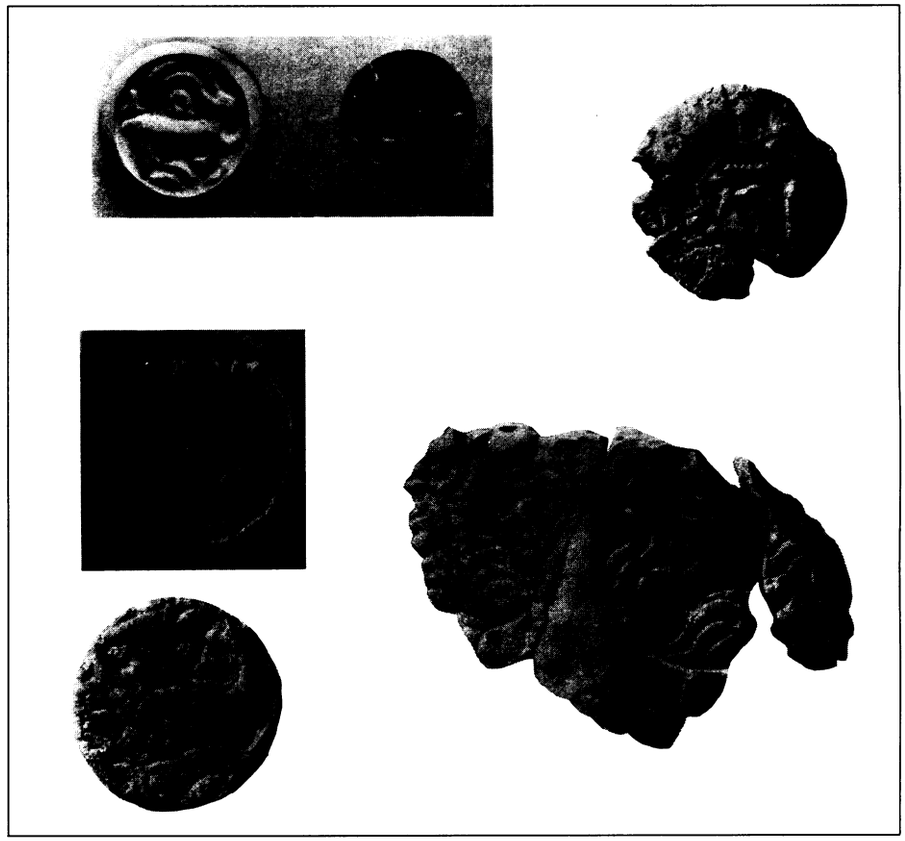
Algaze's book falls squarely within the growing archeological literature that views the Wallersteinian concept of world system as applicable to the ancient world, in this case the late prehistoric development of Mesopotamian civilization. However, Algaze does not attempt to provide a detailed treatment or justification of the use of world systems theory in the study of ancient civilizations. He is content to state his conviction that the concept is useful, even necessary, and move on from there.

The particular focus of the book is the so-called Late Uruk expansion, a subject that has long intrigued scholars of Mesopotamia. Archeologists have traced late-fourth-millennium-B.C. Uruk artifacts, architectural styles, and bureaucratic accounting practices—presumably originating in the southern Mesopotamian alluvial lowlands, now part of Iraq—over a vast geographical area, from the Iranian plateau and the Zagros valleys to southeastern Anatolia and Egypt. After no more than a couple of centuries at most this widespread distribution of material culture appears to have been replaced by a marked regionalization.

Algaze proposes that the "Late Uruk expansion" is best explained as an example of "informal empire." He argues that while some empires arise strictly as political entities whose main goal is to acquire territory over which they exert direct control, there are other kinds of imperial formations that are based on economic relationships. Algaze stresses in particular the importance of control over long-distance trade as an avenue by which empires might arise. This is an appealing topic to most scholars studying Mesopotamia, a "resource-starved" (p. 18) alluvial region lacking in such seemingly essential resources as stone, metal, and high-quality timber.

In brief, Algaze's argument runs as follows. A world systems approach instructs us to look at systems from a "global" perspective. Such a perspective is necessary if we are to have an adequate understanding of the interregional expansion of the Late Uruk period. Trade of resources available in the highland regions that surrounded alluvial Mesopotamia must have been necessary to sustain the growth of socially and politically complex Uruk societies in the lowlands. Therefore, Uruk society sought to control the all-important trade routes in order to ensure that needed resources were funneled their way on the best possible terms.

To support his argument, Algaze reviews the evidence for settlements outside the alluvial lowlands in which Uruk-style artifacts or architecture have been found. He distinguishes between several different types



"Stamp seals and stamp seal impressions from Uruk levels at Warka of possible northern or highland origin." [From *The Uruk World System*]