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ANCIENT MESOPOTAMIAN ACCOUNTING AND HUMAN COGNITIVE EVOLUTION

Abstract: Recent archaeological evidence supports the claim that the first system of writing and the first use of abstract numerical representation evolved from the clay token accounting system of ancient Mesopotamia. Writing and other abstract symbol systems have subsequently transformed human cognitive capacities within only few millennia, a time period too short for any substantial changes in our biologically-evolved brains. This paper uses Merlin Donald's theory of human cognitive and cultural evolution [in *Origins of the Modern Mind*; 1991] to identify the role played by ancient accounting in these evolutionary processes. Specifically, it is argued that this early accounting system paved the way for writing by instigating revolutionary cognitive structures for processing visual/symbolic artifacts and establishing a primitive but very powerful form of external memory (external to the brain). The paper also explores the role that accounting systems continue to play in the provision of "cognitive scaffolding" with respect to our organizational and institutional environments, and provides a cursory overview of the pioneering developments of ancient Mesopotamian accounting in this regard.

INTRODUCTION

Thanks to the work of the archeologist Denise Schmandt-Besserat [1978; 1986a; 1986b; 1992], an ancient accounting system developed by the Sumerians of Mesopotamia some 10,000 years ago has been attracting a remarkable amount of attention. The reason for the attention is her claim (backed by extensive evidence) that both the first known writing system and the first

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known use of abstract numbers were direct outgrowths of that ancient token accounting system.[1] This role of ancient accounting has thus been highlighted in many of the recent works examining the history of human cultures and the evolution of the modern human mind, including the Pulitzer Prize winning *Guns, Germs and Steel* by Jared Diamond [1999].

Schmandt-Besserat's work has not gone unnoticed by accounting historians. Parker [1990] provided a brief but succinct overview of Schmandt-Besserat's findings, and Vollmers [2003] has discussed Mesopotamian accounting in the context of ancient accounting historiography. But Mattessich is the accounting scholar who has written most extensively in this area. Mattessich [1987] for instance, has argued that Schmandt-Besserat's research sheds important light on "the problem of representation". Specifically, he argues that it provides "evidence for the usefulness of the correspondence theory of representation" [p. 83] that was at the center of Wittgenstein's early work, *Tractatus Logico-Philosophicus* [1922]. Mattessich also argues that "those ancient people of the Middle East had record keeping systems, the basic logical structure of which was virtually identical with that of modern double entry" [1987, p. 80]. Related arguments about ancient Mesopotamian accounting being a precursor to contemporary accounting methods and practices is further elaborated in a series of other works by Mattessich [1989; 1994; 1998; 2000]. A radically different perspective on the implications of ancient token accounting is explored by Ezzamel and Hoskin [2002]. Whereas Mattessich tends to view accounting as a tool for representing pre-existing values and improving the efficiency of economic activities, Ezzamel and Hoskin use the post-structural perspectives of Foucault and Derrida to demonstrate how the early token accounting system promoted new forms of valuing, new economic practices, and new power and knowledge relationships.

The present paper examines the significance of the ancient token accounting system from yet another perspective, the per-

[1] This claim has recently been challenged by Günter Dreyer, a German archaeologist, who purports to have found evidence of a slightly earlier form of writing in Egypt. In a review of this development, Mattessich [2002] points out that Dreyer's claim has yet to be "thoroughly evaluated and assessed by Egyptologists, Assyriologists and archaeologists in general" [p. 202], and that preliminary evaluation "casts doubt on Dreyer's claim" [p. 203]. Schmandt-Besserat's claim, on the other hand, has been documented in great detail [Mattessich, 2002, p. 203].

spective of human cognitive evolution. Specifically, it uses Merlin Donald's [1991] book, *Origins of the Modern Mind: Three Stages in the Evolution of Culture and Cognition*, to identify the crucial role played by the token accounting system in altering cognitive structures and transforming human cognitive capabilities. In a nutshell, this accounting system consisted of cognitive devices that existed outside the human brain; devices that served as external memory storage and computational aides. Ancient token accounting facilitated the development of what the cognitive philosopher Andy Clark [1997] has characterized as "cognitive scaffolding", allowing us to do far more than the naked brain could ever do. Indeed, it is the author's contention that accounting history could usefully be studied as a history of developments that facilitated scaffolded cognition, and from this perspective the accounting system of ancient Mesopotamia is the appropriate place to begin. The present paper is intended as a step in that direction.

The methodological affiliation of this project is with "embodied realism" as articulated by Lakoff and Johnson in their 1999 book *Philosophy in the Flesh: The Embodied Mind and Its Challenge to Western Thought*. Consistent with Donald's [1991] view of human cognitive evolution, Lakoff and Johnson argue that human thought and language are rooted in a prelinguistic conceptual structure; a neural-based conceptual structure that has evolved during millennia of interaction between brain, body and world. The resultant "embodiment of meaning", according to Lakoff and Johnson, "locates meaning in the body and in the unconscious conceptual system" [p. 462]. Embodied realism thus claims that important basic level conceptual structures are shared by human beings by virtue of having the same perceptual systems, the same sensori-motor systems, the same biological needs, and by the fact that they share the same physical world. Yet as Donald [1991] makes clear, and as Lakoff and Johnson acknowledge, the same basic level structures can support the addition of differing culturally-specific conceptual structures as human cultural evolution takes divergent paths through geographical space and historical time. This view of biologically-based conceptual structures, together with culturally-evolved additions and modifications, provides the context for the present project – namely, to identify the role played by ancient accounting practices in these evolutionary processes.

The first section below provides a broad overview of human cognitive/cultural evolution, drawing primarily on Donald's

[1991] book. The next section provides a brief review of Mesopotamian accounting and the origin of writing. This is followed by a closer look at Donald's scheme of cognitive evolution, which is used to locate precisely the nature of the contribution made by these early accounting systems in terms of new cognitive pathways involving visual/symbolic processing and external memory devices. Finally, the last major section provides a cursory exploration of accounting techniques as devices for cognitive scaffolding and argues that the ancient Mesopotamians were pioneers in such development.

COGNITIVE/CULTURAL EVOLUTION – AN OVERVIEW

Chimpanzees, our closest biological relatives, have demonstrated an ability to integrate patterns of action associated with relationships and events, as evidenced by their manufacture and use of rudimentary tools, and their (limited) forms of social cooperation [Donald, 1991, pp. 155-156]. Their apparent ability to recall situations, events, and action patterns has been characterized as "episodic memory" by Donald, and their "culture", which is based upon episodic memory, is referred to as "episodic culture". But even though they are at the pinnacle of ape cultures and cognitive capabilities, their representational capabilities are limited to episodes or series of episodes involving concrete situations and events. They apparently are not capable of re-presenting situations or of developing shared understandings based on representational knowledge of events, situations and circumstances.

On the evolutionary tree, early hominid species split off from the apes some five or six million years ago, but there is little in the archeological evidence to indicate that the early hominids transcended the episodic-type cognitive capabilities of apes. This is not the case, however, with respect to homo erectus, the hominids that emerged some 1.5 million years ago. Unlike earlier hominids, the archaeological evidence indicates that homo erectus had significantly larger brains, developed very distinctive tools, constructed shelters, used fire, engaged in mass migrations, and used base camps for seasonal hunting activities. These types of activities involve pedagogical practices, social communication and social coordination that are unlikely with episodic cognitive capabilities.

Homo erectus had apparently developed new cognitive capabilities which were intermediate between episodic cognition and the cognitive capabilities associated with language. Con-

trary to the view that consciousness requires language,[2] Donald [1991] theorizes that they had developed the ability to engage in conscious mimetic communication. "Mimetic skill or mimesis rests on the ability to produce conscious, self-initiated, representational acts that are intentional but not linguistic" [Donald, 1991, p. 168]. Whereas apes demonstrate limited forms of self-awareness, the mimetic mind must be able to integrate self-awareness with "voluntary action schemas" and to combine models of the self in action with the contents of episodic memory to produce mimetic re-presentations of recalled events and situations [Donald, 1991, p. 192]. With mimesis individuals could communicate information about feelings, about animals, food sources, dangerous places, etc. They could communicate information about how to hunt, how to maintain a fire, how to build shelter, and how to make tools. And not insignificantly, they could engage in reciprocal game-playing. The significance of mimetic games is the way such games promote ideas about social roles, consequences of social actions, the development of shared attitudes, and social conformity. Mimetic game-playing is also closely related to mimetically based ritual, the outcome of which may be shared understandings of the world and shared understandings about the society itself. In sum, "mimetic culture" was radically more sophisticated and complex than the episodic cultures of apes and early hominids. Contrary to some widely held views of language and human culture,[3] mimetic culture was, according to Donald [1991], "the first truly human culture" [p. 193].

Indeed, Donald [2001] argues that the next great revolution in cognitive capabilities (the one associated with homo sapiens sapiens and the evolution of language 50,000 or more years ago) was in many respects an extension of cultural directions already put in motion by mimetic culture. With language it was possible to construct more finely tuned descriptions of places, things, events, and techniques than was possible with mimesis alone. In and of itself, this meant that humans could expand their shared informational data base, they could improve the effectiveness of

[2] As Donald [2001, p. 35] points out, Jaynes' [1976] theory links consciousness to language. More recently, Dennett [1991] has made a sophisticated argument for a language-based theory of consciousness. For contrary theories – i.e., that consciousness does not require language, and that certain non-human species exhibit consciousness, see Churchland [1995] and Damasio [1999].

[3] Ong [1982, p. 2] for example, asserts that "Human society first formed itself with the aid of oral speech".

pedagogy with respect to tool-making and other skills, and they could enhance their social coordination and planning with respect to migration, hunting and defense. But even more importantly, they could construct abstract narratives that, in essence, generalized across the concrete information about specific episodes; they could construct shared stories about their immediate world and about the nature of the universe. The ultimate products of such shared stories were the grand unifying thematic worldviews that have subsequently been characterized as mythological. As Donald [1991] notes, in hunter-gatherer societies "[m]yth permeates and regulates daily life, channels perceptions, determines the significance of every object and event in life" [p. 215]. He accordingly characterizes such cultures as "mythic cultures".

If we limit our consideration to biological evolution, the evolution of language can be seen as the last major revolution in human cognitive capabilities. But Donald [1991; 2001] argues that there was another revolution, a non-biological revolution, in human cognitive capabilities. This, of course, was the revolution that added external symbol systems, external memory and external computational devices to the human cognitive tool kit. The first significant steps toward this revolution were arguably the use of two and three-dimensional pictorial representations, beginning 30,000 to 40,000 years ago during Paleolithic times. The most famous Paleolithic art works are the cave paintings near Lascaux, France. These paintings were apparently interrelated to convey "narrative-type" representations relating to hunting and fertility, which according to Donald [1991] were "the two great mythic themas of hunter-gatherer societies" [p. 282]. As narrative-type representations, these paintings constitute a form of external memory, an external storage system for representations of important shared ideas and events. But such pictorial representations did not tend to undermine the orally-based mythic culture; they were essentially used "to explore and develop the mythic ideas that were already the governing cognitive constructs of human society" [Donald, 1991, p. 282].

In Donald's view, the first truly significant development that would eventually begin to undermine mythic culture was the development of writing some 5,000 years ago in Mesopotamia. But before continuing with Donald's story of that transition, the reader should be alerted to the one shared characteristic of all contemporary theories of writing – they are all, to some extent, controversial. Unfortunately, an in-depth review of this contested territory is beyond the scope of the present paper. But it

may be helpful to briefly locate Donald's view of writing with respect to two prominent aspects of the controversies. In the first place, there is disagreement about whether writing is essentially a mechanism for transferring speech to a more permanent visible medium. Those who hold that this is indeed the case, are dubbed *scriptists* by the noted writing theorist Roy Harris [2000, pp. 234-5]. In his 1986 book, *The Origin of Writing*, Harris indicts the scriptists for promoting what he terms "the tyranny of the alphabet"; i.e., the notion that alphabetic writing provides "the central paradigm of a writing system" [p. 37] and uses alphabetic writing as the basis for invidious comparisons with other writing systems and indeed "as a model of what the spoken reality ought to be" [p. 46]. Harris sees this as reflecting "the ethnocentric bias of a European approach to non-European languages" [p. 37]. In any case, until recently the scriptist account was the mainstream academic view. Beginning in the 1960s, however, an *anti-scriptist* school began to take shape. McLuhan is the most famous of the anti-scriptists, but Harris includes Havelock and Ong as other prominent members of this school. "Their major thesis is that writing, far from being merely speech made visible in the guise of inscriptions, constitutes a radically different cognitive enterprise. In their account, writing is not just a convenient way of recording speech, but involves a restructuring of thought" [Harris, 2000, p. 235]. As will become clear below, Donald's views can be located solidly in the anti-scriptist camp.[4]

Another dimension of the contested territory surrounding theories of writing has to do with the cultural implications of writing and is typically addressed under the heading of 'literacy and orality'. Rosalind Thomas [1992], one of the foremost voices in this controversy, identifies the two main trends in studies of literacy and orality as follows: "Put crudely, the first seeks broad psychological and cultural implications (or effects) of literacy.

[4] Harris also rejects the scriptist view, but he suggests that the nature of writing has not yet been fully understood. He argues for a rethinking of writing from the standpoint of what he calls *integrational semiology*. From an integrationist perspective, signs are used to integrate activities, either one's own individual activities or social activities. The semiological value of signs thus "depends on the circumstances and activities in which, in any particular instance, they fulfill an integrational function" [Harris, 2000, p. 69]. From this perspective, "there is no simple, universal relationship between the written sign and the spoken sign of the kind that Saussurean semiology postulates" [p. 81], and semiological meaning "emerges from the integration of activities" [p. 92].

The second pursues detailed, culturally specific studies of the manifestations of literacy in a given society, often eschewing entirely any of the wider claims made for the effects of literacy" [p. 15]. Thomas' own work is a notable example of the latter trend, and she is highly skeptical of attempts to draw broad cross-cultural implications regarding the influence of writing on cultural and cognitive evolution.

Donald's work, on the other hand, is characteristic of the trend that looks for broad psychological and cultural implications of literacy. As noted above, he claims that writing played a crucial role in the transition from a predominantly mythic to a predominantly theoretic culture. But in contrast with many of the views that Thomas targets for criticism, Donald's theory makes no claim that literacy, in and of itself, produces a quick, uniform and complete cultural transformation. For Donald, the cultural transformation must be seen in longer, evolutionary terms in which both narrative-type pictorial art and writing emerged as new visuographic forms of representation. But whereas pictorial representations were primarily indexical and/or iconic representations, writing evolved a means of using abstract symbols that could be arranged and rearranged in an infinite number of ways to capture the world of linguistic representations in a media external to the individual human mind. But more importantly, it eventually opened up the possibility that humans would begin to reflect upon their own construction of representations; their own collective views of their social world, the physical world and the veracity of their own, previously taken-for-granted, knowledge.

With Greek culture in the 1st millennium B.C., these possibilities came to fruition as "[i]deas on every subject, from law and morality to the structure of the universe, were written down . . . " [Donald, 1991, p. 342]. As written commentaries were shared and discussed, processes of critique and evaluation were developed, including the famous Socratic dialectic which was immortalized in written form by Plato. "The result was that, for the first time in history, complex ideas were placed in the public arena, in an external medium, where they could undergo refinement over the longer term, that is well beyond the lifespan of single individuals" [Donald, 1991, p. 344]. The Greeks thus cultivated new habits of critical, analytical thought that were largely alien to mythic thought. They developed the logic of formal argument, systematic taxonomies, and formal methods of measurement and verification. They developed elaborate theoretical systems of thought in areas such as philosophy,

mathematics, biology and ethics; systems of thought which bore little resemblance to mythological thought. As Donald [1991] notes, "Ancient Greece, from around 700 B.C., was undoubtedly the birthplace of theoretic civilization" [p. 340].

The theoretic accomplishments of the Greeks would not have been possible without the development of new cognitive skills. The habits of analytical thought and the metalinguistic skills associated with presentation and evaluation of ideas were formally taught to generation after generation of Greek students. These skills were honed in the formal study of rhetoric, which "emphasized the large-scale, on-line structuring of linguistic thought products" [Donald, 1991, p. 348]. The rigor of Greek rhetoric as a field of study is manifested in Aristotle's three-volume work on the subject. The formal teaching of these habits of thought were subsequently carried forward in one form or another by the Romans and then by Medieval universities, eventually playing a major role in laying the foundation for the development of modern science.

In sum, the development of writing opened up vast possibilities for the external storage of human knowledge, including knowledge of language and analytic thought processes. Furthermore, although writing was initially used in the service of solidifying and disseminating mythological perspectives, the impetus toward critical, analytical thought was essentially a demythologizing move. And although mythology continued to play a major role in subsequent cultures, including our own, the products of theoretical thought processes have taken over an increasingly influential role in major institutions related to education, business, science and politics. In this sense, the development of writing can be seen as the major development that initiated the chain of events by which the forces of theoretic culture have eclipsed those associated with mythic culture.

MESOPOTAMIAN ACCOUNTING AND THE ORIGIN OF WRITING

Accounting played a crucial role in the transition from mythic culture to theoretic culture. Specifically, ancient accounting provided the bridge between mythic culture and the origin of writing. In fact, the first known writing system emerged some 5,000 years ago in Mesopotamia in the form of written accounting records. This development has been explored in considerable detail by Schmandt-Besserat [1992] and by Nissen et. al. [1993], and their findings have been introduced into

the accounting literature by Mattessich [1987; 1989; 1994; 1998; 2000] and Ezzamel and Hoskin [2002]. Thus, only a brief review of these and related developments is provided before turning (in the next section) to an analysis of their relevance to human cognitive evolution.

Until recently, the reigning hypothesis about the development of cuneiform writing in Mesopotamia was that a relatively concrete pictographic writing had evolved first and gradually been modified into the more abstract cuneiform writing as evidenced by the many clay tablets that have been discovered by archeological researchers. This hypothesis has essentially been overturned by the archeological research of Schmandt-Besserat, which was first published in the late 1970s. Schmandt-Besserat [1978; 1986a; 1986b; 1992] has provided persuasive evidence that the Mesopotamian cuneiform writing system developed not from a previously existing pictographic writing system but from an ancient clay token accounting system which originated at least 10,000 years ago. In this accounting system, baked clay tokens were used to represent various agricultural goods (such as sheep, wheat and oil), and later manufactured goods (such as pottery and rugs). Certain shapes and sizes of tokens, and tokens with certain markings, were used to represent and to count specific types of items: "Sheep were counted with disks, small and large measures of grain with cones and spheres, and ovoids served to compute jars of oil" [Schmandt-Besserat, 1986a, p. 266].

This system was modified in the 4th millennium B.C. when the Mesopotamian accountants began enclosing tokens in clay envelopes (bullae) and impressing the tokens on the outside to indicate the contents. In fact, it was a clay envelope found in the late 1920s that provided "the key to understanding what the tokens were" [Schmandt-Berrerat, 1992, p. 8]. The cuneiform inscriptions on the outside of the envelope have been interpreted as follows by Schmandt-Besserat [1992, p. 8]:

> Counters representing small cattle:
>
> 21 ewes that lamb
> 6 female lambs
> 8 full grown male sheep
> 4 male lambs
> 6 she-goats that kid
> 1 he-goat
> 3 female kids
>
> The seal of Ziqarru, the shepherd.

When the envelope was opened, it contained 49 clay tokens, corresponding to the number of animals indicated in the above list. Since this example provides a clear indication that the tokens were "used for bookkeeping", Schmandt-Besserat characterizes it as "the Rosetta stone of the token system" [1992, p. 9].

By the middle of the 4th millennium B.C., however, some of the ancient accountants began impressing the image of the tokens directly into solid clay tablets, a step that would lead to the obsolescence of clay envelopes and the tokens. As Schmandt-Besserat puts it, "Whereas the markings on envelopes repeated only the message encoded in the tokens held inside, the signs impressed on tablets were the message" [1992, p. 129]. The next significant development began around 3,100 B.C. when a pointed stylus was used to incise pictures of tokens in clay tablets instead of impressing the tokens themselves. This in fact, was the beginning of pictographic writing in ancient Mesopotamia and, as pointed out by Nissen et. al. [1993], the cuneiform characteristic of this early writing began to emerge when a pointed stylus was replaced by a writing instrument with a triangular tip: "By pressing the tip of the stylus into the smooth clay surface and drawing it down, a short, straight wedge-shaped impression . . . was made" [p. 118]. The Latin word *cuneus* means wedge [Nissen et. al., 1993, p. 118]; thus, the name cuneiform for the writing that developed in ancient Mesopotamia.

Developments in the token accounting system are directly associated not only with the world's first writing, but also with the development of numerals and "abstract counting". In fact, it was the development of abstract counting, according to Schmandt-Berrerat's theory, that paved the way for the development of the Mesopotamian cuneiform writing system. The early token system involved a very *concrete* form of counting in which the concept of number was not distinct from the concept of the type of item counted. "Ovoids were used to count jars of oil and spheres to count measures of grain; vice-versa, jars of oil could only be counted with ovoids and measures of grain with spheres" [Schmandt-Besserat, 1992, p. 190]. A quantity such as three sheep would, accordingly, be represented by three sheep tokens: "Such a group of three tokens indicated, literally 'sheep, sheep, sheep' instead of the modern western usage, '3 sheep' (or 'three sheep')" [Schmandt-Besserat, 1986a, p. 266]. Schmandt-Besserat [1992], however, has marshaled an impressive amount of archeological evidence to support her claim that gradual modifications of this accounting system led to an increasingly

abstract form of counting. Indeed, as she points out, the practice of impressing the image of tokens in clay tablets and clay envelopes was a move toward greater abstraction. "Compared to three-dimensional clay counters, the two-dimensional markings represented commodities in greater abstraction since they could no longer be grasped in the hand and manipulated" [1992, p. 191]. Then about 3,100 B.C., ancient Mesopotamian accountants "invented the first numerals" [p. 192] when they began incising a pictograph *of a token* for a type of good together with impressed signs denoting numbers. "For example, a tablet from Uruk features two accounts of '5 sheep' shown by the pictograph for 'sheep' (a circle with a cross) and '5' appearing as five impressed wedges . . . " [p. 192]. This example indicates a clear separation of the numerical concept separate from the concept of the item counted; a crucial step for the development of abstract counting.[5]

According to Schmandt-Besserat, the development of abstract counting was, in turn, the crucial move in the development of writing. It had a freeing effect on the system of pictographs in the sense that they could be modified more easily, and expanded, to represent concepts that were not immediately associated with counting. Thus, the system of pictographs "could expand to communicate any subjects of human endeavor" [Schmandt-Berrerat, 1992, p. 194]. This capability was further enhanced as signs began to be linked with phonetics early in the 3rd millennium B.C. Thus, Nissen et. al. [1993] note that, "[f]rom the early third millennium B.C., script had factually the potential to faithfully represent spoken language" [p. 117]. And due to the flexibility of the cuneiform script system [Nissen, et. al., 1993, p. 123], it was adaptable by languages other than Sumerian, thus facilitating the spread of writing "to Egypt, Elam, and the Indus Valley" [Schmandt-Besserat, 1992, p. 1].

As noted by Hallo [1992], Schmandt-Besserat's views have been refined to deal with previous challenges, and at least some of the revisions presented in *Before Writing* will probably be challenged. *Before Writing* [1992], however, "furnishes to date

[5] The Mesopotamians went on to develop several different numeral systems that were used in differing contexts [Nissen, et. al., 1993, p. 27]. The most important of these was the sexagesimal place value system, widely associated with signs for the numbers 1, 10, 60, 600, and 3600. The sexagesimal system, invented sometime around 2000 B.C., "afforded Babylonian scribes the means to develop general methods of computation similar to those we use today" [Nissen, et. al., 1993, p. 143]. They could add, subtract, multiply, divide, use fractions, etc.

the most coherent working hypothesis to account for the prehistory of the historic invention known as writing" [Hallo, 1992, p. xi]. According to that account, the ancient clay token accounting system of Mesopotamia played a major role in the development of writing and the invention of numerals. But Schmandt-Besserat pushes the claim a bit further by noting that the token accounting system actually ushered in a revolution in human cognitive capabilities: "Tokens and clay tablets functioned as an extension of the human brain to collect, manipulate, store, and retrieve data" [Schmandt-Besserat, 1992, p. 197]. She doesn't elaborate on this claim, but it is a claim that is quite congruent with Donald's [1991] theory of human cognitive evolution. The goal here, accordingly, is to employ Donald's theory to focus attention on the role played by this early accounting system in the establishment of new cognitive pathways that, in turn, paved the way for the cognitive skills used in writing and reading.

ANCIENT ACCOUNTING AND NEW COGNITIVE PATHWAYS

Donald's [1991] account of human cognitive-cultural evolution involves four stages – episodic, mimetic, linguistic (oral mythic culture), and external symbolic storage (theoretic culture). For each new stage, new neural-cognitive pathways were required to enable new types of representations and new types of cognitive processing. The first two transitions – from episodic to mimetic and from mimetic to linguistic – required the biological evolution of new innate neural systems. The third transition – from oral-linguistic to external symbolic storage – was not accompanied by any change in the innate biological brain. It was a transition that relied solely on the plasticity of neural networks. That is, the cognitive changes related to the third transition are changes that rely upon the ability of the brain to literally generate new neural circuitry as a result of our experiences in the world (both physical and socio-cultural). The neuro-cognitive research program that supports this perspective on plasticity is increasingly referred to as "neural constructivism" and two of its most influential proponents are Steven Quartz (Director of the Social Cognitive Neuroscience Laboratory at the California Institute of Technology) and Terrence Sejnowski (Director of the Computational Neurobiology Laboratory at the Salk Institute). A technical outline of their view was published as "The neural basis of cognitive development: A constructivist manifesto" [1997]. A more accessible version,

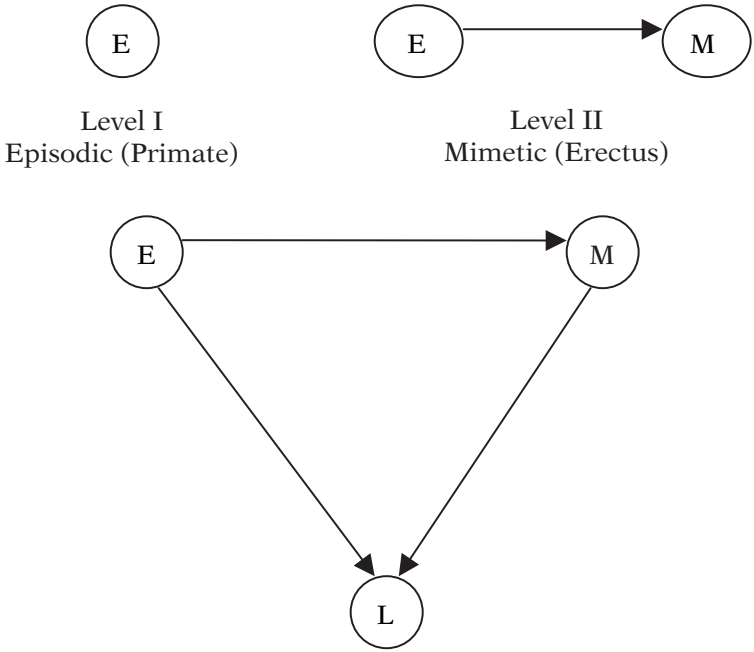
which is interwoven with an exploration of implications for understanding human socio-cultural evolution, is available in their book *Liars, Lovers, and Heroes: What the New Brain Science Reveals About How We Become Who We Are* [2002]. A full review of neural constructivism is beyond the scope of the present paper, but some of the ideas will be introduced below in support of Donald's account of cognitive/cultural evolution.

Donald's diagrammatic portrayal of the first two transitions is reproduced below as Figure 1. The cognitive processes associated with the event perceptions of episodic culture are indicated by an E enclosed in a circle. The cognitive processes associated with mimetic representations are indicated by an M enclosed in a circle. And those associated with linguistic representations are indicated by an L enclosed in a circle. Note the asymmetric relationship between the "episodic system" (E) and the 'mimetic system' (M). The event perceptions of E can be modeled mimetically, but the episodic system has no way to model the voluntary action schemas inherent in mimetic representations. Likewise, note that both the event perceptions of E and the mimetic representations of M can be represented linguistically, while neither E nor M is capable of representing language. The evolution of language required major additions to the cognitive structure of the mimetic mind. For the production of speech, it required neuro-cognitive systems capable of encoding human ideas and representations into abstract sound units, as well as the related muscular-skeletal structures capable of producing the rapid, finely modulated sounds that constitute human speech. For hearing and understanding, it required neuro-cognitive networks capable of distinguishing the sounds of human speech and decoding them.

The transition to literacy, on the other hand, required no changes in the innate biological brain. The new cognitive structures associated with the construction and interpretation of abstract visual symbols have been accomplished by experiential training and re-structuring the neural systems of the innate brain. This is evidenced by the fact that anthropologists have studied many pre-literate human cultures that have the full use of spoken language and display the full ability to *learn* the skills of literacy, and by evidence that the time frame for the evolution of writing has been too short for any significant change in the biologically-evolved brain. Also, the aforementioned neural constructivist research program provides scientific support for this view. Quartz and Sejnowski [1997, p. 538] note that "the currency of cognition is representations", and that cognitive

FIGURE 1

The First Two Transitions in Donald's Theory of Human Cognitive Evolution
(Adapted from Donald's [1991] Fig. 8.4.)



neuroscience is capable of characterizing "representational change in terms that correspond to structural changes in the [brain's] learning mechanism". Basically, they argue that solid neuro-scientific evidence exists to support the theory that representational neuronal structures grow in complexity as a result of interaction with one's environment (both physical and socio-cultural).[6] Such interactions promote an increasingly complex

[6] Quartz and Sejnowski note that the name *neural constructivism* "reflects the Piagetian view that there is an active interaction between the developing system and the environment in which it is embedded" [1997, pp. 538-539]. They further point out that, "Like Piaget's theory, ours also emphasizes the constructive nature of this interaction…" [1997, p. 539]. But neural constructivism does not depend upon Piaget's view that "a universal endogenous process guides the construction" [Damerow, 1988, p. 129].

representational structure that is capable of "constructive learning"; learning that, to use a computer metaphor, involves not only the software, but "causes major changes to the underlying hardware" [Quartz and Sejnowski, 1997, p. 537].[7] In sum, both the anthropological evidence and cutting-edge neuro-cognitive research support Donald's view that the new cognitive structures associated with the construction and interpretation of abstract visual symbols have been accomplished by experiential training and re-structuring of the neural systems of the innate brain.

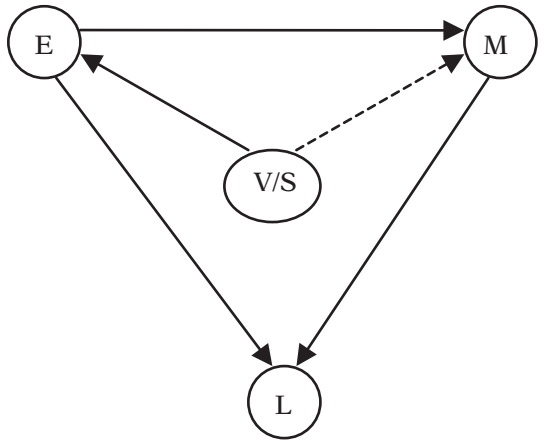
It is at this level, the transition to literacy, that the ancient accounting techniques of Mesopotamia made their crucial contribution in terms of a 'visuo-symbolic system'. But this contribution needs to be put in historical perspective. The early cave paintings, for instance, were apparently used to 'tell stories' about hunting and fertility; 'stories' that were certainly visual, and in a loose sense probably contained symbolic references. Thus, in Donald's [1991] theory of cognitive evolution, they suggest a development beyond the stage of mimetic cognition; a development that required new cognitive pathways for the construction and processing of abstract visual symbols. This is indicated in Figure 2 (below) by adding a V/S enclosed in a circle, with related linkages to the E and M systems. However, since the symbolic aspect was more indexical and/or iconic than it was abstract, Donald argues that the linkage between the V/S system and the M system was tentative and not solidly established. This is indicated in Figure 2 by showing a solid line linking V/S with E and a dashed link linking V/S with M.

Consider, however, the change in cognitive structure that was entailed by the early token accounting system. According to Schmandt-Besserat [1978, p. 57], the basic types of tokens were

[7] The evidence presented in their 1997 article is primarily in terms of growth in the number of synapses, and the spread of dendritic and axonal connections as a result of environmental interactions during development. But they make clear in their 2002 book that our constructive learning mechanism continues to change throughout life. If you learn to play the piano as an adult, the structure of your brain is altered [2002, p. 41]. When a blind person learns Braille, the visual cortex is "transformed into one for processing touch information for Braille" [2002, p. 40]. And when one becomes more and more adept at playing a new computer game, evidence suggests that special brain circuits are developed; circuits devoted to the game [2002, p. 245]. Furthermore, this perspective is quite consistent with Damerow's conclusions regarding ancient Mesopotamian accounting and the cultural evolution of arithmetical thinking; i.e., that it suggests "a substantial influence of culturally transmitted representations on the emergence of cognitive structures in ontogenetic development" [1988, p. 150].

FIGURE 2

New Cognitive Pathways Linking Visuo-graphic Cognitive Structures with Episodic and Mimetic Cognitive Structures (Adapted from Donalds's [1991] Figure 8.4.)



Level IVa

spheres, discs, cones and cylinders. Unlike the cave paintings, these were used as abstract symbolic representations of things of value. The basic tokens surely bore little, if any, indexical or iconic relationship to the things represented. In terms of Donald's diagrammatic depiction of cognitive structures, the use of these tokens entailed a solidifying of the linkage between V/S and M, and they entailed the tentative establishment of a linkage between the V/S structure and an emerging 'external memory field' (EXMF). Donald [1991] describes an external memory field as "essentially a cognitive workspace external to biological memory" [pp. 296-297]. He elaborates in a footnote: "The EXMF usually consists of a temporary array of visual symbols immediately available to the user. The symbols are durable and may be arranged and modified in various ways, to enable reflection and further visual processing" [1991, p. 297].

In accordance with this definition, the accounting tokens and their potential arrangements constituted a potential EXMF. And since Donald uses the term "external symbolic storage system" to refer to "all memory items stored in some relatively permanent external format" [1991, p. 306], the token accounting

system also constituted an ESS and any related EXMF would be a subset of the ESS (the portion that is in use at any given time).[8]

The ESS represented by the token accounting system expanded as additional sub-types of tokens were created, as the tokens were modified by incisions and punch marks, as the representations of the tokens themselves were imprinted into clay envelopes, and as the related cuneiform writing was developed. In terms of cognitive structure, the EXMF is linked (initially, in a relatively tentative manner) to the visuo-symbolic cognitive system which, in turn, is tentatively linked with the linguistic cognitive system, as indicated in Figure 3. With each evolutionary step of this ancient accounting system the cognitive linkages between the V/S system and the budding EXMF became more substantial. These new cognitive developments are shown diagrammatically in Figure 3.

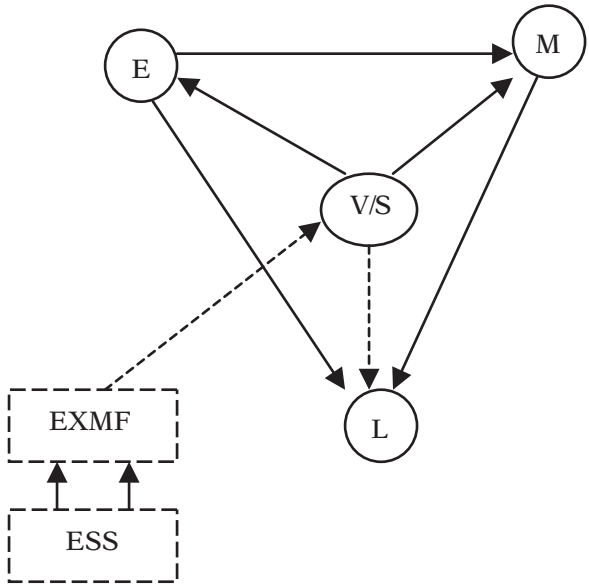
But even as the evolution of the accounting system approached a full-fledged system of cuneiform writing, as described earlier, Donald does not consider the ESS sufficiently developed to support the transition to 'theoretic culture'. The early forms of writing that evolved from the Mesopotamian accounting system were extremely difficult and time consuming to master. As a result they were learned by a small elite who were, in turn, charged with maintaining records of economic and legal transactions, and with preparing official accounts related to religious and political matters. It was only with the evolution of the Greek phonetic alphabet that writing and reading became accessible to a wider range of individuals and writing became a catalyst for critical reflective thought on *all* aspects of life, the world and human affairs. Beginning with the Greeks, written stories, reflections, speculations, and critiques formed an increasingly elaborate 'external symbolic storage system' (ESS) which was available to the EXMF.

Thus, while the writing systems of the ancient Mesopotamians, Egyptians, and others constituted external symbolic

[8] Donald's precise differentiation of the ESS and the EXMF is as follows: "The ESS is distinguished from the EXMF on the basis of its availability and permanence. The term ESS applies to all memory items stored in some relatively permanent external format, whether or not they are immediately available to the user. The EXMF is a temporary arrangement of some of the material in the ESS, for the use of one person. Thus, I may have a whole library of material available for a project, but I can remove only a few items and arrange them for my immediate needs; the former is part of the ESS, while the latter constitutes my EXMF for the moment" [1991, p. 306].

FIGURE 3

The Beginnings of an External Memory Field (EXMF) and Tentative Linkages Between the V/S System and the Oral Linguistic System (Adapted from Donald's [1991] Figure 8.4.)

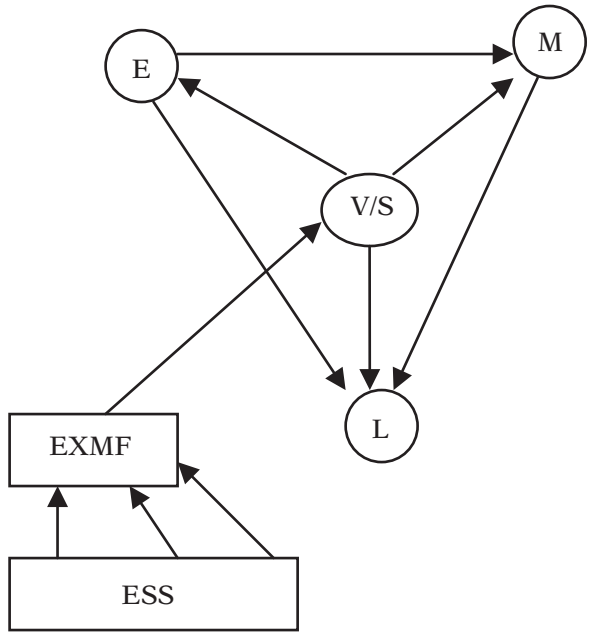


Level IVb

storage systems, their cultural impact was much more circumscribed than the ESS developed by the Greeks. Stimulated by the Greek phonetic alphabet, the growing body of books and other written artifacts began to have an increasingly potent influence on the conduct of human affairs, culminating eventually in a transition from a predominantly mythic culture to a predominantly theoretic culture. Thus, in Donald's diagrammatic scheme, the phonetic alphabet can be seen as the beginning of the most recent phase of human cognitive evolution, with a solidly established ESS and cognitive pathways linking the ESS, via the EXMF, to the V/S cognitive structures. And finally, the phonetic writing system created direct linkages between the V/S structures and the cognitive structures of language, L. These cognitive structures and their linkages are indicated diagrammatically as Level IVc in Figure 4.

FIGURE 4

The Expanded ESS System and Related Cognitive Structure Supporting the Development of 'Theoretic Culture' (Adapted from Donald's [1991] Figure 8.4.)



Level IVc

In summary, Donald's thesis about the stages of human cognitive evolution are presented in diagrammatic form in Figures 1 to 4. Note that the fourth stage of cognitive structure, the one involving an EXMF and an ESS is indicated as going through three evolutionary phases indicated as Levels IVa, IVb, and IVc (portrayed in Figures 2, 3, and 4, respectively). In this scheme of cognitive evolution, the ancient Mesopotamian accounting system played the most influential role in the developments leading to cognitive level IVb [Figure 3]. This ancient accounting system solidified the linkage between V/S and M; it established a tentative EXMF with tentative linkage to the V/S system; and the system of writing that emerged from the accounting system

eventually incorporated the use of syllabaries, providing a tentative linkage between the V/S structures and the linguistic structures, L.

This diagrammatic scheme thus offers an interesting way to pinpoint the role of accounting in human cognitive evolution, but in and of itself it conveys only a partial and altogether too modest a picture of the cognitive significance of Mesopotamian accounting. A more complete picture can be fleshed out from the perspective of Clark's [1997] notion of scaffolded cognition; a notion that is thoroughly compatible and closely related to Donald's ideas about external memory fields and external symbolic storage systems.

MESOPOTAMIAN ACCOUNTING AND SCAFFOLDED COGNITION

According to Clark [1997], "scaffolding . . . denotes a broad class of physical, cognitive, and social augmentations – augmentations that allow us to achieve some goal that would otherwise be beyond us" [pp. 194-195]. Thus, just as physical scaffolding allows house painters to reach and paint at heights that would otherwise be unreachable, our capabilities for working with abstract symbol systems allow us to perform tasks and solve problems that would be impossible for the "naked brain" (Clark's term). A succinct example of cognitive scaffolding discussed by Rumelhart, et. al. [1986, p. 45] and reiterated by Clark involves the multiplication of large multi-digit numbers. Whereas we can easily multiply 6 x 7 in our heads to get 42, few of us are able to multiply 6,348 x 9,235 in our heads. But with the aid of pencil and paper we can set up the problem in a way that facilitates breaking it down into a series of smaller problems (5 x 8; 5 x 4; etc.) that we can solve by pattern recognition, write down the result (i.e., store it in 'external memory' on paper), and move on to the next small pattern recognition problem.

But the significance of cognitive scaffolding goes far beyond the leveraging effect that it has with respect to the cognitive capabilities of individuals. Cognitive scaffolding is a crucial prerequisite for the complex organizational structures of contemporary human society. Our schools, businesses, transportation systems, and our governmental systems require elaborate systems that can be characterized as cognitive scaffolding. Consider, for instance, the importance of written signs and labels that we build into our environments to provide information, to warn, to recommend, etc. From labels such as 'Ground Floor' on an el-

evator panel to signs with street names, from 'Out of Order' to 'Road closed 2 miles ahead', signs and labels are used extensively to enable us to plan, to find places, things and people, and to navigate through buildings, airports and cities that we have never seen before. We work in organizations that have been designed to pursue constrained goals and objectives. We perform tasks that are more or less well defined and tightly constrained. We navigate daily through streets, offices and factories that are designed to ease the cognitive load on individual brains. In Clark's words, we function within "designer environments" in the sense that "[w]e manage our physical and spatial surroundings in ways that fundamentally alter the information-processing tasks our brains confront" [1997, p. 63]. The cognitive cues and crutches that we build into our environments allow us to function in a vast, elaborate network of social institutions, organizations, coordinated social practices and physical artifacts that organize information for us, channel our actions, and constrain the decision-making situations we face.

Accounting has obviously played a huge role in the production of 'designer environments'. Accounting organizes information in the form of documents, journals, ledgers, and reports. By means of formal information systems and procedures manuals, accounting organizes and controls the sequence of information processing. Accounting enlists technology in the form of calculators and computers to assist in the processing of information. It formulates budgets and standards that serve to channel action. It provides calculative techniques, such as discounted cash flow and capital budgeting, that serve to focus decision making. And it defines targets such as contribution margin, return on investment, earnings per share, and so forth, that serve to guide efforts and focus attention. In these ways accounting can be seen as playing a major role in the construction and maintenance of the 'designer environments' in which most of us spend our working lives. Indeed, much of management accounting could be portrayed as a history of designing and implementing cognitive scaffolding within organizations.

But this role is not a new one for accounting. In their book, *Archaic Bookkeeping*, Nissen et. al. [1993] present evidence that during the 3rd millennium B.C. the Mesopotamians were developing ever more sophisticated accounting techniques to keep track of grain production, storage and use, together with detailed records concerning the distribution of grain and grain-based products. As an extensive illustration, they devote an entire chapter to analysis of the accounts of an administrator

putatively named Kushim, who is mentioned in a total of 18 tablets: "Kushim was apparently entrusted with the administration of a storage facility containing the basic ingredients for the production of beer" [Nissen, et. al., 1993, p. 36]. One tablet shows Kushim's 'signature' and a sign indicating distribution, together with the sign for barley and a designated amount. Beneath this information is a second signature of an official who frequently acted "as a co-signatory in documents concerning barley allocations" [p. 39]. The other side of this tablet shows four separate amounts (adding up to the total on the previous side) and an official's signature below each amount. Another tablet discussed, shows "calculations pertaining to the exact ingredients required for nine different cereal products and eight different kinds of beer in a tabular compilation" [p. 43]. And yet another shows details of the distribution of different quantities and different kinds of beer, and Nissen, et. al. suggest that "[t]he difficult reverse of the tablet probably contains references connected to the labor time which various named brewers required for the production of the beer" [1993, p. 46].

Examples from later periods (the mid and later centuries of the 3rd millennium) indicate that the types of clay tablet record-keeping which were previously characterized as proto-cuneiform script, had developed into full-blown cuneiform writing together with the ability to record accounts in considerably more detail. These examples also demonstrate a sophisticated development of production standards, techniques for comparing actual with expected performance, the calculation of production 'deficits' and 'surpluses'. The deficits and surpluses were treated as balancing entries for the accounting period and were carried forward to the subsequent period. As noted by Nissen, et. al., "A precondition for the feasibility of such global balancing of all expected and real performances was the standardization and calculability of the expected performances . . . " [1993, p. 49]. They point out that "performance standards" and "value equivalences" can be reconstructed. "Depending on the economic sector, the means of comparison or the measure of standardized norms and duties could be silver, barley, fish, or 'laborer-days', that is, the product of the number of workers multiplied by the number of days they worked" [Nissen, et. al., 1993, p. 51]. As an example, they analyze a very elaborate tablet which contains the accounts of a foreman who apparently was in charge of female workers involved in grain milling processes. The tablet shows the deficit (in female laborer days) from the previous year, the expected production (again in female laborer days), the actual

flour produced and converted into female laborer days, and the resulting "increased deficit" [p. 54].

The milling of grain, the production of bread, beer and other food items were made possible, of course, by the agricultural activities of Mesopotamian farmers. And here too there is evidence that budgeting and production planning and other forms of management control had achieved a rather sophisticated form by the middle of the 3rd millennium. Clay tablets included reports and budgetary-type information concerning the amount of grain to be set aside for seeding. Other tablets manifested the use of surveying, sketched plans for fields, and calculations of area measurements. Indeed, the technique used for surveying irregularly shaped fields is a classic example of how the ancient Mesopotamians used their external 'symbolic storage system' as scaffolding to solve a difficult cognitive problem. According to Nissen, et. al. [1993, pp. 68-69], an irregularly shaped field was sub-divided into smaller triangular sections, which were then measured individually and the measurements were "entered into the plan" [p. 69]. The areas of the smaller sections were then calculated and entered into the plan and summed to obtain the approximate area of the larger irregularly shaped field.

Accounting for sheep, goats, cattle and other domesticated animals was even more detailed. Records were kept with details regarding sex and age of animals, production quotas for cheese, milk and dairy fat, and the amount of fodder needed for monthly feed requirements. "One unusual document" discussed at length by Nissen, et. al. [1993, pp. 97-102] shows the hypothetical ten year growth of a cattle herd, together with the annual expected production of dairy fat and cheese.

Examples such as these leave no doubt that the Mesopotamians were pioneers in the development and use of scaffolded cognition. Their accounting systems were used to sort and store information, to formulate production standards, and to produce detailed plans for the future. These accounting and related calculative techniques served to define targets, focus attention, and channel action; all of which was made possible by the extensive use of information which was recorded and stored in external memory devices, namely clay tablets. Their accounting systems enabled them to achieve a high level of comprehension and control over the economic aspects of their lives. As Crosby [1997] has noted with respect to double-entry bookkeeping and Renaissance European merchants, accounting enabled the Mesopotamians (at least the ruling classes) "to achieve comprehension

and, thereby, control of the moiling multitude of details of their economic lives" [p. 208].

It must be pointed out, however, that these claims regarding scaffolded cognition cannot be used to infer socio-political progressiveness. Indeed, as Nissen, et. al. point out, the civilizations of ancient Mesopotamia were made possible by centralized planning and strict control over state-controlled laborers: "One of the unanswered questions", they note, "is whether the individuals in the labor force should be called slaves or whether they should be regarded as having simply restricted freedom" [1993, p. 70]. In a previous chapter, however, they cite evidence that strongly suggests slavery: "So-called inspection texts regularly report on large numbers of escaped laborers. In view of the total control the laborers were subjected to, it is not difficult to imagine why they tried to flee" [1993, p. 54]. Nevertheless, the advances in scaffolded cognition pioneered by the Mesopotamians has had a huge impact, for better or worse, upon the subsequent evolution of human cultures, at least in the West.

CONCLUDING OBSERVATIONS AND COMMENTS

Within a few millennia, a very short period from an evolutionary perspective, human cultures have been totally transformed. They have been transformed from hunter-gatherer societies dominated by oral-mythic traditions, mimetic ritual and narrative thought to hierarchically-stratified, post industrial societies dominated by shared theoretic world-models, large scale theoretic artifacts and massive external symbolic networks [Donald, 2001, p. 260]. While it may seem bizarre to claim that something as mundane as accounting played any significant role in this transition, it is an increasingly well documented fact that the development of writing was the salient catalyst in this transition, and that the first system of writing evolved from a system of keeping accounting records in ancient Mesopotamia. In fact, this early accounting system paved the way for writing by instigating revolutionary cognitive structures for processing visual/symbolic artifacts and establishing a primitive but very powerful form of external (to the brain) memory.

Perhaps surprisingly, the evolution of writing did not involve any significant change in the innate biological brain. It did reflect a massive change in cognitive capabilities, but those enhanced capabilities are more aptly characterized as the product of cognitive scaffolding, that is, the use of external devices to leverage our cognitive abilities, to enhance memory, to focus

attention, to assist in processing information, and to aid decision-making and guide action. The leveraging power of writing is captured very succinctly by Diamond [1999] in his description of its role in the patterns of conquest:

> Writing marched together with weapons, microbes, and centralized political organization as an agent of conquest. The commands of the monarchs and merchants who organized colonizing fleets were conveyed in writing. The fleets set their courses by maps and written sailing directions prepared by previous expeditions. Written accounts of earlier expeditions motivated later ones, by describing the wealth and fertile lands awaiting the conquerors. The accounts taught subsequent explorers what conditions to expect, and helped them prepare themselves. The resulting empires were administered with the aid of writing. While all those types of information were also transmitted by other means in preliterate societies, writing made the transmission easier, more detailed, more accurate, and more persuasive [pp. 215-216].

But cognitive scaffolding has played a less dramatic, though perhaps more insidious, role in recent cultural evolution. And it is here that accounting can certainly be identified as one of the major players. Cognitive scaffolding has been employed in the service of fine-tuning and controlling much of the environment that we occupy on a daily basis – our schools, our workplaces, our governmental offices, and other major institutional settings. Accounting practices such as budgeting and performance standards in conjunction with the construction of abstract spaces of responsibility such as 'cost centers', 'investment centers' and 'profit centers' are prime examples of cognitive scaffolding deployed to focus attention and guide action. Such techniques and practices are usually thought of as relatively recent outcomes of the rise of management accounting. The fact is, however, that the ancient Mesopotamians pioneered the use of such techniques some 5,000 years ago. By the 3rd millennium B.C., they had developed a primitive form of cost accounting, elaborate techniques of budgeting and planning, and calculative techniques for devising labor standards.

In sum, the ancient Mesopotamian accounting practices played the key role in the development of writing and the use of these early accounting techniques were highly instrumental in pioneering some basic aspects of cognitive scaffolding that are so evident in the contemporary post-industrial world. Having

said this, however, it must be reiterated that these claims for ancient accounting are not to be taken as unadulterated claims of praiseworthiness. They are claims concerning the actual course of events, even though that course of events has, in many ways, been far from laudatory. As Diamond [1999] notes, "Early writing served the needs of political institutions (such as record keeping and royal propaganda), and the users were full-time bureaucrats nourished by stored food surpluses grown by food-producing peasants" [p. 236].

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