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PREHISTORIC ACCOUNTING AND THE PROBLEM OF REPRESENTATION: ON RECENT ARCHEOLOGICAL EVIDENCE OF THE MIDDLE-EAST FROM 8000 B.C. TO 3000 B.C.

Abstract: Recent archeological research offers revolutionary insight about the precursor of abstract counting and pictographic as well as ideographic writing. This precursor was a data processing system in which *simple* (and later complex) *clay tokens* of various shapes were aggregated in *hollow clay receptacles or envelopes* (and later *sealed string systems*) to represent symbolically assets and economic transactions. Scores of such tokens (the recent explanation of which is due to Prof. Schmandt-Besserat) were found by archeologists all over the Fertile Crescent in layers belonging to the time between 8000 B.C. to 3100 B.C. — after this date cuneiform clay tablets emerged.

The economic-philosophic implications of this discovery are important. First, it suggests that *accounting preceded abstract counting as well as writing*. Second, it suggests that *conceptual representation* emerged gradually. Third, it confirms the previous hypotheses that *counting* emerged in *several stages*. Fourth, it reveals the existence of an *abstract input-output principle* some 10,000 years ago and a kind of double entry over 5,000 years ago. Finally, it offers the earliest illustration of the (occasional) validity of the *correspondence theory*.

To assist readers I have inserted at the beginning of the fifth section some explanatory paragraphs on Wittgenstein's work.

Introduction

The quest for the *origin of symbolic representation* is not unrelated to Wittgenstein's perennial question: How is lan-

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guage possible? Indeed a disclosure of the historical roots of representation might lead to a novel and empirical answer to Wittgenstein's major query — at least as far as *written* language is concerned.

During the last decade Professor Schmandt-Besserat, an archeologist at the University of Texas in Austin [1978, 1980, 1981, 1981a, 1982, 1984, 1986, 1986a] has shed much light on the origin of writing and counting.¹ I shall concisely recapitulate the history and results of her research² and offer interpretations of it from a philosophic as well as economic point of view.

Symbolic Representation and the Evolution of Writing

The invention of writing has long been shrouded in awe and mystery. Over the centuries many unsuccessful attempts have been made to explain the origin of this event [Schmandt-Besserat 1986, pp. 31-32] until in the early 19th century archeological expeditions to Mesopotamia began to clarify this problem by hard and fast evidence. A pictographic limestone tablet unearthed at Kish, dating from about 3000 B.C.³ is usually regarded as the earliest piece of writing known. But such isolated pictographs are very rare. In contrast to them are the oldest collections of clay tablets found in great quantities in Uruk (the biblical Erech), dating from 3100 B.C. The writing they contain is predominantly *ideographic* (abstract) intermingled with only occasional pictographic signs (sketches of objects such as a plow, chariot, sledge, boar, etc.) — but at this stage the boundary between ideographic and pictographic signs is blurred, and interpretations vary. This ideographic nature of early cuneiform writing from the 4th millennium B.C. was already recognized by Falkenstein [1936, p. 25], the first person to investigate them.⁴ The meaning of this early or

¹For details about the individual contributions of A. Leo Oppenheim, Pierre Amiet, Denise Schmandt Besserat, and others to the clarification of the origin of writing and the record keeping use of clay envelopes and string aggregates, see: Schmandt-Besserat [1980, pp. 358-361] as well as Jasim and Oates [1986, p. 348]. For a somewhat different interpretation see Vallat [1986, pp. 334-337].

²The *recapitulation* is mainly based on Schmandt-Besserat [1986].

³Mallowan [1961, p. 67] as well as Hawkes [1963, p. 378] still state this date with 3500 B.C.

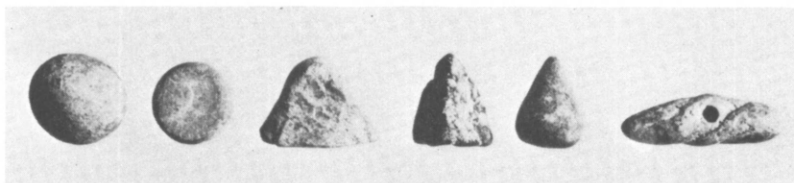
⁴Falkenstein [1964, p. 11] also emphasizes that the invention of cuneiform writing is the invention of the Sumerians, and that it was created exclusively for the recording of *economic transactions*.

archaic writing is still an enigma, partly because of its ideographic nature, partly because most ideographs could not be traced back to the later cuneiform writing of the first and second millennium B.C. — only the ideographs for sheep, oil, metal, labourer, measures of grain, animal and a few others were traceable.

The *abstract form* of these symbols as well as the *large repertory* of them (over a thousand different signs) combined with the scarcity of preceding pictographs posed a vexing question as to the evolution of writing. Surely it cannot have happened overnight, it must have gradually evolved. Yet where was the missing link, where was the prototype? It seems plausible that writing started with a relatively small number of pictographs, which gradually increased in number, slowly changing into ideographs. Out of lack of any evidence, it was hypothesized that the proto-writing must have been on perishable material and thus lost to posterity [Diringer 1968, p. 19].

However, Schmandt-Besserat advanced a much better substantiated and more plausible hypothesis. She noticed (from 1969 onwards) on occasion of visits to many archeological sites and museums an unexpectedly large number of odd and hitherto unexplained artifacts of various shapes to which she refers as “tokens” and among which she distinguished two major types: the earlier *plain tokens* (spheres, disks, cylinders, triangles, rectangles, cones, ovoids, and tetrahedrons) from ca. 8000 B.C. onwards, and the later *complex tokens* (variously incised or punctated and usually perforated, also of a greater variety of forms — *added shapes*: e.g. vessel forms, parabolas and bent coils). These small, ubiquitous objects (ca. 1 to 4 cm. across) were carefully hand-molded of clay and hardened by

Exhibit 1

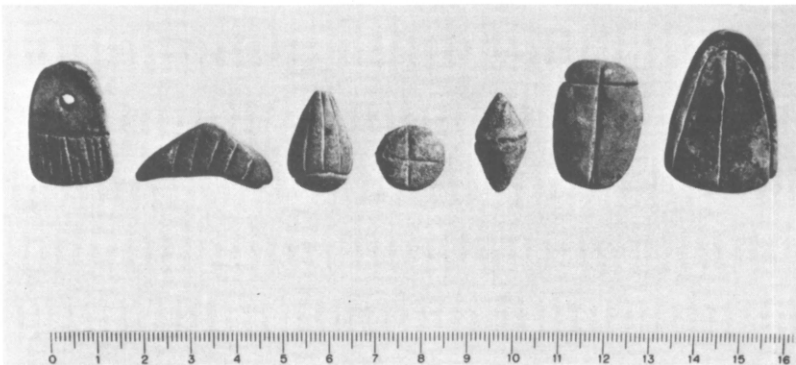


1. Plain clay tokens

burning at a relatively low temperature (of ca. 600° C). At some sites only small numbers of these tokens were preserved, but at other sites (e.g. at Jarmo, Iraq, dated 6500 B.C.) some 1500

specimens were unearthed. Whether in Israel, Syria, Iraq, Turkey or Iran those artifacts were present all over the Middle East in layers dating from ca. 8000 to 3000 B.C. and even later. This ubiquity and wide dispersion obviously pointed at their religious, cultural or economic importance; but what was this important function? All archeologists and experts working in this area encountered these tokens, but none had a satisfactory explanation for their former use; a few experts thought they were amulets or game figures. *But Schmandt-Besserat* [cf. 1986, p. 34-35] *noticed that the shape of many tokens matched with the form of archaic signs on tablets.* For example, a disk with a cross, can be found among the tokens as well as among the signs on clay tablets where it became a circle with cross enclosed. But this ideograph is traceable to later writings and *stands for "sheep"*; similarly, an ovoid with circular incision stands for a "jar of oil", a triangle with five incised lines means "metal (silver?)." The cone and the sphere stand for small and large measures of grain respectively; a cylinder may be interpreted as "one animal (sheep or goat?)" while a disk refers most likely to a "flock of animals probably half a score (i.e. ten)." But let us listen to Schmandt-Besserat herself:

Exhibit 2



2. Complex clay tokens

"About 200 spherical clay envelopes (including fragments) have been recovered in an area extending from Palestine to Iran, including Saudi Arabia. The seals impressed upon their surface indicate their formal character, and it seems clear that the tokens they contain stood for goods and stated liabilities. The envelopes would have remained of esoteric

interest but for the discovery of their relationship to the invention of writing. Indeed, their evolution illustrates no less than the transition between an archaic abacus and writing according to the following sequence: (1) the invention of envelopes to hold tokens of specific transactions; (2) the impression of markings on the surface of the envelopes to indicate the shape and number of tokens included inside; (3) the collapse of the envelopes into clay balls or tablets bearing impressed signs; and (4) the elaboration of the impressed signs into incised pictographs.

The study of the envelopes therefore provides new insights into the origins of writing. It makes clear the process of its emergence from an archaic recording system based on tokens and throws light upon the fortuitous nature of its invention. It demonstrates that the cradle of writing was not confined to Mesopotamia but extended to the west as far as the upper Euphrates valley in Syria and to Elam at the east. The date of the events can be pinpointed to the Uruk IV period of 3200-3100 BC" [Schmandt-Besserat, 1980, p. 385].

On the basis of this evidence few experts will doubt that the precursor of writing was the representation of commodities by means of clay symbols, not all of which were miniature models but *many were abstract shapes the meaning of which was determined by convention*. But what kind of messages did these symbols convey?

Data Processing and Accounting in Prehistoric Times

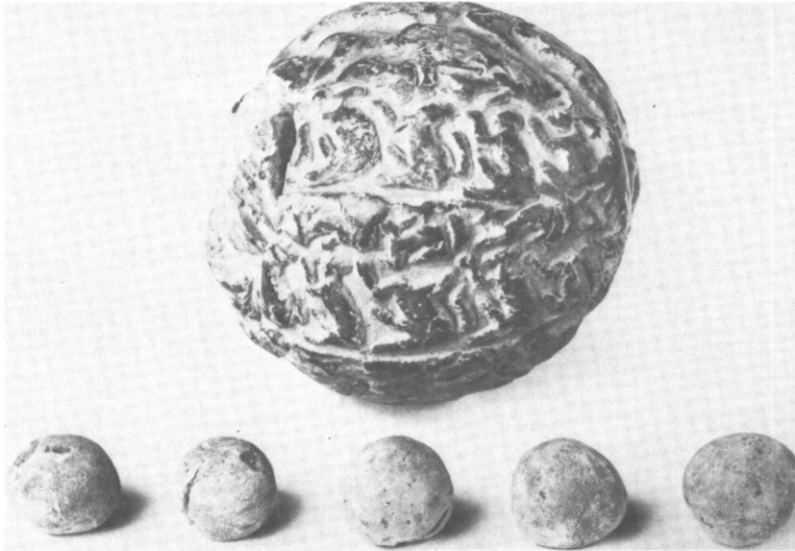
The *plain* clay tokens are dating from ca. 8000 B.C. onwards and were discovered among village finds (and later temple finds) unearthed in the Fertile Crescent of the Middle East.⁵ These tokens were sometimes *enclosed in a "clay envelope"* (hollow clay ball some 10 cm in diameter, the surface of which bore markings — which in turn are among the first

⁵The first plain tokens (around 8000 B.C.) were extracted from the remains of "round hut compounds" on many archeological sites of the Fertile Crescent — typical sites: Tell Mureybet and Tell Aswad in Syria, as well as Tepe Asiab and Ganj Dareh Tepe in Iran. By the seventh millennium B.C. simple tokens were also used in an area reaching from present Turkey to Israel.

The proportion of perforated tokens varies according to sites. At Uruk, only 46% are perforated but at other sites, such as Habuba Kabira in Syria, up to 80% of the tokens have a hole.

evidence of writing — indicating the content for quick recognition, and seem to represent one of the earliest systematic accounting systems. One or several specimen from Uruk, for example, yielded the following tokens which Schmandt-Besserat could match to the corresponding commodities as shown below (adapted from Schmandt-Besserat 1983, p. 120):

Exhibit 3



3. Clay envelope (showing seal on surface) with five clay spheres.

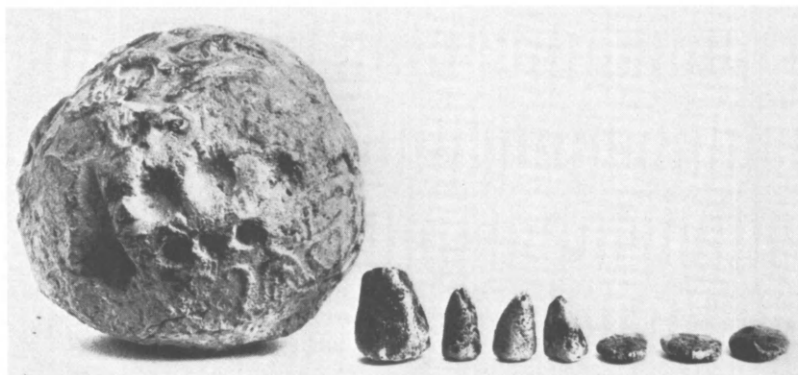
| | |
|------------------------------|-----------------------------------|
| 3 incised ovoids | = 3 jars of oil |
| 1 cylinder | = 1 animal (sheep or goat) |
| 9 tetrahedrons | = 9 units of services |
| 3 trussed ducks ⁶ | = 3 trussed ducks |
| 5 ovoids | = 5 ? |
| 4 parabolas | = 4 ? |
| 1 triangle | = 1 small measure of grain? |
| 26 spheres | = 26 bariga of grain ⁷ |

⁶“Trussed ducks” on the left hand side refers to small clay tokens resembling trussed ducks, while the same expression on the right hand side refers to the slaughtered animals, similar to those in the supermarket.

⁷A *bariga* is a (larger) unit of measure used in Sumer — perhaps equivalent to the English “bushel.”

It is not difficult to recognize that each of these eight lines represents a different *commodity account* identified by a specific shape of concrete tokens — just as businessmen give different names to different accounts, so the inhabitants of ancient Mesopotamia assigned *different shapes* (or tokens of different shapes) to different commodity accounts. Thus the singularity of “token accounting” lies in the multiplicity of shapes given to easily malleable clay tokens. Although these simple and concrete tokens were first associated with village life and agriculture, later on these “accounts” were kept (often together and even mixed with collections of the more sophisticated abstract tokens) by priests and temple administrators, so that the various shapes did not easily change their meaning — the shapes were conventionalized and seem to have kept their meaning for thousands of years. An *envelope* of tokens probably functioned as a *personal account about a steward or debtor* indicating the equity invested in such a person; but simultaneously it was an inventory list detailing this investment. Not always did one token stand for a single piece of commodity, sometimes it represented a specific measure of grain or a jar of oil, etc. Yet those units were only loosely standardized and should not be interpreted in any mathematical sense. But it is crucial to note that before 3,200 B.C. there is still no evidence that those concrete tokens represent numerals. At this stage, counting *in the abstract sense*, as we know it today, had not yet

Exhibit 4



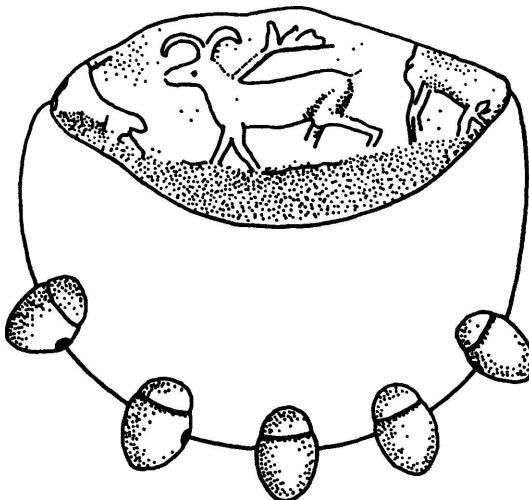
4. Clay envelope (showing traces of seal as well as impressions of hardened tokens) with tokens.

emerged.⁸ Thus it is correct to say that *accounting preceded abstract counting*.

Complex Tokens

Complex tokens are distinguished from plain tokens by a *greater variety of token shapes, by markings on those tokens (incisions, punctations or appliqué coils, and pellets added to the token surface), by a perforation of those tokens for the purpose of stringing them and sealing them together (instead of putting them into a clay envelope), and, above all, by their more abstract usage.*⁹ The term “abstract token” might be confusing

Exhibit 5



5. Sketched reconstruction of a string aggregate (showing clay seal on top and five perforated ovoid tokens on string) — designed by Ellen Simmons.

⁸The *crucial step* from token counting to a numerical system is best described by Bertrand Russell [1919/60, p. 3] who points out that “it must have taken ages to discover that a brace of pheasants and a couple of days were both instances of the number two.”

⁹Whereas the *plain or concrete tokens* had plain unmarked surfaces and came in a limited number of simple geometric shapes (flat and lenticular disks, cones, tetrahedrons, cylinders and occasionally commodity and animal shapes), the *later complex or abstract tokens (closely tied to Sumerian temple institutions)* bore marks on their surface and came in a much greater number of shapes (spheres, disks, cones, tetrahedrons, biconoids, ovoids, cylinders, bent coils, triangles, parabolas, rectangles, rhomboids, container, animal and other shapes). Each shape and marking had a well specified meaning. Typical objects of reference of a token were: a measure of grain, a jar of oil, a fleece of wool, or even a pot of beer. The *cone* and *sphere* were usually used for grain. They correspond to the Sumerian *ban* and *bariga* which find their analogy in the English peck and bushel.

because those complex tokens are still concrete clay objects, but *now they are used in a way that approaches numerals in the abstract sense*. Thus the term "abstract" does not refer to the token itself but to its use. But just as in the case of clay envelopes, those sealed string collections are equivalent to personal accounts about stewards and debtors, and simultaneously lists of inventories.

The Input-Output Principle: From Ancient Mesopotamia to the 20th Century

We have seen that by 3200 B.C. two kinds of accounting techniques were employed, often simultaneously. The first consisted in keeping plain tokens of different shapes in a marked and sealed clay envelope, the other in keeping an even greater variety of complex (incised), perforated tokens on a sealed string. There is sufficient evidence indicating that the plain tokens referred to such assets as grain and cattle while the complex tokens referred to services and manufactured goods. *This separation resembles the distinction between cash items (including receivables, payables, etc.) and non-cash items (inventories, equipment, land, etc.) in double entry accounting of the Italian Renaissance.* And since grain and cattle were the payment units or "cash items" of ancient Mesopotamia, the parallel is all the more striking.

Each kind of token shape, whether plain or complex, can be interpreted as a type of account, and the number of tokens (in a clay envelope or on a string) of a particular shape represents the quantity of pertinent items. Then all tokens together (of different shapes in a particular envelope or on a string) represent an *equity* loosely aggregated by an envelope or string (instead of the highly abstract aggregation attainable by monetary values). This may seem primitive, yet *it spared the Sumerian scribe the valuation problem*, which not only plagues modern accountants but also removed accounting representation one further step from objective reality, creating subjectivity and adding ambiguity. Thus the "aggregate" or superaccount represented by a clay envelope or a collection of tokens on a string, is not too much different from a balance sheet. It certainly had a *dual* significance: in its details, it represented the individual assets, in its totality it represented an equity.

But what was the entity behind this equity? Since these "aggregates" were most frequently (but not exclusively) found in former temple grounds (often a great number of such envelopes and string systems were stored in a single temple), the

entity usually was a temple or, less frequently, an individual person, family, or other small social group. There is archeological evidence that temples levied taxes possibly on the basis of farming out temple assets to individual persons (debtors or stewards). Thus the entity was (at least by 3200 B.C.) in most cases a *temple institution*, and the “debtor” probably was a particular person. But to determine the entire equity of such a temple government one would have had to further aggregate all the envelopes and string aggregates within a temple precinct — but there may not have been any need for doing this since the main purpose of those accounting systems was the monitoring of the obligations and levies from individual stewards and tax payers. Such a system also lends itself to recording the actual payments in kind by the debtor — archeologists have, indeed, repeatedly emphasized the debt-nature of such a token aggregate and of many clay tablets of a later age. It is possible even that the tokens or token aggregates were handed over as receipts to the debtor or donor by the temple administrator once the former’s debt was “paid” or a donation was made. But whatever the individual practices and techniques may have been, there can be little doubt that those ancient people moved clay tokens from one place to another in strict correspondence with the transfer of commodities and debt relations.

A Duality Principle

This means, first of all, 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.*¹⁰ *One might reply that the transfer of ordinary goods, from one person to another, already possessed this logical structure which we call the input-output or duality principle. This is perfectly correct, but the ingenious stroke was to transfer this idea or principle from actual commodities by a one-to-one correspondence to a conceptual system of representation. Once this crucial*

¹⁰For some thirty years I have tried to make clear to accountants that the crucial event in accounting is not double entry — which, after all, is a mere technique — but *the logic structure* behind it [Mattessich 1957/82, 1964, 1987]. A set-theoretical analysis of this “flow” or “input-output” structure in terms of ownership and debt relations is found in Appendix A of Mattessich [1964, pp. 448-465]. I have also demonstrated that this structure can manifest itself in matrices, net works, vectors, algebraic equations, etc. Now we have evidence that this logic structure was already present in record keeping systems some 10,000 years ago.

fact of the *input-output* or *duality* principle has been established, the question whether the ancient Sumerians or any other tribe used (more than five thousand years ago) a *double entry system*, is of secondary importance.

However, a good case can be made that even *double entry* (in the literal sense of the word) emerged as early as 3200 B.C. From this time stem the earliest clay envelopes (bullae) that bear on their surface the impressions of the tokens contained inside. Putting those tokens into an envelope undoubtedly meant the recording of quantities of various assets, or what we today would call "making debit entries." But apart from this were two further needs: (1) to reveal from outside the hidden content of the envelope, and (2) to reveal at a glance the entire equity represented by the envelope — as far as such an aggregation is possible without a common denominator. By sheer coincidence both of these functions could be fulfilled by a single act, namely by impressing the hardened tokens into the surface of the softer clay envelope. If this interpretation is correct, then those "mirror impressions" can be regarded as genuine counter-entries (in this case, credit entries) on the equity side of such an accounting system — since each token inside the envelope represents an asset, and each impression outside is part of the total equity.

Considering that this not only happened more than five thousand years ago, before writing and abstract counting was invented, the long tradition of accounting must either inspire some awe or reinforce the view that accounting is a *dusty* discipline indeed — one that literally arose out of the clay or dust of the earth. But there are at least two further important aspects to be discussed, both of which have philosophic implications.

The Correspondence Theory of Representation

The importance of Ludwig Wittgenstein for the philosophy of science as well as for every individual science lies in his enduring concern with *questions of representation*: How can language represent reality? What makes it possible for a combination of words to represent a fact? How is it that a sentence can say that such-and-such is the case?

In his first major work, the *Tractatus Logico-Philosophicus*, Wittgenstein [1922] developed his "picture theory" which regards a sentence as a picture (i.e. a model of reality) in the following sense: How is it possible that confronted for the first time with a sentence (composed of familiar words), we under-

stand this sentence without any explanation? Although a sentence cannot *say* its meaning (it is only capable of saying that so-and-so is the case), it can *show* its meaning.¹¹ And if it can show this, then it must be some kind of picture of reality. Even more critical is that in the *Tractatus* Wittgenstein asserts that the relation between the elementary or atomic parts of a *true* sentence must be in one-to-one correspondence with the objects and constituents of a fact, i.e. with reality — and it is, above all, this “logical atomism” together with its “correspondence theory of truth” which he abandons in his later philosophy.¹² Because if

challenged to explain *why* we must suppose that language is related to the world in that particular way, he was — on his own confession — in no position to give any literal reply . . . Propositions were capable of modeling and, so, describing reality; but they could not simultaneously describe *how* they described it, without becoming selfreferential and consequently meaningless” [Janik and Toulmin, 1973, pp. 189-190].

Thus the *Tractatus* has the merit of *revealing the limitations* of propositional language. It shows that *logic* as well as *ethics* are transcendental. The *Tractatus* must not be misinterpreted to be a positivistic work: “Positivism holds — and this is its essence — that what we can speak about is all that matters in life. *Whereas Wittgenstein passionately believes that all that really matters in human life is precisely what, in his view, we must be silent about*” [Engleman, 1967, p. 97].

Wittgenstein’s second major work, *The Philosophical Investigations* (published posthumously in 1953) at least as influential as the *Tractatus*, constitutes a rejection of some of his major previous thoughts, but it also is a continuation of his

¹¹“In a letter to Russell, Wittgenstein remarked that his “main contention” was this distinction between what can be said in propositions — i.e. in language — and what cannot be said but can only be shown. This he said, was “the cardinal problem of philosophy” Malcolm [1967, p. 330].

¹²With reference to the *important* problem of Wittgenstein’s *connecting of elementary or atomic propositions with complex propositions*, [Hintikka, 1987, p. 30] offers the following crucial insight: “In the *Tractatus*, Wittgenstein used the truth function theory to extend his picturing idea from atomic propositions to all complex ones. In 1928-29 he gave up his belief that truth-function theory could serve as such a bridge. Henceforth the same role had to be played by suitable human activities (“calculi”, later “language games”). The nature of these activities was the main problem of his later philosophy.”

earlier philosophic quest. Here the notion of “language games” and the importance of linguistic *conventions* supersede the “picture theory.” From now on the *meaning* of a sentence is not derived from the picture property but from the *use and application* of the sentence. Wittgenstein’s second philosophy is no longer limited to the natural sciences and rejects the notion that every form (structure) of a proposition can be anticipated as a new combination of simple objects.¹³ On the contrary, new language games are possible and embody new “forms of living” (*Lebensformen*). The meaning of a name is not the object it pertains to; and naming is not prior to the meaning of a sentence because before we know what a name stands for, we must already have mastered the pertinent language game.

So, from now on, Wittgenstein focused his attention instead on *language as behaviour*: concentrating his expressions, on the *language games* within which those rules are operative, and on the broad *forms of life* which ultimately give those language games their significance. The heart of the “transcendental” problem thus ceased (for Wittgenstein) to lie in the formal character of linguistic representations; instead, it became an element in “the natural history of man” [Janik and Toulmin, 1973, p. 223].

The accounting systems of the Sumerians and other ancient peoples are obviously not comprehensive or complete language systems (in the ordinary sense), and thus cannot offer any evidence for or against the validity of logical atomism and the correspondence theory of truth. But they are something like specialized and limited language systems or, more precisely, *representational systems* for the purpose of giving account of an entity’s wealth and its flow. And as such they might provide evidence for the *usefulness* of the *correspondence theory of representation*. Not only did every piece of commercial reality (a measure of grain, a ewe or ram, a jar of oil or a weight of silver)

¹³“The *Tractatus* held that the ultimate elements of language are names that designate simple objects. In the *Investigations* it is argued that the words “simple” and “complex” have no *absolute* meaning.” In the *Tractatus* the existence of simple objects was conceived as following from the requirement that the sense of sentences is *definite*. In the *Investigations* this requirement is regarded as another philosophical illusion. We have imagined an “ideal” of languages that will not satisfy actual needs . . . Wittgenstein denied that we always understand a sentence . . . sentences have sense only in special circumstances; in other circumstances we do not understand them . . . The view of the *Tractatus* is entirely different [Malcolm, 1967, pp. 335-336].

correspond to a specific token, but also such *relations*, as transfer, property rights, and debt claims, were represented by proper correspondences in this accounting system (through the location of certain tokens in a particular aggregate).¹⁴ It does not matter that this system itself consisted of relatively concrete objects (like clay cylinders, cones, etc.) instead of more abstract, written symbols; on the contrary this intermediary step reveals to us the evolution of a conceptual system — it not only demonstrates that *abstraction is a matter of degree* but also how more abstract representational systems evolved from less abstract ones. Above all, the archeological evidence shows that the first systematic representational system was based on a correspondence notion. The crucial thing is that *input-output relations apply not only to the actual transfer of commodities but also to their representations*. Because for the purpose of giving account of those transfers of commodities, property claims, and their results, clay tokens were removed from one place and put into another.

This archeological evidence shows two things: (1) that the precursor of written language was a system of representation that exploited the one-to-one correspondence between segments of reality and certain more or less abstract symbols, and (2) that such a one-to-one correspondence proved useful for almost five thousand years as a major element of what was probably the only systematic representational system available to early agricultural communities as well as to the first phase of urban culture. With this statement we do *not* negate the objections raised against logical atomism, but we suggest that in certain representations situations — particular in those with a manageable range and clearly defined concepts — there is a place for the correspondence theory.

¹⁴One might argue that the much older paleolithic cave paintings and miniature art constitute earlier evidence for a correspondence theory of representation. But in these caves only objects (e.g. animals and hunters) are clearly represented while the relationships are, at best, merely implied. Certainly, the *systematics* necessary for a representational system, and the evidence afforded by the clay envelopes and string aggregates of the token accounting systems, is nowhere found in paleolithic art. In other words, paleolithic art represented mainly objects while neolithic record keeping represented *objects* as well as *facts* in Wittgenstein's sense (i.e. relations between objects). However, this hypothesis may founder if Margulis and Sagan's [1986, p. 222] *guess* is correct that "hunter-gatherers were sketching maps and plotting the movement of planets and stars as early as 40,000 years ago."

Janik and Toulmin [1973] claim that the historical root of Wittgenstein's concern for language and "pictorial" representation lies less in Russell's influence than in Wittgenstein's Viennese background:

Far from originating in Wittgenstein's *Tractatus*, as we shall see, the idea of regarding language, symbolism and media of expression of all kinds as giving us "representations" (*Darstellungen*) or "pictures" (*Bilder*) had by 1910 become a commonplace in all fields of Viennese cultural debate. Among scientists this notion had been in circulation at least since the time of Hertz, who had characterized physical theories as providing just such a *Bild* or *Darstellung* of natural phenomena [footnote omitted]. At the other extreme, it was equally familiar among artists and musicians; Arnold Schönberg, for instance, wrote an essay on musical thoughts, with the title *Der Musikalische Gedanke und die Logik, Technik, und Kunst seiner Darstellung* [footnote omitted]. By the time Wittgenstein came to the scene, this debate had been going on for some fifteen or twenty years in the drawing rooms of Vienna. . . ." [Janik and Toulmin, 1973, p.31].

These authors also refer to the influence which the writings of the renowned physicist Heinrich R. Hertz [1894] — who was trying to present a "picture theory" as a system of mathematical models — had on Wittgenstein:

We form for ourselves images or symbols of external objects; and the form which we give them is such that the necessary consequence of the images in thought are always the images of the necessary consequence in nature of the things pictured. In order that this requirement may be satisfied, there must be a certain conformity between nature and our thought. Experience teaches us that the requirement can be satisfied, and hence that such a conformity does in fact exist. When from our accumulated previous experience we have once succeeded in deducing images of the desired nature, we can then in a short time develop by means of them, as by means of models, the consequences which in the external world only arise in a comparatively long time, or as the result of our own interposition. We are thus enabled to be in advance of the facts, and to decide as to present affairs in accordance with the insight so obtained. The images which we here speak of are our

conceptions of things. With the things themselves they are in conformity in one important respect, namely, in satisfying the above-mentioned requirement. For our purpose it is not necessary that they should be in conformity with the things in any other respect whatever [Hertz, 1899, pp. 1-2].

It seems that Hertz too had in mind a correspondence theory, but limited to mathematics in relation to the essential features of physics. Wittgenstein, on the other hand was ambitious enough in his *Tractatus* to expand this idea to language in general as well as to all aspects of factual reality (i.e. excluding value judgments). And this venture had to fail as the emergence of Wittgenstein's [1953] second philosophy clearly showed [Mattessich, 1978, pp. 95-97]. In other words the correspondence theory of representation may be defensible only when applied to certain precisely defined languages in correspondence with a limited aspect of reality (physical phenomena, certain economic and accounting phenomena, etc.).

Early Accounting Systems as Precursor of Counting, Writing and Model Building

Counting seems to have emerged in three different stages — counting by (1) one-to-one matching of *unspecialized* tokens like pebbles, sticks, etc., (2) by *specialized* tokens (abstract symbols as well as those with morphological similarities to the objects represented), and (3) counting with genuine numerals, abstracted from any token symbols [Schmandt-Besserat, 1983 and 1986a]. Only the last stage is counting in the proper or modern, abstract sense; it seems to have emerged around 3200 B.C., simultaneously with writing. This is no coincidence because the evidence is strong that both activities arose from the need to mark the surface of the clay envelopes in such a way that the number and kinds of tokens contained in them could easily be discerned. This was done by impressing each token contained on the soft clay surface (the precursor of cuneiform writing), but often not enough space may have been on the surface, so a specific shape may have been combined with a purely numerical sign (e.g. a number of dots, the first truly abstract numerals).

But those early accounting systems reveal more, something of special interest to philosophers pondering over Wittgenstein's ideas. Those token systems show that the one-to-one correspondence between the tokens (including their position in a specific envelope or on a string aggregate) and the pertinent

economic facts, are *not* logic relations that can be syntactically defined,¹⁵ but are *semantic relations to be "shown" by usage*. But this might hold only when dealing with "abstract token shapes." Where tokens with morphological similarities to the commodities are involved, one might be able to argue that the link between the written language and reality is a geometric, hence logical-mathematical relation.

In spite of the fact that this still leaves a "semantic gap" between written and spoken language, it hints at the possibility that there may be an evolutionary link between logic (in the narrow sense of syntactics) and semantics — not only on the theoretical but also on the practical level. This difference between syntactics and semantics might come close to the distinction between "stating" and "showing." And the connection between the two assumes particular importance in our modern world of video and computer technology. Because the latter has acquired the ability to *state* or *describe* certain aspects of reality by means of a logical sequence of magnetized dots (*digital* representation) which in turn are further processed to *show* this reality in form of sounds and more or less genuine pictures (*analogue* representation).

To master their environment and to manipulate it for the satisfaction of their own needs, biological organisms have evolved a great variety of reaction mechanisms. In the higher animals the most important one is the creation of ideas or mental images. This is our window to the world, which, however, requires certain intermediaries. These are *encoding/decoding* systems in the form of the internal neuronal language system and various external language systems. Whether it is a representation through neurons, or the prehistoric representation of reality through tokens, or modern video-computer imagery, in all cases the semantic gap between an *abstract* representation (e.g. a sequence of magnetic dots) and the *more concrete* representation (a television picture) is bridged by some kind of language code. Such a code may be purely syntactical, but usually incorporates a system of conventions ("usages") which go beyond mere logical relations. But whether the latter are too complex or ambiguous for scientific purposes or whether it is for any other reason, the fact is that modern semantics fashioned itself to a considerable extent on

¹⁵In Wittgenstein's terminology: "said", "stated" or "described" *in contrast* to "shown". But possibly my interpretation of those words somewhat differs from that of Wittgenstein.

the syntax of logic which, however, should not blur the difference between the two.

Two Views

Furthermore we have seen that both, the prehistoric recording systems as well as the modern video and computer systems, demonstrate that the *representational view* (of the early Wittgenstein) and the *functional view* (of the later Wittgenstein) are compatible and do not need to exclude each other. Prehistoric accounting systems reveal the logical, indeed set-theoretical, structure inherent in certain economic aspects of reality. The clay envelopes and string aggregates possess the structure of sets — or precisely sets of sets, because the superset of the entire aggregate can be understood as containing subsets, each represented by a different token shape. Hence the relations involved are those of “being a *subset* of” (\subset), “being an *element* of” (\in) and a “transaction” (an input-output vector). And the notorious *duality* of accounting arises out of the dual interpretation of a set as a collection of elements (the input) on one side, and as a kind of totality (the output), on the other. And a deeper analysis reveals that this duality, in turn, is rooted in a physical input-output dichotomy manifesting a *conservation principle*: the giving account of a certain input in terms of its output in such economic transactions as the transfer of commodities from one “place” to another, be it for the purpose of buying, lending, repaying, manufacturing, selling, etc.

My Answer to Wittgenstein

Based on the preceding analysis, let me draw my conclusions:

First, how can we characterize the *difference* between “saying” and “showing”? And is there a link between the two? To simply state that sentences *say*, while pictures *show*, will not do. Probing into the prehistory and early history of writing has hopefully lifted some fog. Token accounting as well as cuneiform writing, hieroglyphs, offer many examples of various steps by which *morphological tokens* (i.e. those with similarity to its referent) and *pictographs* (both of which seem “to show”) developed into abstract tokens and ideographs (both of which seem “to say”). And now we may raise two questions: (1) At what stage did a symbol lose its ability “to show”? And (2) at what stage did it gain the ability “to say”?

The first question is relatively easy to answer: As soon as the *structural similarity* between a symbol and its referent gets lost, it can no longer “show” — in this morphology and its loss lies *the difference* between “showing” and “saying.” And this loss usually occurs at a fairly early stage in the development of a sign.

Even more important, and perhaps more difficult to answer, is the second question. My personal reply is this: morphological tokens and pictographs do not only “show”, they also “say” (Marshall McLuhan may have said: “pictographs are the message”); or more formally: *from its earliest development on such symbols are endowed with the power to say.*¹⁶ Thus the *morphological tokens and pictographs not only describe structures, they themselves are similar structures.* Yet in subsequent steps of development — when these morphological similarities have vanished — how can those now abstract tokens or signs (in conjunction with some relations: e.g. placing a token into a specific receptacle) continue to describe factual entities and relations? The evolution of those tokens and linguistic signs clearly shows that this “miracle” is made possible through the previously established *associations* between each abstract sign and the corresponding morphological token or pictograph which in turn is structurally related to the pertinent empirical object or fact. On a higher or later level this crucial *association* is established by conventions — which might explain why the later Wittgenstein put so much emphasis on linguistic conventions.

Our fact is that morphological tokens and pictographs are a common denominator for “showing” and “saying” — those symbols might be the *missing link* between those two activities. And because there exists such a connection, it might be possible that aggregates of machines like a complete video system is capable of transforming something that shows into something that says, and *vice versa*.

And finally, my answer to Wittgenstein’s *perennial* question is that: the representation of reality by means of signs is possible because language itself is a double-sided *Janus-faced* creation — not unlike our mind/brain system. *Language is*

¹⁶This seems to be in disagreement with Wittgenstein’s [1922 item 4.1212] “what *can* be shown, *cannot* be said” and I wonder whether this is due to a difference in our notions of “showing” and “saying” or in some misunderstanding.

capable of conveying ideas, yet it is deeply rooted in such physical realities as vibrations of air, tokens and tablets of clay, ink on papyrus or paper, magnetized dots on plastic tapes, etc. Both, language and the mind/brain system, belong to the realm of concepts and forms as well as to the realm of matter and energy. Everyday languages as well as scientific and technical languages are possible for the same reason that makes our genetic, our neuronal and our hormonal language systems possible. Our social languages are certainly not our own original inventions, they are merely copies or re-inventions of nature's work; and it seems that all "natural" as well as "social" languages are a manifestation of nature's basic duality of conceptualization and legislation, on one side, and execution and material manifestation on the other.

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The illustrations of Clay Tokens and Token Accounting Systems are from Susa, Iran, ca. 3350-3200 B.C. (courtesy Musée du Louvre, Department des Antiqués Orientales).