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A Western Apache Writing System: The Symbols of Silas John

The writing of prayers by a Western Apache shaman is a unique achievement among American Indians.

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In a lengthy essay published in 1886, Garrick Mallery, a retired military officer employed as an anthropologist by the Bureau of American Ethnology, invited explorers, missionaries, and ethnographers to provide him with information pertaining to systems of graphic communication then in use among the Indian tribes of North America. Expressing his conviction that these "primitive forms of writing provide direct and significant evidence upon the evolution of an important aspect of human culture" (*1*, p. 26), Mallery also warned that they were rapidly disappearing and that, unless those in existence were studied immediately, the opportunity would be lost forever (*1*). Unfortunately for anthropology, Mallery's invitation went largely unheeded and his prophesy came true. In the closing decades of the 19th century, a number of native graphic systems went out of existence, and a fledgling social science, occupied with more urgent concerns, scarcely took note of their passing.

The lack of enthusiasm that greeted Mallery's early call for research set a precedent that was destined to continue, for to this day the ethnographic study of so-called "primitive" writing systems —including those stimulated by contact with Europeans—has failed to engage the sustained interest of either linguists or cultural anthropologists. The result, I. J. Gelb has observed, is that "Some of these writings are known very inadequately, others are known only from hearsay, and still others must exist in obscure corners of the globe as yet unnoticed by scholars" (*2*, p. 210).

Under these circumstances, it is with considerable enthusiasm that we greet the opportunity to report upon a previously undescribed writing system that is in active use today among Western Apache Indians living on the Fort Apache and San Carlos reservations in east-central Arizona. This system has persisted essentially unchanged since its invention in 1904 by Silas John Edwards, a preeminent Western Apache shaman who was also the founder and leader of a nativistic religious movement that established itself on both of these Western Apache reservations in the early 1920's and subsequently spread to the Mescalero Apache in New Mexico (*3*).

Silas John Edwards is 91 years old, almost blind, but still very active and alert. Known to other Apaches and Anglo-Americans alike simply as Silas John, he created a writing system in order that an extensive set of prayers expressing the ideological core of his religion could be recorded in permanent form and disseminated among his followers. Although these prayers contain much Christian symbolism—a result of Silas John's early association with Lutheran missionaries on the Fort Apache Reservation—the written script was entirely his own invention, initially conceived in a "dream from God" and later developed without assistance from Anglo-Americans or other Apaches. An ability to read and write English, acquired by Silas John as a young man, undoubtedly accounts for his interest in the idea of writing. However, it does not account for the graphic form of his script or its underlying structural principles, which depart radically from those of the English alphabet. Like the Cherokee syllabary invented by Sequoyah around 1820, the writing system of Silas John represents a classic case of stimulus diffusion, resulting in the creation of a totally unique cultural form (*4*). As such, it ranks, we believe, among the significant intellectual achievements of an American Indian during the 20th century.

Methodological Problems

Since Mallery's day and before, American Indian writing systems have been described with a set of time-honored concepts that were originally devised by European epigraphers to classify distinct types of graphic symbols and, by extension, to classify whole systems (*1*, *2*, *4–6*). For example, if all the symbols in a particular system were identified as pictographs, the system itself was classified as pictographic; on the other hand, if stylized ideographs existed side by side with pictographs, the system was considered pictographic-ideographic. In this way, different systems were compared on the basis of what types of symbols they were composed of and, on the basis of historical data, arranged in their presumed chronological order.

The typologies constructed for these purposes, almost all of which classify graphs according to attributes of external form, are strictly etic in character—the products of a long tradition of Western scholarship that often lacked access to native informants and was chiefly concerned with the formulation of broad-scale comparative strategies (*7*, *8*). Although no one would dispute the importance of such strategies or deny the fact that adequate typologies are basic to their development, it is

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essential to point out that serious problems may arise when etic concepts are applied a priori in describing *individual* writing systems. Unless it is first established that the distinctions and contrasts imposed by these concepts coincide with those considered meaningful by users of the system—and in most studies of American Indian writing systems no such evidence is adduced—the resulting description is almost certain to suffer from bias and distortion (*9*).

It would be a simple task, for example, to classify every symbol in the Silas John script according to whether it is pictographic or ideographic. Yet, as we shall show, this distinction has no significance for the Western Apache, who classify these symbols on the basis of very different criteria. An account of the Silas John script that ignored these native—or emic—distinctions and proceeded in terms of the pictographic-ideographic contrast instead would fail to reveal the basic principles that impart structure to the system as a whole. Simultaneously, and equally damaging, such an account would suggest that the system's operation was predicated on rules that, in fact, are irrelevant to it and altogether absent from Western Apache culture.

Methodological problems of this kind cannot be dismissed as inconsequential; nor can they be ignored on the supposition that their occurrence has been infrequent. To the contrary, a recent survey of the literature on American Indian graphic systems reveals the use of etic concepts to be so pervasive that, in all but a few cases, it is impossible to determine the kinds of conceptual skills that were actually required to produce and read intelligible written messages (*10*).

The adequacy of an ethnographic description of a writing system should be judged by its ability to permit someone who is unfamiliar with the system—but who has a knowledge of the language on which it is based—to read and write. It should provide him, in other words, with an explicit formulation of the knowledge necessary to become literate. Among other things, this requires that the basic units in the system be identified and defined in accordance with criteria that persons already literate recognize as valid, necessary, and appropriate. If these criteria are not disclosed, or if they are arbitrarily replaced with criteria derived from the investigator's own culture, the knowledge necessary to use the system correctly will remain hidden.

Ward Goodenough has observed that an adequate etic typology must be sufficiently sensitive ". . . to describe all the emic distinctions people actually make in all the world's cultures in relation to the subject matter for which the etic concepts are designed" (*8*, p. 129). This requirement applies as much to typologies of writing as it does to those for any other cultural phenomenon. Goodenough also emphasizes that the emic and etic enterprises are not mutually exclusive, but complementary and logically related (*8*). Emic concepts provide us with what we need to know to construct valid etic concepts, while etic concepts, besides determining the form and content of comparative propositions, assist in the discovery and description of emic concepts.

Studies of American Indian writing systems contain so few emic analyses that the basic materials needed to construct adequate etic typologies are all but absent. Consequently, the few etic concepts that have been proposed are open to serious question. On the one hand, it has not been shown that these categories describe ". . . all the emic distinctions people actually make . . ." (*6*, p. 129) and, on the other hand, they are so all-encompassing that their utility for comparative purposes is seriously impaired (*6*). Obviously, these difficulties cannot be overcome through the creation of more arbitrary categories. The surest solution lies in the continued investigation of individual writing systems, which, if properly described, will contribute to an inventory of demonstrably relevant emic distinctions and thus assure that subsequent etic typologies have a more secure grounding in cultural fact. Our account of the Silas John writing system is such an investigation.

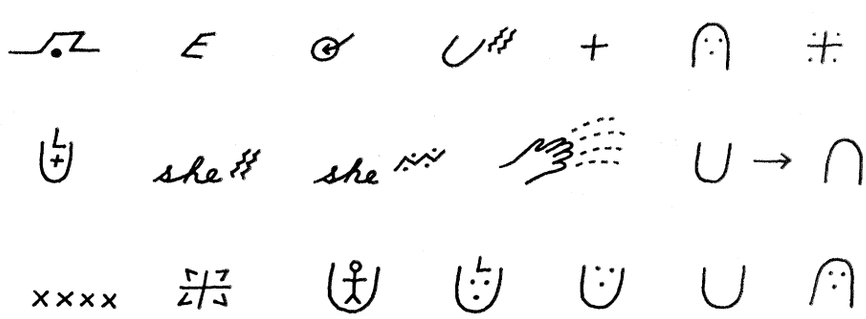

Fig. 1. Text of a "prayer for life" in correct reading form, from left to right in descending order.

Development of the Writing System

In 1904, when Silas John Edwards was 21 years old and living in the community of East Fork on the Fort Apache Indian Reservation, he experienced a vision in which he was presented with a set of 62 prayers and an accompanying set of graphic symbols with which to write them. Silas John recalls his vision as follows:

> There were 62 prayers. They came to me in rays from above. At the same time I was instructed. He [God] was advising me and telling me what to do, at the same time teaching me chants. They were presented to me—one by one. All of these and the writing were given to me at one time in one dream. . . .
>
> God made it [the writing], but it came down to our earth. I liken this to what has happened in the religions we have now. In the center of the earth, when it first began, when the earth was first made, there was absolutely nothing on this world. There was no written language. So it was in 1904 that I became aware of the writing; it was then that I heard about it from God.

Silas John used his writing system for the sole purpose of recording the 62 prayers he received in his vision. The script was never applied to the large body of traditional Apache prayers already in existence by 1904, nor was it ever emloyed as a vehicle for secular speech. This is important to keep in mind, because the merits of the script, as well as its limitations, stem directly from the fact that it was designed to communicate information relevant to the performance of ritual, *not* to write the entire spoken language of the Western Apache.

In 1916, Silas John publicly proclaimed himself a messiah and began to preach. At the same time, he wrote down each of his prayers on separate pieces of tanned buckskin, using paints made from a mixture of pulverized minerals and the sap of yucca plants. By 1925, however, prayer-texts were written in ink on squares of cardboard. Today, many (and possibly all) of the original painted buckskins have been lost or disposed of, and Silas John's script is preserved in paper "prayer

books" (*sailiš ǰaan bi?okąąhi*) belonging to Apaches living on the San Carlos and Fort Apache reservations.

By 1920, it was apparent to Silas John that his acceptance as a religious prophet was assured, and he then selected 12 "assistants" (*sailiš ǰaan yiłnanałse?hi*) to circulate among the Apache people, pray for them, and encourage them to congregate. The assistants were taught to read and write and, after demonstrating these skills, went through an initiation ritual in which they were presented with painted buckskins of their own. Thus equipped, they were placed in charge of carefully prepared sites known as "holy grounds" and were urged to perform ceremonials on a regular basis, using their buckskins as mnemonic aids. As time passed and members of the original group of assistants began to die, Silas John appointed new ones, who, in turn, were taught the script, formally initiated, and given the texts of prayers. This process, which has continued unmodified up to the present, accounts for the fact that, even among Apaches, knowledge of Silas John's writing system is not widespread. From the very beginning, access to the system was tightly controlled by Silas John himself, and competence in it was intentionally restricted to a small band of elite ritual specialists. Commenting on this point, one of our informants observed:

> Silas John just let a few people know what the writing meant. He once told my father that it had to be kept just like it was when he heard about it from God. If some person ever tried to change it, he said, God would stop listening to the people when they prayed. He knew that if he let it out for all the people to know some wouldn't know about this, some wouldn't take it seriously. Maybe some would try to change it. So he just gave it to a few people, men and women who would learn it right—just the way he taught them—and leave it alone. It has been that way for a long time, and it [the writing] is still the way it was when it came to this earth from God.

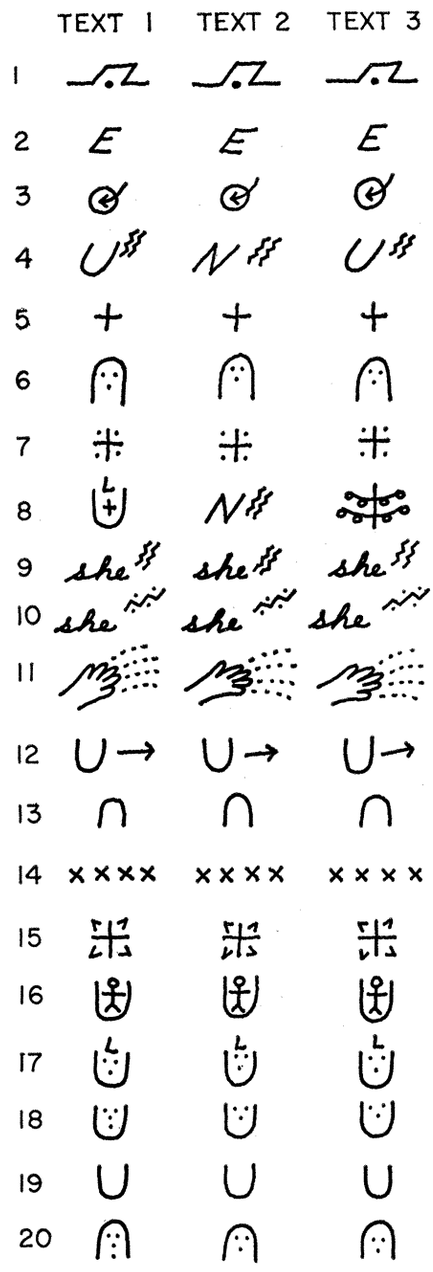

Fig. 2. Three texts of "prayer for life," arranged in vertical order for ease of comparison.

Description of the Writing System

The following account of Silas John's writing system is based upon an analysis of six texts that were copied from a prayer book belonging to one of his youngest assistants on the San Carlos Reservation. This was the only prayer book we were permitted to see, and, although it contained several additional texts, instruction in these was prevented by the sudden hospitalization of our chief informant, a much older assistant whom Silas John had recommended as a particularly well-qualified teacher. The fact that we were unable to enlarge our sample hindered our analysis at certain points (*11*). However, it did not prevent us from discovering the underlying principles according to which the system operates, the kinds of information it conveys, or the concepts Western Apaches must learn to become literate. Our description should enable anyone with a knowledge of spoken Apache to read fully and correctly the six prayer-texts that constitute our corpus. No more can be claimed, since these were the only texts in which we ourselves received adequate training and developed an acceptable measure of competence by Western Apache standards.

A "Silas John prayer-text" (*sailiš ǰaan bi?okąąhi*) may be defined as a set of graphic "symbols" (*ke?eščin*) written on buckskin or paper whose members are arranged in horizontal lines to be read from left to right in descending order (Fig. 1). Each symbol is separated from the one that follows it by an empty space, and each corresponds to a single line of prayer, which may consist of a word, a phrase, or one or more sentences.

The 62 prayers are separated into three major categories:

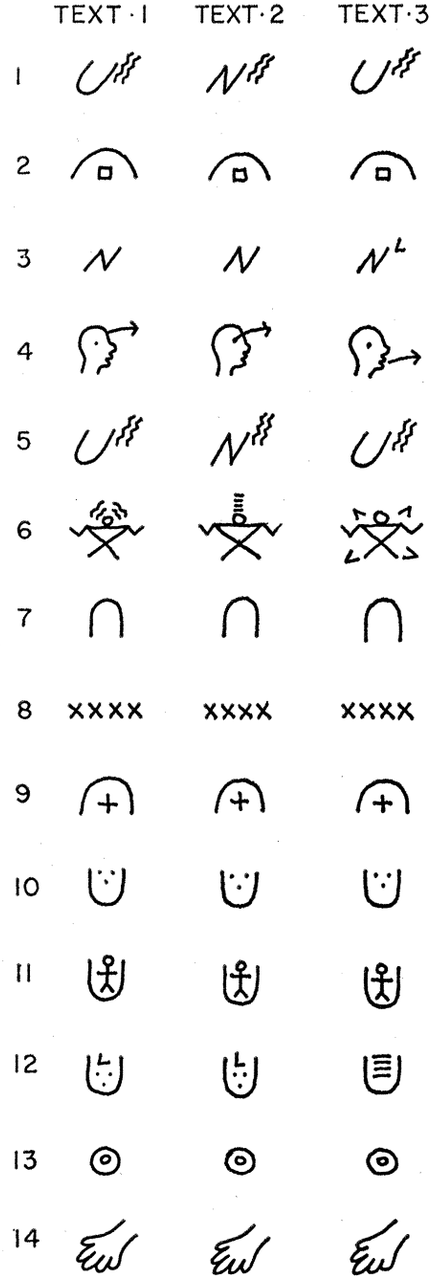

Fig. 3. Three texts of "prayer for sickness," arranged in vertical order for ease of comparison.

1) "Prayers for life" (*?indee bi?okąąhi*), which promote health, longevity, and the maintenance of tension-free social relations.

2) "Prayers for man and woman" (*?indee ke?istsane bi?okąąhi*), which are invoked to combat and resolve marital discord.

3) "Prayers for sickness" (*?ida?an bi?okąąhi*), which are employed to relieve physiological and mental illnesses caused by witchcraft, snakebite, or supernatural forces that have been antagonized by disrespectful behavior.

Fig. 4. Noncompound and compound symbols.

Prayers belonging to the same category are virtually identical in linguistic structure, with the result that the number and sequential arrangement of their written symbols exhibit very little variation. Consider, for example, the three "prayers for life" whose texts are presented in Fig. 2; note that each text contains the same number of symbols (20) and that their serial order is disturbed at only two points (4 and 8). Because this kind of uniformity is typical, the texts in each prayer category manifest a characteristic pattern. Two of these patterns can be readily discerned by comparing the "prayers for life" (Fig. 2) with the three texts of "prayers for sickness" (Fig. 3).

Western Apaches assert that symbols in the Silas John script are composed of isolable "symbol elements" (also termed *ke?eščin*), and they emphasize that, to write and read a prayer-text properly, it is essential to discriminate among symbols that consist of two or more elements and those that consist of only one. The former class, whose members we shall refer to as compound symbols, is labeled by the Western Apache expression *ke?eščin łeedidilgoh* (symbol elements put together), while the latter, whose members we shall refer to as noncompound, symbols, is termed *ke?eščin dołeedidildaahi* (symbol elements standing alone). Figure 4 presents the Western Apache classification of the symbols in our corpus into these two categories.

Symbol elements are not to be equated with discrete graphic components, for as a glance at Fig. 4 will show, noncompound symbols may consist of more than one component. For example, the symbol ⊛, which might suggest itself to an outsider as having two graphic components, ○ and ↙, is not construed as such by the Western Apaches, who consider it a noncompound symbol that cannot be dissected. The reason, our informants explained, is that, by themselves, neither ○ or ↙ has meaning and, as a result, must always occur in association with each other. In other words, they become meaningful only as a unit, and in this respect contrast sharply with the components of compound symbols, which, besides having meaning in combination, also have meaning in isolation. Thus we arrive at an important insight: the classification of compound and noncompound symbols is based upon other than visual criteria and cannot be deduced solely from inspection of a symbol's outer form.

When requested to identify and define the individual symbol elements in our corpus, our informants sorted them into three classes. Class A is made up of elements that occur only in isolation and function exclusively in the capacity of noncompound symbols. Elements in Class B also occur alone, but can also be combined with other elements to form compound symbols. Class C consists of elements that occur only in compound symbols and never in isolation. In Fig. 5, each of the 28 symbol elements that appear in our corpus has been assigned to one of these three classes.

Compound symbols may be divided into five structural types, according to the number of elements they contain (two or three) and the classes (B or C or both) to which these elements belong. For the sake of convenience and economy, the members of each type are expressed in Fig. 6 as the outcome of simple formulas that operate on individual elements and specify the manner in which they are combined. We make no claim for the psychological reality of either the typology or the formulas; they are employed here simply as descriptive devices that allow us to make explicit the knowledge an Apache must possess in order to form the compound symbols that appear in the prayer-texts at our disposal.

Compound symbol type 1: One element from class B is combined with one element from class C.

Fig. 5. Symbols grouped into classes A, B, and C.

Compound symbol type 2: One element from class **B** is combined with one other element from class **B**.

Compound symbol type 3: One element from class **C** is combined with one other element from class **C**.

Compound symbol type 4: Two elements from class **B** are combined with one element from class **C**.

Compound symbol type 5: One element from class **B** is combined with two elements from class **C**.

A striking feature of the Silas John script is that it encodes information calling for nonverbal behavior as well as for speech. This is made explicit in a distinction Apaches draw between "symbols that tell what to say" (*keʔeščin hantʔe ndii*) and "symbols that tell what to do" (*keʔeščin hantʔe ʔanleʔ*). All symbols "tell what to say" in the sense that each one signals the vocalization of some particular prayer-line. However, a few symbols—those that "tell what to do"—function simultaneously to signal the performance of key ritual actions without which the prayer, no matter how correct in its linguistic details, is considered incomplete. In essence, then, a prayer-text consists of a set of highly detailed instructions that specify what an individual must say and do to perform ceremonials in a manner that meets the standards held by Silas John and the members of his religion. So fundamental is the knowledge necessary to read these instructions, Apaches claim, that any attempt to execute the role of "ceremonial leader" (*diiyin*) without it is certain to be flawed and unacceptable.

One of our informants commented along these lines as follows:

> It's all in here [pointing to a prayer-text], how to pray in just the right way. That's why he [Silas John] made them like this, so the ones who pray can be sure they know how to do it right. Only the ones who can read can pray. . . . I heard of a man at Whiteriver who wanted to be a ceremonial leader like the ones who work for Silas John. So he went to many ceremonials and tried to watch everything they did. After a long time he thought he knew what to do and got ready to try it out. . . . The people came to where he was and he started up. But pretty soon they knew he didn't really know it. . . . This was because no one had taught him to read buckskins; he couldn't do it without them. When he [Silas John] chooses you to be a ceremonial leader, first you learn what the symbols say, then, after that, what the symbols mean for you to do. You must know both, because if you don't you will make mistakes like that Whiteriver man I was telling you about before.

Meaning of the Symbols

The process of learning what the symbols in a prayer-text represent may be considered complete when the linguistic referent of each symbol—that is, the prayer-line it serves to recall in the performance of a ceremonial—has been committed to memory. The process begins, however, with the memorization of expressions that define the meaning of symbol elements. These expressions are termed "symbol elements names" (*keʔeščin bižiʔ*) and are held by Apaches to constitute the basic semantic units of the Silas John writing system.

The "names" of elements that function as noncompound symbols are identical to the prayer-lines these symbols elicit in ritual contexts. Consequently, the linguistic referent of a noncompound symbol is always isomorphic with the meaning of the element that forms it and can be learned in a single operation. The linguistic referents of the noncompound symbols that appear in our corpus (those symbols formed by elements in class A and, when occurring in isolation, elements in class B) are presented below. The numbers refer to the symbols in Fig. 5.

Noncompound Symbols

Class A elements (occur only alone)

1. *niʔ ʔaγolzą̨ą̨ną̨ʔ* (earth, when it was made)
2. *ʔiiyaaʔ ʔaγolzą̨ą̨ną̨ʔ* (sky, when it was made)
3. *daitsee dagoyą̨ą̨ną̨ʔ niʔ ʔiłdįįžę* (first, when it all began in the center of the earth)
4. *šilagan hadaažęʔ dįįgo bihadaaʔ-*

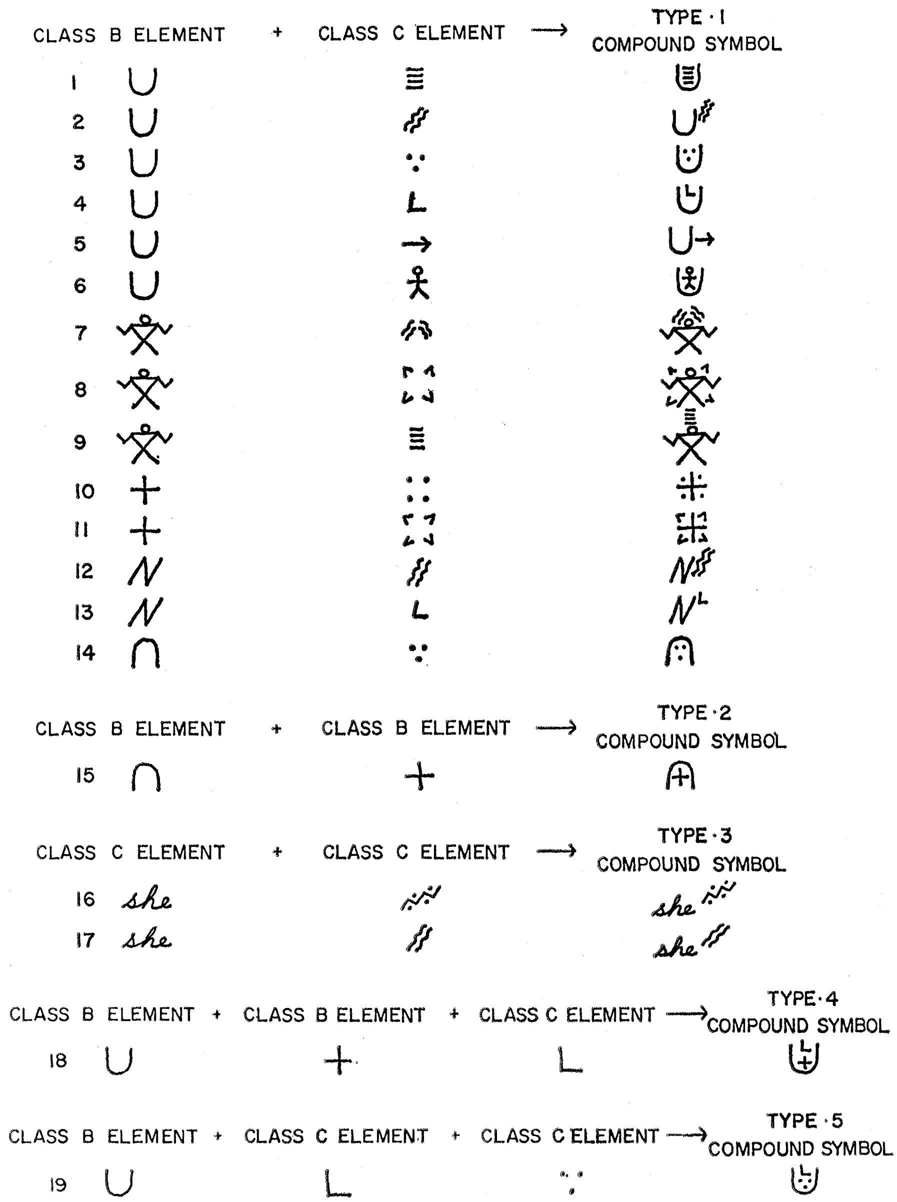

Fig. 6. Formulas for the formation of types of compound symbols.

istɨɨgo (my fingers, from their tips, like four rays, power emanates) *šilagan hadaažę? biha?dit?ɨɨgo* (my fingers, from their tips, power illuminates all) (*12*)

5. *nagowaahi nagoščǫǫdi nagołdiihi behegozini* (sinful things occurring, bad things occurring, sickness and evil occurring, together with harmful knowledge) (*13*)
6. *biɁii hadndin* (his heart, sacred pollen)
7. *ya?itsii košyo* (from where his thoughts dwell)
8. *ya? ?odišyo* (from where he looks out)
9. *ya? ?iiyałtii?yo* (from where he speaks out)
10. *yoosn bihidaahi yoosn binadidzooł behe?ndzili yedaadoldi tsiyaago daadoldi niką?žę?* (with his life, his breath, his power, God extends his hand and blesses you)
11. *yoosn bigoγąą* (God, his dwelling)
12. *hadndin ła?ašniidn* (he who is decorated with and enriched by pollen) (*14*)

Class B elements (occur alone or in compounds)

13. *hadndin ?iškɨɨn* (sacred pollen boy) (*15*)
14. *yoosn* (God)
15. *naalezgane* (Jesus) (*16*)
16. *hadndin ?ihna?aahi* (sacred pollen, that which is crossed)
17. *nagostan biγalatažę?* (world, on the surface of it)

The "names" of elements in class C must also be memorized, since a knowledge of these "names" together with those that label class B elements, is basic to the interpretation of compound symbols. The numbers refer to the symbols in Fig. 5.

Combining Symbols

Class C elements (occur only in compounds)

1. *hidaa* (life)
2. *?intin* (path; trail; road)
3. *šii* (I; me; mine)
4. *?okąąhi* (prayer, that which is)
5. *hadndin* (sacred pollen)
6. *hadndin* (sacred pollen)
7. *hadndin* (sacred pollen)
8. *?indee* (man; men) (*17*)
9. *dɨɨyo* (four places)
10. *dɨɨžę?* (in; from four directions)
11. *dɨɨ?ɨɨ* (four times)

When an Apache learns the expressions that label elements in a compound symbol, he does not simultaneously learn that symbol's associated prayer-line. This is because the linguistic referents of compound symbols are never isomorphic with the "names" of the class B or C, or both, elements that form them. Consider, for example, compound symbol 2 (Fig. 6). The meaning of class B element 14 is *yoosn* (God) and the meaning of class C element 5 (Fig. 5) is *hadndin* (sacred pollen). The prayer-line evoked by compound symbol 2 is *yoosn bihadndin* (God, his sacred pollen), which, while replicating exactly the meanings of its elements, is not identical to either one because of the addition of the possessive pronoun *bi* (his). It should be emphasized that the degree of correspondence between the referent of a compound symbol and the expressions that define its elements is not always this high. In the case of compound symbol 5 (Fig. 6), for example, whose referent is *dašižǫ? beišgaał č?idii* (it is said that I alone go forth with this power), the meaning of class B element 14 (Fig. 5) is *yoosn* (God) and that of class C element 2 is *?intin* (path; trail; road).

Because the prayer-line associated with a compound symbol is structurally and semantically more complex than the "names" of its elements, it cannot be inferred from these elements and, as a consequence, must be memorized separately. However, since the "names" either form some part of the prayer-line or allude metaphorically to key concepts embedded within it, the elements serve as indispensable aids for bringing the prayer-line to mind.

The linguistic referents of the compound symbols in our corpus are as follows. The numbers refer to the symbols in Figs. 5 and 6.

Compound symbol type 1

1. Class B element 14 (*yoosn*: God) plus class C element 7 (*hadndin*: pollen) produces compound symbol 1 (*yoosn bihadndin*: God, his sacred pollen) (*18*)
2. Class B element 14 (*yoosn*: God) plus class C element 5 (*hadndin*: pollen) produces compound symbol 2 (*yoosn bihadndin*: God, his sacred pollen)
3. Class B element 14 (*yoosn*; God) plus class C element 6 (*hadndin*: pollen) produces compound symbol 3 (*yoosn bihadndin*: God, his sacred pollen)
4. Class B element 14 (*yoosn*: God) plus class C element 1 (*hidaa*: life) produces compound symbol 4 (*yoosn bihidaa*: God, his life)
5. Class B element 14 (*yoosn*: God) plus class C element 2 (*?intin*: path; trail; road) produces compound symbol 5 (*dašižǫ? beišgaał č?idii*: it is known that I alone go forth with this power)
6. Class B element 14 (*yoosn*: God) plus class C element 8 (*?indee*: man; men) produces compound symbol 6 (*bit?la nabąąže? yoosn biyi? siziɨhi*: following this, God entered into man)
7. Class B element 13 (*hadndin ?iškɨɨn*: sacred pollen boy) plus class C element 11 (*dɨɨ?ɨɨ*: four times) produces compound symbol 7 (*dɨɨ?ɨɨ hadndin ?iškɨɨnihi*: four times, that which is sacred pollen boy)
8. Class B element 13 (*hadndin ?iškɨɨn*: sacred pollen boy) plus class C element 10 (*dɨɨžę?*: from four directions) produces compound symbol 8 (*hadndin ?iškɨɨn dɨɨžę? nadiyoołhi*: sacred pollen boy, he who breathes in four directions)
9. Class B element 13 (*hadndin iškɨɨn*: sacred pollen boy) plus class C element 7 (*hadndin*: sacred pollen) produces compound symbol 9 (*?izidadasdil hadndin ?iškɨɨn*: from above it cures, pollen boy)
10. Class B element 16 (*hadndin ?iłn?aahi*: sacred pollen, that which is crossed) plus class C element 9 (*dɨɨyo*: four places) produces compound symbol 10 (*hadndin ?iłna?-aahi dɨɨyo nadiyooł*: sacred pollen, that which is crossed, breathing in four places)
11. Class B element 16 (*hadndin? iłna?-aahi*: sacred pollen, that which is crossed) plus class C element 10 (*dɨɨžę?*: in four directions) produces compound symbol 11 (*dɨɨžę? biłhadaagoyaa*: these things dispersed in four directions)
12. Class B element 15 (*naalezgane*: Jesus) plus class C element 5 (*hadndin*: sacred pollen) produces compound symbol 12 (*naalezgane bihadndin*: Jesus, his sacred pollen)
13. Class B element 15 (*naalezgane*: Jesus) plus class C element 1 (*hidaa*: life) produces compound symbol 13 (*naalezgane bihidaa*: Jesus, his life)
14. Class B element 17 (*nagostsan*: world) plus class C element 6 (*hadndin*: sacred pollen) produces compound symbol 14 (*hadndin hidaahi*: sacred pollen, that which is alive) (*19*)

Compound symbol type 2

15. Class B element 17 (*nagostsan*: world) plus class B element 16 (*hadndin ʔiłnaʔaahi*: sacred pollen, that which is crossed) produces compound symbol 15 (*hadndin ʔiłnaʔ aahi nagostsan bikažęʔ*: pollen, that which is crossed, on the surface of the world)

Compound symbol type 3

16. Class C element 3 (*šii*: I; me; mine) plus class C element 4 (*ʔokąqhi*: prayer) produces compound symbol 16 (*šii siʔokąqhi*: mine, that which is my prayer)
17. Class C element 3 (*šii*: I; me; mine) plus class C element 5 (*hadndin*: sacred pollen) produces compound symbol 17 (*šii šihadndinihi*: mine, that which is my sacred pollen)

Compound symbol type 4

18. Class B element 14 (*yoosn*: God) plus class B element 16 (*hadndin iłnaʔaahi*: sacred pollen, that which is crossed) plus class C element 1 (*hidaa*: life) produces compound symbol 18 (*yoosn bihadndin ʔiłnaʔaahi hidaahi*: God, his sacred pollen, that which is crossed, that which is alive)

Compound symbol type 5

19. Class B element 14 (*yoosn*: God) plus class C element 6 (*hadndin*: sacred pollen) plus class C element 1 (*hidaa*: life) produces compound symbol 19 (*yoosn binadidzoołhi*: God, that which is his breath) (*20*)

Coding of Nonverbal Behavior

We have already drawn attention to the fact that certain symbols in the Silas John script call for the performance of specific types of nonverbal behavior, as well as the utterance of a prayer-line. To cite an example, compound symbol 2 (Fig. 6) requires that, simultaneous with the vocalization of its linguistic referent, which is *yoosn bihadndin* (God, his scared pollen), the speaker bless the ritual paraphernalia that identify him as a ceremonial leader by sprinkling each item with a pinch of cattail pollen. Actions of this kind, which constitute what we shall henceforth describe as a symbol's kinesic referent, consistently involve the manipulation of material culture, and for this reason a brief description of the physical settings in which ceremonials take place is essential.

All rituals connected with the Silas John religion are conducted within the perimeters of what both monolingual and bilingual Apaches call "holy grounds." These are small areas of land, usually about 15 feet square (1 foot = 0.304 meter), whose corners correspond to the 4 cardinal directions and are marked by upright wooden crosses (*ʔiłnaʔaahi ʔindeez*: long crosses). Each cross is approximately 7 feet tall, painted a different color—east (black), north (yellow), west (green), south (white)—and decorated with the breastfeathers of eagles.

Other objects of material culture that assume importance in ceremonial activities include:

1) "Wooden hoops" (*bąąse*). Used only in rituals held for the purpose of curing the sick, hoops are made in sets of four and are suspended on the crosses that define the corners of "holy grounds." Each hoop is roughly a yard in diameter, painted to match the color of the cross on which it hangs, and adorned with eagle feathers or strips of colored ribbon.

2) "Painted buckskins" (*ʔepan keʔeščin*). Every ceremonial leader is the owner of one or more buckskins, which lie spreads on the ground before the start of a ceremonial. Roughly square or rectangular in shape, these buckskins are inscribed with nonorthographic symbols that represent "sandpaintings" (*niʔkegoščiʔ*). Unless the ceremonial is of a particular type that requires the creation of these designs, the buckskins serve no mnemonic purpose.

3) "Personal crosses" (*ʔindee biʔiłnaʔaahi*). Every ceremonial leader also owns a personal cross, which he displays at ritual gatherings by placing it on top of his buckskins. Between 10 and 14 inches long and 6 to 10 inches wide, these objects are fashioned from wood and are sometimes enclosed in an outer covering of buckskin. An eagle feather and at least one turquoise bead are attached to the center of personal crosses with a strand of sinew, and it is not unusual to see specimens whose arms have been painted yellow.

4) "Sacred pollen" (*hadndin*). All ceremonials involve the use of cattail pollen, which is kept in an open container (usually a shallow basket) that is placed on the ground near the ceremonial leader's buckskins and personal cross.

We may now return to our prayer-texts and discuss in greater detail "symbols that tell what to do." Ten symbols of this type occur in our corpus. Each is a compound symbol and is listed below with a description of the actions that collectively comprise its kinesic referent. In keeping with the verbal style of our Apache informants, these descriptions are phrased as instructions to be followed by ceremonial leaders.

1) Compound symbol 17—Face toward the east. Extend fully the right arm, fold the left arm across the chest, and bow the head. After remaining in this position for a few moments, drop the left arm and trace the sign of a cross on one's chest.

2) Compound symbol 1—Face toward the east. Take a pinch of sacred pollen in the right hand and hold it directly over the ritual paraphernalia, which are lying on the ground.

3) Compound symbol 3—Take a pinch of sacred pollen in the right hand and trace four circles in the air directly over the ritual paraphernalia.

4) Compound symbol 2—Take a pinch of sacred pollen in the right hand and place a small amount on each item of the ritual paraphernalia.

5) Compound symbol 12—Same as No. 4.

6) Compound symbol 10—Take a pinch of sacred pollen in the right hand and place a small amount on each arm of the ceremonial cross that marks the eastern corner of the holy ground.

7) Compound symbol 11—Same as No. 6.

8) Compound symbol 9—Take a pinch of sacred pollen in the right hand and place a small amount on the head of the person (seated on the ground) for whom the ceremonial is being given.

9) Compound symbol 8—Take a pinch of sacred pollen in the right hand and with the same hand trace the sign of a cross on the chest of the person for whom the ceremonial is being given.

10) Compound symbol 7—Remove the wooden hoop from the cross that defines the eastern corner of the holy ground and pass it four times over the head and shoulders of the person for whom the ceremonial is being given.

"Symbols that tell what to do" appear to be the only ones in the Silas John script that sometimes lack unique linguistic referents. We have seen, for example, that the referent of compound symbol 1 (*yoosn bihadndin*: God, his sacred pollen) is identical to that of compound symbols 2 and 3. Nor do all symbols of this type possess unique kinesic referents; the actions associated with compound symbol 10 are exactly the same as those associated with com-

pound symbol 11. It should be noted, however, that symbols with identical linguistic referents never possess the same kinesic referents, and vice-versa. In other words, two symbols may be kinesic allographs or they may be linguistic allographs, but they are never both at once.

According to one of our informants, the kinesic values of "symbols that tell what to do" are indirectly expressed by their linguistic referents. In some instances, this seems plausible, as when compound symbol 17 (*šii šihadndinihi*: mine, that which is my sacred pollen) calls for the ceremonial leader to bless himself with cattail pollen. In other cases, however, the relationship is more obscure, as with compound symbol 2 (*yoosn bihadndin*: God, his sacred pollen), which requires the ceremonial leader to perform a blessing on his ritual paraphernalia.

What is significant is not that symbols vary to the extent that their kinesic values can be inferred from their linguistic referents, but rather that they encode both kinds of information. Silas John might easily have chosen to convey kinesic instructions with one set of symbols and linguistic instructions with another. Instead, he created a script in which single symbols function in both capacities, thereby reducing the total number of symbols in the system and endowing it with added economy.

It should now be possible for the reader of this article to translate into speech and action any or all of the prayer-texts in our corpus. At this stage, of course, he will not have memorized the referent or referents of every symbol element and therefore will not be able to read spontaneously. However, he has been provided a complete inventory of these referents as well as an explicit formulation of the rules that govern their combination and interpretation.

In general terms, the reader of a prayer-text must be able to distinguish compound symbols from noncompound symbols, associate each with a particular linguistic construction, and pronounce that construction in Western Apache. In addition, he must be able to recognize symbols that call for nonverbal behavior, associate each of these with a particular kinesic referent, and transform that referent into the appropriate set of ritual gestures. With these skills and an ability to apply them swiftly and flawlessly in the physical context of a "holy ground," the newly literate reader should be able to give a total performance that comes satisfactorily close to that expected of an experienced Apache ceremonial leader.

Translation of a "Prayer for Life"

As an illustration of what these performances consist of, we now present a detailed account of the "prayer for life" that appears in Fig. 1. The Apache text is accompanied by full kinesic instructions and a free translation, in which we attempt to capture some of the drama and dignity of Silas John's ritual poetry. Numbers refer to symbols in Text 1, Fig. 2.

1. *ni??aɣolzą́ną?*—when the earth was first created
2. *?iiyaa? ?aɣolzą́ną?*—when the sky was first created
3. *daitsee dagoyą́ną? ni??iłdįįžę?*—in the beginning, when all was started in the center of the earth
4. *yoosn bihadndin*—God's sacred pollen (Take a pinch of sacred pollen in the right hand and place a small amount on each item of the ritual paraphernalia.)
5. *hadndin ?iłna?aahi*—a cross of sacred pollen
6. *hadndin hidaahi*—living sacred pollen
7. *hadndin ?iłna?aahi dįįyo nadiyooł*—a cross of sacred pollen breathing in four directions (Take a pinch of sacred pollen in the right hand and place a small amount on each arm of the ceremonial cross that marks the eastern corner of the holy ground.)
8. *yoosn bihadndin ?iłna?aahi hidaahi*—God's cross of living sacred pollen.
9. *šii šihadndinihi*—My own, my sacred pollen (Face toward the east, extend fully the right arm, fold the left arm across the chest, and bow the head. After remaining in this position for a few moments, drop the left arm and trace the sign of a cross on one's chest.)
10. *šii ši?okąą́hi*—my own, my prayer
11. *šilagan hadą́ą́žę? dįįgo bihadaa?istįįgo*—like four rays, power is flowing forth from the tips of my fingers *šilagan hadą́ą́žę? biha?dit?įįgo*—power from the tips of my fingers brings forth light
12. *dašižǫ? beišgaał č?idii*—now it is known that I go forth with power
13. *nagostsan biɣalatažę?*—On the surface of the world
14. *nagowaahi nagoščǫ́odi nagołdiihi behe?gozini*—sinful things are occurring, bad things are occurring, sickness and evil are occurring, together with harmful knowledge
15. *dįįžę? biłhadaagoyaa*—in four directions, these things are dispersed and fade away (Take a pinch of sacred pollen in the right hand and place a small amount on each arm of the cross that marks the eastern corner of the holy ground.)
16. *bitl?anabą́ą́žę yoosn biyi? siziįhi*—following this, God came to live with man
17. *yoosn binadidzoołhi*—the breath of God
18. *yoosn bihadndin*—God's sacred pollen (Take a pinch of sacred pollen in the right hand and trace four circles in the air directly over the ritual paraphernalia.)
19. *yoosn*—God Himself
20. *hadndin hidaahi*—living sacred pollen

Summary and Conclusion

At the outset of this article, it was observed that the adequacy of an etic typology of written symbols could be judged by its ability to describe all the emic distinctions in all the writing systems of the world. In conclusion, we should like to return to this point and briefly examine the extent to which currently available etic concepts can be used to describe the distinctions made by Western Apaches in relation to the writing system of Silas John.

Every symbol in the Silas John script may be classified as a phonetic-semantic sign. Symbols of this type denote linguistic expressions that consist of one or more words and contrast as a class with phonetic-nonsemantic signs, which denote phonemes (or phoneme clusters), syllables (or syllable clusters), and various prosodic phenomena (*2*, pp. 2, 248).

Phonetic semantic signs are commonly partitioned into two subclasses: logographs (which denote single words) and phraseographs (which denote one or more words). Although every symbol in the Silas John script can be assigned to one or the other of these categories, such an exercise is without justification (*21*). We have no evidence to suggest that Western Apaches classify symbols according to the length or complexity of their linguistic referents, and therefore the imposition of distinctions based on these criteria would be inappropriate and misleading.

A far more useful contrast, and one we have already employed, is presented

in most etic typologies as an opposition between compound (composite) and noncompound (noncomposite) symbols. Used to break down the category of phonetic-semantic signs, these two concepts enable us to describe more or less exactly the distinction Apaches draw between "symbol elements put together" (*ke?eščin łedidilgoh*) and "symbol elements standing alone" (*ke?-eščin dołedidildaahi*). The former may now be defined as consisting of compound phonetic-semantic signs, while the latter is composed of noncompound phonetic-semantic signs.

Up to this point, etic concepts have served us well. However, a deficiency appears when we search for a terminology that allows us to describe the distinction between "symbols that tell what to say" and "symbols that tell what to do." As far as we have been able to determine, standard typologies make no provision for this kind of contrast, apparently because their creators have tacitly assumed that systems composed of phonetic-semantic signs serve exclusively to communicate linguistic information. Consequently, the possibility that these systems might also convey nonlinguistic information seems to have been ignored. This oversight may be a product of Western ethnocentrism; after all, it is we who use alphabets who most frequently associate writing with language (*22*). On the other hand, it may simply stem from the fact that systems incorporating symbols with kinesic referents are exceedingly rare and have not yet been reported. In any case, it is important to recognize that the etic inventory is not complete.

Retaining the term "phonetic sign" as a label for written symbols that denote linguistic phenomena, we propose that the term "kinetic sign" be introduced to label symbols that denote sequences of nonverbal behavior. Symbols of the latter type that simultaneously denote some unit of language may be classified as "phonetic-kinetic" signs. With these concepts, the contrast between "symbols that tell what to say" and "symbols that tell what to do" can be rephrased as one that distinguishes phonetic signs (by definition nonkinetic) from phonetic-kinetic signs. Purely kinetic signs—symbols that refer solely to physical gestures—are absent from the Silas John script.

The utility of the kinetic sign and the phonetic-kinetic sign as comparative concepts must ultimately be judged on the basis of their capacity to clarify and describe emic distinctions in other systems of writing. However, as we have previously pointed out, ethnographic studies of American Indian systems that address themselves to the identification of these distinctions—and thus provide the information necessary to evaluate the relevance and applicability of etic concepts—are in very short supply. As a result, meaningful comparisons cannot be made. At this point, we simply lack the data with which to determine whether the kinetic component so prominent in the Silas John script is unique or whether it had counterparts elsewhere in North America.

The view is still prevalent among anthropologists and linguists that the great majority of American Indian writing systems conform to one or two global "primitive" types. Our study of the Silas John script casts doubt upon this position, for it demonstrates that fundamental emic distinctions remain to be discovered and that existing etic frameworks are less than adequately equipped to describe them. The implications of these findings are clear. On the one hand, we must acknowledge the possibility that several structurally distinct forms of writing were developed by North America's Indian cultures. Concomitantly, we must be prepared to abandon traditional ideas of typological similarity and simplicity among these systems in favor of those that take into account variation and complexity.

References and Notes

1. G. Mallery, *Annu. Rep. Bur. Amer. Ethnol.* **4**, 25 (1886).
2. I. J. Gelb, *A Study of Writing* (Univ. of Chicago Press, Chicago, 1963). We have adapted Gelb's broad definition of writing as "a system of human intercommunication by means of conventional visible marks" (p. 12). The Silas John system is a script because it consists of phonetic signs.
3. K. H. Basso, *The Cibecue Apache* (Holt. Rinehart & Winston, New York, 1970), p. → G. Goodwin and C. R. Kaut, *Southwest. J. Anthropol.* **10**, 385 (1954); W. La Barre, *Curr. Anthropol.* **12**, 26 (1971); M. Opler *An Apache Odyssey* (Holt, Rinehart & Winston, New York, 1969), p. 191; E. H. Spicer, *Cycles of Conquest* (Univ. of Arizona Press, Tucson, 1962), pp. 259–60, 532, 534. References to the impact of the Silas John movement upon Western Apache and Mescalero Apache religion are not infrequent, but a systematic appraisal of the cultural and historical factors that precipitated its appearance and acceptance has yet to be made. The earliest example of the Silas John script consists of the texts of two prayers recorded by Harry Hoijer on the Mescalero Reservation in New Mexico during the summer of 1931. A number of symbols that occur in Hoijer's Mescalero texts are absent from those we collected at San Carlos (and vice versa), but at present we do not know whether these symbols represent innovations by the Mescalero or whether they originally appeared in Western Apache texts not included in our sample.
4. A. L. Kroeber, *Anthropology* (Harcourt, Brace, New York, 1948) pp. 369–70.
5. P. E. Cleator, *Lost Languages* (Hale, London, 1959); M. Cohen, *La Grande Invention de l'Ecriture et son Evolution* (Imprimeur National, Paris, 1958); D. Diringer, *The Alphabet* (Hutchinson's, London, 1949); *Writing* (Praeger, New York, 1962); J. Février, *Histoire de l'Ecriture* (Payot, Paris, 1948); G. Mallery, *Annu. Rep. Bur. Amer. Ethnol.* **10**, 25 (1893); A. C. Moorhouse, *The Triumph of the Alphabet* (Schuman, New York, 1953).
6. C. F. Voegelin and F. M. Voegelin, *Anthropol. Ling.* **3**, 55 (1961).
7. The terms "etic" and "emic" are used in this article to refer to contrasting types of anthropological description. A description of a linguistic or cultural system is emic to the extent that it is based on distinctions which are demonstrably meaningful and functionally significant for competent users of the system. A description is etic to the extent that it rests upon distinctions (typically drawn from crosscultural typologies) whose meaningfulness for a particular system's users has not been demonstrated and whose functional significance within the system is therefore open to question. For an extended treatment of the etic-emic distinction and its implications, see W. H. Goodenough (*8*). Other general discussions of this topic include W. H. Goodenough, *Culture, Language and Society* (Addison-Wesley, Reading, Mass., 1971); D. H. Hymes, in *Method and Theory in Linguistics*, P. L. Gavin, Ed. (Mouton, The Hague, 1970), pp. 249–325; K. Pike, *Language in Relation to a Unified Theory of the Structure of Human Behavior* (Mouton, The Hague, 1967); W. C. Sturtevant, *Amer. Anthropol.* **66**, 99 (1964).
8. W. H. Goodenough, *Description and Comparison in Cultural Anthropology* (Aldine, Chicago, 1970).
9. As a general methodological premise in cultural anthropology, this point has been made repeatedly in recent years. However, its relevance to the study of writing systems has not been explicitly noted. We are inclined to attribute this to two major factors. On the one hand, cultural anthropologists have not been accustomed to view the description of writing systems as an exercise in ethnographic theory construction. On the other, students of writing seem only rarely to look to modern anthropology for theories and methods that might aid them in their own investigation.
10. K. H. Basso, "An annotated bibliography of American Indian writing systems" (unpubl. ms., 1971, in the Arizona State Museum Library, University of Arizona, Tucson).
11. For example, we were unable to record the full inventory of symbols used by Silas John to write his 62 original prayers.
12. "Power" is the power God confers upon those who truly believe in Him.
13. "Harmful knowledge" refers to the body of techniques employed by "witches" (*?iłkašn*) to cause sickness and misfortune. For a description of some of these techniques, see K. H. Basso, *Western Apache Witchcraft* (Univ. of Arizona Press, Tucson, 1969).
14. This is the ritual name of Silas John. It is spoken only during the performance of ceremonials.
15. In all rituals associated with the Silas John religion, the phrase *hadndin ?iškiin* (sacred pollen boy) refers metaphorically to male ceremonial patients. If the patient is female, the phrase is modified accordingly to *hadndin nailin* (sacred pollen maiden).
16. In traditional Western Apache myths and prayers, the term *naalezgane* is the name of a prominent male figure who, with a twin brother, rid the earth of much that was evil and made it a suitable dwelling place for man. See G. Goodwin, *Amer. Folklore Soc.* **Mem. 33**, 1 (1939). Silas John uses the term in an extended sense to refer to Jesus.
17. In all the prayers we collected, the term *?indee* (man, men) is used in the more general sense of "all men" or "mankind."
18. Cattail pollen is the foremost cultural symbol of God and Jesus and their spiritual presence upon this earth.
19. Like God and Jesus, pollen is construed as having life.
20. Pollen, a symbol of God, has life; to live is to breathe, hence the equation of pollen with the breath of God.
21. Writen symbols that denote single phonemes (alphabetic graphs) and single syllables (syllabic graphs) are absent from the Silas John script. Four symbols in our corpus (class A-2; class B-14, 15; class C-3; all in Fig. 5) represent clear borrowings from the English alphabet, but all of these denote specific words or sentences and, as such, would have to be classified as logographs or phraseographs.

22. In this connection, it is interesting to note that etic concepts for the classification of alphabetic and syllabic systems have received far more attention—and have proven far more adequate—than those used to classify simpler forms of writing. See, for example, the classification of alphabetic systems by C. F. Voegelin and F. M. Voegelin (*6*).

23. We thank the following Western Apaches, whose understanding, cooperation, and friendship made this study possible: Silas John Edwards, for permission to undertake the study, to publish the results, and for providing us with essential information about the origin and history of his writing system; Marshall Miller, for gifted instruction in how to read; John Nolene, for his generous loan; Marion and Violet Zahgotah, who allowed us to disrupt the daily routine of their household and never once complained; and Maggie Anderson, who opened her home to us as a base of operations and whose advice, warmth, and sheer goodwill made everything that much better. We also thank David Schneider who brought the Silas John script to our attention by pointing out the presence of Harry Hoijer's Mescalero texts in an unpublished manuscript by the late Jules Henry. Henry had given Schneider access to the manuscript, and Schneider supposed, quite correctly, that it would be of singular interest to us. We are grateful to Harry Hoijer for allowing us to examine his original field notes. Finally, we thank Bernard Fontana, Dell Hymes, William Sturtevant, and Sol Tax, who urged us not to delay our investigation and took steps that enabled us to begin. Our field research was sponsored by the Center for the Study of Man, Smithsonian Institution, Washington, D.C., and the Doris Duke American Indian Oral History Project, Arizona State Museum, University of Arizona. Finally, we thank the following scholars, whose comments on an earlier draft of this paper were especially helpful: Ellen Basso, Roy D'Andrade, Harold Conklin, Regna Darnell, Bernard L. Fontana, I. J. Gelb, Erving Goffman, McGuire Gibson, Philip Greenfeld, Kenneth Hale, Harry Hoijer, Dell Hymes, Morris Opler, Alfonso Ortiz, Joel Sherzer, William Sturtevant, and Richard Thompson.

Zymogens of Proteolytic Enzymes

These enzyme precursors, formerly thought to be inert substances, have inherent proteolytic activity.

Beatrice Kassell and John Kay

The enzymes that digest proteins in the alimentary canal are synthesized as precursors called zymogens. These zymogens are stored in granules (*1*) in the synthesizing organ; for example, pepsinogen in the lining of the stomach and trypsinogen, chymotrypsinogen, proelastase, and procarboxypeptidases in the pancreas. Synthesis as precursors and storage in granules protect the tissues from self-destruction by their own enzymes.

The ingestion of food causes secretion of hydrochloric acid into the stomach along with pepsinogen and other components of the gastric juice. On contact with acid, by a process called autoactivation, pepsinogen is converted to pepsin (*2*), which is the enzyme responsible for gastric digestion of proteins. Similarly, the exocrine pancreas secretes its zymogens into the duodenum, the first part of the intestine, where the activation process begins with the conversion of trypsinogen to trypsin. This activation can be accomplished in two ways, either by the action of enterokinase, an enzyme of the intestinal wall (*3*), or by autoactivation. Under physiological conditions, activation by enterokinase is probably the predominant reaction (*4*) but in vitro, trypsinogen undergoes autoactivation in the absence of enterokinase (*3*).

Trypsin is a key enzyme important for the conversion of other zymogens to their active enzymes, for example, chymotrypsinogens to chymotrypsins, proelastase to elastase, and procarboxypeptidases to carboxypeptidases. These enzymes, all acting at their own specific sites in protein macromolecules, cooperatively break down food proteins to small peptides and amino acids.

The activation of pepsinogen and trypsinogen in vitro are the two classical examples of autoactivation (*2, 3*). Activation begins slowly, but as enzyme is formed, it catalyzes further activation and a rapid acceleration takes place. An S-shaped curve is obtained for the appearance of enzymic activity, as illustrated for trypsinogen in Fig. 1. It has been assumed for many years that activation is initiated by a small amount of active enzyme present as a contaminant. This does not explain how the *first* molecule of pepsin or trypsin was formed.

The process of conversion of the zymogens to enzymes occurs by hydrolysis of a peptide linkage, usually accompanied by removal of a fragment from the amino terminal of the protein chain, and thus involves proteolytic action by the activating agent. The formation of physiologically active molecules by limited proteolysis has been reviewed (*5*) and is not restricted to formation of digestive enzymes or to higher organisms. To cite a few examples, insulin is formed from a larger protein called proinsulin (*6*); a series of proteolytic reactions forms the enzymes that participate in blood clotting (*7*); phospholipase A of porcine pancreas is formed from its zymogen by the action of trypsin (*8*); the peptide hormone, gastrin, is derived from a larger molecule (*9*); and a streptococcal proteinase is derived from a zymogen (*10, 11*). Thus these zymogen to enzyme conversions are part of a general process by which macromolecules are synthesized in precursor forms and are converted by enzymic modification to physiologically active substances.

In this article we discuss the recent discovery that certain zymogens have inherent enzymic activity so that in some instances they are capable of activating themselves. In this way, they are capable of producing the elusive first enzyme molecule. We consider the evidence for this activity in some detail, using as illustrations the zymogens of different types of proteolytic enzymes: acid proteases, serine proteases, a sulfhydryl enzyme, and a metalloenzyme.

Acid Proteases

The first suggestion that a zymogen may have activation power of its own was made by Foltmann (*12, 13*) who conducted studies with prorennin, the precursor of the milk-clotting enzyme, rennin (chymosin) of the calf stomach. Above *p*H 5.3 prorennin is relatively stable. Between *p*H 5 and *p*H 2, as the *p*H is lowered the rate of activation is

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