

FORMALISATION AND ORALITY IN PĀṆINI'S AṢṬĀDHYĀYĪ

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The first sample of advanced formalised language in the universal history of science is the technical language of Pāṇini's grammar. Considering the great number of devices used by the grammarian to formulate rules of generation of words and sentences, the bold alterations that he has brought to natural features of the language, the regularity of these procedures, we can say that Pāṇini is really the creator of a metalanguage. His methods of formalisation are different from those of modern scientists, chiefly because of their oral character. Modern formalisation, such as the mathematical one, relies entirely on writing and on visual typographical signs. Pāṇini's methods rely on oral devices based on natural features of spoken language. The main devices of formalisation in his exposition are: use of phonemes as markers to indicate qualifications; use of pronouns to indicate variables; use of compounds and of ellipsis (*anuvṛthi*) to indicate conjunction abbreviations; management of lists for easy memorisation, etc. We note that all these devices have a base in the spoken form of the language, the use of which is extended far beyond the natural limits, without any reliance on writing.

Pāṇini's work has a prominent place in the history of ancient science for two reasons: (1) its objective approach of the subject, and (2) its formalized language. Pāṇini's *Aṣṭādhyāyī* contains a description of the components of Sanskrit words and sentences, which is quite accurate and does not indulge in any kind of non-realistic speculation. It reveals a high power of observation of reality which is not marred by any irrational attitude of mind. The subject matter of the book is the way to build up a Sanskrit sentence from the basic elements of the language, i.e. roots and affixes. The emphasis is on procedures. There is an evident practical goal; it provides answers to the question: when one wants to express a meaning, what are the available elements in language for this purpose and how to join them? The book has been composed in order to enable the user to express his ideas in definite sets of word forms deemed to be correct if the enjoined procedures have been applied.

Therefore, the author has paid utmost attention to the presentation of his rules, to make them fit for the purpose. The language of presentation is Sanskrit, which is also the object language. It is obvious that there is some difference between the language of presentation and the described language. And this difference is large enough to make modern scientists agree in calling Pāṇini's language of presentation a real metalanguage. Pāṇini's attempt at formalisation is the most ancient one known to universal history of science. Of course, it is not comparable to modern formal languages in every aspect. But its high degree of formalisation remains unique for its

time, and Europe has reached such a high degree only in modern times.

Pāṇini's metalanguage displays very original characteristics, when compared with modern formal languages. The purpose of this article is to show the oral nature of Pāṇini's formalisation devices, in contrast with the written devices of modern culture. A common statement of modern historians of science and anthropologists is that writing has permitted the development of science and has been a necessary instrument for the rise of scientific knowledge. The service of writing to the human mind cannot be denied. But one cannot also deny that, without writing, the human mind was able of remarkable progress and achievements. The historian of science has to record all of man's attempts at enlarging and improving his knowledge. Pāṇini's attempts are quite remarkable, even though they appear to have been made without the help of writing.

The date of Pāṇini is a subject of controversy, as well as the time of appearance of writing in India. Current hypotheses place the grammarian around the fifth century BC. That writing existed in India at that time has not been definitely proved to be untrue. There is a possible mention of writing in the *Aṣṭādhyāyī* itself. *Sūtra* "indra-varuṇa-bhava-śarva-rudra-mṛḍa-hima-aranya-yava-yavana-mātula-ācāryāṇām ānuk" 4.1.49 allows the formation of the word *yavanānī* (*yavana-ān-ī*), which according to Kātyāyana's *Vārttika* "yavanāl lipyām iti vaktavyam" refers specifically to a script which may be the Greek script or even a script of the Ancient Near East, such as the aramaic script of the Near East, to which Ancient India was certainly exposed when the Persian Empire extended its dominion over Gandhāra and Sindhu, from the sixth to the fourth century BC. Now, Pāṇini may have had knowledge of writing and may have used it for some purpose. That does not imply that he necessarily used it for the composition of his grammar. On the contrary, a careful scrutiny of *Aṣṭādhyāyī* does not show that he composed his work with reliance on written or visual devices, nor with the idea that it should be used in written form.

The *Aṣṭādhyāyī* appears to be composed and arranged for being committed to memory, circulated through oral channel and orally used in practical applications. History shows that it was used in this way for more than two millennia. Even in modern times, when writing is the most practical tool for education and communication of intellectual matter, when the text is available in a plenty of printed editions with many helpful tools to handle it and apply the rules. such as *indices*, comments, charts, etc., even then many traditional Sanskrit *pandits* know the text by heart and obviously have no difficulty in using it for practical purposes without the help of books and writing. Many claim that it is easier to handle the grammatical matter when the complete text with its appendices, *dhātupāṭha*, etc. is present in the mind, than when a manuscript or a modern printed book is consulted. Any researcher who has not committed the text to memory will confess that this claim is perfectly true. One explanation of this fact is the oral character of the formalisation.

Pāṇini was well aware of the difference between his metalanguage and normal

language. He calls the latter *bhāṣā* “spoken language”¹ and the former *upadeśa*, for instance, in *sūtra* “upadesē’j anunāsikaḥ (a nasalised vowel in the *upadeśa* receives the technical name *it*)” 1.3.2. This *sūtra* applies to markers added by Pāṇini to word-forms in order to signal some of their characteristics. These markers do not belong to the spoken language; they pertain only to the describing metalanguage.

Pāṇini was also well aware of the fact that the words and forms belonging to his metalanguage, but not to the normal language, were created, in contrast with normal language which is held as eternal, at least as already realised (*siddha*) when the speaker uses it, being always inherited by him from elders and never created by the grammarian. He was himself the creator of some new technical names and technical modes of expression. He also uses some technical words and devices which he does not define himself, but which he had received from earlier grammarians considered as their authors.

He was aware of the difference between the use of a word to refer to its meaning in normal language, and the use of a word to refer to its form in grammatical description. He felt the need to define the latter as a technical name of the form of a word: “*svam rūpaṃ śabdasyāśabdasamjñā*” 1.1.68. In normal usage when a word is heard, the form is perceived as it is and the meaning is understood. In a rule of grammar, an operation is enjoined as applicable to the form and only to the form; the notation of the meaning is not relevant. Therefore, Pāṇini states: “The proper form is the object denoted by a word (in the grammar), except in the case of a technical name of a word”. The word enunciated in a rule is the technical name of its form. In “*agner dhak* (the suffix *dhak* (*eya*) comes after *agni*)” the wording “*agneḥ*” denotes the form *agni* only and consequently the operation, i.e. the suffixation of *dhak*, will be applied to the form *agni*. In modern European grammars, the convention is to place the form of a word between quotes or in italics, in order to signal the shift from the normal denotation of the meaning to the technical denotation of the form. The way of signalling that shift is a punctuation mark or a printing device. This is a purely visual feature. We remark that Pāṇini has used here the mere oral utterance of the word to express the form and in order to signal the shift he had to formulate as a special convention that in his treatise a word, when enunciated, referred to its form instead of its meaning. No punctuation mark, no written sign were at his disposal. His material was only the sounds of the word. He had nothing else than the form of the word to express the form. And he has not introduced any additional marker to obtain this expressivity.

The denotation of the form by a word is possible in natural language, even though it is a rare procedure. A stock example of Indian grammarians is: “*rāmeti dvyakṣaraṃ nāma manābhaṅgaḥ pinākinaḥ | gravabhaṅgo bhārgavasya śauryabhaṅgaś ca vāliṅgaḥ ||* (the name of two syllables ‘*rāma*’ breaks the pride of Pinākin, the arrogance of Bhārgava and the valour of Vālin)”, where the particle *iti* indicates that the words ‘*rāma*’ and ‘*nāma*’ refer to the same object, i.e. the form of the word, not the hero. When Pāṇini declares that the word enunciated in his rules denotes its form, he does

not create a totally new mode of expression; he extends an existing feature of natural language.

The most striking feature of Pāṇini's formalisation is the creation of markers². They are sounds attached to speech elements in order to indicate some particular property. For instance, the marker *ṇ* attached to a *taddhita* suffix indicates a *vrddhi* replacement of the first vowel of the base. Pāṇini has used almost all the sounds of Sanskrit as markers, but as a general rule the sounds selected for this purpose are not the most frequent sounds of Sanskrit, or if they are frequent they are placed in unusual positions, so that there is no conflict with real words. For example, the most common markers are (1) nasalised vowels which are not in use in Sanskrit; (2) final consonants, which are less frequent than final vowels, for example, the guttural and palatal nasal *ṇ* and *ṅ* used independently by Pāṇini, whereas in the natural language they occur only in connection with *k kh g gh* and *c ch j jh* respectively; (3) initial retroflex consonants, which are rare; (4) *ṣ*, palatal and retroflex consonants at the beginning of a suffix; (5) *l*, *ṣ* and gutturals in a non-secondary suffix; the situations (4) and (5) do not occur in usage, with only rare exceptions; (6) *anudātta* and *svarita* accents, etc.

We remark that Pāṇini has used also properties of sounds as markers. This is the case with nasality and accents. In fact, the enunciation of nasality or accent cannot be done without the enunciation of the sound which they qualify. So Pāṇini formulates the vowel with the property. When he says "anudāttaṇita ātmanepadam (the *ātmanepada* endings appear after roots marked by the *anudātta* accent or by *ṇ*)" 1.3.12, this is a reference to the enunciation of *édhém*, *spárdhám*³, etc. in his *Dhātupāṭha*, where the final *a* is enunciated only as a support for the nasality and accent markers.

By definition, a marker has a significance. However, in Pāṇini's wordings there appear sounds, which are appended to original elements, but for which no special significance is ascribed. Their function is to be a mere support for a significant marker, as we have seen, or just to render a wording fit for easy pronunciation. For example, the marker *p* is to be appended to the suffix *mat* to indicate that it is unaccented; the non-significant vowel *u* is inserted to make the pronounceable sequence: *matup*. The same vowel *u* is often added in designations of increments. The marker *ṭ* indicates that an increment is placed at the beginning, the marker *m* indicates that it is placed after the last vowel, the marker *k* indicates that it is placed at the end of the element to which it has to be applied. Several increments are made of a single consonant, *n*, for the plural genitive ending *ām*, in *rāmāṇām*, etc.; *n* after the last vowel of a stem ending in a consonant, *s* etc., in *manāṃsi*, etc.; *t* at the end of a vowel-ending root before the suffix *kvip* (=ϕ), in *-kṛt*, etc.; these increments are designated by the respective names *nut*, *num*, *tuk* with the non-significant letter *u* inserted only for pronunciation. In the enunciation of a set of elements, vowels, usually *a* for *i*, are freely inserted by Pāṇini for the ease of pronunciation; see, for example, the list of consonant-ending roots in: "ruda-vida-muṣagrahi-svapi-pracchaḥ saṃś ca" 1.2.8, etc.

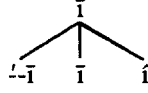
For the selection of his markers, Pāṇini has used only sounds taken in the natural language, but has not always used them in the positions naturally allowed in that language. He has selected his markers, starting from the material available in the natural language and has gone beyond the natural ways of using this material. This procedure could be achieved in the frame of orality. The fact that he has inserted vowels for the sake of easy pronunciation in all cases where appending consonantal markers would have created some difficulty, shows that he devised his system of markers only in that frame. We remark also that Pāṇini has used this device profusely. There is practically no basic grammatical element, i.e. root, suffix, substitute, increment, which has not been specified with at least one marker, and some elements have received more than one. There is no similar regular use of markers in the modern formalization of linguists and other scientists. Pāṇini's markers produce new words similar to words of the natural language; they are inflected and submitted to the rules of syntax in the same way. Symbolic letters are used profusely in modern formalization, but they remain independent objects, generally do not enter in words of the natural language and do not form words by themselves.

Modern translators usually transliterate Pāṇini's wordings with the help of some typographic devices to distinguish markers from original elements, for example, 'nUṬ, nUM, tUK' or *nuṭ, num, tuk*', etc. The visual sign in the form of lower case versus upper case character or roman versus italics shows the difference. Pāṇini has made eight general rules to recognize sounds as markers from their position in word-form, but has no special sign to add to the marker to indicate that it is a marker. Only vowels used as markers are identified as such by the nasality which marks them. We remark that this is again an oral device. There is no visual marker of a marker.

Markers are generally used to specify a property of an object. They are *viśeṣaṅgārtha*. In some cases, a marker aims at showing that several elements have a character in common. They are *sāmānyārtha*. For example, there are three accentual situations for the word ending with the feminine suffix *ī*: the base placed before *ī* is accented on its first syllable (*śārṅgaravī*) or the base retains its original accent when it is followed by *ī* and the suffix remains non-accented (*daṇḍīnī*), or the feminine suffix itself is accented (*nartakī*). Pāṇini describes these situations by appending markers to the suffix: *n* refers to the first situation, *p* to the second and *ṣ* to the third. In some rules, there is no need to specify the accentual differences; a common designation of the feminine suffix is required; the marker *ñ* is used for this common purpose. So four designations are used by Pāṇini: *ñī* is a common one and refers to the feminine suffix *ī*, whatever is the accent; the three accentual situations are referred to by *ñīn*, *ñīp* and *ñīṣ*. The marker *ñ* serves only the purpose of a common designation.

We remark that Pāṇini uses a sound, whereas in such a case modern formalization generally takes recourse to a typographical indication, for example using an upper case letter for the common designation and numbered lower case letters for the specific objects: *I* versus *ī_p*, *ī₂*, *ī_ṣ*. In roman transliterations done by Pāṇini's translators are found such devices as: *!-ī* for *ñīn*, *ī* for *ñīp*, *ī* for *ñīṣ*. Nowadays, the most convenient

device to denote a hierarchy of objects, such as the relation of general and particulars, appears to be the visual design of a tree:

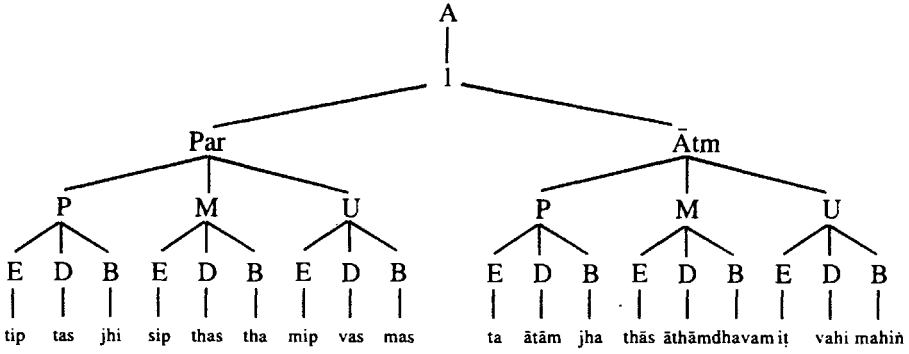


Pāṇini has other methods to signify such hierarchies, and his methods are based only on the possibilities of oral language. There are two sets of nine verbal personal endings, *tip*, *tas*, *jhi*, etc. They have the common property to occur when the speaker wants to express the idea of agent, etc. of the action signified by the verbal root. In order to state this fact Pāṇini requires a common designation for the 18 endings. There is no letter common to all of them. In order to refer to all of them by one word, Pāṇini has the wording ‘laḥ “laḥ (kartari) karmaṇi ca...” 3.4.69. This is an artificial word made of the stem (*prātipadika*) ‘I’ with the letter *a* for easy pronunciation and the nominative ending. By the quoted rule, *l* appears to be a suffix occurring after a root when the meaning is agent, object, etc.; we obtain, for example, an artificial form ‘kṛ-l’ to signify ‘the agent of the action to do’. Then another rule introduces the real endings *tip*, etc. as replacements of this suffix *l*. Each of these is told to occur to express an individual meaning, i.e. first person singular, etc. The rule is: “lasya, tip-tas-jhi-sip-tas-tha-mib-vas-mas-ta-ātām-jha-thās-āthām-dhvam-iḍ-vahi-mahiṅ” 3.4.77-78; it means: “in place of *l tip*, etc. occur”.

The list “tip-....” contains 18 items. The technical name ‘parasmaipada’ is prescribed for each of these items by the rule “laḥ parasmaipadam” 1.4.99, where the common designation “laḥ” is used for all the items of the list. This rule is a general one (*utsarga*). Its application is prevented in a number of particular cases stated in a subsequent restrictive rule (*apāvada*) “tañānāv ātmanepadam” 1.4.100 which cancels the application of the name ‘parasmaipada’ for the 9 items *ta* to *mahiṅ* in the above list and prescribes for them the name ‘ātmanepada’. A subsequent rule considers the 18 items three by three and prescribes three names ‘prathama, madhyama, uttama’ as applicable to the sets of three in the order of enumeration, i.e. two times to three sets: ‘prathama’ applies to “tip-tas-jhi” and “ta-ātām-jha”, etc. The subsequent rule considers these sets of three and prescribes again three names for the respective members of each one: “tāny ekavacana-dvivacana-bahuvacanāny ekaśaḥ”.

The basic set is enunciated only once. There is no repetition of any of the items. The reference to all the list is done through the mention of the suffix *l*. The consideration of sub-sets is enjoined with distributive expressions “tṛṇi tṛṇi”, “ekaśaḥ” with reference to the list. Thus, Pāṇini presents in a very short compass an ordered classification and we remark again that he uses only linguistic oral devices. There is no use of writing to handle such a system of references to diverse items.

Modern formalization habits will handle the same classification through a chart or a tree:



(A = suffix expressing the agent; Par = parasmaipada; Ātm = ātmanepada; P = prathama; M = Madhyama; U = uttama; E = ekavacana; D = dvivacana; B = bahuvacana)

A list of 18 items can be easily memorized and handled without any external help. Long lists may create more difficulty. Pāṇini gives them a separate treatment. Short lists are inserted in the *sūtras* which prescribe some operation to be applied to their items. Long lists have been composed and, even if there is only one rule dealing with them, they have not been inserted in the text of that rule. They have been separated and are kept in an appendix to the *Aṣṭādhyāyī*. This is the *Gaṇapāṭha*. The longest list is a second appendix by itself and is the *Dhātupāṭha*; it contains nearly 2000 roots (*dhātu*). A *pāṭha* is an oral recitation, not a written text. The long lists of basic grammatical elements which Pāṇini has collected and ordered are conceived as pieces for oral recitation to be memorized, like the *Aṣṭādhyāyī* itself. An operation applicable to one of these lists is formulated in a *sūtra* with a reference to the list in the form of a *bahuvrīhi* compound made of the first item followed by the word *ādi* 'beginning': "gargādibhyo yañ (the patronymic suffix *yañ* occurs after words, the first of which is *garga*" 4.1.105, etc. Long lists are eventually subdivided. Lists and sub-lists are named by the head item with the word *ādi* or *prabhṛti*. The technical word *vṛt* is inserted in *Dhātupāṭha* to indicate the end of a sub-list. There is no indication that even the longest lists were written and that writing was necessary to handle them. The system is done for memorization. It appears that the well-trained user, i.e. the traditional pandit who has learnt the *Aṣṭādhyāyī* and its appendices verbatim from his young age, is able to find a reference to a list, a part of list or a single item, in less time than the user of modern printed *indices*.

An important component of a formal language is the device to express variables. In modern formalization, the most common device is the use of a symbolic letter, generally "x". This is a graphic notation. The symbol is the letter taken in the alphabet of Latin script. Pāṇini has not used a written letter, nor a symbolic pronounced sound. He used sounds only as markers of existing words or speech elements, in order to make well-formed expressions similar to natural words. We have seen that his use of markers is very different from the use of symbolic written letters. To express variables, he selected a mode of expression current in the natural language, i.e. the use of

pronouns. A pronoun which he calls ‘sarvanāman’ litt. ‘name for all’ is a word inviting reference to a set of terms which are present in the mind of the speaker or which the speaker has the capacity to call to his mind. A variable enunciated in a formula is such that the user of the formula may replace it by an item at his disposal, to which he will apply the operation enjoined in the formula. This situation occurs often in *Aṣṭādhyāyī*. For example, Pāṇini declares the meaning of a suffix; a suffix comes after a number of stems; its meaning is common for all the stems. The grammarian has to declare the meaning once for all the possible stems. This is done in a rule like “tasyāpatyam (descendant of this [person])” 4.1.92 formulated in the context of the prescription of patronymic suffixes *aṅ*, etc. By this rule we know that *aṅ* means “descendant of” whatever may be the name to which it is appended. “Tasya” is a mode of denoting a variable. The variable is here the meaning of the stem *prātipadika*) after which the suffix occurs. Modern formalization will write the above rule as: *aṅ* means ‘descendant of X’. This is the use of a written letter. In this case again Pāṇini relies on a mode of expression available in his spoken language.

In modern formal languages, the notation of logical connectors has a special importance and is carefully differentiated from the modes of expression provided by natural languages. This is for example ‘^’ for ‘and’ ‘v’ for ‘or’, etc. Pāṇini’s treatment cannot be compared with modern formal logic, but we can assert that he had a similar intention of formalization aiming at shortness of expression and practicability. He achieved it by relying on his natural oral language. To express conjunction Pāṇini uses three methods depending on the nature of the conjoined objects: (1) *dvandva* compounds in the establishment of a short list of words, etc.; (2) use of the conjunction *ca* to connect two rules or a small number of rules; (3) *anuvṛtti* or recurrence of a word or expression in a long list or long set of rules. *Anuvṛtti* is a feature of normal language as well as the two first methods. It is an extension of the natural device of ellipsis. Ellipsis consists in dropping a form of word, if its meaning is understood: “kumudāny eva śaśānkaḥ savitā bodhayati pañkajāny eva (Sun wakes up day-lotuses only, Moon night-lotuses only)” (*Śākuntala* 5.28), where the verb “bodhayati” is dropped in the first sentence, creating an expectancy which is filled up in the second sentence. Ellipsis works under two conditions: the proximity of mention (*saṃnidhi*), or at least the presence in the mind, of the missing item, and an expectancy (*ākāṅkṣā*) for this item. It may be a way of expressing conjunction, since an expectancy in one proposition connects it with another. Pāṇini lists the suffixes occurring after a verbal root by formulating one sentence of one word in ablative case “dhātoḥ (after a root)” 3.1.91 and formulating in subsequent sentences prescriptions of suffixes under proper circumstances: “tavyattavyānīyaraḥ (*tavyat*, etc. occur)” 3.1.96, “aco yat (*yat* occur [after a root]) ending with a vowel)” 3.1.97, etc. The word “dhātoḥ” is thus understood in some 500 rules up to the end of chapter 3. Pāṇini was aware of his going beyond the normal use of ellipsis and of the difficulty to identify recurring words. Therefore, he established a convention according to which the first mention of recurring words is marked with a *svarita* accent.

In normal use, a high number of places of recurrence seems to be untractable. In

the case of Pāṇini's grammar we have to consider that it was composed for memorisation. If it is perfectly memorised, as is done with great skill by traditional *pandits*, the user is able to consider in his mind a long set of rules, or one particular rule in a set, and to keep in mind the recurring element, without difficulty. The condition of *saṃnidhi* necessary for the mechanism of ellipsis is more easily realised in the mind, when the text is well memorised, and can only be badly represented in a written text. Therefore, the *anuvṛtti* device may be more tractable in the memorised form of the text than in its written form.

In modern written formalised expositions punctuation is a very important feature. Pāṇini ignores punctuation. And sometimes that creates ambiguities. In a system of oral teaching and communication the end of an utterance is marked by a pause of the speaker, i.e. a silence. The presence of the living teacher is necessary to ascertain the end of rules, or to separate items. The only oral indication of the end of an utterance in spoken Sanskrit is the particle *iti*. Pāṇini did not use it. And he had no oral pronounceable marker for this purpose. In written manuscripts, the vertical stroke called *daṇḍa* was introduced. The couching of *Aṣṭādhyāyī* in the written form is certainly very late. There is no clear and definite indication that a written form of *Aṣṭādhyāyī* existed originally or came in use in Ancient times. On the contrary, there is an indication that it was not in use in the time of Patañjali. The great commentator who probably belonged to the 2nd century B.C., i.e. several centuries after Pāṇini, sometimes expresses doubts about the end of utterances. He discusses the problem to know where a division can be done in a chain of *sūtras*. A method of interpretation consists in changing the division of a chain. The wording of *Aṣṭādhyāyī* is very carefully respected and preserved, but commentators have the liberty to decide where a *sūtra* ends and the next begins, to take a sequence of words as made of one or two rules. For example, the sequence "saha supā" comes in *Aṣṭādhyāyī* 2.1.4. Patañjali proposes to read it as two rules: "saha" and then "supā". He interprets the first as signifying "(samarthena) saha (sup samasyate)", which means "an inflected noun is compounded with a syntactically connected form" and permits the formation of 'anuvyācalat' where the proverbs *anu* and *vi* are compounded with the verb *ācalat*. He interprets the second rule as signifying "supā" (ca saha sup samasyate)" which means "an inflected noun is compounded with an inflected noun", provides recurrent words for following rules of composition and permits the formation of compounds not dealt with subsequently ("punarutsyūtam, punarṇiṣkṛtaḥ"). If "saha supā" is read as one sentence, compounding is limited to an inflected noun with another inflected noun, the composition of a proverb (considered by Pāṇini as inflected noun, the nominal case-ending being subsequently dropped) and a verb is not realisable. Reading the same wording as two sentences allows the formation of a compound of an inflected noun with a verb, as the limitation "supā (compounded with an inflected noun)" is rejected in the second rule.

Another example of the absence of marking of the end of an utterance is given by Patañjali, when he raises the question to know how to recognize the roots in the *Dhātupāṭha*: "parimāṇagrahaṇam ca kartvayam | iyān avadhir dhātusaṃjñō bhavātī

vaktavyam | kuto hy etad bhūśabdo dhātusamjñō bhaviṣyati na punar bhavedhaśabda iti (a mention of the size [of the form called *dhātu*] should be done: such and such limited [sequence of sounds] is called *dhātu*. How is it that only the form *bhū* will be called *dhātu*, but not the form *bhvedha*?)”. If Patañjali raises this question, it means that he knew only an oral form of *dhātupāṭha*, where there was no oral marking of the separation between the forms of the individual roots. It implies that there was no punctuation such as a *danḍa* available in a written form⁴.

Marking the end of an utterance was not provided by Pāṇini in oral form. Only written punctuation could have supplied such information. The fact that this information was not available to the successors of Pāṇini up to the time of Patañjali, since they had discussions about the ends of *sūtras* and the divisions of utterances in lists of items, leads to the surmise that no written form was in use, nor was considered as authoritative, whereas the oral form is considered as endowed with absolute authority.

To summarize the above, we see that Pāṇini has built up a formalized language which is an extension of the natural spoken form of Sanskrit he was using himself. The devices he uses are oral devices. We may test the nature of his metalanguage by searching what he did in cases where modern formal languages have created written devices of formalization. Only oral devices appear in these cases. The mere form is made the name of a word-form. The markers are not symbolic written letters; they are only oral sounds and they enter in formations of inflected words similar to the words of the natural spoken language. Variables and logical connectors are expressed with words and devices of the normal language. Written punctuation is conspicuous by its absence. Then Pāṇini's work has been received in oral form by his successors, and is being used for practical purposes with the mere support of human memory.

Thus, there are many cumulative indications that Pāṇini could have composed his *Aṣṭādhyāyī* without the help of writing. It is hard to find indications that writing was indispensable for the composition of such a work. It is probable that the transmission of the work was done through memory from generation to generation, even though writing could be used secondarily. It is a fact that nowadays the grammar is of practical use especially for those who have memorized it. Pāṇini's achievement is illustrative of the possibility of creative, rational, scientific work in the frame of an oral culture and tradition. The opinion that a formalised scientific language can be only a written one and more generally that writing is an indispensable tool to conduct a correct analysis, classification, sorting, etc. of facts of reality⁵, has to be revised by being confronted with the works of Pāṇini and other intellectuals of ancient India who used Sanskrit as their medium of thought and expression. These works constitute an admirable and incontrovertible document on ancient human intellectual activity.

NOTES & REFERENCES

1. The designation “saṃskṛta” for the language is not attested in Pāṇini's work, nor in his commentators' works, Kātyāyana's *Vārttika* and Patañjali's *Mahābhāṣya*. That name became current in a later period.

Pāṇini describes the language he spoke; he has no other name for it than the general word *bhāṣā* "speech" and does not show any awareness of the existence of other languages.

2. A marker is called 'it' by Pāṇini. The common designation among later grammarians is *anubandha* 'appendage'.
3. We transliterate the nasal property of the vowel with the sign *ṁ* subsequent to the vowel. The grave accent transliterates the *svarita* accent.
4. The remark of Patañjali implies also that the mention of the meanings of the roots, of accentual properties of the roots and their markers, etc. were not yet inserted in the *Dhātupāṭha* in his time. The introduction of the meanings is ascribed to a grammarian called Bhīmasena who seems to be unknown to Patañjali. For the author of the *Mahābhāṣya*, the *Dhātupāṭha* was only "bhvedhaspardhagādhrbādhr-...".
5. See, for example, J. Goody's works, *The Domestication of the Savage Mind*, Cambridge, 1977; *The interface between the written and the oral*, Cambridge University Press, 1987, Ch. 4: "Oral composition and oral transmission, the case of the Vedas", pp. 110-22, where the author argues that the Vedas may have been transmitted without the help of writing, but that writing was necessary to compose them. He refers to an article of Oliver C.F. 1979: "Some aspects of literacy in Ancient India" in *The Quarterly Newsletter of the Laboratory of Comparative Human Cognition* 1: 57-62, which argues that writing was necessary for the composition of *Aṣṭādhyāyī*.